Revised PM_{10} State Implementation Plan for the Salt River Area

Technical Support Document

AIR QUALITY DIVISION
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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1.1 OVERVIEW

Through the Clean Air Act, the U. S. Environmental Protection Agency (EPA) has established health standards for airborne particulate matter. These standards are for particles with an aerodynamic diameter of 10 microns and smaller, otherwise know as PM_{10}. The two averaging periods for these PM_{10} standards are 24 hours and annual. Their numerical values, expressed in mass of particles per volume of air: specifically, as micrograms per cubic meter ($\mu g/m^3$), are 150 $\mu g/m^3$ for 24 hours and 50 $\mu g/m^3$ for annual.

Metropolitan Phoenix, which has not attained the annual standard for PM_{10} at all monitoring sites, is under a State Implementation Plan to achieve this standard by 2006 (MAG 1999). A separate plan revision, submitted in 1997, included a technical analysis of the elevated 24-hour PM_{10} concentrations recorded in the Salt River PM_{10} Study area in southwest Phoenix. Since monitoring began with the Salt River PM_{10} monitoring site near 19th Avenue and Lower Buckeye Road in 1994, this monitor has recorded violations of the 24-hour PM_{10} standard every year. The site was supposed to attain the standard by 1999, as detailed in the above mentioned technical analysis. That it did not achieve the standard has led the EPA to require the state to develop a State Implementation Plan (SIP) demonstrating that the 24-hour PM_{10} standard can be attained by the end of 2006. This entire report constitutes the technical documentation supporting that demonstration.

An additional issue concerns the historical Salt River monitoring site, which had been located on City of Phoenix property, was relocated to another section of the property in January 2002, and was discontinued altogether at the end of year. Removal of the equipment had been requested by the City due to substantial construction on and near the property. Actions to find a suitable replacement site with comparable PM_{10} concentrations and industrial emissions were taken by the Maricopa County Environmental Services Department (MCESD) and staff from the Assessment Section of the Air Quality Division of ADEQ. Such a site was identified and established, with the name of “West 43rd Avenue.” MCESD has agreed to long-term PM_{10} data collection at this site as a component of the SIP. As part of this SIP demonstration, the Assessment Section has shown that the PM_{10} concentrations and source contributions between this new site and the Salt River site are equivalent.

In carrying out this overall demonstration of improved PM_{10} levels with additional controls, three projects were completed:

1. An intensive air quality monitoring study was conducted April – December 2002.

2. A complete inventory of PM_{10} emissions was constructed, and it was made ready for use in a numerical air quality model.

3. Air quality modeling was then conducted; potential controls to reduce PM_{10} emissions were translated into numerical reductions; and future (2006) air quality was evaluated.

This work is fully described in chapters 2 – 7. The remainder of this introductory chapter begins with a general discussion of particulate matter. A brief description of PM_{10} concentrations throughout the metropolitan area follows to put the Salt River PM_{10} levels into a larger context. The chapter concludes with a historical view of PM_{10} monitoring in the Salt River PM_{10} Study area.

1.2 THE GENERAL NATURE OF PARTICULATE MATTER

Particulate matter is a collective term describing very small solid or liquid particles that vary considerably in size, geometry, chemical composition and physical properties. Produced by both natural processes (pollen and wind erosion) and human activity (soot, fly ash, and dust from paved and unpaved roads), particulates contribute to visibility reduction, pose a threat to public health and cause economic damage through soil disturbance. PM_{10} is particulate matter 10 microns and smaller, and can be divided into two size fractions, coarse and fine. Some fine particulates (2.5 microns and smaller, or "$PM_{2.5}$") are formed by the condensation of vapors or by their subsequent growth through coagulation or agglomeration. Others are emitted directly from the sources, either by combustion or from mechanical grinding of soils. Coarse particulates (2.5 to 10 microns) are formed through mechanical processes such as the grinding of matter and the atomization of liquids. Fine particulates can also be classified as primary – produced within and emitted from a source with little subsequent change – or secondary – formed in the atmosphere from gaseous emissions.

Secondary particulate nitrates and sulfates, for example, form in the atmosphere from the oxidation of sulfur dioxide and nitric oxide, which are two gases. In contrast, most atmospheric carbon is primary, having been emitted directly from combustion sources, although some of the organic carbon in the aerosol is secondary, having been formed by the complex photochemistry of gaseous volatile organic compounds.

The size, shape and chemical composition of particulates determine their health effects. Particles larger than 10 microns are deposited in the upper respiratory tract. Particles from 2.5 to 10 microns are inhalable and are deposited in the upper parts of the respiratory system. Particles smaller than 2.5 microns are respirable and are deposited in the pulmonary tissues. Particles in the size range of 0.1 to 2.5 microns are most efficiently deposited in the alveoli, where their effective toxicity is greater than larger particles because of the higher relative content of toxic heavy metals, sulfates and nitrates. Epidemiological studies have shown causal relationships between particulates and excess mortality, aggravation of bronchitis, and, in children, small, reversible changes in pulmonary function. Acidic aerosols have been linked to the inability of the upper respiratory tract and pulmonary system to remove harmful particles.

The Arizona Comparative Environmental Risk Project – a multi-disciplinary investigation into human exposure to all environmental risks completed in 1995 – ranked outdoor air quality in general and particulate matter in particular as the highest environmental risk in the State. In this study, annual premature deaths from exposure to PM_{10} concentrations in Arizona were estimated at 963, which included 667 in Maricopa County and 88 in Tucson. Increased percentages of hospital admissions for respiratory disease (1 to 4 percent, depending on the city), of asthma episodes (5 to 14 percent), of lower respiratory symptoms (5 to 15 percent) and of coughs (2 to 6 percent) were attributed to the prevailing annual PM_{10} concentrations in 1991. Chronically high particulate concentrations in the ambient air continue to pose a serious health threat to many Arizonans.

Coarse particulate emissions are mostly geological and are dominated by dusts from three activities: re-entraining dust from paved roads, driving on unpaved roads and earthmoving associated with construction. Soil dust from these sources and others contribute more than 70 percent of the coarse particulates in Phoenix. On days with winds in excess of 15 miles per hour, wind erosion of soil contributes to this loading.

PM_{10} concentrations are not evenly distributed throughout the Phoenix metropolitan area, because each monitoring site is strongly influenced by the degree of localized emissions of coarse particulates. Background concentrations of PM_{10} are about 20 percent of the urban maxima (10 $\mu g/m^3$ for an annual average background versus about 50 $\mu g/m^3$ for the urban maximum). Concentrations of particulates tend to be higher in the late fall and winter, when atmospheric dispersion is at a seasonal low. PM_{10} maximum concentrations can occur in any season, provided nearby sources of coarse particulates are present or when strong and gusty winds suspend soil disturbed by human activities. Hourly concentrations of particulates tend to peak during the hours of the worst dispersion, which is from sunset to mid-morning.

Controls to reduce particulates have been in place for decades, beginning with an ordinance that required watering to reduce dust from construction in Pima County in the 1960s. Maricopa County's umbrella dust abatement rule, Rule 310, has been revised many times through the years and now regulates construction dust, track-out dust from construction sites, and dust from unpaved parking and vacant lots. Efforts to reduce dust resuspended from paved roads have concentrated on eliminating track-out from construction sites, curbing and stabilizing road shoulders, and using more efficient street sweepers. Secondary fine particulates have been reduced by vehicular emission controls, which have reduced the gaseous emissions from which they are formed. Reducing gaseous hydrocarbon emissions has led to a significant reduction in the primary carbon emitted in motor vehicle exhaust. In Maricopa County, the Governor's Agricultural Best Management Practices Committee developed a rule containing best management practices for agricultural activities intended to reduce particulate emissions from tilling and harvesting activities, cropland and non-cropland. In a recent PM_{10} SIP, the Maricopa Association of Governments obtained commitments from local and state governments to implement 77 new measures, including enhanced enforcement of the county dust rules, implementation of agricultural best management practices, use of PM_{10} efficient street sweepers and requirements for cleaner burning fireplaces.

1.3 PARTICULATE MATTER CONCENTRATIONS IN METROPOLITAN PHOENIX

Metropolitan Phoenix PM_{10} concentrations are measured at fixed monitoring stations operated by three government agencies: the Maricopa County Environmental Services Department, the Arizona Department of Environmental Quality, and the Pinal County Air Quality Control District. In the filter-based methods, particulates are monitored by pulling ambient air through a filter, generally for 24 hours every sixth day, weighing the filter before and after, and measuring the volume of air sampled. Common particulates instruments include the high-volume sampler (Hi-Vol) and the dichotomous sampler (dichot), the latter of which measures both fine and coarse particulates. Particulates are also monitored continuously with a tapered element oscillating microbalance (TEOM) instrument.

The PM_{10} concentrations presented in Table 1-1, based only on the Hi-Vol and Dichot networks, shows three sites exceeded the 24-hour standard of 150 $\mu g/m^3$; and that most sites are well within the standards. In the remainder of this report, ambient concentrations from the filter-based samplers (Hi-Vol and Dichot) and continuous samplers (TEOM) will be presented. The last line of the table gives the PM_{10} concentrations at Organ Pipe National Monument, considered to be Sonoran Desert background. For PM_{10} a rule of thumb to understand annual concentrations is:

	$\mu g/m^3$
Desert or plateau background	10
Urban fringe	20 – 30
General urban	30 – 45
Urban with elevated concentrations	45 – 55
Urban with serious problems	60 – 80

TABLE 1-1 **PM_{10} Concentrations in Metropolitan Phoenix for 2002 (µg/m^3)**			
Site or City	Method	24-Hour Average	
		Max Value	2nd High
Phoenix – Salt River *	Hi-Vol	**249**	**174**
Phoenix – Durango Complex*	Hi-Vol	**232**	**158**
Phoenix - West 43rd Avenue*	Hi-Vol	**172**	135
Higley	Hi-Vol	138	134
South Phoenix*	Hi-Vol	137	123
Chandler	Hi-Vol	128	117
Phoenix – Greenwood	Hi-Vol	116	102
West Phoenix	Hi-Vol	122	98
Maryvale	Hi-Vol	142	90
Central Phoenix	Hi-Vol	81	76
Glendale	Hi-Vol	88	85
West Chandler	Hi-Vol	80	77
North Phoenix	Hi-Vol	80	72
South Scottsdale	Hi-Vol	64	62
Mesa	Hi-Vol	102	86
Tempe – Community Center	Dichot	65	60
Phoenix – JLG Supersite	Dichot	72	52
Surprise	Hi-Vol	81	67
Estrella	Dichot	92	68
Palo Verde	Dichot	100	78
Apache Junction	Hi-Vol	62	49
Organ Pipe Cactus National Monument	Dichot	27	26

* Salt River PM_{10} Study area site

Bold means an exceedance of the standard (150 µg/m^3 for 24 hours)

Note that the 24-hour standard was exceeded only within the Salt River PM_{10} Study area. While the air pollution levels in this area, as measured by PM_{10}, may not be unique to the Phoenix metropolitan area, they at least border on it. The sheer magnitude of the recorded concentrations –greater than 200 µg/m^3 for the worst of the 24-hour averages – tends to set this area apart.

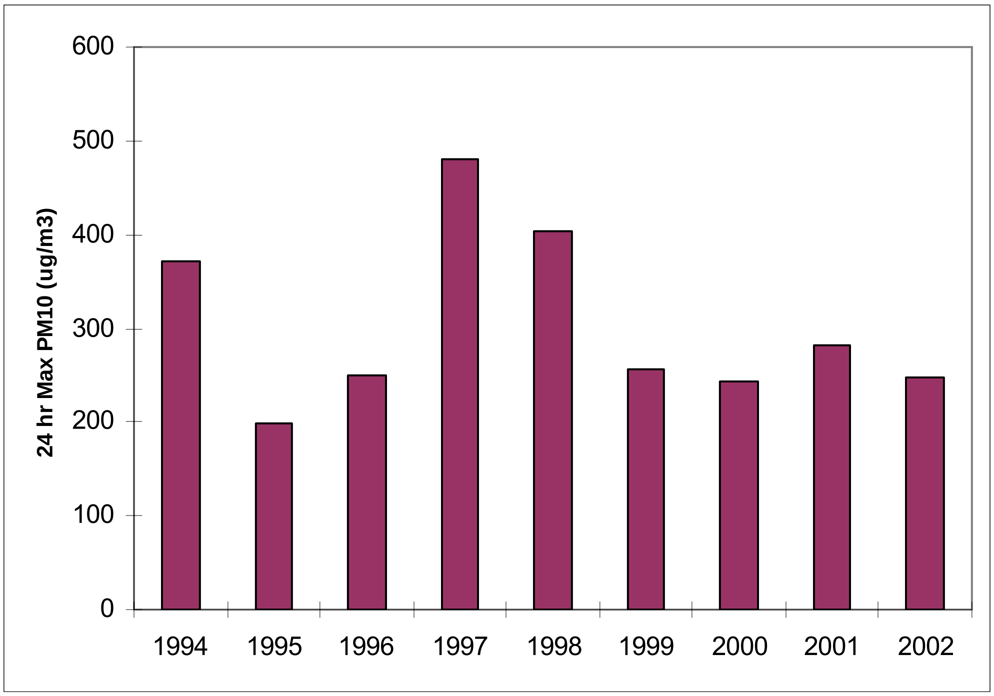
The above discussion about the spatial distribution of PM_{10} concerned a single year, 2002, the same year of the intensive monitoring study in the Salt River PM_{10} Study area. It is worthwhile to consider the historical levels of air pollution within the Salt River PM_{10} Study area. The longer-term considerations speak to the duration of the elevated PM_{10} concentrations in the area.

1.4 PM_{10} TRENDS IN THE SALT RIVER PM_{10} STUDY AREA: 1994 – 2002

Data from three PM_{10} monitoring sites in the Salt River area were analyzed over an eight year period (1994 to 2002), to determine if the PM_{10} concentrations have decreased significantly. Analysis of the data indicates that the PM_{10} concentrations in the Salt River area have decreased from 1997 to 2002.

The 24-hour Maximums for the Salt River site are displayed in Figures 1-1.

Figure 1-1 Salt River – 24 Hour Maximum

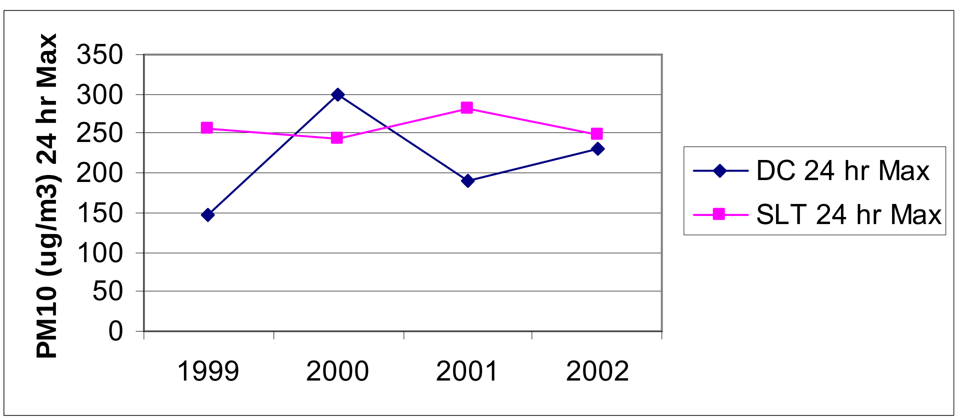


The 24-hour maximums are high in 1997 and 1998 (400 µg/m^3 and higher), but they are significantly lower from 1999 through 2002. However, all of the 24-hour maximums exceed the 150 µg/m^3 requirement. When compared with other sites in this area (Durango and South Phoenix), as in Table 1-2 the Salt River area has a much higher number of exceedances.

TABLE 1- 2 Number of 24-Hour Exceedances per Year			
Year	Salt River	South Phoenix	Durango Complex
1994	12	0	
1995	14	0	
1996	11	0	
1997	14	0	
1998	4	1	
1999	9	0	0
2000	7	0	2
2001	5	1	1
2002	2	0	2

Comparison of the data for Salt River and Durango Complex from 1999 to 2002 indicates that the Salt River PM_{10} concentration decreases in 2002, while the Durango Complex concentration increases. The two locations are within one mile of each other, so the concentration variation should be in the same direction. Since it is not, one can conclude that the lower PM_{10} in 2002 for the Salt River site is due to the higher elevation of the monitor (starting in January 2002). Figure 1-2 displays the data.

Figure 1-2 24-Hour Maximums at Durango and Salt River Monitors (DC = Durango Complex, SLT = Salt River)



A histogram of all the Salt River site PM_{10} data is displayed in Figure 1-3. It is a normal distribution, with a mean of 89.1 μg/m$^{3.}$ There are a few outliers that are greater than 225 μg/m3. Even the data points that exceed the PM_{10} limit (150 μg/m3 for a 24-hour average) are within the distribution.

Figure 1-3 Histogram of PM_{10} at Salt River Monitor (1994 to 2002)

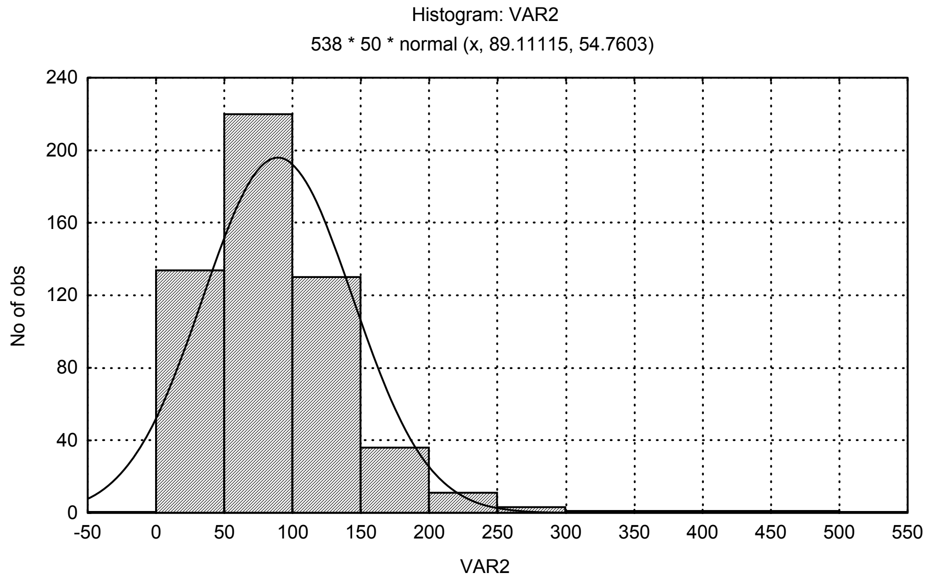
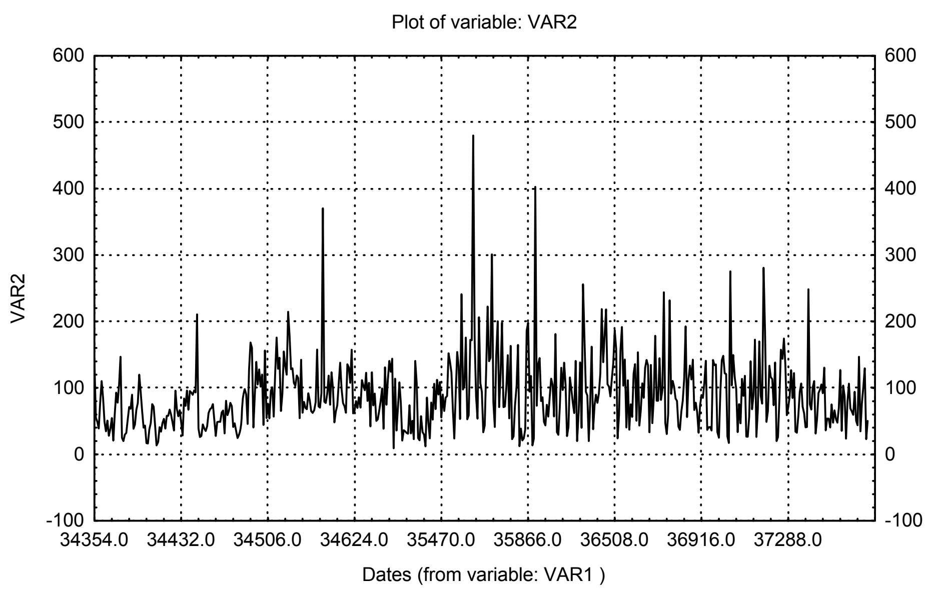


Figure 1-4 24 hour average PM_{10} trends 1994-2002 at Salt River Site



In the day to day data no pattern is seen. One would expect seasonal variation, but that is seen in the hourly data, as described in the next section.

This analysis shows the lack of seasonality, or any other fixed pattern and suggests that localized emissions in a random fashion dominate over the importance of other factors such as wind speed or direction.

2.0 CHAPTER 2 – AMBIENT AIR QUALITY DATA

2.1 AMBIENT AIR QUALITY IN 2002

In the introduction, the PM_{10} concentrations in the Salt River PM_{10} Study area were briefly discussed. A short comparative analysis with other monitoring sites in metropolitan Phoenix in 2002 was presented, as well as an historical trends analysis. In this chapter, these PM_{10} concentrations in the Salt River study area will be thoroughly examined, based on the intensive monitoring performed in 2002. First, the monitoring network, its instruments, and sampling frequencies will be laid out. Second, the important regulatory statistics for the entire calendar year of 2002, including the 8-month intensive study, will be discussed. Third, those days when any Salt River area monitor exceeded the 24-hour average standard for PM_{10} of 50 μg/m^3 will be examined in some detail, especially the underlying meteorological conditions contributing to the elevated concentrations. Fourth, the hourly variation of PM_{10} at the four sites will be presented and interpreted. Fifth, the seasonal variation of PM_{10} will be explained. Sixth, and last, the authors will give some concluding remarks on the ambient PM_{10} concentrations in the Salt River PM_{10} Study area.

2.2 INTENSIVE AIR POLLUTION MONITORING: INSTRUMENTS AND SITES

Three monitoring sites have been operated by Maricopa County Environmental Services Department (MCESD) in the Salt River PM_{10} Study area for a number of years. These three sites operated throughout 2002, but were supplemented by additional instruments in the April – December intensive study. In addition, a fourth site was established in the spring of 2002 for the intensive study. These sites, listed in Table 2-1, provide adequate monitoring coverage for the 4x8 mile study area.

TABLE 2-1
Intensive Study Monitoring Sites
(All are in Phoenix)

Site Name	Abbreviation	Address	Remarks
Salt River	SR	3045 S. 22nd Ave	SIP site of 1997 work
South Phoenix	SP	33 W. Tamarisk	Long-term
Durango Complex	DC	2702 AC Esterbrook Blvd.	Began 1999
West 43rd Ave	WF	3940 W. Broadway	New as of April 2002

Of these sites, the South Phoenix site is the only one classified as population oriented; the other three are all designed to capture maximum concentrations. The major cross streets for the sites are Salt River, 22nd Avenue and Lower Buckeye Road; South Phoenix, Central and Broadway; Durango Complex, 27th Ave and Durango; and West 43rd Avenue, Broadway east of 43rd Avenue.

During 2002, the three longer-term sites ran the entire year, while West 43rd began in April. The instrumentation at the various sites, described below, was directed towards the measurement of either meteorological variables or PM_{10}. Three types of PM_{10} monitors were employed. The first two types are termed “filter-based samplers”, and operate by pulling air through a pre-weighed filter. After running for 24 hours, the filter and its collected particulates are weighed, thus giving the mass of particulates, which, divided by the volume of air, gives the concentrations of PM_{10}. The first is called the high-volume sampler, or “hi-vol”, which is a filter-based sampler that employs a large (about 8x10 inch) filter and a high volume of air. The second type is called a dichotomous sampler, or “dichot”. It pulls a much lower volume of air than the hi-vol, uses a much smaller filter (47 mm in diameter, or about two inches), and separates the incoming air into two ports, each with its own filter. One side measures $PM_{2.5}$; the other, PM_{10}; with the difference called PM coarse. Both of these samplers are run for 24 hours, midnight to midnight, on a fixed schedule. Yet a third type of PM_{10} monitor is called a “TEOM”, which stands for tapered element oscillating microbalance. Unlike the filter-based instruments, this unit monitors particulates continuously, with concentrations typically stored in either five or 60 minute averages. In addition to the particulate measurements, wind speed and wind direction were monitored with standard meteorological equipment at a height of 10 meters. In conclusion, Table 2-2 shows which sites at what monitors were operating at what frequency.

TABLE 2-2
Intensive Study: Instruments and Operating Frequency (April – December 2002)

Site Name	Abbreviation	Wind Speed & Direction[1]	PM_{10} by TEOM[1]	PM_{10} Filter Based[2]	Frequency of Filter-Based PM_{10}
Salt River	SR	None	Yes	Hi-vol, dichot	1 in 3; 1 in 6
South Phoenix	SP	Yes	Yes	Hi-vol	1 in 3
Durango Complex	DC	Yes	Yes	Hi-vol	1 in 3
West 43rd Avenue	WF	Yes	Yes	Hi-vol, dichot	1 in 3; 1 in 6

See Appendix N for wind roses of the wind speed and direction data collected during the Salt River PM_{10} Study.

[1] Continuous measurements, averaged hourly
[2] Filter-based measurements, averaged for 24 hours

2.3 STUDY PERIOD AND ANNUAL STATISTICS

The intensive study period began in April 2002, with the deployment of the instruments described above. By the middle of the month, most of the equipment was in place, and by the end of the month, all of it was. Therefore, the intensive study can best be described as an eight-month study, May – December 2002, with some of the specialized measurements beginning as early as mid-April. Regulatory concerns, however, dictate that elevated concentrations of PM_{10} – especially those that exceed the 24-hour standard of 150 μg/m^3 – be examined throughout the year. As matters developed, potential design dates, a subset of those days with elevated PM_{10} concentrations slated for air quality modeling, included a January date, two in April, and one in December. Recall that three of the four sites have measurements throughout the year, while West 43rd Avenue measurements began in mid-April.

Study-period and annual statistics are readily available, although the continuous collection of PM_{10} by TEOM and the every-third day collection by high-volume sampler provide different data sets. A clear picture of the overall air pollution at the four study sites would include long-term averages and the maximum values. In this case, "long-term" means nine months, April through December. These data, presented in Table 2-3, show that Salt River site has the highest long-term average, followed closely by West 43rd Avenue and Durango, and that South Phoenix is the cleanest of the four. The data also show that all sites except South Phoenix have 24-hour average maxima above the standard of 150 ug/m^3. Because these concentrations come from both the filter-based and continuous samplers, these statistics differ slightly from the data presented in Table 1-1, which come only from the filter-based network.

TABLE 2-3
Study Period PM_{10} Statistics

Statistic	Salt River	West 43rd	Durango	South Phoenix
9-Month Average	75.4	68.2	66.0	59.0
High 24-Hr	**249**	**243***	**232**	137
2nd	**184***	**181***	**198***	123
3rd	**175**	**174***	**158**	102
4th	**174**	118	133	101
5th	147	113	132	94

Bold values exceed the standard of 150 ug/m^3.

*TEOM concentration, which was not recorded by the Maricopa County Department of Environmental Services high-volume sampler network.

2.4 HOURLY VARIATION OF PM_{10} BY SITE

For each site, an average was calculated for each hour, using the data from April (or May) through December, 2002. The hourly PM_{10} values were plotted to see the variation in a 24-hour period. The results are displayed in Figures 2-1 through 2-4. Figure 2-5 compares the diurnal pattern at the four sites, for the intensive study period.

For all the months and sites, the data shows a pattern. PM_{10} values tend to be highest during the four hours after sunrise and during four hours after sunset.

Figure 2-1 Diurnal Variation of PM_{10} at Salt River Monitor April-December 2002

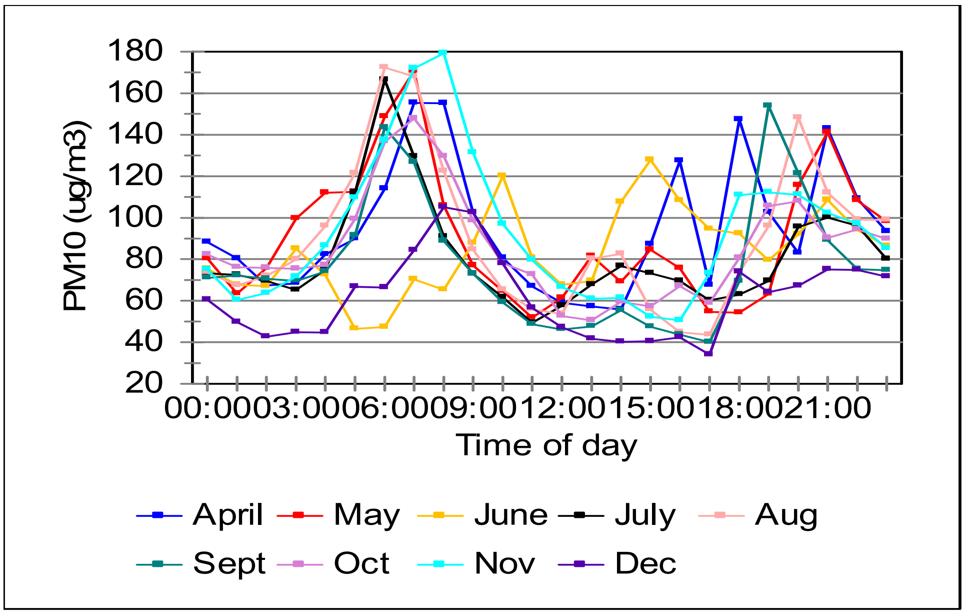


Figure 2-2 Diurnal Variation of PM_{10} at Durango Complex Monitor May-December 2002

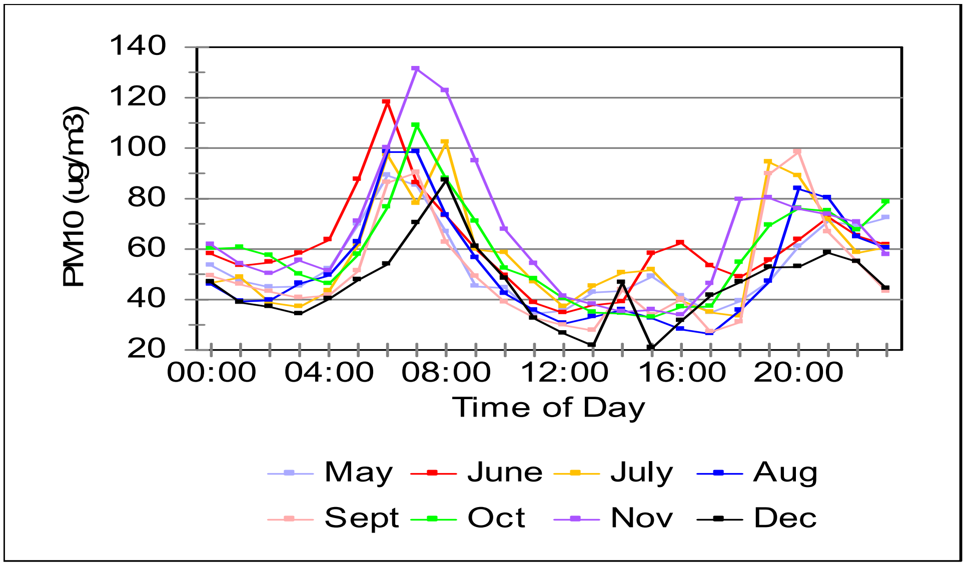


Figure 2-3 Diurnal Variation of PM_{10} at South Phoenix Monitor April-December 2002

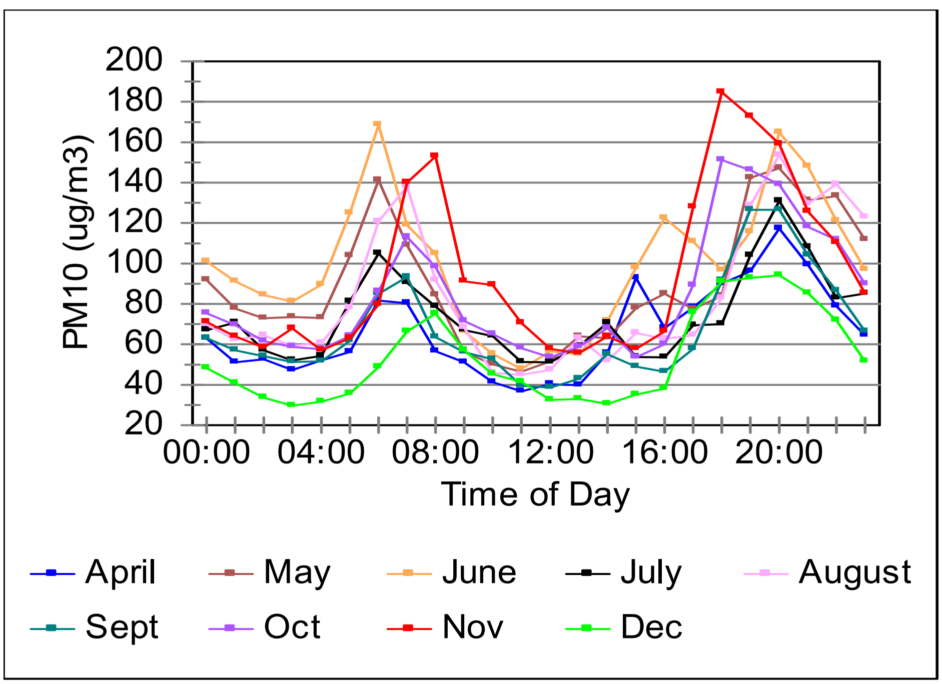


Figure 2-4 Diurnal Variation of PM_{10} at West 43rd Avenue Monitor April-December 2002

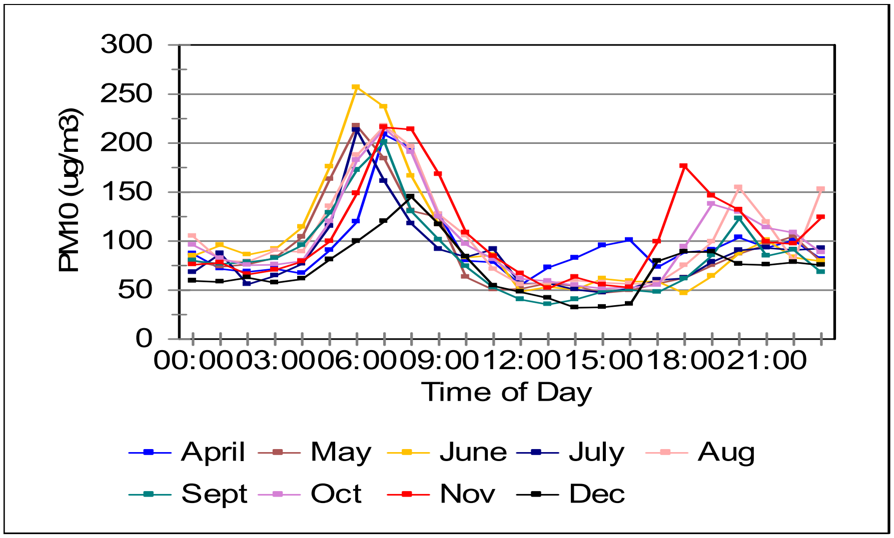
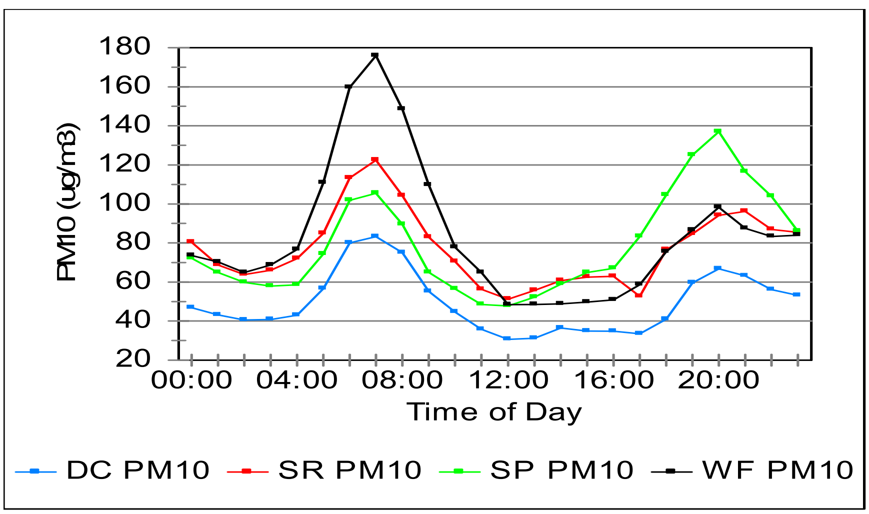


Figure 2-5 Diurnal Variation Comparison of 4 Sites



For West 43rd, Durango Complex, and Salt River the higher peak occurs at 8 am, but for South Phoenix it occurs at 8 p.m.

Table 2-4 lists the peak values and times of day at Salt River Study area sites during the study period.

TABLE 2-4
Peak Hourly PM_{10} Values ($\mu g/m^3$)

Time	West 43rd	Salt River	South Phoenix	Durango Complex
8 a.m.	180	120	105	80
Noon	50	50	50	35
8 p.m.	100	100	140	75
11 p.m.	85	85	85	55

2.5 SEASONAL VARIATION OF PM_{10}

The average PM_{10} for each month during the intensive study was plotted for each site, at the same six times, in order to see the monthly variation, which can translate into seasonal variation. The summer months (June, July, August) are expected to display a substantially different behavior from the cooler months (October, November, December). Data for January through March were not available for comparison. The monthly variation of PM_{10} for each site is displayed in Figures 2-6 through 8.

Figure 2-6 Monthly Average PM_{10} Values for Salt River Monitor by Time of Day

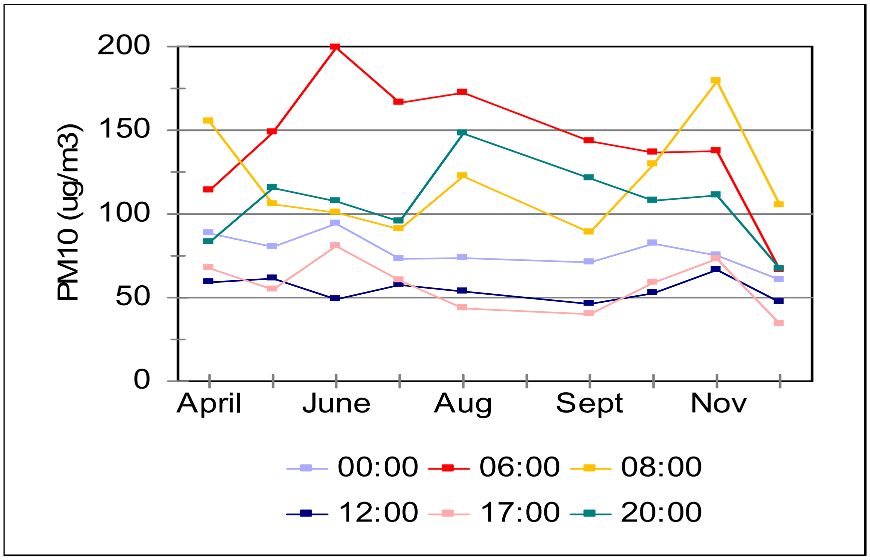


Figure 2-7 Monthly Variation of PM_{10} Values for Durango Monitor by Time of Day

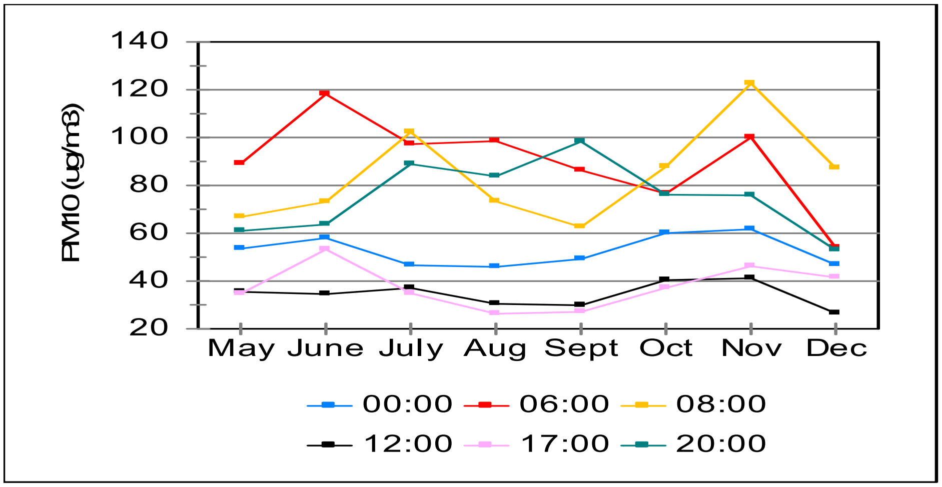


Figure 2-8 Monthly Variation of PM_{10} for West 43rd Avenue Monitor by Time of Day

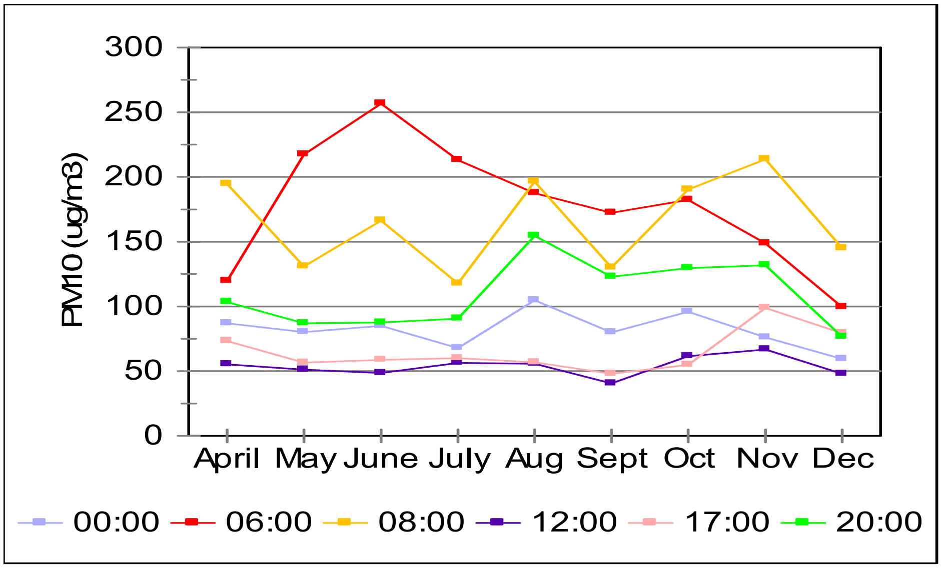
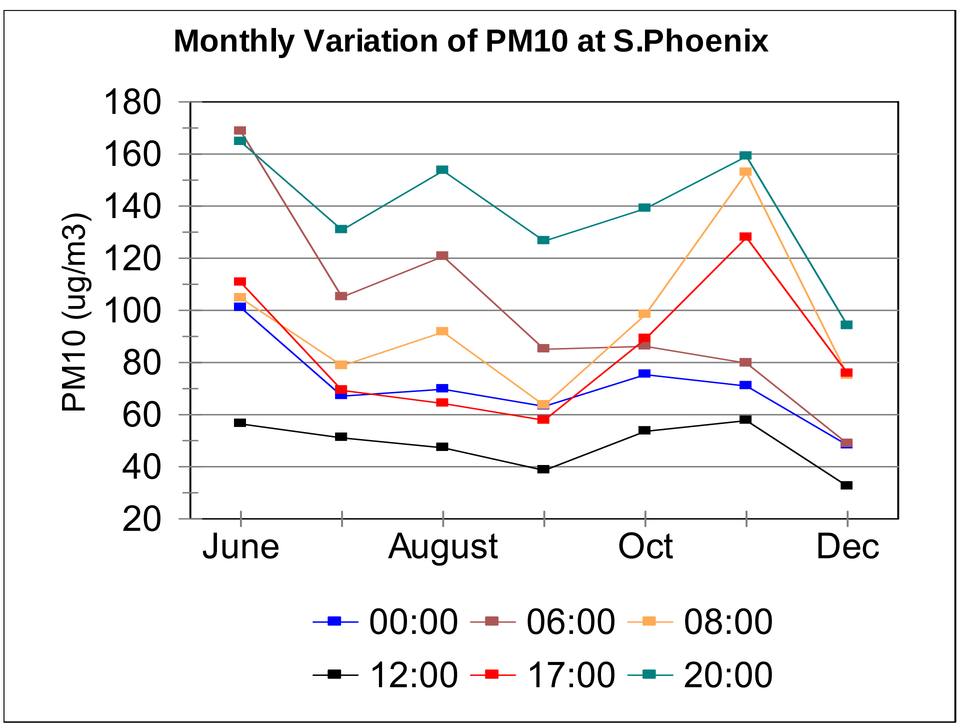


Figure 2-9 Monthly Variation of PM_{10} Values at South Phoenix Monitor by Time of Day



2.6 CONCLUSIONS

PM_{10} concentrations in the Salt River PM_{10} Study Area are the highest in metropolitan Phoenix. Based on intensive monitoring at four sites in 2002 within the study area, the highest long-term (nine-month) concentrations are, in decreasing order, at the Salt River, West 43rd Avenue, Durango, and South Phoenix sites. All except South Phoenix recorded violations of the 24-hour standard, with the highest three concentrations in the 230 – 250 ug/m^3 range. The four sites exhibit similar diurnal patterns averaged for the study period, although the magnitude of the concentrations is different. This pattern is characterized by a rather sharp morning peak, a low, even plateau in the mid-day, another peak about 8:00 p.m., and another, but gently sloping plateau from 10:00 p.m. through 4:00 a.m. Each site exhibits a complex set of monthly diurnal patterns. Monthly variation from April through December varies by hour of the day, though the variation isn't pronounced, and the patterns are not consistent from site to site.

3.0 CHAPTER 3 – REPLACEMENT OF SALT RIVER MONITOR

Although not a part of the official call for a State Implementation Plan (SIP) revision, the matter of a specific air pollution monitoring site for the Salt River PM_{10} Study Area was brought up by the U. S. Environmental Protection Agency in 2002. The precise monitoring location established in 1994 on the City of Phoenix Southwest Service Center property was scheduled for construction and therefore had to be moved. The City agreed to have the monitor relocated to the roof of their office building on the property, but would allow it to operate only until the end of 2002. In the meantime, County and State staffs were planning the intensive air monitoring study that forms the backbone of this technical analysis for the SIP. As part of this study, State and County officials agreed to establish a new monitoring site in the Salt River area. This new site would be for monitoring PM_{10}, would replace the discontinued site at the City service center, and would have PM_{10} concentrations equivalent to those measured at the former site. Various details of the monitoring sites are presented in this chapter, with a concluding argument that the West 43rd Avenue site is an adequate replacement for the old "Salt River" site.

3.1 CHARACTERISTICS OF THE SALT RIVER SITE

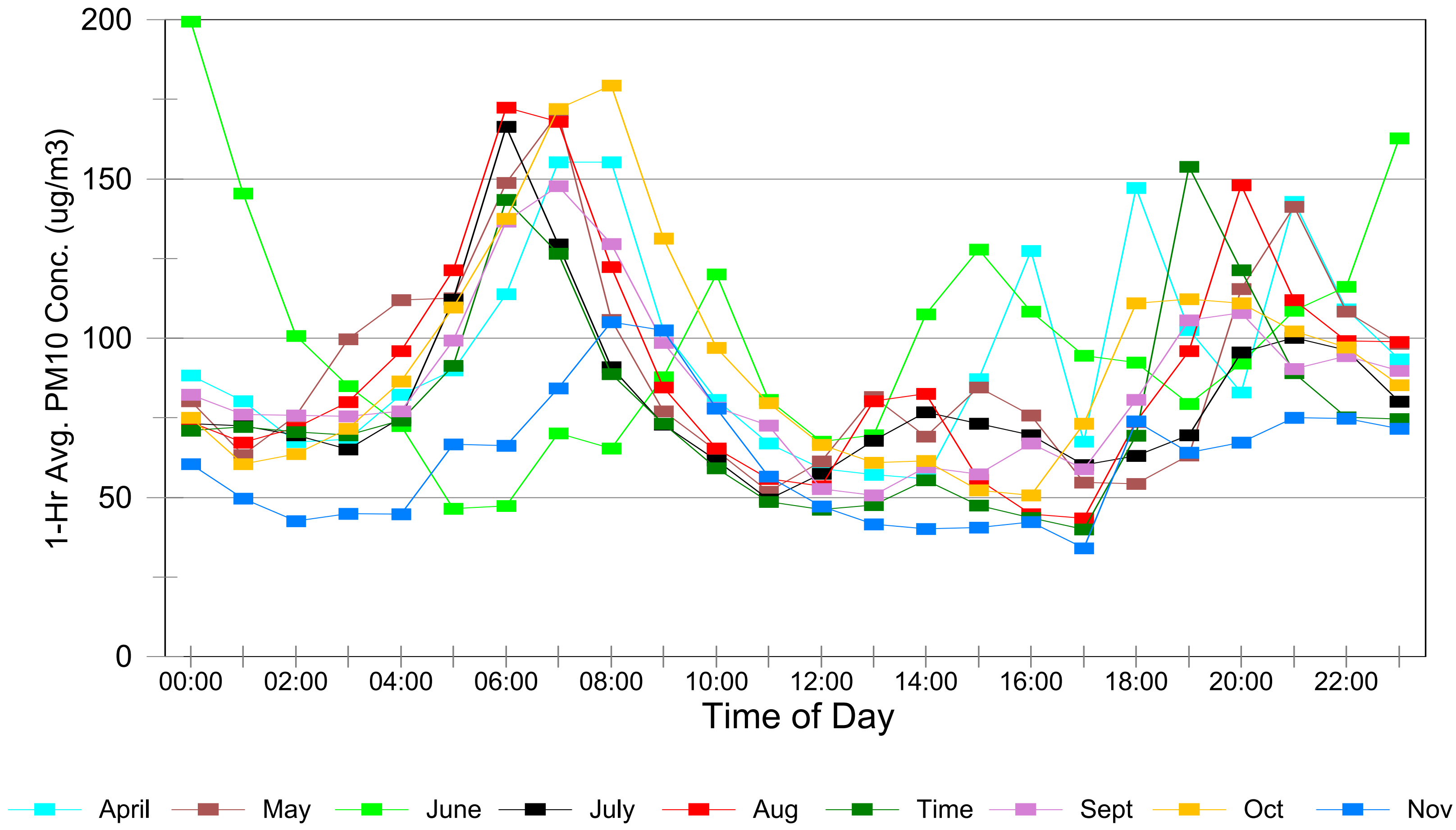
PM_{10} concentrations measured at the Salt River site were discussed in the previous chapter. What follows here are a table of the maximum 24-hour averages through the years and a figure that shows the diurnal variation of PM_{10} by month.

Table 3-1 lists the number of 24-hour PM_{10} exceedances that were recorded at the Salt River site in the study area during the years 1994 through 2002.

TABLE 3-1
Salt River Site PM_{10} (1994-2002) Hi-Vol Data

Year	Number of Exceedances	24 hr Max ($\mu g/m^3$)
1994	12	371
1995	14	191
1996	11	250
1997	14	480
1998	4	403
1999	9	256
2000	7	244
2001	5	281
2002	2	249

Figure 3-1 Hourly PM_{10} at Salt River Site, April – December 2002 (TEOM)



PM_{10} concentrations of this magnitude, with peak period hourly averages of 160 ug/m3, and with maximum 24-hour concentrations above 200 ug/m3, are a consequence of nearby emissions that elevate the levels high above the urban background concentration. As discussed in Chapter 5, background concentrations comprise about half of the PM_{10} measured in the Salt River PM_{10} Study Area. What is of concern here are the characteristics and activities on the land surface near the Salt River monitor. Figure 3-2 is an enlargement of the satellite image of March 2002 that was used in the construction of the emissions inventory. Both the long-term and 2002 locations of the monitor are shown. While comparisons between these two monitoring sites would be helpful in analyzing the 1994 – 2002 trends, the purpose of this chapter is to compare the "Salt River" site with the "West 43rd Avenue" site, both their PM_{10} concentrations and their site characteristics. The air quality comparison is limited to the eight months of 2002 when data were collected at both the West 43rd Avenue and the Salt River sites. During this time the monitoring instruments at the Salt River site were on the roof of the office building of the City of Phoenix Southwest Service Center, shown in the upper left of the image. Therefore, it is more instructive to analyze the roof top site and omit the original location.

This site is surrounded by activities and land surfaces with considerable potential for PM_{10} emissions. To the southwest and south is a sand and gravel operation, a portion of which is visible in the lower left corner. A concrete beam fabrication company lies to the south and east. Unpaved roadways of this facility show up as a dark brown. Nineteenth Avenue lies to the east and carries 22,000 vehicles per day. North of the site extending to Lower Buckeye Road, are the City of Phoenix bus storage and maintenance yards. West of the site (not shown in the image) is a wide expanse of mostly bare land, that also contains the 23rd Avenue Wastewater Treatment Plant's dry sludge ponds. The immediate area around the office building is paved. Vehicle parking lots, clearly visible in the image, virtually surround the site. In summary, the vehicular traffic on roads, entrance roads, and parking lots; the sand and gravel and industrial activity; and the bare land all have considerable potential for PM_{10} emissions.

Figure 3-2 IKONOS Satellite Photograph of the Area Showing the Locations of the Salt River Monitor

3.2 CHARACTERISTICS OF THE NEW WEST 43rd AVENUE SITE

PM_{10} concentrations at the West 43rd Avenue site have been thoroughly examined for the April – December 2002 period. Already discussed in Chapter 2, these concentrations proved to be similar to the Salt River site. Figure 3-3 presents the diurnal variation at the site, by month, and shows that the morning peak concentrations are on the order of 200 ug/m3, depending on the month. Figure 3-4 is a satellite photograph showing the location of this monitor.

Figure 3-3 Diurnal Variation of PM_{10} at West 43[rd] Avenue Monitor, April – Dec 2002

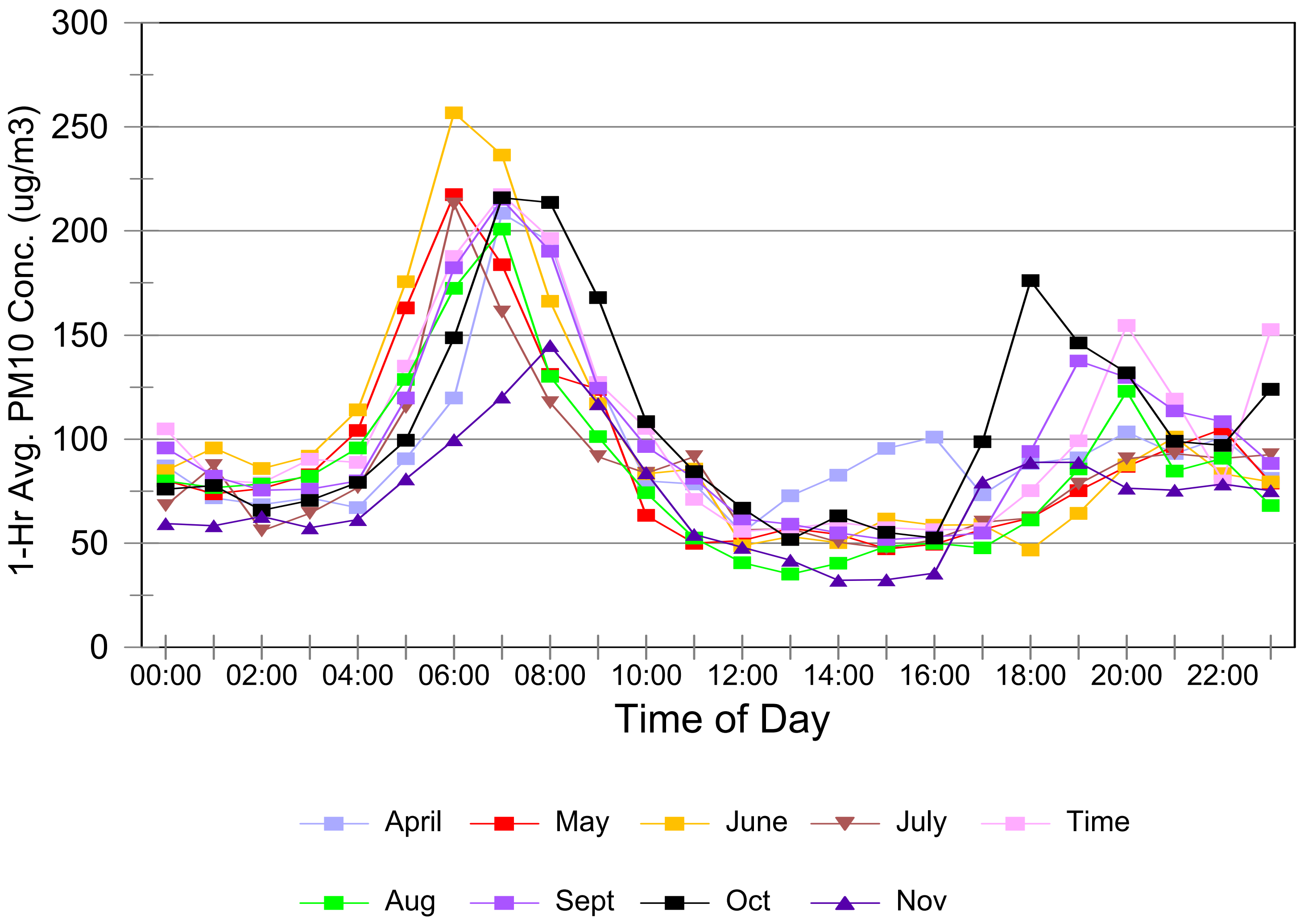


Figure 3-4 IKONOS Satellite Photograph of the Area Showing the Location of the W. 43rd Avenue Monitor

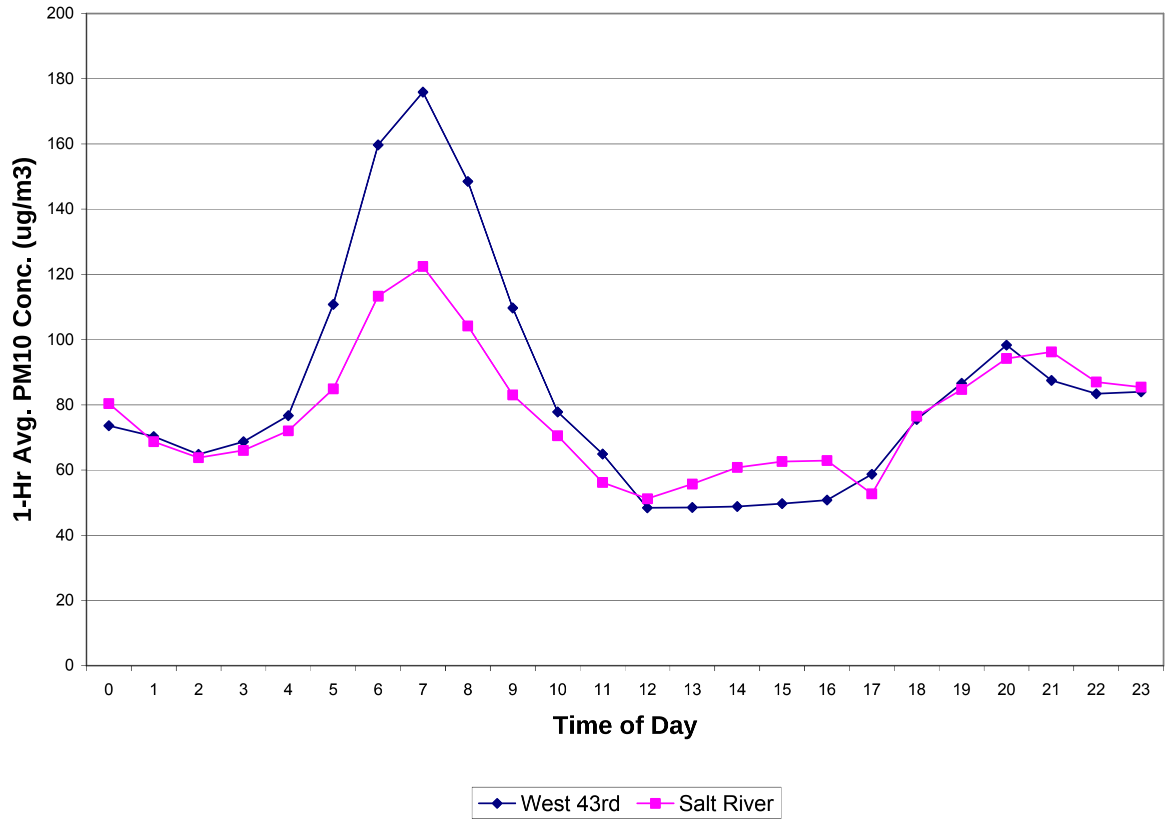
Similar to Figure 3-2, Figure 3-3 shows the land use around the West 43rd Avenue site. Broadway Road with an average daily traffic count of 4,500 vehicles per day, curves across the lower part of the image. Residential housing is in the lower right; bare land that extends north to the bed of the Salt River lies north of the monitor; storage and light industrial activities can be seen to the southwest and south of the monitor. The nearest major industrial activity, a sand and gravel operation, lies about ¾ mile to the west southwest. This site is not subject to the same degree of close-in emissions as the Salt River site

3.3 COMPARISON OF WEST 43rd AVENUE AND SALT RIVER PM_{10}

Despite the contrast between the two sites in their nearby emission sources, the PM_{10} concentrations are nearly equivalent. This equivalency can be seen in any number of statistics: only a few will be presented here. Figure 3-5 shows that diurnal patterns are similar, with West 43rd Avenue having a higher morning peak than the Salt River site. These patterns are based on eight months of data in 2002. The higher afternoon plateau at the Salt River site reflects its greater nearby vehicular and industrial activity. The nearly identical late evening and early morning concentrations suggest that the PM_{10} concentrations throughout the Salt River PM_{10} Study Area are uniform for these hours. This uniformity is consistent with the lack of localized emissions near the monitors through the night.

A statistical analysis using the Student's t-test for the two sets of the all the diurnal values indicates that they are statistically different. However, when the data from 6am to 8am are deleted, they are statistically same. Since the PM_{10} concentrations at the West 43rd Avenue site are higher than the Salt River site, the former is an adequate replacement for the latter. This equivalence is also born out by a cursory look at the regulatory important extreme values. In 2002, the Salt River PM_{10} maximum concentrations were 249, 184, and 174 ug/m3, with the first two under high wind conditions. At West 43rd Avenue, the highest PM_{10} concentrations were about the same: 243, 174, and 181 ug/m3, with the first two under high wind conditions. Under both low-wind and high-wind conditions, the two sites recorded equivalent maximum 24-hour average PM_{10} concentrations.

Figure 3-5 Diurnal Variation of PM_{10} at Salt River and West 43rd Avenue Monitors



4.0 CHAPTER 4 - SALT RIVER PM_{10} EMISSIONS INVENTORY

4.1 INTRODUCTION

This chapter presents the methodology, assumptions and data used to build a gridded PM_{10} emissions inventory for modeling 24-hour PM_{10} levels in the Salt River PM_{10} Study Area. The boundaries of the study area are approximately, Van Buren Street on the north, Baseline Road on the south, 59th Avenue on the west and 10th Street on the east. This area is approximately 101 square kilometers (39 square miles). See Appendix A for a satellite image of the study area with the locations of the four air quality monitors and grid overlay (Map A-1).

A base year emissions inventory was constructed for 2002 and a base case emissions inventory was constructed for 2006. Gridded hourly emissions were calculated for the four design days: January 8, 2002, April 15, 2002, April 26, 2002, and December 16, 2002. The design days have two different meteorological regimes – two days with low wind speeds and a thermal inversion and two days with wind speeds over 15 miles per hour. Thus the design days will have a different mix of emission sources. The design days with low wind speeds were January 8, 2002 and December 16, 2002, and the design days with wind speeds over 15 miles per hour were April 15, 2002 and April 26, 2002.

The four major anthropogenic PM_{10} emission categories that were investigated are listed below:

- Point Sources - major stationary sources, defined as all facilities emitting greater than five tons per year (TPY) PM_{10}, Point source emissions include emissions from combustion, process operations, material transfers, storage pile wind erosion, and paved and unpaved roads within facility grounds.

- Area Sources - smaller stationary sources (both anthropogenic and non-anthropogenic) not included in the point source inventory. These include small industrial facilities, agricultural tillage and harvesting, construction activity, and wind erosion of areas with disturbed topsoil.

- On-Road Mobile Sources - vehicles certified for highway use – cars, trucks, and motorcycles. Road dust from paved and unpaved roads is also included.

- Off-Road Mobile Sources - a wide variety of gasoline and diesel equipment that either move under their own power or can be moved from site to site. Off-road mobile sources are defined as equipment not licensed or certified as highway vehicles and will move or be moved at least once during a 12-month period. Off-road mobile sources include equipment used in agriculture, construction, mining, commercial and industrial operations, lawn and garden maintenance, aircraft, airport ground support, locomotives, railroad, recreational, and water craft.

See Appendix B for a glossary of terms used in this technical support document (TSD).

A major category of non-anthropogenic PM_{10} emissions in the Salt River PM_{10} Study Area is the alluvial channel of the Salt River west of the 43rd Avenue monitor.

The gridded land use and PM_{10} emissions source files for the Salt River PM_{10} Study Area were constructed from:

1) Inspection of satellite images of the Salt River PM_{10} Study Area. (IKONOS, March 2002),

2) Maricopa County Environmental Services Department (MCESD) permits records for industrial sources and earthmoving operations,

3) Site visits of monitoring sites and surrounding areas, and

4) Interviews with MCESD staff, other government staff and industrial sources.

4.2 OVERVIEW OF METHODOLOGY

Wind direction and PM_{10} concentrations recorded by the four air quality monitors and meteorological stations located in the Salt River PM_{10} Study Area during the May through June 2002 Salt River Monitoring Study were reviewed for elevated ambient PM_{10} levels. Site visits and satellite image interpretation in conjunction with wind direction analysis were used to determine an appropriate study area for the Salt River area. In addition, all significant permitted industries within the study area were identified from MCESD permit records and site visits, and then located on satellite images of the Salt River PM_{10} Study Area. The resulting study area consisted of 630 grid cells, 400 meters by 400 meters with the southwest corner of the grid set at 59th Avenue and Baseline Road. A Cartesian coordinate system was used to specify the gridding of the study area.

ADEQ estimated the point source and area source PM_{10} emissions for the Salt River PM_{10} Study Area based on MCESD's earthmoving and industrial sources files and through satellite image analysis of land use, road networks, and field trips to verify land use and to collect activity data. An hourly PM_{10} source emissions profile file was also built for the various PM_{10} sources in the Salt River PM_{10} Study Area whose emissions can vary by hour of the day. These sources included vehicular traffic and various types of construction and industrial activity. After the gridded land use and hourly emissions profile files were built, the files were input to GRIDTEST.

GRIDTEST is an emissions model, written by ADEQ Air Evaluation staff, which converts land use and traffic data to hourly emission rates and hourly emission scalars for each of the 630 grid cells in the Salt River PM_{10} Study Area. The output of GRIDTEST, PM_{10} emissions ($g/s/m^2$) for each cell in the study area was combined with a file of PM_{10} emissions from industrial point sources in the study area to produce the PM_{10} emissions file that was input to EPA's ISCST3 model for estimating ambient PM_{10} levels (ISCST3 modeling will be discussed in Chapter 5 of this TSD). The GRIDTEST program was also used to generate individual categories of PM_{10} emissions to model in ISCST3 to perform area source sensitivity tests.

The following sections will describe in detail the methodology used to build the PM_{10} emissions inventory for the Salt River PM_{10} Study Area.

4.2.1 Satellite Image Analysis

Land use of the areas in the Salt River Study Area was characterized from a 1-meter satellite image (IKONOS, March 2002). This image was a pan sharpened composite of 1-meter black and white image and a 4-meter color with infrared band. The satellite image was used to identify and quantify area and linear sources of PM_{10}. The linear sources included freeway, paved primary, paved secondary and unpaved roads. The area sources included paved and unpaved parking lots, surface mining, areas with disturbed topsoil, and earth moving activities.

GIS and satellite image processing software were used to process and analyze satellite images of the Salt River PM_{10} Study Area to estimate emissions from land use, roads, and industrial sources. Following are the steps used to identify and quantify land use that contributed to PM_{10} emissions in the Salt River PM_{10} Study Area:

1) Overlay grid pattern on satellite image (630 grid cells, 400 x 400 meters)

2) Print enlargements of satellite image - blocks of 4 grid cells (approx. 158 blocks for reference during field trips) and selected individual grid cells that have complex land use.

3) In the office, make preliminary land use identification and annotate the land use on the satellite image printouts (e.g., location and extent of agricultural fields, paved roads).

4) In the field, verify land use, and if necessary, revise the annotated satellite image printouts.

5) In the office, use ArcGIS Editor (ESRI) to digitize the land use into the categories listed below.

6) Using ArcGIS, sum the area or length of each land use category by grid cell (e.g., 800 square meters of agricultural land and 1,000 meters of primary paved roads in grid cell #145) and export to a spreadsheet.

7) QA / QC the land use totals and produce a gridded land use file for input to the GRIDTEST emissions model for calculating gridded hourly emissions.

Based on satellite image analysis and field trips, the following categories were identified and assigned to the Salt River PM_{10} Study Area for input into the GRIDTEST program and are discussed in detail in the following sections:

- Agricultural Land
- Alluvial Channels
- Construction Areas
- Misc. Disturbed Areas (a.k.a. open areas)
- Paved Primary Roads
- Paved Secondary Roads
- Paved Parking Lots
- Unpaved Roads
- Unpaved Road Shoulders
- Unpaved Parking Lots
- Surface Mining
- Vacant Lots

See Appendix A for a map showing a satellite image of the study area with an overlay of the above land uses (Map A-2).

4.2.2 Fugitive Dust Study

MCESD and ADEQ conducted a field study between June 1 and December 31, 2002 to identify the locations of activities in the Salt River PM_{10} Study Area that produce fugitive dust. Every three days during the study (except for weekends and holidays), two teams would drive through the study area looking for fugitive dust being produced (e.g., see dust in the air). One team would do a survey in the morning and the other team would do a survey in the afternoon. While in the field, the teams would record the locations and types of fugitive dust producing activities on printouts of a satellite image of the study area.

These observations were not a comprehensive survey of land use in the study area, nor a complete time line of when fugitive dust was produced in the study area. Rather, the observations were “snapshots” of when the teams saw fugitive dust being produced (i.e., emissions could not be directly quantified from the observations). The observations were used to identify those areas in the study area that had possible fugitive dust problems for further follow up in developing an emissions inventory for the study area.

In the office, the teams reviewed the observations and grouped the observations into the following twelve categories:

- Agriculture – General activity associated with agricultural practices (e.g., plowing, harvesting).
- Earthmoving – General activities associated with construction (e.g., scraping, grading, trenching).
- Trackout – Soil or bulk material on a paved street surface
- Material Handling – Vehicle traffic on dirt or gravel roads at construction, industrial, or commercial sites (e.g., front-end loaders, bulldozers, loading bulk material into haul trucks or processing equipment)
- Diesel Exhaust – Exhaust from internal combustion engines that use diesel as fuel (e.g., haul trucks, front-end loaders, industrial equipment)
- Wind Event – Dust that becomes airborne due to wind movement (e.g., material being picked up by wind gusts, dust devils)
- Unpaved Hauling – Vehicle traffic on dirt or gravel roads at construction, industrial, or commercial sites (e.g., haul trucks on roads and forklifts in work areas)
- Process Equipment – Mechanical equipment used to produce a product or perform a specific function that produces particulates (e.g., crushers, screens, conveyor belts, abrasive blasting) and associated control equipment to reduce emissions (e.g., cyclones, baghouses)
- Unpaved Parking – Vehicle traffic on unpaved parking areas (e.g., unpaved parking areas at a business or commercial enterprise)
- Burning – Open burning (e.g., cooking fires, fire fighting training)
- Street Work – Activity associated with street maintenance (e.g., street sweeping, general road construction, disturbance of road surface to access underground utilities)
- Other – General hazy or dusty conditions in an area that can not be attributed to a specific fugitive dust source and other miscellaneous emission sources, such as landscaping equipment

See Appendix A for a map depicting the locations and types of fugitive dust producing activities that were observed during the study (Map A-3). Figure 4-1 contains a pie graph showing the relative percentages of the different types of fugitive dust sources observed during the Fugitive Dust Study.

Figure 4-2 shows the percentage of material handling observations attributed to vehicle traffic on dirt or gravel roads at construction and industrial sites. Figure 4-3 shows the percentage of trackout observations that were attributed to construction, industrial, and private sources and Figure 4-4 shows the percentage of unpaved hauling observations that were attributed to industrial and commercial sources.

Figure 4-1

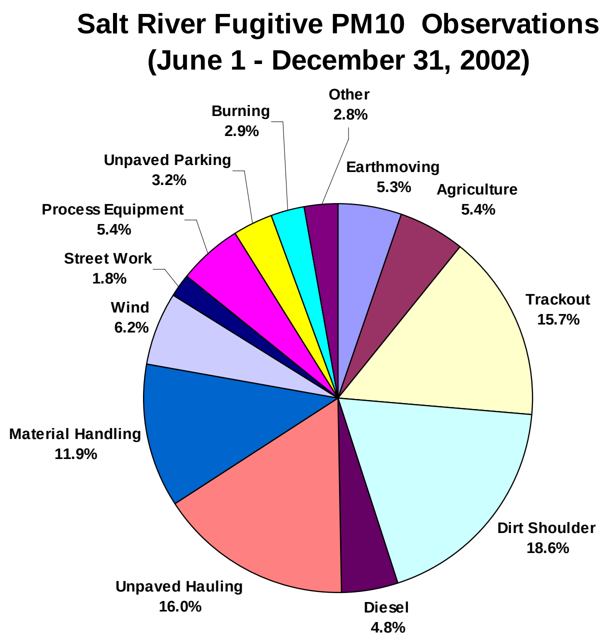


Figure 4-2

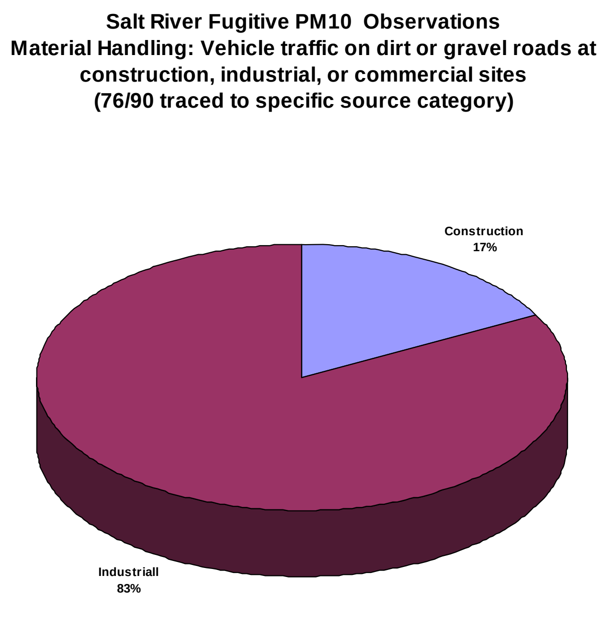


Figure 4-3

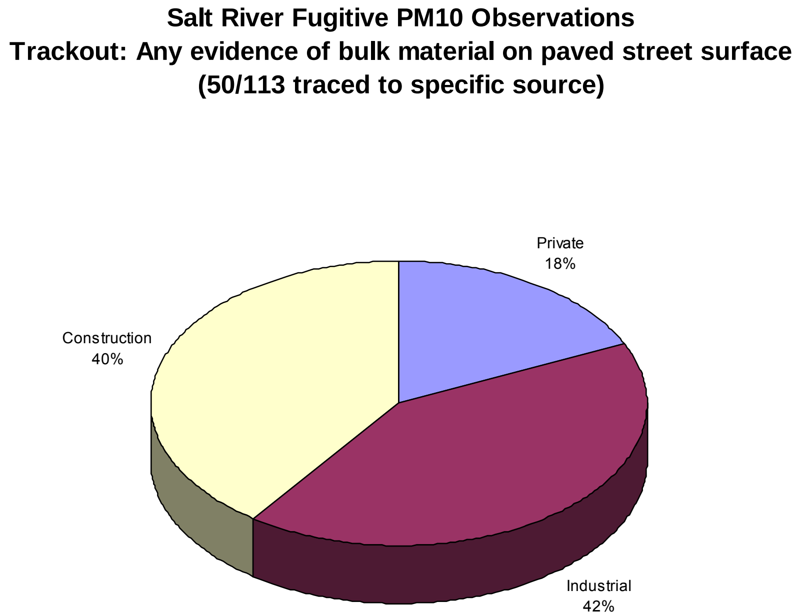
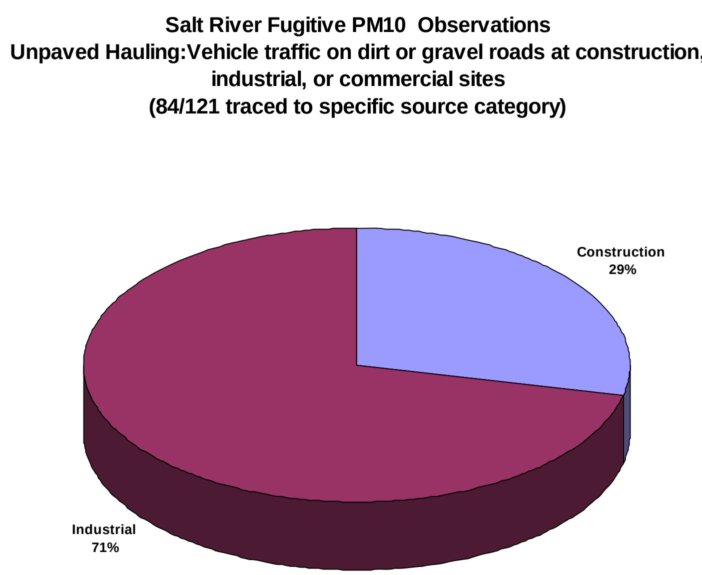


Figure 4-4



4.3 DEVELOPMENT OF 24-HOUR EMISSIONS INVENTORY

The following sections describe the data sources, assumptions and equations used for calculating PM_{10} emissions from sources in the Salt River PM_{10} Study Area.

4.3.1 Paved Roads

4.3.1.1 Interstate 17

EPA's MOBILE6.2 model was used to develop PM_{10} emission factors for the Durango Curve section of Interstate 17, which is the portion of Interstate 17 that is in the Salt River PM_{10} Study Area. The Durango Curve is an eight-lane freeway with an average daily traffic volume of about 120,000 vehicles per day. Traffic count data provided by the Arizona Department of Transportation (ADOT) were processed and formatted for input to the MOBILE6.2. The PM_{10} monitoring sites nearest the Durango Curve are the Salt River and Durango monitors, located 0.7 and 0.65 miles respectively from the freeway.

The MOBILE6.2 model (released by EPA in 2002) was used to calculate PM_{10} emissions factors for exhaust, brake wear and tire wear emissions from mobile sources on the Durango Curve using hourly and day of week traffic count data as inputs. The reentrained road dust emission factor was calculated using EPA's AP-42 guidance. In addition, the above emission factors were separated into two vehicle class categories: heavy duty vehicles (HD) and light duty vehicles (LD) that reflected the vehicle mix on the Durango Curve. ADOT, in their traffic count data, defines HD vehicles as vehicles that are more than thirty feet in length and LD vehicles as vehicles thirty feet or less in length.

Table 4-1 lists the emission factors used to estimate PM_{10} emissions from mobile sources on the Durango Curve. The weighted average PM_{10} emission factor (HD traffic count vs. LD traffic count) of LD and HD vehicles was 0.124 g/mi, while the HD vehicle emission factor was 0.438 g/mi and the LD vehicle emission factor was 0.089 g/mi. It is important to note that the overall HD vehicle emission factor (brakes, tire, exhaust and reentrained road dust) is approximately five times higher than the LD vehicle emission factor, and that the HD vehicle emission factor for brakes, tires, and exhaust is over twelve times higher than the LD vehicle emission factor for this category. These differences in emission rates between HD and LD vehicles points to the necessity to segregate traffic count data into HD and LD vehicles before calculating freeway emissions.

TABLE 4-1 Freeway Emission Factors for Durango Curve		
PM_{10} Emission Factor Category	**Emission Factor g / VMT**	**Ratio of HD Emissions to LD Emissions**
Combined Emissions - Weighted (brakes, tires, exhaust, reentrained road dust from LD and HD vehicles)	0.124	5
Combined Emissions - HD Vehicles (brakes, tires, exhaust, reentrained road dust)	0.438	
Combined Emissions - LD Vehicles (brakes, tires, exhaust, reentrained road dust)	0.089	
Reentrained Road Dust – Weighted	0.059*	1
Brakes, Tires, Exhaust - Weighted	0.060	13
Brakes, Tires, Exhaust – HD Vehicles	0.379	
Brakes, Tires, Exhaust – LD Vehicles	0.030	
* EPA AP-42 guidance recommends that the average weight of all vehicles be used to calculate an emission factor for reentrainment and that a separate emission factor not be calculated for individual vehicle classes. (Bill Kuykendal, with EPA at 919-541-5372, also confirmed that an average vehicle weight should be used when calculating the reentrainment emission factor.)		

4.3.1.2 Primary Paved Roads

Primary paved roads within the Salt Site Study Area included the roads running east to west - Van Buren, Buckeye, Lower Buckeye Road, Broadway Road, Southern Avenue, and Baseline, and north to south – 59th Avenue (northbound only), 51st Avenue, 43rd Avenue, 35th Avenue, 27th Avenue, 19th Avenue, 7th Avenue, Central Avenue and 7th Street. Average Daily Traffic (ADT) for each primary road in the study area was obtained from the City of Phoenix Traffic Volume Map, 1999. This map can be found on the web at http://www.ci.phoenix.az.us/STREETS/counts.html. All sections of primary roads occurring in an individual cell of the study area were assigned ADT from this map. See Appendix C for a listing of ADT for Primary and Secondary Paved Roads for each grid cell in the Salt River PM_{10} Study Area.

Following is an example of the ADT assignment:

Given,

Primary Road #1 in Cell #10

- ADT_1 = 1,000 vehicles per day
- L_1 = Length of Primary Road #1 in Cell #10 = 350 meters

Primary Road #2 in Cell #10

- ADT_2 = 6,000 vehicles per day on Primary Road #2
- L_2 = Length of Primary Road #2 in Cell #10 = 200 meters

Then,
Average ADT in Cell #10 = $[(ADT_1 \times L_1) + (ADT_2 \times L_2)] / (L_1 + L_2)$

Average ADT = [(1000 x 350) + (6000 x 200)] / (350 + 200) = 2,818 vehicles / day in Cell #10

The total length of primary paved roads in the Salt River PM_{10} Study Area was approximately 144 kilometers. Vehicle miles traveled (VMT) were calculated for each grid cell by multiplying the average daily traffic (ADT) by the length of primary paved roads in a grid cell.

ADEQ collected road dust samples from paved roads at 5 locations in the Salt River PM_{10} Study Area. The road dust samples were collected using a vacuum cleaner while the roads were temporarily blocked by City of Phoenix Road Department staff using a sign truck. The following road locations were sampled:

- Sample 1 - 19th Avenue south of Lower Buckeye Road
  November 7, 2002, road dust was collected from the two southbound lanes. Area = 24 ft wide by 12 ft long (288 square feet).

- Sample 2 - 19th Avenue between Salt River Bridge and Broadway Road
  On November 7, 2002, road dust was collected from the two northbound lanes. Area = 24 feet wide by 15 feet long (360 square feet).

- Sample 3 - West Broadway Rd just east of 38th Drive
  On October 22, 2002, road dust was collected from the two eastbound lanes. Area = 24 feet wide by 12 feet long (288 square feet).

- Sample 4 - 51st Ave just south of Salt River Bridge.
  On October 22, 2002, road dust was collected from the northbound lane. Area = 14 feet wide by 18 feet long (252 square feet).

- Sample 5 – Lower Buckeye Rd just west of 35th Avenue
  On October 22, 2002, road dust was collected from the two eastbound lanes. Area = 30 feet wide by 12 foot long (360 square feet).

These samples were sent to an engineering laboratory, Kleinfelder and Associates, to determine their silt content and mass. An average silt loading value of 0.30 g/m^2 was determined based on the laboratory's sieve analyses. (Engineering Science,1988).
Following are the calculations and PM_{10} emission factors that were used to calculate the PM_{10} emissions from primary paved roads.

Paved Road Emission Factor - $EF_{paved\ road}$

The paved road emission factor ($EF_{paved\ road}$) includes reentrained road dust along with contributions from vehicle exhaust, brake wear and tire wear. The emission factor for paved roads was calculated using the following equation from Section 13.2.1 of AP – 42 (EPA, 2001c):

$$EF_{paved\ road} = 7.3 * (sL / 2)^{0.65} * (W/3)^{1.5}$$ *in units of g/VMT*

where:

$EF_{paved\ road}$ = Paved road emission factor grams/vehicle miles traveled (g/VMT).

sL = road surface silt loading (g/m^2).

W = average vehicle weight (tons).

Using an average silt loading of value of 0.30 g/m^2, and an average vehicle weight of 3 tons (national average), the PM_{10} emission factor for paved roads is 2.13 g/VMT.

Brake, Tire, Exhaust Emission Factors

The MOBILE6 model was used to derive the emission factors for brake, tire, and exhaust for traffic activity on primary paved roads in the Salt River PM_{10} Study Area:

- Exhaust Emission Factor ($E_{vehicle\ exhaust}$) = 0.065 g/VMT
- Brake Wear Emission Factor ($E_{brake\ wear}$) = 0.013 g/VMT
- Tire Wear Emission Factor ($E_{tire\ wear}$) = 0.009 g/VMT

The above emission factors were reported in Pechan's report, "1999 and 2013 Emission Estimates for the Yuma Arizona PM_{10} Nonattainment Area Maintenance Plan, Final Report" (Pechan, 2002).

Primary Paved Roads Emissions Calculation

$$E_{paved\ roads} = EF_{paved\ road} \times (L / 1{,}600\ m/mi) \times Veh/day$$

where:

$E_{paved\ roads}$ = PM_{10} emissions from paved roads (grams)

$EF_{paved\ roads}$ = Paved road emission factor in g/VMT = 2.13 g/VMT

L = Length of paved road (meters)

Veh/day = Vehicles per day

Note: The paved road emission factor (2.13 g / VMT) incorporates the emission factors for reentrained road dust (2.043 g/VMT), vehicle exhaust (0.065 g/VMT), brake wear (0.013 g/VMT), and tire wear (0.009 g/VMT). The reentrained road dust emission factor was derived by subtracting the emission factors for vehicle exhaust, brake wear and tire wear from the paved road emission factor (2.13 g/VMT).

The emissions for reentrained road dust, vehicle exhaust, brake wear, and tire wear were calculated separately using the above paved roads emissions equation with the appropriate emission factor (e.g., use the vehicle exhaust emission factor of 0.065 g/VMT to calculate vehicle exhaust emissions).

4.3.1.3 Secondary Paved Roads

Daily traffic counts were not available for secondary paved roads. ADEQ assumed that the daily traffic counts on secondary paved roads are 10% of the daily traffic counts on primary paved roads. This assumption was based on previous work in the 1997 Maricopa County PM_{10} SIP (ADEQ, 1997). The total length of secondary paved roads in the study area was approximately 402 kilometers. The calculation of PM_{10} emissions from secondary paved roads was treated in a similar fashion to the calculations of PM_{10} emissions from primary paved roads.

4.3.2 Unpaved Shoulders

Unpaved shoulders of paved roads produce PM_{10} emissions when high profile vehicles (e.g., buses, large vans, delivery trucks, semi trucks, dump trucks) reentrain dust from the unpaved shoulders as these vehicles travel down the road. This is due to the wake effect of these large vehicles, which is much larger than the wake effect from automobiles or other small vehicles.

To better evaluate the contribution of unpaved shoulders to PM_{10} emissions in the study area, ADEQ conducted a field survey to determine the amount of high profile vehicle traffic. This survey was patterned after a study reported in the Journal of Air & Waste Management Association (Moosmuller et al, 1998), in which a PM_{10} emission factor for unpaved shoulders along paved roads was developed.

Three sites were selected in the study area for surveying high profile vehicle traffic: a) Southern Avenue and Hidalgo, b) 35th Avenue, one block north of Baseline, and c) Baseline between 43rd and 51st Avenues. The survey was conducted in the late morning (11 am), early afternoon (1 pm) and mid afternoon (4 pm) for 15 minutes at a time. The vehicles that were counted during each 15-minute observation were: a) low profile vehicles, which included cars and pickup trucks, and b) high profile vehicles which included buses, large delivery vans, semi trucks, dump trucks, vans whose length to height ratio was two or greater, and vans with roofs that an average person could barely touch from the ground. ADEQ's survey indicates that approximately 10% of vehicle traffic in the study area is high profile vehicles.

The Moosmuller (1998) study reported that high profile vehicles, traveling at 50 – 60 mph, had a PM_{10} emission factor of 12.88 ± 6.44 gm/VMT (8 ± 4 gm/VKT). The emission factor previously calculated for primary roads in the Salt River Study Area is

2.13 gm/VMT. Thus, a high profile vehicle may have an emission rate 10.75 g/VMT greater than a low profile vehicle. Since high profile vehicles represent ten percent of the average daily traffic in the study area, the additional emissions from overall vehicle traffic in the study area would be calculated using an emission rate of 1.08 gm/VMT. The emissions from unpaved shoulders were estimated using a similar equation to that used for paved road emissions:

$$E_{road\ shoulder} = EF_{road\ shoulder} \times (L / 1{,}600 \text{ m/mi}) \times \text{Veh/day}$$

where:

$E_{road\ shoulder}$ = PM_{10} emissions from unpaved shoulder in grid cell (grams)

$EF_{road\ shoulder}$ = 1.08 g/VMT

L = Total length of unpaved shoulders (meters).

Veh/day = Total number of vehicles per day (both low profile and high profile)

4.3.3 Trackout Onto Paved Roads

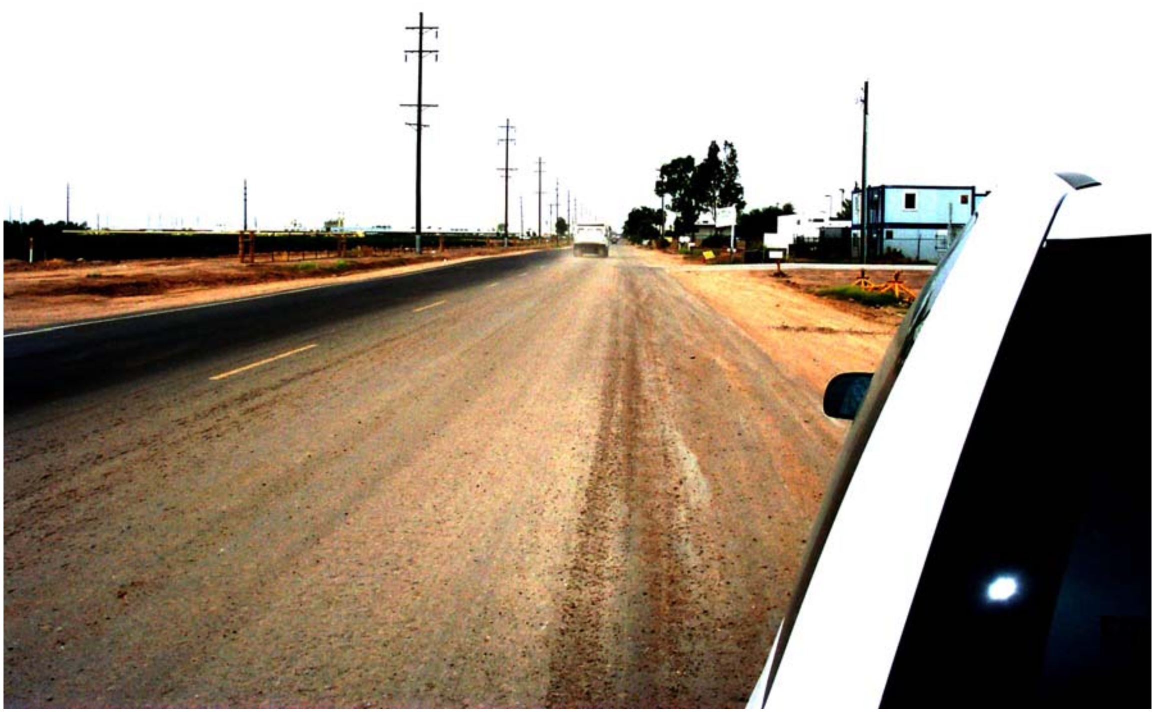
Trackout onto paved roads can be transitory, especially after a rain event or a material spill on a road. Prompt cleanup and street sweeping will greatly reduce the emissions in these instances. However, there appeared to be long term trackout on 43rd Avenue south of Lower Buckeye Road due to facilities along that road. This was reported to ADEQ by City of Phoenix Road Department staff and was also observed by ADEQ staff during site visits (See Figure 4-5 for two photographs of trackout). See Appendix D for a detailed description of a trackout field study done by ADEQ to assess trackout conditions on 43rd Avenue. Trackout was grouped into four classes of loading on unpaved roads with associated silt loading and emission factors based on ADEQ's trackout study. Table 4-2 lists these values for trackout classifications, silt loadings and emission factors. See Appendix K for a discussion of the methodology used for weighting trackout emissions.

TABLE 4-2
Trackout and Emission Factors

Trackout Classification	Description	Silt Loading (g/m^2)	Emission Factor (g/VMT)
Class 1 Extreme	Equivalent to heavy trackout found on 43rd Avenue south of Lower Buckeye Road	8 – 11 Avg. = 9	29
Class 2 Average	Equivalent to the trackout values recommended by ADOT. Emission factor is approximately 6X larger than the average primary road emission factor (Class 4 in this table) per ADOT guidance.	3	12
Class 3 Minimum	Equivalent to silt loading halfway between Class 2 value (3 g/m^2) and Class 4 value (0.3 g/m^2). Emission factor is also halfway between Class 2 value (12 g/VMT) and Class 4 value (2 g/VMT).	1.65	7
Class 4 No Trackout	No trackout associated with this class. The silt loading and emission factor are equivalent to average values for primary roads in study area.	0.3	2

Figure 4-5 – Trackout on 43rd Avenue, looking south and north respectively.

Photos taken September 22, 2003



4.3.4 Unpaved Roads and Unpaved Parking Lots

The location and extent of unpaved roads and unpaved parking areas were determined from satellite image analysis and site visits by ADEQ and MCESD staff.

4.3.4.1 Unpaved Roads

Emissions from unpaved roads in the Salt River PM_{10} Study Area are considered negligible (data on unpaved haul roads are included in MCESD's permit records for industrial sources). After analysis of the satellite image of the Salt River PM_{10} Study Area, field trips by ADEQ staff, and meetings with MCESD inspectors, only two unpaved roads were located in the study area. ADEQ staff, in a subsequent field trip to investigate the two unpaved roads, determined that the two roads were private industrial access roads and had minimal VMT. One road is located south of Lower Buckeye Road off of 35th Avenue and extends about 200 meters west. The other road is located west of 35th Avenue off of Lower Buckeye Road and follows a railroad spur south about 400 meters.

4.3.4.2 Unpaved Parking Lots

The majority of small unpaved parking lots in the Salt River PM_{10} Study Area are located along Broadway Road between 19th Avenue and 35th Avenue. The Manzanita Speedway located at Broadway Road and 35th Avenue has unpaved parking for spectators on the north side of the speedway and dirt parking for contestants on the south side of the racetrack. The Manzanita Speedway's parking lot has entrance gates which are typically locked except for the Friday and Saturday night races. The Maricopa County Jail on Durango Road also has large unpaved parking areas for staff and visitors.

PM_{10} emissions from unpaved parking lots were calculated using the same type of formulas with the same emission factors as those used for unpaved roads (EPA ,1988 and Engineering Science, 1988). Following is the PM_{10} emission factor and the calculations that were used to estimate the PM_{10} emissions from unpaved parking lots.

Unpaved Parking Lot Emission Factor - EF_{up}

(Note: the same emission factor is used in calculating PM_{10} emissions from both unpaved parking lots and unpaved roads.)

$$EF_{up} = 5.9K \times (s/12) \times (S/30) \times (W/3)^{0.7} \times (w/4)^{0.5} \times ((365-p)/365)$$

Where:

EF_{up}	=	Unpaved road PM_{10} emission factor (lb/VMT)
s	=	Silt content - fraction of particles 75 μm diameter or less
S	=	Average vehicle speed in miles per hour (mi/hr)
W	=	Vehicle weight in tons or megagrams (Mg)
w	=	Number of wheels per vehicle
p	=	Number of days per year with greater than 0.01 inches precipitation
K	=	Aerodynamic particle size multiplier
VMT	=	Vehicle miles traveled

For PM_{10}

$K = 0.36$

Default values used to calculate EF_{up}:

$s = 10$ percent
$S = 15$ mi/hr
$W = 2$ tons
$w = 4$ wheels per vehicle
$p = 30$ days

The result is an unpaved road emission factor of $EF_{up} = 0.55$ lb/VMT or 250 g/VMT. (To convert from lb/VMT to g/VMT multiply by 454 g/lb.)

Unpaved Parking Lot PM_{10} Emissions Calculations

Average hourly traffic (AHT) on unpaved parking lots is needed to estimate the contribution of unpaved parking lots to PM_{10} emissions in the study area. Following are the assumptions, ADEQ used to estimate AHT on unpaved parking lots:

- Average time a car is parked in an unpaved parking lot is 30 minutes = 20% turnover of parked cars per hour
- Average distance driven in an unpaved parking lot = length + width of the parking lot

The following equation was used to estimate PM_{10} emissions from unpaved parking lots:

$$E_{\text{unpaved parking lot}} = EF_{up} * (L + W) * 0.2 * N$$

Where:

$E_{\text{unpaved parking lot}}$ = PM_{10} emissions from unpaved parking lot (grams)
EF_{up} = Unpaved road emission factor = 250 g / VMT
L = length of unpaved parking lot
W = width of unpaved parking lot
0.2 = 20% turnover of parked cars (e.g., 20% entering / leaving parking lot)
N = number of parked vehicles

ADEQ estimated the length and width of unpaved parking lots from satellite image analysis and field trips, and estimated the number of parked vehicles in a parking lot through field trips.

The uncontrolled emissions calculated in the preceding equation were reduced by 55% to account for the control measures in MCESD's Rule 310.01. Parking lots with a gravel surface are estimated to have 60% less emissions than dirt parking lots.

4.3.5 Wind Erosion of Disturbed Areas

PM_{10} emissions were estimated from areas with disturbed topsoil that are vulnerable to wind erosion in the Salt River PM_{10} Study Area. Following are the categories of disturbed areas that were investigated:

- Wind Erosion – Agricultural
- Wind Erosion – Alluvial Channels
- Wind Erosion – Construction
- Wind Erosion – Miscellaneous Disturbed Areas
- Wind Erosion – Vacant Lots
- Wind Erosion – Unpaved Parking Lots

PM_{10} emissions from wind erosion of unpaved road shoulders were considered negligible since the surface area of unpaved road shoulders was 0.2% of the total surface area of all disturbed areas ((68,889 m^2 / 30,256,222 m^2 = 0.00227 or 0.2%). See Appendix E for a detailed description of a field study conducted by ADEQ to identify and quantify areas in the Salt River alluvial channel that had different soil stabilities and thus different wind erosion PM_{10} emissions.

PM_{10} emissions resulting from wind erosion were estimated for the two design days with hourly wind speeds greater than 15 mph – April 15 and April 26, 2002. April 15, 2002 had four hours with wind speeds greater than 15 mph: 14:00, 15:00, 16:00, and 17:00. April 26, 2002 also had four hours with wind speeds greater than 15 mph: 14:00, 15:00, 17:00, and 18:00 (18:00 is 6:00 PM).

The emission factor used in estimating PM_{10} emissions from wind erosion was based on studies by Nickling and Gillies (1986) and Engineering Science (1988). These studies used a portable wind tunnel and silt sampling at various locations in Arizona to determine an emission factor for wind erosion of Arizona soils. The wind erosion emission factor equation appears below.

Wind Erosion Emission Factor ($EF_{wind\ erosion}$)

$$EF_{wind\ erosion} = F * FC$$

where:

$EF_{wind\ erosion}$ = PM_{10} emission rate for wind erosion (g / cm^2 / sec)
F = flux rate of $1.71 * 10^{-21} * U^{4.355}$ (g / cm^2 sec)
U = wind speed at 10 meter height (cm / sec)
FC = Fetch correction = 1/3 (log (3.281* d)) for d < 300 meters
d = fetch length (meters)

The wind erosion emission factor equation is from the Nickling and Gillies report, "Evaluation of Aerosol Production Potential of Type Surfaces in Arizona", 1986. The threshold wind speed for wind erosion is an important factor in estimating emissions for a windblown dust episode. As previously discussed, portable wind tunnel studies conducted in Arizona have reported threshold wind speeds ranging from 12 mph to 25 mph depending on location. Threshold wind speed can vary due to local soil moisture, local silt content, type of soil, amount of crusting, and amount of wind shadowing.

In the Phoenix PM_{10} Microscale Study, conducted by ADEQ and MCESD in 1995 (ADEQ, 1997) wind speed, wind direction and ambient PM_{10} measurements were made every 30 minutes (PM_{10} measurements made using a TEOM or tapered element oscillating microbalance). After ADEQ reviewed the meteorological and PM_{10} data for the April 9, 1995 24-hour PM_{10} exceedance, it was apparent that the PM_{10} levels began to increase dramatically after the wind speed reached 15 mph. A threshold wind speed of 15 mph was also reported in a DRI study of wind erosion and PM_{10} levels in Las Vegas, Nevada (DRI, 2000). Thus, ADEQ used 15 mph as the threshold wind speed for wind erosion.

Wind Erosion Emission Calculation ($E_{wind\ erosion}$)

$$E_{wind\ erosion} = EF_{wind\ erosion} * (A * (10^4\ cm^2 / m^2)) * (T * 3600\ sec/hr) * (metric\ ton / 10^6\ g)$$

Where:

$E_{wind\ erosion}$ = PM_{10} emissions due to wind erosion (metric tons)

$EF_{wind\ erosion}$ = PM_{10} emission rate for wind erosion (g / cm^2 / sec)

A = Area of disturbed areas (m^2) from agriculture, alluvial channels, construction activity, misc. disturbed, vacant lots, and unpaved parking lots (each emission category calculated separately for wind erosion)

T = Number of hours with wind speed greater than 15 mph

Example for 50 meter x 10 meter Field:

$EF = 6.22 * 10^{-8}$ gm / (cm^2 – sec)
A = 50 meters * 100 meters = $5 * 10^3\ m^2 = 5 * 10^7\ cm^2$
T = 4 hours wind duration greater than 15 mph

$$E = (6.22 * 10^{-8}\ gm/cm^2\text{-}sec) * (5 * 10^7\ cm^2) * (4\ hrs * 3600\ sec/hr) * (1\ metric\ ton / 10^6\ g) = 0.045\ metric\ tons\ per\ day$$

Example for Construction Windblown Dust in Study Area (converting total area in m^2 to metric tons per day):

The emission factor per m^2 is given by:

$EF = 6.22 * 10^{-8} * 10^4\ m^2 * 4 * 3600 / 10^6 = 8.9568 * 10^{-6}$ metric tons per day per meter^2
A = 5,661,710 meters^2 of areas under construction in Salt River PM_{10} Study Area

$E = 8.9568 * 10^{-6}$ metric tons per m^2 per day * 5,661,710 m^2 of construction = 18.76 metric tons / day

(See Table 4-5 which lists 18.76 metric tons per day for construction windblown dust)

Wind Erosion Control Measures
– *Vacant Lots, Misc. Disturbed Areas, Construction Sites*

MCESD conducted a rule effectiveness study in 2003 (MCESD, 2003). Based on this study, MCESD revised the control effectiveness of control measures for the following sources for the Year 2002:

- Wind Erosion - Vacant lots and misc. disturbed areas = 55%
- Wind Erosion – Construction = 63%

Following are MCESD's calculations for Year 2002 control measure effectiveness

Wind Erosion - Vacant Lots:

- Year 2002 control effectiveness = 90% control efficiency * 62% compliance rate = 55% overall control effectiveness in Year 2002[1]

Wind Erosion – Construction:

- Year 2002 control effectiveness = 90% control efficiency * 70% compliance rate = 63% overall control effectiveness in Year 2002[1]

Wind Erosion Control Measure – Agricultural Fields
Agricultural fields are considered to be vulnerable to wind erosion when the topsoil has been disturbed (e.g., by tilling). ADEQ assumed that the corn and cotton fields in the study area had not been planted before the two high wind design days (planting time of corn and cotton varies depending on weather conditions and the availability of irrigation allotments which may be reduced due to drought conditions). According to the Maricopa County Farm Bureau and the University of Arizona Cooperative Extension Service, planting of corn and cotton is associated with twice-a-month irrigation and the development of a soil crust which greatly reduces wind erosion.

The fields for some crops are tilled after harvest, while other crops are not tilled until shortly before planting. See Appendix F for a detailed description of how ADEQ estimated which agricultural crops were being grown in the study area and when the different crop fields may have experienced wind erosion in Year 2002. These data were provided by the Maricopa County Farm Bureau and the University of Arizona Cooperative Extension Service and spatially allocated using satellite image analysis and field trips.

The Agricultural PM_{10} General Permit (URS and ERG, 2001) for agricultural best management practices includes a control measure for wind erosion of agricultural land [The Arizona Administrative Register (A.A.R), Title 18, Chapter 2, §609-611 contains the rulemaking for the "Agricultural PM_{10} General Permit."]. This control measure is listed in the general permit as "Limited Activity During High Wind Events". The URS report (URS and ERG, 2001), which evaluated the agricultural best management practices, gives this measure a midpoint control efficiency of 9.3%. However, this

[1] MCESD conducted a rule effectiveness study in 2002 and 2003 (Appendix G), to review the compliance rate of Maricopa County Rules 301, 310.01, and Rule 316 in the Salt River PM_{10} Study Area. The compliance rate for Rule 310 was determined to be 80%, however, wind erosion was not a factor in the observations, therefore, MCESD adjusted the compliance rate for wind erosion – construction to 70%, as a conservative estimate.

measure takes effect when wind speeds are over 25 miles per hour. The wind speed on the two high wind design days did not exceed 15 mph. Thus, the emission reductions from this control measure were not applied to ADEQ's estimate of emissions from wind erosion of agricultural land.

4.3.6 Agricultural Tilling

Crop types, acreage of crops grown, and a crop calendar (which months agricultural operations occur) in the Salt River PM_{10} Study Area were obtained from satellite image analysis of the study area to locate agricultural fields and from the Maricopa County Farm Bureau and University of Arizona Cooperative Extension Service. Land preparation data for specific crops were obtained from the Technical Support Document for Quantification of Agricultural Best Management Practices report (URS and ERG, 2001).

Agricultural Tillage Emission Factor

The agricultural tillage emission factor was calculated as follows:

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

where:

EF	=	agricultural emission tillage factor (lbs PM_{10} / acre-pass)
k	=	particle size multiplier (value of 0.15 for PM_{10})
s	=	silt content of soil (percent).

Setting s to 35.2% (URS and ERG, 2001), then

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

Agricultural Tillage Emission Calculation

The months that the four design days occurred were compared with the crop calendar (see Appendix F) to determine which design days had agricultural tillage activity. Of the four design days, only January 8, 2002 appears to have agricultural tillage activity.

PM_{10} emissions from agricultural tillage were calculated for the January 8, 2002 design day using the following equation (ARB, 1997):

$$Tillage_{Crop} = EF \times AP_{Crop} \times A_{Crop} \times x\ AF_{crop}$$

where:

$Tillage_{Crop}$	=	tillage emissions for a specific crop type (lbs PM_{10})
EF	=	tillage emission factor (lbs PM_{10}/acre-pass)
AP_{Crop}	=	number of tillage passes per crop (passes)
A_{Crop}	=	surface area of tilled land for a specific crop type (acres)
AF_{Crop}	=	fraction of annual tillage activity occurring on design day

Example:
Assume:

EF	=	6.10 lbs PM_{10} / acre-pass
AP_{Crop}	=	7 tillage passes for a cotton crop (e.g., laser level, rip, disk, landplane, incorporate herbicide/disk, list, mulch)
A_{Crop}	=	10 acres of cotton fields per grid cell of study area
AF_{Crop}	=	0.01 (for January 8, 2002 design day)

Then:

$$Tillage_{Cotton} = 6.10 \text{ lbs } PM_{10} \text{ / acre-pass} \times 7 \text{ passes} \times 10 \text{ acres} \times 0.01$$
$$= 4.27 \text{ lbs } PM_{10}$$

These PM_{10} emissions calculations do not take into account the emissions reductions from the recent implementation of the general permit for agricultural best management practices (BMPs), which includes control measures for agricultural tillage [Arizona Administrative Code (A.A.C), Title 18, Chapter 2, §610-611].

The URS and ERG report (2001) quantified the emission reductions for three agricultural best management practices listed in the Agricultural PM_{10} General Permit for tillage

- Combining tractor operations – midpoint control efficiency of 7.9%
- Limited activity during high wind events – midpoint control efficiency of 9.3%
- Multi-year crops – midpoint control efficiency of 15.8%

The "Combining Tractor Operations" best management practice was selected for the January 8, 2002 design day because this design day was not considered a high wind event because fields with multi-year crops had already been identified for the time period of the monitoring study.

Following is the calculation of PM_{10} emissions from agricultural tillage after accounting for the potential emission reductions from Maricopa County farmers implementing Ag BMPs (URS and ERG, 2001).

$$E_{Controlled} = E \times (100\% - BMP)$$

where:

$E_{Controlled}$	=	Controlled PM_{10} emissions from agricultural tillage after agricultural BMPs
E	=	Uncontrolled PM_{10} emissions from agricultural tillage
BMP	=	Percent emissions reduction from the BMPs

Example:

E = 10 tons PM_{10} from cotton
BMP = 7.9%

Then:

$$E_{Controlled} = 10 \text{ tons } PM_{10} \times (100\% - 7.9\%) = 9.21 \text{ tons } PM_{10}$$

The total amount of cotton and corn in the Salt River PM_{10} Study Area that was tilled on the January 8, 2002 design day was 1,769,600 m^2 of cotton and 856,000 m^2 of corn (haylage).

4.3.7 Agricultural Harvesting

The months that the four design days occurred were compared with the crop calendar (see Appendix F) to determine which design days may have had agricultural harvesting activity. None of the four design days (January 8, April 15, April 26, December 16) appear to have agricultural harvesting activity. Thus, no emissions were calculated for this source category.

See Appendix F for additional details on the development of crop types, crop calendar, and estimated number of acres of crops in the Salt River PM_{10} Study Area.

4.3.8 Construction Activity

4.3.8.1 Road Construction

ADEQ planned on using the road construction emission factor listed in MRI's 1996 report, "Improvement of Specific Emission Factors", for estimating emissions from road construction (0.11 tons/acre/month or 0.0338 gm/m^2/hour). However, review of MCESD's earth moving permit records and conversations with MCESD staff indicate that there was no road construction in the Salt River PM_{10} Study Area in Year 2002. Thus, no road construction emissions were estimated for the study area.

4.3.8.2 Residential and Industrial Construction

Areas with residential and construction activity in the Salt River PM_{10} Study Area were identified through satellite image analysis, MCESD records, site visits, and quarterly aerial photograph books that show current and planned construction (Rupp Aerial Photo 2001 and 2002) .

Construction Emission Factors ($EF_{wind\ erosion}$)

EPA developed a new set of emission factors for residential construction that is an improvement on the AP-42 emission factors. The factors are based on based on a 1996 study by Midwest Research Institute (MRI, 1996). The new factors are as follows:

Single Home Construction Emission Factor ($EF_{Const - New Home}$)

- $EF_{Const - Single Home}$ = 0.032 tons/acre/month = 0.0098 g / m^2 / hour

Apartment Construction Emission Factor ($EF_{Const - Apartment}$)

- $EF_{Const - Apartment}$ = 0.11 tons/acre/month = 0.0338 g / m^2 / hour

The apartment construction emission factor also applies to construction of housing developments and industrial construction that do not involve substantial earth moving.

The MRI report included an emission factor for a worst-case construction emissions scenario. This emission factor is appropriate for large-scale construction projects that involve substantial earthmoving operations.

Large Scale Construction Emission Factor ($EF_{Const – Large Scale}$)

- $EF_{Const – Large Scale}$ = 0.42 tons/acre/month = 0.129 g / m^2 / hour

MRI's report points out that the emission factor for large scale construction is approximately 71% lower than the previous emission factor listed in EPA's AP-42, Fourth Edition.

South Coast Air Quality Management District (SCAQMD) uses the large-scale construction emission factor for estimating PM_{10} emissions from construction projects that involve substantial earthmoving operations. The remainder of California, which does not have as detailed construction information as SCAQMD, uses the construction emission factor of 0.11 tons/acre/month (0.0338 g / m^2 / hour).

Clark County, Nevada also uses the construction emission factor of 0.11 tons/acre/month (0.0338 g / m^2 / hour) for estimating emissions from construction projects.

Finally, the same values for emission rates for single home construction (0.032 tons/acre/month) and apartment construction (0.11 tons/acre/month) were used by Pechan and Associates for developing a PM_{10} emission inventory for Yuma, Arizona (Pechan, 2002).

Construction Emission Calculations ($E_{construction}$)

$E_{construction} = EF_{construction} * A$

where:

$E_{construction}$ = PM_{10} emissions due to construction (g)

$EF_{construction}$ = PM_{10} emission rate for construction (g / m^2 / hour)

- 0.0098 g / m^2 / hour for single home construction
- 0.0338 g / m^2 / hour for housing developments, apartments, industrial construction
- 0.129 g / m^2 / hour for large-scale construction projects that involve substantial earthmoving operations

A = Area under construction (m^2)

During 2002, construction in the Salt River PM_{10} Study area consisted of apartment complexes (multi-dwelling) and tract homes. ADEQ used a construction emission factor of 0.0338 g / m^2 / hour (0.11 tons/acre/month) for these construction projects and applied MCESD's control measure effectiveness of 56% for construction activity (MCESD Rule 310). MCESD estimated the overall control effectiveness for construction activity for Year 2002 to be 56% based on a 90% control efficiency and a 80% compliance rate and an adjustment to reflect future test method improvements [90% x 80% = 72%; 72% - 16% = 56%]. This will be discussed in the Emissions Summary section of this report.

4.3.9 Lawn Care

Exhaust emissions from gasoline powered equipment used for professional lawn care in the Salt River PM_{10} study area were estimated using satellite image analysis and U.S. Census data. Using a gridded satellite image, the number of housing units in each grid cell (400 x 400 meters) in the study area that contained residential housing with lawns were counted (lawns show up as false color red on infrared band of satellite image). The number of housing units per cell was then multiplied by three to obtain an estimate of the number of people per grid cell. According to the U.S. Census Bureau, (http://factfinder.census.gov/), the average size household in Arizona is approximately three people (census map shows a household range from 2.67 to 2.80 people).

Lawn Care Equipment Emission Factor:

The Maricopa Association of Governments, in their 1999 particulate plan (MAG, 2000), reported that 0.65 metric tons of PM_{10} per day originated from lawn and garden equipment exhaust. This value was based on a 1994 population of 2,355,900. Thus, the lawn care equipment emission factor is calculated as follows:

$EF_{lawn\ care}$ =

$(0.65 \text{ metric tons } PM_{10} \ / \ 2{,}355{,}900 \text{ people}) \times 1{,}000{,}000 \text{ grams / metric ton} =$

0.276 grams per person per day.

Lawn Care Emission Calculations ($E_{lawn\ care}$):

$E_{lawn\ care} = EF_{lawn\ care} * N$

Where:

$E_{lawn\ care}$ = PM_{10} emissions due to lawn care emissions (g)
$EF_{lawn\ care}$ = PM_{10} emission rate for lawn care emissions (g / person / day)
N = Number of people

Example:

$EF_{lawn\ care}$ = 0.276 grams per person per day.
N = 100 people

Then:

$E_{lawn\ care} = 0.276 \text{ g / person / day} \times 100 \text{ people} = 2.76 \text{ g } PM_{10}$

Due to the very small amount of emissions from this source (2.43 x 10^{-6} metric tons / day), ADEQ classified its emissions as negligible.

4.3.10 Restaurant Charbroilers

Through discussions with MCESD food inspectors and field trips, four restaurants were located in the Salt River PM_{10} Study Area that had charbroilers.

Charbroiler Emission Factor:

The Maricopa Association of Governments, in their 1999 particulate plan (MAG, 2000), reported that 23.97 metric tons of PM_{10} per year originated from restaurant charbroilers in the Maricopa County PM_{10} Nonattainment Area. This value is based on a total of 84 restaurants which charbroil meat, a control measure effectiveness of 83% and an assumption that 80% of the restaurants had the control measure in place. Thus, the charbroiler emission factor is calculated as follows:

$EF_{charbroiler}$ =

(23.97 metric tons / year PM_{10}) / 84 restaurants x 1,000,000 grams / metric ton x year / 365 days = 0.000756 grams PM_{10} per restaurant per day.

Charbroiler Emission Calculations ($E_{charbroiler}$)

$E_{charbroiler} = EF_{charbroiler} * N$

Where:

$E_{charbroiler}$ = PM_{10} emissions from restaurant charbroilers (g)

$EF_{charbroiler}$ = PM_{10} emission rate for restaurant charbroiler (g / restaurant / day)

Example:

$EF_{charbroiler}$ = 0.000756 grams PM_{10} per restaurant per day.

N = 4 restaurants

Then:

$E_{charbroiler}$ = 0.000756 g / restaurant / day $\times$ 4 restaurants
= 0.003024 g PM_{10} / day

Due to the very small amount of emissions from this source, ADEQ classified its emissions as negligible.

4.3.11 Industrial Sources

Industrial sources in the Salt River PM_{10} Study Area were identified through MCESD permits records for industrial sources and GIS analysis to determine if a source was located in the study area. 81 industrial sources were identified as operating in the study area during 2002. See Appendix A for a satellite image showing the locations of the 81 industrial sources (Map A-4) and a satellite image of the approximate property boundaries of industrial sources along the Salt River (Map A-5).

MCESD provided emissions data for the 81 sources and these data were used in either assigning PM_{10} emissions from industrial sources to each applicable grid cell within the study area (i.e., treated as an industrial area source) or to a particular coordinate within the study area (i.e., treated as an industrial point source). The following information was provided by MCESD from their permit records database:

1) PM_{10} emission rates for area sources (g/sec/m^2),
2) PM_{10} emission rates for point sources (g/sec),
3) Stack height (m),
4) Stack diameter (m),
5) Stack exit velocity (m/sec),
6) Stack temperature (Kelvin)
7) Operating hours by day of week
8) Street address

ADEQ ranked the 81 industrial sources according to their total annual emissions and their distance from the four air quality monitors in the Salt River PM_{10} Study Area. Based on this ranking, 36 sources were selected to be modeled separately in the ISCST3 model (see Chapter 5 for modeling discussion) and the remaining 45 sources had their emissions added to the grid cell where the source was located. See Appendix G for a detailed discussion of the methodology used to segregate the industrial sources for modeling purposes and for a listing of annual, daily, and hourly emission totals for each source.

Following are the 36 sources that were input to the ISCST3 model as point sources:

- APS WEST PHX POWER PLANT
- UNITED METRO PLANT #11
- PHOENIX BRICK YARD
- METAL MANAGEMENT ARIZONA INC
- VULCAN MATERIALS CO-WESTERN
- THE PROCTER & GAMBLE MFG CO
- TRENDWOOD INC
- WOODSTUFF MANUFACTURING
- HANSON AGGREGATES OF ARIZONA
- VAW OF AMERICA INC
- WESTERN ORGANICS INC
- TPAC A DIVISION OF KIEWIT WESTERN CO
- SOUTH MOUNTAIN GIN
- CORESLAB STRUCTURES (ARIZ) INC
- AMERON INTL-WATER TRANSMISSION GROUP
- OLSON PRECAST OF ARIZONA INC
- AJAX SAND & ROCK
- PHOENIX CEMENT TERMINAL
- SANDVICK EQUIPMENT & SUPPLY CO
- CITY OF PHOENIX 27TH AVE LANDFILL
- SCHUFF STEEL CO
- QUALITY BLOCK INC
- MARLAM INDUSTRIES INC
- MONIER LIFETILE LLC
- ROAD MACHINERY CO INC
- CHEVRON USA ASPHALT DIVISION
- ATC PHOENIX
- CITY OF PHOENIX WASTE WATER TREATMENT PLANT
- UNIVERSAL ENTECH
- U.S. GREEN FIBER
- SOUTHWEST FOREST PRODUCTS
- SMITH PRECAST
- WESTERN BLOCK COMPANY
- ROCKLAND MATERIALS
- MCP INDUSTRIES, INC.
- WEINBERGER TOPSOIL

MCESD Year 2001 emissions data for industrial sources were used to select which industrial sources in the Salt River PM_{10} Study Area would be modeled separately based on their total annual emissions and their proximity to a monitor. This selection was done prior to building the emissions inventory when complete Year 2001 emissions data was available from MCESD. At that time, Year 2002 MCESD emissions inventory was in the process of being reviewed for quality control by MCESD. However, MCESD did accelerate their quality control process to provide ADEQ with Year 2002 emissions data for the 36 industrial sources that ADEQ had selected for separate modeling. Thus, ADEQ used Year 2002 emissions data for the 36 sources and Year 2001 emissions data for the remaining small sources in their modeling. Emissions from the 36 sources (Year 2002 data) are approximately 98% of the emissions in the study area, and emissions from the remaining 45 small sources (Year 2001 data) make up approximately 2% of the emissions in the study area.

The industrial windblown emissions were calculated by first determining the area for each of the major facilities from which windblown dust could originate. This area was generally the area of the facility, less buildings, paved roads, paved parking lots, or other surfaces (e.g. water) without dust potential. This area was then multiplied by the emission factor of 20.0 lbs/acre/hour (0.000622 grams/meter/second), which comes from W. G. Nickling and J. A. Gillies, “Evaluation of aerosol production potential of type surfaces in Arizona”, submitted to Engineering-Science, Arcadia, California, for EPA Contract No. 68-02-388, 1986.

Windblown emissions from stockpiles were determined by examining the satellite images to estimate the area of the stockpiles. Then, following a method from Section 4.1.2 of Control of Open Fugitive Dust Sources, EPA-450/3-88-008, September 1988, emission factors were calculated based on the values of the peak wind gusts. In this method, the four hour high-wind events that occurred on both April 15 and 26, 2002, were treated as one windblown event per day. The emission factor depends on the magnitude of the peak wind gust, which on April 15, 2002 was 28 meters per second, and on April 26, 2002 was 37 meters per second. The corresponding emission factors for the two dates were 90 lbs PM_{10} / acre / event for April 15, 2002 and 197 lbs PM_{10} / acre / event for April 26, 2002 (assuming sand in the stockpiles). Emission factors for stockpiles with aggregate are about 30% lower than stockpiles with sand. The area of the stockpiles was multiplied by the above emission factors to give the windblown emissions from the stockpiles for the two high wind design days.

4.4 SUMMARY OF 2002 PM_{10} EMISSIONS INVENTORY

A summary of the PM_{10} emissions in the Salt River PM_{10} Study Area for the Year 2002 follows. The emissions and land use data calculated for each of the 630 grid cells (400 x 400 meter) in the study area were summed to produce the emission and land use totals listed in the following tables and pie graphs. See Appendix A for 24-hour PM_{10} emissions density maps for 11 emission source categories, total PM_{10} emissions for a low-wind design day, and total PM_{10} emissions for a high-wind day (Map A-9 through Map A-21).

Table 4-3 lists the land use totals for emission sources that are not industrial sources.

TABLE 4-3 **Salt River PM_{10} Emissions Inventory - YEAR 2002** **Land Use Totals (meters or meters^2)**				
	1/8/02	**4/15/02**	**4/26/02**	**12/16/02**
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday	Monday	Friday	Monday
1. AREA SOURCES	**2,625,600 m^2**	**30,256,222 m^2**	**30,256,222 m^2**	
Ag Tilling (Land Preparation)	2,625,600 m^2			
Wind Erosion – Agricultural		14,305,920 m^2	14,305,920 m^2	
Wind Erosion – Construction		5,661,760 m^2	5,661,760 m^2	
Wind Erosion - Cleared Areas				
• vacant lots		5,274,164 m^2	5,274,164 m^2	
• misc. disturbed areas		4,396,542 m^2	4,396,542 m^2	
Wind Erosion – Alluvial Channels		617,836 m^2	617,836 m^2	
3. NONROAD MOBILE SOURCES	**8,287,360 m^2**	**5,661,760 m^2**	**5,661,760 m^2**	**5,661,760 m^2**
Agricultural Equipment Exhaust	2,625,600 m^2			
Construction Activity	5,661,760 m^2	5,661,760 m^2	5,661,760 m^2	5,661,760 m^2

TABLE 4-3
Salt River PM_{10} Emissions Inventory - YEAR 2002
Land Use Totals (meters or meters^2)

	1/8/02	**4/15/02**	**4/26/02**	**12/16/02**
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday	Monday	Friday	Monday
4. ONROAD MOBILE SOURCES				
Paved Roads	**552,588 m**	**552,588 m**	**552,588 m**	**552,588 m**
Freeway (Interstate 17, Durango Curve)	7,200 m	7,200 m	7,200 m	7,200 m
Primary Roads	143,606 m	143,606 m	143,606 m	143,606 m
Secondary Roads	401,782 m	401,782 m	401,782 m	401,782 m
Unpaved Sources	**259,439 m^2**	**259,439 m^2**	**259,439 m^2**	**259,439 m^2**
Unpaved Road Shoulders	22,963 m (68,889 m^2)*	22,963 m (68,889 m^2)*	22,963 m (68,889 m^2)*	22,963 m (68,889 m^2)*
Unpaved Parking Lots - reentrained dust	190,550 m^2	190,550 m^2	190,550 m^2	190,550 m^2

* Based on an unpaved road shoulder width of 3 meters

Table 4-4 lists the emission factors and rule effectiveness for applicable emission source categories. See Appendix I for MCESD's Rule Effectiveness Study.

TABLE 4-4
Salt River PM_{10} Emissions Inventory - Year 2002
Emission Factors and Rule Effectiveness

Emission Category	**Emission Factor**	**Percent Rule Effectiveness**	**Applicable ADEQ, City of Phoenix or MCESD Rule**
1. AREA SOURCES			
Ag Tilling (Land Preparation)	General: 6.10 lbs PM_{10} / acre-pass Crop Specific: **0.427 lbs PM_{10} / acre of cotton** 0.305 lbs PM_{10} / acre of corn (haylage)	7.9%	Agricultural PM_{10} General Permit for tillage (Ag BMPs): Combining Tractor Operations - midpoint control efficiency
Wind Erosion – Agricultural	$6.22 * 10^{-8}$ gm / (cm^2 – sec)	This control measure takes effect when 10-meter height wind speed exceeds 25 mph. The maximum wind speed for the high wind design days was 21 mph. Thus, the 9.3% rule effectiveness was not applied.	Agricultural PM_{10} General Permit for wind erosion (Ag BMPs): Limited Activity During High Wind Events - midpoint control efficiency
Wind Erosion – Construction	$6.22 * 10^{-8}$ gm / (cm^2 – sec)	63%	MCESD Rule 310
Wind Erosion – Cleared Areas:			
• vacant lots	$6.22 * 10^{-8}$ gm / (cm^2 – sec)	55%	MCESD Rule 310.01
• misc. disturbed areas	$6.22 * 10^{-8}$ gm / (cm^2 – sec)	55%	MCESD Rule 310.01
Wind Erosion – Alluvial Channels	Max $37.32*10^{-8}$ Avg.$6.22 * 10^{-8}$ Min $3.11*10^{-8}$ gm / (cm^2 – sec)	None	None

TABLE 4-4 Salt River PM_{10} Emissions Inventory - Year 2002 Emission Factors and Rule Effectiveness			
Emission Category	**Emission Factor**	**Percent Rule Effectiveness**	**Applicable ADEQ, City of Phoenix or MCESD Rule**
2. INDUSTRIAL SOURCES			
Stack Emissions	Varies by source	88%	MCESD Rule 310 MCESD Rule 316
Non-Stack Emissions (e.g., crushing, screening, earthmoving, mining, hauling, cement and asphalt formulation, and stockpiles)	Varies by source	Equivalent Control = 62%	
Windblown Industrial Sources	Wind-speed dependent	0%	
3. NONROAD MOBILE SOURCES			
Agricultural Equipment Exhaust	0.4 g / hp-hr	None	None
Construction Activity	Single Home = 0.032 tons/acre/month Apartment = 0.11 tons/acre/month Large Scale = 0.42 tons/acre/month	56%	MCESD Rule 310

TABLE 4-4 Salt River PM_{10} Emissions Inventory - Year 2002 Emission Factors and Rule Effectiveness			
Emission Category	**Emission Factor**	**Percent Rule Effectiveness**	**Applicable ADEQ, City of Phoenix or MCESD Rule**
4. ONROAD MOBILE SOURCES			
Paved Roads			
Freeway - Interstate 17 Durango Curve	0.124 g / VMT (specific to vehicle mix on Durango Curve)	None	None
Primary Roads	Reentrained Road Dust = 2.043 g/VMT Exhaust Emission Factor = 0.065 g/VMT Brake Wear Emission Factor = 0.013 g/VMT Tire Wear Emission Factor = 0.009 g/VMT	None	None
Secondary Roads	Same as Primary Road Emission Factors	None	None
Trackout	Extreme = 29g/VMT Medium = 12g/VMT Low = 7g/VMT No Trackout = 2g/VMT	Minimal	MCESD Rule 316 MCESD Rule 310 MCESD Rule 310.01
Unpaved Road Shoulders	1.08 gm/VMT	None	None
Unpaved Parking Lots - reentrained dust	250 g/VMT	55% for unpaved parking lots > 0.10 acre	MCESD Rule 310.01

The Equivalent Control Percentage of 62% listed for Non-Stack Emission sources in the Industrial Source category of Table 4-4 was based on the following:

EQ = equivalent control = CE * RE * RP

Where:

CE = control efficiency (how well a control device works)

RE = rule effectiveness (how a control device's efficiency is reduced by failure and/or uncertainty of performance)

RP = rule penetration (percentage of sources covered by the regulation)

In 2003, MCESD and ADEQ staff determined the effectiveness of Rules 310 and 316 in their application to the Salt River study area sources (see Appendix I, "Rule Effectiveness Study for Salt River PM_{10} Study Revised Final", December 18, 2003). For Rule 316, 11 sources (sand and gravel, topsoil, concrete blocks, etc) had an average rule effectiveness of 88%. For Rule 310, 10 Salt River area facilities (precast concrete, sand and gravel, aggregate, block manufacture) had an average rule effectiveness of 77%. Facilities were graded on stack and fugitive emission opacity, recordkeeping, unpaved haul and access roads, trackout control devices, observations of trackout, and water availability.

Given these survey results, the Year 2002 industrial emissions can be characterized with the following percentages:

Rule Effectiveness = 82% (average of the 310 and 316 sources)

Control Efficiency = 75% (overall estimate, higher for process emissions; lower for fugitives such as haul road emissions)

Rule penetration = 100% (small geographical area with limited number of sources)

EQ equivalent control = 62%

Note that Industrial Source emissions for the Year 2002 and for the Year 2006 Base Case are the same. Only in the Year 2006 Attainment Case are additional emission reductions invoked for this category.

Table 4-5 lists the major PM_{10} source categories in the Salt River PM_{10} Study Area for the four design days. Figures 4-6, 4-7, 4-8 and 4-9 depict these PM_{10} source categories by percent. As can be seen from Table 4-5 and the pie graphs in Figures 4-6 through 4-9, the major source categories on the low wind design days are Primary Roads, Secondary Roads, Construction Activity, and Industrial Sources; and on the high wind design days are Wind Erosion – Agricultural, Wind Erosion - Cleared Areas (vacant lots and misc. disturbed areas), Wind Erosion – Construction, and Wind Erosion – Alluvial Channels.

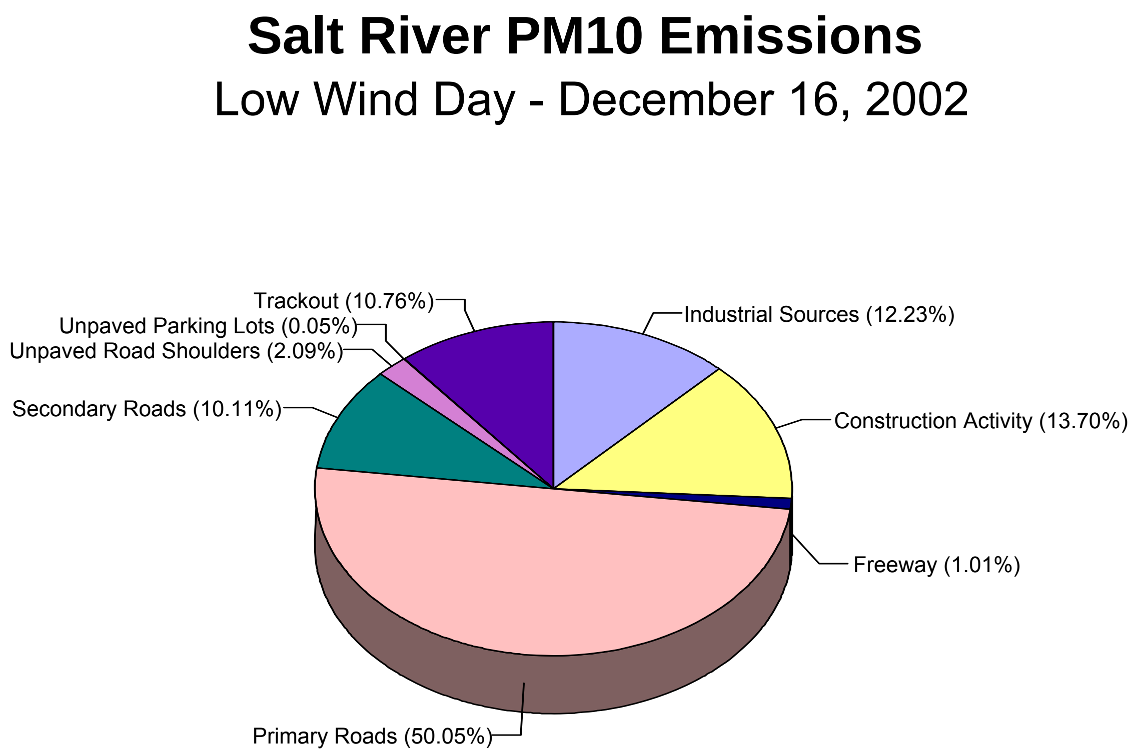
TABLE 4-5
Salt River PM_{10} Emissions Inventory - Year 2002
(Metric Tons / Day)

	1/8/02	**4/15/02**	**4/26/02**	**12/16/02**
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday	Monday	Friday	Monday
1. AREA SOURCES	**0.11**	**114.34**	**114.34**	
Ag Tilling (Land Preparation)	0.11			
Wind Erosion – Agricultural		46.76	46.76	
Wind Erosion – Construction		18.76	18.76	
Wind Erosion - Cleared Areas		39.01	39.01	
• vacant lots		*21.27*	*21.27*	
• misc. disturbed areas		*17.74*	*17.74*	
Wind Erosion - Alluvial Channels		9.81	9.81	
2. INDUSTRIAL SOURCES	**0.75**	**48.61**	**56.05**	**0.75**
MCESD Permitted Sources – Windblown Stockpiles		4.94	12.38	
MCESD Permitted Sources – Windblown Cleared Areas		42.92	42.92	
MCESD Permitted Sources - Stacks	0.27	0.27	0.27	0.27
MCESD Permitted Sources – Process	0.45	0.45	0.45	0.45
MCESD Permitted Sources – Small	0.03	0.03	0.03	0.03

TABLE 4-5 Salt River PM_{10} Emissions Inventory - Year 2002 (Metric Tons / Day)				
	1/8/02	**4/15/02**	**4/26/02**	**12/16/02**
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday	Monday	Friday	Monday
3. NONROAD MOBILE SOURCES	**0.85**	**0.84**	**0.84**	**0.84**
Agricultural Equipment Exhaust	0.005			
Construction Activity	0.84	0.84	0.84	0.84
4. ONROAD MOBILE SOURCES	**4.33**	**4.33**	**4.33**	**4.33**
Paved Road				
Freeway – (subtotal) Brakes, Tires, Exhaust, Reentrainment	*0.06*	*0.06*	*0.06*	*0.06*
Primary Roads				
• reentrained road dust	2.95	2.95	2.95	2.95
• exhaust	0.09	0.09	0.09	0.09
• brakes	0.02	0.02	0.02	0.02
• tires	0.01	0.01	0.01	0.01
Primary roads emissions subtotal	*3.07*	*3.07*	*3.07*	*3.07*
Secondary roads				
• reentrained road dust	0.59	0.59	0.59	0.59
• exhaust	0.02	0.02	0.02	0.02
• brakes	0.004	0.004	0.004	0.004
• tires	0.003	0.003	0.003	0.003
Secondary roads emissions subtotal	*0.62*	*0.62*	*0.62*	*0.62*
Paved Road Total Emissions	**3.69**	**3.69**	**3.69**	**3.69**

TABLE 4-5 Salt River PM_{10} Emissions Inventory - Year 2002 (Metric Tons / Day)				
	1/8/02	**4/15/02**	**4/26/02**	**12/16/02**
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday	Monday	Friday	Monday
5. Trackout	**0.66**	**0.66**	**0.66**	**0.66**
6. Unpaved Shoulders & Parking Lots	**0.133**	**0.133**	**0.133**	**0.133**
Unpaved Road Shoulders	0.13	0.13	0.13	0.13
Unpaved Parking Lots - reentrained dust	0.003	0.003	0.003	0.003
PM_{10} EMISSIONS - GRAND TOTAL	**6.25**	**168.43**	**175.87**	**6.14**

Figure 4-6



Salt River PM10 Emissions
Low Wind Day - December 16, 2002
Trackout (10.76%)
Unpaved Parking Lots (0.05%)
Unpaved Road Shoulders (2.09%)
Secondary Roads (10.11%)
Industrial Sources (12.23%)
Construction Activity (13.70%)
Freeway (1.01%)
Primary Roads (50.05%)

Figure 4-7

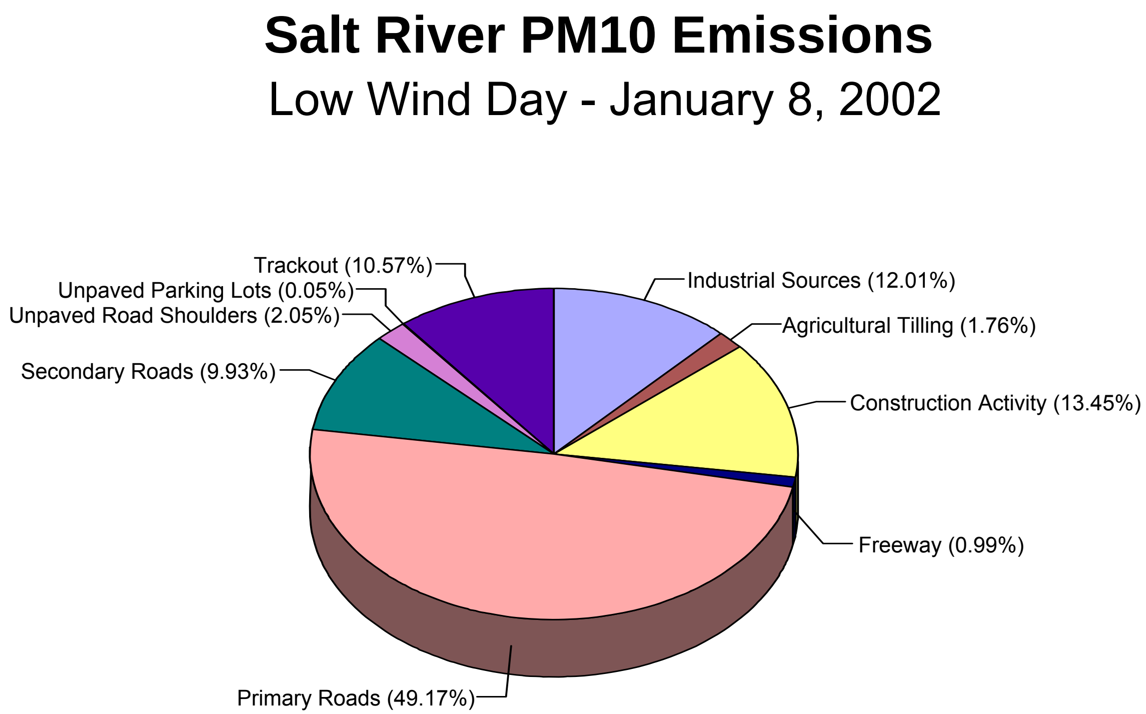
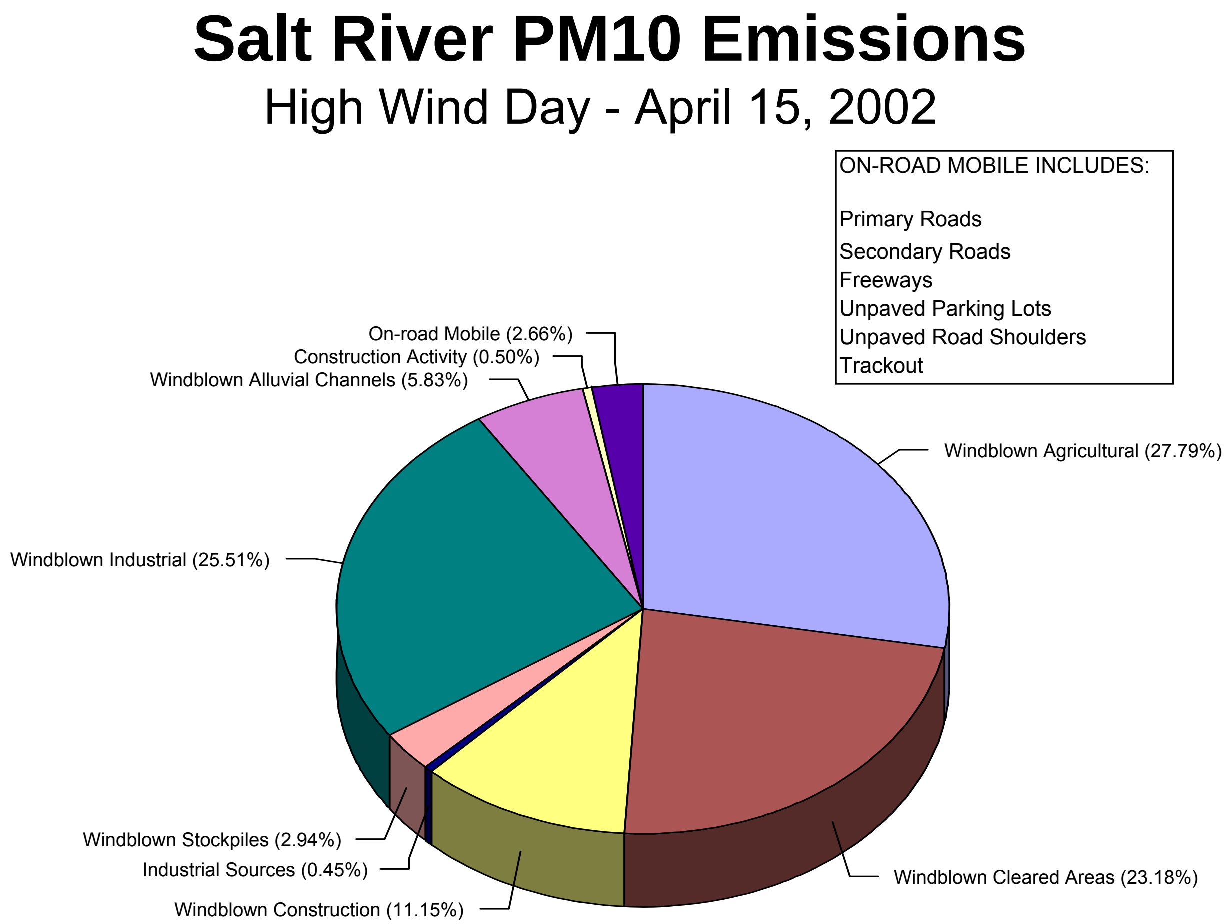

Salt River PM10 Emissions
Low Wind Day - January 8, 2002
Trackout (10.57%)
Unpaved Parking Lots (0.05%)
Unpaved Road Shoulders (2.05%)
Secondary Roads (9.93%)
Industrial Sources (12.01%)
Agricultural Tilling (1.76%)
Construction Activity (13.45%)
Freeway (0.99%)
Primary Roads (49.17%)

Figure 4-8

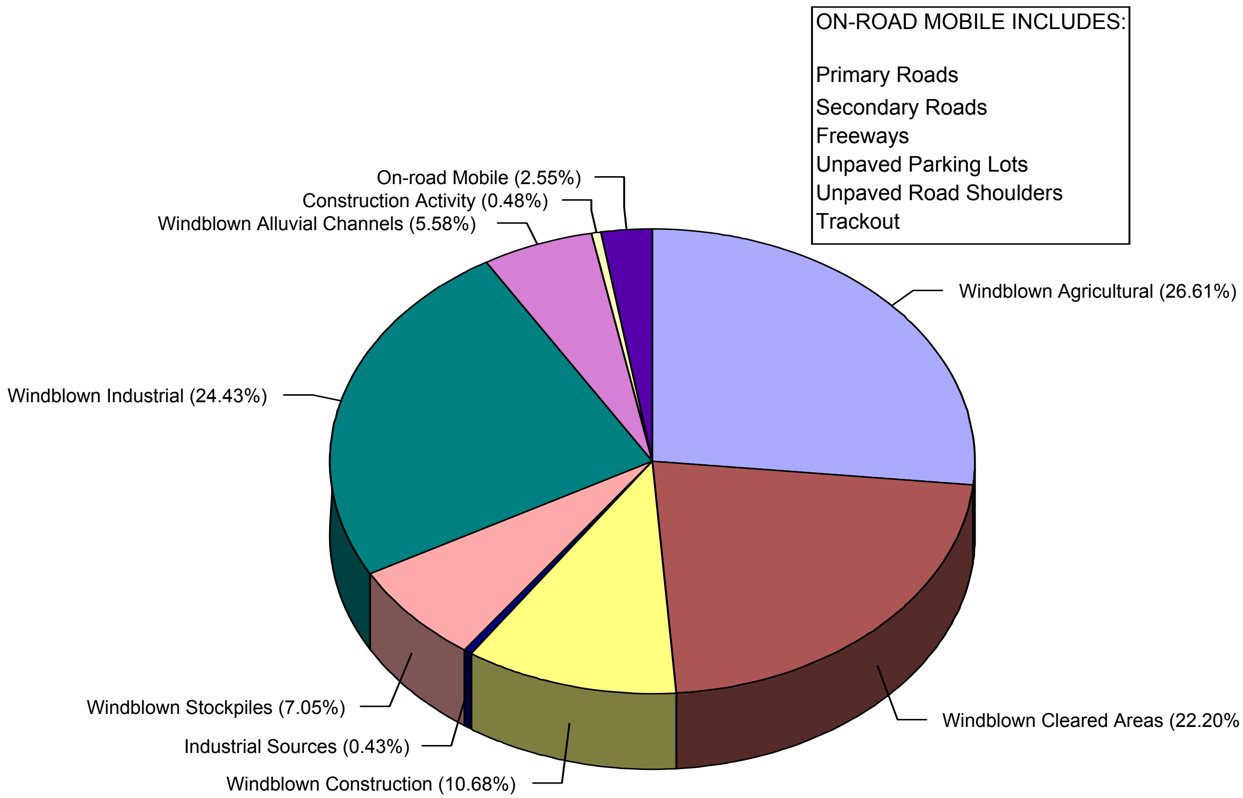


Salt River PM10 Emissions
High Wind Day - April 15, 2002
ON-ROAD MOBILE INCLUDES:
Primary Roads
Secondary Roads
Freeways
Unpaved Parking Lots
Unpaved Road Shoulders
Trackout
On-road Mobile (2.66%)
Construction Activity (0.50%)
Windblown Alluvial Channels (5.83%)
Windblown Agricultural (27.79%)
Windblown Industrial (25.51%)
Windblown Stockpiles (2.94%)
Industrial Sources (0.45%)
Windblown Construction (11.15%)
Windblown Cleared Areas (23.18%)

Figure 4-9

Salt River PM10 Emissions

High Wind Day - April 26, 2002



4.5 PROJECTED YEAR 2006 BASE CASE EMISSIONS

The following emission source categories in the Salt River PM_{10} Study Area are projected to show a change in their total emissions between Year 2002 and Year 2006 (Base Case): These projected emissions reflect a base case approach, and do not include additional emission reductions resulting from new control measures or enhancements to existing control measures that are discussed in Chapter 6.

- *Agricultural Tillage.* The amount of agricultural land, and emissions from agricultural tillage, are projected to decrease 80% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003 and ADEQ analysis – see Appendix F).

- *Construction Activity.* Emissions from construction activity are projected to decrease due to MCESD's enhanced enforcement of Rule 310 to increase the rule effectiveness for this category from 56% to 72%. (See Appendix Q for discussion of projected construction activity.)

- *Roads – Freeway, Primary, and Secondary.* Traffic is projected to increase by 6% between 2002 and 2006 based on the growth in traffic volumes in the Salt River Area which occurred between 1998 and 2002. Since there are no plans for road building projects in the Salt River PM10 Study Area, this estimate of VMT growth (1.47% per year), based on a MAG analysis of City of Phoenix traffic counts, is consistent with the central location and older neighborhoods characteristic of the study area.

- *Unpaved Parking Lots.* Emissions from unpaved parking lots greater than 0.10 acres are projected to decrease due to MCESD's strengthening and enhancing enforcement of Rule 310.01 to increase the rule effectiveness for this category from 55% to 71%.

- *Unpaved Road Shoulders*. The amount of unpaved road shoulders in the Salt River PM_{10} Study Area has decreased by 10% since the Year 2002 due to shoulder stabilization projects that have been completed since the Year 2002. Thus, the amount of PM_{10} emissions from unpaved road shoulders in the study area will also decrease by 10%.

- *Wind Erosion – Agricultural.* The amount of agricultural land, and emissions from wind erosion of agricultural land, are projected to decrease 80% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003 and ADEQ analysis – see Appendix F).

- *Wind Erosion – Alluvial*. Application of MCESD Rule 310.01 to those parcels with windblown dust potential will result in a reduction of emissions of 57%

- *Wind Erosion – Construction*. Emissions from wind erosion of disturbed areas due to construction are projected to decrease due to MCESD's enhanced enforcement of Rule 310 to increase the rule effectiveness for this category from 63% to 70%. (See Appendix Q for discussion of projected construction activity.)

- *Wind Erosion – Vacant Lots and Miscellaneous Disturbed Areas*. The amount of vacant lots is projected to decrease by 39%, based on an ADEQ field survey of vacant lots converted to residential and commercial uses between Years 2002 and 2004 (See Appendix R). The survey included 171 vacant lots, 14 of which had been converted over a 10-month period, resulting in an 8.2% conversion rate. This ten-month conversion rate is equivalent to an annual conversion rate of 9.8% and a four-year conversion rate of 39.3%.

  Miscellaneous disturbed areas are projected to decrease 13.6% due to conversion to residential and commercial uses. ADEQ estimated the decrease in miscellaneous disturbed areas would parallel the conversion of agricultural land to residential and commercial uses (URS and ERG, 2001). ADEQ's field survey did not have sufficient miscellaneous disturbed areas converted to residential and commercial use over the 10-month period to provide a statistically valid estimate (Appendix R). In addition, MCESD is strengthening and enhancing enforcement of Rule 310.01 to increase the rule effectiveness for this category from 55% to 71%.

An example of the calculations used to quantify the percent change in emissions from Year 2002 to 2006 for those sources subject to the MCESD's Rule 310.01 wind erosion control measure appears below.

Example of Percent Reduction Emission Calculation:
MCESD strengthened Rule 310.01 to increase the rule effectiveness (RE) for vacant lots from 55% to 71% between Year 2002 and 2006. This results in a 36% in emissions from this category from Year 2002 to 2006:

E_{2002} (controlled emissions) = E_{2002} (uncontrolled emissions) * (1 – Year 2002 RE)
E_{2002} (controlled emissions) = E_{2002} (uncontrolled emissions) * (1 – 0.55)

E_{2006} (controlled emissions) = E_{2002} (uncontrolled emissions) * (1 – Year 2006 RE)
E_{2006} (controlled emissions) = E_{2002} (uncontrolled emissions) * (1 – 0.71)

Percentage emissions change from Year 2002 to Year 2006

$$= \frac{[E_{2002}\text{ (controlled) - }E_{2006}\text{ (controlled)}]}{E_{2002}\text{ (controlled)}}$$

$$= \frac{[E_{2002}\text{ (uncontrolled) (1 – 0.55) - }E_{2002}\text{ (uncontrolled) (1 – 0.71)}]}{E_{2002}\text{ (uncontrolled) (1 – 0.55)}}$$

$$= ((1 - 0.55) – (1- 0.71)) / (1 – 0.55) = 0.16 / 0.45 = 0.36 \text{ or } 36\%$$

Table 4-6 lists those emission categories that showed a change in emissions between Year 2002 and Year 2006 Base Case (no new additional control measures).

TABLE 4-6
Percent Change in Emissions Between Year 2002 and Year 2006 Base Case

Emission Category	Percent Change in Emissions	Reason For Change
AREA SOURCES		
Ag Tilling (Land Preparation)	-80%	Agricultural land projected to decrease 80% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003)
Wind Erosion – Agricultural	-80%	Agricultural land projected to decrease 80% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003)
Wind Erosion – Construction	-19%	MCESD's enhanced enforcement of Rule 310 to increase the rule effectiveness for this category from 63% to 70%.
Wind Erosion – Alluvial Channels	-57%	MCESD applying Rule 310.01 to control this category by 57%
Wind Erosion – Cleared Areas:		
• vacant lots	-36% -39% -61%	MCESD strengthening and enhancing enforcement of Rule 310.01 to increase the rule effectiveness for this category from 55% to 71%. Projected building of residential and commercial areas, based on ADEQ field survey of conversion of vacant lots. Overall reduction of 61%.
• misc. disturbed areas	-36% -13.6% -45%	MCESD strengthening and enhancing enforcement of Rule 310.01 to increase the rule effectiveness for this category from 55% to 71%. Projected building of residential and commercial areas Overall reduction of 45%.
NONROAD MOBILE SOURCES		
Construction Activity	-36%	MCESD's enhanced enforcement of Rule 310 to increase the rule effectiveness for this category from 56% to 72%.
ONROAD MOBILE SOURCES		
Paved Roads		
Freeway - Interstate 17, Durango	+6%	Traffic is projected to increase 6% based on MAG's estimate of traffic increasing 1.5% per year
Primary Roads	+6%	Traffic is projected to increase 6% based on the MAG's estimate of traffic increasing 1.5% per year
Secondary Roads	+6%	Traffic is projected to increase 6% based on the MAG's estimate of traffic increasing 1.5% per year
Unpaved Road Shoulders and Unpaved Parking Lots		
Unpaved Road Shoulders	-10%	Decrease based on recent shoulder stabilization projects that have been completed since the Year 2002.
Unpaved Parking Lots - reentrained dust	-36%	MCESD strengthening and enhancing enforcement of Rule 310.01 to increase the rule effectiveness for this category from 55% to 71%.

Table 4-7 lists the major PM_{10} source categories in the Salt River PM_{10} Study Area for the four design days for the 2006 base case. Figures 4-9 and 4-11 depict these PM_{10} source categories by percent. As can be seen from Table 4-7 and the pie graphs in Figures 4-10 through 4-13, the major source categories on the low wind design days are Primary Roads, Industrial Sources, Secondary Roads, Trackout and Construction Activity.; and on the high wind design days are Wind Erosion – Industrial, Wind Erosion – Cleared Areas, Wind Erosion – Construction, and Wind Erosion – Agricultural.

TABLE 4-7
Salt River PM_{10} Emissions Inventory – Base Case 2006
(Metric Tons / Day)

	1/8/06*	**4/15/06***	**4/26/06***	**12/16/06***
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday*	Monday*	Friday*	Monday*
1. AREA SOURCES	**0.02**	**50.34**	**50.34**	
Ag Tilling (Land Preparation)	0.02			
Wind Erosion – Agricultural		9.35	9.35	
Wind Erosion – Construction		15.20	15.20	
Wind Erosion - Cleared Areas		21.57	21.57	
• vacant lots		*11.76*	*11.76*	
• misc. disturbed areas		*9.81*	*9.81*	
Wind Erosion - Alluvial Channels		4.22	4.22	
2. INDUSTRIAL SOURCES	**0.75**	**48.61**	**56.05**	**0.75**
MCESD Permitted Sources – Windblown Stockpiles		4.94	12.38	
MCESD Permitted Sources – Windblown Cleared Areas		42.92	42.92	
MCESD Permitted Sources – Stacks	0.27	0.27	0.27	0.27
MCESD Permitted Sources – Process	0.45	0.45	0.45	0.45
MCESD Permitted Sources – Small	0.03	0.03	0.03	0.03

TABLE 4-7
Salt River PM_{10} Emissions Inventory – Base Case 2006
(Metric Tons / Day)

	1/8/06*	**4/15/06***	**4/26/06***	**12/16/06***
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday*	Monday*	Friday*	Monday*
3. NONROAD MOBILE SOURCES	**0.54**	**0.54**	**0.54**	**0.54**
Agricultural Equipment Exhaust	0.004			
Construction Activity	0.54	0.54	0.54	0.54
4. ONROAD MOBILE SOURCES	**4.19**	**4.19**	**4.19**	**4.19**
Paved Road				
Freeway – Brakes, Tires, Exhaust, Reentrainment	0.07	0.07	0.07	0.07
Primary Roads				
• reentrained road dust	3.19	3.19	3.19	3.19
• exhaust	0.10	0.10	0.10	0.10
• brakes	0.02	0.02	0.02	0.02
• tires	0.01	0.01	0.01	0.01
Primary roads subtotal	*3.32*	*3.32*	*3.32*	*3.32*
Secondary roads				
• reentrained road dust	0.64	0.64	0.64	0.64
• exhaust	0.02	0.02	0.02	0.02
• brakes	0.004	0.004	0.004	0.004
• tires	0.003	0.003	0.003	0.003
Secondary roads subtotal	*0.67*	*0.67*	*0.67*	*0.67*
Paved Road Total Emissions	**4.06**	**4.06**	**4.06**	**4.06**

TABLE 4-7 Salt River PM_{10} Emissions Inventory – Year 2006 Base Case (Metric Tons / Day)				
	1/8/06*	**4/15/06***	**4/26/06***	**12/16/06***
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday*	Monday*	Friday*	Monday*
5. Trackout	**0.66**	**0.66**	**0.66**	**0.66**
6. Unpaved Shoulders & Parking Lots	**0.133**	**0.133**	**0.133**	**0.133**
Unpaved Road Shoulders	0.13	0.13	0.13	0.13
Unpaved Parking Lots - reentrained dust	0.003	0.003	0.003	0.003
PM_{10} EMISSIONS - GRAND TOTAL	**6.16**	**104.47**	**111.91**	**6.14**

*** Theoretical design days in Year 2006 that have same meteorological conditions, time of year, and day of week to the four design days in Year 2002 Emissions Inventory and Modeling.**

Figure 4-10 Year 2006 Base Case

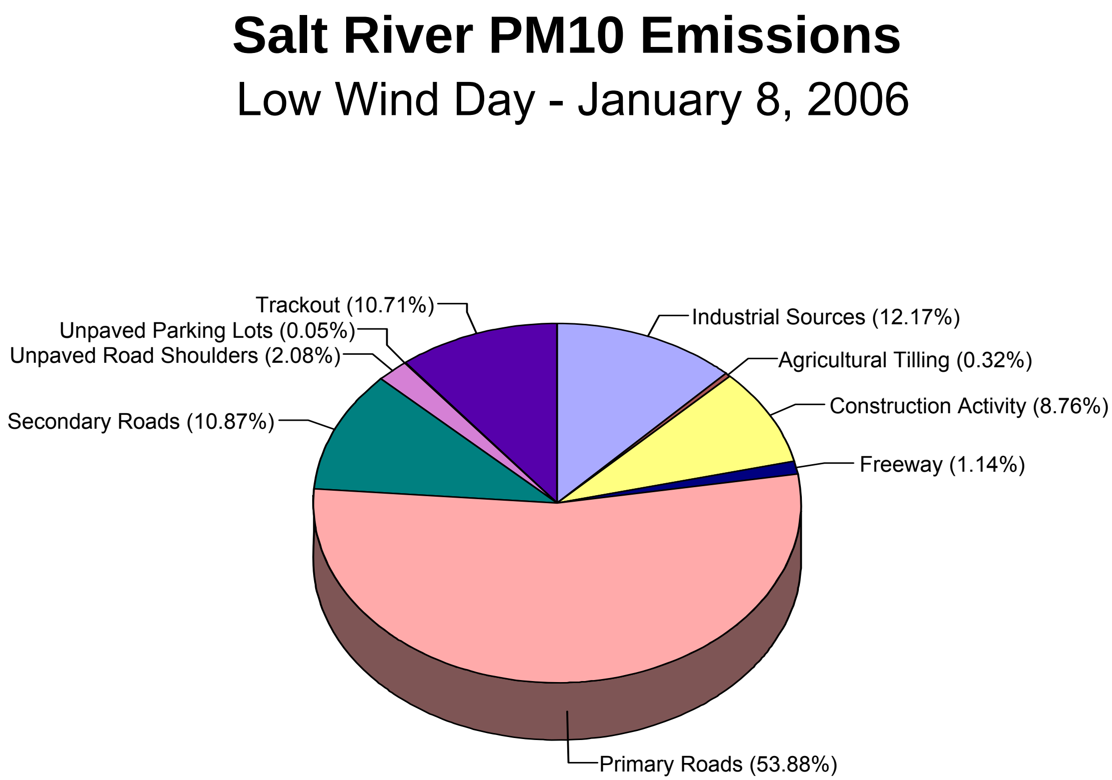


Figure 4-11 Year 2006 Base Case

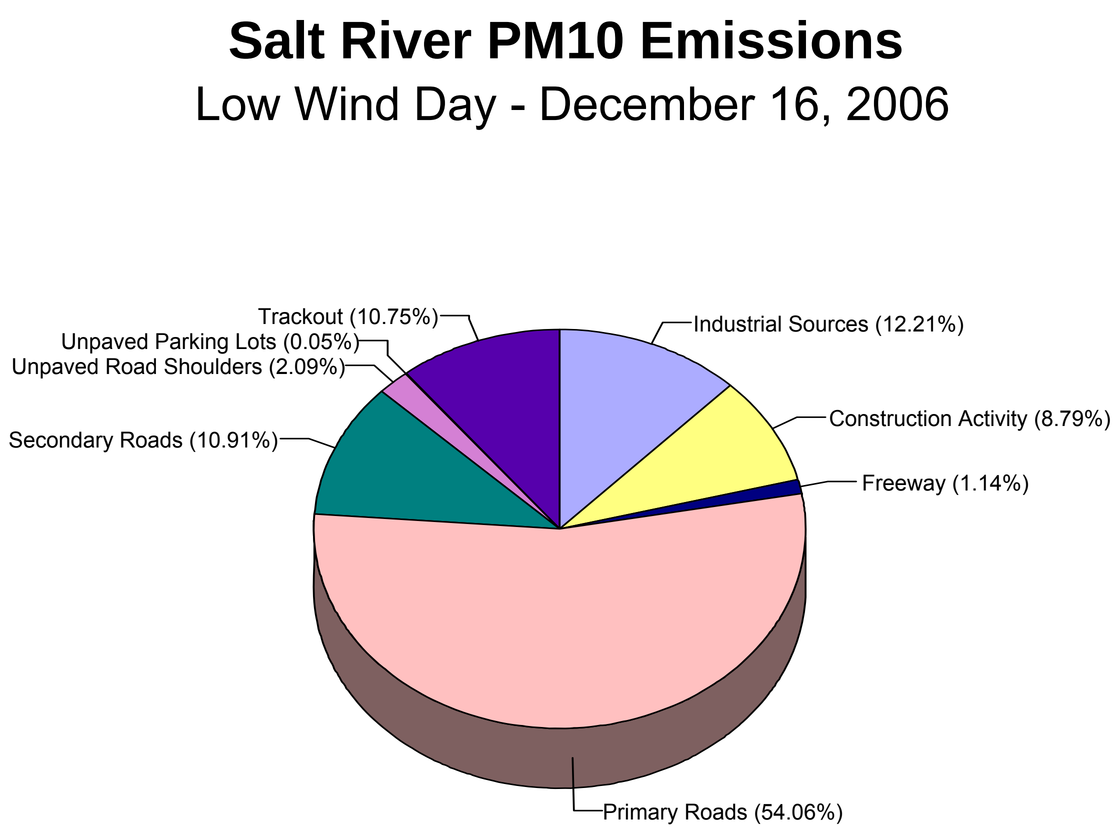


Figure 4-12 Year 2006 Base Case

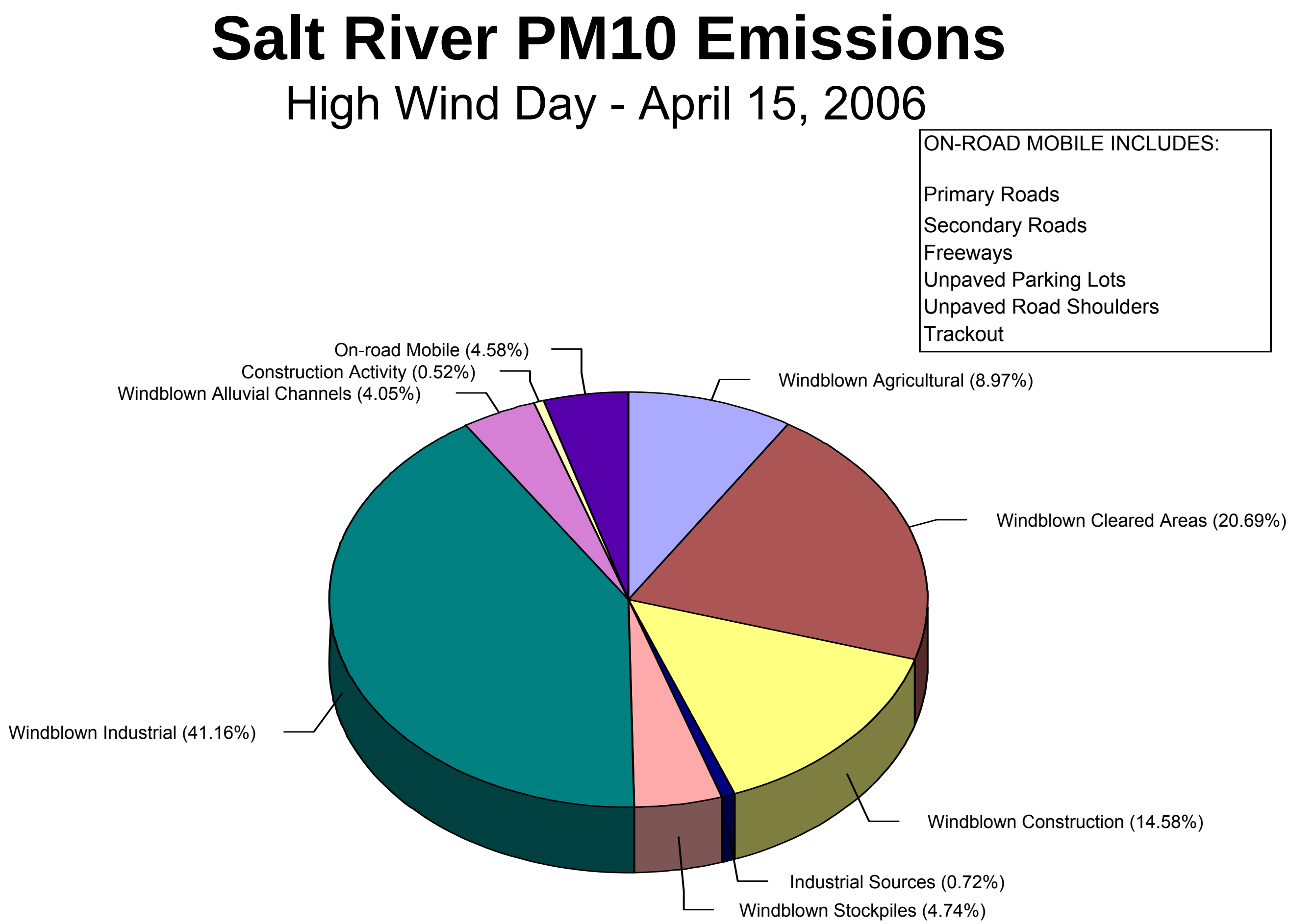
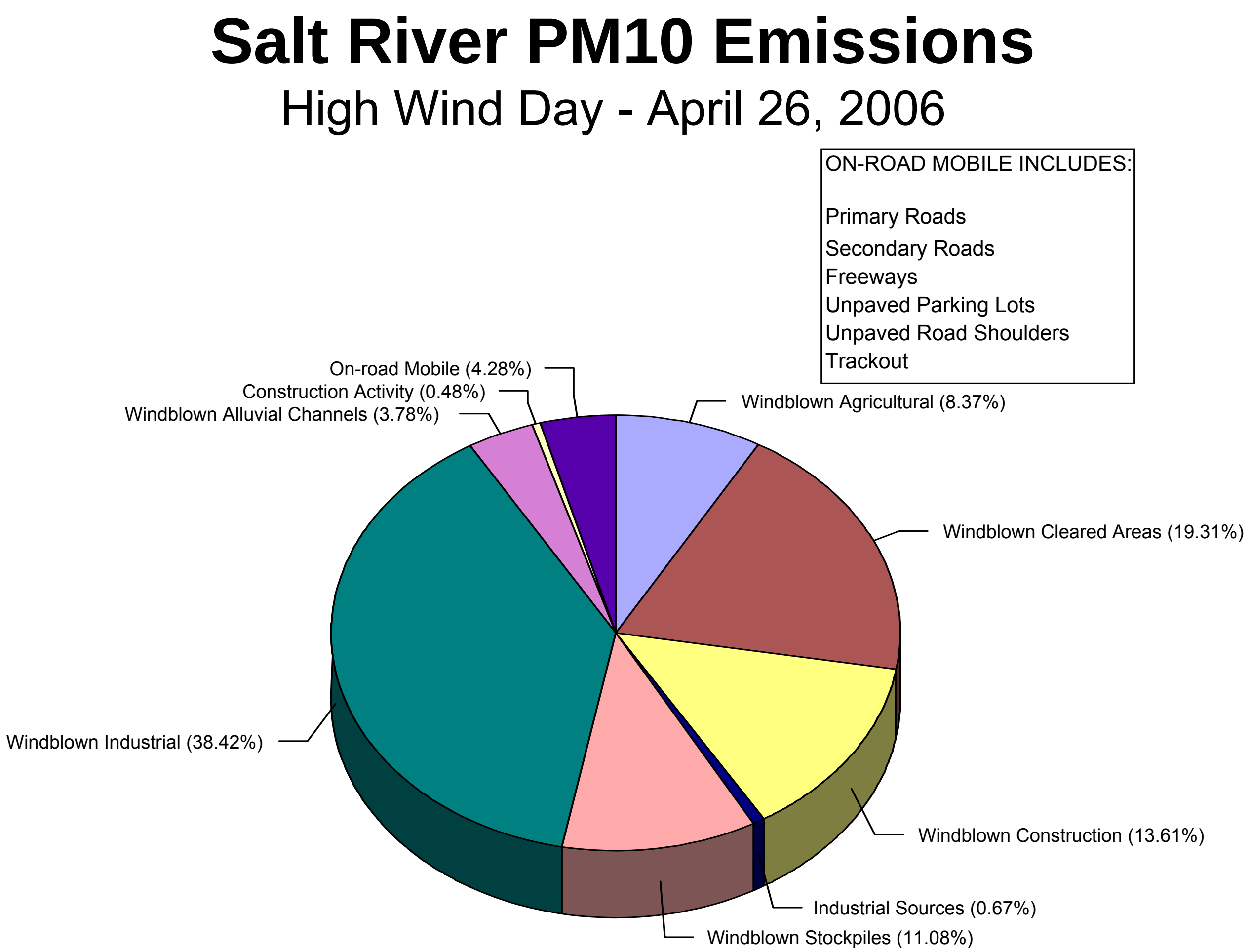


Figure 4-13 Year 2006 Base Case



4.6 CONCLUSIONS

As previously discussed, there are two quite different meteorological regimes for the four design days. Two design days had low wind speeds with a thermal inversion: January 8, 2002 and December 16, 2002; and two design days had wind speeds over 15 miles per hour: April 15, 2002 and April 26, 2002. The design days with low wind speeds will have a different mix of emission sources than the design days with high wind speeds, because the design days with high wind speeds have additional emission sources related to wind erosion of disturbed soil (e.g., wind erosion of agricultural land and wind erosion of alluvial channels).

The major emission source categories projected for the Year 2006 Base Case on the low wind design days were Primary Roads (54%), Industrial Sources (12%), Secondary Roads (11%), Trackout (11%) and Construction Activity (9%) with total daily PM_{10} emissions in the range of 6 tons. The major emission source categories on the high wind design days were Wind Erosion – Industrial (40%), Wind Erosion – Cleared Areas (20%), Wind Erosion – Construction (14%), and Wind Erosion – Agricultural (9%) with total daily PM_{10} emissions in the range of 108 tons, which is more than eighteen times greater than the total PM_{10} emissions on the low wind design days. Thus, different control measures will be needed to reduce emissions on the two types of design days.

The gridded hourly PM_{10} emission files and meteorological conditions for the four design days were used as inputs to EPA's ISCST3 model. The next chapter will discuss the numerical modeling that was conducted to evaluate the relative contribution of the different emission sources to ambient PM_{10} levels. Please note that the relative importance of the emission sources listed in this chapter will not be the same as those emission sources identified in numerical modeling. This is because the ISCT3 model takes into account the transport of particulates throughout the study area (e.g., horizontal wind and vertical mixing) and accounts for the temporal and spatial differences in emission sources to estimate ambient PM_{10} concentrations at specified points in the study area.

The emissions listed in the previous summary tables in this chapter are total emissions that do not reflect the spatial and temporal components, (location of sources and time of day and day of week of emissions). However, the spatial and temporal components of the Salt River PM_{10} Study Area emissions were reflected in the emission files that were input to the ISCST3 dispersion model since these files contained hourly profiles of emissions and the location where the emissions originated, either as a discrete point or spread through one of the 630 grid cells (400 x 400 meter) in the study area.

4.7 REFERENCES

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5.0 CHAPTER 5 -- AIR QUALITY MODELING

5.1 INTRODUCTION

The elevated PM_{10} concentrations in the Salt River Industrial Area were simulated using the Industrial Source Complex Short Term (Version-3) – ISCST-3. This numerical model is a steady-state Gaussian dispersion model that has been approved by the U.S. Environmental Protection Agency and that has a long history of applications in both the industrial and urban settings.

The Salt River Industrial Area was modeled using the urban parameter for ISCST-3 with flat terrain and the regulatory default modeling option. The U.S. Environmental Protection Agency (EPA) maintains the guideline on air quality models which provides the agency's guidance on regulatory applicability of air quality dispersion models in the review and preparation of new source permits and State Implementation Plan (SIP) revisions (EPA, 1995). The regulatory default option selected in this modeling work conforms to the EPA guideline for SIP modeling - 40 CFR part 51, while the urban and flat terrain settings best reflect the conditions seen in the Salt River Industrial Area.

Contributions to overall PM_{10} in the domain were predicted using separate, day specific, source category area emissions files. When these separate category files are used, the predicted concentration of that category will reflect the net contribution of that category to the overall PM_{10} concentration in the domain.

The overall predicted concentration in the domain can be calculated by summing the source category contributions and the background estimations into a total predicted PM_{10} concentration for the domain. This modeling approach provides a means to calculate the relative net contributions from each category in a domain while also providing the total predicted PM_{10} concentration at each receptor.

The modeling domain consisted of an array of 400x400 meter grids, 30 in the east-west (EW) direction and 21 in the north-south (NS) direction, for a total of 630 grids (Figures A-7 and A-8 in Appendix A). Dimensions of the array were 7.5 miles (12 kilometers) EW and 5.2 miles (8.4 km) NS.

The domain size of 8 x 5 miles with its longitudinal center line along the Salt River was a logical choice that:

1. Included all four monitors in the Salt River Study Area;
2. Included most of the major industrial concerns in the area;
3. Took in an expansive area of active agricultural land; and
4. Included some extremely active residential construction sites (in its southwest corner).

Extending the domain to both the east and the west could have been done, but this would have only added to the emissions inventory field work without bringing in emissions that would have significantly influenced the four monitors. A southward extension would have ended one mile south of Baseline Road at the South Mountain Park, not an important source of emissions. A northward extension would have brought in more vehicular and light industrial emissions.

Almost all the air quality modeling relied on a four-point grid of receptors, one at each of the four monitoring sites. Some experimental receptor grids were employed to gauge the effect of windblown agricultural dust on the Durango monitor. Also, a similar grid was employed to investigate the spatial distribution of windblown alluvial dust on the West 43rd Avenue monitor. The model was rerun with a dense grid of receptors so that the spatial distribution of the predicted PM_{10} concentrations could be shown for the entire modeling domain.

With a few exceptions, nearly all the emission sources were treated as area sources and their emissions were distributed evenly throughout the grid. This treatment was applied to roadways -- both reentrained emissions from average silt loading, as well as trackout emissions, to windblown dust of all types, to construction activity, and to all other source categories except industrial. Given the small size of each grid, with 630 grids in the domain, this arrangement worked satisfactorily.

Industrial emissions were treated differently. First, those emissions from stacks, as stated on the Maricopa County emission survey forms, were modeled as stack emission sources with all the usual stack parameters within Industrial Source Complex (ISC). Second, all other industrial emissions were modeled as area sources. This area source modeling was done in two ways. For 45 of the 81 permitted sources in the study area -- those with minimal particulate emissions -- their emissions were merely distributed evenly throughout the grid. For the 36 larger facilities, the "non-stack" emissions were taken from the county field survey; the potential emission area boundaries and its area were estimated from enlarged satellite images, and the emission rate determined, based on the stated hours of operation. These 36 process areas were islands of emissions anchored to their geographic location, rather than being spread throughout a grid. These emissions consisted of trucks on unpaved haul roads, crushing, grinding, and screening, material conveyance, and emissions from stacks too small to require an individual permit.

Windblown industrial emissions and windblown stockpile emissions were given special consideration. "Windblown industrial" refers to that windblown dust that comes from the various disturbed and unstabilized areas of the facility (excluding stockpiles). These emissions were estimated by scrutinizing the enlarged satellite images and determining which portions of the ground surface would be subject to windblown dust. Buildings, paved roads and lots, and other surfaces that could not generate dust were excluded. These windblown industrial areas were fixed on the modeling grid, and their emissions came from the designated areas only, rather than being spread throughout the grid.

The standard emission factor approach was taken, in which a certain mass flux was assigned to each hour with wind above the resuspension speed.

The spatial treatment of windblown stockpiles was done in similar fashion. The difference was in the emission factor application. Rather than being dependent on a threshold wind speed, the emissions factors were based on the speed and frequency of wind gusts.

To summarize, large industrial stacks, industrial non-stack emissions for the 36 larger facilities, and windblown emissions from stockpiles and industrial surfaces were treated with specific coordinates and stack and process area parameters. All other categories had their emissions spread throughout the grid and were treated as area sources within ISC.

5.1.1 Summary of Results and Modeling Methods

Results from this modeling demonstrate a different source mix for two types of exceedance events: low-moderate wind and high wind conditions. Dispersion modeling results show that on the high wind days, windblown dust contributes 76% of the total concentration of $PM_{10;}$ while on the low–moderate wind days there is no one dominant source, with roadways contributing 56%, industrial processes 26%, and trackout 12%, to the total predicted PM_{10} for those days. Figures 5-1 and 5-2 are pie charts summarizing the source contributions under these two conditions. The relative importance of the emission sources to the ambient PM_{10} concentrations in these charts is an average of eight model predictions: four monitors for two days.

Figure 5-1 Modeled Source Contributions for High Wind Exceedances - 2002

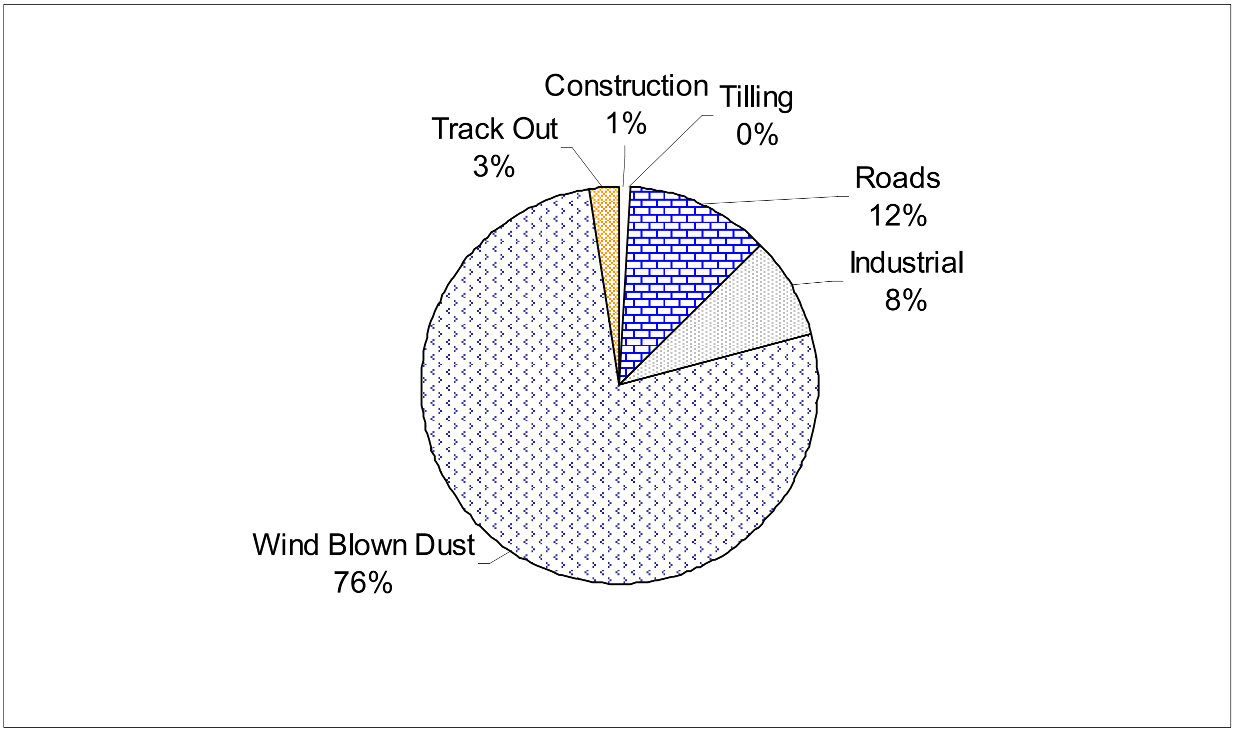
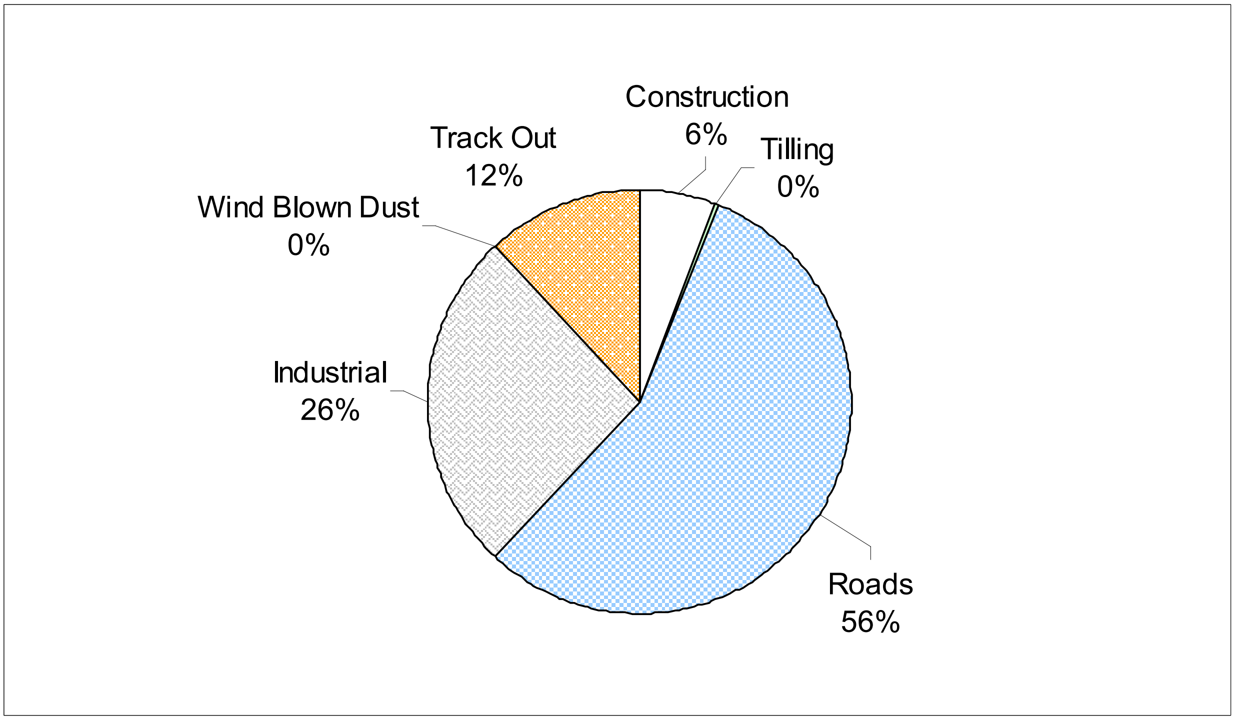


Figure 5-2 Modeled Source Contributions for Low-Moderate Wind Exceedances -- 2002



The remainder of this chapter is devoted to how days were selected for modeling and how the modeling techniques were used. Since this material is necessarily technical, it will be explained here in simpler terms. First, the goal of air quality modeling is to be able to understand the emission sources that contribute to high air pollution levels. This means to identify those sources and to quantify just how much each one contributes to the problem.

There are four steps to achieve this goal:

1. In a particular area for a specific time, make intensive measurements of air pollution and winds at a number of sites.

2. Construct an inventory of emissions, and arrange these emissions in a fashion suitable for input into an air quality model.

3. Through measurements and calculations, determine what fraction of the study-area air pollution originates elsewhere. This fraction is called "background."

4. Put the meteorological and emissions information from specific days into an air quality model. Such a model is nothing more than a numerical tool which estimates pollutant concentrations based on the strength and timing of the emissions, on the wind speed and direction, and on how well the air at the ground surface mixes vertically. These predicted concentrations that come out of the model result from the emissions from the study area only. Background concentrations (step 3) are those pollutant levels that would be present with zero emissions in the study area. Adding the background to the model-predicted concentrations gives the final estimates of air quality that can then be compared with the measurements.

The technically inclined reader is encouraged to look into the details of these four steps as explained in the rest of the chapter. But any reader who understands the concepts behind these steps can skip to the discussions about source contributions, emission controls, and attainment (Chapter 6) without any disadvantages.

5.2 DESIGN DAY SELECTION

In 2002, in the Salt River area, 21 exceedances of the PM_{10} standard were recorded on 14 different days. Of these days, four were selected for modeling: January 8, April 15, April 26, and December 16. Two of these days, January 8 and December 16, had low-moderate wind meteorology, with exceedances measured at one site for each day, and were among the highest concentrations measured under these conditions within the Salt River PM_{10} Study Area. The two April days were very similar in that dry cold fronts were passing through Arizona, bringing sustained winds in excess of 15 miles per hour. On those days, multiple monitoring sites throughout the nonattainment area measured exceedances, and within the Salt River PM_{10} Study Area, three of the four sites exceeded the NAAQS. These were also the two exceedance events with the highest measured concentrations for the year under these meteorological conditions within the Study Area. The other advantage of these two high wind events is that the winds were sustained through most of the day and wind direction was relatively stable. Both of these characteristics simplify the modeling exercise.

Table 5-1 provides a summary of PM_{10} exceedances in the Salt River PM_{10} study area. The shaded exceedances were selected for modeling.

5.3 EMISSIONS INVENTORY

Chapter 4 of this document describes the development of the emissions inventory and the inventory itself. The inventory was delivered as separate day and category dependent files. Each emissions category was modeled separately, and all were later summed to depict total emissions. This separate approach provided a clear and easy way to carry out modeling a large domain with a large number of area sources.

TABLE 5-1
PM_{10} Exceedances in the Salt River PM_{10} Study Area for 2002

Wind Condition Category	Day of Week	Date	Durango Complex		South Phoenix		West 43rd Ave.		Salt River	
			TEOM	HiVol	TEOM	HiVol	TEOM	HiVol	TEOM	HiVol
High	M	4/15/2002	**198**		128		**243**		**184**	
	F	4/26/2002	144	**232**	128	123	**174**	**172**	**173**	**249**
	M	5/20/2002	97	99	129	84	**167**	119		
	SU	6/9/2002	91		**164**		49		67	
	TU	7/9/2002	120		106		**153**		130	
	M	7/22/2002		**203**	102	90	119	120	128	148
Moderate-Low	TU	1/8/2002		**158**		94				**174**
	W	7/3/2002	90		117		**152**			
	M	8/26/2002	70		96		**165**		121	
	SU	10/13/2002	87		131		**154**		116	
	TU	10/15/2002	87		116		**175**		138	
	W	11/6/2002	107		105		**183**		**152**	
	F	11/22/2002	100	133	136	101	**159**	118	**160**	35
	M	12/16/2002	111	132	105	82	**181**	135	126	23

5.4 METEOROLOGICAL DATA

Meteorological data for each design day were based on the wind, temperature and humidity measurements collected at the West 43rd Avenue monitoring site. For a thorough analysis of winds in the Salt River PM_{10} Study Area, see Appendix N. Mixing height was calculated using soundings from the Tucson Airport taken at 5 a.m. and 5 p.m. on those days. These data included data for wind speed, wind direction, stability class, temperature and mixing height. Table 5-2 illustrates a sample meteorological file used for this modeling.

TABLE 5–2
Meteorological Data File Used for January 8 Modeling

DATE/HOUR*	WIND DIRECTION (Degrees)	WIND SPEED (m/sec)	TEMPERATURE (K)	STABILITY CLASS	MIXING HEIGHT (m)
2010801	115	1.4	296.4	6	178
2010802	118	0.8	296.2	6	178
2010803	103	2.1	296.2	7	178
2010804	200	1.5	295.5	7	178
2010805	216	1	294.3	6	178
2010806	195	1.1	293.7	6	178
2010807	328	1	293.2	6	178
2010808	358	0.8	297	5	248.2
2010809	50	0.447	300.5	4	434.7
2010810	319	0.8	301.8	3	624.1
2010811	359	1.7881	302.1	2	807.6
2010812	27	1.2	303.4	3	994.1
2010813	48	1.3411	304.3	3	1180.5
2010814	70	1.6	304.8	4	1367
2010815	78	1.3	303.9	4	1367
2010816	74	1.2	302.3	4	1367
2010817	70	0.8	301.5	4	1367
2010818	75	0.6	300.9	5	1279.8
2010819	69	0.1	299	6	1097.7
2010820	78	0.1	297	7	915.5
2010821	85	1.4	295.3	7	733.4
2010822	81	1	293.5	7	551.3
2010823	44	1.5	292.5	7	369.1
2010824	58	0.8	291.8	6	187

*Format includes one digit for year and two each for month, day and hour – YMMDDhh.

5.5 MODELING METHOD

The ISCST-3 model was used to predict PM_{10} concentrations in the Salt River PM_{10} Study Area for January 8, April 15, April 26 and December 16, 2002. April 15 and April 26 were modeled as 'high-wind' days, as the observed wind speeds exceeded the threshold of dust re-suspension of 15 miles per hour. Each of the four modeling days included emissions for construction, lawn care, roadways and industrial sources; with agricultural tilling included in the January 8th inventory and windblown emissions included in the April 15 and April 26 inventories. Table 5-3 shows the day and inventory assignment.

TABLE 5-3
Source Categories Contributing Emissions for the Four Design Days

Source Category/ Day	Jan 8	April 15	April 26	Dec 16
CONSTRUCTION	X	X	X	X
CORN TILLAGE	X			
COTTON TILLAGE	X			
LAWN CARE	X	X	X	X
FREEWAY	X	X	X	X
PRIMARY ROADS	X	X	X	X
SECONDARY ROADS	X	X	X	X
UNPAVED PARKING LOTS	X	X	X	X
UNPAVED SHOULDERS	X	X	X	X
SMALL INDUSTRIAL SOURCES	X	X	X	X
LARGE INDUSTRIAL AREA SOURCES	X	X	X	X
INDUSTRIAL POINT SOURCES	X	X	X	X
WINDBLOWN AGRICULTURE		X	X	
WINDBLOWN ALUVIAL		X	X	
WINDBLOWN VACANT LOTS		X	X	
WINDBLOWN MISC. DISTURBED		X	X	
WINDBLOWN CONSTRUCTION		X	X	
WINDBLOWN STOCK PILES		X	X	
WINDBLOWN INDUSTRIAL		X	X	

The data in each inventory file was added to the category and day specific input run streams and was used in conjunction with the relative meteorological data file, the ISCST-3 program and a batch file to run the process. This allowed each scenario to be run independently and provided a simple means to adjust independent categories, when adjustments were needed.

The ISCST-3 model was initiated by activating the batch file, which in turn ran the model and instructed the program to read in the appropriate input and meteorological data file. This, in turn, produced an ASCII output file, with the computed values for PM_{10} in the domain.

The output option used produced a PM_{10} plot file with 24-hour average values for each of four receptors and their relative predicted concentrations. The receptor locations were the actual monitoring sites in the domain, so, the predicted concentrations can be directly compared to the measured value at each site for each day.

Data from these plot files were copied to a spread sheet that had been set up by source category, site and day and summed into a receptor (monitoring site) and day specific total. These data were used to test the model performance, by comparing the predicted and measured values at each site.

5.5.1 Model Performance

Model performance data presented here are for the January 8, April 15, April 26, and December 16, 2002 exceedance days. All four sites are included. Figures 5-3 and 5-4 show the relationship between observed and predicted PM_{10} values in the Salt River PM_{10} Study Area. Here these 24-hour average predictions and concentrations are shown with site and wind-condition labels.

Figure 5-3. Salt River PM_{10} Model Predictions vs. Observations, with Monitoring Sites (WF, West 43rd Ave; SP, South Phoenix; SR, Salt River Site; and DC, Durango Complex

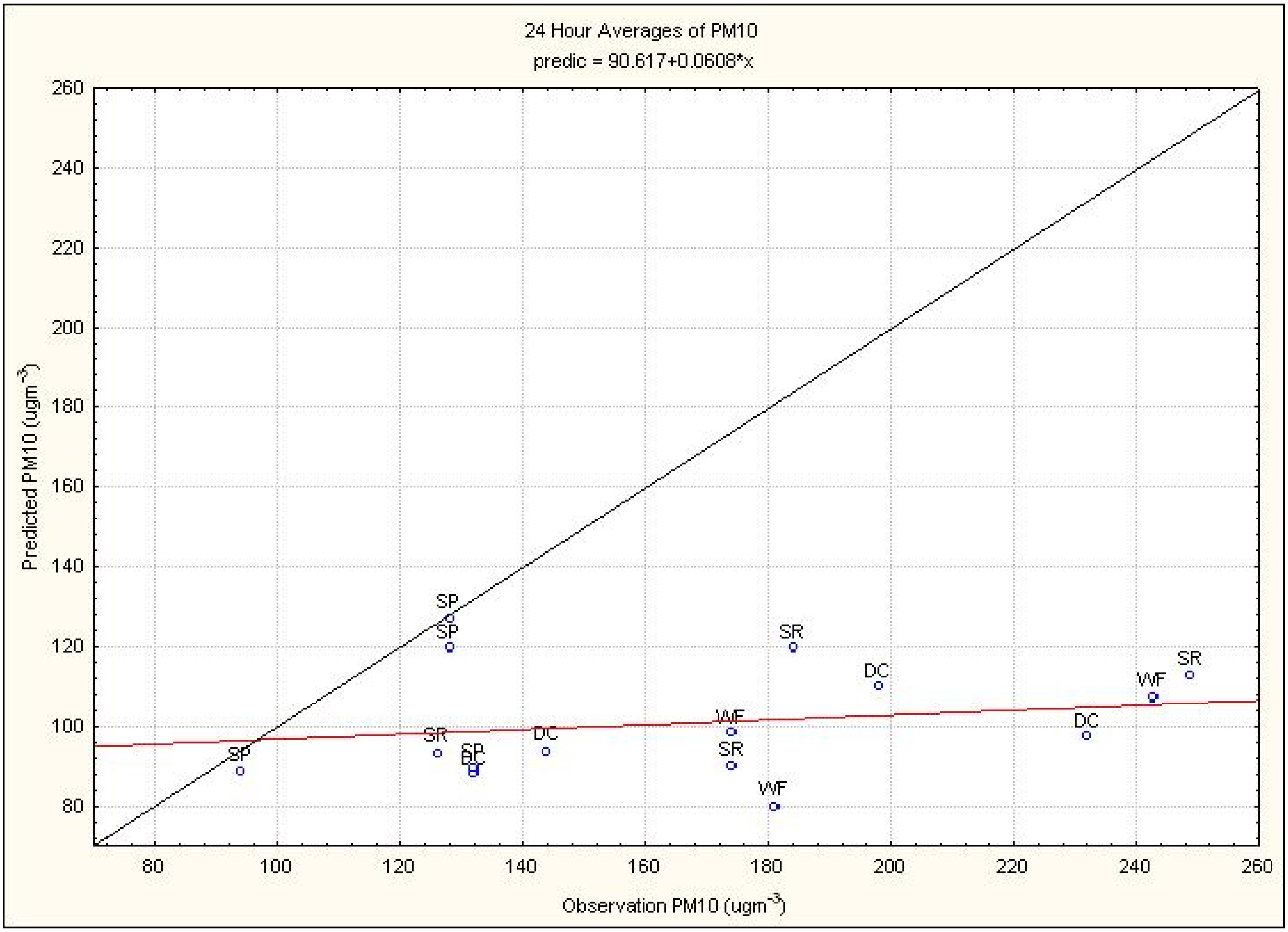


Figure 5-4. Salt River PM_{10} Model Predictions vs. Measurements, with High Wind (High) and Low Wind (Low) Conditions Indicated

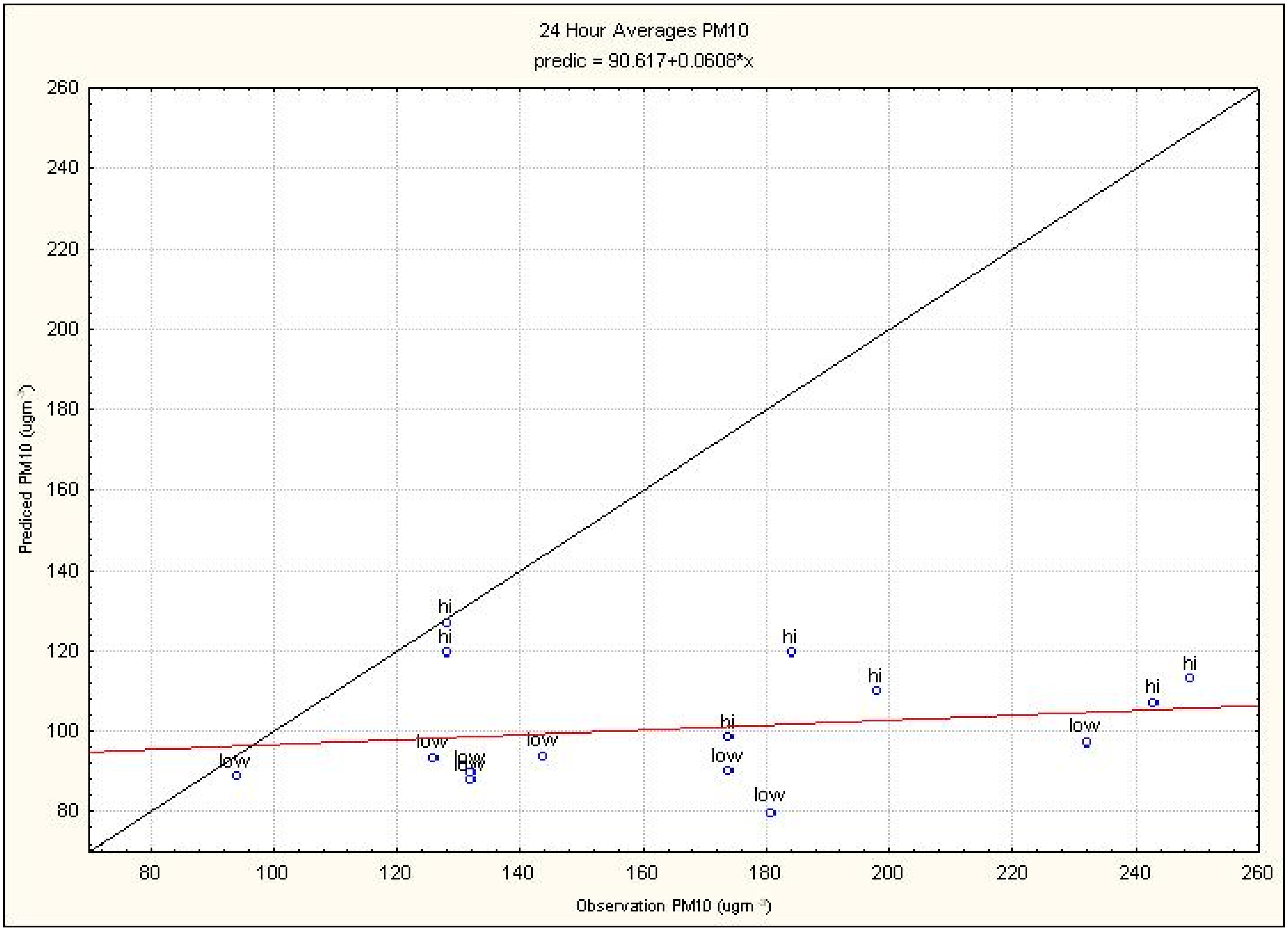


Figure 5-5 presents PM_{10} concentrations domain-wide for December 16. The pattern is generally consistent with emissions and wind directions. The exceedance occurred at West 43rd Avenue and was 181 µg/m3. Winds were light, averaging 1.4 miles per hour, and, during the daylight hours were mostly out of the west, southwest, or northwest (Table 5-4). The pattern of moderately elevated concentrations is coincidental with the network of primary roads. Areas of the most elevated concentrations are close to either primary roads, large industrial sources, or both.

TABLE 5-4
Wind Data for December 16, 2002

	Wind Direction		Wind Speed
Hour	**Compass Degrees**	**Cardinal Direction**	**(mph)**
0	248	W	1.4
1	194	S	0.5
2	114	SE	1.9
3	100	E	2.8
4	59	NE	0.6
5	285	W	2.7
6	255	W	1.3
7	286	W	2.7
8	279	W	1.6
9	209	SW	0.5
10	100	E	2.1
11	161	S	1
12	233	SW	2.1
13	225	SW	1.2
14	276	W	0.8
15	25	NE	0.8
16	334	NW	2
17	48	NE	1.3
18	219	SW	1.6
19	214	SW	1.1
20	96	E	0.7
21	297	NW	1.4
22	168	S	0.5
23	ND	ND	ND
AVG			1.42

On the high-wind day of April 15, 2002, the model once again produced areas of elevated PM_{10} concentrations consistent with the location of nearby emissions (Figure 5-6). Four hours had wind speeds in excess of the dust resuspension threshold of 15 miles per hour (Table 5-5).

TABLE 5-5
Wind Data for April 15, 2002
(from West 43rd Avenue)

Hour	Wind Direction		Wind Speed (mph)
	Compass Degrees	Cardinal Direction	
0	295	NW	2
1	298	NW	6
2	283	W	2.7
3	20	N	5.9
4	36	NE	3.4
5	15	N	2.7
6	148	SE	1.1
7	178	S	0.8
8	230	SW	1.6
9	139	SE	3.2
10	179	S	12.8
11	207	SW	11.3
12	228	SW	8.3
13	250	W	13
14	258	W	16.3
15	254	W	16.6
16	250	W	15.3
17	255	W	16.1
18	249	W	12.3
19	258	W	10.1
20	265	W	13.3
21	261	W	5.5
22	224	SW	3.7
23	238	SW	5.1
AVG			7.88

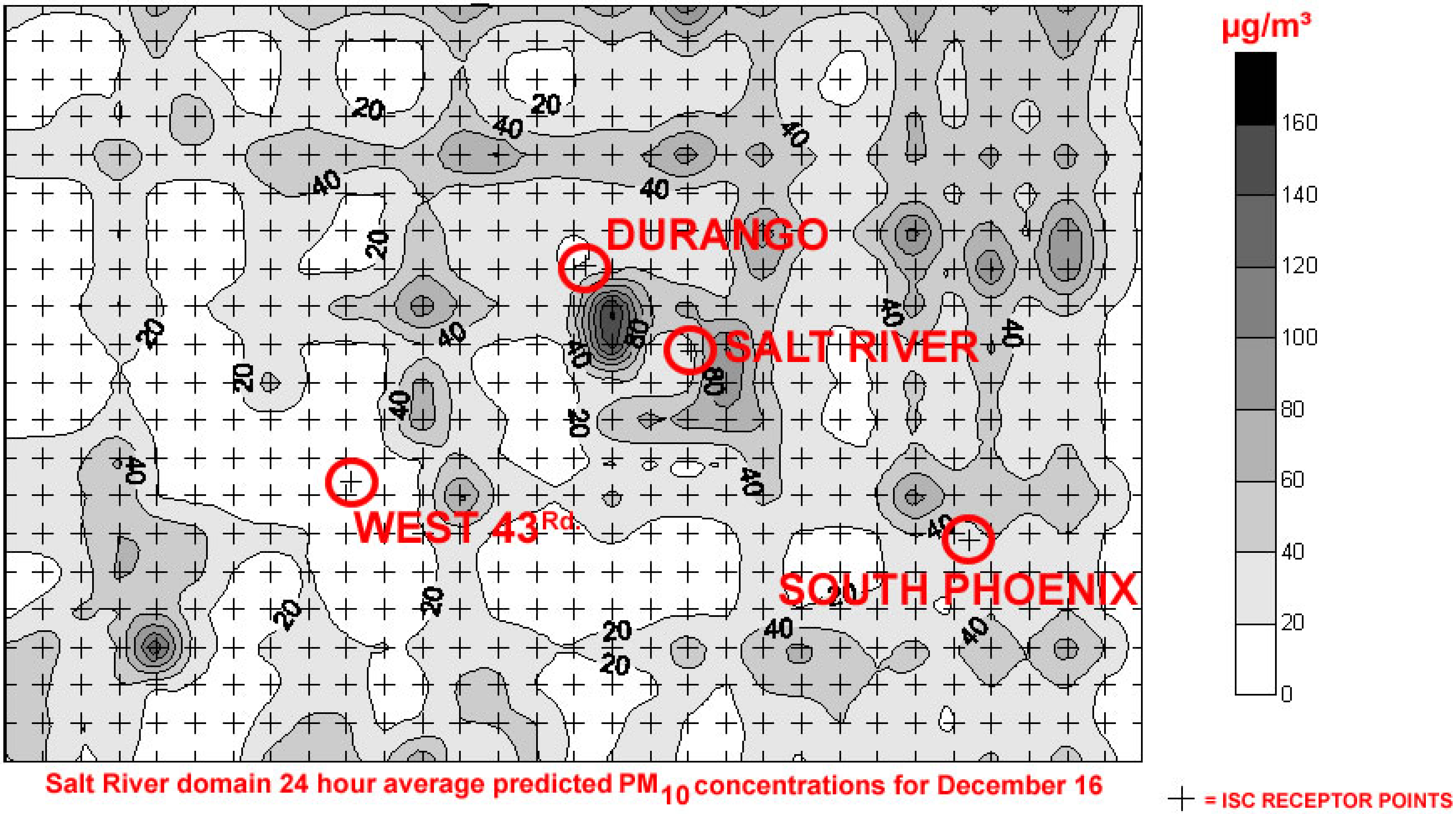


Figure 5-5. Domain-wide PM_{10} Concentrations from the ISC Model for December 16, 2002

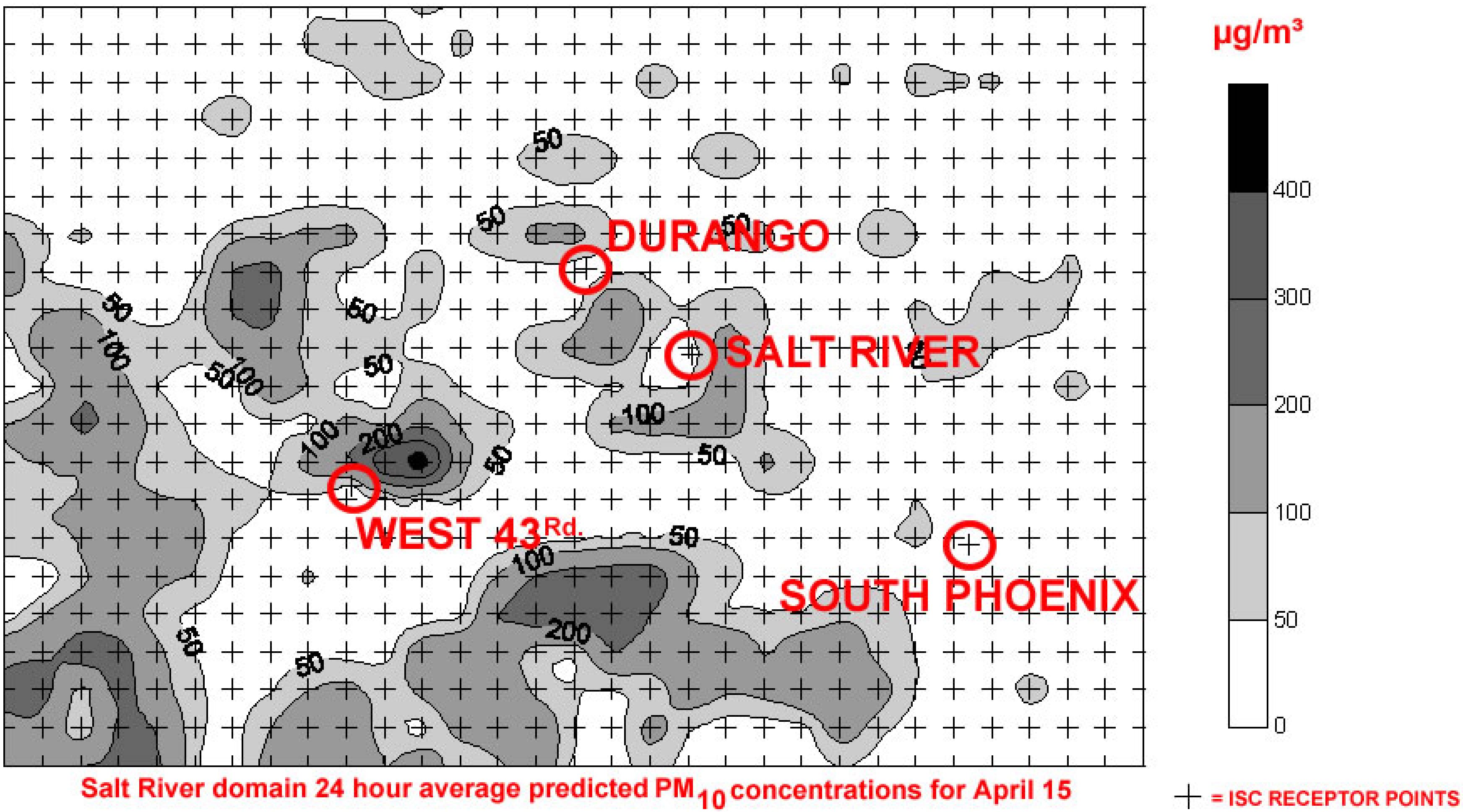
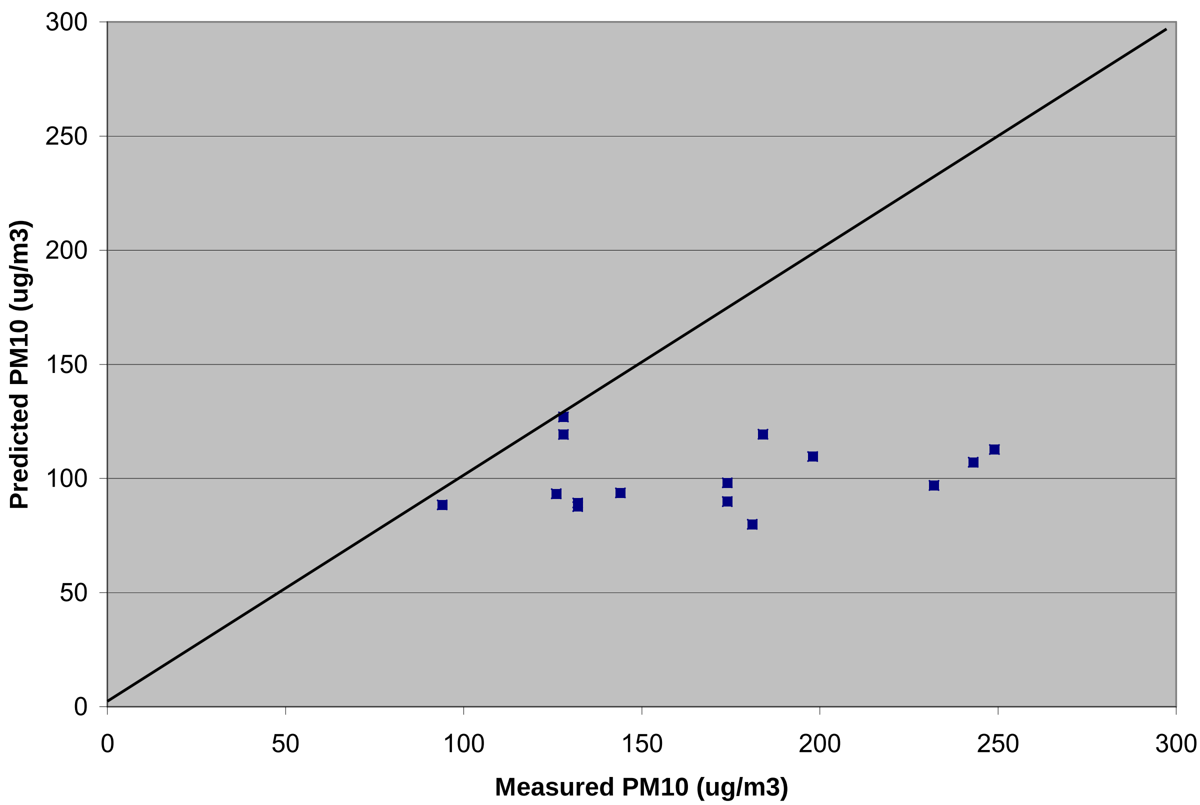


Figure 5-6. Domain-wide PM_{10} Concentrations from the ISC Model for April 15,

Table 5–6, illustrates the total predicted concentration, in µg/m³ at each receptor (monitoring site) in the Salt River PM_{10} Study Area domain, excluding background. Figure 5-7 illustrates the ISCST-3 model performance for the Salt River PM_{10} Study Area. Background values have been added to these results.

TABLE 5-6 Predicted Concentrations for Monitoring Sites				
Total Predicted PM_{10} Concentration (µg/m³)				
	8-Jan	15-Apr	26-Apr	16-Dec
SOUTH PHOENIX	20.4	39.0	47.3	22.3
DURANGO	25.7	21.6	25.0	20.7
SALT RIVER	21.9	31.4	40.7	26.3
WEST 43	9.7	19.1	26.1	12.9

Figure 5-7 Model Performance: Predicted vs. Observed PM_{10} Concentrations



The model performance shows that the predicted values are below the 1:1 line, meaning that the model has consistently under predicted the measurements. Of the 15 measurements, three predictions are within 10% of the measurements, one is within 30%, four are within 40%, three are within 50%, and four are within 60%.

Table 5-7 illustrates the average ISCST-3 results for the Salt River PM_{10} Study Area.

TABLE 5-7
Model Performance:
Average Predicted PM_{10} Concentrations (µg/m³)

	Low Wind	High Wind
Predicted	20.0	31.4
Background	67.5	80.0
Total (Pred + Back)	87.5	111.4
Measured	138.6	192.0
% From Measured	-36.9	-42.0

Appendix O presents model performance data on an hourly basis. This model performance, when put into the context of general dispersion model performance, is more than adequate. The rule of thumb in the modeling community is that any ISCST prediction within a factor of two of the measurements is acceptable. This "rule" has evolved through over three decades of application of the model to large industrial smokestack emissions. These emissions are much better characterized than the fugitive PM_{10} emissions from roads, windblown dust, and industrial sources such as sand and gravel. Within the Salt River PM_{10} Study Area, virtually all of the emissions are of a fugitive nature. This makes it especially difficult to have perfect site and day specific predictions of PM_{10} concentrations.

While the precise cause of the under predictions is unknown, its effects on the overall technical analysis and the determination of the contributing emission sources are minimal. First, the model, as explained in Chapter 6, is used in a relative sense. The absolute prediction does not determine attainment. Second, the emissions inventory represents the state of the art in land use analysis, was fortified by ample local measurements and observations, and relied on the latest EPA-approved emission factors. There is no reason to suppose that one source category was under estimated or over estimated to a much greater degree than another source category. The primary emission sources are roads, industrial sources, and earthmoving from construction, and with windblown dust on the high-wind days. The rigorous methods of emission inventory construction provide confidence that the relative amounts of emissions from the different source categories are close to the real-world mark.

5.6 BOUNDARY CONCENTRATIONS AND URBAN BACKGROUND

5.6.1 PM_{10} Measurements at the Boundaries

Monitors were set up at Mule Stables (67th Avenue, just north of the Salt River), Battery Shop (16th Street, just south of the Salt River) and West 43rd Avenue to measure PM_{10}, from January 2003 through March 10, 2003. Data for West 43rd Avenue were available from January 23, 2003. Wind directions and wind speeds were measured at these sites.

Hourly averages were calculated from the data. The Battery Shop location is six streets east of the east boundary of the Salt River area. The west boundary is at 57th Avenue, which was close to the Mule Stables at 67th Avenue. Hence it was assumed that the boundary concentrations were represented by the readings at these two locations.

Other sites in the region had monitors and wind direction/speed readings. Data from Durango and Supersite were used to estimate boundary concentrations where direct measurements were not available, as described in the next section.

5.6.2 Calculation of Boundary Values

Since simultaneous PM_{10} readings were available at West 43rd Avenue and at the east and west boundary sites, the fractions at the east and west boundaries with respect to West 43rd Avenue were calculated from these measurements.

North boundary concentrations could not be determined directly from measurements at or near the boundary. They were estimated using 80% of the readings at Supersite, which is north of the north boundary, and 20% of the readings at Durango, which is south of the north boundary. The Durango site, which is in the Salt River area, has considerably higher PM_{10} readings than the Supersite. However, due to the effect of wind, not all of PM_{10} at Durango is likely to contribute to the North boundary concentrations. It was assumed that 80% of the contribution to the North boundary came from Supersite.

For the South boundary, no measurements were available. For potential PM_{10} emission areas, there are 8 square miles south of Baseline Road (south boundary) and 60 square miles north of Van Buren Street. The south boundary concentrations were estimated as 8/60 of the north boundary concentrations for each hour. Again, the wind directions were used to select south boundary concentrations, and fractions with respect to West 43rd Avenue were calculated.

Before calculating the boundary concentrations as fractions of West 43rd Avenue PM_{10}, the PM_{10} data were narrowed down to directions that are more likely to contribute to the concentrations at the boundaries. These wind directions are listed in Table 5-8.

TABLE 5-8 Boundary Wind Directions	
Boundary	**Wind Direction**
East	Between 20 and 160
West	Between 200 and 340
North	Less than 70 and greater than 290
South	Between 110 and 250

The measured wind directions at the particular sites were used whenever available. When they were not available, the data for the site nearest to it were used, as in the case of West 43rd Avenue. For January, and up to February 5, 2003, the wind directions for West 43rd Avenue were available. For the remainder of February and March, wind data at Mule Stables were used.

In the calculations of the west boundary fraction with respect to the West 43rd Avenue PM_{10} concentrations, diurnal distributions were calculated using the data from January 2003-March 2003, and the selected wind directions. The fraction at 2 p.m. was very high (1.2) compared to those around it. It was due to a very high reading (725.7 µg/m³) at Mule Stables, and only a moderately high (334.6 µg/m³) reading at West 43rd Avenue, on February 2, 2003. The concentrations before and after 2 p.m. were significantly lower, by an order of magnitude. Examination of meteorological data indicated that there was a cold front with gusting winds (35 mph) and blowing dust in the afternoon of that day. The winds decreased in the evening. It is possible that the winds were strong as they entered the Mule Stables area, creating very high PM_{10} concentrations, but decreasing as they entered West 43rd Avenue site. By 3 p.m. the gusting winds may have left these sites, although not the Phoenix area.

The examination of the hourly fractions west boundary PM_{10} divided by West 43rd Avenue PM_{10} over a 24 hour period indicated that the effect of selective data based on wind direction was minimal in the morning. The fractions with all the wind directions versus. selected wind directions were within 0.1 of each other. In the afternoon, the difference was much greater, as more winds from the west brought in more PM_{10}. This was particularly evident for the data point at 2 p.m. (hour 14). A value of 1.2 indicated that the west boundary concentration was 20% higher than the West 43rd Avenue concentration.

In order to counteract the effect of a single data point raising the mean and standard deviation, it was decided to use a moving average of 3 points (See Figures 5-8 and 5-9) for this data point. For all the other points, the standard deviation was close to the mean in magnitude. Had all the wind data been used, instead of selecting the directions, the mean would have been considerably lower, but it would not have represented the real situation. Hence the very high data point was included, as a moving average, rather than the measured concentration. This gave a west boundary

PM_{10} divided by West 43rd Avenue fraction equal to 1.0, which was more in line with the fractions at other points that afternoon.

Ratios of boundary concentrations with West 43rd Avenue concentrations are displayed in Figure 5-9. They are calculated as fractions of the West 43rd Avenue monitor concentrations, which are known from measurements taken as 24 hour averages from the high volume sampler. Table 5-9 presents these data and the ratio calculations.

Figure 5-8 Moving Averages for West Boundary/West 43rd Avenue Ratio

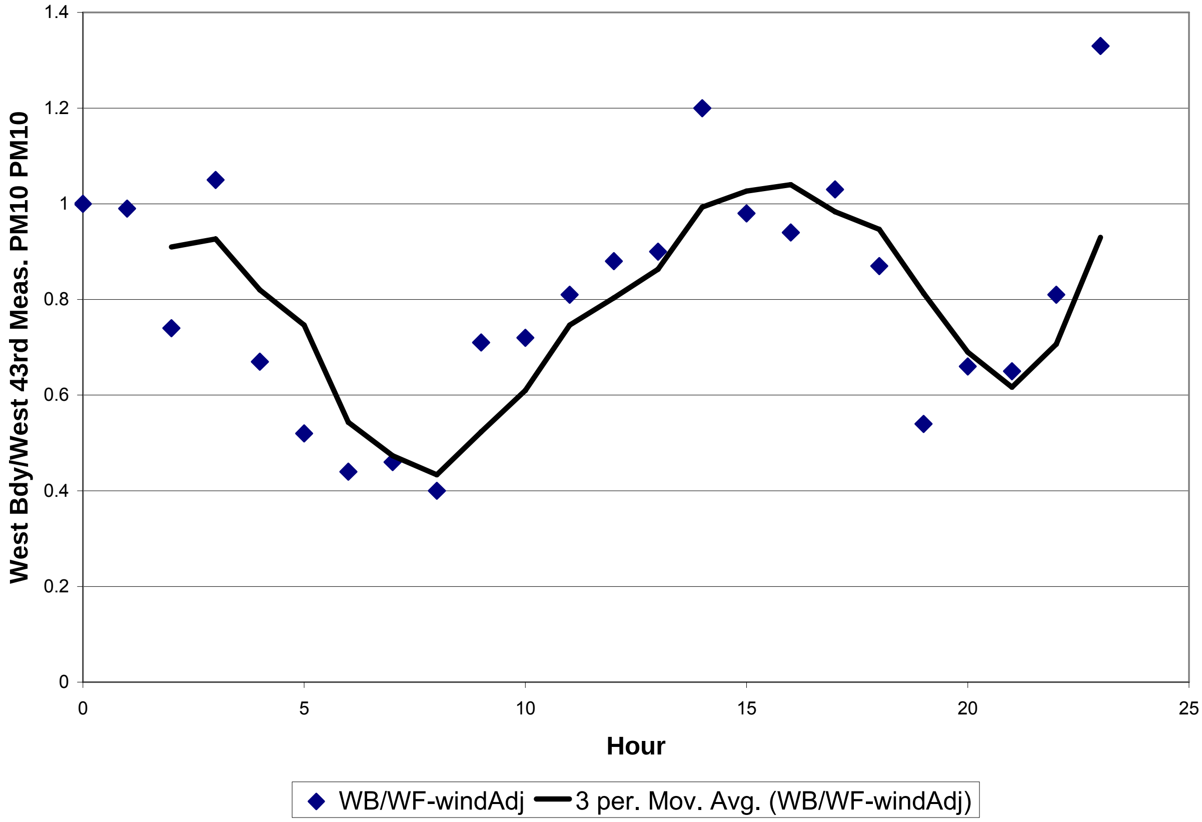


Figure 5-9 PM_{10} Concentration Ratios for East, West and North Boundaries Relative to PM_{10} Concentration at W. 43rd Avenue Monitor

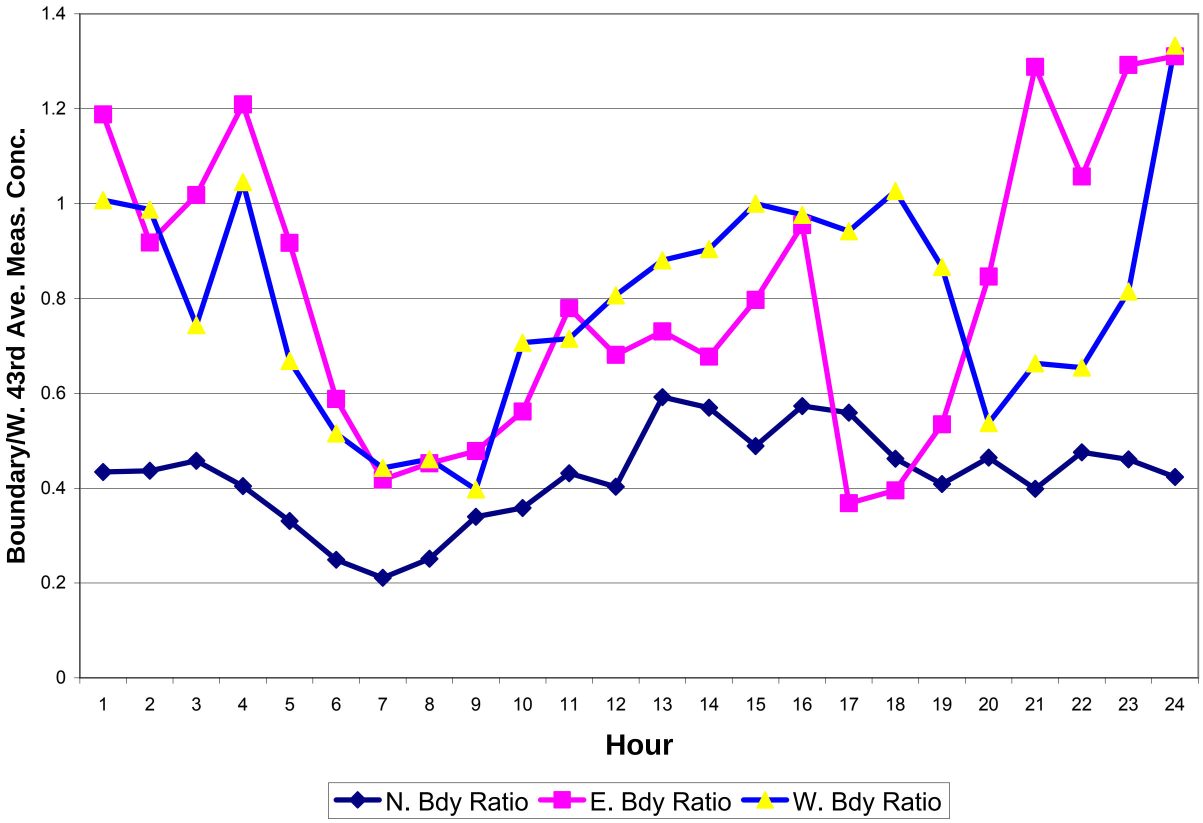


TABLE 5-9 Boundary PM_{10} Concentrations Ratioed with West 43rd Avenue PM_{10} Concentrations							
				Ratio with W. 43rd Avenue PM_{10} Concentration			
Hour	**W. 43rd PM_{10} conc.**	**N. Bdry PM_{10} conc.**	**S. Bdry PM_{10} conc.**	**N. Bdry**	**E. Bdry**	**W. Bdry**	**S. Bdry**
0	99	43	5.73	0.43	1.19	1.01	**0.06**
1	87	38	5.07	0.44	0.92	0.99	**0.06**
2	83	38	5.07	0.46	1.02	0.74	**0.06**
3	92	37.2	4.96	0.40	1.21	1.05	**0.05**
4	107	35.4	4.72	0.33	0.92	0.67	**0.04**
5	147	36.6	4.88	0.25	0.59	0.52	**0.03**
6	232	49	6.53	0.21	0.42	0.44	**0.03**
7	219	55	7.33	0.25	0.45	0.46	**0.03**
8	133	45.2	6.03	0.34	0.48	0.40	**0.05**
9	120	43	5.73	0.36	0.56	0.71	**0.05**
10	70	30.2	4.03	0.43	0.78	0.72	**0.06**
11	66	26.6	3.55	0.40	0.68	0.81	**0.05**
12	51	30.2	4.03	0.59	0.73	0.88	**0.08**
13	46	26.2	3.49	0.57	0.68	0.90	**0.08**
14	54	26.4	3.52	0.49	0.80	1.00	**0.07**
15	52	29.8	3.97	0.57	0.95	0.98	**0.08**
16	54	30.2	4.03	0.56	0.37	0.94	**0.07**
17	74	34.2	4.56	0.46	0.40	1.03	**0.06**
18	92	37.6	5.01	0.41	0.53	0.87	**0.05**
19	90	41.8	5.57	0.46	0.85	0.54	**0.06**
20	136	54.2	7.23	0.40	1.29	0.66	**0.05**
21	103	49	6.53	0.48	1.06	0.65	**0.06**
22	112	51.6	6.88	0.46	1.29	0.81	**0.06**
23	119	50.4	6.72	0.42	1.31	1.33	**0.06**

5.6.3 Summary of Background Calculations

The calculations described above provide a day-specific relationship between PM_{10} concentrations entering the Salt River Area with the measured concentration at West 43rd Avenue monitor. In Table 5-10, this link between boundary and West 43rd Avenue monitor concentrations is given as a "boundary percentage" and is about 50%. This means that for the four exceedance dates, the PM_{10} concentrations at the boundaries of the Salt River Area are about one half of those measured by the West 43rd Avenue monitor. This percentage is applied to the average PM_{10} concentrations from the four monitoring sites ("4-site avg" in the table) to give the background concentration. These background concentrations are added to the prediction from the dispersion model to yield a total estimated concentration at a monitoring site.

TABLE 5-10
PM_{10} Background Concentrations

Date	West 43rd Avenue (µg/m³)	4-Site Average (µg/m³)	Boundary Percentage (%)	Background Concentration (µg/m³)
8-Jan-02	181*	137	49.8	68
15-Apr-02	243	188	46.9	88
26-Apr-02	174	153	47.2	72
16-Dec-02	181	131	50.8	67

* Salt River site was used; West 43rd Avenue site was not set up until April 2002.

6.0 CHAPTER 6 – 2006 PREDICTED CONCENTRATIONS AND CONTROLS

Chapter 4 includes an in-depth accounting of the emissions predicted for 2006. To predict future air quality, these base case 2006 emissions could be put into the Industrial Source Complex model, with the same meteorology as the 2002 design dates. These model predictions would reflect the best estimates of future PM_{10} concentrations in the Salt River PM_{10} Study Area without additional controls. Of particular interest is whether the predicted air pollution concentrations are within the health standards. As the reader will see, given the controls described in Section 6.4, attainment can be achieved for the eight exceedances in 2002 that have been studied in this analysis.

6.1 EMISSION CHANGES BETWEEN 2002 AND 2006 AND THEIR AIR QUALITY CONSEQUENCES

Chapter 4 describes the predicted base case 2006 PM_{10} emissions in considerable detail. In this chapter, only the additional controls necessary to meet the standard will be discussed. Emission reductions will be forthcoming from enhanced controls to be placed on five kinds of dust-producing activities:

1. Earthmoving and related activities associated with residential and commercial construction;

2. Industrial activity that is chiefly materials handling and transport, with haul roads, pile forming and material transfer being the principal sources;

3. Vehicular traffic on paved roads, principally the reentrained dust that vehicles generate, which can be reduced through increased street sweeping;

4. Trackout onto paved roads from a variety of sources, which adds to the reentrained dust from the nominally clean roads; and

5. Windblown dust from areas such as alluvial surfaces, vacant lots, miscellaneous disturbed areas, industrial stockpiles, and industrial sites.

In addition to emission reductions from these activities, reductions in windblown emissions will also be forthcoming from changes in land use, e.g. the conversion of agricultural land, vacant lots, and miscellaneous disturbed areas to residential and commercial uses. Each of these activities contributes PM_{10} to the atmosphere throughout the metropolitan area, and within the Salt River PM_{10} Study Area. Each has some effect on the four monitors within the study area, and the emissions inventory and air quality model have quantified their "source category contributions." In Section 6.5, each of the eight exceedances is examined in light of the base case and future emissions.

6.2 EMISSION REDUCTIONS TO MEET THE STANDARD AND BACKGROUND

6.2.1 Necessary Emission Reductions to Meet the Standard

Eight exceedances that occurred in the Salt River PM_{10} Study Area in 2002 were examined in detail. Each exceedance can be compared with the standard and its percentage above the standard calculated. This percentage above the standard (% above standard) has been calculated by dividing the difference between the $[PM_{10}]$max, or maximum PM_{10} concentration, and the value of the standard, 150 $\mu g/m^3$, by the standard, 150 $\mu g/m^3$,, and multiplying by 100.

$$\% \text{ above std} = \{ \{ [PM_{10}]max – 150 \} / 150 \} * 100\%$$

If there were a one-to-one correspondence between emissions and concentrations, then the percentage above the standard would equal the emission reduction percentage needed to meet it. In the case of most air pollutants studied on most geographical scales, this correspondence is altered by the background value. Discussed in section 5.6, this background concentration makes it more difficult to achieve a standard, because it either does not respond at all to emission reductions that may occur in the study area, or it responds very little. A reasonable example is given by the air pollutant ozone, whose eight-hour natural background concentration is 60 parts per billion (ppb). The air quality standard is 84 ppb. If the exceedance was 100 ppb, the 16 ppb reduction would need to come out of the 40 ppb (100 minus background), not the full 94 ppb; a 40% instead of a 16% reduction. Since the background is present with or without metropolitan emissions or their reductions, the controls have to "work about twice as hard" because they affect about half as much.

In the case of the Salt River PM_{10} concentrations, background values are one half of the elevated concentrations measured within the Study Area. The Study Area is a small fraction of the metropolitan total, as are its emissions (3 to 4%). "Background" in this sense can be regarded as that PM_{10} concentration that would prevail throughout the Salt River PM_{10} Study Area if all study-area emissions were to cease. This background concentration results from the emissions of the rest of the metropolitan area, and their resultant transport into the Study Area.

To arithmetically account for background, the following equation applies, which, except for the addition of a background term in the denominator, denoted as "$[PM_{10}]$ back", is identical to the previously discussed formula to calculate the percentage above the standard.

$$\% \text{ red} = \{\{ [PM_{10}]max – 150 \} / \{ [PM_{10}]max – [PM_{10}]back\}\} * 100\%$$

Before presenting the emission reductions necessary to meet the standard that can be calculated with this equation, another complication has to be explained. The background concentration for some future year will differ from a base year if emission reductions are achieved throughout a metropolitan area. The calculation of emission reductions necessary to meet the standard in 2006 in the Salt River Study Area has to be done with a future background concentration. This is explained below.

Because emission reductions will take place throughout the Maricopa County PM_{10} Nonattainment Area, the background concentration for the Salt River PM_{10} Study Area will be reduced as well. These background reductions, calculated below, affect the percentage reductions of emissions necessary to meet the standard. The effects are small. Because of the size of metropolitan Phoenix, the distribution of these PM_{10} emissions throughout this area, and their diminishing effects with increasing distance, the background values change very little.

The urban-wide control effect on the Salt River PM_{10} Study Area background concentration was calculated as explained above. For each source category of emissions, its percentage of the total metropolitan PM_{10} emissions is calculated (Maricopa Association of Governments emissions inventory [MAG 2000], Quantification of Agricultural Best Management Practices [URS & ERG, 2001]). Next, the spatial distribution of the source-category PM_{10} emissions from the MAG PM_{10} technical analysis was obtained. The spatial distribution, sometimes called "emission density maps", is critical because PM_{10} emissions more distant from the Salt River Area have less effect than those close to it. (See Appendix M for emission density maps for background concentrations.)

For example, emission reductions 20 miles from South Phoenix matter much less than those immediately across the Study Area boundary. The percentage of the source category emissions in each of six zones progressively farther from the Salt River area is then multiplied by a transport weighting factor. This factor is an inverse-squared relationship using distance from the source (r); i.e., $1/r^2$. This effectively assigns a scalar value of one to the nearest zone and of 0.05 to the most distant. Each zone's influence for each source category is added to yield an overall background reduction percentage. These percentages are given in the far right column of Table 6-1.

TABLE 6-1
Salt River PM_{10} Study Area Background Reductions
From Area Wide Controls

Source Category	PM_{10} Emissions (MetricTons/Day)	% Total	Background Reduction Percent
Construction Activity Fugitive Dust	22.85	15.86%	4.53%
Entrainment from Construction Trackout	6.10	4.23%	1.21%
Industrial Processes	2.63	1.83%	0.59%
Process Fugitives	0.42	0.29%	0.09%
Paved Road Dust	56.40	39.14%	11.31%
Agricultural Tillage	5.58	3.87%	1.11%
Windblown	3860	NA	25.27%

These percentages in Table 6-1 mean, for example, that if construction activity fugitive dust is reduced 10% urban wide, the background concentration at the Salt River PM_{10} Study Area would decrease by 4.53% of this, or 0.5%, because of the average distance between the Salt River Study Area and all of the construction activity in the nonattainment area. If windblown dust were reduced by 50% urban-wide, then the Salt River PM_{10} Study Area background concentrations would go down by about 12%. The Maricopa Association of Governments is carrying out a metropolitan-wide program to purchase PM_{10} efficient street sweepers. Their staff estimates that between 2002 and 2006, this program will lead to a 7% reduction of reentrained dust from paved roads. The Salt River PM_{10} Study Area background concentration reduction from this enhanced sweeper program, then, is 11.31% (fifth line of the table, far right) times 7%, or 0.8%.

The response of the Salt River PM_{10} Study Area background concentrations to nonattainment-wide emission reductions did not account for that portion of the background that cannot be reduced. As the following discussion will show, this error turns out to be immaterial in the demonstration of attainment. Nonetheless, the following text discusses how these calculations should have proceeded.

6.2.2 Urban Background – The Irreducible Portion

Background concentrations of air pollutants are those concentrations that would be present without any emissions in the domain of interest. For the Salt River PM_{10} Study Area, these background concentrations represent the degree of PM_{10} concentrations that would prevail within the Study Area if all activity within it were to cease. The background concentrations occur because of emissions in the rest of the metropolitan area being transported into the Salt River Study Area. The same concept applies to the Phoenix metropolitan area as a whole. Since area-wide emission reductions by 2006 would apply to the nonattainment area only, then that portion of the PM_{10} loading that comes from outside the metropolitan area would be unaffected. If one were able to zero out all emissions within the metropolitan area and set up air pollution monitors, they would not produce zero readings. Emissions both natural and anthropogenic from outside the area will be transported in and will comprise the background levels for the area.

Background concentrations of PM_{10} are available for three of the four days on which the eight exceedances occurred. One day, April 15, 2002, was not a network run day, so the only PM_{10} data are the continuous TEOM instruments, none of which is in a background area. Because the meteorology of this date was so similar to its April 26 counterpart, however, that data adequately represents April 15. Table 6-2 presents the background concentrations.

Organ Pipe National Monument is a close-to-pristine Sonoran Desert environment whose particulate levels have been among the lowest measured anywhere in the state. Its long-term average of PM_{10} is about 10 $\mu g/m^3$. It lies 98 miles south-southwest of downtown Phoenix. Palo Verde is 45 miles west of downtown Phoenix and is subject to considerably more vehicular, construction, and agricultural activity than is Organ Pipe.

Its long-term average of PM_{10} is about 25 µg/m^3, although it has been increasing in recent years. Estrella Park is a Maricopa County Park that has large rugged mountainous area with some developed parklands next to the Gila River. On the western fringe of the Phoenix urban area, it lies 17 miles west-southwest of downtown Phoenix. Its long-term PM_{10} concentration is 30 µg/m^3. In 2002 all three sites were equipped with Andersen dichotomous samplers. An EPA equivalent method for PM_{10}, these instruments measure fine particles (about 2.5 microns and smaller) and coarse particles (about 2.5 to 10 microns) separately.

TABLE 6-2
Background PM_{10} Concentrations on Exceedance Days in 2002 (µg/m^3)

Date	Organ Pipe			Palo Verde			
	Fine	Coarse	PM_{10}	Fine	Coarse	PM_{10}	
1/8/2002	3.0	4.6	7.6	6.7	28.2	35.0	
4/15/2002							
4/26/2002	5.8	16.4	22.2	11.6	64.5	76.1	
12/16/2002	6.6	9.8	16.4	41.3	8.7	50.0	
	Estrella Park			Super-site TEOM PM_{10}	Salt River Back-ground	AVG*	AVG/BK
	Fine	Coarse	PM_{10}				
1/8/2002				49.9	68.0	21.3	0.31
4/15/2002				107.5	88.0		
4/26/2002	6.6	59.6	66.3	89.2	72.0	54.9	0.76
12/16/2002	11.7	36.3	48	50.9	67.0	38.1	0.57

*AVG:

- Average Value for January 8, 2002 based on Organ Pipe and Palo Verde PM_{10} monitors
- Average Value for April 26 and December 16, 2002 based on Organ Pipe, Palo Verde, and Estrella PM_{10} monitors

Note that the Phoenix Supersite TEOM concentrations have been shown for reference; and that the 2002 calculated background concentrations for the Salt River study area are also shown. Dividing the average of the two or three measured rural background concentrations by the Salt background gives the fractions in the lower right of the table. These fractions suggest that of the metropolitan Phoenix PM_{10} concentrations outside of the Salt River PM_{10} Study Area, the exceedance-day percentages that can be considered a rural background are:

31% on January 8,

76% on April 15 and 26, and

57% on December 16.

The Salt River PM_{10} Study Area background concentrations for 2006 will now be shown in three ways: as they would appear with no credit taken for area-wide emission reductions (Table 6-3), as they would appear with the above background corrections made to the area-wide background reduction (Table 6-4), and as they appear in the TSD with full credit taken for area-wide emission reductions, (Table 6-5). Each of the tables has the measured concentration of the exceedance, the percentage above the standard, the background concentration, the necessary emission reduction to meet the standard ("Needed"), and that reduction obtained from the optimal set of air pollution controls ("Obtain").

TABLE 6-3
Salt River PM_{10} Attainment Demonstration with Background Concentrations that have No Credit for Area-Wide Emission Reductions

Date	Site	Winds	Measured PM_{10} (µg/m^3)	% Above Std	Back-ground (µg/m^3)	Reduction %		Is the Standard Attained?
						Needed	Obtain	
26-Apr-02	SR	High	249	40	72	55.9	58	YES
15-Apr-02	WF	High	243	38	88	60.0	63	YES
26-Apr-02	DC	High	232	35	72	51.3	58	YES
15-Apr-02	DC	High	198	24	88	43.6	44	YES
15-Apr-02	SR	High	184	18	88	35.4	54	YES
26-Apr-02	WF	High	174	14	72	23.5	74	YES
16-Dec-02	WF	Low	181	17	67	27.2	36	YES
8-Jan-02	SR	Low	174	14	68	22.6	41	YES

TABLE 6-4 Salt River PM_{10} Attainment Demonstration with Background Concentrations that have Credit for Area-Wide Emission Reductions which Accounts for the Rural Background (or Irreducible) Portion of the Metropolitan PM_{10} Loading								
Date	**Site**	**Winds**	**Measured PM_{10} (µg/m^3)**	**% Above Std**	**Back-ground (µg/m^3)**	**Reduction %**		**Is the Standard Attained?**
						Needed	**Obtain**	
26-Apr-02	SR	High	249	40	70.8	55.6	58	YES
15-Apr-02	WF	High	243	38	86.6	59.4	63	YES
26-Apr-02	DC	High	232	35	70.8	50.9	58	YES
15-Apr-02	DC	High	198	24	86.6	43.1	44	YES
15-Apr-02	SR	High	184	18	86.6	34.9	54	YES
26-Apr-02	WF	High	174	14	70.8	23.3	74	YES
16-Dec-02	WF	Low	181	17	66.6	27.1	36	YES
8-Jan-02	SR	Low	174	14	67.3	22.5	41	YES

TABLE 6-5 Salt River PM_{10} Attainment Demonstration with Background Concentrations that have Full Credit for Area-Wide Emission Reductions, with No Accounting for the Irreducible Portion of the Metropolitan Background								
Date	**Site**	**Winds**	**Measured PM_{10} (µg/m^3)**	**% Above Std**	**Back-ground (µg/m^3)**	**Reduction %**		**Is the Standard Attained?**
						Needed	**Obtain**	
26-Apr-02	SR	High	249	40	67	54.4	58	YES
15-Apr-02	WF	High	243	38	82	57.8	63	YES
26-Apr-02	DC	High	232	35	67	49.7	58	YES
15-Apr-02	DC	High	198	24	82	41.4	44	YES
15-Apr-02	SR	High	184	18	82	33.3	54	YES
26-Apr-02	WF	High	174	14	67	22.4	74	YES
16-Dec-02	WF	Low	181	17	66	27.0	36	YES
8-Jan-02	SR	Low	174	14	67	22.4	41	YES

As these tables demonstrate, attainment is shown regardless of the degree to which the area-wide emission reductions are constrained by the irreducible background portion. Air Quality Division staff agree that the benefits from area-wide controls, as expressed in the Salt River PM_{10} Study Area background concentrations, should have accounted for that portion of the urban background that cannot be reduced by more stringent control measures.

6.2.3 Future Background Concentrations

Overall background reduction percentages are obtained by applying these percentages to the appropriate portion of the 2002 and 2006 inventories, and calculating the change as a percentage between the two years. This percentage is then applied to the 2002 background concentration to give the 2006 background value. Both sets of background concentrations are given in Table 6-6.

TABLE 6-6
Salt River PM_{10} Study Area Background PM_{10} Concentrations and their Response to Anticipated Urban-wide Emission Reductions by 2006
(Units are $\mu g/m^3$, 24-hour Averages)

Exceedance Date	Winds	2002	2006	% Change
15-Apr-02	High	88	82	6.8
26-Apr-02	High	72	67	6.9
16-Dec-02	Low/Mod	67	66	1.5
8-Jan-02	Low/Mod	68	67	1.5

The background on the high-wind days is more responsive to area-wide reductions than on low-wind days because the windblown background reduction percentage of 25 is so much greater than the other emission types (See Table 6-1).

This completes the discussion of future background concentrations. With these background values the equation presented on page 6-3 can be applied to the ambient measurements and the future background values to reveal how much emissions have to be reduced to achieve the standard. The necessary percentage reductions are quite high, ranging from about 20 to 60%, depending on the exceedance (Table 6-7). The percentages to meet the standard are considerably higher than their percentage above it. The net result is that the standard is roughly twice as difficult to achieve as it would be without a background. For April 15 at West 43rd Avenue, occupying the second line of the table, the exceedance is 38% above the standard, but the necessary emission reduction to meet the standard is 58% -- 1.6 times the percentage above the standard.

TABLE 6-7 Reductions of Emissions Necessary to Meet the Standard for Eight Salt River PM_{10} Exceedances						
Date	**Site**	**Winds**	**Measured PM_{10} (µg/m^3)**	**% Above Std**	**2006 Background (µg/m^3)***	**% Reduction to Meet the Standard**
26-Apr-02	SR	High	249	40	67	54
15-Apr-02	WF	High	243	38	82	58
26-Apr-02	DC	High	232	35	67	50
15-Apr-02	DC	High	198	24	82	41
15-Apr-02	SR	High	184	18	82	33
26-Apr-02	WF	High	174	14	67	22
16-Dec-02	WF	Low/Mod	181	17	66	27
8-Jan-02	SR	Low/Mod	174	14	67	22

6.3 SIGNIFICANT SOURCES OF PM_{10}

Before discussing the particular mix of sources that lead to the PM_{10} exceedances, and the degree of additional controls necessary to meet the standard, it is first instructive to explain which sources are "significant." In any area, some PM_{10} emission sources are more important than others. Significant sources are defined by EPA as those which contribute more than 5 µg/m^3 to any exceedance of the PM_{10} standard, which itself is 150 µg/m^3 averaged for 24 hours. (EPA, 2001).

The "significance" concentrations were calculated in the following manner. Because the predicted concentrations, even including the background, were lower than the measurements, these values could not be used directly. Instead, the percentage contribution of each source to ambient PM_{10} was determined from the model output. This percentage does not include any background contribution. Next the measured concentration has the background subtracted from it. This difference represents the portion of the measured concentration that comes from the Salt River Area sources. Finally, this difference is multiplied by the percentage contribution from each source to give a significance concentration.

An example to clarify this method is as follows. The measured PM_{10} concentration on January 8, 2002, was 174 µg/m^3 at the Salt River site. Considering just a single source type, primary roads contributed 24.72% of the locally generated PM_{10} concentration at this site. This figure comes from the air quality modeling. The background concentration on that day was calculated to be 68 µg/m^3. Subtracting this background from the measurement gives 106 µg/m^3 – the measured concentration of PM_{10} from the Salt River Area. This difference is multiplied by the percentage to give the significance concentration of 26.21 µg/m^3.

Of all the source categories in the Salt River PM_{10} Inventory, only a few proved to be insignificant:

- Agricultural tillage
- Lawn and garden equipment
- Vehicular emissions from the Durango curve portion of I-17
- Unpaved parking lots

For the other source categories, all of which were significant for at least one of the eight exceedances, EPA guidance requires either that Best Available Control Measures be applied to reduce emissions or that compelling reasons be given to show why and how the measures would be unsuitable or ineffective. Table 6-8 shows the significance concentrations for each source category for each exceedance. The tillage and lawn equipment emission categories were left off for clarity, since all their values except two were zero.

TABLE 6-8
Predicted Significance Concentrations in µg/m³ from Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2002

Source Category – Number of Exceedances for which it was Significant	8-Jan	15-Apr			26-Apr			16-Dec
	SR	DC	SR	WF	DC	SR	WF	WF
Windblown Agricultural --- 4		**24.81**	4.41	**5.63**	**84.90**	**41.12**	3.19	
Windblown Alluvial -- 4		3.49	**16.73**	**59.67**	0.47	**6.29**	**79.52**	
Large Industrial Area -- 6	**54.85**	**11.71**	**18.12**	**7.02**	2.62	**28.84**	4.17	**27.25**
Primary Roads -- 7	**26.21**	**33.30**	**10.12**	**8.33**	**16.47**	**7.72**	2.10	**44.81**
Windblown Vacant Lots -- 3		**5.77**	**5.99**	0.00	3.90	**39.60**	0.08	
Windblown Industrial -- 4		**5.90**	**13.24**	**33.56**	2.62	**28.84**	4.17	
Windblown Disturbed -- 4		**8.42**	**5.53**	**2.03**	**25.93**	**12.01**	3.75	
Trackout -- 4	**6.73**	**6.38**	1.54	3.89	**7.53**	3.46	1.63	**21.15**
Windblown Construction -- 1		0.56	1.87	**14.02**	0.06	0.39	1.25	
Windblown Stockpiles -- 4		1.77	**12.58**	**10.48**	**8.98**	**6.52**	1.28	
Unpaved Shoulders -- 1	2.92	0.70	0.39	1.70	0.00	0.00	0.00	**7.23**
Secondary Roads -- 1	2.69	1.54	1.20	1.24	1.20	0.66	0.27	**6.92**
Construction -- 1	**6.04**	1.17	0.86	4.38	0.45	0.52	0.47	3.44
Industrial Point Sources -- 1	**5.33**	2.68	3.02	2.93	3.03	0.61	0.04	1.47
Unpaved Parking Lots -- 0*	0.27	1.39	0.07	0.04	1.38	0.08	0.01	0.78
Freeway – 0	0.44	0.24	0.27	0.08	0.37	0.29	0.07	0.70

Notes:

Shaded concentrations exceed 5 µg/m³ and are, by definition, "significant."

SR = Salt River monitoring site
DC = Durango Complex site
WF = West 43rd Avenue site

The importance of the 5 µg/m³ significance test is to determine which sources must be considered for Best Available Control Measures (EPA, 1994). Therefore, in this Technical Support Document, each of the source categories that are shaded in Table 6-8 will be evaluated with additional control measures since these source categories meet the 5 µg/m³ criterion.

6.4 EMISSION REDUCTIONS FOR ATTAINMENT

6.4.1 Summary

Table 6-9 assesses the achievement of attainment for eight exceedances in Salt River Study Area for 2002. For each of the eight exceedances, the measured concentration is followed by the percentage reduction necessary to achieve the standard. This is followed by the percentage reduction obtained through the additional controls. This percentage includes the adjustment to background concentrations to reflect metropolitan-wide controls. Attainment is shown for all eight, although several exceedances are in attainment by a narrow margin.

Table 6-9
Salt River PM_{10} Study Area Exceedances and Attainment Status in 2006

Date	Site	Winds	PM_{10} (µg/m^3)	Reduction %		Is the Standard Attained?
				Needed	Obtained	
26-Apr-02	Salt River	High	249	54	58	YES
15-Apr-02	West 43rd		243	58	63	YES
26-Apr-02	Durango		232	50	58	YES
15-Apr-02	Durango		198	41	44	YES
15-Apr-02	Salt River		184	33	54	YES
26-Apr-02	West 43rd		174	22	74	YES
16-Dec-02	West 43rd	Low/Mod	181	27	36	YES
8-Jan-02	Salt River		174	22	41	YES

In the discussion of the individual exceedances to follow, two concepts apply:

1. The 2006 predicted PM_{10} concentrations are a consequence of emission reductions from a number of sectors. It is these predicted future concentrations that are being compared with the standard, not those from the 2006 base case.

2. The model is being applied to the Salt River PM_{10} Study Area concentrations in a relative, not an absolute, sense. The sum of the background concentration and the model-predicted concentration equals the "total prediction". For 2006, the background concentration is lowered to account for the application of all controls urban wide. The model is then run for 2006 with the predicted Salt River area emissions with the additional controls. To show attainment, the percentage difference between the 2002 model predictions and the 2006 model predictions must equal or exceed the necessary reductions calculated from the measured PM_{10} concentration and the background.

6.4.2 Additional Controls

The emission changes from 2002 to 2006 are shown in Table 6-10. Two sets of emission reductions are given. The first set is explained in Section 4.5 of the TSD and is considered to be the "2006 base case" emission reductions. These reductions reflect controls already in place in 2002. As will be shown in the present chapter, attainment cannot be achieved with these base case controls. The second set of emission reductions is called the "2006 attainment case" and is sufficient to show attainment. Each of the controls is explained below the table.

TABLE 6-10
PM_{10} Percentage Emission Changes in the Salt River Study Area from 2002 to 2006 for the Base and Attainment Cases (A Negative Sign Means a Reduction; Positive Means an Increase)

Emission Category	2006 Base Case	2006 Attainment Case
Wind Erosion – Agricultural	-80	-80
Wind Erosion – Alluvial	-57	-72
Wind Erosion – Construction	-19	-19
Wind Erosion -- Vacant Lots	-61	-61
Wind Erosion --Misc. Disturbed Areas	-45	-45
Wind Erosion – Industrial Stockpiles	NA	-55
Wind Erosion – Industrial Surface	NA	-75
Agricultural Tillage (Land Preparation)	-80	-80
Construction Activity	-36	-36
Freeway - Interstate 17 Durango	+6	+6
Primary Roads	+6	-7
Secondary Roads	+6	-1
Trackout	NA	- 80
Unpaved Road Shoulders	-10	-10
Unpaved Parking Lots – Re-entrained Dust	-36	-36
Industrial Area Sources	NA	-60
Industrial Point Sources	NA	-17

Following is a discussion of the percent change in emissions between Year 2002 and 2006:

- **Wind Erosion** – **Agricultural:** Conversion of 80% of the farm land to other uses.

- **Wind Erosion – Alluvial:** The control effectiveness for wind erosion – alluvial emissions is 72% (RP x RE x CE = 72%). This reduction is based on an assumed rule penetration (RP) of 100%, a rule effectiveness of 90% (RE), and an assumed control efficiency (CE) of 80%. The 100% penetration arises from the small number of landowners with dust-producing alluvial properties. Most of the alluvial property is locally owned and much of it is owned by governments. The control efficiency of 80% is consistent with an effective program to keep trespassers out and to stabilize the alluvial surfaces with either vegetation or rock/gravel/concrete. (A control efficiency of 80% was assumed for alluvial soil instead of the 90% control efficiency for vacant lots, because alluvial soil is assumed to be an infinite source of PM_{10} under windy conditions. In contrast, vacant lots will typically produce PM_{10} emissions at the start of a wind event and then taper off to minimal levels as the reentrainable PM_{10} on its surface becomes depleted by wind erosion.)

  An emissions reduction of this size is possible because the windblown dust from the alluvial areas of the Salt River was considered to be uncontrolled in 2002. This lack of control was evident in numerous field inspections conducted in February – May 2004 by ADEQ staff. For those portions of the river bottom area classified as moderate or severe in their windblown dust potential, the investigators noted ample evidence of vehicular traffic, extremely friable soil surfaces (sometimes ankle deep), and scant evidence of any attempts to stabilize the surface. The base case 2006 reduction percentage of 57% (Table 4-6 in Chapter 4) reflects the impact of Maricopa County Rule 310.01 on this area. As explained above, the 72% reduction of the 2006 attainment case comes from a concerted effort on the part of the County (and State) to get the property owners to both effectively bar access and to stabilize the ground surfaces wherever needed.

- **Wind Erosion – Construction:** The 19% reduction results from an increase in overall control efficiency of 63% in 2002 to 70% in 2006. The emission reduction is not equal to the difference of the two efficiencies (this would be 7%). If the uncontrolled emissions were 100 tons, then, 63% control means that the actual emissions are 37 tons. In 2006, with a 70% control efficiency, the actual emissions are 30 tons. The emission reduction percentage, then, is (37-30)/37 times 100% = 19%.

- **Wind Erosion – Vacant Lots:** The 61% figure is a combination of the 36% emission decrease from enhanced enforcement through Rule 310.01 and the 39.0% decrease in area from conversion to residential or commercial buildings. Vacant lots in the Salt River Area were surveyed in May 2004 by ADEQ staff, and 39% was the prorated percentage of vacant lot development for 2002 – 2006 (See Appendix R). There were not enough miscellaneous disturbed areas to yield any new information, so the 13.6% was retained for this category. For vacant lots, 39% of the emissions are first removed and the 36% enhancement is applied to the remaining.

- **Wind Erosion -- Disturbed Areas:** The 45% figure is a combination of the 36% emission decrease from enhanced enforcement through Rule 310.01 and the 13.6% decrease in area from conversion to residential or commercial buildings (URS & ERG, 2001). 13.6% of the emissions are first removed and the 36% enhancement is applied to the remaining

- **Agricultural Tillage:** 80% conversion of farm land to other uses.

- **Construction Activity:** The 36% reduction comes from enhanced enforcement of Rule 310. This reduction comes from an increase in overall control efficiency of 56% in 2002 to 72% in 2006.

- **Freeway - Interstate 17 Durango:** The Maricopa Association of Governments has estimated that traffic volumes in the Salt River Area will increase by 6% from 2002 to 2006. This increase is based on the actual growth rate of traffic counts taken on roads in the Salt River Area between 1998 and 2002.

- **Primary Roads:** Reentrained dust and exhaust emissions from primary and secondary roads increase because of the 6% traffic increase and decrease because of increased sweeping. Primary roads have a net decrease of 7%. This figure is the combination of the 6% VMT increase and a 13% emission decrease from increased sweeping. The dirty portions of the streets, swept once every two weeks in 2002, were assumed to be swept once a week by 2006. In the Salt River Area "dirty streets" were assumed to be those primary streets adjacent to or within one quarter mile of an industrial, construction, or agricultural property (See Appendix L). In 2002, these streets with PM_{10} trackout and deposition potential amounted to 63% of the total length of primary roads.

- **Secondary Roads:** In the Salt River Area emissions inventory, secondary roads are defined as all roads except the one-mile primary streets. The inventory emission total for secondary roads, therefore, includes emissions from collectors and residential streets. As increased sweeping applies only to the mile and half-mile streets, the calculations have taken this limitation into account. There are no projected emission changes or sweeping practices for residential or collector streets. Secondary roads have a net emissions decrease of 1%, a combination of the 6% VMT increase and a 7% decrease in emissions from an assumed doubling of the frequency of sweeping from once every two weeks to once a week on the targeted half-mile streets. Approximately 66% of the half-mile streets would have been subject to increased sweeping in 2002 (See Appendix L).

- **Trackout:** Trackout onto paved streets comes from a variety of sources: industrial, construction, agricultural, commercial, private, and road shoulders. An ADEQ survey in May 2004 divided trackout into these six categories, and subdivided each one into three levels: light, medium, and heavy. Weighting these trackout contributions to ambient PM_{10} concentrations by the typical length and severity of the trackout showed that the industrial category accounted for about 85% of the total trackout contribution (See Appendix K). Construction contributed 7%, road shoulders 3%, and agricultural 2%.

  Trackout emissions were assumed to be reduced 80% by a combination of more frequent sweeping targeted at the problem streets and of reduced trackout from all the categories, but especially the industrial category. This was assumed to be the result of the more stringent Maricopa County Rule 316, and from better enforcement of all three County dust rules, 310, 310.01, and 316.

  Although ADEQ understands that unpaved road shoulders contribute to trackout, and that street sweeping is less efficient the greater the trackout, staff are confident in their relative weighting of this source's six types. What the survey data show is that the shoulder trackout is more frequent but less severe than trackout from construction and industrial sources. It stands to reason that unpaved road shoulder trackout is shorter than that from industrial and construction sources. While PM_{10} concentrations would most certainly be reduced if all shoulders were stabilized, and if all streets were installed with curbs and gutters, the cost-effectiveness of these improvements is in question.

  The derivation of the 80% emissions reduction credit for trackout is explained below..

  Average weighted contribution:

  Industrial - 85%
  Construction - 7%
  Road shoulders - 3%
  Agricultural - 2%
  Other - 3%

  Assume reductions are all taken from a 0% control baseline because the trackout emissions assessed in the 2002 base year in the Salt River plan are based on actual dirt trackout measurements, and the enhanced measures are aimed at reducing that trackout.

  Example of a hypothetical trackout reduction using a value of 100 tons reduced 80% to 20 tons for simplicity:

Construction trackout = 7 tons

- Credit a 72% reduction (90% RE and 80% CE)
- 7 * 0.72 = 5.04 reduction
- 7 - 5.04 = 2 tons remaining

Road shoulders, agricultural, other = 8 tons

- Credit a 10% reduction to enhanced primary/secondary road street sweeping (this is an average of the 13% and 7% reduction credited to the primary roads and secondary roads, respectively, within the separate paved road re-entrained dust category)
- 8 * 0.10 = 0.8 reduction
- 8 - 0.8 = 7 tons remaining

Industrial trackout = 85 tons

- Credit an 87% reduction (90% RE and 97% CE), with the higher CE supported by more stringent Rule 316 trackout control measures plus street sweeping
- 85 * 0.87 = 73.95 reduction
- 85 - 73.95 = 11 tons remaining

11 + 7 + 2 = 20 tons, or an overall 80% reduction

- **Unpaved Road Shoulders:** Emissions from unpaved shoulders consist of five types:

1. Wake effects from high profile vehicles,
2. Vehicles driving on the shoulders,
3. Vehicles tracking out dirt onto the pavement,
4. Vehicles parking on the shoulders, and
5. Windblown dust from the shoulders themselves.

The wake-induced emissions were assumed to be reduced 10% through shoulder stabilization work. The trackout emissions from unpaved shoulders are treated as part of the road sweeping and general trackout reductions.

The Salt River PM_{10} emissions inventory quantified two of these, the wake effects and the trackout. All five types of emissions are examined below, with the net result that these five activities combined comprise a small percentage of the total emissions. Expressed in dollars per ton of PM_{10} reduced, curb and gutter and stabilizing would be $5.1 million per ton for low-wind days and $2.3 million per ton for low-wind days. These figures are far from being cost-effective.
The five components of unpaved shoulder dust emissions are discussed below.

1. Unpaved shoulder emissions from wake effects were quantified in the emissions inventory.

2. Without any hard data on how many cars drive on the shoulders and for what distances, the figures of 1000 vehicles per day driving on the shoulders for a distance of 100 meters are employed. Applying the unpaved parking lot emission factor to this mileage provides at least an estimate of this activity.

3. Trackout was determined in the inventory, and, using the weighted trackout method, the shoulder contribution to these emissions is easy to calculate (See Appendices K and P).

4. Lacking information on how many vehicles park on the shoulders, an order of magnitude estimate is in the inventory: namely, the emissions from unpaved parking lots.

5. Windblown emissions were calculated as the product of the surface area of the unpaved shoulders and the emission factor.

These components of unpaved road shoulder emissions are summarized in Table 6-11.

TABLE 6-11 PM_{10} Emissions from Unpaved Road Shoulders	
Sources	**Metric Tons per Day**
Wake effects	0.13
Parking	0.003
Driving	0.016
Windblown	0.28
Trackout	0.04
Unpaved Road Shoulders - Low Wind Total	0.19
All sources - Low Wind Total	6.20
% Unpaved Road Shoulders	3.0
Unpaved Road Shoulders - High Wind Total	0.47
All sources-High Wind Total	171.0
% Unpaved Road Shoulders	0.3

Examination of Table 6-11 shows that Unpaved Road Shoulder emissions comprise three percent of the total PM_{10} emissions in the Salt River PM_{10} Study Area on low-wind days, and, on high-wind days, the percentage is 0.3.

Furthermore, the cost-effectiveness of installing curb and gutter on the fourteen miles of streets with unpaved shoulders, and including stabilizing the shoulders themselves, does not appear to be favorable. If the cost of one mile of curb and gutter is $68,000 and the cost of shoulder stabilizing is $8,000, then the cost of reducing a ton of unpaved shoulder PM_{10} is $5.1 million for the low-wind conditions and $2.3 million for the high-wind conditions.

Limiting the remediation to stabilizing only, and invoking a 75% control efficiency for the stabilized shoulder surfaces, produces less costly reductions: $0.8m per ton for low-wind and $0.3m per ton for high-wind conditions. Compared with the more capital-intensive combination of curb and gutter and stabilizing, stabilizing alone is much more cost effective in reducing PM_{10} emissions.

Unpaved road shoulders in their five emissions manifestations do contribute to ambient PM_{10} concentrations. Municipalities in the metropolitan Phoenix area would do well to install curb and gutters along most major streets. Such capital improvements would effectively eliminate four types of the shoulder emissions, leaving only windblown dust and, perhaps, but to a lesser extent, the wake effects. These improvements would also facilitate better drainage and improve roadway safety. Given the cost-effectiveness figures in the millions of dollars per ton; however, an accelerated program of curb and gutter work and shoulder stabilization as an air pollution control measure would be difficult to justify. (See Appendix U for additional information on the contribution of parking and driving on unpaved road shoulders, and wind erosion of unpaved shoulders to total PM_{10} emissions and predicted PM_{10} concentrations)

- **Unpaved Parking Lots – Re-entrained Dust**: PM_{10} emissions from vehicles driving on unpaved parking lots were assumed to be reduced by 36%, through an assumed increase in the overall control efficiency of 56% in 2002 to 72% in 2006. These reductions were based on better enforcement of Rule 310.

- **Industrial Area Sources:** For the 2006 base case, the throughput of materials and their emissions were assumed to be the same as in 2002. This assumption has been borne out by throughput statistics presented in Appendix S. The 60% reduction in PM_{10} emissions from this collection of sources was assumed to be obtained through a strengthened Rule 316. Industrial Area Sources are defined as all sources of emissions from the industrial facilities in the Salt River Area, except registered stacks (or “points”) and windblown dust. This category includes such activities as driving on haul roads (56% of the emissions total), material transfer (20%), pile forming and loading (8%), crushing and screening (6%), and a variety of other activities that contribute the remaining 10%. Emission reductions from 65 to 70% for the first four of these activities would result in the overall 60% reduction. This matter is discussed more fully in Appendix S, which gives additional rationale for the reductions and a sensitivity analysis of the predicted concentrations based on varying control levels in 2002.

    - ***Industrial Activity - Material Transfer*:** The 65% reduction results from the assumed imposition of a fenceline opacity requirement of 0%, except on high wind days when reasonable precautions have been employed. In order for sources to achieve compliance with this requirement it is assumed that material transfer points will be controlled through the application of additional water control systems, increased material moisture content, and voluntarily applied enclosures.

    - ***Industrial Activity - Pile Forming/Loading*:** The 70% reduction results from an assumed imposition of a fenceline opacity requirement of 0%, except on high wind days when reasonable precautions have been employed. In order for sources to achieve compliance with this requirement it is assumed that stockpiles will be controlled through the application of additional water control systems, increased material moisture content, or the application of storage pile covers and partial enclosures. Additionally, loaders and all other ancillary equipment will be required to operate on controlled surface areas.

- ***Industrial Activity - Crushing and Screening***: The 70% reduction results from an assumed imposition of a fenceline opacity requirement of 0%, except on high wind days when reasonable precautions have been employed. In order for sources to achieve compliance with this requirement, sources were assumed to be required to install and operate permanently mounted watering systems on the inlet and outlet of all crushers, shaker screens, and on material transfer points. In addition, sources were assumed to be required to control screening emissions through the application of watering systems at the base of the screen; and loaders and all other ancillary equipment were assumed to be required to operate on controlled surface areas.

  Additional reductions are also expected from Concrete Batch Plants assumed to be applying baghouses designed to meet 0.01 gr/dscf emission standard, pneumatic pressure controls that shut off the silo loading process if excessive pressure is used when loading the silo, and audible or visible overfill warning systems.

  Additional reductions are also expected from Hot Mix Asphalt Plants from an assumed imposition of a 5% opacity requirement, overfill warning systems for silo, and baghouse controls for all drum dryers.

- **Windblown Emissions - Stockpiles:** The 55% reduction results from an assumed fenceline opacity requirement of 0%, except on high wind days when reasonable precautions have been employed. It was assumed that sources would apply additional watering controls, and potentially stockpile covers and enclosures in order to meet this opacity requirement.

- **Windblown Industrial Emissions:** Those particulates from the disturbed ground surface of industrial facilities are an important contributor to elevated PM_{10} levels and are easily reduced. Their contribution to elevated PM_{10} concentrations for the six high-wind exceedances varies from 1.6 to 21.9%, with an average of 10.4%. On average there are fewer than 12 days a year when the wind speeds exceed the resuspension threshold for dust. Managers of industrial properties can take the appropriate actions of watering, tarping, and cessation of activities on the few occasions when winds approach and exceed the dust suspension threshold. With better enforcement of the two County rules, managers of these properties should take the requisite precautions to reduce windblown dust. The 75% emissions reduction for this source category would entail implementation of such control measures as wetting the surface areas prone to erosion when high winds are forecast.

  The implementation of the above control measures for windblown industrial emissions results in an equivalent control percentage of about 75%, based on the following three components:

1. Rule effectiveness: 85%, which accounts for failures and uncertainties that affect the actual performance of a control;

2. Rule penetration: 100%, which is the percentage of a source category covered by a regulation; and

3. Control efficiency: 90%, which is the efficiency of a control device or process change.

Multiplying these percentages gives an equivalent control percentage of 76.5%.

At issue here are 36 industrial facilities in a 32 square mile area no more (at its closest point) than a five minute drive from the MCESD offices. The rule effectiveness of 85% means that the MCESD and the regulated community would have 31 of 36 facilities actively taking the necessary precautions to reduce windblown dust about 12 times a year. Given the small number of facilities, given their proximity to the MCESD offices, and given the fact that they are already equipped with the means to suppress dust, it's not unreasonable to assert that windblown industrial emissions can in fact be reduced by 75% by 2006.

The assumption of 0% equivalent control for Year 2002 for these sources is based on the fact that no citations for windblown industrial emissions were issued in 2002 in the Salt River area; no evidence would suggest that precautions were being taken; and concentrations ranging from 174 to 249 $\mu g/m^3$ of PM_{10}, averaged for 24 hours, were recorded at three monitoring sites close to these industrial sources. ADEQ's analysis of emissions and air quality data from these three sites has demonstrated that their elevated PM_{10} concentrations are in part (average 10%) attributable to windblown industrial emissions. All of these facts lead to the conclusion that control over this source category in Year 2002 was minimal, if not zero.

- **Industrial Point Sources:** These emissions are from those stacks registered with the MCESD as having more than 5 tons per year of PM_{10} emissions. The small percentage reduction reflects the fact that they are already well controlled. An overall reduction of 17% will be forthcoming from assuming the application of the Maximum Achievable Control Technology to one brick manufacturer.

In the discussions of future air quality to follow, these percentage emission reductions by source category are applied to the 2002 predicted concentrations to produce 2006 air quality concentrations. Table 6-12 lists the projected Year 2006 Attainment Case emissions by category.

TABLE 6-12 Salt River PM_{10} Emissions Inventory – Year 2006 Attainment Case (Metric Tons / Day)				
	1/8/06*	**4/15/06***	**4/26/06***	**12/16/06***
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday*	**Monday***	**Friday***	**Monday***
1. AREA SOURCES	**0.02**	**45.36**	**45.36**	
Ag Tilling (Land Preparation)	0.02			
Wind Erosion – Agricultural		9.35	9.35	
Wind Erosion – Construction		15.20	15.20	
Wind Erosion - Cleared Areas		18.06	18.06	
• vacant lots		*8.30*	*8.30*	
• misc. disturbed areas		*9.76*	*9.76*	
Wind Erosion - Alluvial Channels		2.75	2.75	
2. INDUSTRIAL SOURCES	**0.41**	**13.36**	**16.71**	**0.41**
MCESD Permitted Sources – Windblown Stockpiles		2.22	5.57	
MCESD Permitted Sources – Windblown Cleared Areas		10.73	10.73	
MCESD Permitted Sources – Stacks	0.22	0.22	0.22	0.22
MCESD Permitted Sources – Process	0.18	0.18	0.18	0.18
MCESD Permitted Sources – Small	0.01	0.01	0.01	0.01
3. NONROAD MOBILE SOURCES	**0.54**	**0.54**	**0.54**	**0.54**
Agricultural Equipment Exhaust	0.00			
Construction Activity	0.54	0.54	0.54	0.54

TABLE 6-12 Salt River PM_{10} Emissions Inventory – Year 2006 Attainment Case (Metric Tons / Day)				
	1/8/06*	**4/15/06***	**4/26/06***	**12/16/06***
	Low Wind	**High Wind**	**High Wind**	**Low Wind**
	Tuesday*	**Monday***	**Friday***	**Monday***
4. ONROAD MOBILE SOURCES	**3.52**	**3.52**	**3.52**	**3.52**
Paved Road				
Freeway – Brakes, Tires, Exhaust, Reentrainment	0.06	0.06	0.06	0.06
Primary Roads				
• reentrained road dust	2.74	2.74	2.74	2.74
• exhaust	0.08	0.08	0.08	0.08
• brakes	0.02	0.02	0.02	0.02
• tires	0.01	0.01	0.01	0.01
Primary roads subtotal	*2.85*	*2.85*	*2.85*	*2.85*
Secondary roads				
• reentrained road dust	0.58	0.58	0.58	0.58
• exhaust	0.02	0.02	0.02	0.02
• brakes	0.004	0.004	0.004	0.004
• tires	0.003	0.003	0.003	0.003
Secondary roads subtotal	*0.61*	*0.61*	*0.61*	*0.61*
Paved Road Total Emissions	**3.46**	**3.46**	**3.46**	**3.46**
5. Trackout	**0.13**	**0.13**	**0.13**	**0.13**
6. Unpaved Shoulders & Parking Lots	**0.122**	**0.122**	**0.122**	**0.122**
Unpaved Road Shoulders	0.12	0.12	0.12	0.12
Unpaved Parking Lots - reentrained dust	0.002	0.002	0.002	0.002

*** Theoretical design days in Year 2006 that have same meteorological conditions, time of year, day of week to the 4 design days in Year 2002 Emissions Inventory and Modeling.**

6.5 DEMONSTRATION OF ATTAINMENT

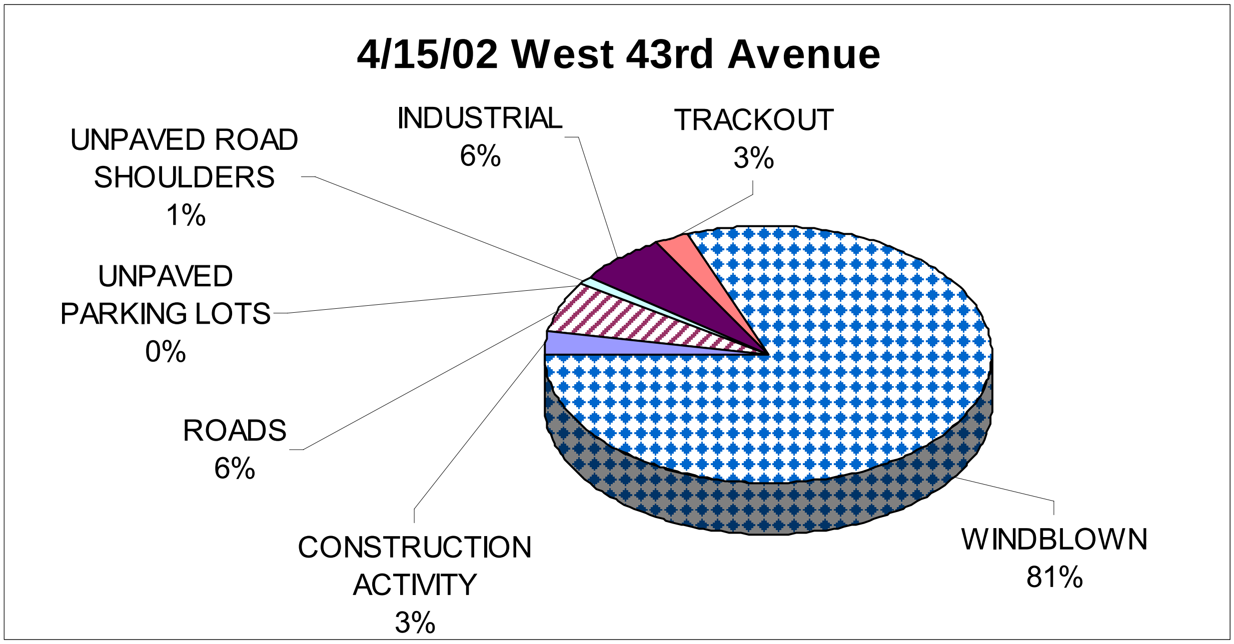
Each of the eight 2002 exceedances is analyzed in the next three subsections.

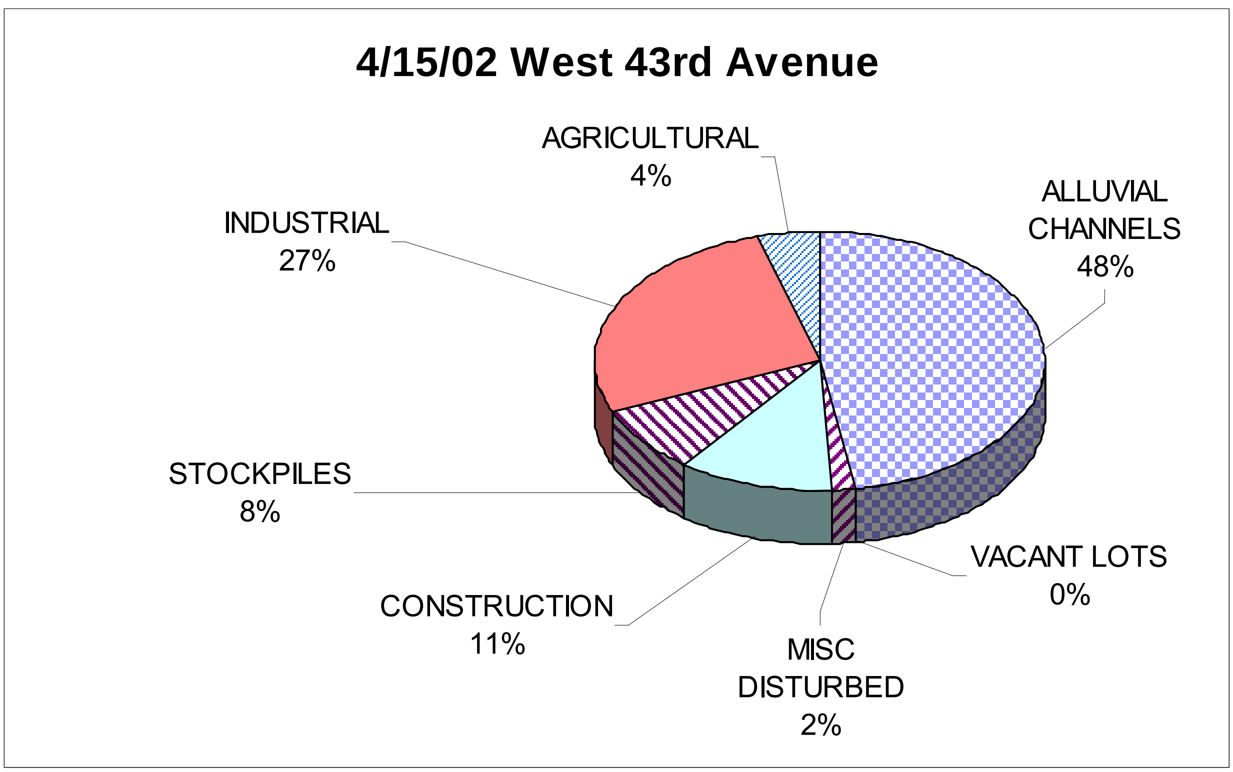
6.5.1 West 43rd Avenue on April 15 and April 26, 2002

In spite of the very high measured concentrations, controls can be implemented to bring these two exceedances within the standard in 2006. Values this high require large emission reductions to meet the standard. Two emission source categories dominate the high concentrations at West 43rd Avenue on these two days: windblown alluvial and windblown industrial emissions on April 15, and windblown alluvial alone on April 26.

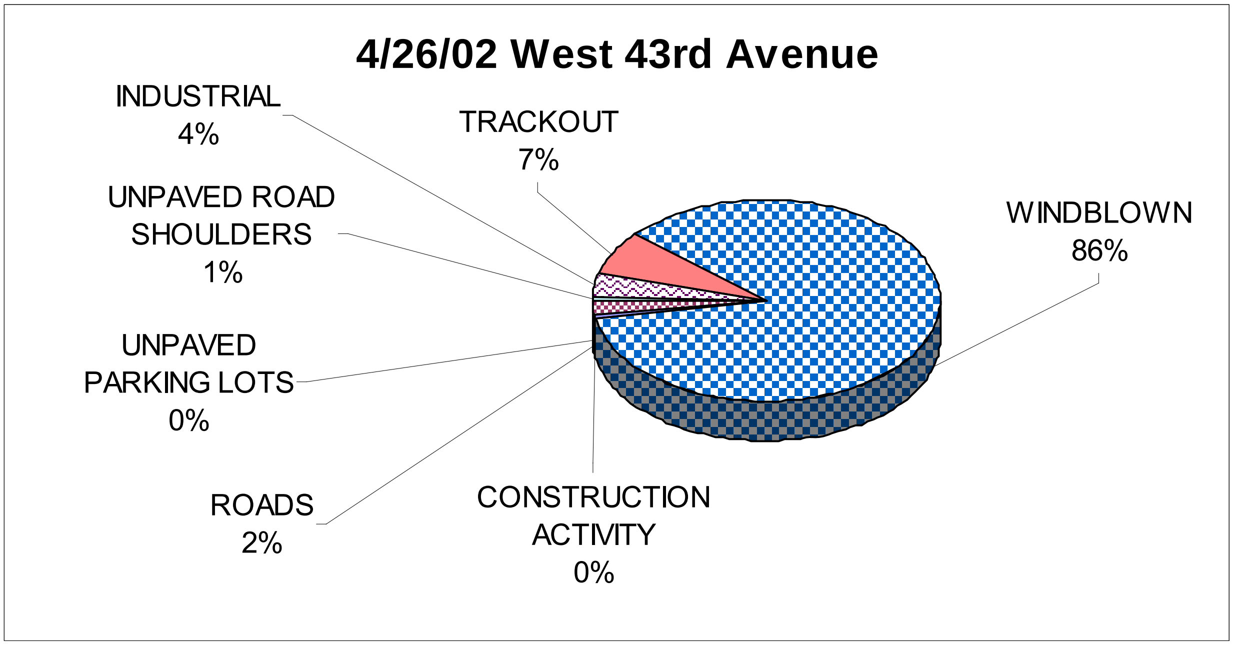
This monitoring site, with each day having four afternoon hours of high west winds capable of re-suspending dust, is downwind of a large expanse of the Salt River alluvial channel and major sand and gravel operations. As the figures below (Figure 6-1 a,b and Figure 6-2a,b) show, windblown dust in general dominates the PM_{10} concentrations on these dates, and alluvial is the larger contributor within the windblown category.

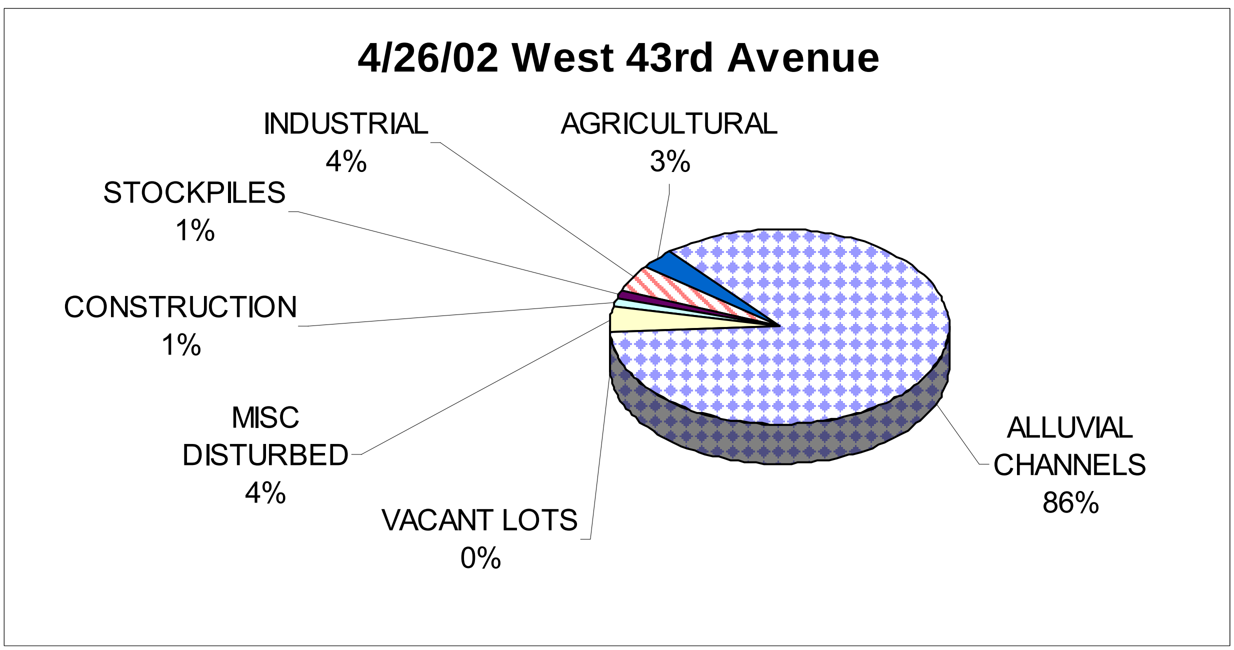
Control strategies envisioned for alluvial dust (72% reduction) and industrial windblown emissions (75% reduction) prove sufficiently strong to meet the standard. For the April 15 exceedance, a reduction in model-predicted air quality of 58% is needed to show attainment; 63% is obtained from the predicted controls. For the April 26 exceedance, a reduction in model-predicted air quality of 22% is needed to show attainment; 74% is obtained from the predicted controls. This may seem an excessive level of control, but all of these reductions are necessary to achieve attainment for all exceedances.





Figures 6-1a (top) and b. Source Contributions to PM_{10} at West 43rd Avenue on April 15, 2002, for all sources (a) and for windblown sources (b). These figures show that the exceedance (243 µg/m^3) was caused by windblown dust (top) and that of the windblown contributors, alluvial channels and industrial dominated.





Figures 6-2a (top) and b. Source contributions to PM_{10} at West 43rd Avenue on April 26, 2002, for all sources (a) and for windblown sources (b). These figures show that the exceedance (174 µg/m^3) was caused by windblown dust (a) and that of the windblown contributors, alluvial channels dominated.

6.5.2 Other High Wind Exceedances: Durango Complex and Salt River on April 15 and April 26, 2002

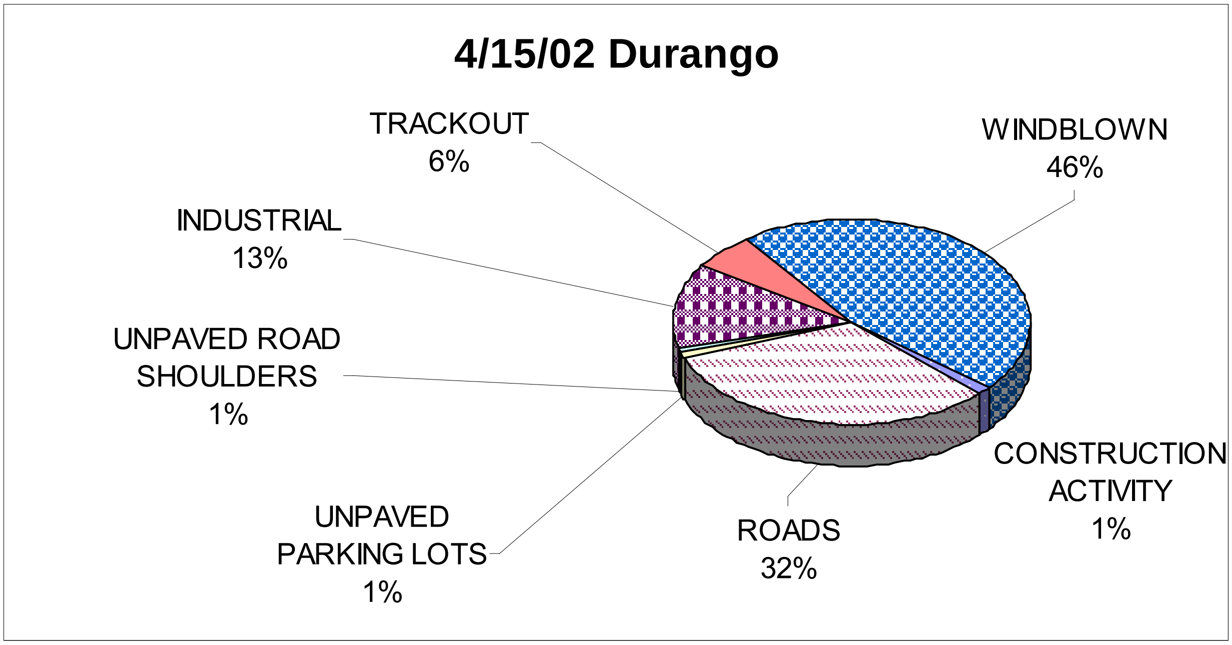
At these sites, as with West 43rd Avenue, attainment has been demonstrated because the controls applied to the emission source categories sufficiently lower the predicted concentrations to meet the standard.

Durango Complex Site
Considering the Durango Complex site exceedances first, the April 15 PM_{10} concentration of 198 μg/m^3 can be attributed to an equal mix of windblown and anthropogenic sources (Figures 6-3 a,b). Roads, industrial, and trackout emissions are all major contributors from the anthropogenic emissions, while agricultural emissions dominate the windblown emissions. The agricultural contribution came from a complex of fields about two miles west of the monitoring site. For attainment in 2006, an emissions reduction of 41% is necessary. Envisioned controls will just exceed this figure at 44%.

Of greater concern is the exceedance of April 26 at Durango, with a PM_{10} concentration of 232 μg/m^3. A reduction of 50% in emissions is necessary to meet the standard on this date. This exceedance, whose sources are shown in Figure 6-4a and Figure 6-4b, was caused by a somewhat different mix of sources than the April 15 exceedance. The windblown contribution has increased from 46% to 78%, and the agricultural contribution to the windblown part has increased from 49% to 68%. While roads contributed 32% of the total PM_{10} concentration on April 15, their contribution on April 26 was down to 11%.

The projected controls account for a 58% reduction in emissions, sufficient to meet the standard. Much of this reduction comes from the removal of 80% of the agricultural land.

Additional outreach to farmers will be made through the Agricultural Best Management Practices program to encourage them to use practices that will minimize the potential for windblown dust during April, when fields are most at risk for generating dust.



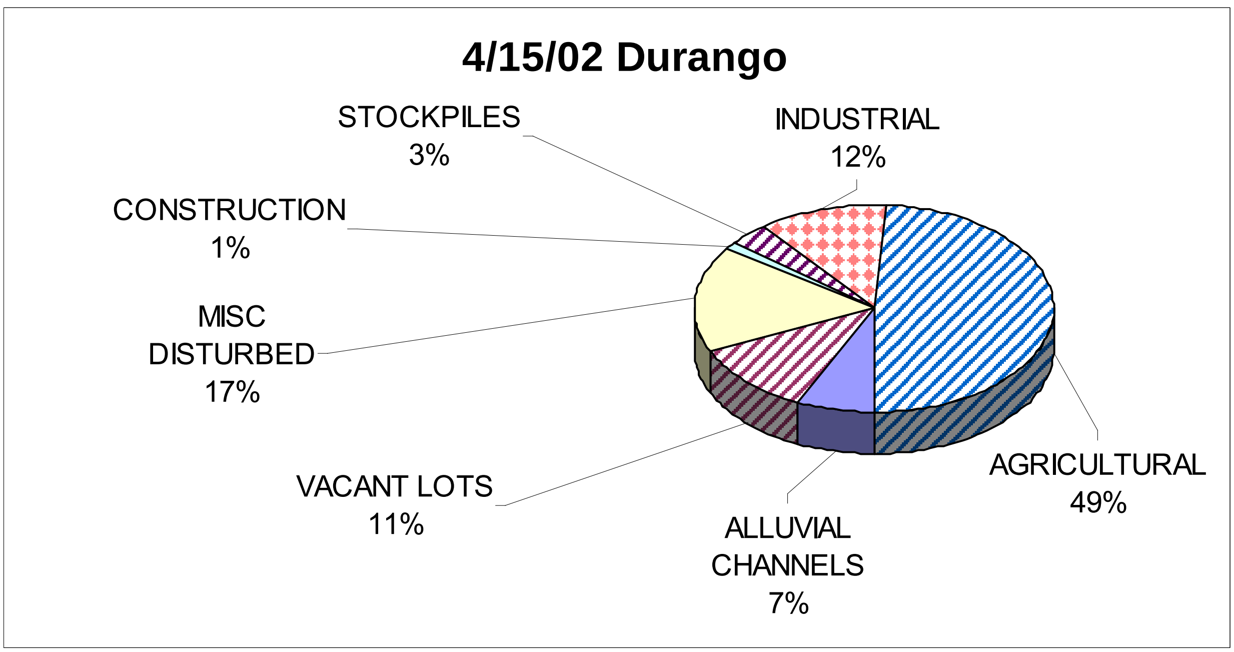
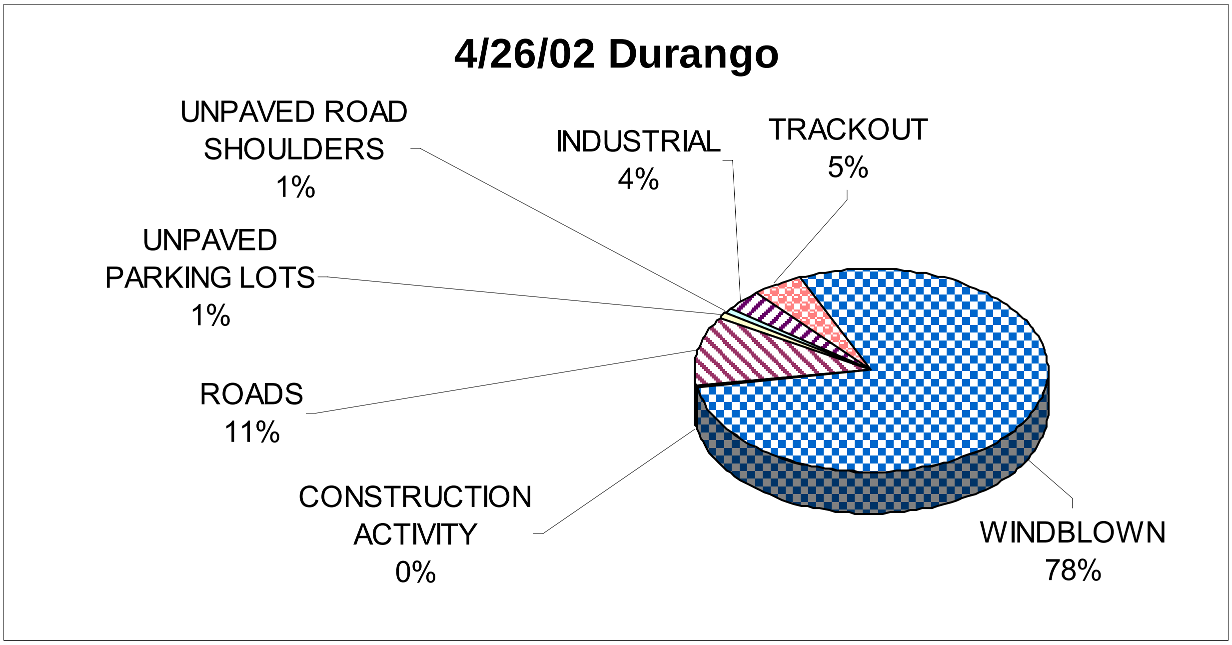


Figure 6-3a (top) and b. Source contributions to PM_{10} at Durango on April 15, 2002, for all sources (a) and for windblown sources (b). These figures show that only about half the exceedance (198 µg/m^3) was caused by windblown dust (a) and that of the windblown contributors, agricultural dominated.



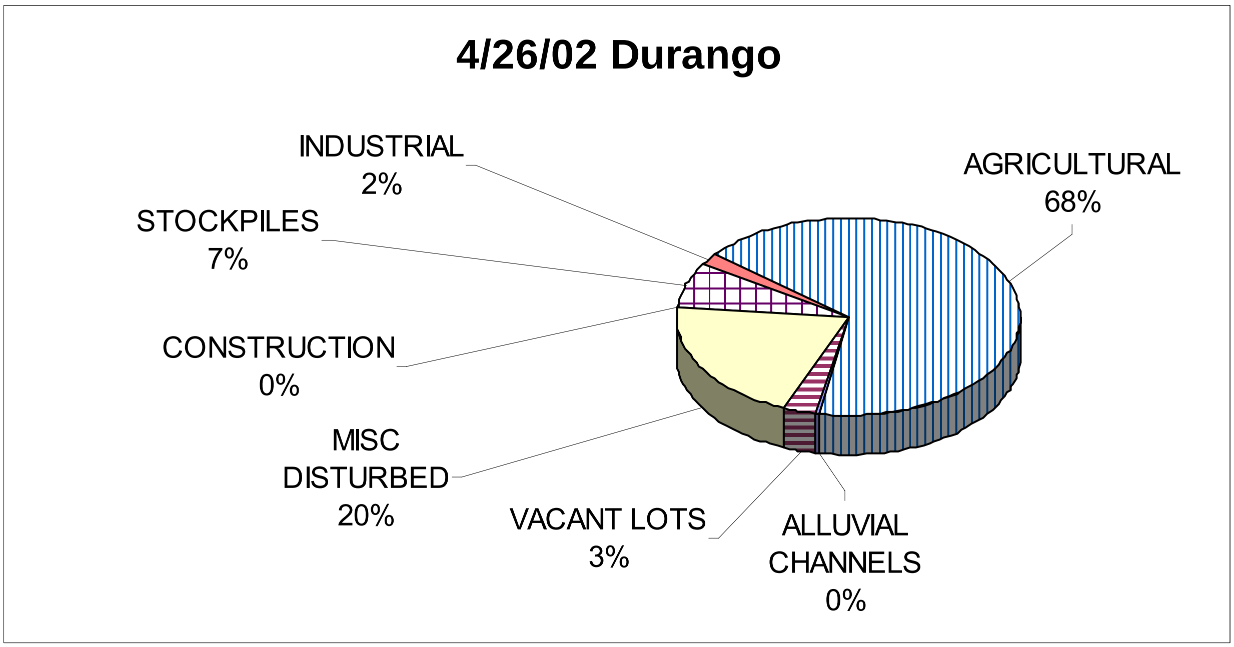
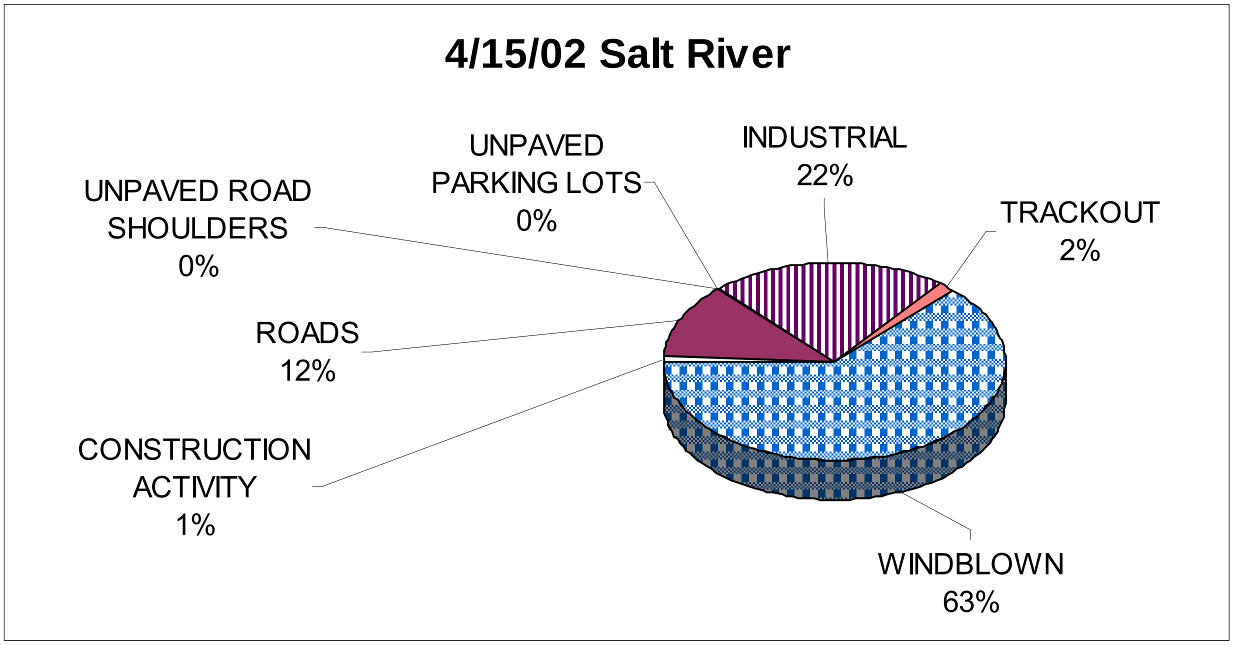


Figure 6-4a (top) and b. Source contributions to PM_{10} at Durango on April 26, 2002, for all sources (a) and for windblown sources (b). These figures show that about three quarters of the exceedance (232 µg/m^3) was caused by windblown dust (a) and that of the windblown contributors, agricultural dominated.

Salt River Site
The two high-wind exceedances at the Salt River site were also on April 15 and April 26, 2002, with 24-hour average PM_{10} concentrations of 184 and 249 μg/m^3, respectively. Emission reductions needed to meet the standard are 33% and 54%, respectively, with credit taken for the urban-wide application of control strategies. Wind speeds high enough to resuspend dust occurred for four afternoon hours of each date. Given this site's proximity to Durango (one mile to the southeast), a similar source distribution might be expected. As Figure 6-5a and Figure 6-5b illustrate, this source mixture is quite different than that at Durango, and is quite receptive to emission reductions.

In comparison with the high-wind exceedances already discussed, the April 15 Salt River site exceedance has a similar windblown contribution (63%). Its anthropogenic source contributions are dominated by industrial emissions (22%) and by reentrained dust from paved roads (12%). The critical difference between this exceedance and the previous ones is that the windblown contribution is more or less equally divided among all of the windblown dust categories. Windblown emissions at West 43rd Avenue and Durango were dominated by a single category: alluvial channels at the former and agricultural at the latter. At the Salt River site the categories of "industrial windblown stockpile" and "industrial surface area" emissions come into play for the first time. The Salt River monitor is the closest of the four to major industrial activity, with facilities on the east, the south, and the west. With the exception of alluvial emissions, all of these categories will be reduced by 2006; consequently, attainment is relatively easy to demonstrate. The necessary emission reduction of 33% is significantly surpassed with the 54% predicted reduction.

Demonstrating attainment for the last of the six high-wind exceedances – that at the Salt River on April 26, 2002 – would seem to be more difficult than demonstrating it for the April 15 exceedance. The measured PM_{10} concentration was the highest recorded in 2002, at 249 μg/m^3. Windblown emissions contribute more on the April 26 date, 76% versus 63% on April 15. The necessary emission reduction to meet the standard on April 26 is 54%, almost twice that of the April 15 reduction of 33%. The influence of industrial windblown emissions – from the stockpiles and ground surfaces combined -- decreases from 43% to 26% from the first to the second April high-wind exceedance. These stockpile and surface area emission reductions from 2002 to 2006 are quite high (55% and 75%, respectively) and are instrumental in achieving attainment. The main difference on this latter April date can be found in the agricultural windblown category, which on April 15 was 7% of the total PM_{10} concentration, but which rises to 31% on April 26 (Figure 6-6). As was seen in the Durango exceedances, because of the 80% elimination of agricultural land, having a high agricultural contribution in 2002 means that it's easier to attain the standard in 2006 than with a smaller agricultural component. For the Salt River exceedance of April 26, 2002, a 54% emission reduction is necessary to attain the standard. With stringent industrial controls, enhanced Rule 310, increased street sweeping, and the retirement of agricultural land, the predicted concentration is reduced by 58% in 2006 – enough to meet the standard.



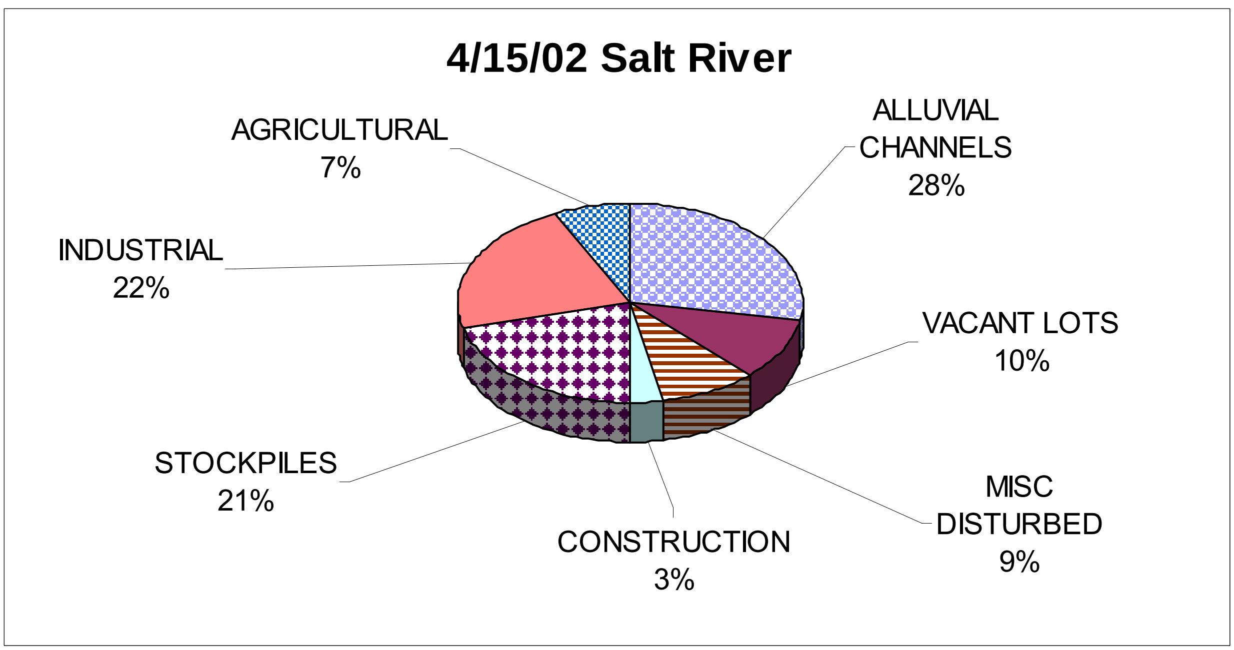
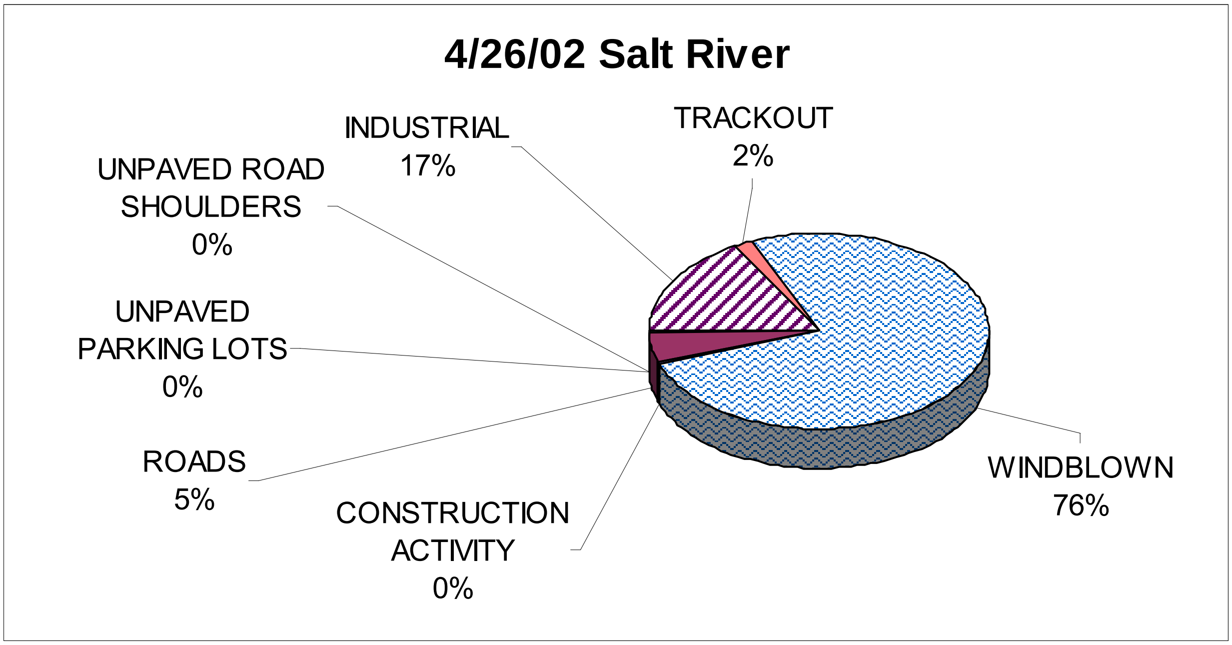


Figure 6-5a (top) and b. Source contributions to PM_{10} at Salt River on April 15, 2002, for all sources (a) and for windblown sources (b). These figures show that two thirds of the exceedance (184 $\mu g/m^3$) was caused by windblown dust (a) and that the windblown contributors were more equally divided among several sources than was the case for exceedances at West 43rd Avenue and Durango.



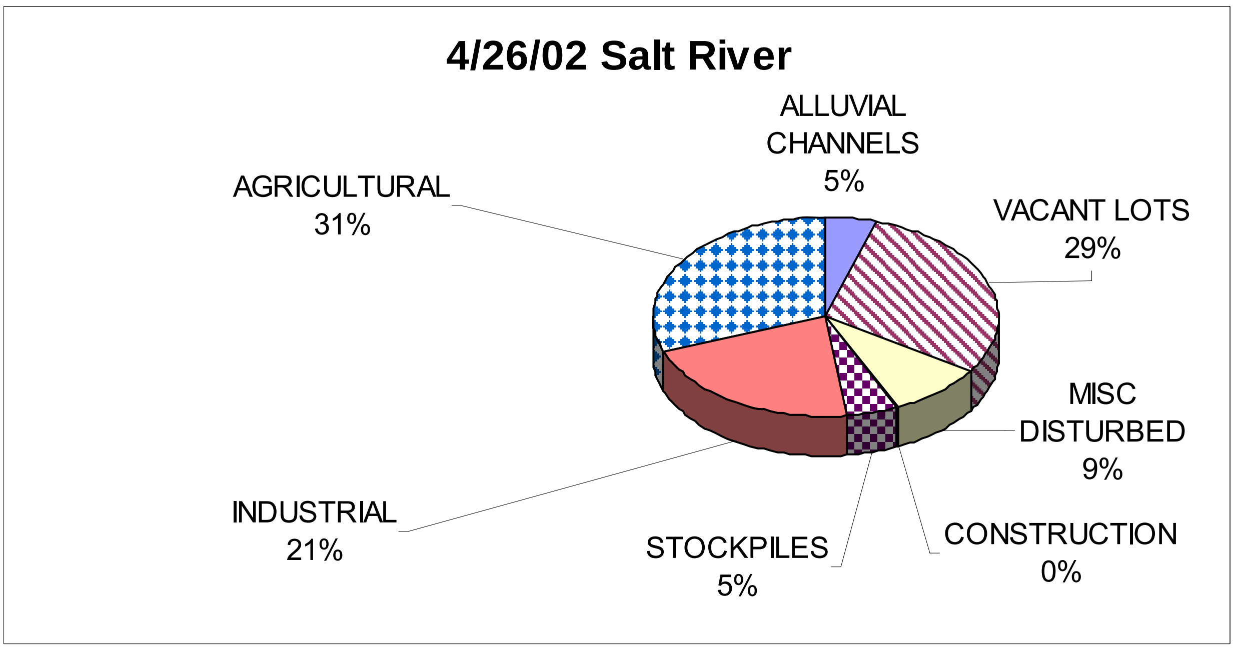


Figure 6-6a (top) and b. Source contributions to PM_{10} at Salt River on April 26, 2002, for all sources (a) and for windblown sources (b). These figures show that 85% of the exceedance (249 µg/m^3) was caused by windblown dust (a) and that the windblown contributors were equally divided among several sources as in the Salt River exceedance of April 15.

6.5.3 Low Wind Exceedances on January 8 and December 16, 2002

Two exceedances were recorded during low wind conditions: January 8, 2002, at Salt River, and December 16, 2002, at West 43rd Avenue with PM_{10} concentrations of 174 μg/m^3; and 181 μg/m^3, respectively. For these exceedances the seven categories of windblown dust are gone, leaving the ten anthropogenic categories. Of these categories, the combined "roads" category and combined "industrial" category prove to be the most influential.

Salt River Site

On January 8, 2002, at the Salt River site, the source contributions to the predicted PM_{10} concentration are led by industrial, roads, and trackout, which together account for 91% of the total, with roughly twice as much from the industrial as from the roads (Figure 6-7a).

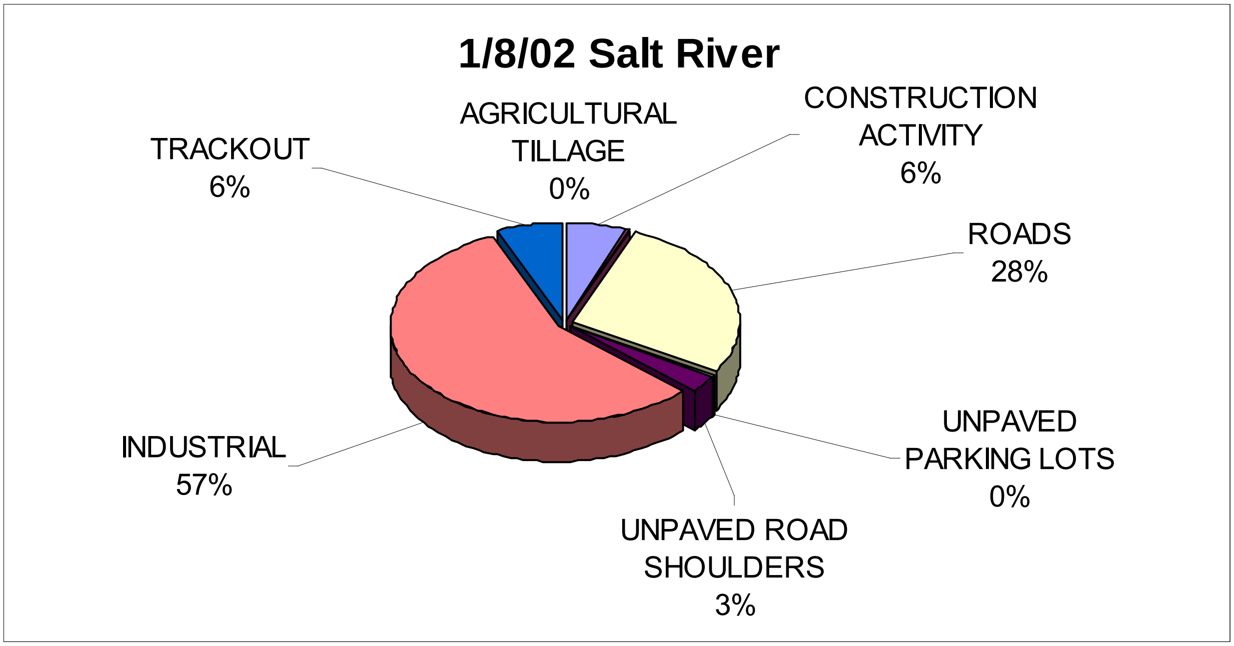
Attainment is shown for the January 8, 2002 exceedance at the Salt River monitor with a needed reduction of 22%, against a predicted reduction in ambient concentrations of 41%, about twice the needed amount.

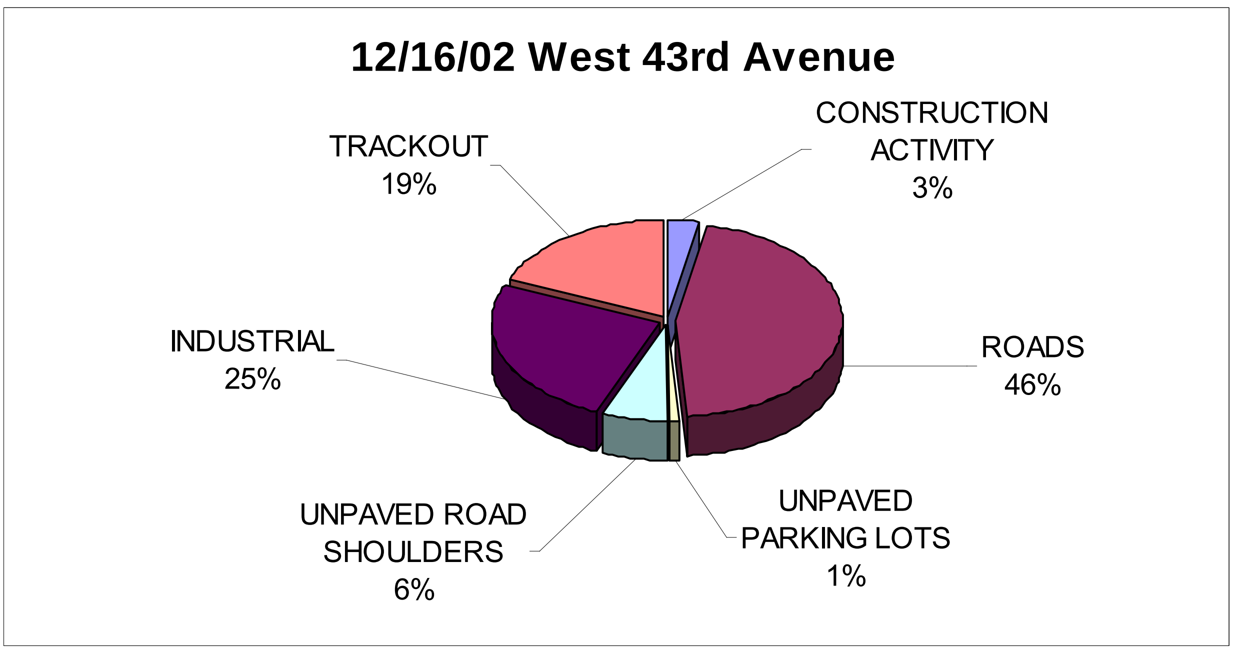
West 43rd Avenue Site

On December 16, 2002, at the West 43rd Avenue site, the three sources still comprise 90% of the total. In this case, however, the roads have twice the impact as the industrial, and the trackout contribution has tripled from 6% to 19%. In both cases, the remaining 10% is construction dust and unpaved road shoulders (Figure 6-7b).

Attainment is shown for the December 16, 2002 exceedance at the West 43rd Avenue site with a needed reduction of 27%, against a predicted reduction in ambient concentrations of 36%.

Attainment for the low wind exceedances at the Salt River Site and the West 43rd Avenue Site is fairly easy because the emissions at these sites are dominated by road, trackout, and industrial sources, which decrease by roughly 7%, 80%, and 60%, respectively, from 2002 to 2006.





Figures 6-7a (top) and b. Source contributions to PM_{10} for the two low-wind exceedances: the Salt River site exceedance of January 8, 2002 (174 µg/m^3) and the West 43rd Avenue exceedance of December 16, 2002 (181 µg/m^3). These figures show that reentrained dust from paved roads ("roads") and industrial emissions comprise about 90% of the total (although their respective shares differ. The contribution from roads is twice that of industrial for the December exceedance but half of industrial for the January exceedance.

6.5.4 Summary of Predicted Concentrations

In the discussion of significant sources of PM_{10} in Section 6.3, the predicted concentrations for the 2002 base case were presented. In the preceding discussions of the eight exceedances events, the 2002 source contributions were presented. Attainment was expressed by comparing the overall emission reductions necessary to meet the 24-hour PM_{10} standard with percentage reductions by emission source category forthcoming from more stringent control measures. This set of controls and its accompanying concentrations can be termed the "2006 attainment case." The 2006 attainment case is a projection of concentrations, divided into their emission source contributions, that would result from a combination of additional emission controls sufficient to show attainment.

The emissions inventory discussion of Section 4.5 of Chapter 4 describes a "2006 base case." This 2006 base case is an estimate of emissions in 2006 with neither no new control measures nor any strengthening of existing control measures, and taking into account projected land use changes and other emission source changes between 2002 and 2006.

In Tables 6-13 and 6-14, the predicted concentrations for the 2006 base and attainment cases are presented. The following considerations should be kept in mind in understanding these tables.

- Only unpaved parking lots and freeway emissions in these tables are insignificant. Other insignificant sources, omitted for clarity, are agricultural tillage, agricultural exhaust, and lawn and garden equipment emissions.

- The predicted concentrations decrease from the 2002 to the 2006 base case, and from the 2006 base case to the 2006 attainment case for those emission source categories with anticipated reductions.

- Background concentrations are lower in 2006 than in 2002.

- The bottom line of the tables is the total predicted concentration for each event that resulted in exceedances in 2002. (SeeTable 6-8 for 2002 measured concentrations by source categories.

- Note that in the 2006 base case, two of the 2002 exceedances are alleviated; in the 2006 attainment case, all eight are.

- The number of source categories that meet the 5 $\mu g/m^3$ significant threshold decreases from 45 to 35 to 25, for the 2002 base, the 2006 base, and the 2006 attainment cases, respectively.

- In Table 6-14 the background is shown in two ways (See Section 6.2.2): with and without corrections for the irreducible portion. Normal background is uncorrected.

TABLE 6-13
BASE CASE - Predicted Concentrations in μg/m^3 from All Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2006

Source category	8-Jan	15-Apr			26-Apr			16-Dec
	SR	DC	SR	WF	DC	SR	WF	WF
Windblown Agricultural		**5.23**	0.94	1.17	**17.51**	**8.46**	0.67	
Windblown Alluvial		1.58	**7.65**	**26.65**	0.21	2.78	**35.87**	
Large Industrial Area	**55.37**	**12.35**	**19.25**	**7.29**	2.70	**29.65**	4.37	**27.49**
Primary Roads	**28.04**	**37.22**	**11.40**	**9.17**	**18.00**	**8.42**	2.34	**47.92**
Windblown Vacant Lots		3.58	3.75	0.00	2.37	**23.99**	0.05	
Windblown Industrial		**6.22**	**14.06**	**34.86**	2.70	**29.65**	4.37	
Windblown Disturbed		**5.23**	3.46	1.24	**15.76**	**7.27**	2.31	
Trackout	6.79	6.73	1.64	4.04	7.76	3.56	1.71	21.33
Windblown Construction		0.48	1.61	**11.80**	0.05	0.33	1.06	
Windblown Stockpiles		1.87	**13.36**	**10.88**	**9.27**	**6.70**	1.35	
Unpaved Shoulders	2.65	0.67	0.37	1.59	0.00	0.00	0.00	**6.56**
Secondary Roads	2.88	1.72	1.35	1.37	1.31	0.72	0.30	**7.40**
Construction	4.35	0.88	0.65	3.25	0.33	0.38	0.35	2.48
Industrial Point Sources	**5.38**	2.82	3.21	3.04	3.12	0.62	0.05	1.49
Unpaved Parking Lots	0.19	1.05	0.05	0.03	1.02	0.06	0.00	0.56
Freeway	0.47	0.27	0.30	0.09	0.40	0.31	0.08	0.75
Sum of Contributions	106	88	83	116	83	123	55	116
Background (2006)	67	82	82	82	67	67	67	66
Background + Sum	173	170	165	198	150	190	122	182

Notes: This table is for the 2006 base case (i.e. no additional regulations or enforcement)

Shaded concentrations exceed 5 μg/m^3 and are, by definition, "significant."

Shaded concentrations in the bottom row exceed the 24-hour standard of 150 μg/m3.

SR = Salt River Monitoring Site
DC = Durango Complex Site
WF = West 43rd Avenue Site

TABLE 6-14
ATTAINMENT CASE - Predicted Concentrations in µg/m³ from All Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2006

Source category	8-Jan	15-Apr			26-Apr			16-Dec
	SR	DC	SR	WF	DC	SR	WF	WF
Windblown Agricultural		**5.23**	0.94	1.17	**17.51**	**8.46**	0.67	
Windblown Alluvial		1.03	4.98	**17.36**	0.14	1.81	**23.36**	
Large Industrial Area	**22.15**	4.94	**7.70**	2.92	1.08	**11.86**	1.75	**11.00**
Primary Roads	**24.71**	**32.80**	**10.04**	**8.08**	**15.86**	**7.42**	2.06	**42.23**
Windblown Vacant Lots		2.37	2.48	0.00	1.57	**15.88**	0.03	
Windblown Industrial		1.55	3.52	**8.71**	0.67	**7.41**	1.09	
Windblown Disturbed		**4.88**	3.23	1.16	**14.71**	**6.79**	2.16	
Trackout	1.36	1.35	0.33	0.81	1.55	0.71	0.34	4.27
Windblown Construction		0.48	1.61	**11.80**	0.05	0.33	1.06	
Windblown Stockpiles		0.84	**6.01**	4.90	4.17	3.02	0.61	
Unpaved Shoulders	2.65	0.67	0.37	1.59	0.00	0.00	0.00	**6.56**
Secondary Roads	2.68	1.60	1.26	1.27	1.22	0.67	0.28	**6.89**
Construction	3.90	0.79	0.58	2.91	0.30	0.34	0.31	2.22
Industrial Point Sources	4.46	2.34	2.66	2.53	2.59	0.52	0.04	1.23
Unpaved Parking Lots	0.17	0.94	0.05	0.03	0.91	0.05	0.00	0.50
Freeway	0.47	0.27	0.30	0.09	0.40	0.31	0.08	0.75
Sum of Contributions	63	62	46	65	63	66	34	76
Background	67	82	82	82	67	67	67	66
Background + Sum	130	144	128	147	130	133	101	142
Normal Background	67	82	82	82	67	67	67	66
Irreducible Background	67.3	86.6	86.6	86.6	70.8	70.8	70.8	66.6
Difference	0.3	4.6	4.6	4.6	3.8	3.8	3.8	0.6
Difference + (Background + Sum)	130	149	133	152	134	136	105	142

Notes: This table is for the 2006 attainment case (i.e. additional regulations, controls, and enforcement).

Shaded concentrations exceed 5 µg/m³ and are, by definition, "significant."
Shaded concentrations in the bottom row exceed the 24-hour standard of 150 µg/m³.

SR = Salt River monitoring site
DC = Durango Complex site
WF = West 43rd Avenue site

6.5.5 Attaining The PM_{10} Standard - Conclusions

The PM_{10} monitoring record in the Salt River PM_{10} Study Area, which began in 1994, as well as the intensive monitoring work conducted in April – December 2002, clearly demonstrates that this portion of the Salt River airshed does not meet the 24-hour National Ambient Air Quality Standard for PM_{10}.

The construction of a complete emissions inventory, the development of a background concentration method, and the application of the most well used, Environmental Protection Agency dispersion model, Industrial Source Complex, have produced the results discussed in Section 6.5. These results have been presented in the form of realized versus necessary reductions to meet the standard, for each of the eight exceedances recorded during the 2002 intensive study period and thoroughly examined in the analyses. The results have also been presented as predicted concentrations in the preceding two tables. The realized reductions -- the predicted 2006 percentage reductions of the model-predicted PM_{10} concentrations from their 2002 concentrations – themselves depend on substantial emission reductions by 2006.

These emission reductions include:

- Earthmoving and related activities;
- Industrial activities, principally materials handling and haul roads;
- Additional street sweeping to reduce reentrained road dust;
- Reduction of trackout by both sweeping and better regulatory efforts aimed chiefly at the industrial and construction facilities,
- Continued retirement of agricultural land in the Salt River area (80% by 2006).

Explained in detail in Chapter 4 and supplemented in Table 6-11, these emission reductions are essential to demonstrate attainment for all eight exceedances by 2006. Commitments will have to be obtained from Maricopa County and the cities and towns within the PM_{10} nonattainment area to amend rules, enforcement efforts, and work practices in such a way as to realize all of these potential emission reductions. With assertive efforts by these entities and the regulated communities, the emission reductions can be achieved by 2006. Considerable technical work has gone into a better understanding of the relationship between emissions and concentrations of PM_{10} in the Salt River PM_{10} Study Area. All of this work strongly suggests that if these emission reductions are forthcoming, the 24-hour PM_{10} standard will be achieved for both future low-wind and high-wind conditions in the Salt River PM_{10} Study Area.

6.6 REFERENCES

EPA, 1994: Federal Register Vol. 59, No. 157, 40 CFR Part 52 [FRL-5052-2] "State Implementation Plans for Serious PM-10 Nonattainment Areas, and Attainment Date Waivers for PM-10 Nonattainment Areas Generally; Addendum to the General Preamble for the Implementation of Title I of the Clean Air Act", page 27, August 16, 1994

EPA, 2001: Federal Register Vol. 66, No. 191, 40CFR Part 52, [AZ0-92-002; FRL-7067-5], "Approval and Promulgation of Implementation Plans; Arizona -- Maricopa County PM-10 Nonattainment Area; Serious Area Plan for Attainment of the 24-hour PM-10 Standard and Contingency Measures", page 61, October 2, 2001

MAG, 2000: "Revised Technical Support Document for Regional PM_{10} Modeling in Support of the Revised MAG 1999 Serious Area Particulate Plan for PM_{10} for the Maricopa County Nonattainment Area", February, 2000.

URS & ERG, 2001: "Technical Support Document for Quantification of Agricultural Best Management Practices, Revised Final Draft", page 4-1, Prepared for Arizona Department of Environmental Quality, ADEQ Contract No. 98-0159-BF, Task Assignment No. 00-0210-01.

7.0 CHAPTER 7 - SALT RIVER PM_{10} ANALYSIS - CONCLUSIONS

Following is a summary of ADEQ's findings from the Salt River PM_{10} Monitoring, Emission Inventory, and Modeling Analyses:

- PM_{10} concentrations in the Salt River Study Area have exceeded the 24-hour average standard since monitoring began in 1994, with annual maxima ranging from 200 to 500 µg/m3, well above the standard of 150 µg/m3.

- In response to a call for a revision to the State Implementation Plan, Arizona Department of Environmental Quality and Maricopa County Department of Environmental Services staff planned and carried out an extensive technical analysis of PM_{10} emissions, concentrations, and controls in a 4x8 mile area along the Salt River: from 10^{th} Street on the east to 55^{th} Avenue on the west, and from Baseline Road on the south to Van Buren Street on the north.

- Intensive PM_{10} monitoring in 2002, with both continuous and filter-based instruments at four sites, revealed the following aspects of Salt River Study Area PM_{10} concentrations:

    a. The diurnal variation is dominated by morning and evening peaks, with the former being greater than the latter except at the South Phoenix monitoring site.

    b. Monthly variation (May through December) varied by hour of the day, but for most hours and most sites, it was slight.

    c. Of the four sites, the Salt River site had the highest overall PM_{10} concentrations, followed closely by the West 43^{rd} Avenue site and the Durango site, with South Phoenix a distant fourth.

    d. Eight exceedances of the 150 µg/m3 standard in 2002 were analyzed intensively, one in January, before the intensive study, and seven during the study. The highest recorded concentrations were in the 175 to 250 µg/m3 range.

- Background concentrations were determined based on continuous PM_{10} monitoring near the east and west boundaries of the Study Area, and were confirmed by an independent method based on the chemical composition of particulates. These background concentrations were about half of the measured concentrations within the Salt River PM_{10} Study Area.

- A thorough inventory of all emission sources within the Study Area was developed. Emissions were put into grids 400x400 meters, and were allocated to hours of the day consistent with the temporal variation of the activity. This inventory also included an in-depth accounting of all land surface types susceptible to erosion during high winds. Relying on satellite images, advanced digitizing techniques, and ground-truthing surveys, this land-surface characterization was exhaustive, thorough, and accurate as the technology allows.

- A U. S. Environmental Protection Agency dispersion model called the "Industrial Source Complex" model was employed to simulate the measured PM_{10} concentrations for each of the exceedances. The model under predicted the measurements by 10 to 60%, but its results were still useful because they were used in a relative, not an absolute, sense.

- Attainment of the standard in 2006 was evaluated for each exceedance. First, the necessary reduction to meet the standard was calculated from the value of the elevated PM_{10} concentration and the background. Second, the source-category emission decreases (or increases) from a set of control strategies were applied to the 2002 predicted concentrations. This step gave the 2006 predicted concentrations that reflected the various controls and land use changes. Third, the PM_{10} concentration in 2006 was compared with the 2002 concentration, the percentage decrease from the earlier to the later year was calculated, and this percentage was compared with the necessary percentage to meet the standard. Background concentrations were employed in this exercise, and 2006 background concentrations reflected the benefit of area-wide controls.

- All eight exceedances could be shown to meet the standard in 2006, with a recommended set of control strategies. These strategies were increased street sweeping, more stringent controls on industrial sources, a variety of dust-reducing measures through a strengthened County dust rule (Rule 310), and expected land use changes such as the retirement of agricultural land. Regulatory commitments for this general type of controls will be sought, adopted and implemented by February 2005.

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APPENDIX A - MAPS

Following are maps / satellite imagery that are referenced in the Salt River PM10 TSD:

Map A-1
- Gridded satellite image with locations of the four air quality monitors

Map A-2
- Land use map

Map A-3
- Fugitive dust study

Map A-4
- Locations of the 81 industrial sources (locations marked with a triangle)

Map A-5
- Approximate boundaries of industrial sources, such as rock products, near the Salt River

Map A-6
- Soil Stability in Salt River Alluvial Channel with Property Ownership

Map A-7
- Modeling Grid

Map A-8
- Modeling Grid with Satellite Image

Map A-9
- 24-Hour PM10 Emissions - Primary Roads

Map A-10
- 24-Hour PM10 Emissions – Secondary Roads

Map A-11
- 24-Hour PM10 Emissions – Alluvial (Windblown)

Map A-12
- 24-Hour PM10 Emissions – Construction

Map A-13
- 24-Hour PM10 Emissions – Construction (Windblown)

Map A-14
- 24-Hour PM10 Emissions – Cleared Area (Windblown)

Map A-15
- 24-Hour PM10 Emissions – Miscellaneous Disturbed (Windblown)

Map A-16
- 24-Hour PM10 Emissions – Agriculture (Windblown)

Map A-17
- 24-Hour PM10 Emissions – Trackout

Map A-18
- 24-Hour PM10 Emissions – Unpaved Shoulders

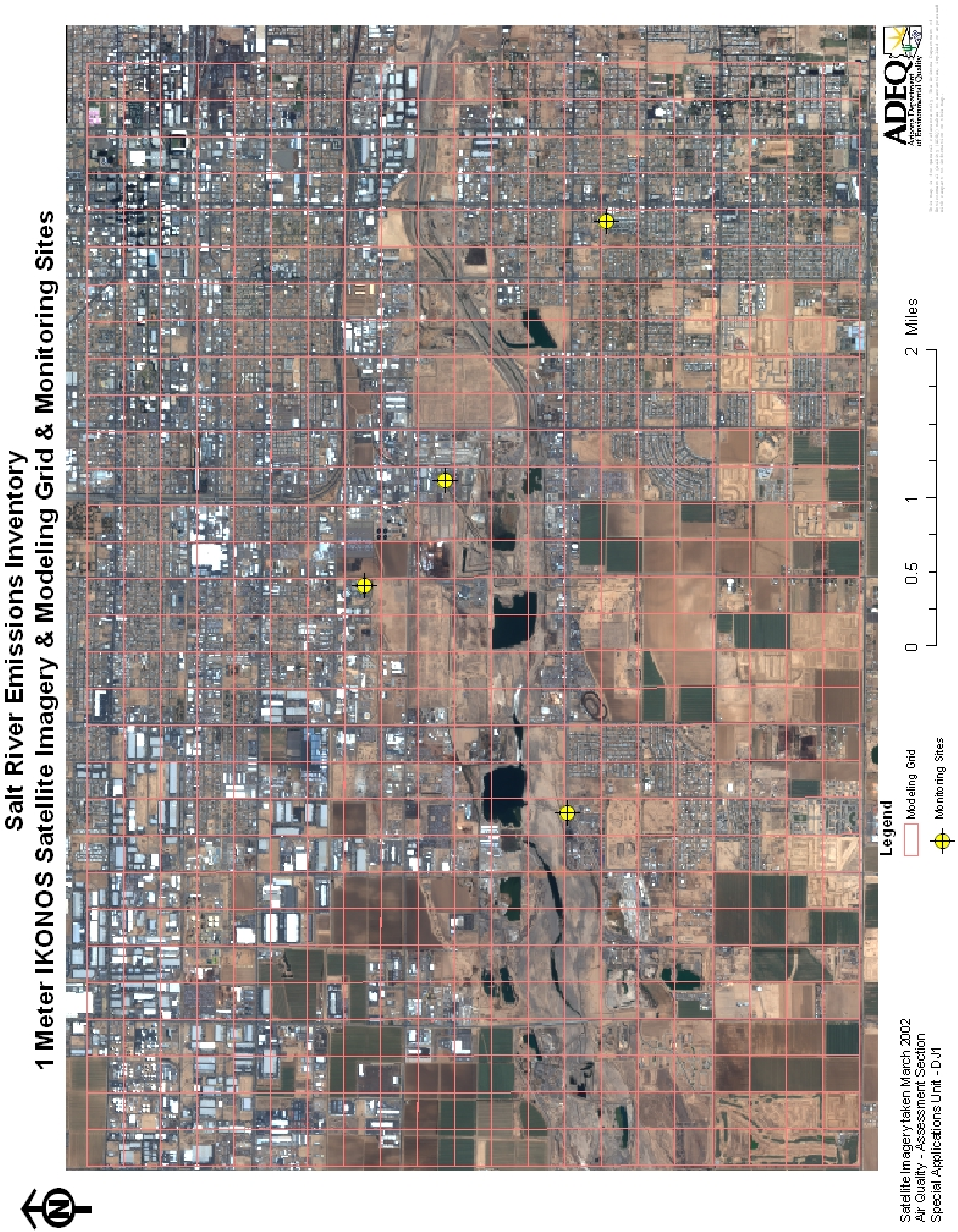
Map A-19
- 24-Hour PM10 Emissions – Vacant Lots (Windblown)

Map A-20
- 24-Hour Total PM10 Emissions – Low Wind Day

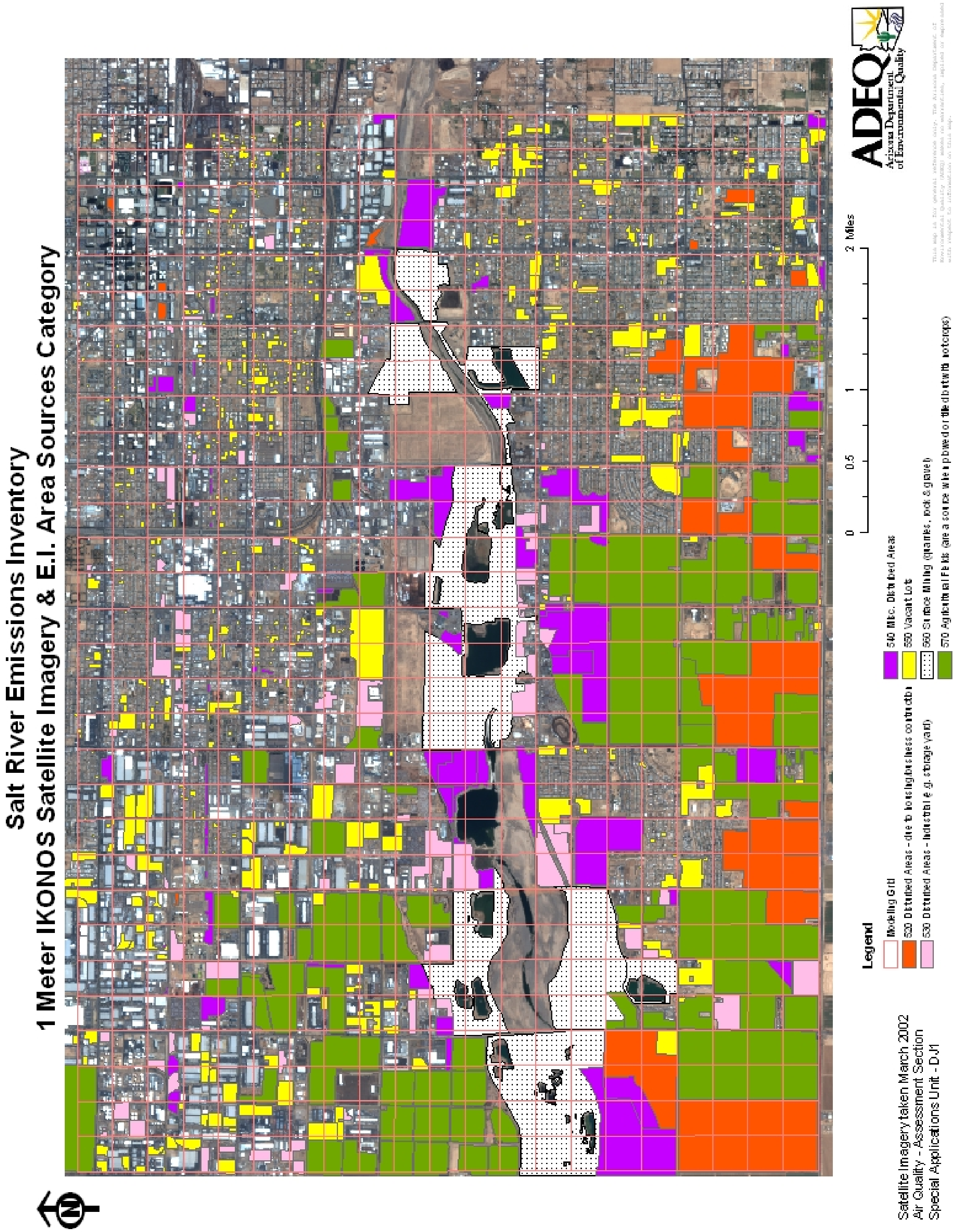
Map A-21
- 24-Hour Total PM10 Emissions – High Wind Day

These maps are on the following pages.

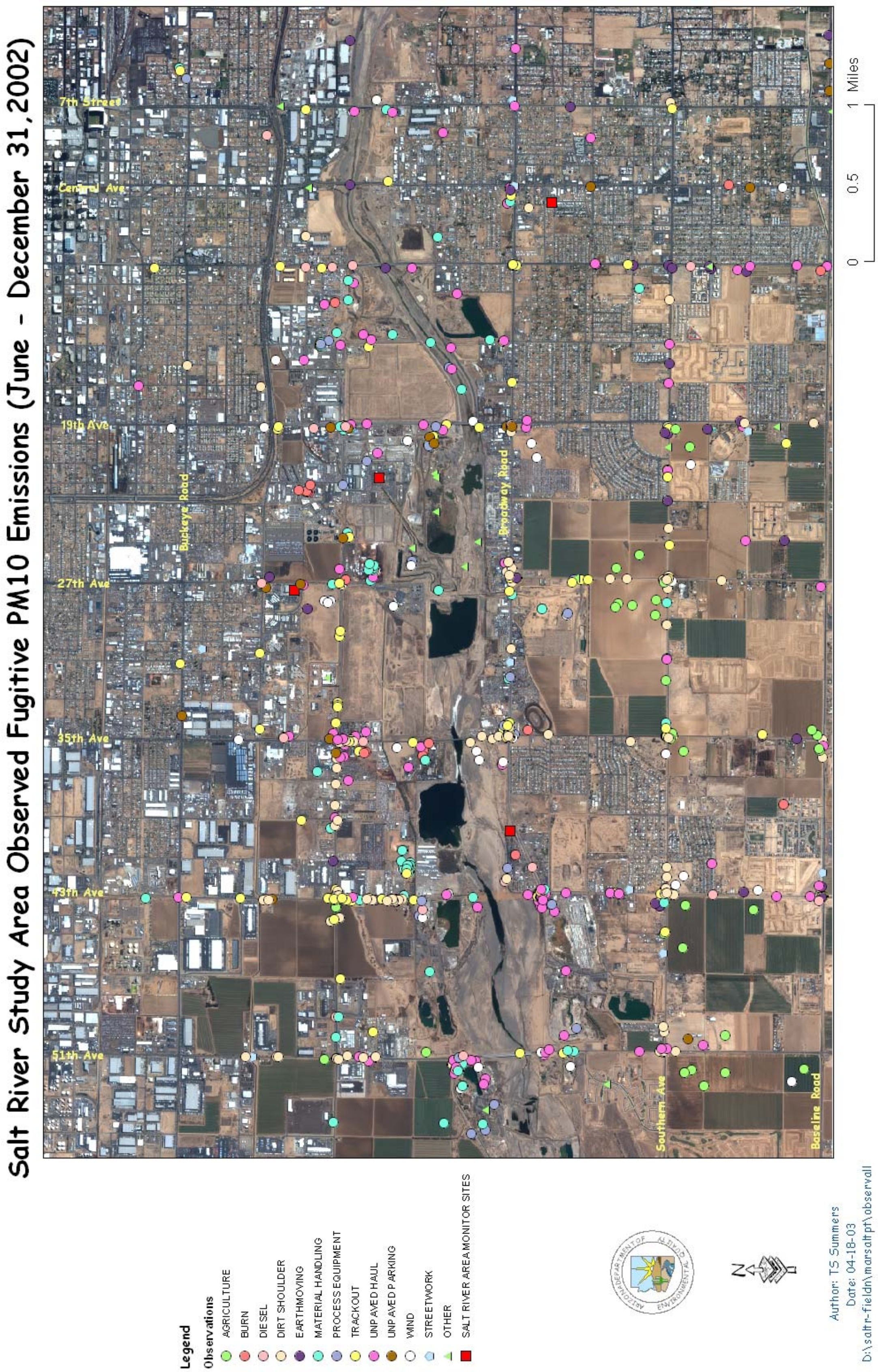
Map A-1 Gridded satellite image with locations of air quality monitors



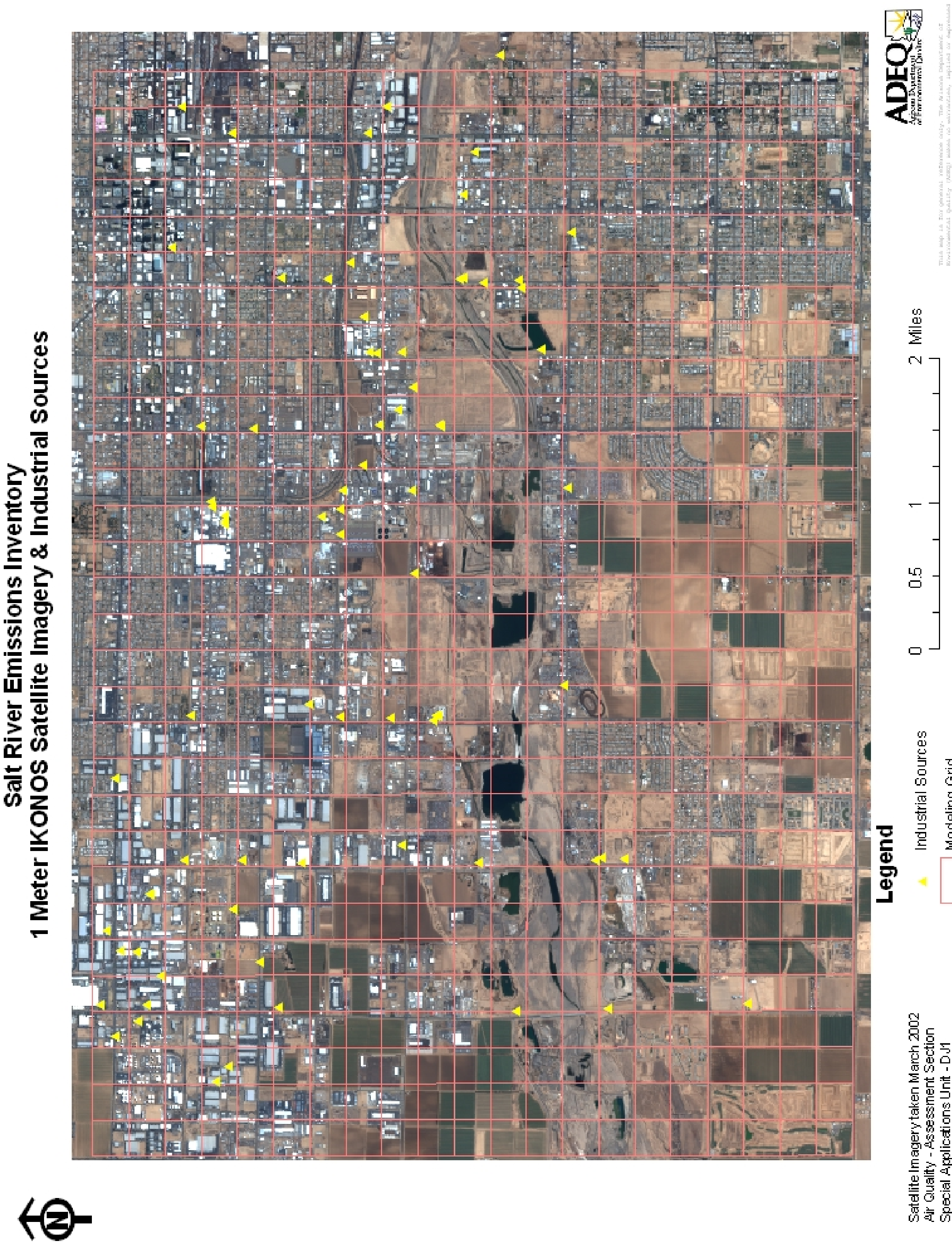
Map A-2 Land Use / Area Sources



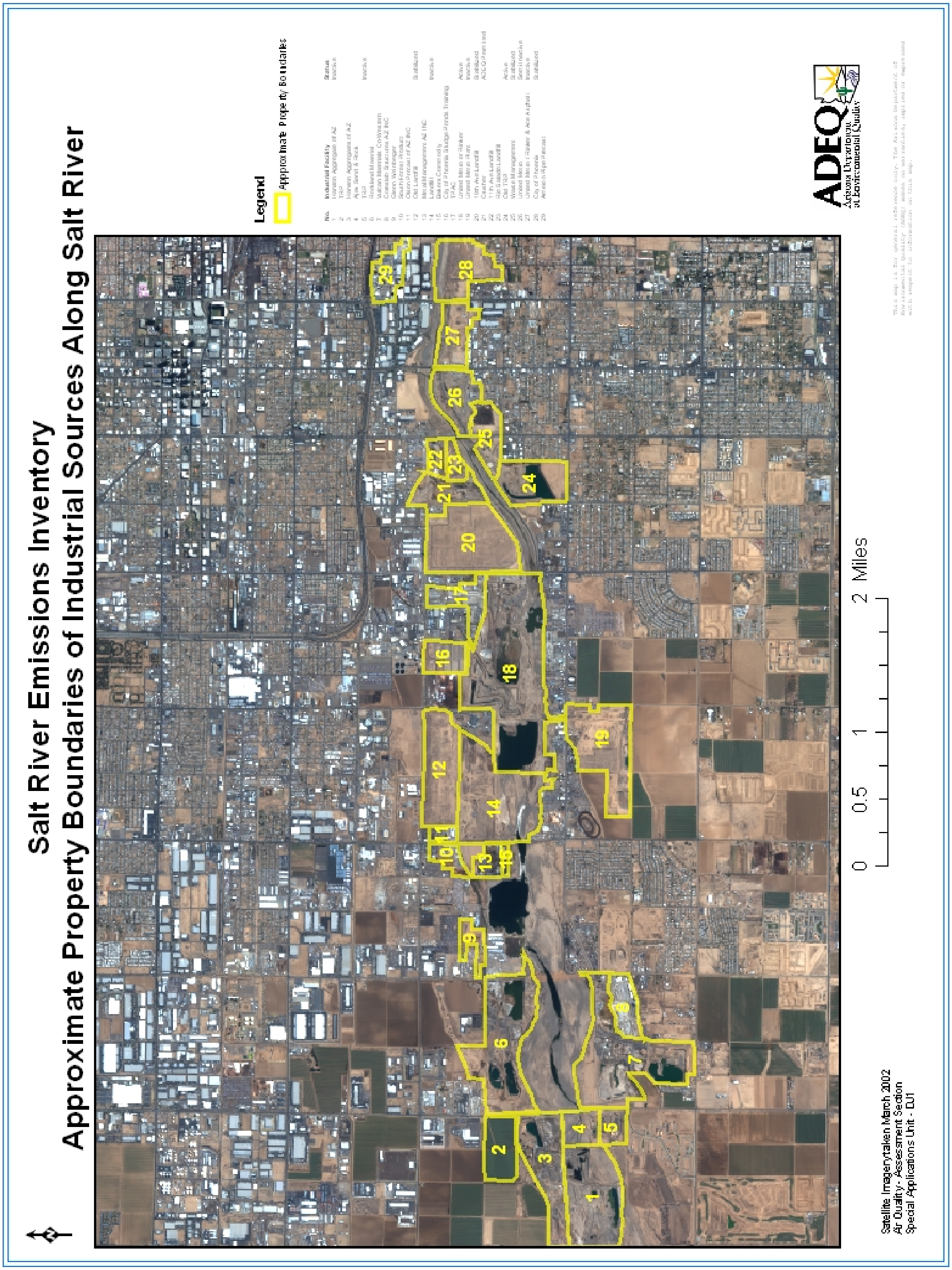
Map A-3 Fugitive Dust



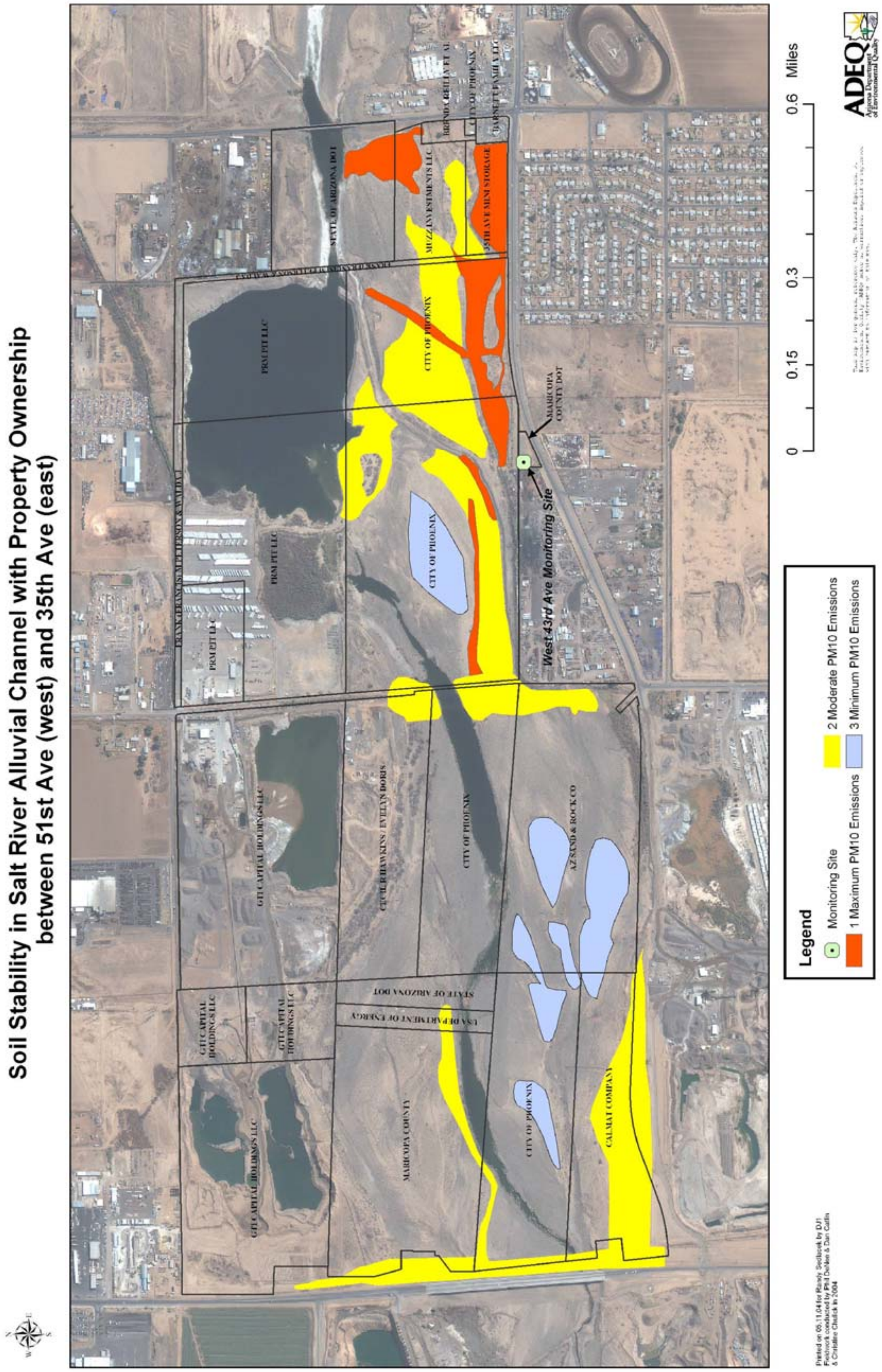
Map A-4 Locations of industrial sources



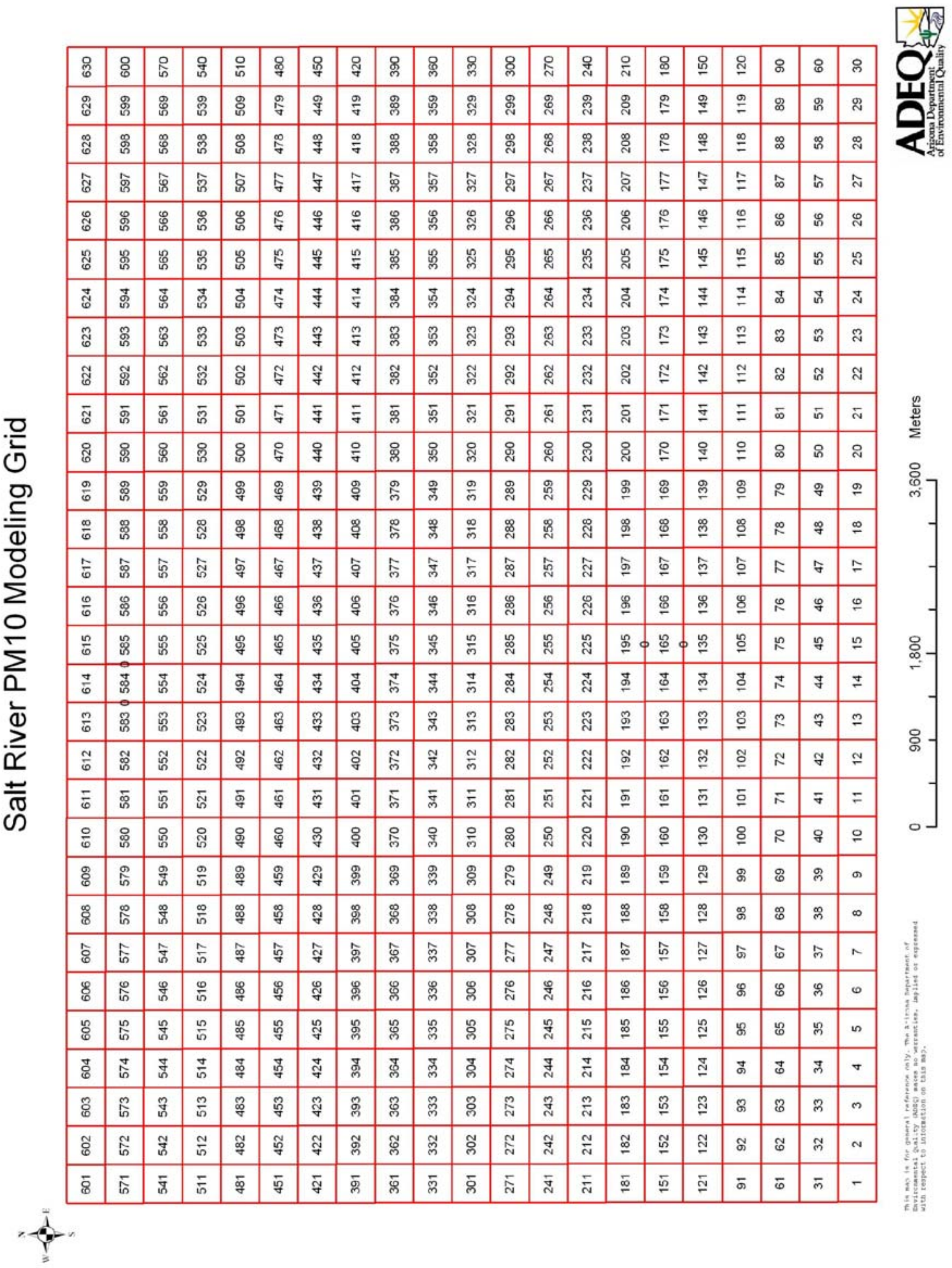
Map A-5 Approximate boundaries of industrial sources near Salt River



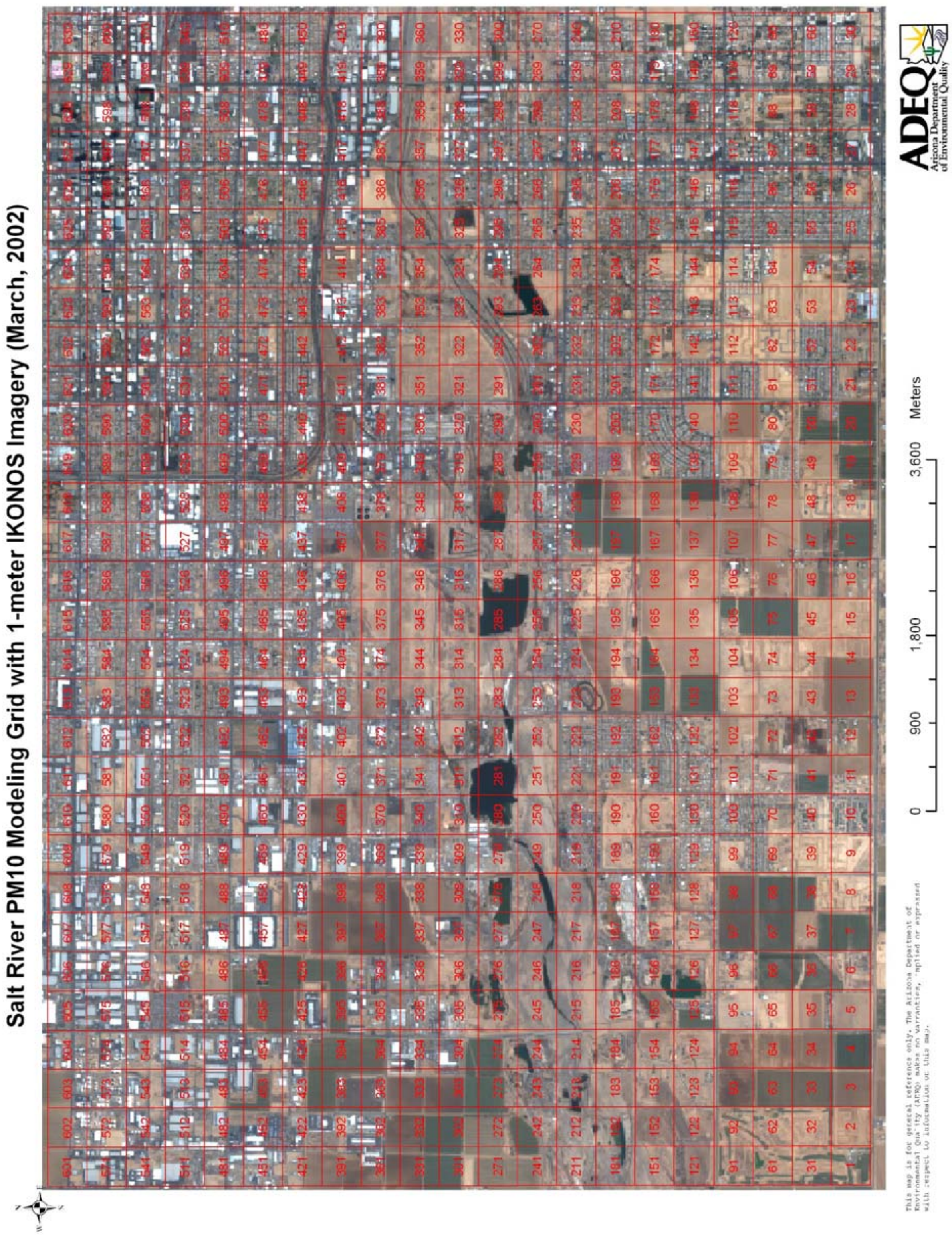
Map A-6 Soil Stability in Salt River Alluvial Channel with Property Ownership



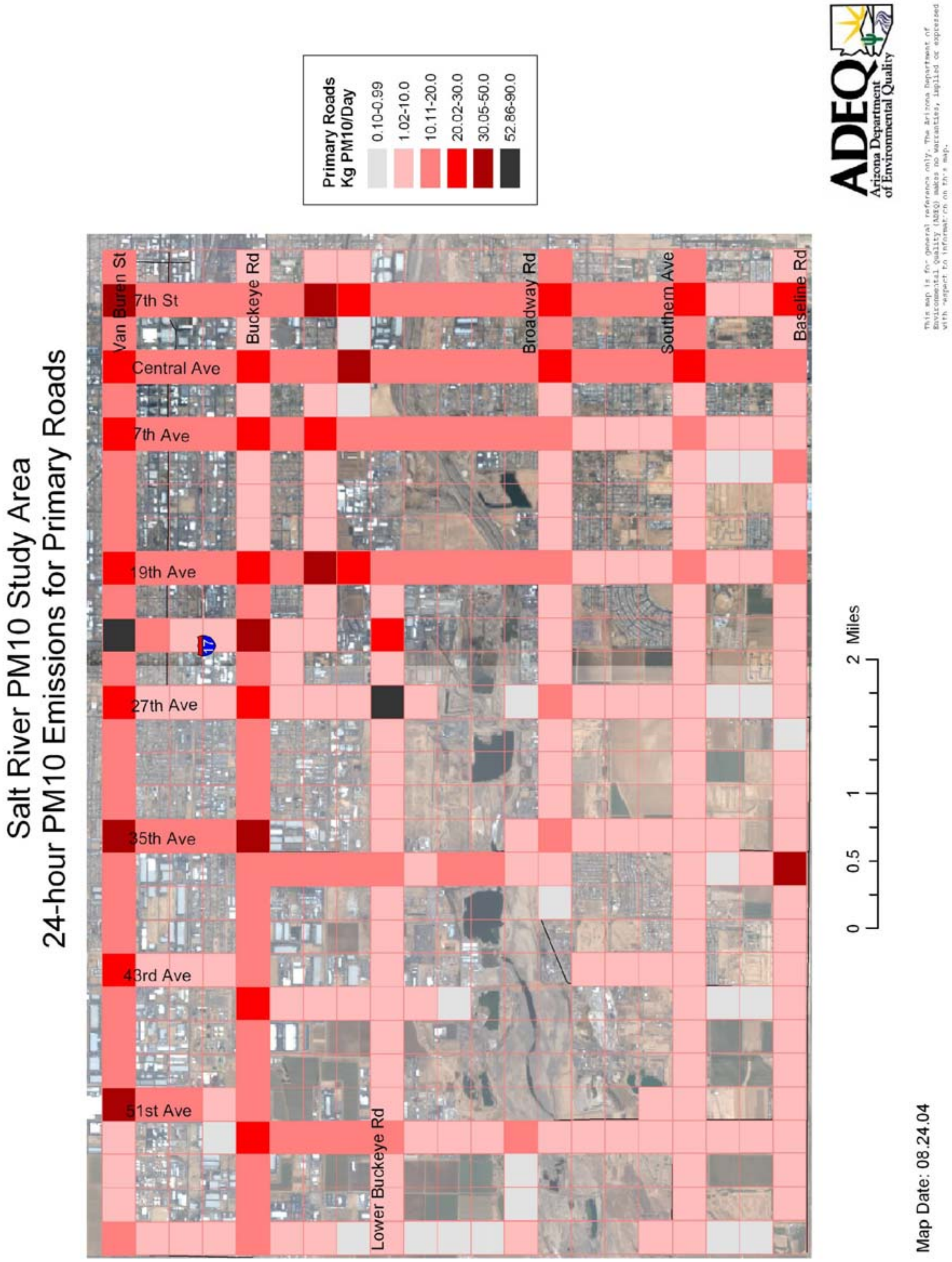
Map A-7 Modeling Grid



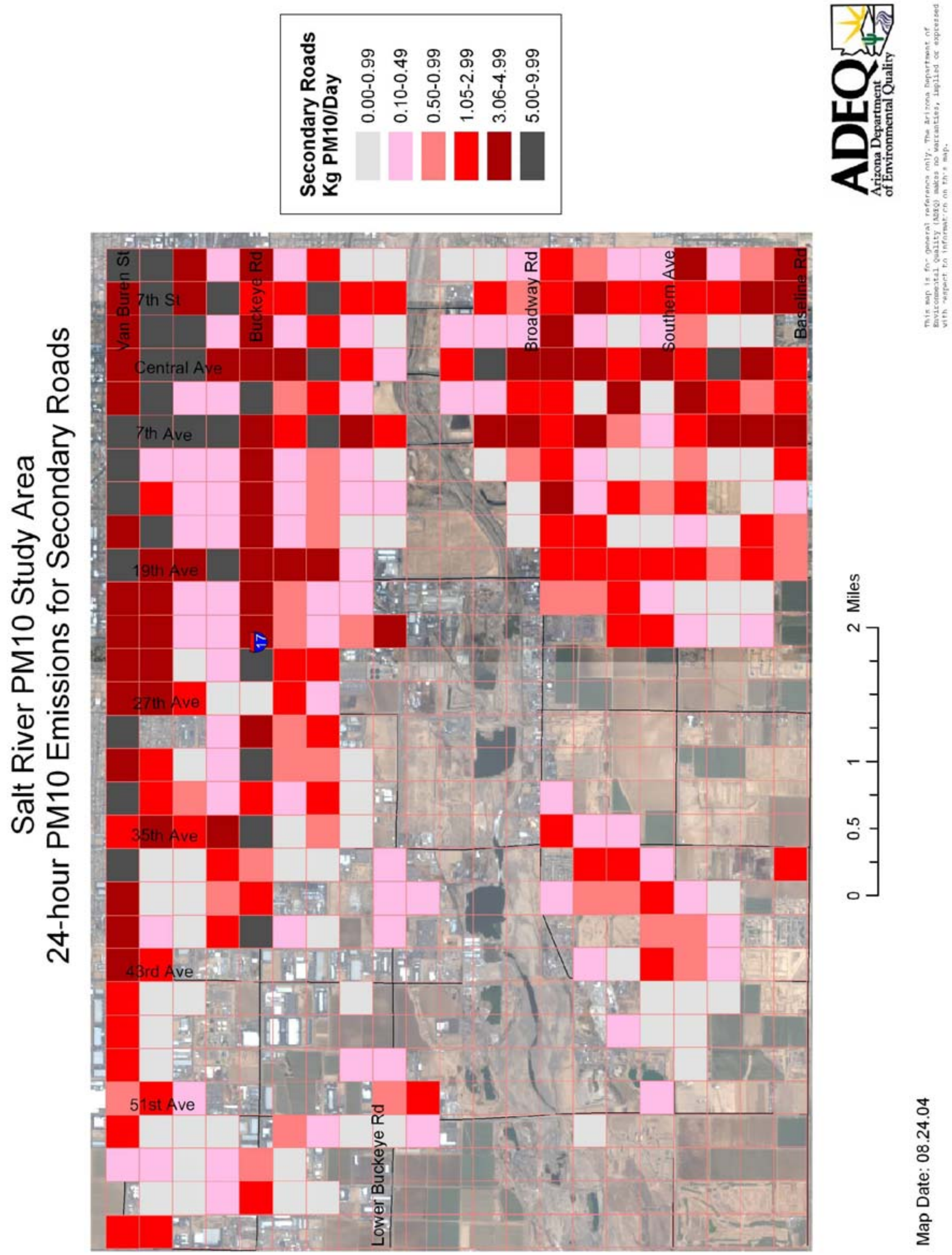
Map A-8 Modeling Grid and Satellite Image



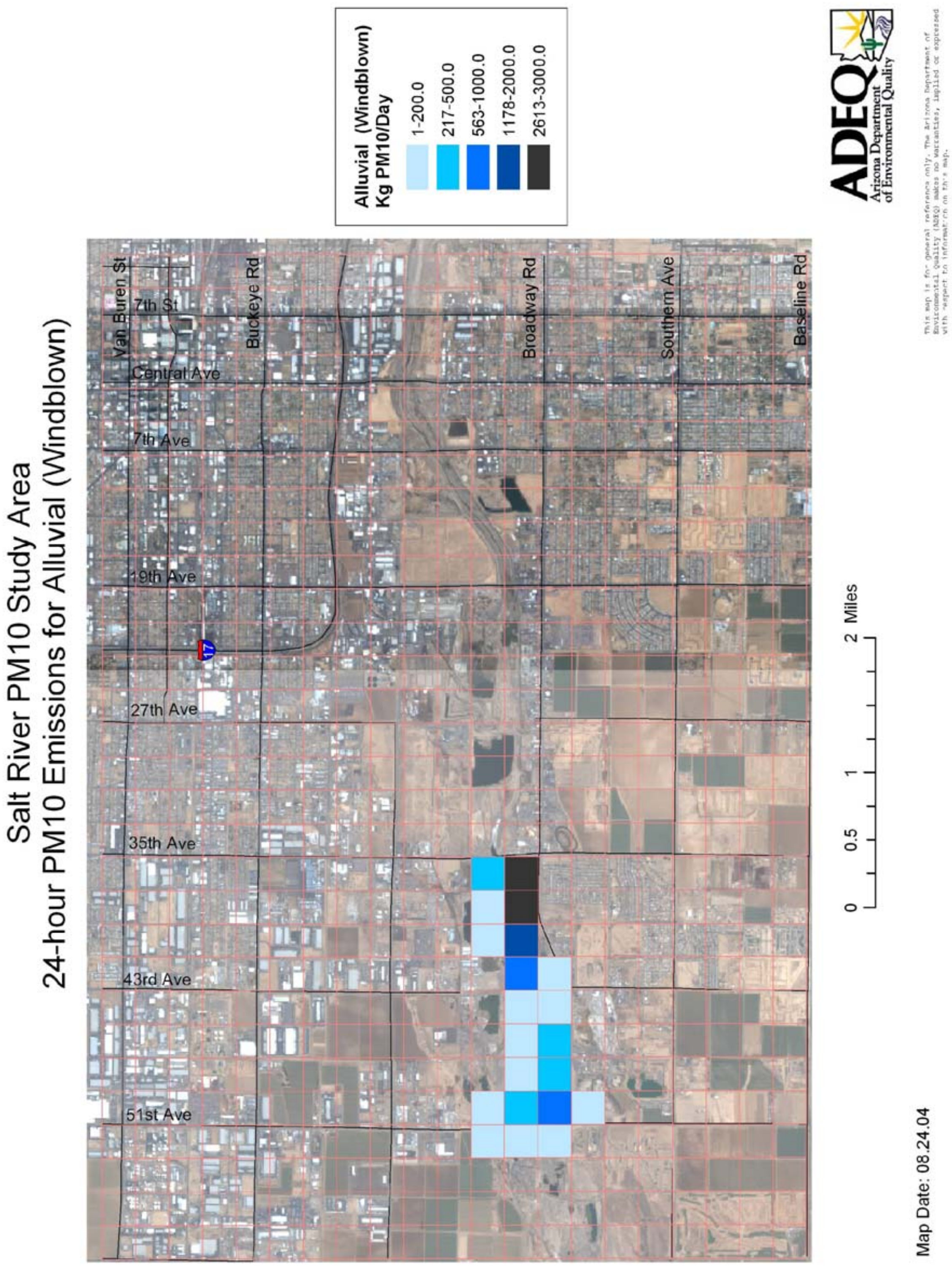
Map A-9 24-Hour PM10 Emissions – Primary Roads



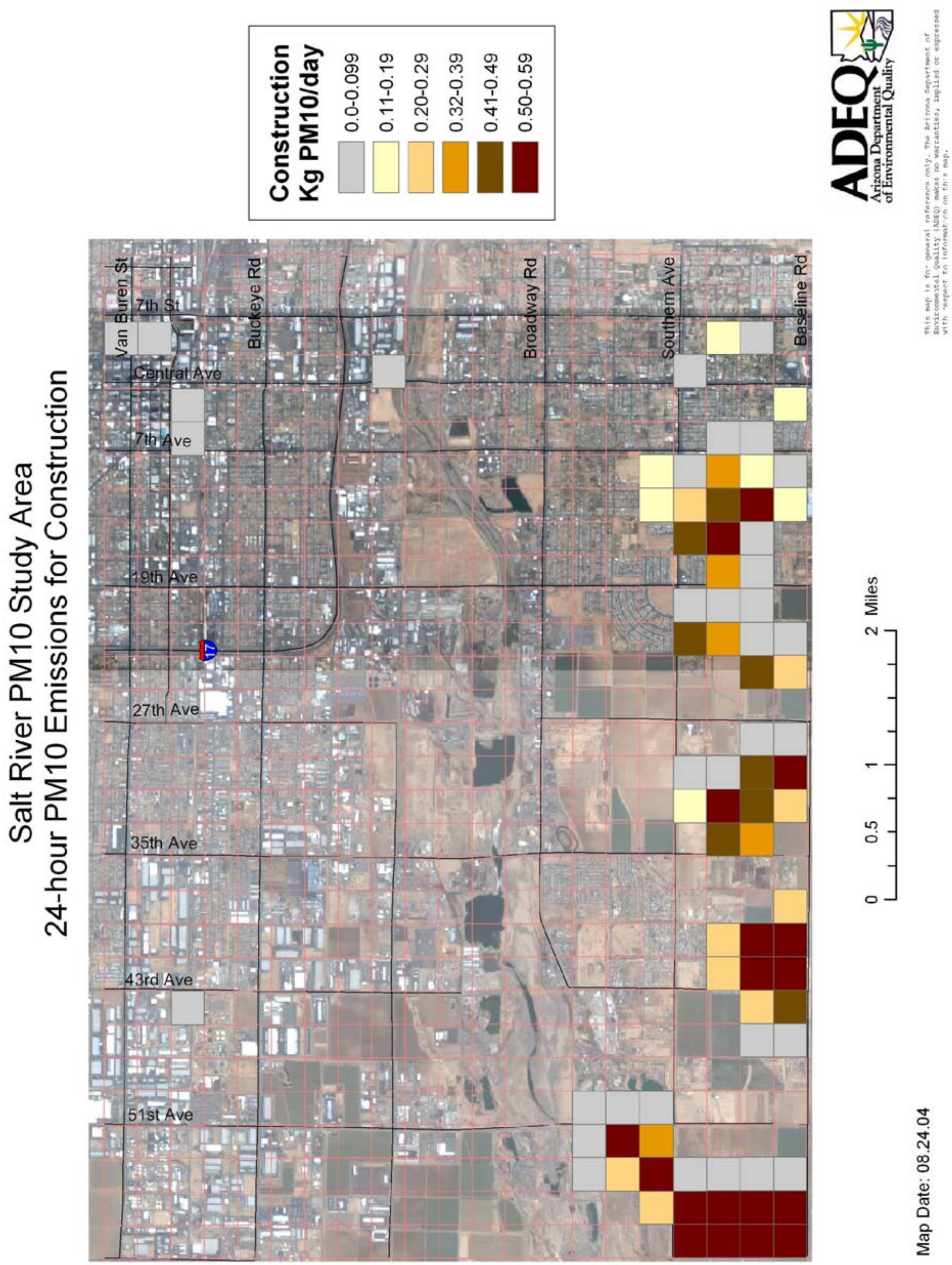
Map A-10 24-Hour PM10 Emissions – Secondary Roads



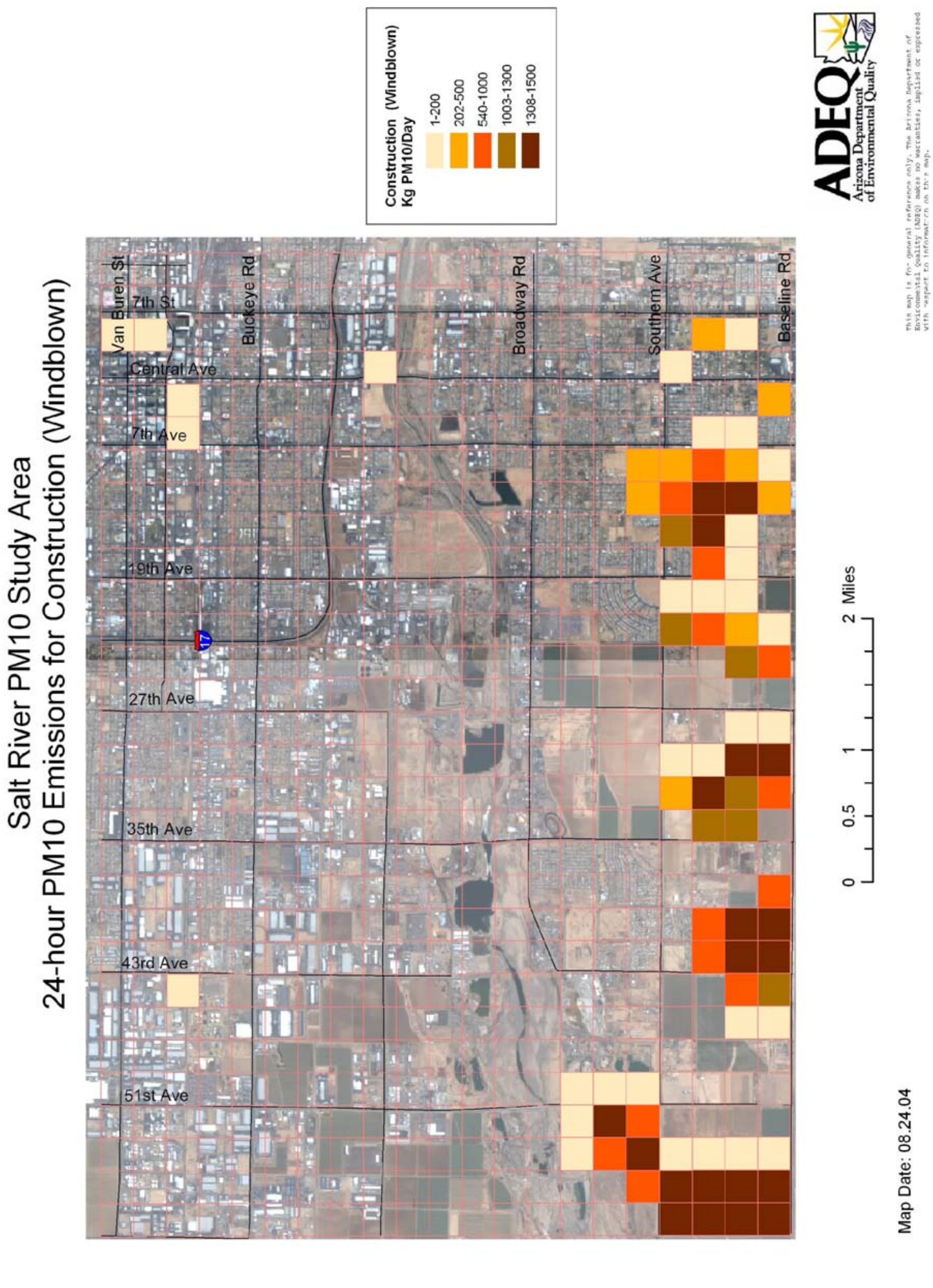
Map A-11 24-Hour PM10 Emissions – Alluvial (Windblown)



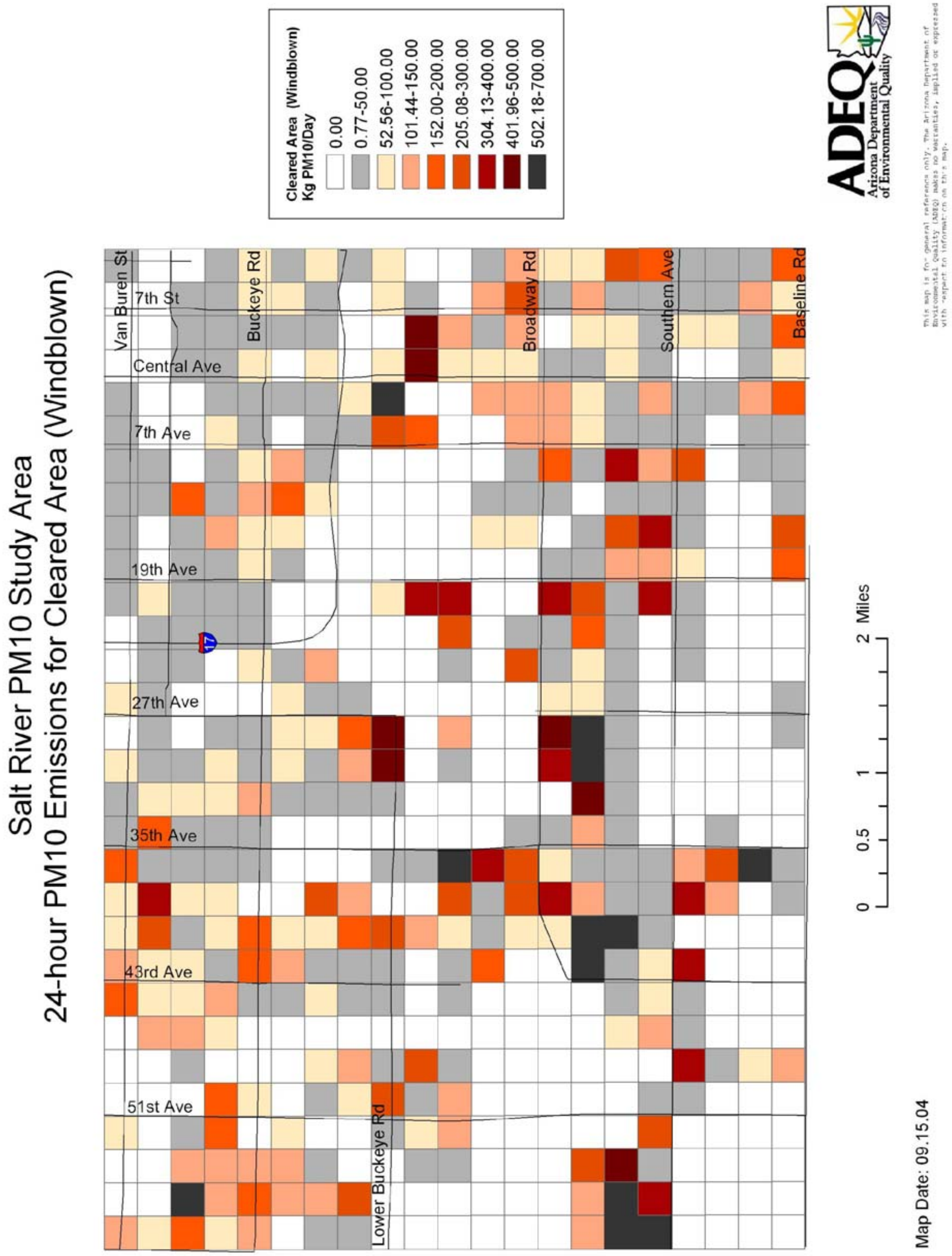
Map A-12 24-Hour PM10 Emissions - Construction



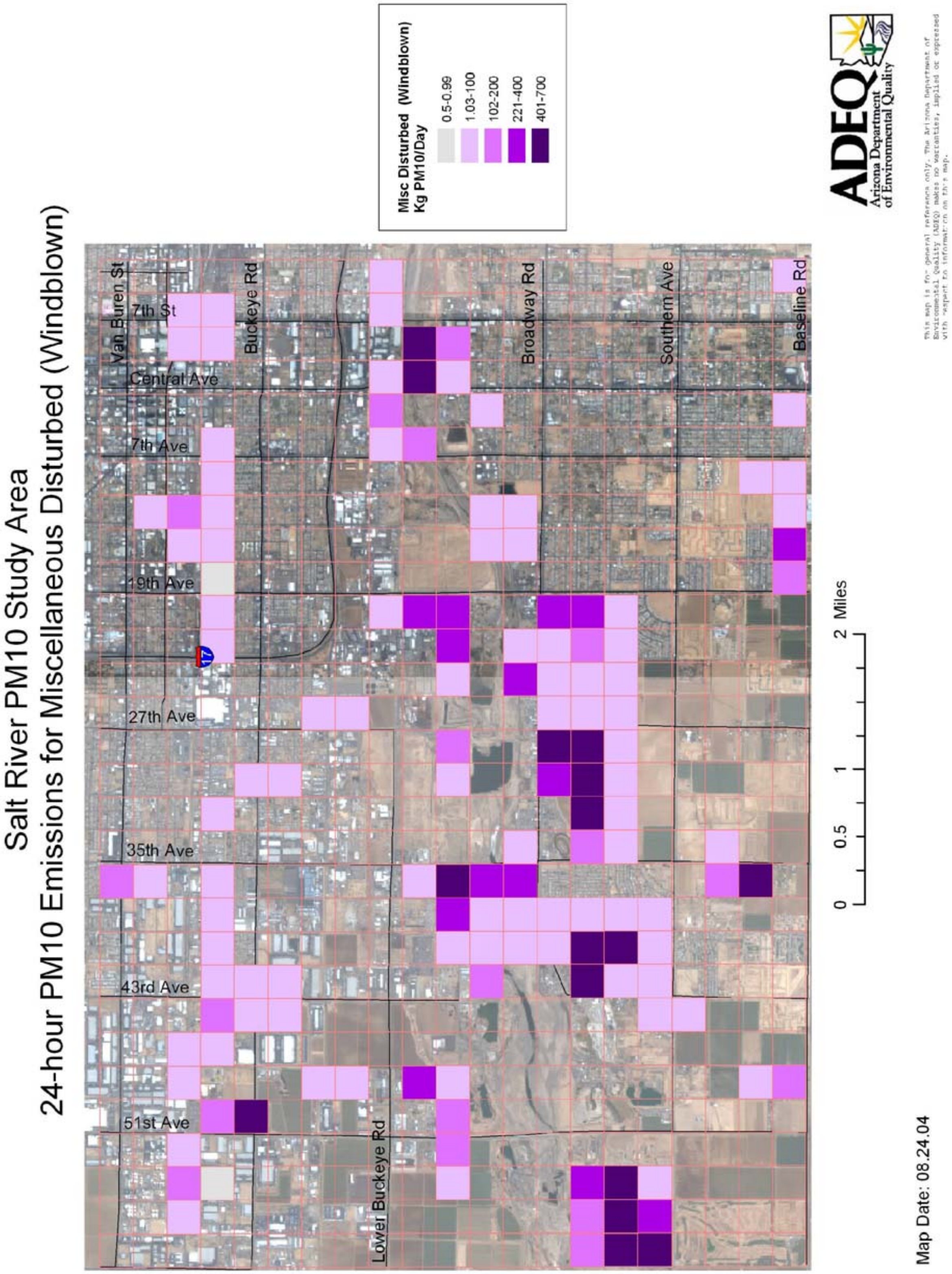
Map A-13 24-Hour PM10 Emissions – Construction (Windblown)



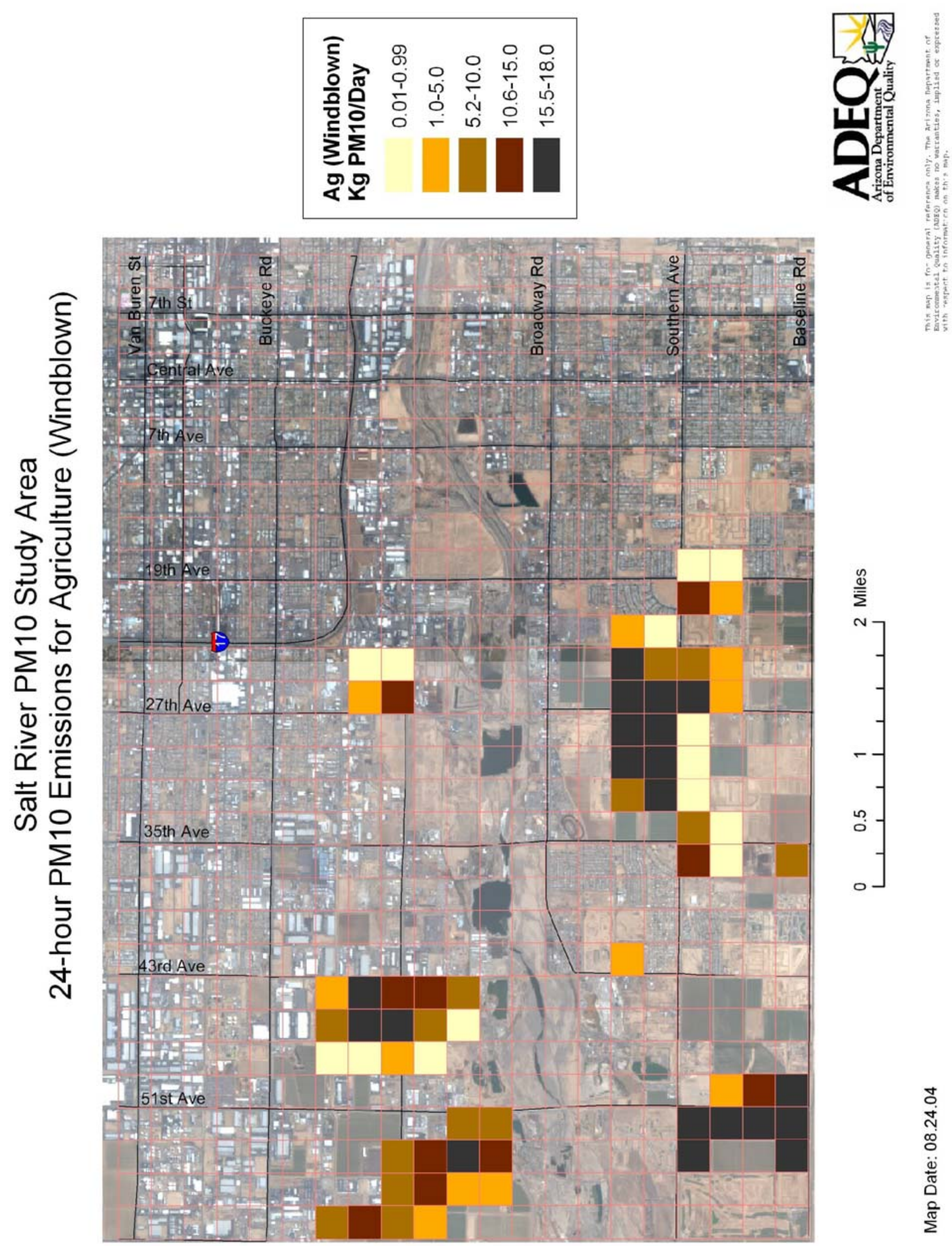
Map A-14 24-Hour PM10 Emissions – Cleared Area (Windblown)



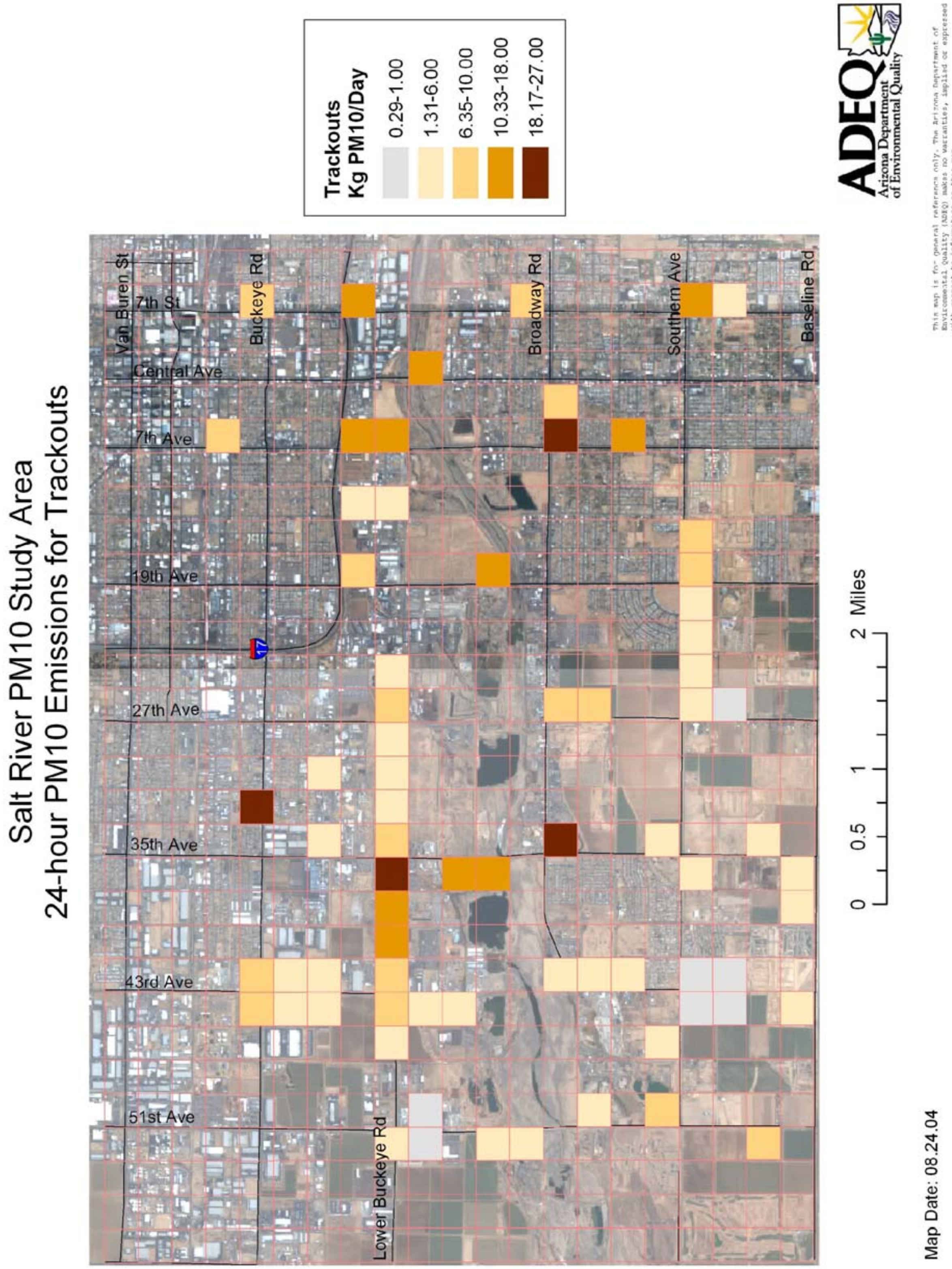
Map A-15 24-Hour PM10 Emissions – Miscellaneous Disturbed (Windblown)



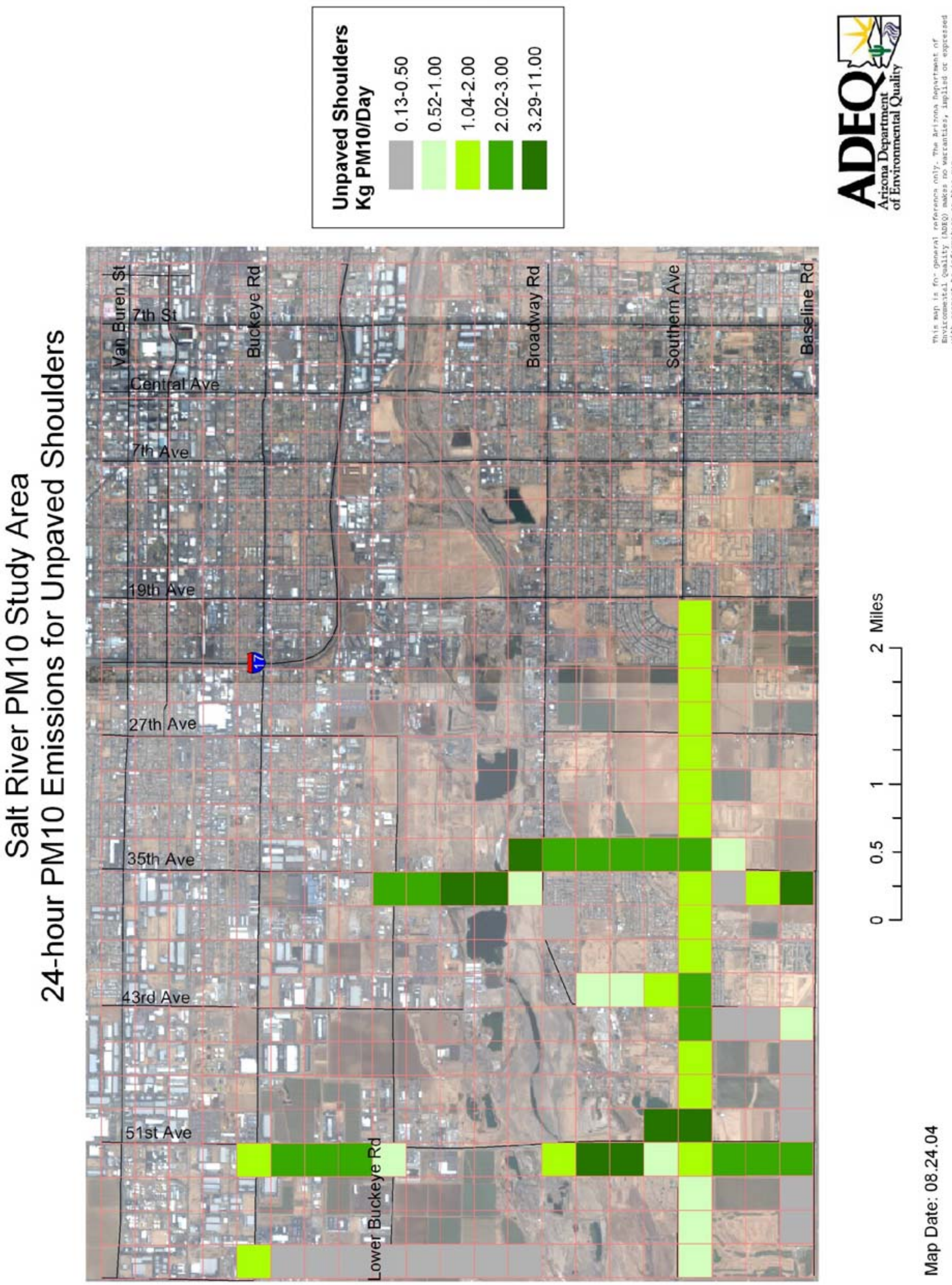
Map A-16 24-Hour PM10 Emissions – Agriculture (Windblown)



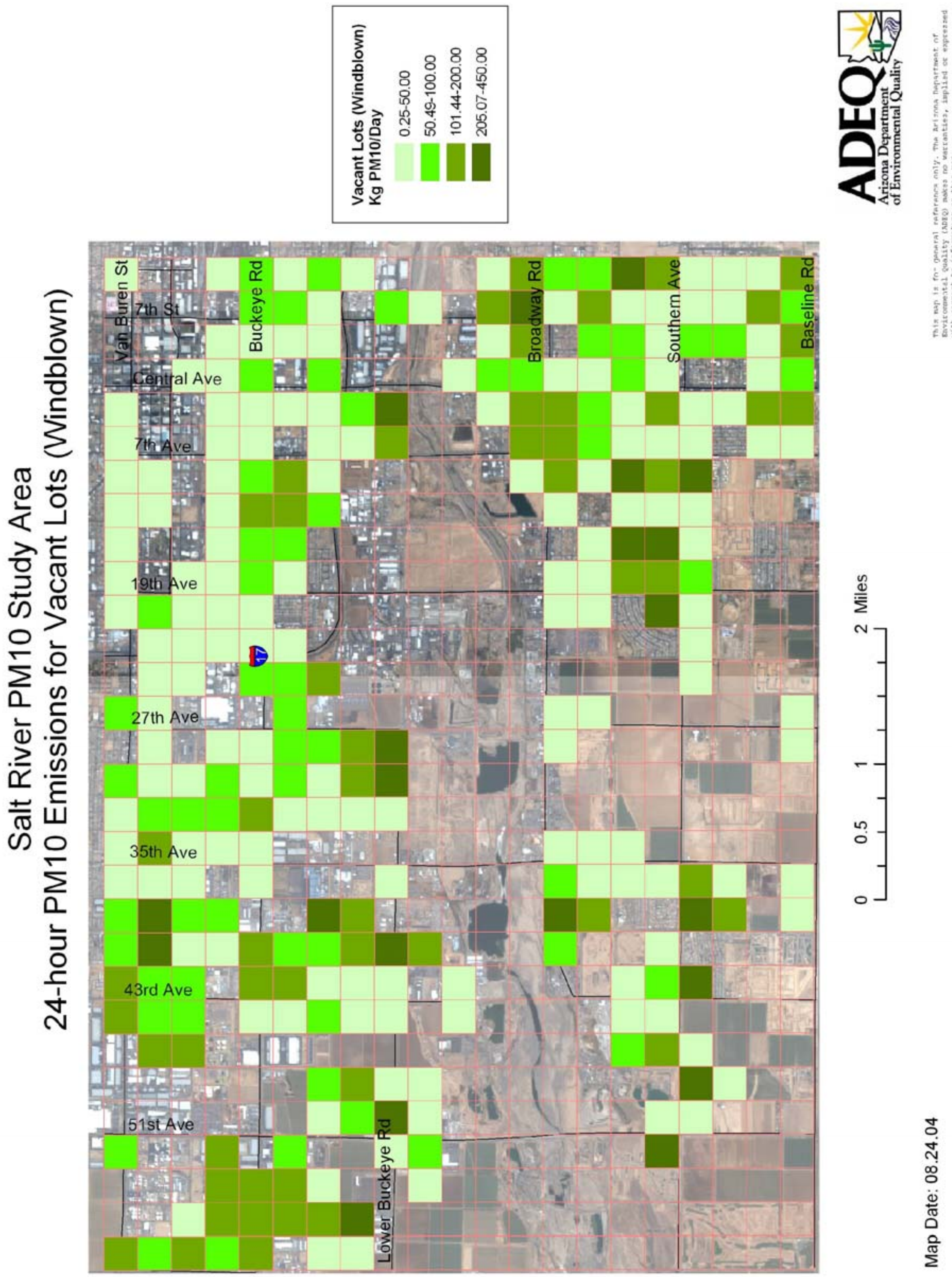
Map A-17 24-Hour PM10 Emissions - Trackout



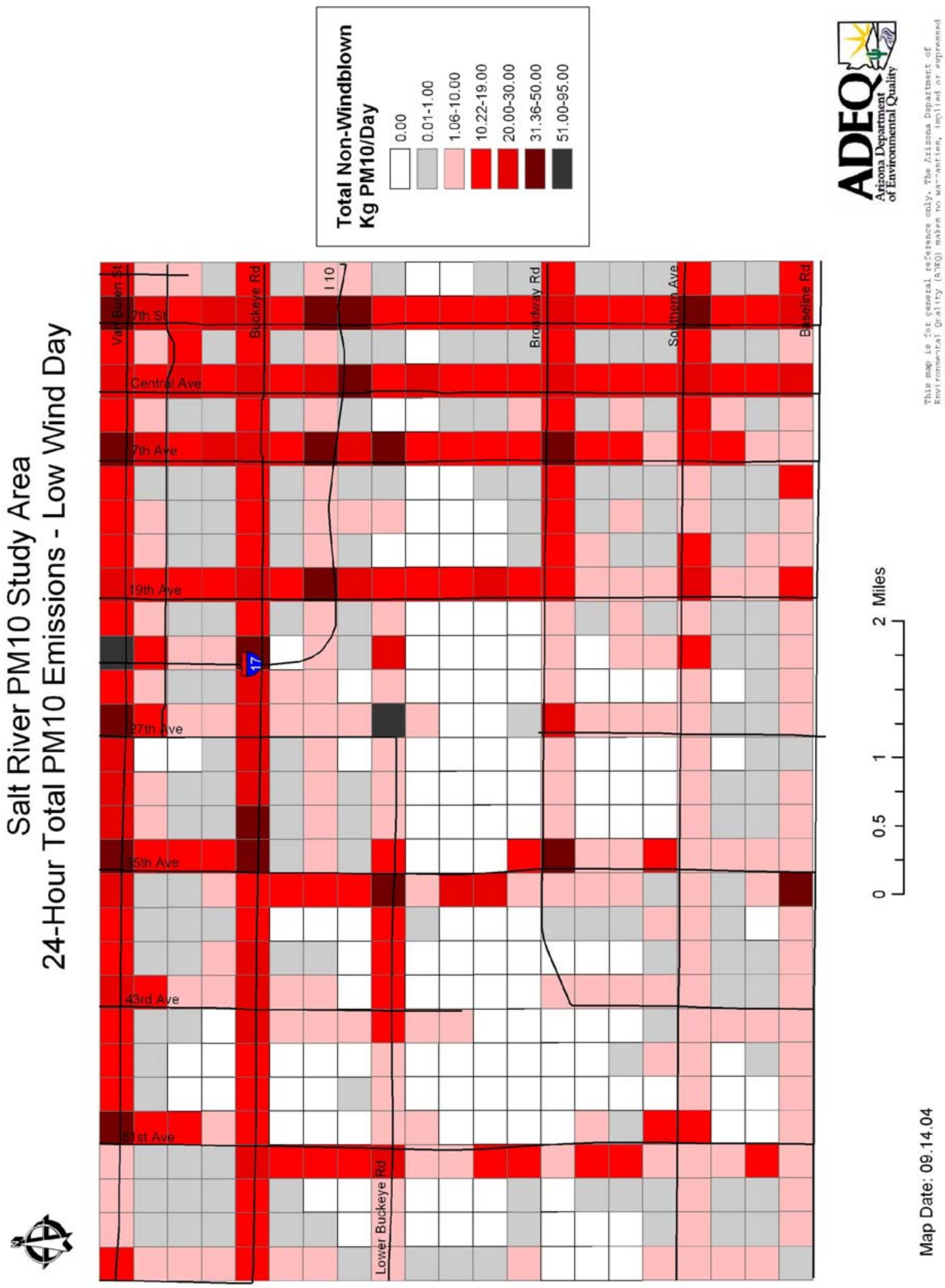
Map A-18 24-Hour PM10 Emissions – Unpaved Shoulders



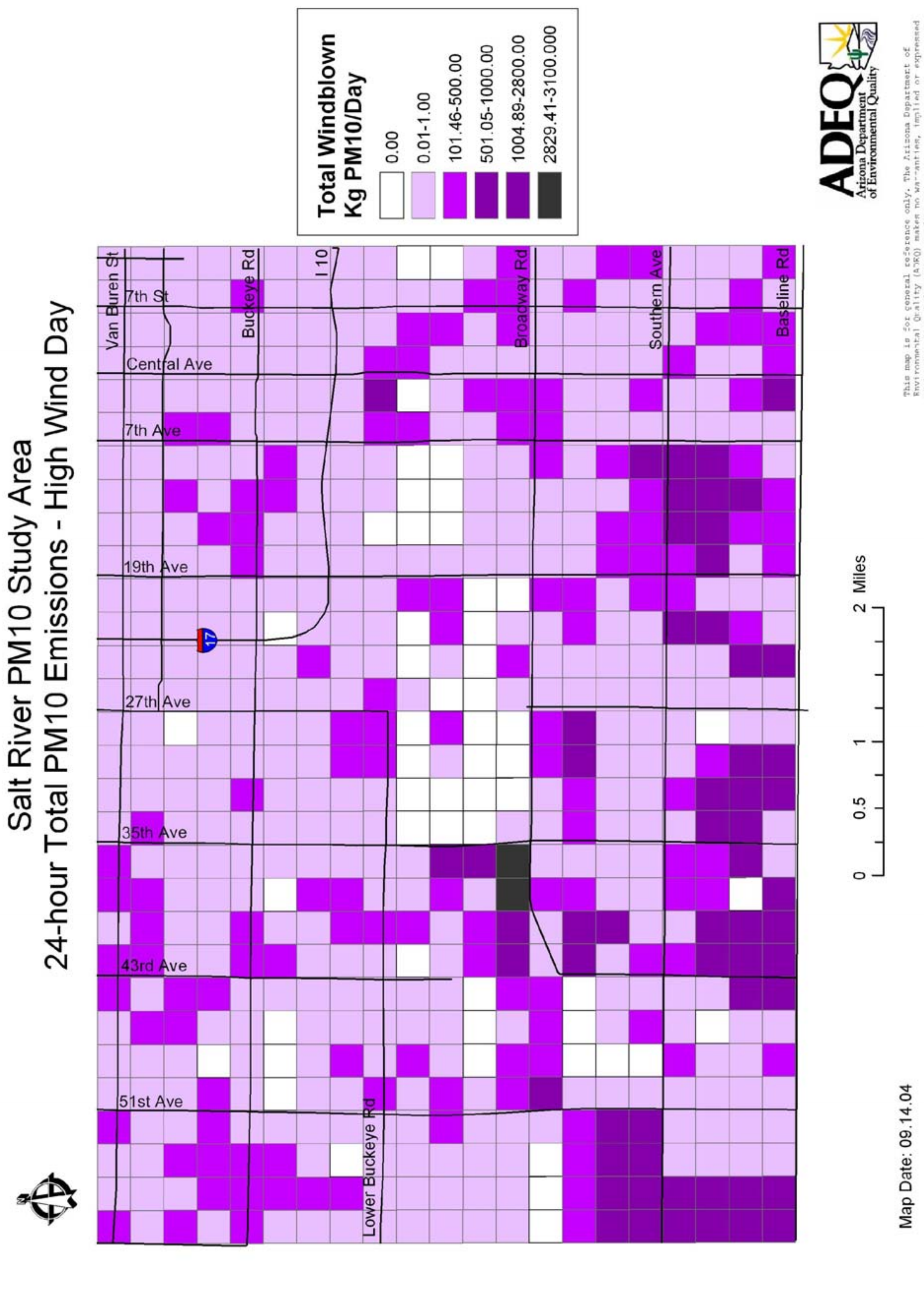
Map A-19 24-Hour PM10 Emissions – Vacant Lots (Windblown)



Map A-20 24-Hour Total PM10 Emissions – Low Wind Day



Map A-21 24-Hour Total PM10 Emissions – High Wind Day



APPENDIX B - GLOSSARY OF TERMS

Following are definitions of terms used in the Salt River PM10 TSD.

Agricultural Tillage
Agricultural tillage is defined as emissions from agricultural operations. The emissions in this category originate from agricultural tilling (land preparation, planting, weed control), and agricultural equipment exhaust.

Construction Activity
Construction activity is defined as construction of residential housing, businesses, and industrial buildings. The emissions in this category originate from earthmoving and to a lesser degree, construction equipment exhaust.

Freeway
Freeway emissions are defined as those emissions from vehicle traffic on the Durango Curve on Interstate 17. The emissions in this category originate from brake wear, tire wear, exhaust, and road dust reentrainment

Industrial Sources
Industrial sources are defined as facilities such as factories, power plants, and rock product operations that are permitted by the county or by the state. The emissions in this category originate from fuel burning, industrial processes, materials processing, construction equipment exhaust, and vehicle traffic over disturbed surfaces. Emissions from these sources are typically separated into four categories: 1) stack emissions, which are emissions that exit through stacks from combustion and materials processing and are specifically described in MCESD's permit and/or emission survey for industrial sources (greater than 10 tons PM10 per year), 2) industrial area emissions, which are all other emissions from the facility, other than windblown, and includes material handling, crushing, screening, traffic on the facility, and the smaller stacks not listed in MCESD's permits or survey forms, 3) windblown emissions from stockpiles, and 4) windblown emissions from the land surface of the facility. Industrial areas emissions have been further divided in to subcategories based on which MCESD rule applies to their operation, and into subcategories based on their nature (e.g., crushing and screening, haul road traffic, combustion, and so forth).

Primary Roads
Primary roads are defined as the major urban paved roads that are located at one-mile intervals. The emissions in this category originate from brake wear, tire wear, exhaust, and road dust reentrainment (road dust "kicked back" into the air from vehicles driving over it).

Secondary Roads
Secondary roads are defined as the minor urban paved roads that are located at half-mile intervals. The emissions in this category are the same as those in the primary roads category.

Unpaved Parking Lots
Unpaved parking lots are defined as parking lots, which have a gravel surface. The emissions in this category originate from reentrained dust from vehicle traffic in the unpaved parking lot.

Unpaved Road Shoulders
Unpaved road shoulders are defined as those road shoulders along paved roads that are not paved or stabilized. The emissions in this category originate from dust from the unpaved road shoulders being reentrained by the wake effect of large vehicles, such as large trucks and buses, traveling on the roadway.

Wind Erosion
Wind erosion is defined as the transport of disturbed / unconsolidated soil due to the movement of wind.

Wind Erosion – Agricultural
Agricultural land is defined as agricultural fields for growing crops. The emissions in this category originate from wind erosion of disturbed topsoil from agricultural fields in the time period between harvesting and when a crop is tall enough to act as a windbreak.

Wind Erosion – Alluvial Channels
Alluvial channels are defined as geological features such as dry streambeds, arroyos, and gullies, that are dry most of the year and contain loose soil, especially silt, due to water and wind erosion. The emissions in this category originate from wind erosion of material in the alluvial channel.

Wind Erosion – Cleared Areas
Cleared areas consist of vacant lots and miscellaneous disturbed areas. Vacant lots are defined as undeveloped land with disturbed topsoil that are in residential or business areas, and miscellaneous disturbed areas are defined as areas with disturbed topsoil that do not fall into the previously mentioned emission categories. The emissions in this category originate from wind erosion of disturbed topsoil.

Wind Erosion – Construction
Construction is defined as those areas that have disturbed topsoil due to construction activity (e.g., earthmoving). The emissions in this category originate from wind erosion of disturbed topsoil on construction sites.

APPENDIX C - ADT BY GRID CELL

The following table lists the average daily traffic counts and lengths of primary and secondary roads for each of the 630 grid cells in the Salt River PM10 Study Area. Source of data: City of Phoenix, Year 2001 Traffic Map and the lengths of the roads were from GIS analysis of a satellite image and a GIS road cover of the study area.

Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)	Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)
1	2767	200		70	1200		1299
2	4300	200		71	500		165
3	4300	200		72	4500	103	
4	8500	600		73	4500	296	
5	5300	200		77	1000	400	
6	5300	200		79	500		768
7	5300	200		80	500		777
8	2767	600		81	10000	399	422
9	6100	200		82	500		34
10	6100	200		83	0		554
11	6100	200		84	1330	61	400
12	37687	599	303	85	13300	400	1992
13	7500	200		86	4500		2182
14	7500	200		87	20000	400	1942
15	7500	200		88	500		603
16	3167	200		89	16500	400	1098
17	8500	600		90	1200		1111
18	8500	200		91	2667	400	
19	8500	200		92	3000	400	
20	9500	200		93	3000	400	
21	12800	600	378	94	3840	449	
22	12800	200	454	95	7500	750	
23	12800	200	104	96	4800	400	10
24	13133	600	737	97	5200	400	12
25	17500	200	1862	98	5200	573	13
26	17500	200	808	99	5100	626	902
27	23133	600	631	100	5100	400	1444
28	29400	200		101	5600	400	269
29	27300	600	844	102	5600	400	
30	27300	200	1042	103	5500	799	
31	2000	200		104	6400	400	
34	10500	400		105	6400	400	
38	1500	399		106	6400	400	
42	4500	400		107	3850	800	
47	1000	400		108	6700	400	
49	8000		399	109	6700	400	400
50	1000		429	110	6700	400	72
51	10000	400	2074	111	12000	800	1284
52	6000		2241	112	13900	400	89
53	1000		598	113	13900	400	581
54	1000	153	736	114	13900	400	444
55	13300	247	1899	115	15050	800	1444
56	3000		1433	116	16800	400	1556
57	20000	400	1201	117	20800	800	650
58	600		1200	118	21600	400	205
59	16500	400	1665	119	19600	800	705
60	3600		1476	120	22700	400	1198
61	2000	200		121	3000	400	
64	10500	399		124	13800	56	
68	1500	400	10	125	13800	351	259
69	1200		984	126	0		352

Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)	Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)
127	600		368	201	12500	400	1138
128	600		332	202	6000		1600
129	5100	406	2194	203	600		1602
130	6000		1200	204	600		1621
131	6000		2063	205	16400	400	2125
132	1800		732	206	1000		574
133	9500	405		207	22600	400	1099
137	3700	404		208	600	400	1543
139	6000		1848	209	19400		1391
140	2400		1546	210	3000		1714
141	12500	403	1618	214	13800	401	
142	600		418	221	2400	128	861
143	3000		1576	222	3200	400	
144	600		762	223	9500	800	2122
145	2000	402	463	224	10000	400	271
146	1000		700	225	10000	400	
147	21600	402	1161	226	10000	400	
148	1000		2132	227	14700	800	
149	22700	401	861	228	14700	400	
150	3000		890	229	14700	400	
154	13800	400		230	14700	400	276
155	0		194	231	14500	800	770
156	0		709	232	16600	400	1200
157			412	233	16600	400	1389
159	2000	400	21	234	16600	400	1299
161	3600		1751	235	18300	800	853
162	4200		2234	236	18300	401	1111
163	9500	400	84	237	19700	800	1239
167	4000	400		238	19700	400	1342
169	4200		1895	239	20000	800	958
170	6000		2162	240	20000	400	794
171	12500	400	1292	241	2000	600	
172	300		800	242	1000	401	
173	6000		2021	243	1000	411	
174	600		899	244	13800	766	
175	6000	400	1251	252	19100	71	
176	10000		2429	253	19100	330	
177	22600	400	956	257	1000	152	
178	600		1087	261	19400	400	
179	19700	401	811	262	500		187
180	1000		1210	263	500		400
184	13800	400	18	264	3600		1092
185	0		400	265	20400	400	1266
186	0		382	266	4800		1748
189	3000	373	372	267	19700	400	1258
190	0		400	268	1000		1374
191	3000		1349	269	21200	400	320
192	6000		1978	270	1800		943
193	9500	400	166	271	2000	200	
197	3700	400		274	13800	400	
200	3000		1439	282	19100	400	

Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)	Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)
291	19400	400		379	92500	199	327
293	0		52	380	15000	400	
294	600		1027	381	25100	418	
295	20400	400	1363	382	100		302
296	1000		1719	383	1000		800
297	24400	400	1631	384	1000		668
298	1000		1627	385	20400	604	1001
299	21200	400	413	387	24400	400	136
300	600		1063	388	500		507
301	2000	200		389	21200	400	874
304	13800	401		390	1000		482
308	1000	149		391	2000	200	
312	19100	401		394	19300	400	29
321	19400	400		395	0		877
323	0		96	396	1000		1172
325	20400	400		397	0		67
326	1000		920	398	12000	400	21
327	24400	400	796	399	0		385
328	1000		892	400	0		400
329	21200	400		402	20000	400	
330	100		43	403	1000		323
331	2000	200		404	1000		738
334	13800	400	90	405	1000		410
335	13800		823	407	5900	400	
338	5900	400		409	7700		591
341	2000		544	410	1000		754
342	10600	399		411	25100	603	137
347	10800	394		412	1000		588
351	19400	400		413	1000		1216
353	0		400	414	1000		857
355	20400	400		415	19700	400	1294
357	24400	400		416	1000	501	1498
359	21200	400		417	24900	1346	692
361	4300	600		418	1000	574	1100
362	5100	400		419	28200	738	525
363	5100	400		420	1000	913	300
364	14400	800	42	421	3900	200	
365	7700	400	518	422	1000		166
366	7700	400	367	424	19300	400	138
367	7700	400		428	12000	400	
368	8300	800		430	1000		747
369	11200	400		432	20000	400	22
370	11200	400	238	433	7300		683
371	11200	400	315	434	7300		1340
372	15400	800	151	435	7300		540
373	10600	400		436	7300		1285
374	10600	400		437	7750	400	400
375	10600	400		438	9600		925
376	10600	400		439	1000	876	1570
377	83500	801		440	2000	402	1451
378	10800	400		441	20600	1318	1820

Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)	Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)
442	3000	403	2079	499	22500	1200	1459
443	3000	1140	1731	500	22500	401	1375
444	2000	1210	1900	501	19000	911	1228
445	19700	937	2952	502	16700	399	1862
446	6000	464	1939	503	15000	400	1829
447	24900	576	1689	504	15000	400	1806
448	4200		2101	505	19100	801	1814
449	28200	1105	1724	506	16400	400	2786
450	6000	307	2300	507	19100	803	1476
451	3900	200		508	17000	400	1609
452	1000		456	509	17000	801	1093
453	1000		400	510	17000	400	1604
454	19300	400	243	511	15100	200	
458	12000	400		512	1000		1029
460	1000		800	513	1000		800
462	20000	400	4	514	1000	188	684
463	1000		627	515	25200	213	
464	3000		1163	519	18100	400	
465	3000		1469	520	5400		1952
466	3000		2129	521	3000		1892
467	5900	400	2346	522	4500		2379
468	4500	803	1572	523	26900	400	1316
470	4500		1526	524	1000		1031
471	20600	400	1142	525	1000		1221
472	1200		2294	526	1000		1097
473	1200		2449	527	13300	400	18
474	1200		1953	528	1000		1779
475	19700	400	800	529	1200	800	2298
476	3000		2298	530	1200		2064
477	24900	401	1109	531	21300	400	2001
478	1000		1163	532	1200		2337
479	28200	400	754	533	1200		1973
480	1800		1515	534	1200		2126
481	16167	600		535	21800	404	2246
482	22300	400	596	536	1000		2601
483	22300	401	205	537	21500	401	1675
484	23800	800		538	1000		2467
485	21100	400		539	28800	401	1451
486	21100	400		540	1000		1149
487	21100	400		541	15100	200	
488	19100	800		542	1000		488
489	27600	400		543	1000		427
490	27600	400	1669	544	1000		154
491	27600	401	293	545	25200	401	147
492	27300	400	266	548	1000		152
493	29000	800	1333	549	18100	400	
494	31000	400	304	550	1000		498
495	31000	400	1274	551	1000		467
496	31000	399	1200	552	1000		182
497	22500	800	13	553	26900	400	715
498	31600	400	1742	554	3000		1635

Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)	Grid Cell Number	Average Daily Traffic	Primary Roads (meters)	Secondary Roads (meters)
555	1200		426	607	20500	400	510
557	13300	399	866	608	20500	400	728
558	1000		642	609	23000	800	1056
559	1000	800	1645	610	27800	400	837
560	1000		1603	611	27800	400	1002
561	21300	400	1599	612	27800	400	1405
562	1000		1389	613	31000	800	517
563	1000		1737	614	28400	400	1834
564	1000		2153	615	28400	400	1309
565	21800	400	1723	616	28400	400	1807
566	1000		2286	617	26000	800	1081
567	28800	400	1675	618	26000	400	945
568	28800		2766	619	25200	1576	1059
569	28800	400	1131	620	25200	400	1488
570	28800		1279	621	22550	800	1670
571	15100	200	1286	622	20700	400	1811
572	1000		77	623	20700	400	1902
573	1000		800	624	20700	401	1893
574	1000		699	625	25000	800	1742
575	25200	401	724	626	21900	400	1600
576	1000		471	627	18800	800	1860
577	1000		359	628	23900	400	1568
578	1000		733	629	32900	800	841
579	18100	400	779	630	29300	400	1522
580	1000		838				
581	1000		214				
582	1000		52				
583	26900	400	928				
584	3600		2297				
585	6000		2379				
586	6000						
587	18000	400	1558				
588	12000		2025				
589	12000	800	2378				
590	12000		2000				
591	20000	400	1417				
592	21800		1742				
593	3000		3042				
594	1200		2567				
595	29100	401	2400				
596	20000		2229				
597	21500	401	1750				
598	20000		2272				
599	29200	400	3124				
600	20000		2280				
601	15500	600	613				
602	15700	400					
603	15700	400	201				
604	15700	400	723				
605	31000	800	240				
606	20500	400	666				

APPENDIX D – TRACKOUT STUDY

A study of trackout onto paved roads was conducted by ADEQ staff to determine silt loading and silt percentage from areas of a paved road with varying amounts of trackout. The study area was a section of 43rd Avenue that extended on the south from the start of paving on 43rd Avenue to the Lower Buckeye Road on the north. The dates of the study were September 29 and 30, 2003. This section of 43rd Avenue (south of Lower Buckeye Road) was selected for silt sampling due to it having the largest amount of trackout observed in the Salt River PM_{10} Study Area.

Methodology

The section of street to be sampled for trackout would first be blocked to traffic by a City of Phoenix sign truck. Following EPA silt sampling methodology, ADEQ staff marked the boundaries of the paved road that would be sampled. A clean, pre-weighed vacuum bag was installed in an electric vacuum cleaner (electricity from a portable generator). The road was sampled by vacuuming within the pre-defined sampling area from the edge of the road to the center of the road and then back to the edge of the road until all of the sampling site area been vacuumed. The vacuum bag would be removed and marked with a sample number. The other lane of the road would be sampled in a similar manner, giving two samples per sampling site. Then the sign truck and sampling equipment would be moved to the next sampling site and the sampling process would be repeated. The trackout samples were sent to an engineering laboratory for analysis of silt content.

Sampling Sites

Following is a description of the four sites that were used for collecting samples of trackout on 43rd Avenue. One pair of trackout samples were collected at each site – one sample from the northbound lane and one sample from the southbound lane of 43rd Avenue. The starting point (origin) for the sampling was the south end of 43rd Avenue (transition on 43rd Avenue from unpaved to paved road).

Site #1 - This sampling site was located just north of GTI Capitol Holdings, LLC (a ready mix concrete and rock products company) on 43rd Avenue. A moderate amount of trackout was present on the northbound lane (Sample #1) and appeared to originate from GTI Capitol Holdings, LLC. A small amount of trackout was apparent on the southbound lane (Sample #2). See Figure D-1 and D-2 for photographs of the sampling site (approximately 455 feet north of the starting point).

Site #2 - This sampling site was located north of the exit roadway from the Glenn Weinberger Company (a top soil and landfill company) on 43rd Avenue. An extreme amount of trackout was present on the northbound lane, Sample #3 (trackout was so heavy that the vacuum cleaner became overloaded and stopped working during the first sampling attempt at this site). Very little trackout was apparent on the southbound lane (Sample #4). See Figure D-3 for photograph of this sampling site (approximately 910 feet north of the starting point).

Site #3 - This sampling site was located approximately 2,003 feet north of the starting point. A moderate amount of trackout was present on the northbound lane (Sample #5). Very little trackout was apparent on the southbound lane (Sample #6). See Figure D-4 for photograph of this sampling site.

Site #4 – This sampling site was located approximately 2,840 feet north of the starting point. A moderate amount of trackout was present on the northbound lane (Sample #7). Very little trackout was apparent on the southbound lane (Sample #8). See Figure D-5 for photograph of the sampling site.

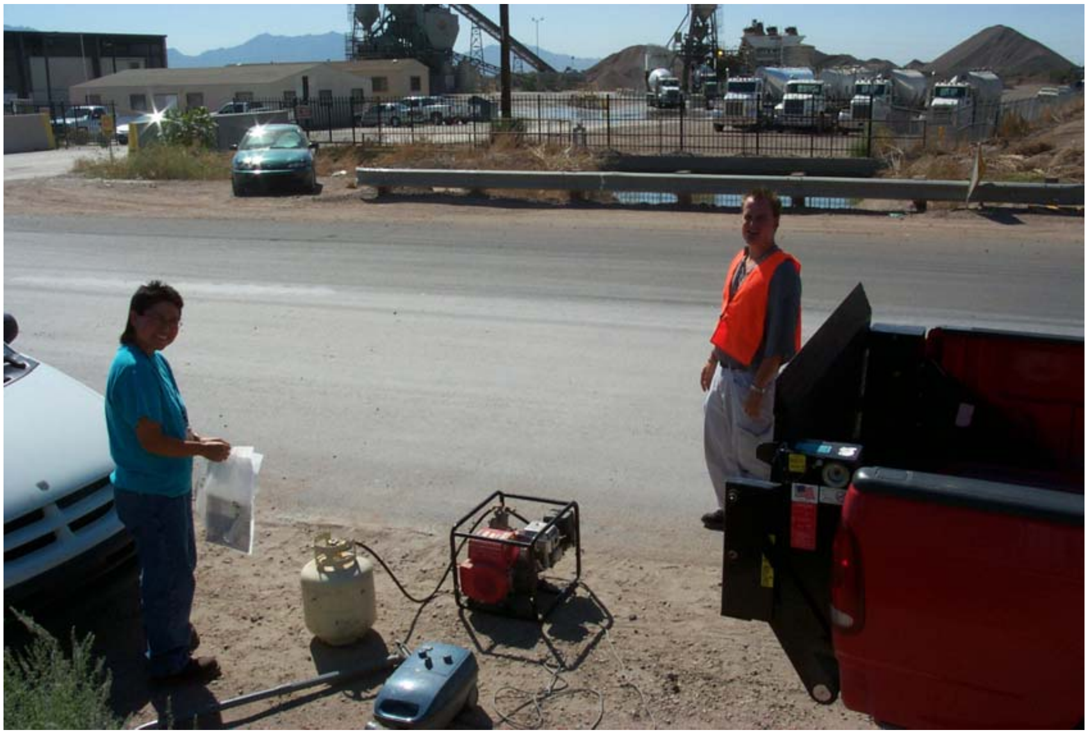


Figure D- 1. Sample #1 taken on northbound lane of 43rd Avenue at Elwood Street, 445 feet north of origin (area dimensions = 3 feet by 18 feet). Photo is looking west.

Figure D-2. Sample #2 taken on south bound lane of 43rd Avenue at Elwood Street, 445 feet north of the origin (area dimensions = 6 feet by 18 feet). Photo is looking southwest.

Figure D-3. Sample #3 (above photo) taken on the northbound lane of 43rd Avenue, 910 feet north of origin (area dimensions = 2 feet by 18 feet). Sample #4 taken directly across (west) from Sample #3 on the southbound lane, just north of exit road from the dirt storage pile (area dimensions = 6 feet by 18 feet). Photo is looking northwest.

Figure D-4. Sample #5 (above photo) was taken on the south bound lane, 2003 feet north of the origin (Area dimensions = 6 feet by 17 feet). Sample #6 was taken directly across (east) from Sample #5 on the north bound lane (Area dimensions = 3 feet by 18 feet). Photo is looking east.

Figure D-5. Sample #7 (above photo) was taken just south of Lower Buckeye Rd (note traffic light) on the northbound lane of 43rd Avenue, 2,840 feet north of the origin (area dimensions = 3 feet by 26 feet). Sample #8 was taken across (west) from sample #7 on the southbound lane (area dimensions = 6' by 18'). Photo is looking east.

Figure D-6. Example of trackout on exit road onto 43rd Avenue & Elwood Road, that is used by the Glenn Weinberger Company. Photo is looking east.

Results of Silt Analysis

The eight trackout samples were sent to an engineering laboratory, Kleinfelder, for silt analysis. This analysis consisted of weighing a sample for total weight and then weighing the resulting fine material or silt that passed through a #200 mesh screen. See Figure D-7 for a copy of the silt analysis results from Kleinfelder. The silt loading value from sample #3 (northbound lane of Site #2) is much higher than any of the other samples due to the large buildup of trackout at this location which was quite deep and thus resulted in a large value of silt per unit area. However, not all of the silt at Site #2 may have been available for reentrainment, since only the top layer of the deep trackout was probably reentrained by vehicles driving over the trackout.

KLEINFELDER

1335 West Auto Drive
Tempe, Arizona 85284
Phone: (480) 763-1200

CLIENT: ADEQ
PROJECT: EPA

KLEINFELDER JOB #: 26124 (6)
KLEINFELDER LAB#' N/A

Sieve Analysis (ASTM C136)

SAMPLE NO.	WEIGHT OF MATERIAL PASSING #200 MESH SCREEN	WEIGHT OF TOTAL SAMPLE	PERCENT PASSING #200
1	56.3	470.1	12.0
2	32.8	419.9	7.8
3	181.5	2561.5	7.1
4	12.7	90.3	14.1
5	3.5	39.7	8.8
6	43.9	372.4	11.8
7	57.5	541.8	10.6
8	5.2	53.3	9.8

Figure D-7. Sieve analysis results from eight trackout samples.

Table D-1 lists the percent silt and silt loading values for the eight trackout samples collected on 43rd Avenue south of Lower Buckeye Road.

Table D-1 – Silt Loading				
Sample #	Distance from Origin (feet)	Percent Silt	Silt Loading (g/m^2)	Traffic Lane
1	455	12.0	11.2	Northbound
2	455	7.8	3.3	Southbound
3	910	7.1	54.3	Northbound
4	910	14.1	1.3	Southbound
6	2,003	11.8	8.8	Northbound
5	2,003	8.8	0.4	Southbound
7	2,840	10.6	7.9	Northbound
8	2,840	9.8	0.5	Southbound

A comparison of the silt loading values in Table D-1 shows that Sample #3 has an extremely high silt loading of 54.3 grams/meter^2. It was assumed that this value was an outlier due to the deep trackout that was present at the area of 43rd Avenue where Sample #3 was collected. Thus, the silt loading value for Sample #3 was not used. Based on the other values in Table D-1, the upper and lower limits of silt loading for trackout was set to 12 grams/meter^2 as a maximum and 0.4 grams/meter^2 as a minimum.

Please note that the silt loading values listed for the southbound lane in Table D-1 most likely represent trackout that has migrated from the adjacent northbound lane that has heavier trackout loadings.

Figure D-7 shows the relationship between percent silt in the trackout samples (northbound and southbound lanes) with increasing distance from the origin of the sampling on 43rd Avenue (southern end of 43rd Avenue where paving begins).

Figure D-8 shows the relationship between silt loading in the trackout samples (northbound and southbound lanes) with increasing distance from the origin of the sampling on 43rd Avenue.

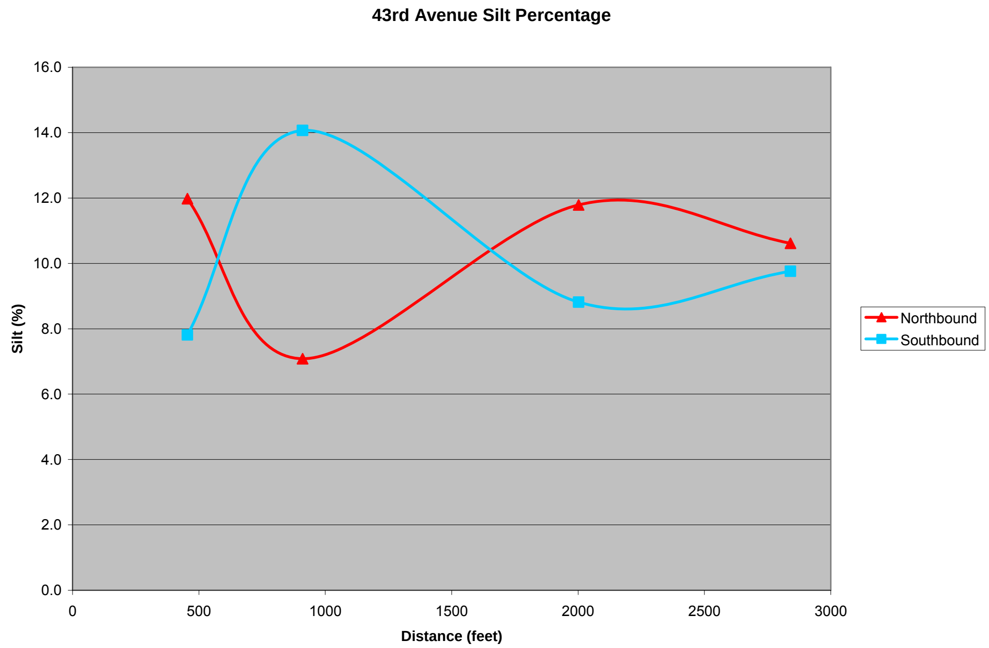


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Figure D-7. Silt Percentage From Trackout on 43rd Avenue

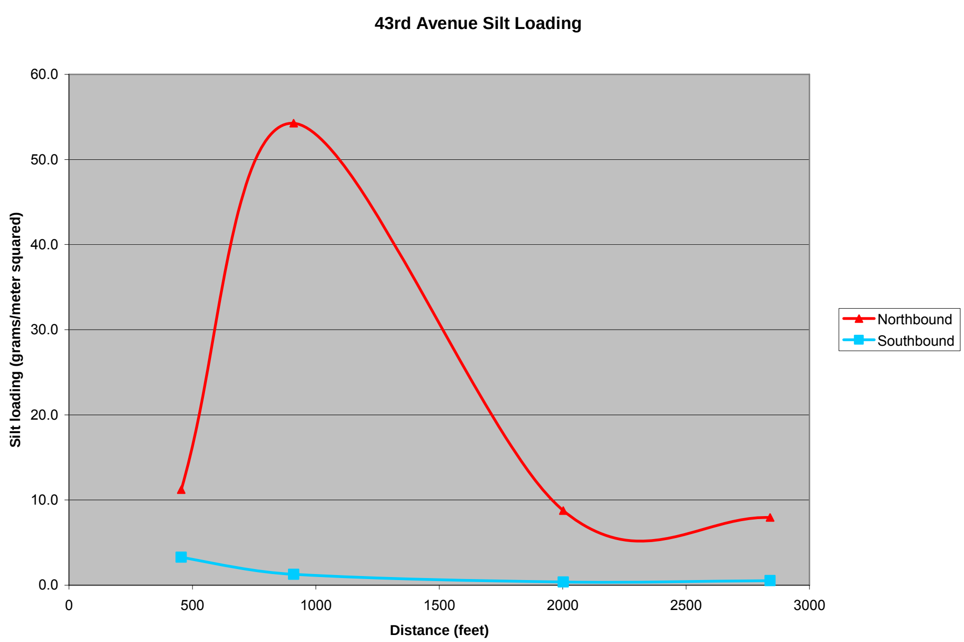

Figure D-8. Silt Loading From Trackout on 43rd Avenue

Table D-2 lists the criteria used to derive the four classes of trackout and their associated silt loadings and emission factors.

TABLE D-2 Trackout and Emission Factors			
Trackout Classification	**Description**	**Silt Loading (g/m^2)**	**Emission Factor (g/VMT)**
Class 1 Extreme	Equivalent to heavy trackout found on 43rd Avenue south of Lower Buckeye Road	8 – 11 Avg. = 9	29
Class 2 Average	Equivalent to the trackout values recommended by ADOT. Emission factor is approximately 6X larger than the average primary road emission factor (Class 4 in this table) per ADOT guidance.	3	12
Class 3 Minimum	Equivalent to silt loading halfway between Class 2 value (3 g/m^2) and Class 4 value (0.3 g/m^2). Emission factor is also halfway between Class 2 value (12 g/VMT) and Class 4 value (2 g/VMT).	1.65	7
Class 4 No Trackout	No trackout associated with this class. The silt loading and emission factor are equivalent to average values for primary roads in study area.	0.3	2

Summary

Based on the results of the ADEQ Trackout study, it appears that silt loading from areas with different amounts of trackout can range from a high of 11.2 grams/meter^2 to a low of 0.4 grams/meter^2, which results in emission factors that range from a high of 29 g/VMT to a low of 2 g/VMT.

APPENDIX E – ALLUVIAL CHANNEL STUDY

ADEQ staff did a field survey of the portion of the Salt River Alluvial Channel between 35th Avenue and 51st Avenue in the Salt River PM_{10} Study Area during March 2004. The purpose of the study was to identify and quantify areas of the alluvial channel that have different soil stabilities and thus different wind erosion potential.

Methodology

ADEQ staff did a number of field surveys of the Salt River Alluvial Channel and identified the location and extent of three categories of areas with wind erosion potential. These categories were: (1) Maximum PM_{10} Emissions, (2) Moderate PM_{10} Emissions, and (3) Minimum PM_{10} Emissions based the soil stability and silt content of the areas. The locations of these areas were annotated on a printout of a satellite image (IKONOS, March 2002). Representative soil samples from the Maximum, Moderate, and Minimum PM_{10} Emissions areas were also collected and sent to an engineering laboratory for silt analysis.

In the office, ADEQ GIS staff digitized the annotated satellite image printout and produced a new map showing the location and extent of the three wind erosion potential categories. Using the new map, ADEQ staff did an additional survey of the alluvial channel to verify that the categories had been correctly assigned. ADEQ GIS staff then calculated the surface area of the three wind erosion potential categories for each of the modeling grid cells that coincided with the Salt River Alluvial Channel. See Figure E-1 for map that shows the location of the areas with wind erosion potential with an overlay of the property ownership in that section of the Salt River Alluvial Channel.

ADEQ staff assigned emission factors to the three wind erosion potential categories based on the surveys and results of the silt analysis of the Salt River alluvial channel. Following are the three categories and their emission factors:

- Moderate (Average) PM_{10} Emissions – These areas were assigned the same AP-42 emission factor as that used for vacant lots and misc. disturbed areas ($6.22 * 10^{-8}$ g / cm^2 – sec).

- Minimum PM_{10} Emissions - These areas were assigned an emission factor which was 1/2 the emission factor used for vacant lots and misc. disturbed areas ($3.11 * 10^{-8}$ g / cm^2 – sec).

- Maximum PM_{10} Emissions – These areas were assigned an emission factor which was six times larger than the emission factor used for vacant lots and misc. disturbed areas. The rationale for the using a multiplier factor of six is that alluvial soils act as almost an infinite source of particulates for wind erosion, whereas other soil types typically stop producing PM_{10} emissions after about one hour of wind erosion. In addition, alluvial soils have a larger silt content and a lower wind speed threshold for wind erosion which leads to higher production of PM_{10} emissions ($37.32 * 10^{-8}$ g / cm^2 – sec)

Summary

The Salt River Alluvial Channel Study identified three types of areas in the Salt River Alluvial Channel that have wind erosion potential ranging from maximum PM_{10} emissions to minimum PM_{10} emissions. The areas that had a potential for high PM_{10} emissions from wind erosion generally had a high silt content and very loose soil (little plant cover or rocks). The areas that had a potential for low PM_{10} emissions generally had a lower silt content and the surface was partially stabilized by plants, rocks, or gravel.

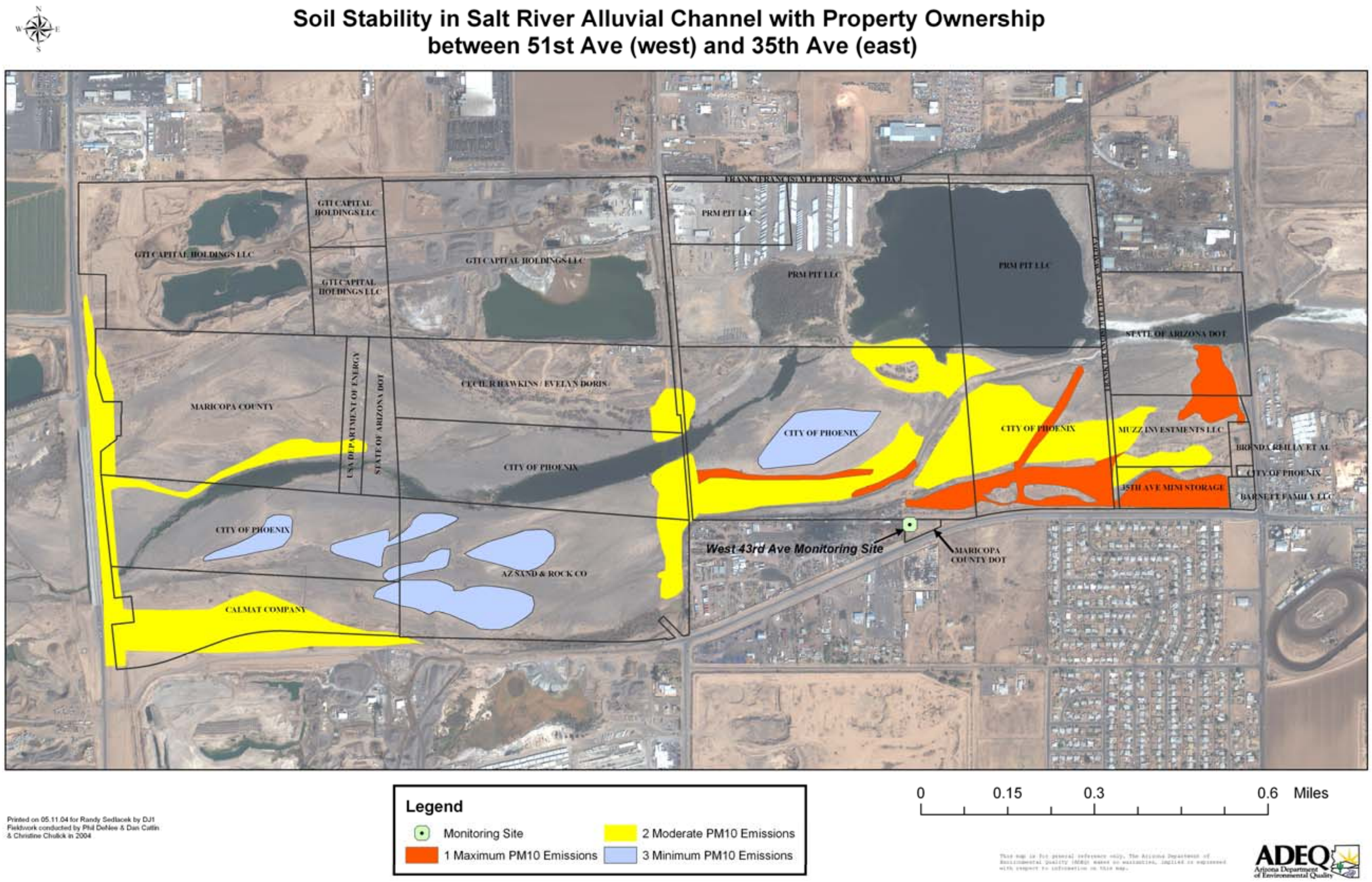

Figure E- 1 Soil Stability in Salt River Alluvial Channel With Property Ownership

APPENDIX F - AGRICULTURAL HARVEST AND TILLAGE

Estimation of PM10 Emissions from Agricultural Tillage and Harvest in Salt River PM10 Study Area

Following is a description of the methods and data used to estimate PM10 emissions from agricultural tillage (land preparation) and harvest activities, and wind erosion of agricultural land in the Salt River PM10 Study Area.

Identification of Crops

The types of crops and the locations of the fields in the Salt River PM10 Study area were identified through a number of steps:

1. Field surveys – ADEQ staff located agricultural fields and identified some of the crop types using printouts of a gridded satellite image (IKONOS, Date: March, 2002) of the Salt River PM10 Study Area.

2. May 21, 2003 Meeting - Maricopa County Farm Bureau and University of Arizona Cooperative Extension Service staff provided ADEQ with detailed information on the crops that were present in the study area during ADEQ's 'Year 2002 PM10 intensive monitoring study.

3. Digitizing – ADEQ staff digitized the following crop areas on the gridded satellite image of the Salt River PM10 Study Area based on the field surveys done by ADEQ staff (see Figure F-1):
   - Corn (Haylage)
   - Corn / Developing / Developed
   - Cotton
   - Oats (Haylage)
   - Pasture / Corn / Milo
   - Pasture / Alfalfa
   - Alfalfa / Oats
   - Vegetables
   - Alfalfa
   - Bermuda Grass
   - Nursery / Greenhouse
   - Pasture

   Crop types such as "Pasture / Corn / Milo" denote a transition in crops. For example, the fields started as out as pasture, then was planted in corn, and then milo during the study period.

   GIS was used to calculate the area (square meters) of each of the above crop types in each grid cell of the Salt River PM10 Study Area.

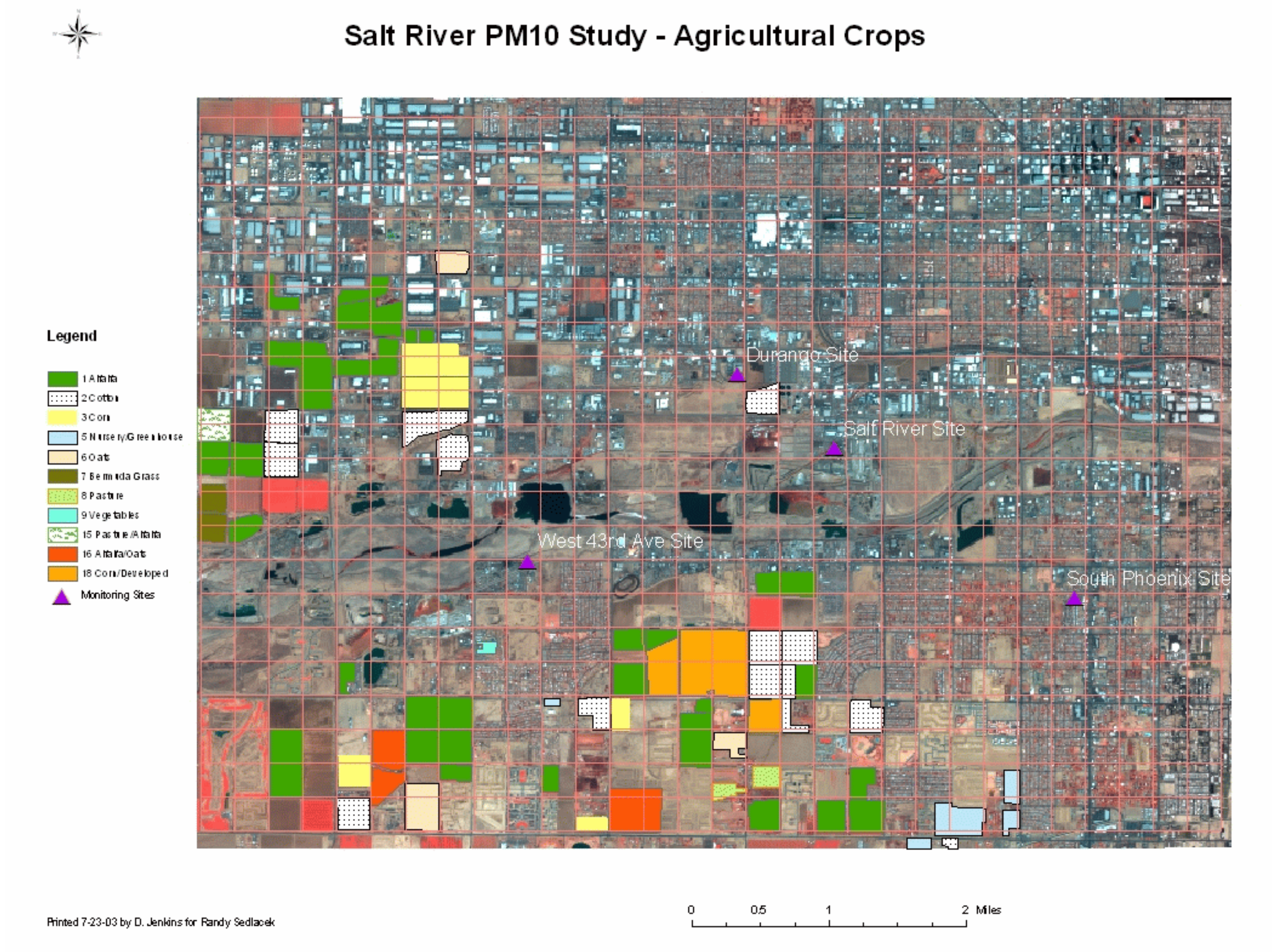

Figure F-1 Agricultural Crops in Salt River PM10 Study Area

Crop Calendar
A crop calendar (see Table F-1) was developed to show the time period that agricultural tillage and harvesting occurred in the Salt River PM10 Study Area. The calendar was based:

- May 21, 2003 meeting with Maricopa County Farm Bureau, and University of Arizona Cooperative Extension Service.

- July 1, 2003 phone call with Maricopa County Farm Bureau

- June 11, 24, 26 and July 1, 2003 phone calls with Patrick Clay

- ADEQ's analysis of quarterly aerial photography books for Year 2002 ("The Aerial Photo Book", Rupp Aerial Photography, 4811 North 7th Street, Phoenix, AZ 85014, Phone: 602-277-0439) to define the months when the land use transition occurred in the "Corn / Developing / Developed" category.

- University of Arizona Cooperative Extension Service website on crop budgets (http://www.ag.arizona.edu/arec/ext/budgets/Maricopa-map.html)

Agricultural Tillage and Harvest Days
The design days selected by ADEQ for modeling ambient PM10 concentrations in the Salt River PM10 Study Area were compared to the previously mentioned crop calendar (Table F-1) to determine which design days may have had agricultural tillage and / or agricultural harvest activity.

Following are the design days that were compared to the crop calendar:

- Primary Design Days
  - January 8, 2002
  - April 15, 2002 (high wind day)
  - April 26, 2002 (high wind day)
  - December 16, 2002

- Optional Design Days
  - May 9, 2002
  - June 25, 2002
  - July 2, 2002
  - August 26, 2002
  - November 9, 2002
  - November 22, 2002

After reviewing the crop calendar, it was found that January 8, 2002 was the only design day that had a potential for agricultural tillage activity. The crops that may have had tillage activity for this design day were corn (haylage) and cotton. Also after reviewing the crop calendar, it was found that four design days had a potential for agricultural harvest activity: May 9, 2002, July 2, 2002, November 9, 2002 and November 22, 2002. The crops that may have been harvested on these four days were cotton, corn, oats, milo.

Table F-1 Year 2002 Crop Calendar for Salt River PM10 Study Area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Corn (Haylage)	Tilling	Tilling	Planting		Crop in Field	Crop in Field	Harvest					
Corn / Developing/Developed	Tilling	Tilling	Planting		Crop in Field	Crop in Field	Harvest					
Cotton	Tilling	Tilling	Tilling	Planting		Crop in Field	Crop in Field	Crop in Field	Crop in Field	Harvest	Harvest	
Oats (Haylage)	Crop in Field	Harvest	Crop in Field	Crop in Field	Harvest				Tilling	Planting	Planting	Crop in Field
Pasture/Corn/Milo	Crop in Field	Tilling	Planting		Crop in Field	Crop in Field	Harvest	Planting		Crop in Field	Harvest	
Pasture/Alfalfa	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Tilling	Planting	Planting	Crop in Field	Crop in Field
Alfalfa/Oats	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Tilling	Planting	Planting	Crop in Field
Vegetables	Crop in Field	Tilling	Planting		Crop in Field	Crop in Field	Crop in Field	Tilling	Planting		Crop in Field	Crop in Field
Alfalfa	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field
Bermuda Grass	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field
Nursery/Greenhouse	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field
Pasture	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field	Crop in Field
Design Days (red = high wind day)	1/8/03			4/15/02 (red) 4/26/02 (red)								12/16/02
Design Days – Optional					5/9/02	6/25/02	7/2/02	8/26/02			11/9/02 (red) 11/22/02	

Legend:

Source of Data:

- May 21, 2003 Meeting with Maricopa County Farm Bureau and U of A Cooperative Extension, July 1, 2003 call
- June 11, 24, 26, July 1, and December 10, 2003 Phone Calls with U of A Cooperative Extension

Note: Wind erosion during planting months is reduced due to irrigation keeping topsoil moist. Harvesting crop as haylage produces minimal emissions since crop is harvested green. May not landplane every year.

Tilling =	(gray)	Planting =	(green)	Crop in Field =	(teal)	Harvest =	(yellow)

Percent Tilling Activity on Design Day

According to the University of Arizona Cooperative Extension Service, tilling for corn typically occurs from the months of January through February, while tilling for cotton typically occurs from January through March. The potential percent tilling activity for the January 8, 2002 design day was calculated following the methodology in the URS and ERG report ("Technical Support Document for Quantification of Agricultural Best Management Practices", Prepared for Arizona Department of Environmental Quality, ADEQ Contract No. 98-0159-BF, Task Assignment No. 00-0210-01, June 8, 2001. Prepared by URS Corporation, 10389 Old Placerville Road, Sacramento, CA 95827 and Eastern Research Group, Inc., 8950 Cal Center Drive, Suite 260, Sacramento, CA 95826-3259).

Paula Fields' methodology assumes that the tilling activity over a given period (e.g., two months for corn and three months for cotton) follows a normal distribution with activity levels peaking towards the middle of the tilling period. A summary of the methodology:

1. The tilling period for each specific crop (in this case, corn and cotton) was divided into 5 segments following the normal distribution curve convention.

2. Each segment was then assigned the number of days in the tilling period according to its percentage of the normal curve.

3. The corresponding calendar days were assigned to each of the five segments for each crop type.

4. Percent tilling activity for each segment was assumed to be::
   - Segment 1 = 10%
   - Segment 2 = 20%
   - Segment 3 = 40%
   - Segment 4 = 20%
   - Segment 5 = 10%

5. Percent tilling activity per day was calculated by dividing the percent tilling activity per segment (step #4) by the number of tilling days per segment (step #2).

6. The percent tilling activity for a design day was found from the appropriate segment for the design day (e.g., segment #1 for corn is from January 1 - January 10. January 8 is thus in segment #1).

Following the above methodology, the percent tilling activity for the January 8, 2002 design day was 1% for both corn (haylage) and cotton. Table F-2 lists the calculations used to determine the percent tilling activity per day for corn (haylage) and cotton.

Table F-2 Agriculture Tilling Days in Salt River PM10 Study Area

A	B	C	D	E	F	G	H
CORN (Tilled from Jan - Feb):						Percent	Percent
	Tilling Activity	Tilling	Tilling	Tilling	Tilling	Tilling	Tilling Activity
	Percent	Jan - Feb	Days	Calendar Days	Activity	Activity	On Jan. 8 Design Day
Segment	(Bell Curve)*	Total Days	Per Segment	Per Segment	Per Segment*	Per Day	
			(B * C)			(F / D)	
1	17%	59	10	Jan 1 - Jan 10	10%	1%	1%
2	11%	59	6	Jan 11 - Jan 16	20%	3%	N/A
3	44%	59	26	Jan 17 - Feb 12	40%	2%	N/A
4	11%	59	6	Feb 13 - Feb 18	20%	3%	N/A
5	17%	59	10	Feb 19 - Feb 28	10%	1%	N/A
COTTON (Tilled from Jan - March):						Percent	Percent
	Tilling Activity	Tilling	Tilling	Tilling	Tilling	Tilling	Tilling Activity
	Percent	Jan - Feb	Days	Calendar Days	Activity	Activity	On Jan. 8 Design Day
Segment	(Bell Curve)*	Total Days	Per Segment	Per Segment	Per Segment*	Per Day	
			(B * C)			(F / D)	
1	17%	90	15	Jan 1 - Jan 15	10%	1%	1%
2	11%	90	10	Jan 16 - Jan 25	20%	2%	N/A
3	44%	90	40	Jan 26 - Mar 6	40%	1%	N/A
4	11%	90	10	Mar 7 - Mar 16	20%	2%	N/A
5	17%	90	15	Mar 17 - Mar 31	10%	1%	N/A

Notes: * Distribution of Tilling Activity from U of A Cooperative Extension Service as listed in Agricultural BMP Technical Support Document, URS and ERG, under contract to ADEQ, June 8, 2001

Wind Erosion from Agriculture

The three design days (total design days = 10) classified as high wind days were compared to the crop calendar (Table F-1) to determine which of these days have a potential for wind erosion of agricultural land and for which crops. The April 15, 2002 and April 26, 2002 design days have a potential for wind erosion of agricultural fields with corn (haylage), cotton, and vegetables. While, the November 9, 2002 design day has a potential for wind erosion of agricultural fields with oats. ADEQ input the gridded agricultural land subject to wind erosion to GRIDTEST (in-house emissions processor) to produce an input file for this category to the ISC model.

Agricultural fields are considered to be vulnerable to wind erosion when the topsoil has been disturbed (e.g., by tilling) and before the crop is tall enough to shield the soil from wind. However, Irrigation and the development of a crust on the soil (in the Salt River PM10 Study Area) during the month a crop is planted will reduce wind erosion.

The fields for some crops are tilled after harvest, while other crops are not tilled until shortly before planting. This is reflected in the crop calendar. University of Arizona Cooperative Extension Service provided the information on the typical months for wind erosion for the crops present in the Salt River PM10 Study Area.

Design Day PM10 Emissions from Ag Tillage

1. Emission Factor:

Tillage emissions for the January 8, 2002 design day were calculated using the tillage emission factor equation listed in Section 9.1 of U. S. EPA's AP-42 report (U.S. EPA, 1995):

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

Where:

EF = agricultural emission tillage factor (lbs PM10 / acre-pass)
k = particle size multiplier (value of 0.15 for PM10)
s = silt content of soil (percent)

Assume:

s = 35.2% (URS, 2001)

Then:

$$EF = 0.15 \times 4.8 \times (35.2)^{0.6} = 6.10 \text{ lbs PM10 / acre-pass}$$

2. Design Day PM10 Emissions

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

Where:

$Tillage_{Crop}$	=	tillage emissions for a specific crop type (lbs PM10)
EF	=	tillage emission factor (lbs PM10 / acre-pass)
AP_{Crop}	=	number of tillage passes per crop (passes)
A_{Crop}	=	surface area of tilled land for a specific crop type (acres)
AF_{Crop}	=	fraction of annual tillage activity occurring on design day

Assume for Cotton:

EF	=	6.10 lbs PM10 / acre-pass
AP_{Crop}	=	7 tillage passes (laser level, rip, disk, landplane, incorporate herbicide / disk, list, mulch from URS, 2001)
A_{Crop}	=	acres of cotton fields per grid cell of modeling domain
AF_{Crop}	=	0.01 (for January 8, 2002 design day)

Then PM10 emissions for tillage of cotton for the January 8, 2002 Design Day for each grid cell in the Salt River PM10 Study Area would be calculated using the following equation:

$Tillage_{Cotton}$ = 6.10 lbs PM10 / acre-pass x 7 passes x A_{Crop} x 0.01

= **0.427 lbs PM10 / acre of cotton**

Converting to metric :

0.427 lbs PM10 / acre x 453.6 grams / lb x 1 acre / 4047 sq. meter = **0.0479 g PM10 / sq. meter of cotton field**

Assume for Corn (haylage):

EF	=	6.10 lbs PM10 / acre-pass
AP_{Crop}	=	5 tillage passes (laser level, rip, disk, landplane, incorporate herbicide / disk, from URS, 2001)
A_{Crop}	=	acres of corn (haylage) fields per grid cell of modeling domain
AF_{Crop}	=	0.01 (for January 8, 2002 design day)

Then PM10 emissions for tillage of corn (haylage) for the January 8, 2002 Design Day for each grid cell in the Salt River PM10 Study Area would be calculated using the following equation:

$Tillage_{Corn}$ = 6.10 lbs PM10 / acre-pass x 5 passes x A_{Crop} x 0.01

= **0.305 lbs PM10 / acre of corn (haylage)**

Converting to metric :

0.305 lbs PM10 / acre x 453.6 grams / lb x 1 acre / 4047 sq. meter = **0.0342 g PM10 / sq. meter of corn field**

Design Day PM10 Emissions from Ag Tillage with Ag BMPs

The PM10 tillage emission factors calculated in the previous section for the January 8, 2002 design day do not take into account the emissions reductions from the recent implementation of the general permit for agricultural best management practices which includes control measures for agricultural tillage [The Arizona Administrative Register (A.A.R), Title 18, Chapter 2, §609-611 contains the rulemaking for the "Agricultural PM10 General Permit."].

Three agricultural best management practices are listed in the Agricultural PM10 General Permit for tillage with quantifiable PM10 emission reductions:

- Combining Tractor Operations - midpoint control efficiency of 7.9%
- Limited Activity During High Wind Events - midpoint control efficiency of 9.3%
- Multi-Year Crops - midpoint control efficiency of 15.8%

The "Combining Tractor Operations" best management practice was selected for the January 8, 2002 design day because this design day was not considered a high wind event and for the time period of the monitoring study, fields with multi-year crops had already been identified

Following are the design day tillage emission factors for cotton and corn (haylage) after accounting for the potential emission reductions from farmers selecting the Combining Tractor Operations best management practice (Ag BMP) for their cotton and corn fields.

Cotton Tillage Emissions after using Combining Tractor Operations Ag BMP:

$\text{Tillage}_{\text{Cotton \& BMP}}$ = 0.0479 g PM10 / sq. meter of cotton field x (100% - 7.9%)

= **0.0442 g PM10 / sq. meter of cotton field**

Corn (Haylage) Tillage Emissions after using Combining Tractor Operations Ag BMP:

$\text{Tillage}_{\text{Corn \& BMP}}$ = 0.0342 g PM10 / sq. meter of corn field x (100% - 7.9%)

= **0.0315 g PM10 / sq. meter of corn (haylage) field**

ADEQ used the above tillage emission factors for cotton and corn (haylage) that account for the emission reductions from the Combining Tractor Operations Ag BMP in GRIDTEST (in-house emissions processor) along with data on the spatial extent of cotton and corn fields by individual grid cells of the Salt River PM10 Study Area to produce an input file of gridded and temporally allocated agricultural tillage PM10 emissions for the ISC model.

The total amount of cotton and corn in the Salt River PM10 Study Area that was tilled on the January 8, 2002 design day were 1,769,600 m^2 of cotton and 856,000 m^2 of corn (haylage).

Design Day PM10 Emissions from Harvesting

After reviewing the crop calendar, it was found that the four optional design days, May 9, 2002, July 2, 2002, November 9, 2002 and November 22, 2002, may have had harvest activity for cotton, corn (haylage), oats (haylage), and milo (haylage) in the Salt River PM10 Study Area. However, harvest emissions from crops grown for haylage (in this case, corn, milo, and oats) are considered negligible since these crops are harvested green for haylage (Fish and Clay, 2003) and thus will not be considered as a PM10 source. Following is discussion of the calculations used to estimate PM10 emissions from cotton harvesting.

Cotton harvest emissions for the two design day were calculated using the harvest emission factor developed by the Air Resource Board (ARB, 1997), 1.12 lbs PM10 / acre. It should be noted that a recent ARB draft report lists the cotton harvest emission factor as 3.41 lbs PM10 / acre. Following is the equation used to calculate cotton harvest emissions for the two design days

$$Harvest_{Crop} = EF \times A_{Crop} \times AF_{Crop}$$

Where:

$Harvest_{Crop}$	=	harvest emissions for a specific crop type (lbs PM10)
EF	=	harvest emission factor (lbs PM10 / acre-pass)
A_{Crop}	=	surface area of harvested land for a specific crop type (acres)
AF_{Crop}	=	fraction of annual tillage activity occurring on design day

Assume for Cotton:

EF	=	1.12 lbs PM10 / acre
A_{Crop}	=	acres of cotton fields per grid cell of modeling domain
AF_{Crop}	=	0.010 (based on 99 harvest days per year for cotton. 1 design day / 99 days = 0.01)

Then PM10 emissions for harvest of cotton for the November 9 and 22, 2002 Design Day for each grid cell in the Salt River PM10 Study Area would be calculated using the following equation:

$$Harvest_{Cotton} = 1.12 \text{ lbs PM10 / acre} \times A_{Crop} \times 0.01$$

$$= 0.0112 \text{ lbs PM10 / acre of cotton}$$

Converting to metric:

0.0112 lbs PM10 / acre x 453.6 grams / lb x 1 acre / 4047 sq. meter = **0.00126 g PM10 / sq. meter of cotton field**

Design Day PM10 Emissions from Ag Harvesting with Ag BMPs

The PM10 cotton harvest emission factors calculated in the previous section for the November 9 and 22, 2002 design days do not take into account the emissions reductions from the recent implementation of the general permit for agricultural best management practices which includes control measures for agricultural harvest [The Arizona Administrative Register (A.A.R), Title 18, Chapter 2, §609-611 contains the rulemaking for the "Agricultural PM10 General Permit."].

Two agricultural best management practices are listed in the Agricultural PM10 General Permit for agricultural harvesting with quantifiable PM10 emission reductions (URS, 2001):

- Combining Tractor Operations - midpoint control efficiency of 17%
- Reduced Harvest Activity - midpoint control efficiency of 20%

The “Combining Tractor Operations” best management practice was selected for the November 9 and 22, 2002 design days to be consistent with the previous Ag BMP selected for the section on tilling emissions and that this BMP has a higher probability of being used by farmers than the reduced harvest activity BMP which entails a larger change to standard farming practices.

Following is the design day emission factor for cotton harvesting that accounts for potential emission reductions from farmers selecting the Combining Tractor Operations best management practice for their cotton fields.

Cotton Harvesting Emissions after using Combining Tractor Operations Ag BMP:

$Harvest_{Cotton\ \&\ BMP}$ = 0.00126 g PM10 / sq. meter of cotton field x (100% - 17%)

= **0.00105 g PM10 / sq. meter of cotton field**

ADEQ used the above emission factor for cotton harvesting that accounts for the emission reductions from the Combining Tractor Operations Ag BMP in GRIDTEST (in-house emissions processor) along with data on the spatial extent of cotton fields by individual grid cells of the Salt River PM10 Study Area to produce an input file of gridded and temporally allocated agricultural harvesting PM10 emissions for the ISC model.

Reduction in Agricultural Land by Year 2006

The Maricopa County Farm Bureau estimates that about eighty percent of agricultural land in the Salt River PM10 Study area will be replaced by residential and commercial uses between Year 2002 and 2006. This figure was corroborated by ADEQ’s analysis of the amount of agricultural land that was converted between March 2002 and December 2002. See Table F-3 for details of this analysis which involved satellite image analysis of March 2002 agricultural land and a field trip on December 12, 2003 to determine conversion of agricultural land.

Summary

Of the ten design days selected by the Evaluation Unit, following are the design days that have either potential agricultural tillage or harvesting activity in the Salt River PM10 Study Area:

- January 8, 2002 - agricultural tillage activity
- November 9, 2002 - harvesting activity
- November 22, 2002 - harvesting activity

The following PM10 emission equations were used in GRIDTEST, ADEQ's in-house emissions processor, to produce a file of gridded temporally allocated PM10 emissions for agricultural tillage and harvest activity in the Salt River PM10 Study Area. It was assumed that these activities would be during daylight hours and average 8 hours per day (URS, 2001).

1. Cotton Tillage PM10 Emissions after using Combining Tractor Operations Ag BMP:

$$\text{Tillage}_{\text{Cotton \& BMP}} = 0.0442 \text{ grams PM10 / square meter of cotton field}$$

2. Corn (Haylage) Tillage PM10 Emissions after using Combining Tractor Operations Ag BMP:

$$\text{Tillage}_{\text{Corn \& BMP}} = 0.0315 \text{ grams PM10 / square meter of corn (haylage) field}$$

3. Cotton Harvesting PM10 Emissions after using Combining Tractor Operations Ag BMP:

$$\text{Harvest}_{\text{Cotton \& BMP}} = 0.00105 \text{ grams PM10 / square meter of cotton field}$$

Table F-3 Conversion of Agricultural Land to Residential and Commercial Uses

Year 2002	Year 2002	Year 2003	Year 2003
North of Salt River	**South of Salt River**	**North of Salt River**	**South of Salt River**
Ag Land	Ag Land	Ag Land	Ag Land
(Square Meters)	(Square Meters)	(Square Meters)	(Square Meters)
5,161,678	9,144,532	4,734,478	4,771,732
Year 2002 Total	Year 2003 Total	Year 2002 – 2003 Change	Year 2002 – 2003 Change
Salt River Total	**Salt River Total**	**Salt River Land Change**	**Salt River % Change**
Ag Land	Ag Land	Ag Land	Ag Land
(Square Meters)	(Square Meters)	(Square Meters)	(% Annual Change)
14,306,210	9,506,210	4,800,000	0.335519 (33.6%)

TREND IN CONVERSION OF AG LAND BETWEEN YEAR 2002 TO YEAR 2006:

(Conversion of area north of Salt River is predominantly industrial and area south of Salt River is predominantly residential**)**

Year 2002	Year 2003	Year 2004	Year 2005	Year 2006
Salt River Total	**Salt River Total**	**Salt River Total**	**Salt River Total**	**Salt River Total**
Ag Land	Ag Land	Ag Land	Ag Land	Ag Land
(Square Meters)	(Square Meters)	(Square Meters)	(Square Meters)	(Square Meters)
14,306,210	9,506,210	6,316,699	4,197,329	2,789,047

Total Percent Conversion of Ag Land to Residential / Commercial between Years 2002 and 2006 = -80.5%

Sources of Data:

- Year 2002 surface area of agricultural land from March 2002 IKONOS satellite image digitized by ADEQ
- Year 2003 surface area of agricultural land from December 12, 2003 field trip by ADEQ

Methodology for Calculating Agricultural Land Conversion:

- The amount of agricultural land in the Salt River PM10 Study Area was determined for Years 2002 and 2003 through satellite image analysis, field surveys, and discussions with Maricopa County Farm Bureau and University of Arizona Cooperative Extension Service staff.

- Based on the Year 2002 and 2003 data, it was calculated that the projected annual decrease in agricultural land was 33.6%. This decrease was due to conversion of agricultural land to residential and commercial uses.

- The 33.6% decrease was applied to the amount of agricultural land in subsequent years (Years 2003, 2004 and 2005) to estimate the amount of agricultural land in Year 2006 (note, if a fixed acreage decrease of 4,800,000 square meters was subtracted per year, the acreage would become negative by 2005).

- Example: Projected Year 2004 agricultural land =

Year 2003 agricultural land x (1 – 0.335519) = 9,506,210 meter^2 X 0.664481 = 6,316,699 meter^2

References

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APPENDIX G – INDUSTRIAL AREA AND POINT SOURCES

OVERVIEW

The industrial sources listed in MCESD's Year 2001 database for the Salt River PM10 Study Area were separated into sources that would be modeled as industrial point sources and industrial area sources. Following are the "rules" used to select whether an industrial source in the Salt River PM10 Study Area would be characterized as a point source or an area source:

1) Salt River industrial sources size-ranked from 1 - 31 will be treated as point sources (#1 having the largest PM10 emissions) except for sources #17, 20, 23, 26 which will be treated as area sources due to the large distance between these sources and the four PM10 monitors.

2) All sources within a 3 x 3 grid around each of the four air quality monitors in the Salt River PM10 Study Area will be treated as a point source (grid cell = 400 meters x 400 meters).

3) The remaining industrial sources not classified as a point source in above rules #1 and #2 will be treated as an area source and their emissions will be added to the grid cell that the source is located.

Based on rules 1 - 3, the following thirty-one sources were initially selected to be modeled as industrial point sources:

- APS WEST PHX POWER PLANT
- UNITED METRO PLANT #11
- PHOENIX BRICK YARD
- METAL MANAGEMENT ARIZONA INC
- VULCAN MATERIALS CO-WESTERN
- THE PROCTER & GAMBLE MFG CO
- TRENDWOOD INC
- BUILDING PRODUCTS CO
- HANSON AGGREGATES OF ARIZONA
- VAW OF AMERICA INC
- GTI CAPITAL HOLDINGS LLC
- WESTERN ORGANICS INC
- TPAC A DIVISION OF KIEWIT WESTERN CO
- SOUTH MOUNTAIN GIN
- CORESLAB STRUCTURES (ARIZ) INC
- AMERON INTL-WATER TRANSMISSION GROUP
- OLSON PRECAST OF ARIZONA INC
- AJAX SAND & ROCK
- PHOENIX CEMENT TERMINAL
- SANDVICK EQUIPMENT & SUPPLY CO
- CITY OF PHOENIX 27TH AVE LANDFILL
- SCHUFF STEEL CO
- QUALITY BLOCK INC
- MARLAM INDUSTRIES INC
- MONIER LIFETILE LLC
- ROAD MACHINERY CO INC
- CHEVRON USA ASPHALT DIVISION

- ATC PHOENIX
- CITY OF PHOENIX WASTE WATER TREATMENT PLANT
- UNIVERSAL ENTECH
- U.S. GREEN FIBER

3 x 3 GRID ANALYSIS

Following is a discussion of the methodology used to determine which industrial sources were located in a 3 x 3 grid (based on modeling grid developed for Salt River PM10 Study Area with each grid cell 400 meter x 400 meter in size).

ADEQ did site visits and analysis of printouts of the satellite image of the Salt River PM10 Study Area to determine the industrial sources that are located within the area bounded by a 3 x 3 grid (400 x 400 meter grid cells) area around each of the four PM10 monitors. The following tables (Tables G-1 through G-4) list, by air quality monitor, the ID number of the grid cells included in the 3 x 3 grids and the industrial sources located within the 3 x 3 grid areas.

TABLE G-1 Durango PM_{10} Monitor

Grid Cell ID #	Industrial Source	Comments	Include in Point Source Category? (Yes / No)
375	Phoenix 27th Avenue Landfill	**Already included as a point source based on 1 - 31 size ranking. MCESD lists it has having emissions, However, Dan notes that the landfill has been capped and should have negligible PM10 emissions.**	Yes
376	Phoenix 27th Avenue Landfill	" "	Yes
377	Western Organics	Street address is listed as being in grid cell 377. In reality, their operations are located within grid cell 316, 346 or 347 (outside the area of interest).	No
405	No industrial sources		No
406	No industrial sources		No
407	No industrial sources		No
435	No industrial sources		No
436	No industrial sources		No
437	No industrial sources		No

Table G-2 Salt River PM_{10} Monitor			
Grid Cell ID #	Industrial Source	Comments	Include in Point Source Category? (Yes / No)
318	No industrial sources		No
319	No industrial sources		No
320	T-Pac Prestressed Concrete Manufacturing	**Already included as a point source based on 1 - 31 size ranking**	Yes
348	No industrial sources		No
349	No industrial sources		No
350	Chevron USA Asphalt Division		Yes
	T-Pac Prestressed Concrete Manufacturing	**Already included as a point source based on 1 - 31 size ranking**	Yes
378	City of Phoenix Waste Water Treatment Plan		Yes
379	ATC Phoenix		Yes
380	T-Pac Prestressed Concrete Manufacturing	**Already included as a point source based on 1 - 31 size ranking**	Yes

Table G-3 South Phoenix PM_{10} Monitor			
Grid Cell ID #	Industrial Source	Comments	Include in Point Source Category? (Yes / No)
175	No industrial point sources	This area consists mostly of housing and commercial property. There are some open/vacant land within this area. No industrial point sources appear to be close enough to impact this monitor.	No
176	“ ”	“ ”	No
177	“ ”	“ ”	No
205	“ ”	“ ”	No
206	“ ”	“ ”	No
207	“ ”	“ ”	No
235	“ ”	“ ”	No
236	“ ”	“ ”	No
237	“ ”	“ ”	No

Table G-4 West 43rd Avenue PM_{10} Monitor			
Grid Cell ID #	Industrial Source	Comments	Include in Point Source Category? (Yes / No)
189	No industrial sources	There is some commercial storage areas near the monitor but no industrial point sources within this area.	No
190	No industrial sources		No
191	No industrial sources		No
219	No industrial sources		No
220	No industrial sources		No
221	No industrial sources		No
249	No industrial sources	There could be a very significant impact on the monitor from off road vehicle (recreational use) usage.	No
250	No industrial sources	“ ”	No
251	No industrial sources	“ ”	No

Results of 3 x 3 Grid Analysis
Five industrial sources were found in the 3 x 3 modeling grid areas around the four PM10 monitors in the Salt River PM10 Study Area. Two of the sources had already been added to the "industrial point source" list based on their size ranking (i.e., within the top 31 highest emitters). The following three additional sources were added to the industrial point source list based on their locations within the 3 x 3 grid modeling grid area:

- Chevron USA Asphalt Division
- City of Phoenix Waste Water Treatment Plant
- ATC Phoenix

LISTING OF INDUSTRIAL POINT AND AREA SOURCES

Based on the previously mentioned three rules, two lists were compiled of industrial point sources and industrial area sources present in the Salt River PM10 Study Area. Table G-5 contains information on the industrial sources that were considered as point sources in preliminary modeling of ambient PM10 concentrations in the Salt River PM10 Study Area and Table G-6 contains information on the industrial sources that were be considered as area sources.

TABLE G-5 Maricopa County Industrial Sites in Salt River PM10 Study Area - Year 2001 PM10 Emissions
Industrial Sources Which Will Be Treated as Point Sources in Modeling

Data Source: Maricopa County Environmental Services Department

Note: Hourly emissions are based on a daily operating schedule of 8 hours

Modeling Grid Cell	Size Ranking	Business Name	Street Address	City	Zip Code	Annual Emissions (Pounds)	Annual Emissions (Tons)	Daily Emissions (Pounds)	Hourly Emissions (Pounds)
517	1	APS WEST PHX POWER PLANT	4606 W HADLEY ST	PHOENIX	85043	132107	66.05	361.94	45.24
291	2	UNITED METRO PLANT #11	3640 S 19TH AVE	PHOENIX	85009	56347	28.17	154.38	19.30
445	3	PHOENIX BRICK YARD	1814 S 7TH AVE	PHOENIX	85007	55602	27.80	152.33	19.04
282	4	METAL MANAGEMENT ARIZONA INC	3640 S 35TH AVE	PHOENIX	850096738	44996	22.50	123.28	15.41
219	5	VULCAN MATERIALS CO-WESTERN	4830 S 43RD AVE	PHOENIX	85041	29635	14.82	81.19	10.15
433	6	THE PROCTER & GAMBLE MFG CO	2050 S 35TH AVE	PHOENIX	85009	28932	14.47	79.27	9.91
413	7	TRENDWOOD INC	2402 S 15TH AVE	PHOENIX	850074400	24301	12.15	66.58	8.32
486	8	BUILDING PRODUCTS CO	4850 W BUCKEYE RD	PHOENIX	85043	24286	12.14	66.54	8.32
513	9	HANSON AGGREGATES OF ARIZONA	4002 S 51ST AVE	PHOENIX	85043	23951	11.98	65.62	8.20
575	10	VAW OF AMERICA INC	249 S 51ST AVE	PHOENIX	85043	23681	11.84	64.88	8.11
309	11	GTI CAPITAL HOLDINGS LLC	3636 S 43RD AVE	PHOENIX	85009	23102	11.55	63.29	7.91

TABLE G-5 Maricopa County Industrial Sites in Salt River PM10 Study Area - Year 2001 PM10 Emissions
Industrial Sources Which Will Be Treated as Point Sources in Modeling

Data Source: Maricopa County Environmental Services Department

Note: Hourly emissions are based on a daily operating schedule of 8 hours

Modeling Grid Cell	Size Ranking	Business Name	Street Address	City	Zip Code	Annual Emissions (Pounds)	Annual Emissions (Tons)	Daily Emissions (Pounds)	Hourly Emissions (Pounds)
377	12	WESTERN ORGANICS INC	2807 S 27TH AVE	PHOENIX	85009	21438	10.72	58.73	7.34
351	13	TPAC A DIVISION OF KIEWIT WESTERN CO	3052 S 19TH AVE	PHOENIX	850096926	18612	9.31	50.99	6.37
65	14	SOUTH MOUNTAIN GIN	6411 S 51ST AVE	LAVEEN	85339	16721	8.36	45.81	5.73
189	15	CORESLAB STRUCTURES (ARIZ) INC	5026 S 43RD AVE	PHOENIX	85041	13195	6.60	36.15	4.52
419	16	AMERON INTL-WATER TRANSMISSION GROUP	2325 S 7TH ST	PHOENIX	85034	9609	4.80	26.33	3.29
343	18	OLSON PRECAST OF ARIZONA INC	3045 S 35TH AVE	PHOENIX	85009	8378	4.19	22.95	2.87
185	19	AJAX SAND & ROCK	5026 S 51ST AVE	LAVEEN	85339	7432	3.72	20.36	2.55
382	21	PHOENIX CEMENT TERMINAL	1802 W LOWER BUCKEYE RD	PHOENIX	85007	6241	3.12	17.10	2.14
263	22	SANDVICK EQUIPMENT & SUPPLY CO	4020 S 15TH AVE	PHOENIX	85041	5496	2.75	15.06	1.88
376	24	CITY OF PHOENIX 27TH AVE LANDFILL	2800 S 27TH AVE	PHOENIX	85009	4684	2.34	12.83	1.60
378	25	CITY OF PHOENIX	2301 W DURANGO ST	PHOENIX	85009	4528	2.26	12.41	1.55

TABLE G-5 Maricopa County Industrial Sites in Salt River PM10 Study Area - Year 2001 PM10 Emissions
Industrial Sources Which Will Be Treated as Point Sources in Modeling

Data Source: Maricopa County Environmental Services Department

Note: Hourly emissions are based on a daily operating schedule of 8 hours

Modeling Grid Cell	Size Ranking	Business Name	Street Address	City	Zip Code	Annual Emissions (Pounds)	Annual Emissions (Tons)	Daily Emissions (Pounds)	Hourly Emissions (Pounds)
561	27	SCHUFF STEEL CO	420 S 19TH AVE	PHOENIX	85009	2317	1.16	6.35	0.79
343	28	QUALITY BLOCK INC	3035 S 35TH AVE	PHOENIX	85009	2217	1.11	6.07	0.76
390	29	MARLAM INDUSTRIES INC	834 E HAMMOND LN	PHOENIX	85034	2075	1.04	5.68	0.71
455	30	MONIER LIFETILE LLC	1832 S 51ST AVE	PHOENIX	85043	1387	0.69	3.80	0.47
539	31	ROAD MACHINERY CO INC	716 S 7TH ST	PHOENIX	85034	1215	0.61	3.33	0.42
351	37	CHEVRON USA ASPHALT DIVISION	3050 S 19TH AVE	PHOENIX	85009	571	0.29	1.56	0.20
379	45	ATC PHOENIX	2225 W LOWER BUCKEYE RD	PHOENIX	85009	185	0.09	0.51	0.06
224	26	UNIVERSAL ENTECH LLC	3330 W BROADWAY RD	PHOENIX	85041	4308	2.15	11.80	1.48
513	23	U S Greenfiber	601 S 55TH AVE	PHOENIX	85043	5414	2.71	14.83	1.85

Table G-6 Maricopa County Industrial Sites in Salt River PM10 Study Area - Year 2001 PM10 Emissions Industrial Sources Which Will Be Treated as Area Sources in Modeling									
Modeling Grid Cell	Size Ranking	Business Name	Street Address	City	Zip Code	Annual Emissions (Pounds)	Annual Emissions (Tons)	Daily Emissions (Pounds)	Hourly Emissions (Pounds)
459	17	WOODSTUFF MANUFACTURING INC	1635 S 43RD AVE	PHOENIX	850096026	2018	1.01	5.53	0.69
325	20	UNITED METRO MATERIALS #101	2875 S 7TH AVE	PHOENIX	85041	6550	3.28	17.95	2.24
229	32	SMITH PRECAST	2410 W BROADWAY RD	PHOENIX	85041	971	0.49	2.66	0.33
605	33	REXAM BEVERAGE CAN COMPANY	211 N 51ST AVE	PHOENIX	85043	798	0.40	2.19	0.27
343	35	BAKER COMMODITIES	3602 W ELWOOD ST	PHOENIX	85009	669	0.33	1.83	0.23
376	38	CITY OF PHOENIX 19TH AVE LANDFILL	1701 W LOWER BUCKEYE RD	PHOENIX	85041	445	0.22	1.22	0.15
529	39	HOLSUM BAKERY INC	2322 W LINCOLN ST	PHOENIX	850095827	433	0.22	1.19	0.15
489	40	HYDRO CONDUIT CORP	1011 S 43RD AVE	PHOENIX	85009	252	0.13	0.69	0.09
438	41	PHOENIX HEAT TREATING INC	2405 W MOHAVE RD	PHOENIX	850096413	207	0.10	0.57	0.07
513	42	CRAFTSMEN IN WOOD MFG	5441 W HADLEY ST	PHOENIX	85043	200	0.10	0.55	0.07
433	43	INSULFOAM	3401 W COCOPAH ST	PHOENIX	85009	192	0.10	0.53	0.07
576	44	HIGHLAND PRODUCTS INC	43 N 48TH AVE	PHOENIX	85043	186	0.09	0.51	0.06
501	46	AMERICAN LINEN SUPPLY CO	1875 W BUCKEYE RD	PHOENIX	85007	174	0.09	0.48	0.06
411	47	SUN VALLEY OAK	2465 S 19TH AVE	PHOENIX	85009	174	0.09	0.48	0.06
330	48	DEL RIO LANDFILL	1150 E ELWOOD ST	PHOENIX	85040	173	0.09	0.47	0.06
295	49	DESERT FIRE INDUSTRIES INC	720 W ILLINI ST	PHOENIX	850411108	168	0.08	0.46	0.06
576	50	MPP OF ARIZONA	230 S 49TH AVE	PHOENIX	85043	149	0.07	0.41	0.05
528	51	PACIFIC DESIGNS	2425 W SHERMAN ST	PHOENIX	85043	146	0.07	0.40	0.05

Table G-6 Maricopa County Industrial Sites in Salt River PM10 Study Area - Year 2001 PM10 Emissions Industrial Sources Which Will Be Treated as Area Sources in Modeling									
Modeling Grid Cell	Size Ranking	Business Name	Street Address	City	Zip Code	Annual Emissions (Pounds)	Annual Emissions (Tons)	Daily Emissions (Pounds)	Hourly Emissions (Pounds)
606	52	MAIL-WELL ENVELOPE	221 N 48TH AVE	PHOENIX	85043	139	0.07	0.38	0.05
328	53	GOODRICH AIRCRAFT INTERIOR PRODUCTS	3414 S 5TH ST	PHOENIX	85040	119	0.06	0.33	0.04
325	54	ACE ASPHALT OF ARIZONA INC	895 W ELWOOD ST	PHOENIX	85041	114	0.06	0.31	0.04
528	55	PAN-GLO WEST	2401 W SHERMAN ST	PHOENIX	85009	109	0.05	0.30	0.04
413	56	NATIONAL COUNTERTOPS & CABINET	2317 S 15TH AVE	PHOENIX	85007	106	0.05	0.29	0.04
578	57	PERMA-FINISH INC	74 N 45TH AVE	PHOENIX	85043	105	0.05	0.29	0.04
604	58	SHELL OIL / PHOENIX TEMINAL	5325 W VAN BUREN ST	PHOENIX	85043	104	0.05	0.28	0.04
475	59	PHOENIX MEMORIAL HOSPITAL	1201 S 7TH AVE	PHOENIX	85007	101	0.05	0.28	0.03
607	60	TROY BIOSCIENCES INC	113 N 47TH AVE	PHOENIX	85043	87	0.04	0.24	0.03
559	61	HENRY PRODUCTS INC	302 S 23RD AVE	PHOENIX	85009	85	0.04	0.23	0.03
414	62	CHEM RESEARCH CO INC	1122 W HILTON AVE	PHOENIX	85007	71	0.04	0.19	0.02
528	63	MEYER & LUNDAHL MANUFACTURING CO	2345 W LINCOLN ST	PHOENIX	85009	51	0.03	0.14	0.02
611	64	SUB ZERO FREEZER CO INC	3865 W VAN BUREN ST	PHOENIX	85009	48	0.02	0.13	0.02
570	65	UPPER CRUST BAKERY	220 S 9TH ST	PHOENIX	85034	43	0.02	0.12	0.01
528	66	J & A OAK INC	2452 W SHERMAN ST	PHOENIX	85009	35	0.02	0.10	0.01
327	67	GLENWOOD MFG INC	44 E PIONEER ST	PHOENIX	85040	34	0.02	0.09	0.01
295	68	BRYANT INDUSTRIES INC	788 W ILLINI ST	PHOENIX	85041	27	0.01	0.07	0.01
578	69	STOROPACK INC	77 N 45TH AVE	PHOENIX	85043	23	0.01	0.06	0.01

Table G-6 Maricopa County Industrial Sites in Salt River PM10 Study Area - Year 2001 PM10 Emissions
Industrial Sources Which Will Be Treated as Area Sources in Modeling

Modeling Grid Cell	Size Ranking	Business Name	Street Address	City	Zip Code	Annual Emissions (Pounds)	Annual Emissions (Tons)	Daily Emissions (Pounds)	Hourly Emissions (Pounds)
410	70	ADOT EQUIPMENT SERVICES	2225 S 22ND AVE	PHOENIX	85009	21	0.01	0.06	0.01
438	71	CAVCO INDUSTRIES LLC/DURANGO PLANT	2502 W DURANGO ST	PHOENIX	85009	21	0.01	0.06	0.01
403	72	CAVCO INDUSTRIES LLC	2602 S 35TH AVE	PHOENIX	85009	16	0.01	0.04	0.01
553	73	PURCELLS WESTERN STATES TIRE	420 S 35TH AVE	PHOENIX	85009	16	0.01	0.04	0.01
566	74	IMPERIAL LITHOGRAPH	210 S 4TH AVE	PHOENIX	85003	15	0.01	0.04	0.01
549	75	TEAM TWO DESIGN ASSOC INC	310 S 43RD AVE	PHOENIX	85009	14	0.01	0.04	0.00
574	76	UNITED MODULAR	5301 W MADISON ST	PHOENIX	85043	13	0.01	0.04	0.00
438	77	EQUIPMENT MAINTENANCE SERVICE	2412 W DURANGO ST	PHOENIX	85009	9	0.00	0.02	0.00
414	78	PRECISION INDUSTRIAL PAINTING	1139 W HILTON AVE	PHOENIX	85007	8	0.00	0.02	0.00
369	79	ZIEMAN MANUFACTURING CO	4205 W LOWER BUCKEYE RD	PHOENIX	85009	1	0.00	0.00	0.00
415	80	PHOENIX SPECIALTIES	1843 S 5TH AVE	PHOENIX	85003	1	0.00	0.00	0.00
383	81	INNOVATIVE WASTE UTILIZATION LLC	2550 S 15TH AVE	PHOENIX	85007	1	0.00	0.00	0.00

After additional inspection of the satellite images of the Salt River PM_{10} Study Area and field surveys, the original list of thirty-one industrial sources to be modeled as industrial point sources was revised to thirty-six sources. Following are the thirty-six sources that were input to the ISCST3 model as point sources:

- APS WEST PHX POWER PLANT
- UNITED METRO PLANT #11
- PHOENIX BRICK YARD
- METAL MANAGEMENT ARIZONA INC
- VULCAN MATERIALS CO-WESTERN
- THE PROCTER & GAMBLE MFG CO
- TRENDWOOD INC
- WOODSTUFF MANUFACTURING
- HANSON AGGREGATES OF ARIZONA
- VAW OF AMERICA INC
- WESTERN ORGANICS INC
- TPAC A DIVISION OF KIEWIT WESTERN CO
- SOUTH MOUNTAIN GIN
- CORESLAB STRUCTURES (ARIZ) INC
- AMERON INTL-WATER TRANSMISSION GROUP
- OLSON PRECAST OF ARIZONA INC
- AJAX SAND & ROCK
- PHOENIX CEMENT TERMINAL
- SANDVICK EQUIPMENT & SUPPLY CO
- CITY OF PHOENIX 27TH AVE LANDFILL
- SCHUFF STEEL CO
- QUALITY BLOCK INC
- MARLAM INDUSTRIES INC
- MONIER LIFETILE LLC
- ROAD MACHINERY CO INC
- CHEVRON USA ASPHALT DIVISION
- ATC PHOENIX
- CITY OF PHOENIX WASTE WATER TREATMENT PLANT
- UNIVERSAL ENTECH
- U.S. GREEN FIBER
- SOUTHWEST FOREST PRODUCTS
- SMITH PRECAST
- WESTERN BLOCK COMPANY
- ROCKLAND MATERIALS
- MCP INDUSTRIES, INC.
- WEINBERGER TOPSOIL

APPENDIX H - SITE VISITS

Following are field notes by ADEQ staff of their site visits to the Salt River PM10 Study Area.

Unpaved Parking Lots Survey
Aug 1, 2003 field trip was to determine which previously identified unpaved parking lots on the satellite image are actually unpaved, and to determine the number of vehicles (capacity of an unpaved parking lot and the frequency of vehicles entering and leaving unpaved parking lots.

Land Use Around Monitoring Sites Survey

<u>West 43rd Avenue Monitoring Site</u>
From the satellite image there were two areas that we decided to look at in grid cell 220. One area south of the monitor is a vehicle junkyard on a dirt lot (picture # 5). The dirt lot is enclosed by a fence that blocks the view of the lot. The other area is just west of the monitor and is an industrial storage lot with logs, concrete blocks, vehicles, construction equipment, etc. in storage (pictures 6 & 7). Northeast of the monitor in grid cells 250 & 251 is an active illegal open dump area (pictures 2, 3, & 4).

<u>Durango Monitoring Site</u>
In grid cell 405 are some large gravel covered parking areas near the county jail complex. See pictures 8, 9, & 10. In parts of grid cells 437, 438, 407, and 408 is a large truck tractor storage area. Appears to be paved. See picture 13. In grid cell 436 are some fenced in dirt lots (see picture 11). In grid cell 435 there is a large area that appeared to be a dirt lot from the satellite image. This area is now paved and fenced off (see picture 12).

<u>South Phoenix Monitoring Site</u>
Northwest of the monitoring site in grid cell 206 and 236 is a dirt lot open to the public. I was in this area about 10 am on July 31 for about 15 minutes. This lot had two cars parked on it this whole time and no additional vehicles drove onto or off of the lot during this time. I estimate that there is enough room to park 40 vehicles on this lot .

<u>Salt River Monitoring Site</u>
West of 19th Avenue in grid cell 320 is a large dirt area used by United Metro (a.k.a. Rinker Materials) for their concrete trucks. The north end of this area is paved (see pictures 14, 15, & 16). The emissions from this area should be included in the emissions inventory for United Metro. North of United Metro is Phoenix Metal Recycling.

APPENDIX I - MCESD RULE EFFECTIVENESS STUDY

Rule Effectiveness Study for Salt River PM_{10} Study

Revised Final

Compiled by: Renee Schindler
Maricopa County Environmental Services Department
Air Quality Division: Planning and Analysis Section

Final May 23, 2003
Revised December 18, 2003

Table of Contents

1.0 Executive Summary

In May 1997, ADEQ submitted *the Plan for Attainment of the 24-hour PM-10 Standard – Maricopa County PM-10 Nonattainment Area*, as a SIP revision. This plan, known as the microscale plan, included attainment and reasonable further progress (RFP) demonstrations for the 24-hour PM-10 standard at the Salt River air quality monitoring site. The attainment demonstration for the Salt River site showed that, with additional controls adopted by Maricopa County Environmental Services Department (MCESD) (improved control of emissions from earthmoving operations and strengthening its inspection program) and the City of Phoenix's commitment to work cooperatively with MCESD to reduce particulate pollution, attainment at the site would occur by May 1998. EPA approved the attainment and RFP demonstrations for the Salt River site and Maricopa County's controls on August 4, 1997 (62 FR 41856). According to the approved attainment demonstration, the Salt River site should not have violated the 24-hour PM-10 standard after May 1998. The site however continues to violate the standard. Based on data recorded in EPA's Aerometric Information Retrieval System (AIRS), the Salt River monitor had 51 expected exceedances in 1999, 43 expected exceedances in 2000, and 19 expected exceedances through 3 quarters in 2001 or an average of 37 expected exceedances per year over the past three years.[1] On July 2, 2002 (67 FR 44369), EPA found the state implementation plan (SIP) for the Metropolitan Phoenix area (Maricopa County), Arizona serious PM-10 nonattainment area to be inadequate to attain the 24-hour particulate (PM-10) air quality standard at the Salt River monitoring site. Under authority from the Clean Air Act, EPA has required a SIP revision to be submitted by the State of Arizona to correct the inadequacy.

The State of Arizona has implemented dust control regulations to help achieve a timely attainment for PM-10. The following Maricopa County and State Air Pollution Control Regulations apply to PM-10 control and can be found in Appendix A:

Maricopa County	Rule 310	Fugitive Dust Sources
Maricopa County	Rule 310.01	Fugitive Dust From Open Areas, Vacant Lots, Unpaved Parking Lots, and Unpaved Roadways
Maricopa County	Rule 316	Nonmetallic Mineral Mining and Processing
Arizona Administrative Code (AAC) R18-2-610 & 611		Agricultural PM10 General Permit

Within Maricopa County, the Maricopa County Air Pollution Control Regulations are applied in lieu of the state of Arizona's Administrative Code Article 6 rules (R18-2-604, 605, 606, and 607). The state of Arizona Air Quality Control General Permit for Crushing and Screening plants incorporates the requirements of Maricopa County Air Pollution Control Rule 310 for the dust control plan requirements and Rule 316 for the visible emission limitations for facilities that operate in Maricopa County. However, at the time of the study, there were no permitted portable sources in the Salt River study area.

To determine the effectiveness of the rules regulating PM-10 emissions in the Salt River Study area, a study team consisting of representatives from Arizona Department of Environmental Quality's Air Quality Division and Maricopa County's Environmental Services Department's Air Quality Division was established. The study team was tasked

[1] The 24-hour PM-10 standard is violated when the expected number of exceedances averages more than 1 per year over a three year period 40 CFR 50.6(a).

with determining the effectiveness of State and County rules for PM10 source categories located in and near the Salt River SIP area and determining compliance effectiveness with existing rules. The study consisted of a field inspection phase and an office investigation phase. The purpose of the field inspection phase was to observe the application of County Regulations. The office investigation phase focused on determining the level of compliance with applicable County Regulations by reviewing and analyzing the rule content, regulatory enforceability, inspection procedures, source files, and training and agency resource management.

An overall rule effectiveness (RE) was calculated using as a guideline EPA's *Rule Effectiveness Guidance: Integration of Inventory, Compliance and Assessment Applications*.[2] The RE correlates Maricopa County's findings to rule effectiveness, compliance effectiveness and SIP effectiveness. Based on the results of the study, recommendations for improvements for dust control and/or rule effectiveness have been offered.

As mentioned, field inspections were conducted as part of this rule effectiveness study. The field inspection types and results are listed below:

Compliance inspectors visited sites that are subject to the Maricopa County PM regulations. The inspectors included in the report which rules applied, which specific parts of the rule applied to the site, the type of site (earthmoving, vacant lot, nonmetallic facility), the compliance status of the site and if any compliance notifications were issued.

2.0 Background

On July 2, 2002, EPA found the state implementation plan (SIP) for the Metropolitan Phoenix area (Maricopa County), Arizona serious PM-10 nonattainment area to be inadequate to attain the 24-hour particulate (PM-10) air quality standard at the Salt River monitoring site. Under authority from the Clean Air Act, EPA has required a SIP revision to be submitted by the State of Arizona to correct the inadequacy.

The State of Arizona has implemented dust control regulations to help achieve a timely attainment for PM-10. The following Maricopa County and State Air Pollution Control Regulations apply to PM-10 control:

Maricopa County	Rule 310	Fugitive Dust Sources
Maricopa County	Rule 310.01	Fugitive Dust From Open Areas, Vacant Lots, Unpaved Parking Lots and Unpaved Roadways
Maricopa County	Rule 316	Nonmetallic Mineral Mining and Processing
AAC R18-2-610 & 611		Agricultural PM10 General Permit

Within Maricopa County, the Maricopa County Air Pollution Control Regulations are applied in lieu of the state of Arizona's Administrative Code Article 6 rules (R18-2-604, 605, 606, and 607) which address particulate matter emissions from open areas, dry washes, riverbeds, roadways, streets, material handling operations, and storage piles. The state of Arizona Air Quality Control General Permit for Crushing and Screening plants incorporates the requirements of Maricopa County Air Pollution Control Rule 310 for the dust control

[2] U.S. EPA, Office of Air Quality Planning and Standards, Rule Effectiveness Guidance: Integration of Inventory, Compliance and Assessment Applications, EPA-452/4-94-001, January 1994.

plan requirements and Rule 316 for the visible emission limitations for facilities that operate in Maricopa County. The state's agricultural PM10 General Permit was not included as part of this study because the amount of agricultural land are projected to decrease significantly due to conversion of agricultural land to residential and commercial uses.

2.1 Study Purpose and Goals

This study was conducted to review implementation and enforcement of Maricopa County Rules 310, 310.01, and 316 in the Salt River Study area. The review of particulate control included an examination of inspection procedures, compliance determinations, source compliance histories, rule enforceability, and source files. This was accomplished by performing a field inspection in conjunction with an office investigation, if appropriate.

The field inspections included visits to ten initial facilities for each rule in the Salt River Study area to determine the level of compliance with applicable County and State Regulations. The type of inspections that will be conducted will be consistent with what would be done presently within the department. The goals of this phase were:

- To determine whether MCESD and ADEQ inspection procedures are adequate to identify and reconcile compliance with rule requirements; and
- To determine the effect the rule has had on decreasing dust-causing pollution.

The office investigation phase focused on rule content and the internal policies and procedures that affect how rules are implemented and enforced, such as rule content, regulatory enforceability, inspection procedures, and training and agency resource management. Inspections will occur consistent to current department schedules. The goals of this phase were:

- To determine whether the current MCESD and ADEQ rule program could ensure that emission reductions for dust control are achieved;
- To evaluate the functions of MCESD and ADEQ emission inventory, permitting and compliance programs as they relate to attainment planning and emission reductions; and
- To determine whether MCESD and ADEQ programs are adequate to 1) determine compliance and 2) deter, detect and correct any instances of noncompliance.

2.2 Study Team

A 16-person team conducted the rule effectiveness study. The team included personnel from MCESD and the Arizona Department of Environmental Services (ADEQ). The following MCESD - Air Quality sections participated: Compliance, Engineering Services (Permitting), Planning and Analysis, and MCESD Community Services (Small Business Assistance).

2.3 Rule Summaries

The following includes a summary of all the Maricopa County rules this study is analyzing to determine their effectiveness in the Salt River area.

Rule 310

Rule 310 applies to all dust generating operations including open areas, vacant lots, unpaved parking lots, and unpaved roadways which are located at sources that require a permit under Maricopa County Rules. Normal farm cultural practices as defined under Arizona Revised Statutes (ARS) §49-457 and ARS §49-504.4 are exempt from this rule. With a 20% opacity limit, fugitive dust sources have to keep dust stabilized and control measures implemented at all times. Measures include installing signs restricting trespassing, applying gravel or paving unpaved parking lots, applying water, gravel, or dust suppressant to haul roads, prewatering work sites, constructing wind barriers and establishing vegetative cover. Earthmoving operations shall have a dust control plan submitted if the project is equal to or greater than 0.1 acres. Specific work practices for different types of activities are described in the rule. Compliance shall be determined by conducting opacity observations, stabilization determinations, and recordkeeping.

Rule 310.01

Rule 310.01 applies to open areas, vacant lots, unpaved parking lots and unpaved roadways which are not regulated by Rule 310. Any open area or vacant lot that is not defined as agricultural land and is not used for agricultural purposes according to ARS § 42-1251 and ARS § 42-1252, and normal farm cultural practices as defined under Arizona Revised Statutes (ARS) §49-457 and ARS §49-504.4, are exempt from this rule. The rule outlines control measures and stabilization limitations required for different dust source activities such as preventing vehicular access to open areas and vacant lots, establishing vegetative cover, uniformly applying and maintaining surface gravel, and application of dust suppressant. Stabilization observations and recordkeeping shall be maintained.

Rule 316

Rule 316 regulates particulate matter emissions from nonmetallic mining operations and rock product processing plants. Opacity limitations are outlined for the different type of operations and stack and fugitive dust emissions. For those sources with air pollution control equipment and/or monitoring equipment, an Operation and Maintenance Plan is required. This rule requires recordkeeping of daily operations and control device data. The site must comply with Rule 310 where it applies.

3.0 Field Inspection Phase

Two types of field inspections were conducted as part of this rule effectiveness study. The first involved team members conducting inspections within the study area at earthmoving sites and vacant lots. The second involved MCESD investigators inspecting stationary permitted sources.

A quality assurance (QA) team was assembled for this study. The team consisted of two MCESD employees and one ADEQ employee, who had a strong comprehension of the rules in this study. The QA team followed one earthmoving inspector and one stationary source inspector one morning and took notes based on what was observed and what was recorded. They accompanied an inspector to two different sites, an earthmoving construction site and a stationary source concrete batch facility. After reviewing how each interpreted that days' observations they then separated and each accompanied a compliance inspector to the remainder of the sites determined to be part of the QA. The QA team will assure consistency is occurring during the investigations. The forms will be reviewed to see that they are being filled out completely and correctly. The team will also evaluate the consistency of what is being considered a violation during the investigations and inspections.

According to EPA's *Guidelines for Estimating and Applying Rule Effectiveness for Ozone/ CO State Implementation Plan Base Year Inventories*[3] (EPA, 1992), sample size should be representative of the categories population as a whole and the standard deviation, degree of accuracy and degree of confidence must be considered. EPA recommends a 90 percent confidence interval and the suggested sample error is 5 percent, but should not exceed 10 percent to be used with Table D-1 in EPA's guideline (see Appendix B). With a 90 percent confidence interval, a standard deviation of 10%, and a sample error around 5%, about 10 stationary sources should be inspected and 10 earthmoving sites. Since there are twenty-seven stationary sources in the study area, nine facilities were an acceptable initial sample size. Since there are over 300 earthmoving sites in the study area, 15 initial inspections were an acceptable sample size.

3.1 Results

Stationary Sources

Ten facilities in the Salt River Study area subject to Rule 316 were inspected during the months of November and December 2002 and two more were inspected in spring 2003. All the inspections were Level 2, which include a source file review, site inspection, record review and written report. There was a difference between facilities because some sources had a complete facility inspection while the others were just focused on the equipment/process applicable to Rule 316 and/or 310.

The following table summarizes what was observed at each facility and if any corrective action taken, according to Rules 310 or 316. There are three corrective actions taken: Notice to Correct, Compliance Status Notification (CSN), and Notice of Violation (NOV), with the NOV as the most serious corrective action.

Table 3.1: List of Inspected Facilities

Date	Permit ID	Site	Address	310/311/316 Violation Observed	NOV/CSN Issued
11/19/02	960737	Smith Precast	2140 W Broadway	Failure to Maintain Records for Dust Control	CSN-310
11/25/02	000169	Eagle Roofing Products	4602 W Elwood St	Failure to Maintain Record of Dust Collector Operating Parameters (in O&M Plan)	CSN-316
				Failure to Maintain Visible Emission Inspection Records (in O&M plan)	CSN-316
				Failure to Maintain Dust Control Plan Log	CSN-310
				Failure to Obtain a Permit	CSN-310
11/25/02	20046	Jensen Patio	515 W	None, but O&M not submitted	None

[3] U.S. EPA, Guidelines for Estimation and Applying Rule Effectiveness for Ozone/ CO State Implementation Plan Base Year Inventories, EPA-452/R-92-010, November 1992.

		Brick	Elwood St		
12/1/02	000066	Glen Weinberger Topsoil	3425 S 43rd Ave	Failure to Maintain Records of Water Log	CSN-310
12/3/02	010216	Precast Manufacturing	301 W Broadway	Failure to have certified emissions observer	CSN-316
12/3/02	990641	Ajax Sand and Rock	5026 S 51st Ave	Failure to Submit Dust Plan	CSN-310
12/5/02	980089	Quality Block Inc	3035 S 35th Ave	None	None
12/9/02	990095	Ultra Kote Products	327 S 27th Ave	Failure to Submit Dust Plan	CSN-310
				Failure to maintain inspection logs	CSN-316
12/9/02	10182	Tpac	3052 S 19th Ave	Failure to include sand blasting equipment	CSN- 200
12/20/02	10066	Western Block Company	4021 S 19th Ave	Failure to Submit Dust Plan	CSN-310
				Failure to Submit O&M Plan	CSN-316
3/12/03	98026	Hansen Aggregate	4002 S 51st Ave	Failure to Submit O&M Plan	CSN-316
4/1/03	10089	Hansen Aggregate of Arizona	Salome Road	None	None

Earthmoving Sites

Fifteen earthmoving sites were observed during the month of December 2002. Seventeen additional earthmoving sites were observed during the spring of 2003. The following table outlines the compliance issues and actions at each site.

Table 3.2: List of Inspected Earthmoving Sites

Date	Permit ID	Site	Address	310 Violation Observed	NOV/CSN Issued
12/5/02	E20102415	Hurley Properties	2505 W Durango	No	No
12/5/02	E20103594	Lockewood Greene E&C	4620 W Hadley	Unstable haul road causing Visible Emissions	Notice to correct
12/5/02	E20102145	Capital Pacific	55th Ave and Baseline	Backhoe running, no water seen in use, but no visible emissions	Notice to correct
12/5/02	E20104856	LGE Corp	43rd Ave and Mojave	No water being used but no visible emissions seen, no project info sign posted	3 Notices to correct
12/5/02	E20103032	KB Homes	27th Ave and Broadway	Very little gravel (for use as trackout device) Pile at exit needs spreading	Notice to correct
12/5/02	E20104603	Standard Pacific	19th Ave and Southern	No	None

Table 3.2 Cont'd: List of Inspected Earthmoving Sites

Date	Permit ID	Site	Address	310 Violation Observed	NOV/CSN Issued
12/5/02	E20104994	Mountain West Estates	27th Ave and Southern	Trackout device too small, needs refreshing	Notice to correct
12/5/02	E20103401	Trend Homes	41st and Alta Vista	Pads being driven on, no water used with backhoe, trackout device needs refreshing , no permit onsite	3 CSNs issued, 2 Notices to Correct
12/5/02	E20103705	Trend Homes	43rd Ave and Baseline	No	No
12/5/02	E20102217	Richmond American	43rd Ave and Baseline	No	No
12/3/02	E20103037	Great Western Homes	7th Ave and Sunland	Trackout along roadway <= 50 feet	Notice to correct
12/3/02	E20104077	LinsenMeyer Partnership	11th Ave and Magnolia	Refresh trackout device at main entrance	Notice to correct
12/3/02	E20104319	Renaissance Companies	101 N 1st Avenue	No	
12/3/02	E20103095	Artisan Homes	7th St and Washington	Trackout on paved public roadway >50 ft	Notice to correct
12/3/02	E20105007	Reliance Commercial	2nd St and Buchanan	Trackout on paved public roadway >50 ft	Notice to correct
4/9/03	E20300312	Tono Contracting	15th Ave and Baseline	Trackout pads need refreshing, trackout on paved public roadway, dust control records not onsite	2 Notices to correct
4/9/03	E20300830	PARS Development	11th Ave and Carter	No permits or dust control records onsite	None
4/9/03	E20300251	Gen Spec A Division of Contractor Abatement	4427 & 4409 S Central Ave	No permits or dust control records onsite	None
4/9/03	E20300294	Complete Decon Inc	512 E Van Buren	No	None
4/8/03	E20105365	Gen Spec A Division of Contractor Abatement	120 S 6th Ave	No	None
4/8/03	E20300345	DL Withers	800 W Adams	No	None
4/8/03	E20300747	Chaparral Construction	1102 E Tonto St	#2- Must have H2O available, #5- Clean up <=50 ft, no Dust Control records	2 Notices to correct

Table 3.2 Cont'd: List of Inspected Earthmoving Sites

Date	Permit ID	Site	Address	310 Violation Observed	NOV/CSN Issued
4/8/03	E20300252	Gen Spec A Division of Contractor Abatement	12th Ave and Madison	No permit or dust control records onsite	None
5/1/03	E20300867	ACE Asphalt	27th Ave and Southern	#1- NTC, needs stabilization #2 NOV-No water onsite #4- CSN no trackout device seen #6 and #8 - same NOV as #2 No permit or dust control plan onsite, no project sign	3 Notices to correct 1 CSN 1 NOV
5/1/03	E20104498	Courtland Homes	35th Ave and Baseline	#2,3,6 NOV- No water used	One NOV
5/1/03	E20105398	Hallcraft	51st Ave and Southern	No	None
5/1/03	E20300386	Richmond American	43rd Ave and Baseline	#2,8 NTC- No water hose	1 NTC
5/1/03	E20104994	Mountain West	27th Ave and Southern	No	None
5/1/03	E20300104	Dietz-Crane	35th Ave and Southern	#4 NTC- trackout surface worn and small, refresh	1 NTC
5/1/03	E20301143	Richmond American	27th Ave and Vineyard	No	None
5/1/03	E20301285	KB Homes	27th Ave and Broadway	No	None
5/1/03	E20301289	KB Homes	27th Ave and Broadway	No	None

Vacant Lot Sites

Fifteen vacant lots in the Salt River Study area subject to Rule 310.01 were inspected during the month of April 2003. A checklist was followed to determine the compliance status of each site. The following table contains the site, location and if any compliance issues were observed.

Table 3.3: List of Inspected Vacant Lot Sites

Date	Permit ID	Address	301.01 Violation Observed
4/9/03	Yee Holdings	35th and Broadway	None
4/9/03	Phyllis Rawlings	39th and Alta Vista	Non-uniform gravel, partial control implementation
4/9/03	Ken Altiman	39th and Southern	None
4/9/03	Mt Baldy Limited	43rd and Southern	60% vegetative cover and non-uniform gravel, partial control measure implementation

Table 3.3 Cont'd: List of Inspected Vacant Lot Sites

Date	Permit ID	Address	301.01 Violation Observed
4/9/03	Michael Rose	19th and Southern	None
4/9/03	First New Life Baptist	19th and Romlex	None
4/9/03	Robert Pennington	19th and Broadway	None
4/9/03	AT&SF	19th and Washington	Trees and some non-uniform gravel, almost complete control implementation
4/9/03	Ray West Development	39th and Washington	Shrubs/trees and some non-uniform gravel, almost complete control implementation
4/24/03	Aljasa Enterprises	15th and Roeser	Partial gravel, failed stabilization tests, out of compliance
4/23/03	Reid Mary Carolyn	Central and Jesse Owens	None
4/24/03	Branham Chanel	17th and Sunland	Partial curbs and fences, almost complete control implementation
4/24/03	Sagarino Frank et al	10th St and Baseline	No control measures, out of compliance
4/24/03	IDRA	Central and Elwood	None
4/24/03	Roosevelt School District	10th St and Baseline	No control measures, out of compliance

3.2 Rule Effectiveness Calculation

In order to quantify the rules' effectiveness the MCESD staff weighted the requirements of Rule 316 and Rule 310 according to its significance in terms of creating emissions. For example, an opacity limit has a direct correlation to pollution being emitted, where recordkeeping requirements are a minor element in decreasing emissions. This is similar to the approach taken in EPA's *Rule Effectiveness Guidance: Integration of Inventory, Compliance and Assessment Applications* [2] for the RE Improvements Matrix. Most RE calculations are determined using baseline emissions and actual emissions after control efficiency is applied to the allowable emissions of a facility. Since the sources of this study are mainly fugitive emissions either without emissions calculated (earthmoving sites), or calculated using low-level emission factors, and the control devices don't have an efficiency (trackout device, watering), a different approach was required.

Rule 316 was evaluated by compiling all the requirements and furnishing a certain amount of points to each requirement. Since there are different requirements for specific types of facilities, those were handled accordingly. For each facility, there are 100 points per rule possible. If a corrective action takes place, no points are given for that requirement. For example, maintaining an O & M Plan onsite is worth 10 points, if a Notice To Correct (NTC), Compliance Status Notification (CSN), or Notice of Violation (NOV) is issued for not maintaining an O & M Plan onsite, then no points would be given for that requirement. If the requirement is not applicable or not observed, then no points are awarded and the points for that requirement are subtracted from the total. The following table outlines the amount of points possible for each requirement.

Table 3.4: Rule 316 Rule Effectiveness Point System

Nonmettallic Mineral Processing Plant	
Standards:	**POINTS**
• Limit stack emissions to 7% opacity/ 0.02 gr./dscf (50mg/ dscm) of PM	20
• Limit fugitive dust to 7% opacity for conveying systems	7.5
• Limit fugitive dust to 15% opacity from a crusher	7.5
• Limit fugitive dust to 10% opacity from any affected operation or process source (excluding the following)	7.5
• Limit fugitive dust to 20% opacity from truck dumping directly into screening operation, feed hopper or crusher.	7.5
O&M Requirements:	
• Shall submit for approval to the control officer	7.5
• Shall be maintained and available onsite-the plan	7.5
• Shall comply with identified actions and schedules provided in each O&M plan	15
Recordkeeping Requirements:	
• General Data- Hours of operation, throughput	5
• Control and Monitoring Device Data- baghouse records, scrubber records, device failure and reasons	5
Compliance Determination: Method 9 certified observer	10
TOTAL	**100**
Concrete Plants and Bagging Operations	
Standards:	**POINTS**
• Limit stack emissions to 7% opacity	25
• Limit fugitive dust to 10% opacity from any affected operation or process source (excluding the following)	15
• Limit fugitive dust to 20% opacity from truck dumping directly into screening operation, feed hopper or crusher.	10
O&M Requirements:	
• Shall submit for approval to the control officer	10
• Shall be maintained and available onsite	10
• Shall comply with identified actions and schedules provided in each O&M plan	10
Recordkeeping Requirements:	
• General Data- Hours of operation, throughput	5
• Control and Monitoring Device Data- baghouse records, scrubber records, device failure and reasons	5
Compliance Determination: Method 9 certified observer	10
TOTAL	**100**

For Rule 310, the Earthmoving Site Inspection Form (Appendix C-1) was used to assign points for different requirements. For each site, there are 83.75 points possible. If a corrective action takes place, then points are deducted from that requirement's points. For issuance of a Notice to Correct, a Compliance Status Notification (CSN), or a Notice of Violation (NOV), no points are given. If the requirement is not applicable or not observed, then no points are awarded and the points for that requirement are subtracted from the total.

The last four requirements are either "yes" or "no", so points are either totally awarded or zero. The following outlines the amount of points possible for each requirement.

Table 3.5: Rule 310 Rule Effectiveness Point System

Requirements:	**POINTS**
Unpaved haul/access roads	10
Disturbed surface areas	10
Trenching Operations	10
Track-out Control Device	10
Track-out along a Paved Public Roadway (≤ 50 ft, >50ft)	10
Bulk Material Handling On-site w/in boundaries or work site	10
Bulk Material Handling Offsite onto paved public roadways	10
Water supply/ availability	10
Permit On-site	1.25
Dust Control Records On site	1.25
Project Information Sign Posted	1.25
Visible Emissions Evaluation Conducted	0
TOTAL	**83.75**

For Rule 310.01, a different type point system was used. There were no CSN, NTC or NOV notices issued, therefore, that could not be used as a measure. Depending on the use of the lot, Rule 310.01 allows for different types of control measures and stabilization determinations, which are outlined on the inspector checklist (Appendix C-2). A stabilization test method must be completed according to the rule to determine if the measure was effectively implemented. One point was allocated for each stabilization test passed and no points were given if a stabilization test failed.

3.3 RE Examples and Results

The point system outlined above was used on each facility that was inspected according to the applicable rule's requirements, and the rule effectiveness calculated. Below is an example of how the rule effectiveness for a Rule 316 applicable facility was calculated.

Rule 316 Example:

Facility- Concrete Plant and Bagging Operation

Standards:	**POINTS**
• Limit stack emissions to 7% opacity (25 points)	25
• Limit fugitive dust to 10% opacity from any affected operation or process source (excluding the following) (15 points)	15
• Limit fugitive dust to 20% opacity from truck dumping directly into screening operation, feed hopper or crusher. (10 points)	10
O&M Requirements:	
• Shall submit for approval to the control officer (10 points)	10
• Shall be maintained and available onsite (10 points)	7.5- records not onsite but were available during follow up visit

• Shall comply with identified actions and schedules provided in each O&M plan (10 points)	10
Recordkeeping Requirements:	
• General Data- Hours of operation, throughput (5 points)	5
• Control and Monitoring Device Data- baghouse records, scrubber records, device failure and reasons (5 points)	5
Compliance Determination: Method 9 certified observer (10 points)	2.5
TOTAL	**90 points**

Out of 100 points for complying with Rule 316, this facility had 90 points and, therefore, was 90% compliant with the rule's requirements. This calculation was done for each facility, and the conclusions are summarized below.

Table 3.6: Rule 316 Rule Effectiveness Results

Site	**RE Calculation**
Smith Precast	100%
Eagle Roofing Products	80%
Jensen Patio Brick	90%
Glen Weinberger Topsoil	NA
Precast Manufacturing	85%
Ajax Sand and Rock	100%
Quality Block Inc	100%
Ultra Kote Products	75%
Tpac	76.3%
Western Block Company	70%
Hansen Aggregate	92.5%
Hansen Aggregate of Arizona	100%
Average	88.1%
Standard Deviation	11.42%

For Rule 310, a very similar calculation was completed for a rule effectiveness value to be determined. The total for each facility was calculated by applying the corrective action deductions where necessary and then dividing by the total possible points. An example of this follows:

Rule 310 Example: Site- Linsenmeyer Partnership

Requirements:	**POINTS**
Unpaved haul/access roads	10
Disturbed surface areas	10
Trenching Operations	N/A
Track-out Control Device	0
Track-out along a Paved Public Roadway (≤ 50 ft, >50ft)	10
Bulk Material Handling On-site w/in boundaries or work site	Not Observed
Bulk Material Handling Offsite onto paved public roadways	Not Observed
Water supply/ availability	10
Permit On-site	1.25

Dust Control Records On site	Not Observed
Project Information Sign Posted	1.25
Visible Emissions Evaluation Conducted	0
TOTAL	**42.50/52.50**

Therefore, out of 52.50 total possible points for complying with Rule 310, this site had earned 42.50 points.

42.50 points/ 52.50 points * 100% = 81.0%

This site was 81% compliant with the rule's requirements. This calculation was done for each site and the conclusions are summarized below.

Table 3.7a: Rule 310 Only Sites RE Results

Site	RE Calculation
Hurley Properties	100%
Lockewood Greene E&C	71%
Capital Pacific	79%
LGE Corp	54%
KB Homes	71%
Standard Pacific	98%
Mountain West Estates	77%
Trend Homes	31%
Trend Homes	98%
Richmond American	100%
Great Western Homes	79%
LinsenMeyer Partnership	81%
Renaissance Companies	100%
Artisan Homes	77%
Reliance Commercial	74%
Tono Contracting	63%
PARS Development	92%
Gen Spec A Division of	94%
Complete Decon Inc	92%
Gen Spec A Division of	92%
DL Withers	100%
Chaparral Construction	60%
Gen Spec A Division of	94%
ACE Asphalt	16%
Courtland Homes	56%
Hallcraft	94%
Richmond American	51%
Mountain West	95%
Dietz-Crane	82%
Richmond American	96%
KB Homes	97%
KB Homes	97%
Average	80.1%
Standard Deviation	21.1%

Rule 310 was applicable at some of the stationary sources inspected. The following table summarizes the rule effectiveness calculated at these facilities.

Table 3.7b: Rule 310 stationary source RE Results

Site	RE Calculation
Smith Precast	76.2%
Eagle Roofing Products	24%
Glen Weinberger Topsoil	97%
Precast Manufacturing	96.2%
Ajax Sand and Rock	61.5%
Quality Block Inc	96%
Ultra Kote Products	61.5%
Western Block Company	61.5%
Hansen Aggregate of Arizona	100%
Hansen Aggregate	100%
Average	77.3%
Standard Deviation	25.33%

Therefore, the average combined RE for sources subject to Rule 310 is 79.5%.

As explained above, Rule 310.01, the rule effectiveness had to be determined with a different calculation. The following is an example of how the rule effectiveness was calculated.

Ray West Development:

- Subject to Rule 310.01 Section 302
- For control measures has shrubs and trees and sporadic gravel
- Facility passed drop ball/steel ball test stabilization test (1 point) and failed flat vegetative cover test (0 points)

Therefore, out of 2 total possible points for complying with Rule 310.01, this site had a total of 1 point.

$(1 + 0)/2 * 100\% = 50\%$

This site was 50% compliant with the rule's requirements. This calculation was done for each site and the conclusions are summarized below.

Table 3.8: Rule 310.01 Rule Effectiveness Results

Site	RE Calculation
Yee Holdings	100%
Phyllis Rawlings	33%
Ken Altiman	50%
Mt Baldy Limited	50%
Michael Rose	100%
First New Life Baptist	50%
Robert Pennington	50%
AT&SF	50%
Ray West Development	50%
Aljasa Enterprises	0%
Reid Mary Carolyn	50%
Branham Chanel	98%

Sagarino Frank etal	50%
IDRA	100%
Roosevelt School District	100%
Average	62.1%
Standard Deviation	30.37%

Sample Size
As referenced earlier in the report, the number of sources in the sample size should be determined based on the standard deviation of the initial inspections conducted. MCESD used EPA guidance to determine adequate sample sizes.[4]

With Rule 316, the standard deviation was 11.42%. Assuming a 90 percent confidence limit and a limit of error of 5.5 percent, the sample size required is equal to 11. Nine sources were initially inspected and two additional sources were inspected to meet the sample size requirement.

With Rule 310, the standard deviation was 21.1%. Assuming the same 90 percent confidence limit and a limit of error of 6.5 percent, the sample size required is 29. Thirty-two sites were inspected.

With Rule 310.01, the standard deviation was 30.37%. Assuming the same 90 percent confidence limit and a limit of error of 10 percent, the sample size required is 25. Fifteen sites were inspected. MCESD will consider conducting additional inspections if time and resources permit.

3.4 Quality Assurance

As mentioned above there was a quality assurance team assembled to follow the inspectors on their visits to the regulated sources. The following outlines their observations and the differences between how the QA team member would have conducted the inspection and how the actual inspector performed.

For the stationary sources, both the QA team member and the inspector had almost identical observations at nine sites and the QA member would have issued the same type of compliance notices. At two facilities the RE difference was 10.0% and at another facility there was a 15% difference in RE calculation because the QA member would have issued an NOV for not maintaining or recording control equipment parameters and also noted opacity created by the cement hopper where control was absent. Overall, the average RE determined by the QA team was 84.5% which is 3.6% difference from the inspections' average RE calculation.

For the earthmoving sites, both the QA team member and the inspector had less than a 5% difference in observations at 23 sites and the QA member would have issued the same type of compliance notices. For the other sites, there were mainly small discrepancies, which created minor differences in RE calculations. Eight sites had greater than 10% difference; five of them were that the QA member and the inspector differed on the number of NTC,

[4] Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories, U.S. EPA, EPA-452/R-92-010, November 1992.

CSN, or NOV issued. At one site, the QA member decided a notice was not required according to the rule since the site had until the end of the workday to fix it. At three sites, the QA member did not see a violation, but the inspector did. Overall, the average QA RE calculated is 81.3%, which is 1.3% greater than the inspection average RE calculation of 80.1%.

For the vacant lots, both the QA team member and the inspector had the same observations at all fifteen sites. The higher percentage of identical observations is likely related to the simpler interpretation that is allowed with this rule.

4.0 Office Investigation Phase

The information and observations collected from the field inspection phase were reviewed in conjunction with the rule content and internal policies to determine if emission reductions for particulate matter are being achieved and to review enforcement procedures. When considering the low percentage of particulate emitting sources that were issued Notices of Violations (4.6% of 43 sites), along with the rule effectiveness values, the conclusion could be drawn that the rules are being implemented and followed by the regulated community. Therefore, the MCESD rule program is ensuring both dust control and a reduction in emissions are occurring. In terms of Compliance Status Notifications, 12 of 43 sites were issued CSNs, nine of which were administrative notifications, for example failure to submit a dust plan or O&M plan. The differences between the inspector and QA member were minimal, however the compliance department did review the differences and determined where more continuity and parity could occur between inspectors. The area with the larger discrepancy was with the earthmoving inspections.

Rules are administered to attain the state implementation plan goals of reducing pollution by requiring control measures to be implemented at applicable emission sources. MCESD's permitting program contains all the requirements of the particulate matter rules, as applicable. When a facility receives its permit and implements the actions necessary to be in compliance with that permit, the facility is fulfilling its duty to assist in attaining emission reductions the county was anticipating when adopting the rule. In terms of emission inventory, all sources with a stationary source permit must be prepared to submit an annual emission report if Maricopa County requests a report submittal. The report is created from recordkeeping required in the permit, and is used to create the SIP inventory that is used for modeling to determine if the pollution levels are decreasing as required by the SIP.
The compliance section ascertains whether the facility complies with its requirements and stays within its limits. As seen in this study, MCESD inspections are thorough and check sheets follow the permit requirements. Inspections occur on a scheduled basis for all dust sources, except vacant lots. Vacant lots are only inspected when a complaint is made, due to a limited number of County inspection employees. The inspectors review all aspects of the source's responsibility including recordkeeping and visible emission observations. Based on this study, it can be stated that the programs for MCESD adequately determine compliance status for all sources subject to the particulate matter rules and are able to detect and pursue correction of noncompliance.

5.0 Recommendations

While conducting the inspections for this study, a slight difference in inspection methods appeared. The main area of difference was which type of corrective notice should be issued to the facility. A guideline with different possible infractions of each requirement given as scenarios would be useful in creating a more equitable inspection process. This would be beneficial for both stationary sources and earthmoving sites. When inspecting stationary sources that have an earthmoving permit, an earthmoving inspection form should be filled out to ensure uniform inspections will occur at all regulated sites.

Since this study took place during a high profile time period in the Salt River study area, sources were aware of the County and State's presence, and were therefore, probably more conscientious at complying with their requirements. It would be a useful exercise to conduct another round of inspections in a couple months to see if compliance with the rules has decreased or has held steady. It would help determine the level of education necessary for a source's full understanding of their responsibilities.

6.0 Policy/Procedure Improvements

The rule effectiveness national protocol provides guidance to states and local agencies to conform to standards set by the Stationary Source Compliance Division (SSCD), now the Office of Enforcement and Compliance Assurance (OECA). The primary purposes for the SSCD studies are to "determine the effectiveness of rules for a specific source category in a specific nonattainment area" and to "identify specific implementation problems which need to be addressed by the State and EPA compliance and enforcement staff." Within one year following a study, a follow-up audit is conducted to determine whether corrective actions were implemented. It is useful exercise to conduct another round of inspections in a couple months to see if compliance with the rules has decreased or has held steady. This would be a useful tool for the county to determine which education would better benefit the sources.

7.0 Summary

In summary, the rule effectiveness calculations for Maricopa County's particulate matter rules in the Salt River Study area is as follows:

- Sites inspected in the Salt River Study area that were subject to Rule 316 had a calculated average rule effectiveness of 88.1%.
- Sites subject to only Rule 310 requirements in the Salt River Area had a calculated average rule effectiveness of 80.1%; All sites subject to Rule 310 requirements in the Salt River Area had a calculated average rule effectiveness of 79.5%.
- The Salt River Study area's vacant lots had a calculated Rule 310.01 average rule effectiveness of 62.1%.

Appendix A-1

REGULATION III - CONTROL OF AIR CONTAMINANTS
RULE 310
FUGITIVE DUST SOURCES
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SECTION 100 - GENERAL

SECTION 200 - DEFINITIONS

Revised 07/13/88
Revised 07/06/93
Revised 09/20/94
Revised 06/16/99

MARICOPA COUNTY
AIR POLLUTION CONTROL REGULATIONS
REGULATION III - CONTROL OF AIR CONTAMINANTS

RULE 310
FUGITIVE DUST SOURCES

SECTION 100 - GENERAL

101 PURPOSE: To limit particulate matter emissions into the ambient air from any property, operation or activity that may serve as a fugitive dust source. The effect of this rule shall be to minimize the amount of PM_{10} entrained into the ambient air as a result of the impact of human activities by requiring measures to prevent, reduce, or mitigate particulate matter emissions.

102 APPLICABILITY: The provisions of this rule shall apply to all dust generating operations except: normal farm cultural practices under Arizona Revised Statutes (ARS) §49-457 and ARS §49-504.4 and open areas, vacant lots, unpaved parking lots, and unpaved roadways which are not located at sources that require any permit under these rules.

SECTION 200 - DEFINITIONS: For the purpose of this rule, the following definitions shall apply. See Rule 100 (General Provisions And Definitions) of these rules for definitions of terms that are used but not specifically defined in this rule.

201 BULK MATERIAL - Any material, including but not limited to, earth, rock, silt, sediment, sand, gravel, soil, fill, aggregate less than 2 inches in length or diameter (i.e., aggregate base course (ABC)), dirt, mud, demolition debris, cotton, trash, cinders, pumice, saw dust, feeds, grains, fertilizers, and dry concrete, which are capable of producing fugitive dust at an industrial, institutional, commercial, governmental, construction, and/or demolition site.

202 BULK MATERIAL HANDLING, STORAGE, AND/OR TRANSPORTING OPERATION - The use of equipment, haul trucks, and/or motor vehicles, such as but not limited to, the loading, unloading, conveying, transporting, piling, stacking, screening, grading, or moving of bulk materials, which are capable of producing fugitive dust at an industrial, institutional, commercial, governmental, construction, and/or demolition site.

203 CARRY-OUT/TRACKOUT - Any and all bulk materials that adhere to and agglomerate on the exterior surfaces of motor vehicles, haul trucks, and/or equipment (including tires) and that have fallen onto a paved public roadway.

204 CONTROL MEASURE - A technique, practice, or procedure used to prevent or minimize the generation, emission, entrainment, suspension, and/or airborne transport of fugitive dust. Control measures include but are not limited to:

204.1 Curbing.

204.2 Paving.

204.3 Pre-wetting.

204.4 Applying dust suppressants.

204.5 Physically stabilizing with vegetation, gravel, recrushed/recycled asphalt or other forms of physical stabilization.

204.6 Limiting, restricting, phasing and/or rerouting motor vehicle access.

204.7 Reducing vehicle speeds and/or number of vehicle trips.

204.8 Limiting use of off-road vehicles on open areas and vacant lots.

204.9 Utilizing work practices and/or structural provisions to prevent wind and water erosion onto paved public roadways.

204.10 Appropriately using dust control implements.

204.11 Installing one or more grizzlies, gravel pads, and/or wash down pads adjacent to the entrance of a paved public roadway to control carry-out and trackout.

204.12 Keeping open-bodied haul trucks in good repair, so that spillage may not occur from beds, sidewalls, and tailgates.

204.13 Covering the cargo beds of haul trucks to minimize wind-blown dust emissions and spillage.

205 **DISTURBED SURFACE AREA -** A portion of the earth's surface (or material placed thereupon) which has been physically moved, uncovered, destabilized, or otherwise modified from its undisturbed native condition, thereby increasing the potential for the emission of fugitive dust. For the purpose of this rule, an area is considered to be a disturbed surface area until the activity that caused the disturbance has been completed and the disturbed surface area meets the standards described in Section 301 and Section 302 of this rule.

206 **DUST CONTROL IMPLEMENT -** A tool, machine, equipment, accessory, structure, enclosure, cover, material or supply, including an adequate readily available supply of water and its associated distribution/delivery system, used to control fugitive dust emissions.

207 **DUST CONTROL PLAN -** A written plan describing all control measures.

208 **DUST GENERATING OPERATION -** Any activity capable of generating fugitive dust, including but not limited to, land clearing, earthmoving, weed abatement by discing or blading, excavating, construction, demolition, material handling, storage and/or transporting operations, vehicle use and movement, the operation of any outdoor equipment, or unpaved parking lots. For the purpose of this rule, landscape maintenance and/or playing on a ballfield shall not be considered a dust generating operation. However, landscape maintenance shall not include grading, trenching, nor any other mechanized surface disturbing activities performed to establish initial landscapes or to redesign existing landscapes.

209 **DUST SUPPRESSANT -** Water, hygroscopic material, 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 U.S. 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.

210 **EARTHMOVING OPERATION -** The use of any equipment for an activity which may generate fugitive dust, such as but not limited to, cutting and filling, grading, leveling, excavating, trenching, loading or unloading of bulk materials, demolishing, blasting, drilling, adding to or removing bulk materials from open storage piles, back filling, soil mulching, landfill operations, or weed abatement by discing or blading.

211 **FREEBOARD -** The vertical distance between the top edge of a cargo container area and the highest point at which the bulk material contacts the sides, front, and back of a cargo container area.

212 **FUGITIVE DUST -** The particulate matter, which is not collected by a capture system, which is entrained in the ambient air, and which is caused from human and/or natural activities, such as but not limited to, movement of soil, vehicles, equipment, blasting, and wind. For the purpose of this rule, 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, and from piledrivers, and does not include emissions from process and combustion sources that are subject to other rules in Regulation III (Control Of Air Contaminants) of these rules.

213 **GRAVEL PAD -** A layer of washed gravel, rock, or crushed rock which is at least one inch or larger in diameter, maintained at the point of intersection of a paved public roadway and a work site entrance to dislodge mud, dirt, and/or debris from the tires of motor vehicles and/or haul trucks, prior to leaving the work site.

214 **GRIZZLY -** A device (i.e., rails, pipes, or grates) used to dislodge mud, dirt, and/or debris from the tires and undercarriage of motor vehicles and/or haul trucks prior to leaving the work site.

215 **HAUL TRUCK -** Any fully or partially open-bodied self-propelled vehicle including any non-motorized attachments, such as but not limited to, trailers or other conveyances which are connected to or propelled by the actual motorized portion of the vehicle used for transporting bulk materials.

216 **INTERMITTENT SOURCE -** A fugitive dust generating operation and/or activity that lasts for a duration of less than six consecutive minutes.

217 **MOTOR VEHICLE -** A self-propelled vehicle for use on the public roads and highways of the State of Arizona and required to be registered under the Arizona State Uniform Motor Vehicle Act, including any non-motorized attachments, such as but not limited to, trailers or other conveyances which are connected to or propelled by the actual motorized portion of the vehicle.

218 **NORMAL FARM CULTURAL PRACTICE -** All activities by the owner, lessee, agent, independent contractor, and/or supplier conducted on any facility for the production of crops and/or nursery plants. Disturbances of the field surface caused by turning under stalks, tilling, leveling, planting, fertilizing, or harvesting are included in this definition.

219 **OFF-ROAD VEHICLE -** Any self-propelled conveyance specifically designed for off-road use, including but not limited to, off-road or all-terrain equipment, trucks, cars, motorcycles, motorbikes, or motorbuggies.

220 **OPEN AREAS AND VACANT LOTS -** Any of the following described in subsection 220.1 through subsection 220.4 of this rule. For the purpose of this rule, vacant portions of residential or commercial lots that are immediately adjacent and owned and/or operated by the same individual or entity are considered one vacant open area or vacant lot.

220.1 An unsubdivided or undeveloped tract of land adjoining a developed or a partially developed residential, industrial, institutional, governmental, or commercial area.

220.2 A subdivided residential, industrial, institutional, governmental, or commercial lot, which contains no approved or permitted buildings or structures of a temporary or permanent nature.

220.3 A partially developed residential, industrial, institutional, governmental, or commercial lot.

220.4 A tract of land, in the nonattainment area, adjoining agricultural property.

221 **OWNER AND/OR OPERATOR** - Any person who owns, leases, operates, controls, or supervises a dust generating operation subject to the requirements of this rule.

222 **PAVE** - To apply and maintain asphalt, concrete, or other similar material to a roadway surface (i.e., asphaltic concrete, concrete pavement, chip seal, or rubberized asphalt).

223 **PUBLIC ROADWAYS -** Any roadways that are open to public travel.

224 **ROUTINE -** Any dust generating operation which occurs more than 4 times per year or lasts 30 cumulative days or more per year.

225 **SILT -** Any aggregate material with a particle size less than 75 micrometers in diameter, which passes through a No. 200 Sieve.

226 **TRACKOUT CONTROL DEVICE -** A gravel pad, grizzly, wheel wash system, or a paved area, located at the point of intersection of an unpaved area and a paved roadway, that controls or prevents vehicular trackout.

227 **UNPAVED HAUL/ACCESS ROAD -** Any on-site unpaved road used by commercial, industrial, institutional, and/or governmental traffic.

228 **UNPAVED PARKING LOT -** Any area larger than 5,000 square feet that is not paved and that is used for parking, maneuvering, or storing motor vehicles.

229 **UNPAVED ROAD -** Any road or equipment path that is not paved. For the purpose of this rule, an unpaved road is not a horse trail, hiking path, bicycle path, or other similar path used exclusively for purposes other than travel by motor vehicles.

230 **URBAN OR SUBURBAN OPEN AREA -** The definition of urban or suburban open area is included in Section 220 (Definition Of Open Areas And Vacant Lots) of this rule.

231 **VACANT LOT -** The definition of vacant lot is included in Section 220 (Definition Of Open Areas And Vacant Lots) of this rule.

232 **VACANT PARCEL -** The definition of vacant parcel is included in Section 220 (Definition Of Open Areas And Vacant Lots) of this rule.

233 **WIND-BLOWN DUST -** Visible emissions from any disturbed surface area, which are generated by wind action alone.

234 **WIND EVENT** – When the 60-minute average wind speed is greater than 25 miles per hour.

235 **WORK SITE -** Any property upon which any dust generating operations and/or earthmoving operations occur.

SECTION 300 - STANDARDS

301 OPACITY LIMITATION FOR FUGITIVE DUST SOURCES: The owner and/or operator of a source engaging in dust generating operations shall not allow visible fugitive dust emissions to exceed 20% opacity.

301.1 Wind Event: Exceedances of the opacity limit that occur due to a wind event shall constitute a violation of the opacity limit. However, it shall be an affirmative defense in an enforcement action if the owner and/or operator demonstrates all of the following conditions:

a. All control measures required were followed and 1 or more of the control measures in Table 2 were applied and maintained;

b. The 20% opacity exceedance could not have been prevented by better application, implementation, operation, or maintenance of control measures;

c. The owner and/or operator compiled and retained records, in accordance with Section 502 (Recordkeeping) of this rule; and

d. The occurrence of a wind event on the day(s) in question is documented by records. The occurrence of a wind event must be determined by the nearest Maricopa County Environmental Services Department Air Quality Division monitoring station, from any other certified meteorological station, or by a wind instrument that is calibrated according to manufacturer's standards and that is located at the site being checked.

301.2 Emergency Maintenance Of Flood Control Channels and Water Retention Basins: No opacity limitation shall apply to emergency maintenance of flood control channels and water retention basins, provided that control measures are implemented.

301.3 Vehicle Test And Development Facilities And Operations: No opacity limitation shall apply to vehicle test and development facilities and operations when dust is required to test and validate design integrity, product quality, and/or commercial acceptance, if such testing is not feasible within enclosed facilities.

302 STABILIZATION REQUIREMENTS FOR FUGITIVE DUST SOURCES:

302.1 Unpaved Parking Lot: The owner and/or operator of any unpaved parking lot shall not allow visible fugitive dust emissions to exceed 20% opacity, and either:

a. Shall not allow silt loading equal to or greater than 0.33 oz/ft^2; or

b. Shall not allow the silt content to exceed 8%.

302.2 Unpaved Haul/Access Road: The owner and/or operator of any unpaved haul/access road (whether at a work site that is under construction or at a work site that is temporarily or permanently inactive):

a. Shall not allow visible fugitive dust emissions to exceed 20% opacity, and either:

(1) Shall not allow silt loading equal to or greater than 0.33 oz/ft^2; or

(2) Shall not allow the silt content to exceed 6%.

b. Shall, as an alternative to meeting the stabilization requirements for an unpaved haul/access road, limit vehicle trips to no more than 20 per day and limit vehicle speeds to no more than 15 miles per hour. If complying with subsection 302.2(b) of this rule, must include, in a Dust Control Plan, the number of vehicles traveled on the unpaved haul/access roads (i.e., number of employee vehicles, earthmoving equipment, haul trucks, and water trucks).

302.3 Open Area And Vacant Lot Or Disturbed Surface Area: The owner and/or operator of an open area and vacant lot or any disturbed surface area on which no activity is occurring (whether at a work site that is under construction, at a work site that is temporarily or permanently inactive) shall meet at least 1 of the standards described in subsection 302.3(a) through subsection 302.3(g) below, as applicable. The owner and/or operator of such inactive disturbed surface area shall be considered in violation of this rule if such inactive disturbed surface area is not maintained in a manner that meets at least 1 of the standards described in subsection 302.3(a) through subsection 302.3(g) below, as applicable.

a. Maintain a visible crust; or

b. Maintain a threshold friction velocity (TFV) for disturbed surface areas corrected for non-erodible elements of 100 cm/second or higher; or

c. Maintain a flat vegetative cover (i.e., attached (rooted) vegetation or unattached vegetative debris lying on the surface with a predominant horizontal orientation that is not subject to movement by wind) that is equal to at least 50%; or

d. Maintain a standing vegetative cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 30%; or

e. Maintain a standing vegetative cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 10% and where the threshold friction velocity is equal to or greater than 43 cm/second when corrected for non-erodible elements; or

f. Maintain a percent cover that is equal to or greater than 10% for non-erodible elements; or

g. Comply with a standard of an alternative test method, upon obtaining the written approval from the Control Officer and the Administrator of the Environmental Protection Agency (EPA).

302.4 Vehicle Test And Development Facilities And Operations: No stabilization requirement shall apply to vehicle test and development facilities and operations when dust is required to test and validate design integrity, product quality, and/or commercial acceptance, if such testing is not feasible within enclosed facilities.

303 DUST CONTROL PLAN REQUIRED: The owner and/or operator of a source shall submit to the Control Officer a Dust Control Plan with any permit applications that involve earthmoving operations which would equal or exceed 0.10 acre. Compliance with this section does not effect a source's responsibility to comply with the other standards of this rule. The Dust Control Plan shall describe all control measures to be implemented before, after, and while conducting any dust generating operation, including during weekends, after work hours, and on holidays.

303.1 A Dust Control Plan shall, at a minimum, contain all the information described in Section 304 of this rule. The Control Officer shall approve, disapprove, or conditionally approve the Dust Control Plan, in accordance with the criteria used to approve, disapprove or conditionally approve a permit. Failure to comply with the provisions of an approved Dust Control Plan is deemed to be a violation of this rule. Regardless of whether an approved Dust Control Plan is in place or not, the owner and/or operator of a source is still subject to all requirements of this rule at all times. In addition, the owner and/or operator of a source with an approved Dust Control Plan is still subject to all of the requirements of this rule, even if such owner and/or operator is complying with the approved Dust Control Plan.

303.2 At least one primary control measure and one contingency control measure must be identified in the Dust Control Plan for all fugitive dust sources. Should any primary control measure(s) prove ineffective, the owner and/or operator shall immediately implement the contingency control measure(s), which may obviate the requirement of submitting a revised Dust Control Plan.

303.3 The following subsections, subsection 303.3(a) and subsection 303.3(b) of this rule, describe the permit applications with which a Dust Control Plan must be submitted.

a. If a person is required to obtain an Earthmoving Permit under Regulation II (Permits And Fees) of these rules, then such person must first submit a Dust Control Plan and obtain the Control Officer's approval of the Dust Control Plan before commencing any dust generating operation.

b. If a person is required to obtain or has obtained a Title V Permit, a Non-Title V, or a General Permit under Regulation II (Permits And Fees) of these rules, then such person must first submit a Dust Control Plan and obtain the Control Officer's approval of the Dust Control Plan before commencing any routine dust generating operation.

303.4 A Dust Control Plan shall not be required:

a. To play on a ballfield and/or for landscape maintenance. For the purpose of this rule, landscape maintenance does not include grading, trenching, nor any other mechanized surface disturbing activities.

b. To establish initial landscapes or to redesign existing landscapes of legally-designated public parks and recreational areas, including national parks, national monuments, national forests, state parks, city parks, and county regional parks, hiking paths, horse trails, bicycle paths, ballfields, playgrounds at camp sites, and camp sites, which are used exclusively for purposes other than travel by motor vehicles. For the purpose of this rule, establishing initial landscapes or redesigning existing landscapes does not include grading, trenching, nor any other mechanized surface disturbing activities.

304 ELEMENTS OF A DUST CONTROL PLAN: A Dust Control Plan shall contain, at a minimum, all of the following information:

304.1 Names, address(es), and phone numbers of person(s) responsible for the submittal and implementation of the Dust Control Plan and responsible for the dust generating operation.

304.2 A drawing, on at least 8½" x 11" paper, which shows:

a. Entire project site boundaries;

b. Acres to be disturbed with linear dimensions;

c. Nearest public roads;

d. North arrow; and

e. Planned exit locations onto paved public roadways.

304.3 Control measures or combination thereof to be applied to all actual and potential fugitive dust sources, before, after, and while conducting any dust generating operation, including during weekends, after work hours, and on holidays.

a. At least one primary control measure and one contingency control measure must be identified, from Table 1 of this rule, for all fugitive dust sources. Should any primary control measure(s) prove ineffective, the owner and/or operator shall immediately implement the contingency control measure(s), which may obviate the requirement of submitting a revised Dust Control Plan.

b. Alternatively, a control measure(s) that is not in Table 1 of this rule may be chosen, provided that such control measure(s) is implemented to comply with the standard(s) described in Section 301 and Section 302 of this rule, as determined by the corresponding test method(s), as applicable, and must meet other applicable standard(s) set forth in this rule.

c. If complying with subsection 302.2(b) (Stabilization Requirements For Fugitive Dust Sources-Unpaved Haul/Access Roads) of this rule, must include the number of vehicles traveled on the unpaved haul/access roads (i.e., number of employee vehicles, earthmoving equipment, haul trucks, and water trucks).

304.4 Dust suppressants to be applied, including product specifications or label instructions for approved usage:

a. Method, frequency, and intensity of application.

b. Type, number, and capacity of application equipment.

c. Information on environmental impacts and approvals or certifications related to appropriate and safe use for ground application.

304.5 Specific surface treatment(s) and/or control measures utilized to control material trackout and sedimentation where unpaved and/or access points join paved public roadways.

305 DUST CONTROL PLAN REVISIONS: If the Control Officer determines that an approved Dust Control Plan has been followed, yet fugitive dust emissions from any given fugitive dust source still exceed Section 301 and Section 302 of this rule, then the Control Officer shall issue a written notice to the owner and/or operator of such source explaining such determination. The owner and/or operator of such source shall make written revisions to the Dust Control Plan and shall submit such revised Dust Control Plan to the Control Officer within three working days of receipt of the Control Officer's written notice, unless such time period is extended by the Control Officer, upon request, for good cause. During the time that such owner and/or operator is preparing revisions to the approved Dust Control Plan, such owner and/or operator must still comply with all requirements of this rule.

306 CONTROL MEASURES: The owner and/or operator of a source shall implement control measures before, after, and while conducting any dust generating operation, including during weekends, after work hours, and on holidays. See subsection 304.3, Table 1, and Table 2 of this rule. For the purpose of this rule, any control measure that is implemented must meet the applicable standard(s) described in Section 301 and in Section 302 of this rule, as determined by the corresponding test method(s), as applicable, and must meet other applicable standard(s) set forth in this rule. Failure to comply with the provisions of Section 308 (Work Practices) of this rule, as applicable, and/or of an approved Dust Control Plan, is deemed a violation of this rule. Regardless of whether an approved Dust Control Plan is in place or not, the owner and/or operator of a dust generating operation is still subject to all requirements of this rule at all times. In addition, the owner and/or operator of a dust generating operation with an approved Dust Control Plan is still subject to all of the requirements of this rule, even if such owner and/or operator of a dust generating operation is complying with the approved Dust Control Plan.

307 PROJECT INFORMATION SIGN: The owner and/or operator of a source shall erect a project information sign at the main entrance, that is visible to the public, of all sites with an Earthmoving Permit that are five acres or larger. Such sign shall be a minimum of four feet long by four feet wide, have a white background, have black block lettering which is at least four inches high, and shall contain the following information:

307.1 Project name; and

307.2 Name and phone number of person(s) responsible for conducting the project; and

307.3 Text stating: "Complaints? Call Maricopa County Environmental Services Department (insert the current/accurate phone number for the complaint phone line)."

308 WORK PRACTICES: When engaged in the following specific activities, the owner and/or operator of a source shall comply with the following work practices in addition to implementing, as applicable, the control measures described in Table 1 of this rule. Such work practices shall be implemented to meet the standards described in Section 301 and Section 302 of this rule.

308.1 Bulk Material Hauling Off-Site Onto Paved Public Roadways:

a. Load all haul trucks such that the freeboard is not less than three inches; and

b. Prevent spillage or loss of bulk material from holes or other openings in the cargo compartment's floor, sides, and/or tailgate(s); and

c. Cover all haul trucks with a tarp or other suitable closure; and

d. Before the empty haul truck leaves the site, clean the interior of the cargo compartment or cover the cargo compartment.

308.2 Bulk Material Hauling On-Site Within The Boundaries Of The Work Site: When crossing a public roadway upon which the public is allowed to travel while construction is underway:

a. Load all haul trucks such that the freeboard is not less than three inches; and

b. Prevent spillage or loss of bulk material from holes or other openings in the cargo compartment's floor, sides, and/or tailgate(s); and

c. Install a suitable trackout control device that controls and prevents trackout and/or removes particulate matter from tires and the exterior surfaces of haul trucks and/or motor vehicles that traverse such work site. Examples of trackout control devices are described in Table 1 (Trackout-1J, 2J, 3J) of this rule.

308.3 Spillage, Carry-Out, Erosion, And/Or Trackout:

a. Install a suitable trackout control device (Examples of trackout control devices are described in Table 1 (Trackout-1J, 2J, 3J) of this rule) that controls and prevents trackout and/or removes particulate matter from tires and the exterior surfaces of haul trucks and/or motor vehicles that traverse such work site at all exits onto a paved public roadway:

(1) From all work sites with a disturbed surface area of five acres or larger.

(2) From all work sites where 100 cubic yards of bulk materials are hauled on-site and/or off-site per day.

b. Cleanup spillage, carry-out, erosion, and/or trackout on the following time-schedule:

(1) Immediately, when spillage, carry-out, and/or trackout extends a cumulative distance of 50 linear feet or more; or

(2) At the end of the work day, when spillage, carry-out, erosion, and/or trackout are other than the spillage, carry-out, erosion, and/or trackout described above, in subsection 308.3(b)(1) of this rule.

308.4 Unpaved Haul/Access Roads: Implement 1 or more control measure(s) described in Table 1 (Unpaved Haul/Access Roads-1C through 5C) of this rule, before engaging in the use of or in the maintenance of unpaved haul/access roads.

308.5 Easements, Rights-Of-Way, And Access Roads For Utilities (Electricity, Natural Gas, Oil, Water, And Gas Transmission) Associated With Sources That Have A Non-Title V Permit, A Title V Permit, And/Or A General Permit Under These Rules:

a. Inside the PM_{10} nonattainment area, restrict vehicular speeds to 15 miles per hour and vehicular trips to no more than 20 per day; or

b. Outside the PM_{10} nonattainment area, restrict vehicular trips to no more than 20 per day; or

c. Implement control measures, as described in Table 1 (Unpaved Haul/Access Roads-1C through 5C) of this rule.

308.6 Open Storage Piles: For the purpose of this rule, an open storage pile is any accumulation of bulk material with a 5% or greater silt content which in any one point attains a height of three feet and covers a total surface area of 150 square feet or more. Silt content shall be assumed to be 5% or greater unless a person can show, by testing in accordance with ASTM Method C136-96A or other equivalent method approved in writing by the Control Officer and the Administrator of EPA, that the silt content is less than 5%.

a. During stacking, loading, and unloading operations, apply water, as necessary, to maintain compliance with Section 301 of this rule; and

b. When not conducting stacking, loading, and unloading operations, comply with one of the following work practices:

(1) Cover open storage piles with tarps, plastic, or other material to prevent wind from removing the coverings; or

(2) Apply water to maintain a soil moisture content at a minimum of 12%, as determined by ASTM Method D2216-98, or other equivalent as approved by the Control Officer and the Administrator of EPA. For areas which have an optimum moisture content for compaction of less than 12%, as determined by ASTM Method D1557-91(1998) or other equivalent approved by the Control Officer and the Administrator of EPA, maintain at least 70% of the optimum soil moisture content; or

(3) Meet one of the stabilization requirements described in subsection 302.3 of this rule; or

(4) Construct and maintain wind barriers, storage silos, or a three-sided enclosure with walls, whose length is no less than equal to the length of the pile, whose distance from the pile is no more than twice the height of the pile, whose height is equal to the pile height, and whose porosity is no more than 50%. If implementing this subsection, subsection 308.6(b)(4), must also implement either subsection 308.6(b)(2) or subsection 308.6(b)(3) above.

308.7 Earthmoving Operations On Disturbed Surface Areas 1 Acre Or Larger: If water is the chosen control measure, operate water application system (e.g., water truck) while conducting earthmoving operations on disturbed surface areas 1 acre or larger.

308.8 Weed Abatement By Discing Or Blading:

a. Apply water before weed abatement by discing or blading occurs; and

b. Apply water while weed abatement by discing or blading is occurring; and

c. Pave, apply gravel, apply water, or apply a suitable dust suppressant, in compliance with subsection 302.3 of this rule, after weed abatement by discing or blading occurs; or

d. Establish vegetative ground cover in sufficient quantity, in compliance with subsection 302.3 of this rule, after weed abatement by discing or blading occurs.

SECTION 400 - ADMINISTRATIVE REQUIREMENTS

401 DUST CONTROL PLAN POSTING: The owner and/or operator of a source shall post a copy of the approved Dust Control Plan in a conspicuous location at the work site, within on-site equipment, or in an on-site vehicle, or shall otherwise keep a copy of the approved Dust Control Plan available on-site at all times. The owner and/or operator of a source that has been issued a Block Permit shall not be required to keep a copy of the plot plan, an element of a Dust Control Plan, on-site.

402 COMPLIANCE SCHEDULE: The requirements of this rule supercede any conflicting requirements that may be found in existing Dust Control Plans.

402.1 For Earthmoving Permits: If any changes to a Dust Control Plan, associated with an Earthmoving Permit, are necessary as a result of the most recent revisions of this rule, such changes shall not be required until the Earthmoving Permit is required to be renewed.

402.2 For Non-Title V Permits And For Title V Permits: If any changes to a Dust Control Plan, associated with a Non-Title V Permit or with a Title V Permit, are necessary as a result of the most recent revisions of this rule, then the owner and/or operator shall submit a revised Dust Control Plan to the Control Officer, according to the minor permit revision procedures described in Rule 220 and Rule 210 of these rules respectively, no later than 6 months after the effective date of the most recent revisions to this rule.

SECTION 500 - MONITORING AND RECORDS

501 **COMPLIANCE DETERMINATION**: To determine compliance with this rule, the following test methods shall be conducted:

501.1 **Opacity Observations:**

a. **Dust Generating Operations:** Opacity observations of a source engaging in dust generating operations shall be conducted in accordance with Appendix C, Section 3 (Visual Determination Of Opacity Of Emissions From Sources For Time-Averaged Regulations) of these rules, except opacity observations for intermittent sources shall require 12 rather than 24 consecutive readings at 15-second intervals for the averaging time.

b. **Unpaved Parking Lot:** Opacity observations of any unpaved parking lot shall be conducted in accordance with Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

c. **Unpaved Haul/Access Road:** Opacity observations of any unpaved haul/access road (whether at a work site that is under construction or at a work site that is temporarily or permanently inactive) shall be conducted in accordance with Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

501.2 **Stabilization Observations:**

a. **Unpaved Parking Lot:** Stabilization observations for unpaved parking lots shall be conducted in accordance with Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules. When more than 1 test method is permitted for a determination, an exceedance of the limits established in this rule determined by any of the applicable test methods constitutes a violation of this rule.

b. **Unpaved Haul/Access Road:** Stabilization observations for unpaved haul/access roads (whether at a work site that is under construction or at a work site that is temporarily or permanently inactive) shall be conducted in accordance with Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rule. When more than 1 test method is permitted for a determination, an exceedance of the limits established in this rule determined by any of the applicable test methods constitutes a violation of this rule.

c. **Open Area And Vacant Lot Or Disturbed Surface Area:** Stabilization observations for an open area and vacant lot or any disturbed surface area on which no activity is occurring (whether at a work site that is under construction, at a work site that is temporarily or permanently inactive) shall be conducted in accordance with at least one of the techniques described in subsection 501.2(c)(1) through subsection 501.2(c)(7) below, as applicable. The owner and/or operator of such inactive disturbed surface area shall be considered in violation of this rule if such inactive disturbed surface area is not maintained in a manner that meets at least 1 of the standards described in subsection 302.3 of this rule, as applicable.

(1) Appendix C, Section 2.3 (Test Methods For Stabilization-Visible Crust Determination) (The Drop Ball/Steel Ball Test) of these rules for a visible crust; or

(2) Appendix C, Section 2.4 (Test Methods For Stabilization-Determination Of Threshold Friction Velocity (TFV)) (Sieving Field Procedure) of these rules for threshold friction velocity (TFV) corrected for non-erodible elements of 100 cm/second or higher; or

(3) Appendix C, Section 2.5 (Test Methods For Stabilization-Determination Of Flat Vegetative Cover) of these rules for flat vegetation cover (i.e., attached (rooted) vegetation or unattached vegetative debris lying on the surface with a predominant horizontal orientation that is not subject to movement by wind) that is equal to at least 50%; or

(4) Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules for standing vegetation cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 30%; or

(5) Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules for standing vegetation cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 10% and where the threshold friction velocity is equal to or greater than 43 cm/second when corrected for non-erodible elements; or

(6) Appendix C, Section 2.7 (Test Methods For Stabilization-Rock Test Method) of these rules for a percent cover that is equal to or greater than 10%, for non-erodible elements; or

(7) An alternative test method approved in writing by the Control Officer and the Administrator of the EPA.

502 RECORDKEEPING: Any person who conducts dust generating operations that require a Dust Control Plan shall keep a daily written log recording the actual application or implementation of the control measures delineated in the approved Dust Control Plan. Any person who conducts dust generating operations which do not require a Dust Control Plan shall compile and retain records that provide evidence of control measure application, by indicating the type of treatment or control measure, extent of coverage, and date applied. Upon verbal or written request by the Control Officer, the log or the records and supporting documentation shall be provided within 48 hours, excluding weekends. If the Control Officer is at the site where requested records are kept, records shall be provided without delay.

503 RECORDS RETENTION: Copies of approved Dust Control Plans, control measures implementation records, and all supporting documentation shall be retained for at least six months following the termination of the dust generating operation. Copies of approved Dust Control Plans, control measures implementation records, and all supporting documentation shall be retained for at least 1 year from the date such records were initiated. If a person has obtained a Title V Permit and is subject to the requirements of this rule, then such person shall retain records required by this rule for at least 5 years from the date such records are established.

504 TEST METHODS ADOPTED BY REFERENCE: The test methods listed in this section are adopted by reference. These adoptions by reference include no future editions or amendments. Copies of the test methods listed in this section are available for review at the Maricopa County Environmental Services Department, 1001 North Central Avenue, Phoenix, AZ, 85004-1942.

504.1 ASTM Method C136-96A ("Standard Test Method For Sieve Analysis Of Fine And Coarse Aggregates"), 1996 edition.

504.2 ASTM Method D2216-98 ("Standard Test Method For Laboratory Determination Of Water (Moisture) Content Of Soil And Rock By Mass"), 1998 edition.

504.3 ASTM Method 1557-91(1998) ("Test Method For Laboratory Compaction Characteristics Of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)"), 1998 edition.

TABLE 1

SOURCE TYPE AND CONTROL MEASURES
Vehicle Use In Open Areas And Vacant Lots: 1A Restrict trespass by installing signs. 2A Install physical barriers such as curbs, fences, gates, posts, signs, shrubs, and/or trees to prevent access to the area.
Unpaved Parking Lots: 1B Pave. 2B Apply and maintain gravel, recycled asphalt, or other suitable material, in compliance with subsection 302.1 of this rule. 3B Apply a suitable dust suppressant, in compliance with subsection 302.1 of this rule.
Unpaved Haul/Access Roads: (The control measures listed below (1C-5C) are required work practices, per subsection 308.4 of this rule.) 1C Limit vehicle speed to 15 miles per hour or less and limit vehicular trips to no more than 20 per day. 2C Apply water, so that the surface is visibly moist and subsection 302.2 of this rule is met. 3C Pave. 4C Apply and maintain gravel, recycled asphalt, or other suitable material, in compliance with subsection 302.2 of this rule. 5C Apply a suitable dust suppressant, in compliance with subsection 302.2 of this rule.
Disturbed Surface Areas: **Pre-Activity:** 1D Pre-water site to the depth of cuts. 2D Phase work to reduce the amount of disturbed surface areas at any one time. **During Dust Generating Operations:** 3D Apply water or other suitable dust suppressant, in compliance with Section 301 of this rule. 4D Apply water as necessary to maintain a soil moisture content at a minimum of 12%, as determined by ASTM Method D2216-98 or other equivalent as approved by the Control Officer and the Administrator of EPA. For areas which have an optimum moisture content for compaction of less than 12%, as determined by ASTM Method D1557-91(1998) or other equivalent approved by the Control Officer and the Administrator of EPA, maintain at least 70% of the optimum soil moisture content. 5D Construct fences or 3 foot - 5 foot high wind barriers with 50% or less porosity adjacent to roadways or urban areas that reduce the amount of wind blown material leaving a site. If constructing fences or wind barriers, must also implement 3D or 4D above. **Temporary Stabilization During Weekends, After Work Hours, And On Holidays:** 6D Apply a suitable dust suppressant, in compliance with subsection 302.3 of this rule. 7D Establish vegetative ground cover in sufficient quantity, in compliance with subsection 302.3 of this rule. 8D Restrict vehicular access to the area, in addition to either of the control measures described in 6D and 7D above. **Permanent Stabilization (Required Within 8 Months Of Ceasing Dust Generating Operations):** 9D Restore area such that the vegetative ground cover and soil characteristics are similar to

	adjacent or nearby undisturbed native conditions, in compliance with subsection 302.3 of this rule.
10D	Pave, apply gravel, or apply a suitable dust suppressant, in compliance with subsection 302.3 of this rule.
11D	Establish vegetative ground cover in sufficient quantity, in compliance with subsection 302.3 of this rule.
Open Areas And Vacant Lots:	
1E	Restore area such that the vegetative ground cover and soil characteristics are similar to adjacent or nearby undisturbed native conditions.
2E	Pave, apply gravel, or apply a suitable dust suppressant, in compliance with subsection 302.3 of this rule.
3E	Establish vegetative ground cover in sufficient quantity, in compliance with subsection 302.3 of this rule.
Control measures 1F – 1M below are required work practices and/or methods designed to meet the work practices, per Section 308 (Work Practices) of this rule.	
Bulk Material Handling Operations And Open Storage Piles:	
During Stacking, Loading, And Unloading Operations:	
1F	Apply water as necessary, to maintain compliance with Section 301 of this rule; and
When Not Conducting Stacking, Loading, And Unloading Operations:	
2F	Cover open storage piles with tarps, plastic, or other material to prevent wind from removing the coverings; or
3F	Apply water to maintain a soil moisture content at a minimum of 12%, as determined by ASTM Method D2216-98, or other equivalent as approved by the Control Officer and the Administrator of EPA. For areas which have an optimum moisture content for compaction of less than 12%, as determined by ASTM Method D1557-91(1998) or other equivalent approved by the Control Officer and the Administrator of EPA, maintain at least 70% of the optimum soil moisture content; or
4F	Meet the stabilization requirements described in subsection 302.3 of this rule; or
5F	Construct and maintain wind barriers, storage silos, or a three-sided enclosure with walls, whose length is no less than equal to the length of the pile, whose distance from the pile is no more than twice the height of the pile, whose height is equal to the pile height, and whose porosity is no more than 50%. If implementing 5F, must also implement 3F or 4F above.
Bulk Material Hauling/Transporting:	
When On-Site Hauling/Transporting Within The Boundaries Of The Work Site When Crossing A Public Roadway Upon Which The Public Is Allowed To Travel While Construction Is Underway:	
1G	Load all haul trucks such that the freeboard is not less than 3 inches when crossing a public roadway upon which the public is allowed to travel while construction is underway; and
2G	Prevent spillage or loss of bulk material from holes or other openings in the cargo compartment's floor, sides, and/or tailgate(s); and
3G	Install a suitable trackout control device that controls and prevents trackout and/or removes particulate matter from tires and the exterior surfaces of haul trucks and/or motor vehicles that traverse such work site. Examples of trackout control devices are described in Table 1 (Trackout 1J, 2J, 3J) of this rule; and

When On-Site Hauling/Transporting Within The Boundaries Of The Work Site But Not Crossing A Public Roadway Upon Which The Public Is Allowed To Travel While Construction Is Underway:

4G Limit vehicular speeds to 15 miles per hour or less while traveling on the work site; or

5G Apply water to the top of the load such that the 20% opacity standard, as described in Section 301 of this rule, is not exceeded, or cover haul trucks with a tarp or other suitable closure.

Off-Site Hauling/Transporting Onto Paved Public Roadways:

6G Cover haul trucks with a tarp or other suitable closure; and

7G Load all haul trucks such that the freeboard is not less than 3 inches; and

8G Prevent spillage or loss of bulk material from holes or other openings in the cargo compartment's floor, sides, and/or tailgate(s); and

9G Before the empty haul truck leaves the site, clean the interior of the cargo compartment or cover the cargo compartment.

Cleanup Of Spillage, Carry Out, Erosion, And/Or Trackout:

1H Operate a street sweeper or wet broom with sufficient water, if applicable, at the speed recommended by the manufacturer and at the frequency(ies) described in subsection 308.3 of this rule; or

2H Manually sweep-up deposits.

Trackout:

1J Install a grizzly or wheel wash system at all access points.

2J At all access points, install a gravel pad at least 30 feet wide, 50 feet long, and 6 inches deep.

3J Pave starting from the point of intersection with a paved public roadway and extending for a centerline distance of at least 100 feet and a width of at least 20 feet.

Weed Abatement By Discing Or Blading:

1K Pre-water site and implement 3K or 4K below.

2K Apply water while weed abatement by discing or blading is occurring and implement 3K or 4K below.

3K Pave, apply gravel, apply water, or apply a suitable dust suppressant, in compliance with subsection 302.3 of this rule, after weed abatement by discing or blading occurs; or

4K Establish vegetative ground cover in sufficient quantity, in compliance with subsection 302.3 of this rule, after weed abatement by discing or blading occurs.

Easements, Rights-Of-Way, And Access Roads For Utilities (Electricity, Natural Gas, Oil, Water, And Gas Transmission) Associated With Sources That Have A Non-Title V Permit, A Title V Permit, And/Or A General Permit Under These Rules:

1L Inside the PM_{10} nonattainment area, restrict vehicular speeds to 15 miles per hour and vehicular trips to no more than 20 per day; or

2L Outside the PM_{10} nonattainment area, restrict vehicular trips to no more than 20 per day; or

3L Implement control measures, as described in Table 1 (Unpaved Haul/Access Roads-1C through 5C) of this rule.

Earthmoving Operations On Disturbed Surface Areas 1 Acre Or Larger:

1M If water is the chosen control measure, operate water application system (e.g., water truck), while conducting earthmoving operations on disturbed surface areas 1 acre or larger.

TABLE 2

Note: Control measures in [brackets] are to be applied only to sources outside the nonattainment area.

SOURCE TYPE AND WIND EVENT CONTROL MEASURES
Dust Generating Operations: 1A Cease dust generating operations for the duration of the condition/situation/event when the 60-minute average wind speed is greater than 25 miles per hour. If dust generating operations are ceased for the remainder of the work day, stabilization measures must be implemented; or 2A Apply water or other suitable dust suppressant twice [once] per hour, in compliance with Section 301 of this rule; or 3A Apply water as necessary to maintain a soil moisture content at a minimum of 12%, as determined by ASTM Method D2216-98 or other equivalent as approved by the Control Officer and the Administrator of EPA. For areas which have an optimum moisture content for compaction of less than 12%, as determined by ASTM Method D1557-91(1998) or other equivalent approved by the Control Officer and the Administrator of EPA, maintain at least 70% of the optimum soil moisture content; or 4A Construct fences or 3 foot - 5 foot high wind barriers with 50% or less porosity adjacent to roadways or urban areas that reduce the amount of wind-blown material leaving a site. If implementing 4A, must also implement 2A or 3A above.
Temporary Disturbed Surface Areas (After Work Hours, Weekends, Holidays): 1B Uniformly apply and maintain surface gravel or dust suppressants, in compliance with subsection 302.3 of this rule; or 2B Apply water to all disturbed surface areas three times per day. If there is any evidence of wind-blown dust, increase watering frequency to a minimum of four times per day; or 3B Apply water on open storage piles twice [once] per hour, in compliance with subsection 302.3 of this rule; or 4B Cover open storage piles with tarps, plastic, or other material to prevent wind from removing the coverings; or 5B Utilize any combination of the control measures described in 1B, 2B, 3B, and 4B above, such that, in total, these control measures apply to all disturbed surface areas.

Appendix A-2

REGULATION III - CONTROL OF AIR CONTAMINANTS

RULE 310.01
FUGITIVE DUST FROM
OPEN AREAS, VACANT LOTS, UNPAVED PARKING LOTS, AND UNPAVED ROADWAYS

INDEX

Adopted 06/16/99
Revised 02/16/00

MARICOPA COUNTY
AIR POLLUTION CONTROL REGULATIONS

REGULATION III - CONTROL OF AIR CONTAMINANTS

RULE 310.01
FUGITIVE DUST FROM
OPEN AREAS, VACANT LOTS, UNPAVED PARKING LOTS, AND UNPAVED ROADWAYS

SECTION 100 - GENERAL

101 PURPOSE: To limit the emission of particulate matter into the ambient air from open areas, vacant lots, unpaved parking lots, and unpaved roadways which are not regulated by Rule 310 (Fugitive Dust Sources) of these rules and which do not require a permit nor a Dust Control Plan. The effect of this rule shall be to minimize the amount of fine particulate matter (PM_{10}) entrained into the ambient air as a result of the impact of human activities by requiring measures to prevent, reduce, or mitigate particulate matter emissions.

102 APPLICABILITY: The provisions of this rule shall apply to open areas, vacant lots, unpaved parking lots, and unpaved roadways which are not regulated by Rule 310 (Fugitive Dust Sources) of these rules and which do not require a permit nor a Dust Control Plan. In addition, the provisions of this rule shall apply to any open area or vacant lot that is not defined as agricultural land and is not used for agricultural purposes according to Arizona Revised Statutes (ARS) §42-12151 and ARS §42-12152. The provisions of this rule shall not apply to normal farm cultural practices according to ARS §49-457 and ARS §49-504.4.

SECTION 200 - DEFINITIONS: For the purpose of this rule, the following definitions shall apply. See Rule 100 (General Provisions And Definitions) of these rules for definitions of terms that are used but not specifically defined in this rule.

201 BULK MATERIAL - Any material, including but not limited to, earth, rock, silt, sediment, sand, gravel, soil, fill, aggregate less than 2 inches in length or diameter (i.e., aggregate base course (ABC)), dirt, mud, demolition debris, cotton, trash, cinders, pumice, saw dust, feeds, grains, fertilizers, and dry concrete.

202 CHEMICAL/ORGANIC STABILIZER - Any non-toxic chemical or organic dust suppressant, other than water, which meets any specifications, criteria, or tests required by any Federal, State, or local water agency and is not prohibited for use by any applicable law, rule, or regulation.

203 COMMERCIAL FEEDLOTS AND/OR COMMERCIAL LIVESTOCK AREAS - Any operation directly related to feeding animals, displaying animals, racing animals, exercising animals, and/or for any other such activity, for the primary purpose of livelihood.

204 **CONTROL MEASURE -** A technique, practice, or procedure used to prevent or minimize the generation, emission, entrainment, suspension, and/or airborne transport of fugitive dust.

205 **DISTURBED SURFACE AREA -** A portion of the earth's surface (or material placed thereupon) which has been physically moved, uncovered, destabilized, or otherwise modified from its undisturbed native condition, thereby increasing the potential for the emission of fugitive dust. For the purpose of this rule, an area is considered to be a disturbed surface area until the activity that caused the disturbance has been completed and the disturbed surface area meets the standards described in Section 501 of this rule, as applicable.

206 **DUST SUPPRESSANT -** Water, hygroscopic material, 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.

207 **FUGITIVE DUST -** The particulate matter, which is not collected by a capture system, which is entrained in the ambient air and which is caused from human and/or natural activities, such as but not limited to, movement of soil, vehicles, equipment, blasting, and wind. For the purpose of this rule, 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, and from piledrivers, and does not include emissions from process and combustion sources that are subject to other rules in Regulation III (Control Of Air Contaminants) of these rules.

208 **MOTOR VEHICLE -** A self-propelled vehicle for use on the public roads and highways of the State of Arizona and required to be registered under the Arizona State Uniform Motor Vehicle Act, including any non-motorized attachments, such as but not limited to, trailers or other conveyances which are connected to or propelled by the actual motorized portion of the vehicle.

209 **NORMAL FARM CULTURAL PRACTICE -** All activities by the owner, lessee, agent, independent contractor, and/or supplier conducted on any facility for the production of crops and/or nursery plants. Disturbances of the field surface caused by turning under stalks, tilling, leveling, planting, fertilizing, or harvesting are included in this definition.

210 **OFF-ROAD VEHICLE -** Any self-propelled conveyance specifically designed for off-road use, including but not limited to, off-road or all-terrain equipment, trucks, cars, motorcycles, motorbikes, or motorbuggies.

211 **OPEN AREAS AND VACANT LOTS -** Any of the following described in subsection 211.1 through subsection 211.4 of this rule. For the purpose of this rule, vacant portions of residential or commercial lots that are immediately adjacent and owned and/or operated by the same individual or entity are considered one vacant open area or vacant lot.

211.1 An unsubdivided or undeveloped tract of land adjoining a developed or a partially developed residential, industrial, institutional, governmental, or commercial area.

211.2 A subdivided residential, industrial, institutional, governmental, or commercial lot, which contains no approved or permitted buildings or structures of a temporary or permanent nature.

211.3 A partially developed residential, industrial, institutional, governmental, or commercial lot.

211.4 A tract of land, in the nonattainment area, adjoining agricultural property.

212 **OWNER AND/OR OPERATOR -** Any person who owns, leases, operates, controls, or supervises a fugitive dust source subject to the requirements of this rule.

213 **PAVE -** To apply and maintain asphalt, concrete, or other similar material to a roadway surface (i.e., asphaltic concrete, concrete pavement, chip seal, or rubberized asphalt).

214 **PUBLIC ROADWAYS** - Any roadways that are open to public travel.

215 **UNPAVED PARKING LOT -** Any area larger than 5,000 square feet that is not paved and that is used for parking, maneuvering, or storing motor vehicles.

216 **UNPAVED ROADWAY (INCLUDING ALLEYS) -** A road that is not paved and that is owned by Federal, State, county, municipal, or other governmental or quasi-governmental agencies. For the purpose of this rule, an unpaved roadway (including alleys) is not a horse trail, hiking path, bicycle path, or other similar path used exclusively for purposes other than travel by motor vehicles.

217 **VACANT LOT -** The definition of vacant lot is included in Section 211 (Definition Of Open Areas And Vacant Lots) of this rule.

SECTION 300 - STANDARDS

301 **VEHICLE USE IN OPEN AREAS AND VACANT LOTS:** If open areas and vacant lots are 0.10 acre or larger and have a cumulative of 500 square feet or more that are driven over and/or used by motor vehicles and/or off-road vehicles, then the owner and/or operator of such open areas and vacant lots shall implement one of the control measures described in subsection 301.1 of this rule within 60 calendar days following the initial discovery of vehicle use on open areas and vacant lots. For the purpose of this rule, such control measures shall be considered effectively implemented when the open areas and vacant lots meet one of the stabilization limitations described in subsection 301.2 of this rule. Use of or parking on open areas and vacant lots by the owner and/or operator of such open areas and vacant lots and/or landscape maintenance of such open areas and vacant lots shall not be considered vehicle use in open areas and vacant lots. For the purpose of this rule, landscape maintenance does not include grading, trenching, nor any other mechanized surface disturbing activities performed to establish initial landscapes or to redesign existing landscapes.

301.1 Control Measures:

a. Prevent motor vehicle and/or off-road vehicle trespassing, parking, and/or access, by installing barriers, curbs, fences, gates, posts, signs, shrubs, trees, or other effective control measures. Once vehicular traffic has been restricted from an open area or a vacant lot, such open area or vacant lot is no longer subject to the requirements of Section 301 of this rule, but rather such open area and vacant lot is subject to the requirements of Section 302 (Open Areas And Vacant Lots) of this rule.

b. Uniformly apply and maintain surface gravel or chemical/organic stabilizers to all areas disturbed by motor vehicles and/or off-road vehicles in compliance with one of the stabilization limitations described in subsection 301.2 of this rule.

c. Apply and maintain an alternative control measure approved in writing by the Control Officer and the Administrator of the Environmental Protection Agency (EPA).

301.2 Stabilization Limitations:

a. A visible crust shall be implemented, as determined by Appendix C, Section 2.3 (Test Methods For Stabilization-Visible Crust Determination) (The Drop Ball/Steel Ball Test) of these rules; or

b. A threshold friction velocity (TFV) corrected for non-erodible elements of 100 cm/second or higher shall be implemented, as determined by Appendix C, Section 2.4 (Test Methods For Stabilization-Determination Of Threshold Friction Velocity (TFV)) (Sieving Field Procedure) of these rules; or

c. Flat vegetative cover (i.e., attached (rooted) vegetation or unattached vegetative debris lying on the surface with a predominant horizontal orientation that is not subject to movement by wind) that is equal to at least 50% shall be implemented, as determined by Appendix C, Section 2.5 (Test Methods For Stabilization-Determination Of Flat Vegetative Cover) of these rules; or

d. Standing vegetative cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 30% shall be implemented, as determined by Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules; or

e. Standing vegetative cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 10% and where the threshold friction velocity is equal to or greater than 43 cm/second when corrected for non-erodible elements shall be implemented, as determined by Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules; or

f. A percent cover that is equal to or greater than 10% for non-erodible elements shall be implemented, as determined by Appendix C, Section 2.7 (Test Methods For Stabilization-Rock Test Method) of these rules; or

g. An alternative test method approved in writing by the Control Officer and the Administrator of the Environmental Protection Agency (EPA) shall be implemented.

302 OPEN AREAS AND VACANT LOTS: If open areas and vacant lots have 0.5 acre or more of disturbed surface area and remain unoccupied, unused, vacant, or undeveloped for more than 15 days, then the owner and/or operator of such open areas and vacant lots shall implement one of the control measures described in subsection 302.1 of this rule within 60 calendar days following the initial discovery of the disturbance on the open areas and vacant lots. For the purpose of this rule, such control measures shall be considered effectively implemented when the open areas and vacant lots meet one of the stabilization limitations described in subsection 302.2 of this rule.

302.1 Control Measures:

a. Establish vegetative ground cover on all disturbed surface areas within 60 calendar days following the initial discovery of the disturbance. Such control measure(s) must be maintained and reapplied, if necessary, until the disturbed surface areas are stabilized, in compliance with one of the stabilization limitations described in subsection 302.2 of this rule. Stabilization shall be achieved, per this control measure, within eight months after the control measure has been implemented.

b. Apply a dust suppressant to all disturbed surface areas, in compliance with one of the stabilization limitations described in subsection 302.2 of this rule.

c. Restore all disturbed surface areas within 60 calendar days following the initial discovery of the disturbance, such that the vegetative ground cover and soil characteristics are similar to adjacent or nearby undisturbed native conditions. Such control measure(s) must be maintained and reapplied, if necessary, until the disturbed surface areas are stabilized, in compliance with one of the stabilization limitations described in subsection 302.2 of this rule. Stabilization shall be achieved, per this control measure, within eight months after the control measure has been implemented.

d. Uniformly apply and maintain surface gravel, in compliance with one of the stabilization limitations described in subsection 302.2 of this rule.

e. Apply and maintain an alternative control measure approved in writing by the Control Officer and the Administrator of the Environmental Protection Agency (EPA).

302.2 Stabilization Limitations:

a. A visible crust shall be implemented, as determined by Appendix C, Section 2.3 (Test Methods For Stabilization-Visible Crust Determination) (The Drop Ball/Steel Ball Test) of these rules; or

b. A threshold friction velocity (TFV), corrected for non-erodible elements of 100 cm/second or higher, shall be implemented, as determined by Appendix C, Section 2.4 (Test Methods For Stabilization-Determination Of Threshold Friction Velocity (TFV)) (Sieving Field Procedure) of these rules; or

c. Flat vegetative cover (i.e., attached (rooted) vegetation or unattached vegetative debris lying on the surface with a predominant horizontal orientation that is not subject to movement by wind) that is equal to at least 50% shall be implemented, as determined by Appendix C, Section 2.5 (Test Methods For Stabilization-Determination Of Flat Vegetative Cover) of these rules; or

d. Standing vegetative cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 30% shall be implemented, as determined by Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules; or

e. Standing vegetative cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) that is equal to or greater than 10% and where the threshold friction velocity is equal to or greater than 43 cm/second when corrected for non-erodible elements shall be implemented, as determined by Appendix C, Section 2.6 (Test Methods

For Stabilization-Determination Of Standing Vegetative Cover) of these rules; or

f. A percent cover that is equal to or greater than 10% for non-erodible elements shall be implemented, as determined by Appendix C, Section 2.7 (Test Methods For Stabilization-Rock Test Method) of these rules; or

g. An alternative test method approved in writing by the Control Officer and the Administrator of the EPA shall be implemented.

303 UNPAVED PARKING LOTS: The owner and/or operator of an unpaved parking lot shall implement one of the control measures described in subsection 303.1 of this rule. For the purpose of this rule, the owner and/or operator of an unpaved parking lot on which vehicles are parked no more than 35 days per year, excluding days on which ten or fewer vehicles enter, shall implement either the control measure described in subsection 303.1(b) or subsection 303.1(c) below for the duration of time that over 100 vehicles enter and/or park on such unpaved parking lot. In addition, for the purpose of this rule, such control measures shall be considered effectively implemented when the unpaved parking lot meets the stabilization limitation described in subsection 303.2 of this rule.

303.1 Control Measures:

a. Pave.

b. Apply dust suppressants, in compliance with the stabilization limitation described in subsection 303.2 of this rule.

c. Uniformly apply and maintain surface gravel, in compliance with the stabilization limitation described in subsection 303.2 of this rule.

303.2 Stabilization Limitation: For the purpose of this rule, control measures shall be considered effectively implemented when stabilization observations for fugitive dust emissions from unpaved parking lots do not exceed 20% opacity and do not equal or exceed 0.33 oz/ft^2 silt loading, or do not exceed 8% silt content, as determined by Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

304 UNPAVED ROADWAYS (INCLUDING ALLEYS): If a person allows 150 vehicles or more per day to use an unpaved roadway (including alleys) in the nonattainment area, then such person shall first implement one of the best available control measures described in subsection 304.1 of this rule. Existing unpaved roadways (including alleys) with vehicular traffic of 250 vehicles or more per day must be stabilized by one of the best available control measures described in subsection 304.1 of this rule by June 10, 2000. Existing unpaved roadways (including alleys) with vehicular traffic of 150 vehicles or more per day must be stabilized by one of the best available control measures described in subsection 304.1 of this rule by June 10, 2004. For the purpose of this rule, the best available control measures shall be considered effectively implemented when the unpaved roadway (including alleys) complies with subsection 304.3 of this rule.

304.1 Best Available Control Measures:

a. Pave.

b. Apply dust suppressants, in compliance with the stabilization limitation described in subsection 304.3 of this rule.

c. Uniformly apply and maintain surface gravel, in compliance with the stabilization limitation described in subsection 304.3 of this rule.

304.2 Implementation Of Best Available Control Measures: For the purpose of this rule, best available control measures shall be considered effectively implemented, under the following conditions:

a. The unpaved roadway (including alleys) meets the stabilization limitation described in subsection 304.3 of this rule; and, where applicable,

b. Existing unpaved roadways (including alleys) are stabilized according to the following schedule:

(1) Roadways with vehicular traffic of 250 vehicles or more per day are stabilized by June 10, 2000.

(2) Roadways with vehicular traffic of 150 vehicles or more per day are stabilized by June 10, 2004.

304.3 Stabilization Limitation: For the purpose of this rule, control measures shall be considered effectively implemented when stabilization observations for fugitive dust emissions from unpaved roadways (including alleys) do not exceed 20% opacity and do not equal or exceed 0.33 oz/ft^2 silt loading, or do not exceed 6% silt content, as determined by Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

305 COMMERCIAL FEEDLOTS AND/OR COMMERCIAL LIVESTOCK AREAS: The owner and/or operator of any commercial feedlot and/or commercial livestock area shall implement one of the control measures described in subsection 305.1 of this rule.

305.1 Control Measures:

a. Apply dust suppressants, in compliance with the stabilization limitation described in subsection 305.2 of this rule.

b. Uniformly apply and maintain surface gravel, in compliance with the stabilization limitation described in subsection 305.2 of this rule.

c. Install shrubs and/or trees within 50 feet to 100 feet of animal pens, in compliance with the stabilization limitation described in subsection 305.2 of this rule.

305.2 Stabilization Limitation: No fugitive dust plume emanating from commercial feedlots and/or commercial livestock areas shall exceed 20% opacity, as determined by Appendix C, Section 3 (Visual Determination Of Opacity Of Emissions From Sources For Time-Average Regulations) of these rules.

306 EROSION-CAUSED DEPOSITION OF BULK MATERIALS ONTO PAVED SURFACES: In the event that erosion-caused deposition of bulk materials or other materials occurs on any adjacent paved roadway or paved parking lot, the owner and/or operator of the property from which the deposition eroded shall implement both of the control measures described in subsection 306.1 of this rule. Such control measures shall be considered effectively implemented when the deposition meets the stabilization limitation described in subsection 306.2 of this rule. Exceedances of the opacity limit, due to erosion-caused deposition of bulk materials onto paved surfaces, shall constitute a violation of the opacity limit.

306.1 Control Measures:

a. Remove any and all such deposits by utilizing the appropriate control measures within 24 hours of the deposits' identification or prior to the resumption of traffic on pavement, where the pavement area has been closed to traffic; and

b. Dispose of deposits in such a manner so as not to cause another source of fugitive dust.

306.2 Stabilization Limitation: For the purpose of this rule, control measures shall be considered effectively implemented when stabilization observations for fugitive dust emissions from erosion-caused deposition of bulk materials onto paved surfaces do not exceed 20% opacity, as described in Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

307 EASEMENTS, RIGHTS-OF-WAY, AND ACCESS ROADS FOR UTILITIES (ELECTRICITY, NATURAL GAS, OIL, WATER, AND GAS TRANSMISSION): If a person allows 150 vehicles or more per day to use an easement, right-of-way, and access road for utilities (electricity, natural gas, oil, water, and gas transmission) in the nonattainment area, then such person shall first implement one of the control measures described in subsection 307.1 of this rule. For the purpose of this rule, the control measures shall be considered effectively implemented, when the easement, right-of-way, and access road for utilities (electricity, natural gas, oil, water, and gas transmission) complies with subsection 307.2 of this rule.

307.1 Control Measures:

a. Pave.

b. Apply dust suppressants, in compliance with the stabilization limitation described in subsection 307.2 of this rule.

c. Uniformly apply and maintain surface gravel, in compliance with the stabilization limitation described in subsection 307.2 of this rule.

307.2 Stabilization Limitation: For the purpose of this rule, control measures shall be considered effectively implemented when stabilization observations for fugitive dust emissions from easements, rights-of-way, and access roads for utilities (electricity, natural gas, oil, water, and gas transmission) do not exceed 20% opacity and do not equal or exceed 0.33 oz/ft^2 silt loading, or do not exceed 6% silt content, as determined by Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

SECTION 400 - ADMINISTRATIVE REQUIREMENTS (NOT APPLICABLE)

SECTION 500 - MONITORING AND RECORDS

501 STABILIZATION OBSERVATIONS:

501.1 Stabilization observations for unpaved parking lots and/or unpaved roadways (including alleys) shall be conducted in accordance with Appendix C, Section 2.1 (Test Methods For Stabilization-For Unpaved Roads And Unpaved Parking Lots) of these rules.

501.2 Stabilization observations for an open area and vacant lot shall be conducted in accordance with the following:

a. Appendix C, Section 2.3 (Test Methods For Stabilization-Visible Crust Determination) (The Drop Ball/Steel Ball Test) of these rules; or

b. Appendix C, Section 2.4 (Test Methods For Stabilization-Determination Of Threshold Friction Velocity (TFV)) (Sieving Field Procedure) of these rules, where the threshold friction velocity (TFV) for disturbed surface areas corrected for non-erodible elements is 100 cm/second or higher; or

c. Appendix C, Section 2.5 (Test Methods For Stabilization-Determination Of Flat Vegetative Cover) of these rules, where flat vegetation cover (i.e., attached (rooted) vegetation or unattached vegetative debris lying on the surface with a predominant horizontal orientation that is not subject to movement by wind) is equal to at least 50%; or

d. Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules, where standing vegetation cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) is equal to or greater than 30%; or

e. Appendix C, Section 2.6 (Test Methods For Stabilization-Determination Of Standing Vegetative Cover) of these rules, where the standing vegetation cover (i.e., vegetation that is attached (rooted) with a predominant vertical orientation) is equal to or greater than 10% and where the threshold friction velocity, corrected for non-erodible elements, is equal to or greater than 43 cm/second; or

f. Appendix C, Section 2.7 (Test Methods For Stabilization-Rock Test Method) of these rules where a percent cover is equal to or greater than 10% for non-erodible elements.

g. An alternative test method approved in writing by the Control Officer and the Administrator of the EPA.

502 **RECORDKEEPING:** Any person subject to the requirements of this rule shall compile and retain records that provide evidence of control measure application (i.e., receipts and/or purchase records). The records should describe the type of treatment or control measure, extent of coverage, and date applied. Upon verbal or written request by the Control Officer, the records and supporting documentation shall be provided within 48 hours, excluding weekends. If the Control Officer is at the site where requested records are kept, records shall be provided without delay.

503 **RECORDS RETENTION:** Copies of the records required by Section 502 (Recordkeeping) of this rule shall be retained for at least one year.

Appendix A-3

REGULATION III - CONTROL OF AIR CONTAMINANTS

RULE 316
NONMETALLIC MINERAL MINING AND PROCESSING

INDEX

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Adopted 07/06/93
Revised 04/21/99

MARICOPA COUNTY
AIR POLLUTION CONTROL REGULATIONS

REGULATION III - CONTROL OF AIR CONTAMINANTS

RULE 316
NONMETALLIC MINERAL MINING AND PROCESSING

SECTION 100 - GENERAL

101 **PURPOSE:** To limit the emission of particulate matter into the ambient air from any nonmetallic mining operation or rock product processing plant.

102 **APPLICABILITY:** The provisions of this rule shall apply to any commercial and/or industrial nonmetallic mineral mining and/or rock product plant operation. Compliance with the provisions of this rule shall not relieve any person subject to the requirements of this rule from complying with any other federally enforceable New Source Performance Standards. In such case, the more stringent standard shall apply.

SECTION 200 - DEFINITIONS: For the purpose of this rule, the following definitions shall apply:

201 **AFFECTED OPERATION -** An operation that processes nonmetallic minerals or that is related to such processing and process sources including, but not limited to, crushers, grinding mills, screening equipment, conveying systems, elevators, transfer points, bagging operations, storage bins, enclosed truck and railcar loading stations and truck dumping.

202 **APPROVED EMISSION CONTROL SYSTEM -** A system for reducing particulate emissions, consisting of collection and/or control devices which are approved in writing by the Control Officer and are designed and operated in accordance with good engineering practice.

203 **ASPHALTIC CONCRETE PLANT/ASPHALT PLANT -** Any facility used to manufacture asphaltic concrete by mixing graded aggregate and asphaltic cements.

204 **BAGGING OPERATION -** The mechanical process by which bags are filled with nonmetallic minerals.

205 **BELT CONVEYOR -** A conveying device that transports material from one location to another by means of an endless belt that is carried on a series of idlers and routed around a pulley at each end.

206 **CONCRETE PLANT -** Any facility used to manufacture concrete by mixing water, aggregate, and cement.

207 **CONVEYING SYSTEM -** A device for transporting materials from one piece of equipment or location to another location within a facility. Conveying systems

include, but are not limited to, feeders, belt conveyers, bucket elevators and pneumatic systems.

208 **CRUSHER -** A machine used to crush any nonmetallic minerals, including, but not limited to, the following types: jaw, gyratory, cone, roll, rod mill, hammermill, and impactor.

209 **DRY MIX CONCRETE PLANT -** Any facility used to manufacture a mixture of aggregate and cements without the addition of water.

210 **ENCLOSED TRUCK OR RAILCAR LOADING STATION -** That portion of a nonmetallic mineral processing plant where nonmetallic minerals are loaded by an enclosed conveying system into enclosed trucks or railcars.

211 **FUGITIVE DUST EMISSION -** Particulate matter that is not collected by a capture system and is released to and suspended in the ambient air.

212 **GRINDING MILL -** A machine used for the wet or dry fine crushing of any nonmetallic mineral. Grinding mills include, but are not limited to, the following types: hammer, roller, rod, pebble and ball, and fluid energy. The grinding mill includes the air conveying system, air separator, or air classifier, where such systems are used.

213 **NONMETALLIC MINERAL -** Any of the following minerals or any mixture of which the majority is any of the following minerals:

213.1 Crushed and broken stone, including limestone, dolomite, granite, rhyolite, traprock, sandstone, quartz, quartzite, marl, marble, slate, shale, oil shale, and shell.
213.2 Sand and gravel.
213.3 Clay including kaolin, fireclay, bentonite, fuller's earth, ball clay, and common clay.
213.4 Rock salt.
213.5 Gypsum.
213.6 Sodium compounds, including sodium carbonate, sodium chloride, and sodium sulfate.
213.7 Pumice.
213.8 Gilsonite.
213.9 Talc and pyrophyllite.
213.10 Boron, including borax, kernite, and colemanite.
213.11 Barite.
213.12 Fluorspar.
213.13 Feldspar.
213.14 Diatomite.
213.15 Perlite.
213.16 Vermiculite.
213.17 Mica.
213.18 Kyanite, including andalusite, sillimanite, topaz, and dumortierite.
213.19 Coal.

214 **NONMETALLIC MINERAL PROCESSING PLANT -** Any facility utilizing any combination of equipment or machinery that is used to mine, excavate, separate, combine, crush, or grind any nonmetallic mineral, including, but not

limited to: lime plants, coal fired power plants, steel mills, asphalt plants, concrete plants, portland cement plants, and sand and gravel plants. Rock Product Processing Plants are included in this definition.

215 PARTICULATE MATTER - Any material, except uncombined water, which has a nominal aerodynamic diameter smaller than 100 microns (micrometers), and which exists in a finely divided form as a liquid or solid at actual conditions.

216 PARTICULATE MATTER EMISSIONS - Any and all finely divided solid or liquid materials other than uncombined water released to the ambient air as measured by the applicable state and federal test methods.

217 PROCESS - One or more operations including those using equipment and technology in the production of goods or services or the control of by-products or waste.

218 PROCESS SOURCE - The last operation of a process or a distinctly separate process which produces an air contaminant and which is not a pollution abatement operation.

219 SCREENING OPERATION - A device that separates material according to its size by passing undersize material through one or more mesh surfaces (screens) in series, and retaining oversize material on the mesh surfaces (screens).

220 STACK EMISSIONS - The particulate matter emissions that are released to the atmosphere from a capture system through a building vent, stack or other point source discharge.

221 STORAGE BIN - A facility enclosure, hopper, silo or surge bin for the storage of nonmetallic minerals prior to further processing or loading.

222 TRANSFER POINT - A point in a conveying operation where nonmetallic mineral is transferred from or to a belt conveyor except for transfer to a stockpile.

223 TRUCK DUMPING - The unloading of nonmetallic minerals from movable vehicles designed to transport nonmetallic minerals from one location to another. Movable vehicles include, but are not limited to, trucks, front end loaders, skip hoists, and railcars.

224 VENT - An opening through which there is mechanically or naturally induced air flow for the purpose of exhausting air carrying particulate matter.

SECTION 300 - STANDARDS

301 LIMITATIONS - NONMETALLIC MINERAL PROCESSING PLANTS: No person shall discharge or cause or allow to be discharged into the ambient air:

301.1 Stack emissions exceeding 7% opacity and containing more than 0.02 gr/dscf (50 mg/dscm) of particulate matter.

301.2 Fugitive dust emissions from any "transfer point" on a conveying system exceeding 7% opacity.

301.3 Fugitive dust emissions exceeding 15% opacity from any crusher.

301.4 Fugitive dust emissions exceeding 10% opacity from any affected operation or process source, excluding truck dumping directly into any screening operation, feed hopper or crusher.

301.5 Fugitive dust emissions exceeding 20% opacity from truck dumping directly into any screening operation, feed hopper or crusher.

302 LIMITATIONS - ASPHALTIC CONCRETE PLANTS: No person shall discharge or cause or allow to be discharged into the ambient air:

302.1 Stack emissions exceeding 20% opacity and containing more than 0.04 gr/dscf (90 mg/dscm) of particulate matter.

302.2 Fugitive dust emissions exceeding 20% opacity from any other affected operation or process source.

303 LIMITATIONS - CONCRETE PLANTS AND BAGGING OPERATIONS: No person shall discharge or cause or allow to be discharged into the ambient air:

303.1 Stack emissions exceeding 7% opacity.

303.2 Fugitive dust emissions exceeding 10% opacity from any affected operation or process source, excluding truck dumping directly into any screening operation, feed hopper or crusher.

303.3 Fugitive dust emissions exceeding 20% opacity from truck dumping directly into any screening operation, feed hopper or crusher.

304 LIMITATIONS - OTHER ASSOCIATED OPERATIONS: All other activities not specifically listed in Sections 301, 302, or 303 of this rule associated with the mining and processing of nonmetallic minerals, shall, at a minimum, meet the provisions of Rule 310 of these rules.

305 REQUIREMENT FOR AIR POLLUTION CONTROL EQUIPMENT AND EMISSION CONTROL SYSTEM (ECS) MONITORING EQUIPMENT: For the purposes of this rule, an emission control system (ECS) is a system for reducing emissions of particulates, consisting of both collection and control devices, which are approved in writing by the Control Officer and are designed and operated in accordance with good engineering practices.

305.1 Operation And Maintenance (O&M) Plan Requirements For ECS:

a. An owner or operator of a facility shall provide and maintain, readily available on-site at all times, (an) O&M Plan(s) for any ECS, any other emission processing equipment, and any ECS monitoring devices that are used pursuant to this rule or to an air pollution control permit.

b. The owner or operator of a facility shall submit to the Control Officer for approval the O&M Plans of each ECS and of each ECS monitoring device that is used pursuant to this rule.

c. The owner or operator of a facility shall comply with all the identified actions and schedules provided in each O&M Plan.

305.2 **Providing And Maintaining ECS Monitoring Devices:** An owner or operator of a facility operating an ECS pursuant to this rule shall install, maintain, and calibrate monitoring devices described in the O&M Plan. The monitoring devices shall measure pressures, rates of flow, and/or other operating conditions necessary to determine if the control devices are functioning properly.

305.3 **O&M Plan Responsibility:** An owner or operator of a facility that is required to have an O&M Plan pursuant to subsection 305.1 of this rule must fully comply with all O&M Plans that the owner or operator has submitted for approval, even if such O&M Plans have not yet been approved, unless notified in writing by the Control Officer.

SECTION 400 - ADMINISTRATIVE REQUIREMENTS

401 **O&M PLAN COMPLIANCE SCHEDULE:** Any owner or operator of a facility employing an ECS device as of April 21, 1999 to meet the requirements of this rule, shall file, by October 18, 1999, an O&M Plan with the Control Officer in accordance with subsection 501.3 of this rule.

SECTION 500 - MONITORING AND RECORDS

501 **RECORDKEEPING AND REPORTING:** Any person subject to this rule shall comply with the following requirements. Records shall be retained for 5 years and shall be made available to the Control Officer upon request.

501.1 Operational information required by this rule shall be kept in a complete and consistent manner on site and be made available without delay to the Control Officer upon request.

501.2 Records of the following process and operational information, as applicable, are required:

a. **General Data:** Daily records shall be kept for all days that a plant is actively operating. Records shall include the following: hours of operation; type of batch operation (wet, dry, central); throughput per day of basic raw materials including sand, aggregate, cement, (tons/day); volume of concrete and asphaltic concrete produced per day; volume of aggregate mined per day (cu. yds./day); composition of a cubic yard of concrete produced (percent cement, sand, aggregate, admixture, water, fly ash, etc.); composition of a cubic yard of asphaltic concrete produced (percent cement, sand, aggregate, gypsum, admixture, water, fly ash, etc.); amount of each basic raw material including sand, aggregate, cement, fly ash delivered per day (tons/day).

b. **Additional Data For Dry Mix Concrete Plants:** The number of bags of dry mix produced per day; weight (size) of bags of dry mix produced per day; kind and amount of fuel consumed in dryer (cu. ft./day or gals./day); kind and amount of any back-up fuel (if any).

c. **Control And Monitoring Device Data:** Baghouse records shall include dates of inspection, dates and designation of bag replacement, dates of service or maintenance, related activities, static pressure gauge (manometer) hourly readings. Scrubber records shall include dates of service or maintenance related activities; the scrubbing liquid flow rate; the pressure or head loss; and/or any other operating parameters which need to be monitored to assure that the scrubber is functioning properly and operating within design parameters. Records of time, date and cause of all control device failure and down time shall also be maintained.

501.3 ECS O&M Plan Records: An owner or operator of a facility shall maintain a record of the periods of time than an approved ECS is used to comply with this rule. Key system parameters, such as flow rates, pressure drops, and other conditions necessary to determine if the control equipment is functioning properly, shall be recorded in accordance with the approved O&M Plan. The records shall account for any periods when the control system was not operating. The owner or operator of a facility shall also maintain results of the visual inspection and shall record any corrective action taken, if necessary.

502 COMPLIANCE DETERMINATION: The test methods for those subparts of 40 Code Of Federal Regulations (CFR) Part 60, Appendix A, adopted as of July 1, 1998, as listed below, are adopted by reference as indicated. This adoption by reference includes no future editions or amendments. Copies of test methods referenced in Section 502 of this rule are available at the Maricopa County Environmental Services Department, 1001 North Central Avenue, Phoenix, Arizona, 85004-1942. When more than one test method is permitted for a compliance determination, then an exceedance of the limits established in this rule, determined by any of the applicable test methods, constitutes a violation of this rule.

502.1 Grain Loading: Particulate matter and associated moisture content shall be determined using the applicable EPA Reference Methods 1 through 5, 40 CFR Part 60, Appendix A.

502.2 Opacity Determination: Opacity observations to measure the opacity of visible emissions shall be conducted in accordance with the techniques specified in EPA Reference Method 9, 40 CFR Part 60, Appendix A, except the opacity observations for intermittent visible emissions shall require 12 (rather than 24) consecutive readings at 15-second intervals.

APPENDIX J – Maricopa County PM_{10} Monitors

24-Hour PM_{10} Ambient Air Quality Monitoring Network Data for Maricopa County and the Salt River PM_{10} Study Area

Table J-1 1994 PM_{10} Monitoring Data Summary (μ/m³), from *ADEQ Annual Air Quality Report for Arizona*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m³)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Number of Samples
				MAX	2nd Hi		
Chandler	1475 E. Pecos	MCESD	HI-VOL	127	114	0	56
Glendale	6000 W. Olive	MCESD	HI-VOL	76	54	0	51
Mesa	Broadway/Brooks	MCESD	HI-VOL	73	51	0	43
South Phoenix	4732 S. Central	MCESD	HI-VOL	97	89	0	56
West Phoenix	3847 W. Earll	MCESD	HI-VOL	98	93	0	53
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	92	80	0	54
North Phoenix	601 E. Butler	MCESD	HI-VOL	73	66	0	51
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	76	65	0	50
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	371	215	12	55

Table J-2. 1995 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Number of Samples
				MAX	2nd Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	252	160	2	146
Gilbert[1]	15500 S. Higley	ADEQ	DICHOT	110	106	0	55
Glendale	6000 W. Olive	MCESD	HI-VOL	70	63	0	53
Goodyear[2]	15099 W. Casey Abbott	ADEQ	DICHOT	86	65	0	44
Mesa	Broadway & Brooks	MCESD	HI-VOL	89	70	0	57
South Phoenix	4732 S. Central	MCESD	HI-VOL	78	74	0	50
West Phoenix	3847 W. Earll	MCESD	HI-VOL	99	88	0	61
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	88	76	0	55
Phoenix[3]	4701 W. Thunderbird	ADEQ	DICHOT	57	51	0	51
Phx-JLG Site[4]	4530 N. 17th Ave.	ADEQ	HI-VOL	73	63	0	2084
Phoenix	4530 N. 17th Ave.	ADEQ	DICHOT	71	59	0	56
North Phoenix	601 E. Butler	MCESD	HI-VOL	84	68	0	58
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	75	69	0	61
Tempe[5]	3340 S. Rural	ADEQ	DICHOT	63	62	0	58
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	199	196	15	57

Table J-3. 1996 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix 1*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Number of Samples
				MAX	2^{nd} Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	140	130	0	59
Gilbert	15500 S. Higley	ADEQ	DICHOT	179	114	1	55
Glendale	6000 W. Olive	MCESD	HI-VOL	67	60	0	57
Goodyear	15099 W. Casey Abbott	ADEQ	DICHOT	82	72	0	55
Mesa	Broadway & Brooks	MCESD	HI-VOL	67	62	0	54
Mesa[6]	6001 S. Power Road	ADEQ	DICHOT	53	50	0	30
South Phoenix	4732 S. Central	MCESD	HI-VOL	96	96	0	75
West Phoenix	3847 W. Earll	MCESD	HI-VOL	102	100	0	55
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	105	89	0	59
Phoenix	4701 W. Thunderbird	ADEQ	DICHOT	58	57	0	55
Phoenix	4530 N. 17th Ave.	ADEQ	HI-VOL	137	104	0	8177
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	83	68	0	54
North Phoenix	601 E. Butler	MCESD	HI-VOL	71	66	0	74
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	80	64	0	59
Tempe	3340 S. Rural	ADEQ	DICHOT	193	185	3	54
Phx-Salt River	3045 S. 22^{nd} Avenue	MCESD	HI-VOL	250	238	11	55

Table J-4. 1997 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix I*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Number of Samples
				MAX	2nd Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	221	148	1	57
W. Chandler[7]	163 S. Price Road	MCESD	HI-VOL	194	162	2	57
Gilbert	535 N. Lindsay Road	MCESD	HI-VOL	170	108	1	55
Glendale	6000 W. Olive	MCESD	HI-VOL	170	87	1	57
Goodyear	15099 W. Casey Abbott	ADEQ	DICHOT	179	146	1	50
Higley[8]	15500 S. Higley	ADEQ	DICHOT	288	234	2	56
Maryvale[9]	6180 W. Encanto	MCESD	HI-VOL	345	161	2	61
Mesa[10]	Broadway & Brooks	MCESD	HI-VOL	129	119	0	59
Palo Verde[11]	36248 W. Elliot Road	ADEQ	DICHOT	124	73	0	62
South Phoenix	4732 S. Central	MCESD	HI-VOL	160	114	1	61
West Phoenix	3847 W. Earll	MCESD	HI-VOL	224	137	1	60
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	108	96	0	55
North Phoenix	601 E. Butler	MCESD	HI-VOL	152	81	0	51
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	131	82	0	57
Phx-JLG Site[12]	4530 N. 17th Ave.	ADEQ	HI-VOL	147	143	0	7328
Phoenix[13]	27th Ave./I-10	ADEQ	DICHOT	148	103	0	53
Phoenix	27th Ave./I-10	ADEQ	HI-VOL	161	113	1	7792
Phoenix	27th Ave./I-10	MCESD	HI-VOL	220	125	1	56
Phoenix	4701 W. Thunderbird	ADEQ	DICHOT	164	92	1	55
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	480	301	15	59
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	154	84	0	60
Tempe	3340 S. Rural	ADEQ	DICHOT	90	74	0	56
Wickenburg	155 North Tegner	MCESD	HI-VOL	125	65	0	48

Table J-5. 1998 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix I*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)								
City Location	Site Location	Operator	Method	24-Hour Average			Number of Exceedances	Number of Samples
				MAX	2nd Hi	99th Pct		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	136	104	136	0	52
W. Chandler	163 S. Price Road	MCESD	HI-VOL	78	74	78	0	55
Gilbert	535 N. Lindsay Road	MCESD	HI-VOL	133	91	133	0	55
Glendale	6000 W. Olive	MCESD	HI-VOL	61	57	61	0	56
Goodyear / Estrella	15099 W. Casey Abbott	ADEQ	DICHOT	56	56	56	0	61
Higley	15500 S. Higley	ADEQ	DICHOT	135	116	135	0	61
Maryvale	6180 W. Encanto	MCESD	HI-VOL	92	83	92	0	59
Mesa	Broadway & Brooks	MCESD	HI-VOL	64	61	64	0	61
Palo Verde	36248 W. Elliot Road	ADEQ	DICHOT	47	46	47	0	55
South Phoenix	4732 S. Central	MCESD	HI-VOL	77	67	77	0	25
West Phoenix	3847 W. Earll	MCESD	HI-VOL	107	106	107	0	57
Phx-Salt River[14]	3045 S. 22nd Avenue	MCESD	HI-VOL	NA	NA	NA	0	25
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	70	62	70	0	23
North Phoenix	601 E. Butler	MCESD	HI-VOL	67	62	67	0	57
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	69	67	69	0	54
Phx-Greenwood	27th Ave./I-10	ADEQ	DICHOT	106	95	106	0	37
Phx-Greenwood	27th Ave./I-10	MCESD	HI-VOL	121	115	121	0	61
Phx-ASU West	4701 W. Thunderbird	ADEQ	DICHOT	55	53	55	0	61
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	81	66	81	0	58
Tempe	3340 S. Rural	ADEQ	DICHOT	70	68	70	0	61
Wickenburg[15]	155 North Tegner	MCESD	HI-VOL	55	42	55	0	17

Table J-6. 1999 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix I*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Number of Samples
				MAX	2nd Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	110	100	0	59
W. Chandler	163 S. Price Road	MCESD	HI-VOL	104	92	0	59
Gilbert	535 N. Lindsay Road	MCESD	HI-VOL	90	88	0	55
Glendale	6000 W. Olive	MCESD	HI-VOL	77	63	0	58
Goodyear / Estrella	15099 W. Casey Abbott Drive	ADEQ	DICHOT	80	73	0	59
Higley	15500 S. Higley	ADEQ	DICHOT	208	110	1	58
Maryvale	6180 W. Encanto	MCESD	HI-VOL	104	96	0	60
Mesa	Broadway & Brooks	MCESD	HI-VOL	80	71	0	60
Palo Verde	36248 W. Elliot Road	ADEQ	DICHOT	83	46	0	53
Phx-Durango[16]	2702 AC Esterbrook	MCESD	HI-VOL	148	143	0	29
South Phoenix	4732 S. Central	MCESD	HI-VOL	67	62	1	18
West Phoenix	3847 W. Earll	MCESD	HI-VOL	111	103	0	57
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	148	143	0	29
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	85	85	0	45
North Phoenix	601 E. Butler	MCESD	HI-VOL	70	63	0	57
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	78	70	0	58
Phx-Greenwood	27th Ave./I-10	ADEQ	DICHOT	111	111	0	55
Phx-Greenwood	27th Ave./I-10	MCESD	HI-VOL	117	115	0	59
Phx-ASU West	4701 W. Thunderbird	ADEQ	DICHOT	55	53	0	59
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	87	80	0	57
Tempe	3340 S. Rural	ADEQ	DICHOT	82	78	0	55

Table J-7. 2000 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix I*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Number of Samples
				MAX	2nd Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	202	145	0	59
W. Chandler	163 S. Price Road	MCESD	HI-VOL	135	95	0	51
Gilbert	535 N. Lindsay Road	MCESD	HI-VOL	128	109	0	60
Glendale	6000 W. Olive	MCESD	HI-VOL	122	100	0	58
Goodyear / Estrella	15099 W. Casey Abbott Drive	ADEQ	DICHOT	82	77	0	44
Higley	15500 S. Higley	ADEQ	DICHOT	136	129	0	53
Higley[17]	15500 S. Higley	MCESD	HI-VOL	327	143	0	38
Maryvale	6180 W. Encanto	MCESD	HI-VOL	173	109	1	61
Mesa	Broadway & Brooks	MCESD	HI-VOL	126	94	0	61
Palo Verde	36248 W. Elliot Road	ADEQ	DICHOT	75	43	0	57
Phx-Durango	2702 AC Esterbrook	MCESD	HI-VOL	300	173	2	61
South Phoenix	4732 S. Central	MCESD	HI-VOL	175	122	1	61
West Phoenix	3847 W. Earll	MCESD	HI-VOL	151	133	1	59
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	244	232	6	54
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	135	105	0	59
North Phoenix	601 E. Butler	MCESD	HI-VOL	114	114	0	59
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	84	84	0	61
Phx-Greenwood	27th Ave./I-10	ADEQ	DICHOT	151	108	1	49
Phx-Greenwood	27th Ave./I-10	MCESD	HI-VOL	164	159	2	60
Phx-ASU West	4701 W. Thunderbird	ADEQ	DICHOT	101	84	0	59
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	100	98	0	61
Tempe	3340 S. Rural	ADEQ	DICHOT	95	81	0	57

Table J-8. 2001 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix I*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Percent Data Recovery
				MAX	2^{nd} Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	146	99	0	100
W. Chandler	163 S. Price Road	MCESD	HI-VOL	134	58	0	100
Gilbert[18]	535 N. Lindsay Road	MCESD	HI-VOL	121	119	0	100
Glendale	6000 W. Olive	MCESD	HI-VOL	110	63	0	97
Goodyear / Estrella	15099 W. Casey Abbott Drive	ADEQ	DICHOT	122	51	0	90
Higley[19]	15500 S. Higley	ADEQ	DICHOT	NA	NA	NA	NA
Higley	15500 S. Higley	MCESD	HI-VOL	176	93	1	97
Maryvale	6180 W. Encanto	MCESD	HI-VOL	123	94	0	97
Mesa	Broadway & Brooks	MCESD	HI-VOL	98	55	0	100
Palo Verde	36248 W. Elliot Road	ADEQ	DICHOT	71	54	0	85
Phx-Durango	2702 AC Esterbrook	MCESD	HI-VOL	189	142	1	100
South Phoenix	4732 S. Central	MCESD	HI-VOL	143	92	0	98
West Phoenix	3847 W. Earll	MCESD	HI-VOL	142	91	0	100
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	281	275	2	98
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	124	65	0	98
North Phoenix	601 E. Butler	MCESD	HI-VOL	99	55	0	100
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	109	58	0	97
Phx-Greenwood[20]	27th Ave./I-10	ADEQ	DICHOT	NA	NA	NA	NA
Phx-Greenwood	27th Ave./I-10	MCESD	HI-VOL	145	99	0	97
Phx-ASU West[21]	4701 W. Thunderbird	ADEQ	DICHOT	42	39	0	59
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	110	53	0	100
Tempe	3340 S. Rural	ADEQ	DICHOT	109	55	0	95
Surprise[22]	18600 N. Reems	MCESD	HI-VOL	107	52	0	97

Table J-9. 2002 PM_{10} Monitoring Data Summary (μ/m^3), from *ADEQ Annual Air Quality Report for Arizona*, *Appendix I*

MARICOPA COUNTY PM_{10} MONITORS - (24-Hour National Ambient Air Quality Standard - 150 μ/m^3)							
City Location	Site Location	Operator	Method	24-Hour Average		Number of Exceedances	Percent Data Recovery
				MAX	2^{nd} Hi		
Chandler	1475 E. Pecos Road	MCESD	HI-VOL	128	117	0	100
W. Chandler	163 S. Price Road	MCESD	HI-VOL	80	77	0	100
Glendale	6000 W. Olive	MCESD	HI-VOL	88	85	0	98
Goodyear / Estrella	15099 W. Casey Abbott Drive	ADEQ	DICHOT	92	68	0	85
Higley	15500 S. Higley	MCESD	HI-VOL	138	134	0	95
Maryvale	6180 W. Encanto	MCESD	HI-VOL	142	90	0	92
Mesa	Broadway & Brooks	MCESD	HI-VOL	102	86	0	100
Palo Verde	36248 W. Elliot Road	ADEQ	DICHOT	100	78	0	97
Phx-Durango	2702 AC Esterbrook	MCESD	HI-VOL	232	158	2	100
South Phoenix	4732 S. Central	MCESD	HI-VOL	137	123	0	100
W. 43rd Ave.[23]	3940 W. Broadway Road	MCESD		172	135	1	100
West Phoenix	3847 W. Earll	MCESD	HI-VOL	122	98	0	100
Phx-Salt River	3045 S. 22nd Avenue	MCESD	HI-VOL	249	174	2	98
Central Phoenix	1845 E. Roosevelt	MCESD	HI-VOL	81	76	0	100
North Phoenix	601 E. Butler	MCESD	HI-VOL	80	72	0	98
Phx-JLG Site	4530 N. 17th Ave.	ADEQ	DICHOT	72	52	0	74
Phx-Greenwood	27th Ave./I-10	MCESD	HI-VOL	116	102	0	100
South Scottsdale	2857 N. Miller	MCESD	HI-VOL	64	62	0	100
Tempe	3340 S. Rural	ADEQ	DICHOT	65	60	0	90
Surprise	18600 N. Reems	MCESD	HI-VOL	81	67	0	97

1 ADEQ added its Gilbert monitor site in 1995.

2 ADEQ added its Goodyear monitor in 1995.

3 ADEQ added a monitor at 4701 W. Thunderbird, in 1995.

[4] ADEQ added two monitors at 4530 North 17th Avenue, in Phoenix, in 1995.

[5] ADEQ added a monitor in Tempe, in 1995.

[6] ADEQ added a monitor in Mesa, in 1996.

[7] MCESD added a monitor in West Chandler, in 1997.

[8] ADEQ added a Higley monitor in 1997.

[9] MCESD added a Maryvale monitor in 1997.

[10] ADEQ removed its Mesa monitor at 6001 South Power Road, in 1997.

[11] ADEQ added the Palo Verde monitor in 1997.

[12] ADEQ's monitor was closed in 1997 at the Phoenix-JLG Site.

[13] Three monitors were added to sites at I-10 and 27th Avenue, just north of the current Salt River study area, in 1997. Two monitors were operated by ADEQ, and one by MCESD.

[14] MCESD added its Phoenix-Salt River monitor in 1998.

[15] MCESD removed its Wickenburg monitor in 1998.

[16] MCESD added the Phoenix-Durango Complex monitor in 1999, adding to monitoring data for the Salt River study area.

[17] MCESD added a monitor in Higley, in 2000.

[18] The Gilbert monitor was closed on December 31, 2001.

[19] ADEQ's Higley monitor was removed in 2001.

[20] ADEQ's Phoenix – Greenwood monitor was removed in 2001.

[21] The Phoenix – ASU West monitor was closed on August 6, 2001.

[22] MCESD placed an SPM monitor in Surprise, Arizona, in 2001.

[23] The West 43rd Avenue monitoring site was opened on April 1, 2002.

APPENDIX K – WEIGHTING TRACKOUT EMISSIONS

This approach was applied to data from an April 2004 ADEQ trackout survey, in which the incidents of trackout were divided into six source categories and three levels of severity. Table K-1 shows that the heaviest trackout occurred infrequently (i.e. 5 to 16% of the time for three categories and completely absent in the other three). Average and minimum trackouts were far more prevalent.

TABLE K-1
Trackout Survey Summary

Trackout Category	Observations		Severity (Percent)		
	Number	Percent	Max	Avg	Min
Agricultural	11	12.2	9	18	73
Construction	19	21.1	5	48	47
Industrial	19	21.1	16	68	16
Private	1	1.1	0	0	100
Commercial	9	10.0	0	44	56
Unpaved shoulders	31	34.4	0	66	34

These survey data would suggest, at first glance, that unpaved shoulders are the principal trackout source, with 34% of all observations from this category. But when severity is factored in, a much different picture emerges. Recalling the discussion on the length of trackout , the unpaved shoulders trackout loses even more ground to the industrial, construction, and agricultural categories. The survey confirms the expected: that a car driving on an unpaved shoulder will track out some, but not much, dirt onto the roadway for a fairly short distance. In contrast to this lightweight trackout, the trucks leaving construction or industrial sites will track out considerably more dirt for longer distances. Unpaved shoulders are an important source of trackout – as are all the sources. But by comparison with the heavier hitters, they are minor contributors. The weighting method, as explained in this appendix, is both logical and driven by data.

All of these survey data are presented in Table K-2.

TABLE K-2 Trackout Survey of May – June 2004: Salt River PM_{10} Study Area				
Cell #	Trackout Class	ADT	Severity	Notes
125	1	(5.2)/2	2	West bound Southern
159	1	3.2	2	43rd Ave South of Broadway
185	1	(13.8)/2	3	North bound 51st Ave
189	1	3.2	2	43rd Ave south of Broadway
197	1	(10+3.7)/2	2	27th Ave & Broadway
219	1	3.2	2	43rd Ave south of Broadway
223	1	(10+19.5)/2	2	Broadway & 35th Ave.
227	1	(10+3.7)/2	2	27th Ave & Broadway
282	1	19.1	2	35th Ave south of Lower Buckeye
291	1	19.4	2	19th Ave south of freeway
308	1	5.9	1	43rd Ave south of Lower Buckeye
312	1	19.1	2	35th Ave south of Lower Buckeye
334	1	(13.8)x10%	2	Minor street off 51st Ave.
335	1	(13.8)x10%	2	Minor street off 51st Ave.
338	1	5.9	1	43rd Ave south of Lower Buckeye
368	1	5.9	1	43rd Ave south of Lower Buckeye
372	1	19.1	2	35th Ave south of Lower Buckeye
383	1	2.2	3	15th Ave south of freeway
413	1	2.2	3	15th Ave south of freeway
11	2	(6.1)/2	1	West bound Baseline
12	2	(6.1)/2	3	West bound Baseline
43	2	(4.5)/2	2	North bound 35th Ave.
68	2	(1.5)/2	2	South bound 43rd Ave
77	2	(1)/2	2	27th Ave south of Southern
98	2	(1.5)/2	2	South bound 43rd

TABLE K-2 Trackout Survey of May – June 2004: Salt River PM_{10} Study Area				
				Ave
102	2	(5.6)/2	2	East bound Southern
111	2	13.9	3	Southern Ave east of 19th Ave
112	2	13.9	3	Southern Ave east of 19th Ave
175	2	(16.4)/2	3	7th Ave south of Roeser
175	2	(16.4+.1x16.4)/2	3	7th Ave & Sunland
235	2	(20.4+18.3)/2	2	7th Ave & Broadway
357	2	24.4	2	Central Ave south of river
373	2	10.6	3	Lower Buckeye between 35th Ave & 27th Ave
378	2	(10.8)/2	3	Lower Buckeye east of 27th Ave. east bound lane
415	2	20.4	3	7th Ave south of freeway
419	2	21.2	3	7th Street south of freeway
433	2	7.3	2	Durango Rd.
435	2	7.3	2	Durango Rd.
89	3	(16.5)/2	3	7th Street south of Alta Vista
8	4	1.5	2	
107	4	6.7	3	Southern Ave east of 27th Ave
108	4	6.7	3	Southern Ave east of 27th Ave
125	4	(5.2)/2	1	West bound Southern
133	4	(6.4)/2	2	West bound Southern
364	4	(5.1+19.3)/4	3	NW corner of 51st Ave & Lower Buckeye
367	4	7.7	3	Lower Buckeye between 51st & 43rd Ave
368	4	7.7	3	Lower Buckeye between 51st & 43rd Ave
376	4	(10.6)/2	3	Lower Buckeye between 35th Ave & 27th Ave. west bound lane
377	4	(10.8+5.9)/2	3	Lower Buckeye between 35th Ave & 27th Ave. west bound lane and north bound 27th Ave
411	4	(26.1+.1x26.1)/2	3	19th Ave south of freeway
223	5	(10 +19.5)/2	2	Broadway & 35th Ave.
269	5	(21.2)/2	3	7th Street south of river

TABLE K-2
Trackout Survey of May – June 2004: Salt River PM_{10} Study Area

370	5	11.2	2	Lower Buckeye between 43rd & 35th Ave
371	5	11.2	2	Lower Buckeye between 43rd & 35th Ave
372	5	11.2	2	Lower Buckeye between 43rd & 35th Ave
385	5	20.4	3	7th Ave south of freeway
494	5	31	3	Buckeye Rd
509	5	(17.2)/2	3	Buckeye Rd west bound lane east of 7th street
535	5	(21.8+9)/2	3	Northwest corner of 7th Ave & Lincoln
8	6	(6.1)/2	3	East bound Baseline
8	6	(6.1)/2	3	West bound Baseline
34	6	10.6	3	
69	6	(1.5)/2	2	North bound 43rd Ave
99	6	(1.5)/2	2	North bound 43rd Ave
109	6	6.7	3	Southern Ave east of 27th Ave
110	6	6.7	3	Southern Ave east of 27th Ave
119	6	(16.5+21.6)/2	3	7th Street & Southern
125	6	(5.2)/2	2	West bound Southern
125	6	(13.8)/2	2	North bound 51st Ave
127	6	(5.2)/2	2	West bound Southern
133	6	(6.4)/2	2	West bound Southern
197	6	(3.7)/2	2	27th Ave south of Broadway
223	6	(10+19.5)/2	2	Broadway &35th Ave.
227	6	(3.7)/2	2	27th Ave south of Broadway
235	6	(20.4+18.3)/2	3	7th Ave & Broadway
236	6	(18.3)/2	3	Broadway west of Central Ave
244	6	(13.8)/2	2	North bound 51st Ave
274	6	(13.8)/2	2	North bound 51st Ave
369	6	11.2	2	Lower Buckeye between 43 rd & 35th Ave
370	6	11.2	2	Lower Buckeye between 43 rd & 35th Ave
371	6	11.2	2	Lower Buckeye between 43 rd & 35th Ave
373	6	(10.6)/2	3	Lower Buckeye between 35th Ave & 27th Ave west bound

TABLE K-2 Trackout Survey of May – June 2004: Salt River PM_{10} Study Area				
				lane
374	6	(10.6)/2	3	Lower Buckeye between 35th Ave & 27th Ave. west bound lane
375	6	(10.6)/2	3	Lower Buckeye between 35th Ave & 27th Ave. west bound lane
428	6	(12)/2	2	South bound 43rd Ave
429	6	(12)/2	2	North bound 43 rd Ave
458	6	(12)/2	2	South bound 43rd Ave
459	6	(12)/2	2	North bound 43 rd Ave
488	6	(18.1)2	2	South bound 43rd Ave
489	6	(18.1)/2	2	North bound 43 rd Ave

Trackout Class	**ADT**	
	ADT = Average Daily	
1 = Industrial	Traffic Count	
	Using 1999	
2 = Construction	Totals	
3 = Private	in Thousands	**Severity**
4 = Agriculture		1 = Maximum
5 = Commercial		2 = Moderate
6 = Unpaved Shoulders		3 = Minimum

The next step in the weighting approach was to assign silt loading values to the maximum, average, and minimum trackout segments. In Table K-3, these silt loadings are given on the top row, with a weighted silt loading based on the percentage occurrence given in the far right column.

TABLE K-3 Silt Loading Values by Source Category				
Note: Bold figures are silt loading in g/m^2; other figures are percentages from Table K-1				
Trackout Category	**Maximum**	**Average**	**Minimum**	**Combined Silt Loading (g/m^2)**
Silt loading (g/m^2)	**12**	**1.5**	**0.75**	
Agricultural	9%	18%	73%	**1.90**
Construction	5%	48%	47%	**1.67**
Industrial	16%	68%	16%	**3.06**
Private	0%	0%	100%	**0.75**
Commercial	0%	44%	56%	**1.08**
Unpaved shoulders	0%	66%	34%	**1.25**

These source category silt loadings, weighted by the percentage occurrence of the minimum, average, and maximum observed trackout segments, result in an overall silt loading for each of the source categories. As this set of silt loadings depends critically on the assigned values, these are discussed below.

The average value of 1.5 g/m^2 is used in the inventory for trackout, and is six times the average value for "clean streets" of 0.3 g/m^2, less 0.3. This value is consistent with local silt loading data, as evidenced in Tables K-4 and K-5.

TABLE K-4 Silt Loading Measurements in the Salt River PM_{10} Area from 2003	
Location	**Silt Loading (g/m^2)**
19th Ave S Lower Buckeye	0.38
19th Ave S river N Broadway	0.57
W. Broadway 38th Drive	0.24
51st Ave S of bridge	0.12
Lower Buckeye W 35th Ave	2.10

TABLE K-5 Silt Loading Measurements in Tucson and Phoenix from the Mid 1980s		
Site	**Silt Loading (g/m^2)**	**Type**
6th Ave & 28th Street	1.269	arterial
Avalon & 25th	0.523	local
Speedway Blvd E. of Pantano	0.398	busy arterial
Apache (9th/10th Streets)	0.279	busy arterial
Orange Grove E. of C. dl Tierra	0.160	mod arterial
Broadway/Central	0.126	busy arterial
Ft. Lowell E. of Alvernon	0.112	mod arterial
La Canada, N of Orange Grove	0.105	local
59th Ave & Peoria	0.098	busy arterial
Mesa Drive	0.098	mod arterial
South Central	0.084	mod arterial
3rd & Miller	0.070	local
43rd Ave & Vista	0.042	busy arterial
Indian School/28th St	0.035	busy arterial
28th Street & Glenrosa	0.035	local
17th Ave and Highland	0.028	local
22nd St. E. of Camino Seco	0.028	busy arterial
Ina Rd E. of La Cholla	0.021	busy arterial
E. McKellips & Olive	0.014	busy arterial
Anklam Rd, St Mary's Rd	0.014	mod arterial
Oracle Rd S. of Kanmar	0.014	busy arterial

The silt loading assigned to the average trackout of 1.5 g/m^2 places it above the distribution of Table K-4 but lower than four of the five Salt River silt loading measurements in Table K-5.

The maximum value of 12 g/m^2 in Table K-3 is somewhat problematic, but numbers as high as 50 g/m^2 were obtained on 43rd Avenue. Three 43rd Avenue values were around 10, and one was 55 g/m^2, all in the heavily tracked out lane. The assigned value would appear to be approaching the mean of this heavily tracked out section of pavement.

The minimum value of 0.75 g/m^2 in Table K-3 is higher than the 0.3 g/m^2 average. The average silt loading of 0.3 g/m^2 was applied to all primary and secondary streets in the Salt River PM_{10} Study Area, and, therefore drove the vehicular emissions calculations for the inventory. The 0.3 g/m^2 value is the average of the top four contemporary silt loading measurements in Table K-4. Since these measurements were taken on pavement with no visual trackout, assigning a value somewhat more than double the average for light trackout is reasonable.

With the assigned silt loading values for the three degrees of trackout, and with the percentages by source category, the overall source category silt loading values have been calculated (Table K-6). These silt loading values then enabled the calculation of emission rates. When these rates were combined with the estimated average length of the trackout by source category, the relative emission rate of the trackout type was obtained (Table K-6, far right column, “Norm to Industrial”).

Table K-6
Reentrained Emission Rates for Six Trackout Source Categories

Trackout Category	Distance (m)	*Silt (g/m^2)	**E (g/mi)	***Distance x E	****Norm to Industrial
Agricultural	100	1.90	4.214	421	0.36
Construction	200	1.67	3.866	773	0.66
Industrial	200	3.06	5.826	1165	1.00
Private	50	0.75	2.209	110	0.09
Commercial	50	1.08	2.857	143	0.12
Unpaved Shoulders	50	1.25	3.154	158	0.14

* Silt = Silt loading in grams per meter squared

**E = PM_{10} reentrained emission rate in grams per mile

*** “Distance x E = Distance of the trackout segment times the emission rate in grams times meters per mile

**** “Norm to Industrial = Normalized to the industrial category: i.e. all figures in the “Distance X E” column have been divided by the value for industrial, 1165.

The distance values listed in Table K-6 are estimates from discussions with staff who conducted the survey. The silt loading values come from Table K-3. The emission rates in grams per mile come directly from the AP-42 equation below.

E = k {sL/2}^.65 *(W/3)^1.5 – C

where :

sL = silt loading in g/m^2

W = average vehicle weight

C = constant that reflects the 1980 exhaust, brake, and tire wear emissions

K = constant that reflects the particle size fraction, and

E = reentrained emission rate in grams per mile.

Example:

W = 2.2 tons
C = .2119 g/mi
k = 7.3 for PM_{10}

E = 7.3*{sL/2)^.65 * (2.2/3)^1.5 - .2119
= 4.58*(sL/2)^.65 - .2119

Then plugging various values of silt loading (sL) into the above equation results in the reentrained emission rates listed in Table K-7.

TABLE K-7
Reentrained Emission Rates

Silt Loading ($sL\ g/m^2$)	Emission Rates (g/mi)
3.00	5.749
0.30	1.123
1.50	3.587
0.75	2.209

This method provides a set of distance-weighted and silt-loading weighted emission rates that account for both the length and severity of the trackout. For example, if industrial trackout is set to an emission factor of 1.0, then the other categories have the weightings shown in Table K-8.

TABLE K-8
Trackout from Six Source Categories
Weighted by Length and Severity

Category	Relative Emission Rate
Industrial	1.00
Construction	0.66
Agricultural	0.36
Unpaved shoulders	0.14
Commercial	0.12
Private	0.09

These relative weightings were applied to the predicted concentrations from the Industrial Source Complex model by source category (Appendix P). The weighted concentrations formed the basis of the predicted impacts of trackout on the ambient air at the four Salt River PM_{10} Study Area monitors.

Table K-9 lists the total lengths associated with the six trackout categories found in the Salt River PM_{10} Study Area.

TABLE K-9 Total Length of Trackout By Source Category			
Track-Out Type	Average Track-Out Distance (meters)	Number of Occurences by Track-Out Type	Total Length of Track-Out (meters)
Agricultural	100	11	1,100
Construction	200	19	3,800
Industrial	200	19	3,800
Private	50	1	50
Commercial	50	9	450
Unpaved Shoulders	50	31	1,550

APPENDIX L - HOW STREET SWEEPING REDUCTIONS WERE CALCULATED

The basis of these calculations is a set of tables, produced by Sierra Research, Inc, that quantify the emission reductions from both conversion of conventional street sweepers to PM_{10} efficient sweepers as well as the reductions from an increase in sweeping frequency. These tables appear in a Maricopa Association of Governments document called "Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects", December 9, 2003, pages 31 – 36. All sweepers in the Salt River PM_{10} Study Area were reported to be of the PM_{10} efficient kind in 2002, the base year of the study. Reductions in this study area, then, depend solely on an increase of frequency.

Other aspects of reducing reentrained emissions from paved roads concern the silt loading and the portion of roads targeted for increased sweeping. For the calculation of basic reentrained emissions (and street sweeping benefits), the silt loading was held constant at 0.3 g/m^2, the average value for the Study Area. Areas of heavy trackout with their elevated emissions were put into the inventory and were modeled explicitly. Their emission reduction of 80% was attributed to better enforcement of Maricopa County Rules 316, 310, and 310.01 and to the increased sweeping of targeted streets. This reduction, however, is independent of the general paved road reentrained emission reduction from increased sweeping. Because of insufficient information on trackout silt loading and trackout length, treating trackout silt loading and sweeping frequency explicitly was impossible.

Therefore, the only calculated PM_{10} reentrained emission reductions come from increasing the frequency on targeted streets. Streets in the Salt River area were divided into three types: primary (one-mile), one-half mile, and all others, i.e. collector, local, residential. Targeted increased sweeping was limited to those one-mile and half-mile streets adjacent to industrial, construction, or agricultural properties.

Tables L-1 through L-3 illustrate how reentrained road emissions vary with sweeping frequency. The "Conven" column refers to the conventional sweeper; the "PM_{10}" refers to the PM_{10} efficient sweeper. The emission rates are expressed in units of grams per vehicle mile traveled.

TABLE L-1 Reentrained Road Emissions with Sweeping Once Every Two Weeks		
	EF (g/VMT)	
Day	**Conven**	**PM_{10}**
Sweep 1	0.87	0.39
2	0.95	0.5
3	1.03	0.61
4	1.1	0.7
5	1.1	0.79
6	1.1	0.87
7	1.1	0.95
8	1.1	1.03
9	1.1	1.1
10	1.1	1.1
11	1.1	1.1
12	1.1	1.1
13	1.1	1.1
14	1.1	1.1
Sweep 15	0.87	0.39
16	0.95	0.5
17	1.03	0.61
18	1.1	0.7
19	1.1	0.79
20	1.1	0.87
21	1.1	0.95
22	1.1	1.03
23	1.1	1.1
24	1.1	1.1
25	1.1	1.1
26	1.1	1.1
27	1.1	1.1
28	1.1	1.1
1 Sweep Every Two Weeks (2 Sweeps per month)	1.07	0.89

TABLE L-2 Reentrained Road Emissions with Sweeping Once a Week		
	EF (g/VMT)	
Day	**Conven**	**PM_{10}**
Sweep 1	0.87	0.39
2	0.95	0.5
3	1.03	0.61
4	1.1	0.7
5	1.1	0.79
6	1.1	0.87
Sweep 7	1.1	0.39
8	0.87	0.5
9	0.95	0.61
10	1.03	0.7
11	1.1	0.79
12	1.1	0.87
Sweep 13	1.1	0.39
14	1.1	0.5
15	0.87	0.61
16	0.95	0.7
17	1.03	0.79
18	1.1	0.87
Sweep 19	1.1	0.39
20	1.1	0.5
21	1.1	0.61
22	0.87	0.7
23	0.95	0.79
24	1.03	0.87
25	1.1	0.39
26	1.1	0.5
27	1.1	0.61
28	1.1	0.7
1 Sweep Once a Week (4 sweeps per month)	1.04	0.64

TABLE L-3 Reentrained Road Emissions with Sweeping Three Times a Month		
	EF (g/VMT)	
Day	Conven	PM_{10}
Sweep 1	0.87	0.39
2	0.95	0.5
3	1.03	0.61
4	1.1	0.7
5	1.1	0.79
6	1.1	0.87
7	1.1	0.95
8	1.1	1.03
Sweep 9	1.1	0.39
10	1.1	0.5
11	1.1	0.61
12	1.1	0.7
13	1.1	0.79
14	1.1	0.87
15	0.87	0.95
16	0.95	1.03
17	1.03	1.1
Sweep 18	1.1	0.39
19	1.1	0.5
20	1.1	0.61
21	1.1	0.7
22	1.1	0.79
23	1.1	0.87
24	1.1	0.95
25	1.1	1.03
26	1.1	1.1
27	1.1	1.1
28	1.1	1.1
3 Sweeps per Month	1.07	0.78

Notice that the type of sweeper results in marked differences in emission rates.

1. The emission rates for the PM_{10} efficient sweepers are lower than for the conventional sweepers; and

2. Streets swept by conventional sweepers return to their pre-sweeping equilibrium value of 1.1 g/VMT on the fourth day but the streets swept with PM_{10} efficient machines don't reach equilibrium until the ninth day (see Table L-1).

Averaging the emissions for the 28 day period, with the PM_{10} efficient sweepers, gives a 0.89 g/VMT value for the once every two weeks schedule, and a 0.64 g/VMT value for the once a week schedule. Three sweeps in the 28-day period gives an emission rate of 0.74 g/VMT. Therefore, doubling the frequency of sweeping from once every two weeks to once a week reduces emissions by 28.1%.

Applying these emission reductions to the Salt River PM_{10} Area becomes somewhat complicated, because not all the streets would be subject to increased sweeping. First, the half-mile streets need to be separated from the remainder of the "secondary roads." This was done in consultation with MAG staff and amounted to the assumption that 80% of the vehicle miles traveled (VMT) on secondary roads occurs on the half-mile streets. Second, the fraction of mile and half-mile streets subject to frequent trackout had to be estimated. This was done by reviewing satellite images of the area and counting the primary and secondary (in this case, half-mile streets only) street lengths adjacent to and within one quarter a mile of industrial, construction, and agricultural land.

The percentages of mile and half-mile roads subject to additional sweeping are given in Table L-4.

TABLE L-4
Salt River PM_{10} Study Area Roads
Subject to Additional Sweeping

	Length of All Streets (Miles)	Percentage of Streets with Potential Trackout			
		Industrial	Miscellaneous*	Agricultural	Total
One-mile	89	14.1	20.3	28.9	63.3
Half-mile	50	6.2	22.1	37.7	66.0

*The miscellaneous category consists of construction sites, unpaved shoulders, and trackout from private (not industrial, construction, or agricultural) sources.

Combining the roads subject to trackout, and therefore, increased sweeping, with the emission reductions of Tables L-1 and L-2, results in the emission rates and estimated emission reduction shown in Table L-5.

The following notes are provided to assist in understanding Table L-5.

1. Road Type: Primary is one-mile; secondary is half-mile streets

2. Trackout Type: "Misc" consists of construction, road shoulders, and private, or "miscellaneous."

3. % Swp: % of roadways in Salt River Area subject to this type of sweeping

4. Base Freq: Sweeping frequency assumed for the base year.

5. SIP Freq: Projected 2006 sweeping frequency. For the rain and dust sweeping, the base frequency is once per two weeks, with 12 days added per year for sweeping after major rains and dust storms.

6. "% Visible": All figures are 100%, reflecting that targeted sweeping would take place along the entire length of the street with trackout potential, not just the visibly dirty portion.

7. % Covered: The percentage of roadways that would be swept at a higher frequency. These percentages are equal to the "% swp" column except for agricultural trackout. Agricultural streets have been reduced by 80%, reflecting the 20% of the year that fields are being worked or tilled or recently planted. It is only under these conditions that agricultural trackout is likely.

8. Emission Rates: Based on PM10 efficient street sweepers only, for base and future years. The overall emission rate is the combination of the base rate and its street percentage with the control rate with its percentage.

9. % Reduc: The emission reduction percentages on the far right of the table come from increasing the sweeping frequency on that fraction of the streets affected by the five trackout types. These types are
   Industrial
   Miscellaneous (private, road shoulder, construction)
   Agricultural
   Heavy rain washout
   Heavy dust deposition.

10. The heavy rain washout and heavy dust deposition lines in the table require additional explanation. First, 10% and 5% of primary and secondary roads are assumed to be affected. The base frequency of one sweep per two weeks is supplemented with one additional sweeping day a month (12 days of

storms per year). Thus, the base emission rate of 0.89 g/VMT changes to the control rate of 0.78 g/VMT which comes from Table L-3.

To further clarify the calculations, the following bullets explain the results shown in the first row, for primary roads near industrial sites.

- First, 14.1% of the primary roads in the Salt River area either border or are within 1/4 mile of an industrial site.

- Second, the base (2002) frequency of sweeping is once every two weeks, with PM10 efficient sweepers.

- Third, the proposed industrial sweeping criterion is to "sweep weekly or whenever visible trackout is observed." The frequency could be anywhere from daily to weekly, depending on the prevalence of visible trackout. The table reflects an assumed frequency of once per week.

- Fourth, the %visible figures have been set to 100%. This reflects the fact that the sweeper would sweep the entirety of the street near the industrial site, even if the trackout does not occur on the entire length of the street.

- Fifth, "% covered", 14.1%, is the percentage that the primary roads near industrial sites comprises of all primary roads.

- Sixth, base and control emission rates (0.89 g/VMT and 0.64 g/VMT) were taken from Tables L-1 and L-2. These emission rates reflect the base and proposed sweeping frequencies.

- Seventh, the overall emission rate of 0.85 g/VMT is the rate for all primary roads. This overall emission rate accounts for the 14.1% of primary roads that border or are within ¼ mile of an industrial facility being swept once a week and the remaining primary roads being swept once every two weeks.

- Eighth, the percentage reduction is that of the overall emission rate compared with the base emission rate.

- Ninth, the "primary" percent reduction of 12.58% near the bottom right of the table is the sum of the four primary percentage reductions.

- Tenth, the half-mile street reduction of 7.19% is merely the secondary street reduction of 8.99 multiplied by 80%.

The figures of primary (one-mile) and half-mile reentrained emission reductions from increased sweeping appear on page 6-12 of the TSD.

TABLE L-5
Calculation of Reentrained Emissions for the Salt River PM_{10} Study Area

							Emission Rate	(g/VMT)		
	Type	**% Swp**	**Base Freq**	**SIP Freq**	**% Visible**	**% Covered**	**Base**	**Control**	**Overall**	**% Reduc**
Primary	Indus	14.1	1 per 2 wks	1per wk	100	14.1	0.89	0.64	0.85	3.96
Second	Indus	6.2	1 per 2 wks	1per wk	100	6.2	0.89	0.64	0.87	1.74
Primary	Misc	20.5	1 per 2 wks	1per wk	100	20.5	0.89	0.64	0.84	5.76
Second	Misc	22.1	1 per 2 wks	1per wk	100	22.1	0.89	0.64	0.83	6.21
Primary	Agric	28.9	1 per 2 wks	1per wk	100	5.8	0.89	0.64	0.82	1.62
Second	Agric	7.5	1 per 2 wks	1per wk	100	1.5	0.89	0.64	0.87	0.42
Primary	Rain/Dst	10.0	1 per 2 wks	Base + Rain/Dust	100	10.0	0.89	0.78	0.88	1.24
Second	Rain/Dst	5.0	1 per 2 wks	Base + Rain/Dust	100	5.0	0.89	0.78	0.88	0.62
Primary		63.5	% of roads covered							12.58
Secondary		35.8	% of roads covered							8.99
1/2 Mile Only (no Residential), with 1/2 Mile Streets having 80% of VMT										7.19

APPENDIX M - EMISSION DENSITY MAPS OF BACKGROUND

Changes to background concentrations from area-wide controls are calculated for specific emission types by:

1. Figuring the percentage that each emission type comprises of the total metropolitan PM10 inventory;

2. Dividing the spatial distribution of the category emissions into six zones of increasing distance from the Salt Industrial area;

3. Figuring the percentage of emissions occurring in each of the six zones;

4. Applying a $1/r^2$ weighting as the transport potential to the emission percentage by zone;

5. Adding these weighted percentages (This gives a transport percentage by emission type); and

6. Multiplying this transport percentage by the percentage of the emission type of the total inventory, giving an "urban background reduction percentage."

This percentage would then be applied to any control-strategy based metropolitan wide reduction percentage to give the ultimate background reduction.

The PM_{10} emissions for metropolitan Phoenix come from the Maricopa Association of Governments 1995 emission inventory. Only certain components of the inventory matched up with source categories from the Salt River inventory. These are given in Table M-1.

TABLE M-1 Urban-wide PM_{10} Emissions					
Emission Type	**Category**	**Tons/ Day**	**% Total**	**Transport Percent**	**Reduction Percent**
Construction activity fugitive dust	Nonroad	22.85	15.86	28.59	4.53
Entrainment from construction trackout	Nonroad	6.10	4.23	28.59	1.21
Industrial processes	Point	2.63	1.83	32.42	0.59
Process fugitives	Stationary Area	0.42	0.29	32.42	0.09
Paved road dust	Onroad	56.40	39.14	28.90	11.31
Ag tilling		5.58	3.87	28.59	1.11
Total of all sources*		144.05			
Windblown is treated separately, since it is its own category					
Windblown		3860	100	25.27	25.27

*The total of all sources means the total in the inventory. This figure is much higher than the total of the sources listed in the table, since many categories did not have a match in both the metropolitan and Salt River inventories.

The spatial distribution of these emission sources throughout the metropolitan area is given in emission density plots built by MAG for their PM_{10} SIP inventory. These plots are shown below, along with the designated six zones of increasing distance from the Salt River study area. The emissions in each zone are tabulated in Table M-2. Table M-3 presents the emissions by category and by zone, with first the raw percentages and seconds the weighted percentages. The weighting is based on a $1/r^2$ decay, with the decimal weighting factors shown for convenience. Moving from zone 1, the closest to the Salt River study area, to zone 6, the farthest away, the decimal zone fractions decrease, and so must the weighted percentages. All of this is merely a numerical and tabular illustration that the influence of emissions diminishes with distance.

When the weighted percentages from all six zones are summed, the result is an overall “transport percentage.” This figure can be considered the overall metropolitan potential for a particular emission category to reach the Salt River study area. These transport percentages, calculated in Table M-3, are also shown in Table M-1. When this transport percentage is multiplied by the percentage that the emission category comprises of the total emissions, the product is the “urban background reduction percentage.” To put this necessarily numeric argument into practice, consider the top line of Table M-1, concerning “construction activity fugitive dust.” This emission source at 22.85 tons/day comprises 15.86% of the metropolitan PM_{10} emissions. From Table M-2 and the nonroad emission density map, with the $1/r^2$ for the distance weighting factor, the transport percentage of 28.59 is calculated. Multiplying this percentage by 15.86%, the share of the total inventory attributed to construction dust, gives the "urban background reduction percentage" of 4.53. This figure should be interpreted as follows: if construction dust throughout the metropolitan area were reduced by 50% (from about 23 tons to 11.5 tons), then the PM_{10} concentrations at the border of the Salt River study area would be reduced by 2.27% (50% of 4.53%). The response of Salt River background concentrations to metropolitan-wide emission reductions depends on:

1. What reduction can be expected to a particular source category, and how important that source category is to the metropolitan emission total; and

2. How the emissions of that particular source category are distributed throughout the metropolitan area.

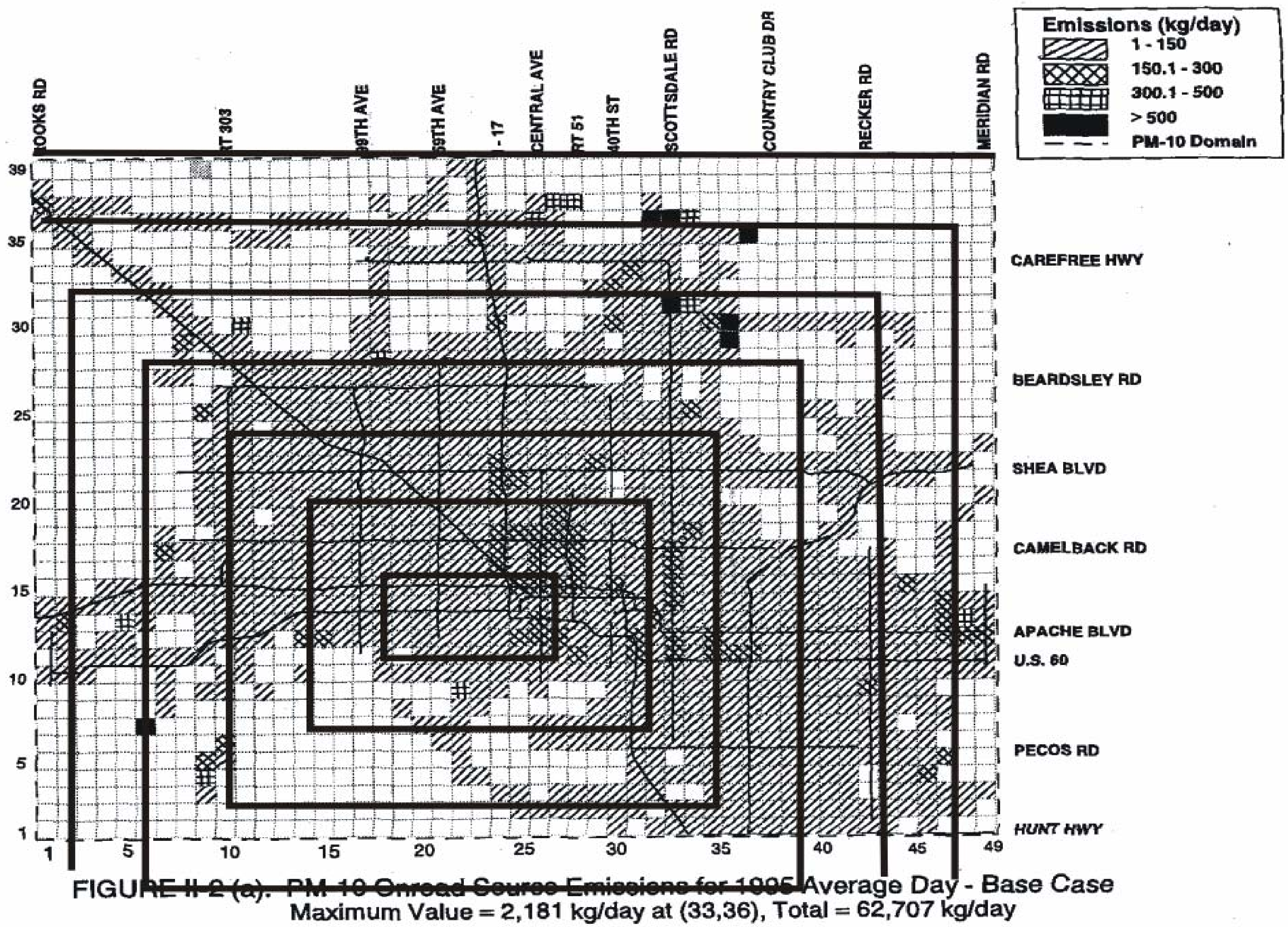


Figure M-1. Onroad Mobile PM_{10} Emission Density Plot for Metropolitan Phoenix with Salt River Zones of Influence

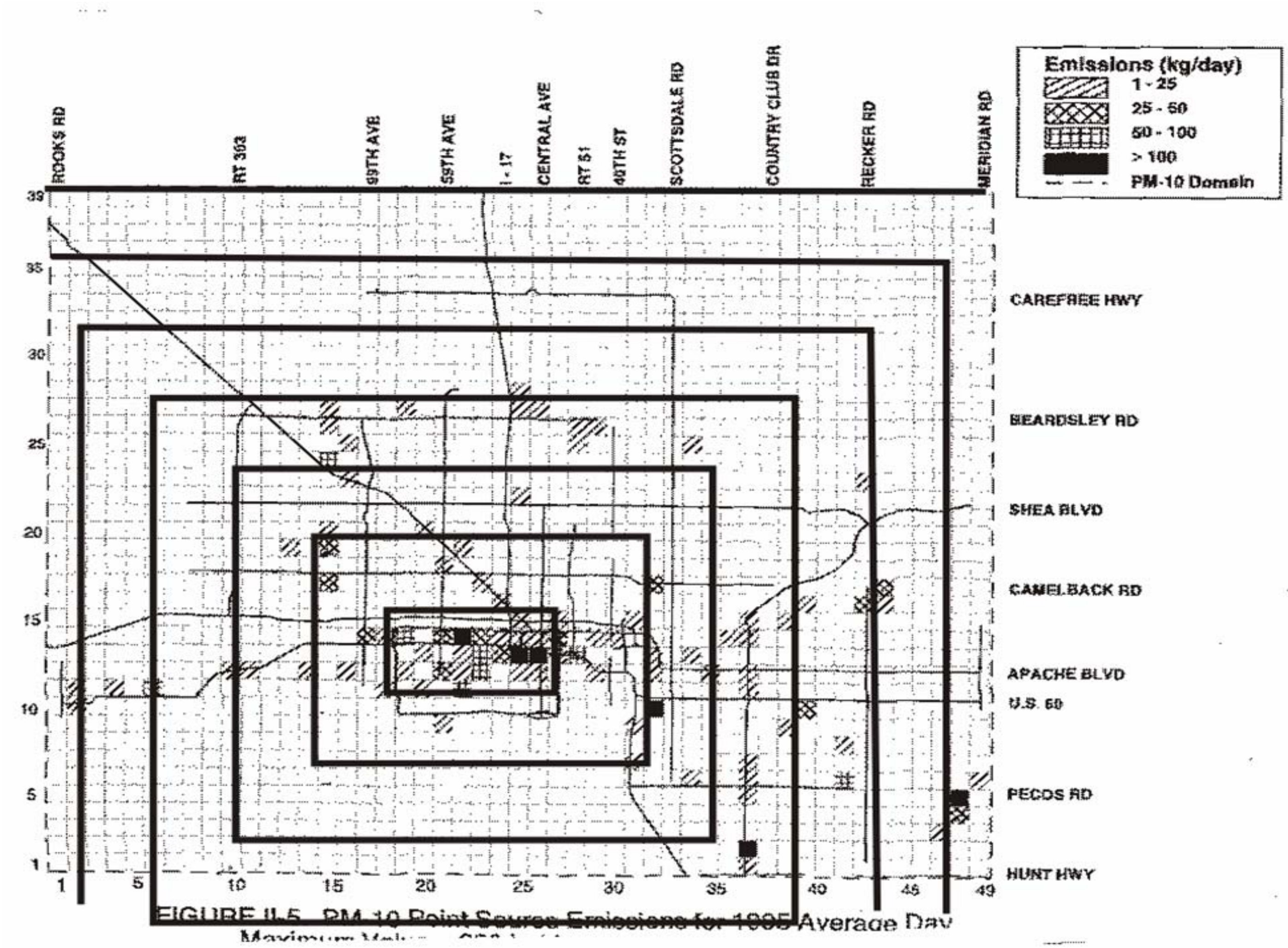


Figure M-2. Point source PM_{10} Emission Density Plot for Metropolitan Phoenix with Salt River Zones of Influence

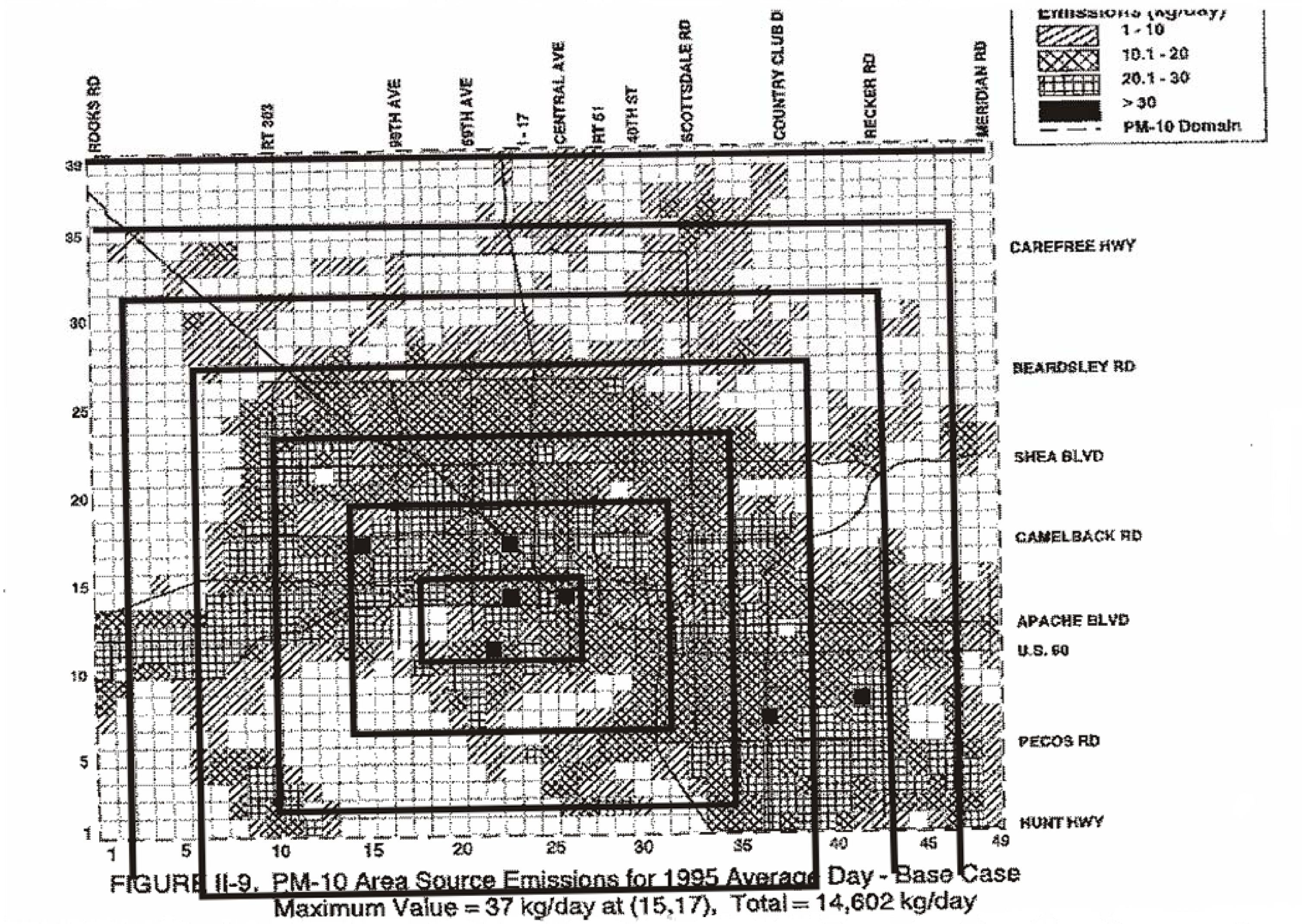


Figure M-3. Area source PM_{10} Emission Density Plot for Metropolitan Phoenix with Salt River Zones of Influence

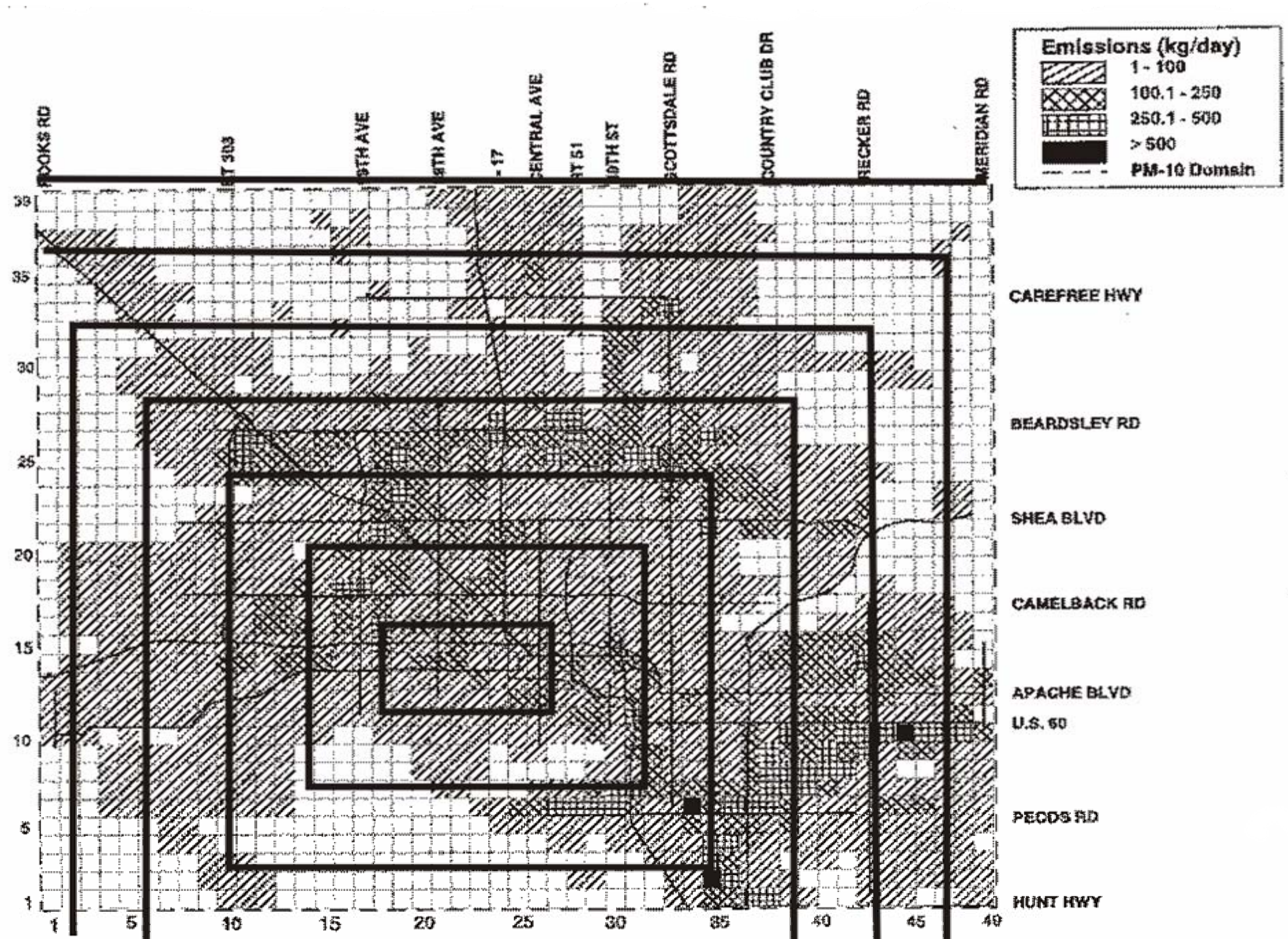


FIGURE II-13. PM-10 Nonroad Mobile Source Emissions for 1995 Average Day - Base Case
Maximum Value = 773 kg/day at (34,6), Total = 77,511 kg/day

Figure M-4. Nonroad Mobile PM_{10} Emission Density Plot for Metropolitan Phoenix with Salt River Zones of Influence

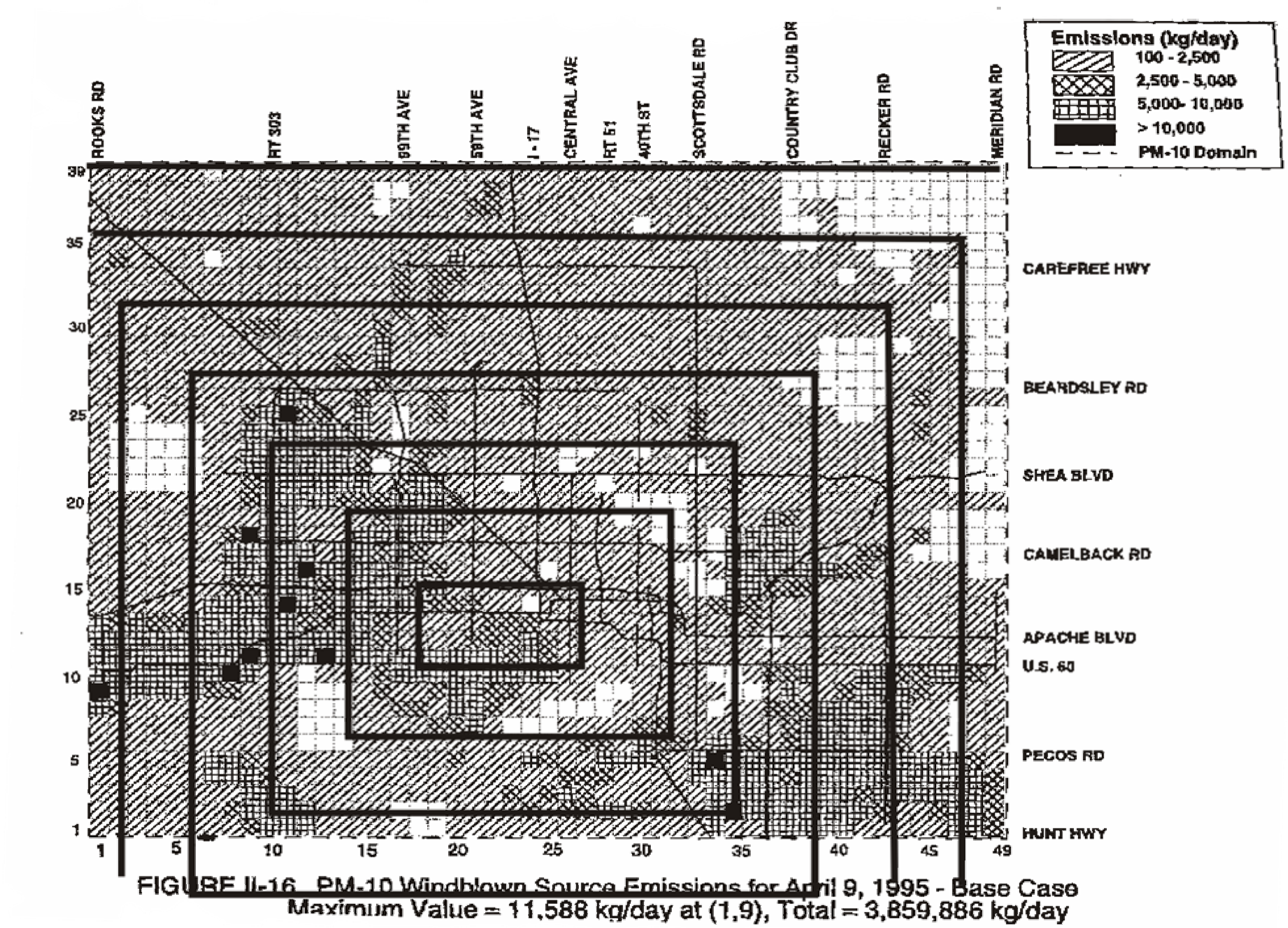


Figure M-5. Windblown PM_{10} Emission Density Plot for Metropolitan Phoenix with Salt River Zones of Influence

TABLE M-2
Number of Grid Cells with a Specified Emission Range by Zone

Point Sources				
	Emissions (kg/day)			
Zone	**1-25**	**25-50**	**50-100**	**>100**
Average Emissions	**12.5**	**37.5**	**75.0**	**150.0**
1	15	1	1	0
2	14	1	0	0
3	19	0	1	1
4	8	2	2	0
5	4	1	0	0
6	1	1	0	1
Nonroad				
	Emissions (kg/day)			
Zone	**1-100**	**100-250**	**250-500**	**>500**
Average Emissions	**50.0**	**175.0**	**375.0**	**750.0**
1	103	22	11	0
2	208	31	4	2
3	233	66	25	0
4	232	29	12	0
5	125	16	4	1
6	94	4	1	0
Onroad				
	Emissions (kg/day)			
Zone	**1-150**	**150-300**	**300-500**	**>500**
Average Emissions	**75.0**	**225.0**	**400.0**	**750.0**
1	98	24	1	0
2	140	16	0	0
3	237	7	1	0
4	189	5	3	3
5	135	9	1	0
6	61	3	5	3
Windblown				
	Emissions (kg/day)			
Zone	**100-2500**	**2500-5000**	**5-10,000**	**>10,000**
Average Emissions	**1300.0**	**3750.0**	**7500.0**	**15000.0**
1	68	17	28	1
2	108	32	65	4
3	175	20	62	6
4	245	26	56	2
5	242	20	21	0
6	225	11	15	0

TABLE M-3

Calculation Table for Emissions by Zone, Percent, and Weighted Percent: Urban Background Adjustment

Point Sources

	Emissions (kg/day)							
Zone	1-25	25-50	50-100	>100				
Average Emissions	12.5	37.5	75.0	150.0	Total	Percent	Zone Weight	Weighted Percent
1	187.5	37.5	75.0	0.0	300.0	18.9	1.00	18.90
2	175.0	37.5	0.0	0.0	212.5	13.4	0.36	4.82
3	237.5	0.0	75.0	150.0	462.5	29.1	0.18	5.35
4	100.0	75.0	150.0	0.0	325.0	20.5	0.11	2.27
5	50.0	37.5	0.0	0.0	87.5	5.5	0.07	0.41
6	12.5	37.5	0.0	150.0	200.0	12.6	0.05	0.67
Total					1587.5			32.42

Nonroad

	Emissions (kg/day)							
Zone	1-100	100-250	250-500	>500				
Average Emissions	50	175	375	750	Total	Percent	Zone Weight	Weighted Percent
1	5150	3850	4125	0	13125	12.8	1.00	12.77
2	10400	5425	1500	1500	18825	18.3	0.36	6.59
3	11650	11550	9375	0	32575	31.7	0.18	5.82
4	11600	5075	4500	0	21175	20.6	0.11	2.29
5	6250	2800	1500	750	11300	11.0	0.07	0.82
6	4700	700	375	0	5775	5.6	0.05	0.30
Total					102775			28.59

Onroad

	Emissions (kg/day)							
Zone	1-150	150-300	300-500	>500				
Average Emissions	75	225	400	750	Total	Percent	Zone Weight	Weighted Percent
1	7350	5400	400	0	13150	15.0	1.00	14.98
2	10500	3600	0	0	14100	16.1	0.36	5.78
3	17775	1575	400	0	19750	22.5	0.18	4.13
4	14175	1125	1200	2250	18750	21.4	0.11	2.37
5	10125	2025	400	0	12550	14.3	0.07	1.06
6	4575	675	2000	2250	9500	10.8	0.05	0.58
Total					87800			28.90

TABLE M-3

Calculation Table for Emissions by Zone, Percent, and Weighted Percent: Urban Background Adjustment

Windblown

	Emissions (kg/day)							
Zone	100-2500	2500-5000	5-10,000	>10,000				
Average Emissions	1300	3750	7500	15000	Total	Percent	Zone Weight	Weighted Percent
1	88400	63750	210000	15000	377150	9.7	1.00	9.67
2	140400	120000	487500	60000	807900	20.7	0.36	7.45
3	227500	75000	465000	90000	857500	22.0	0.18	4.04
4	318500	97500	420000	30000	866000	22.2	0.11	2.47
5	314600	75000	157500	0	547100	14.0	0.07	1.04
6	292500	41250	112500	0	446250	11.4	0.05	0.61
Total					3901900			25.27

APPENDIX N - WIND ROSES

Three of the four monitoring sites in the Salt River PM_{10} Study Area were equipped with meteorological instruments in 2002. These sites were South Phoenix, West 43rd Avenue, and Durango. The Salt River site had no meteorological equipment. The West 43rd Avenue site began operation in April; the other two, both long-term County sites, had full annual records. Because of the shortened record at West 43rd Avenue, seasonal and annual patterns of winds shown in the following figures are based on either South Phoenix or Durango. A three-site comparison will be limited to the last three months of 2002.

Distances between the three sites are given in Table N-1.

TABLE N-1
Salt River PM_{10} Study Area Sites with Meteorological Data

Site A to Site B	Direction	Meters	Miles
West 43rd Ave. to South Phoenix	E	7133	4.43
West 43rd Ave to Durango	NE	3667	2.28
Durango to South Phoenix	SE	5267	3.27

South Phoenix and West 43rd Avenue lie near the south bank of the Salt River, at distances of 1.4 and 0.4 miles, respectively, from the center line of the channel. Durango is on the north bank of the river, at a distance of 1.2 miles.

A complete discussion of how the topographical features influence wind patterns is beyond the scope of this response. Only a few of the basic features will be discussed. Figure N-1 shows the elevations of the terrain in south-central Arizona and in the Phoenix metropolitan area. First, the Salt River Valley of metropolitan Phoenix lies at the southwestern edge of some rapidly rising terrain. Second, to the west and southwest of the valley, desert elevations, punctuated by mountain ranges, predominate all the way to the Colorado River at Yuma. The meso-scale circulation is driven by valley-to-mountain flow in the daytime (winds from the west) and by mountain-to-valley downslope flow at night (winds from the east and northeast). Third, on a metropolitan scale, these three wind monitors would be expected to be influenced by Salt River channel flow and by nocturnal drainage off the slopes of the South Mountains and, perhaps, from downslope flow from the Estrella Mountains. Slope flow from the north would not be expected, as the southerly flowing Agua Fria River lies 10 miles to the west of the Study Area and the southerly flowing Verde River lies 18 miles to the east-northeast. Figure N-=2 shows the location of the meteorological stations on a satellite image of the Salt River PM_{10} Study Area.

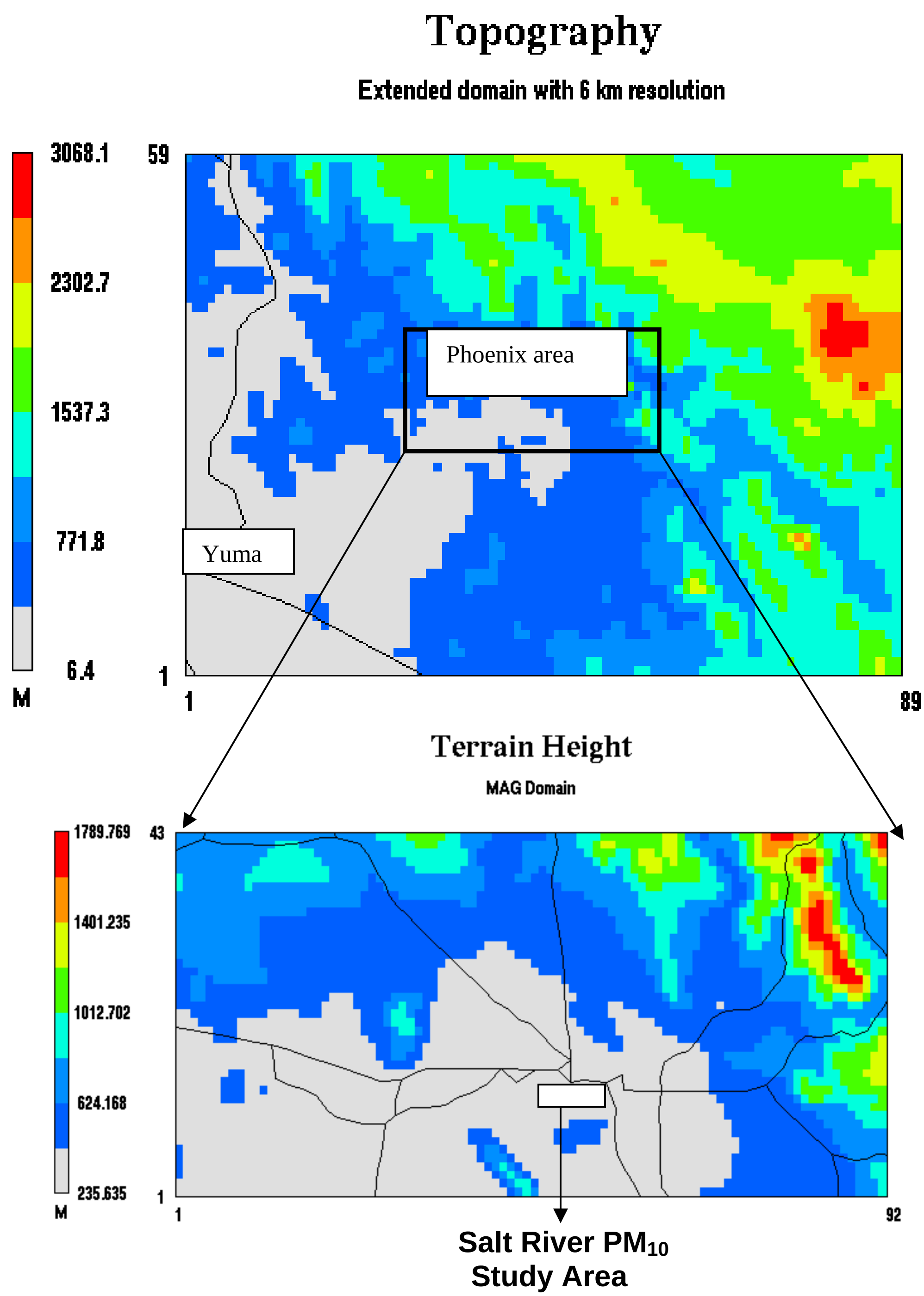
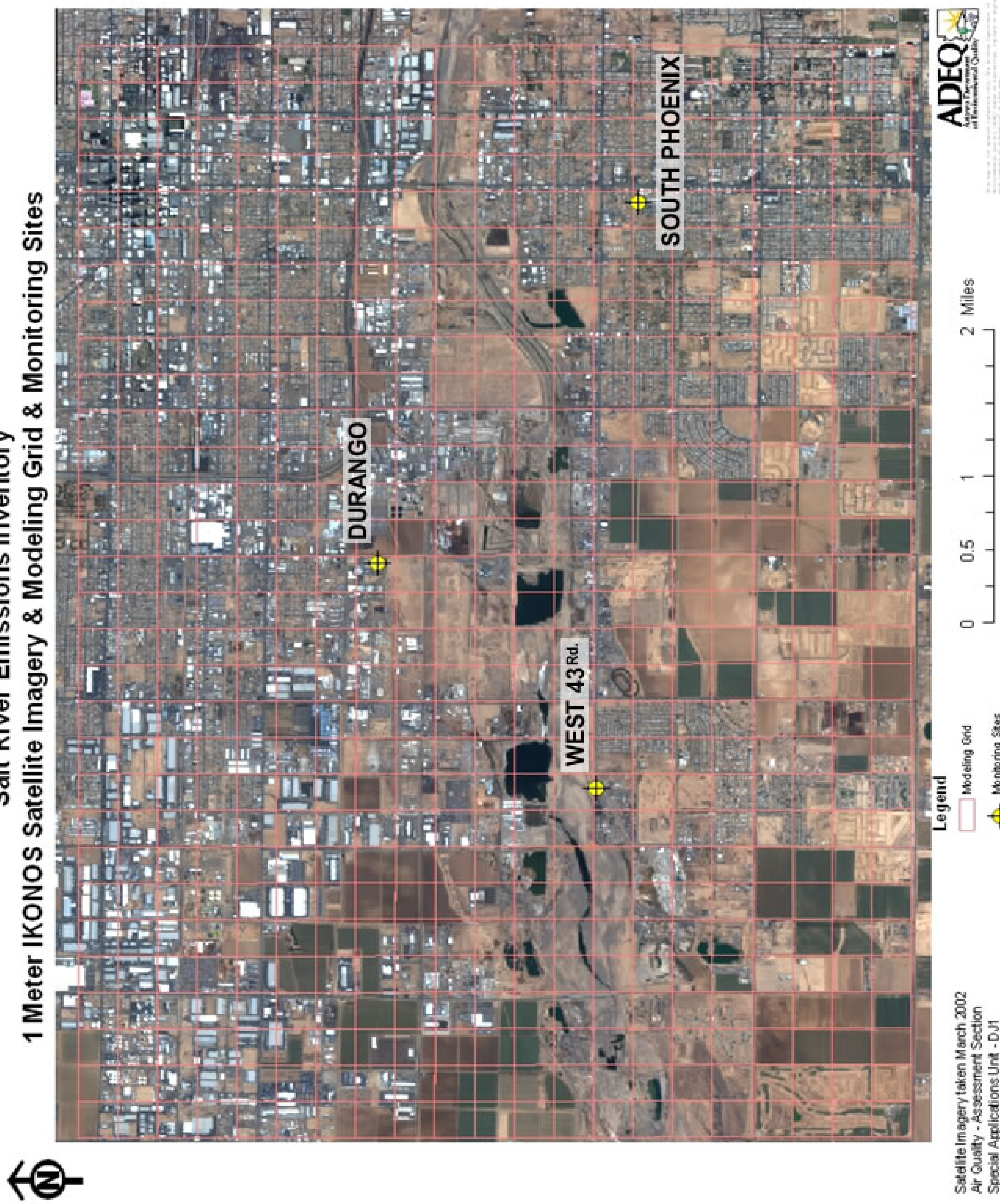


Figure N-1. Elevations in South-central Arizona (top), in Metropolitan Phoenix (bottom), with the Salt River PM_{10} Study Area Shown in the Lower Figure

Figure N-2.   Salt River Meteorological Sites



A series of wind roses from these three monitors is shown below. In each rose, the length of the bar (and its designated numerical value) is the percentage of the time that the wind is coming from a particular direction. Each directional bar is divided into sub-lengths of wind speed. The speeds in meters per second can be converted to miles per hour by multiplying by 2.24. The first set of roses is from South Phoenix: annual, seasonal, and seasonal in blocks of six hours. Following this are a wind rose from Durango and then roses from all three sites. A few observations on this series, all from South Phoenix, except the last two figures, are:

- The annual pattern (Figure N-3) is dominated by local down-valley and up-valley wind flow, resulting in the high and nearly equal frequencies of east and west winds. “Down and up valley’ refer to the Salt River Valley, aligned east and west. Given this dominance, the southerly and northerly components are minor. Southerly winds occur more often than northerly winds, reflecting the influence of down-slope drainage from the South Mountains.

- In the seasonal variation, spring and summer (Figure N-4) have more westerlies than the other two seasons, about 25% in contrast to 15%. This may reflect the spring and early summer dry cold fronts that move into the Salt River Valley from the west. The higher wind speeds in these seasons can be attributed to the same phenomenon. In contrast, the fall and winter lower wind speeds are a consequence of high pressure patterns that suppress the passage of high-wind synoptic fronts.

- The six-hour blocks by season (Figures N-5 through N-8) illustrate the daytime (hours 12 – 17) upslope flow from the west and the nighttime (hours 00 – 05) downslope flow from the east.

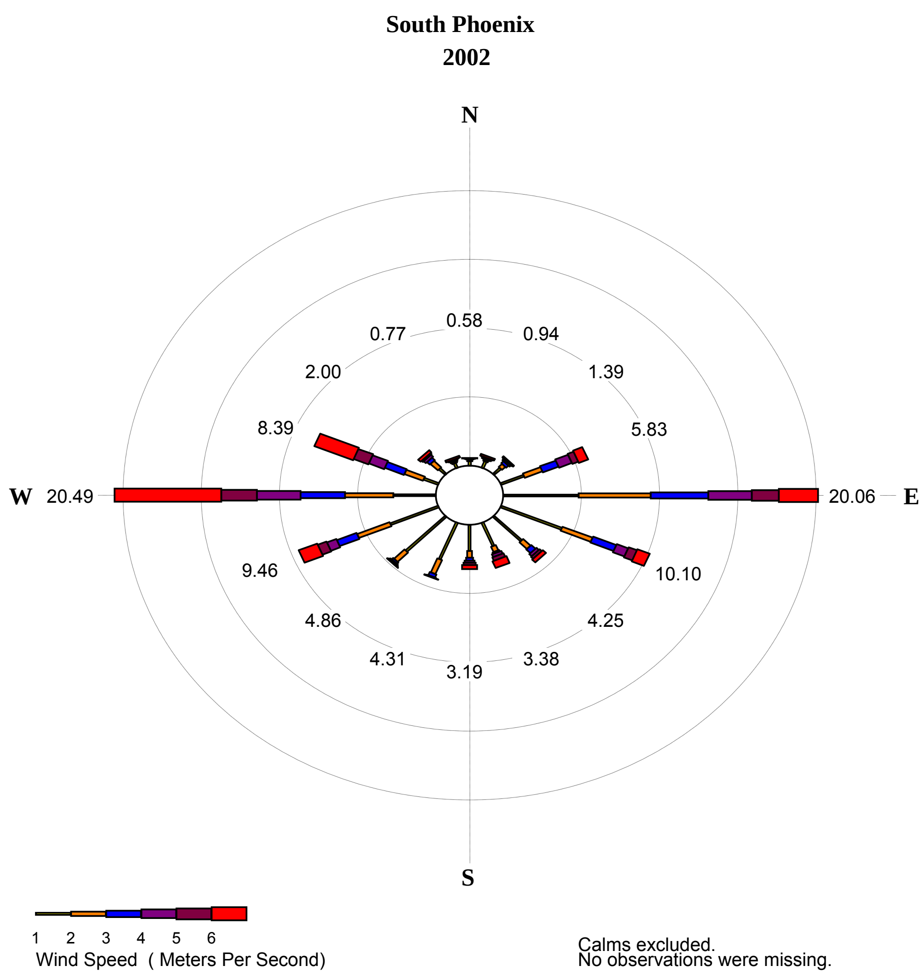
- In the seasonal hourly block pattern, drainage flow from the South Mountains (Figure N-5) is evident in the winter and fall hours of 18 – 23, but is either absent or muted in the other seasons and hourly blocks. By the 00 – 05 hours, the wind direction has completed its transition from west to east. To further explain, the mesoscale flow reversal along the Salt River takes place from 1800 to 2300 hours. During this reversal west and east winds would be suppressed, perhaps allowing the southerly drainage flow to persist. By midnight the mesoscale easterly flow has been established, and has apparently grown strong enough to overwhelm the South Mountain nocturnal drainage flow.

- Also in the seasonal pattern of hourly blocks, the “local wind” pattern differs between spring and summer on the one hand and fall and winter, on the other. In spring and summer the westerly flow lasts longer into the night (block 18 – 23) and maintains higher speeds than in fall and winter. The reversal of the nocturnal wind flow is not completed until the early morning. This later upslope flow is consistent with the later sunset times and residual surface heat of the late spring and summer.

- In comparing the patterns at Durango and South Phoenix, Figure N-9 (Durango) should be contrasted with Figure N-5 (South Phoenix), Daytime hours (12 – 17) are nearly identical in directions with Durango having higher speeds. For the evening and nighttime hours (hours 18 – 23) the wind patterns at the two sites are quite different. Durango is dominated by westerlies, but South Phoenix has pronounced easterly and southerly components. This difference can be interpreted as the earlier transition from westerlies to easterlies at South Phoenix than at Durango, with the latter site once again having higher speeds. Midnight through 5:00 a.m. (hours 00 – 05) has a significant northerly component at Durango that’s completely absent from South Phoenix. Also during this time the South Phoenix winds are dominated by a strong easterly vector. At Durango, in contrast, the winds are more evenly distributed among the west, north, and east directions, indicating that on the north side of the Salt River the transition to nocturnal down-valley flow is slower to arrive than at South Phoenix. During the 6 – 11 hours, although the principal components of the easterly direction are nearly the same at the two sites, Durango has a much stronger southerly component than does South Mountain. All of this demonstrates that two sites 3.3 miles apart along the same major river can have significantly different wind patterns. Apparently the South Phoenix site’s being closer to the South Mountain ridgeline than Durango has a pronounced influence on the timing of the flow reversal, as well as on the overall directional patterns and lower speeds.

  Also of considerable importance for all hourly blocks is the difference in wind speeds: Durango is substantially higher than South Phoenix. This holds for all hourly blocks and virtually all directions.

- The last Figure (number N-10) is a comparison of the three sites. With the data record at West 43rd Avenue being incomplete, and realizing that the instrument was operated only for April – December, 2002, it was not possible to present three annual wind roses. Instead, wind patterns for October through December are shown. Differences among the sites are that Durango has higher speeds than the other two; South Phoenix has a much higher frequency of east winds than the other two; and both Durango and West 43rd Avenue have a small but perceptible northerly component absent from South Phoenix. Surprisingly South Phoenix fails to exhibit a stronger southerly component than the other two, in spite of its location closest to down slope from the South Mountains.



PERCENTOCCURRENCE:
LOWER BOUND OF CATEGORY

DIR	1	2	3	4	5	6
N	0.33	0.13	0.06			
NNE	0.51	0.12	0.04			
NE	0.63	0.31	0.19			
ENE	1.59	1.22	1.07			
E	4.78	4.62	3.67			
ESE	4.20	2.09				
SE	2.50	0.69				
SSE	1.83	0.42				

Figure N-3. South Phoenix Wind Rose: Annual

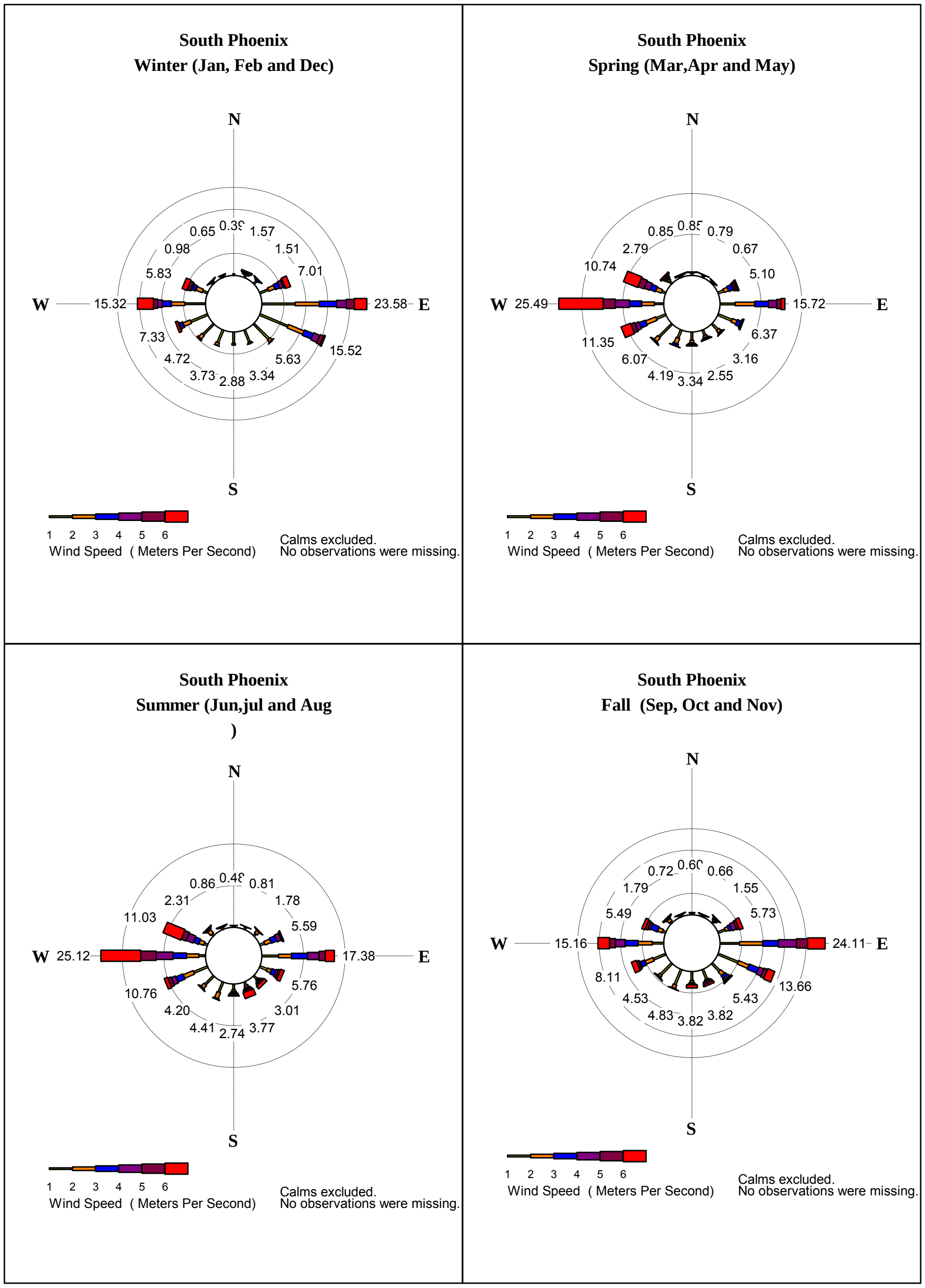


Figure N-4. South Phoenix Wind Rose: Seasonal

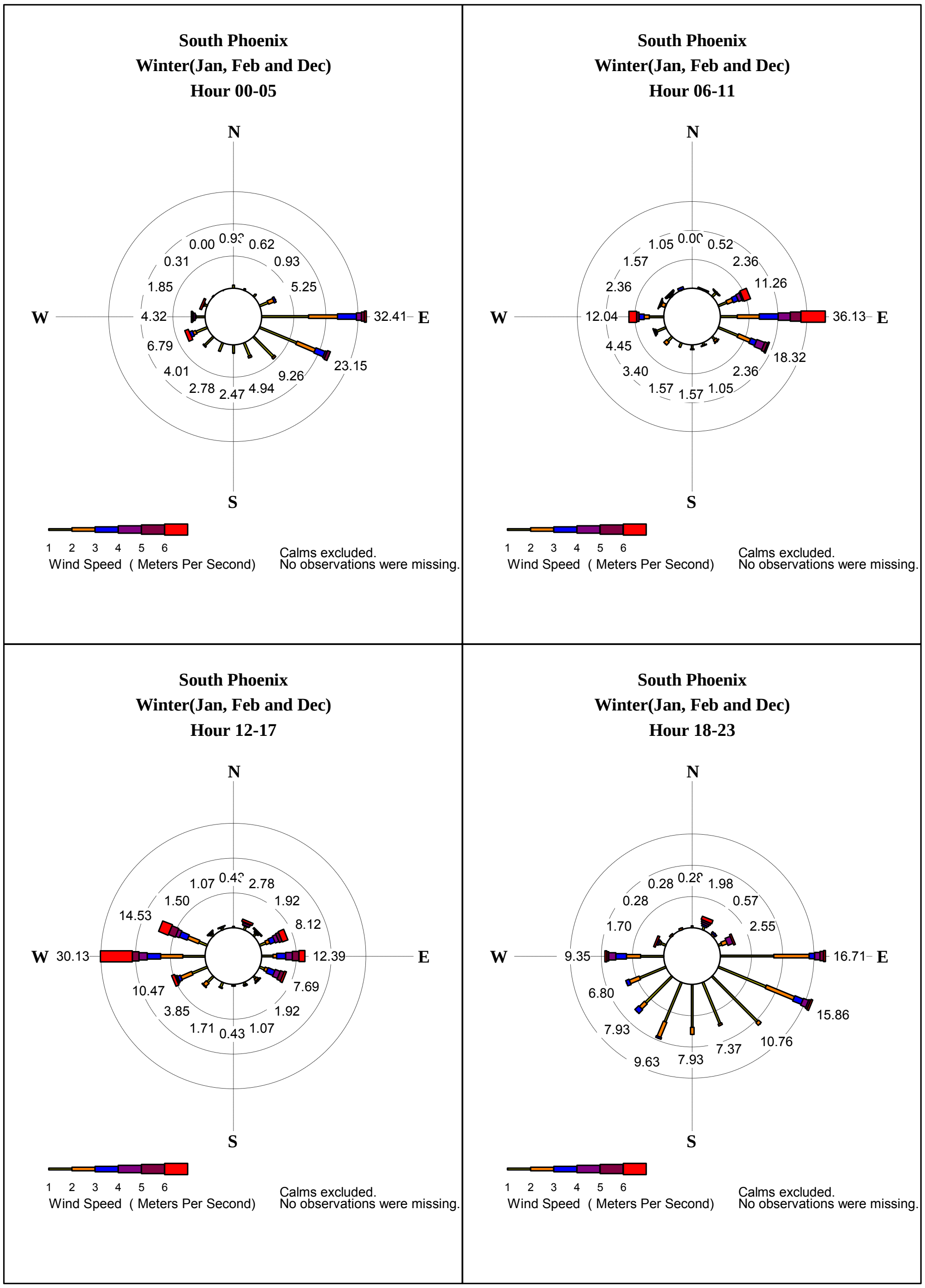


Figure N-5. South Phoenix Wind Rose: Winter, Six-Hour Blocks

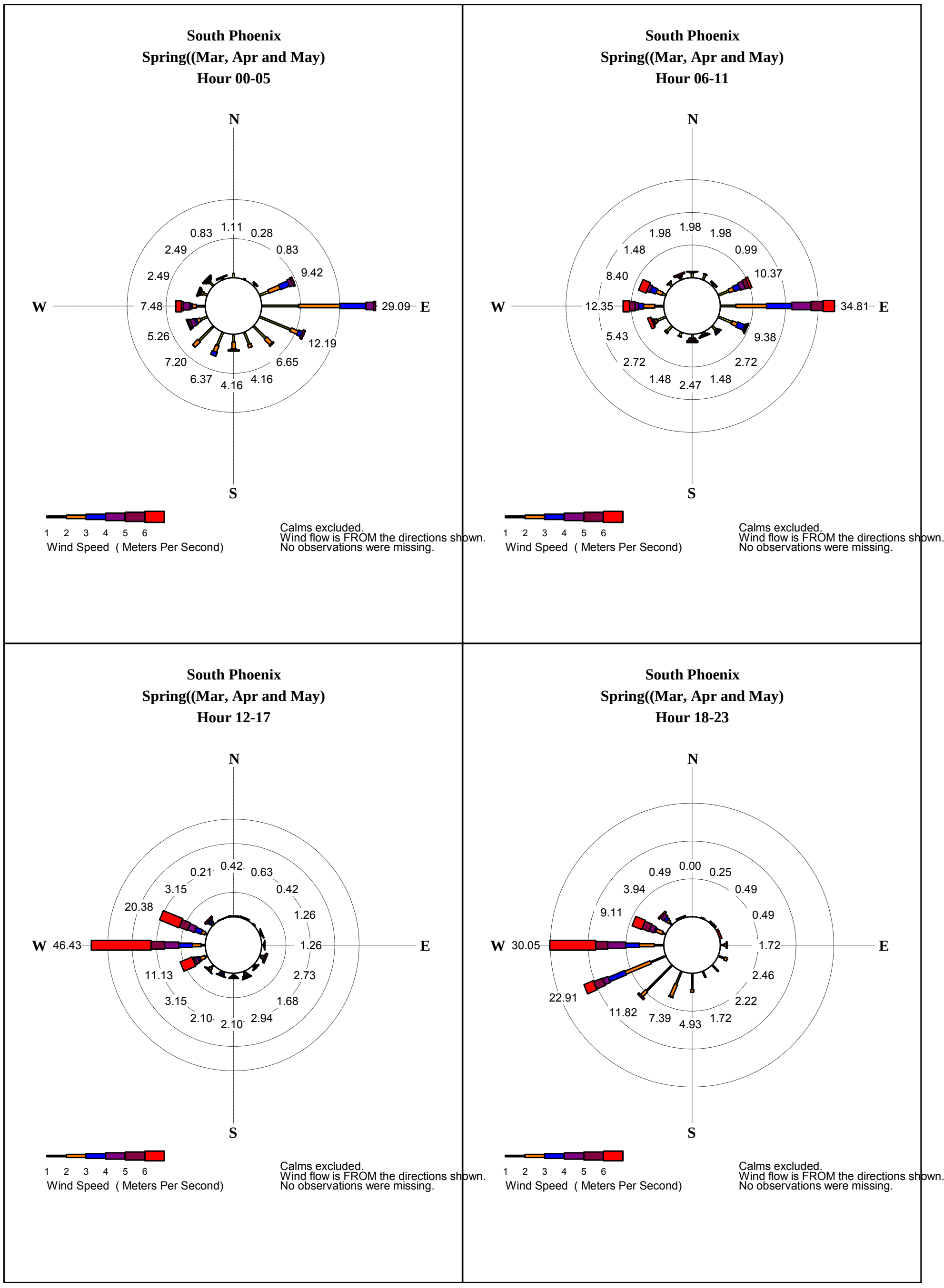


Figure N-6. South Phoenix Wind Rose: Spring in Six-Hour Blocks

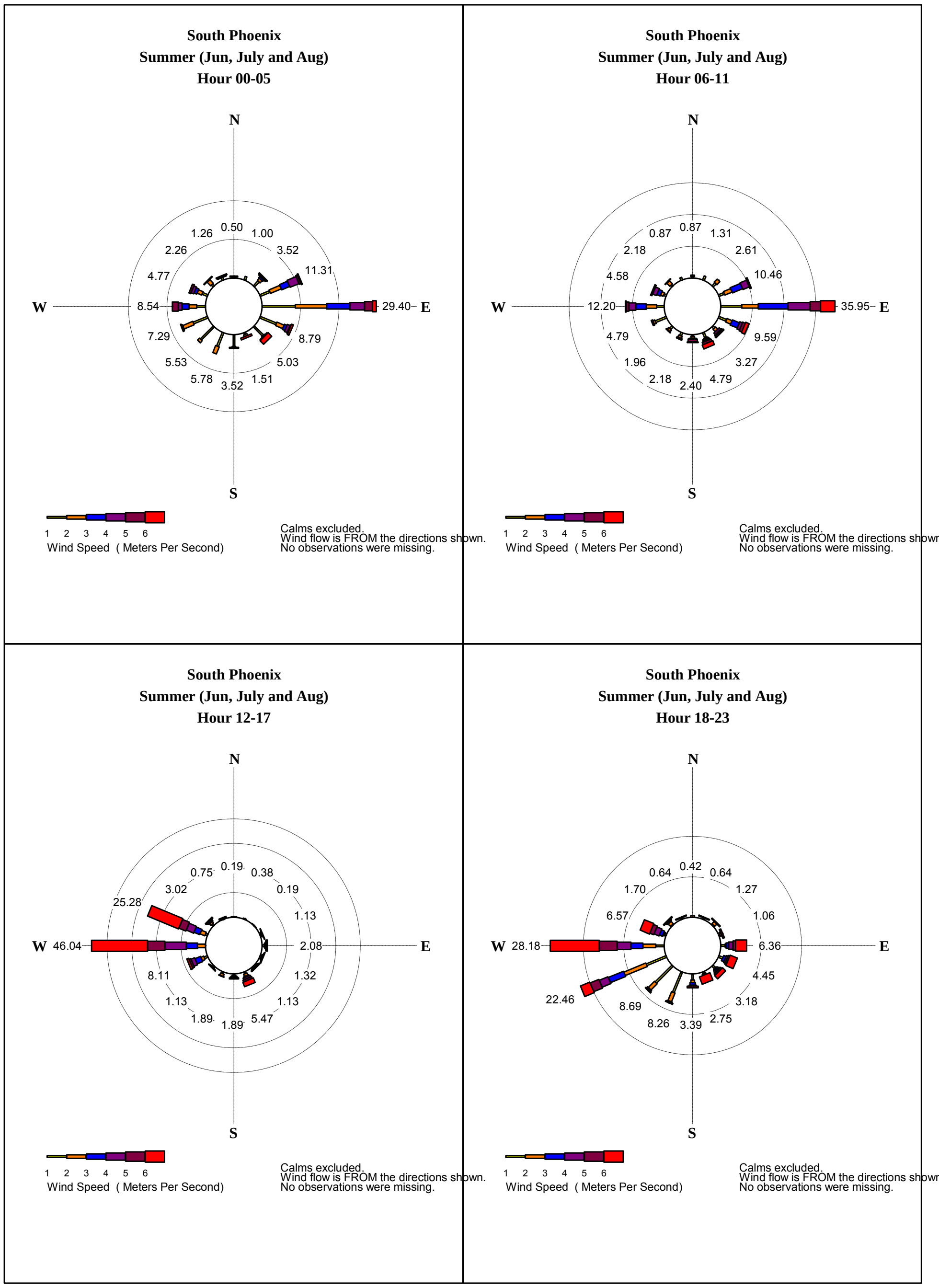


Figure N-7. South Phoenix Wind Rose: Summer in Six-Hour Blocks

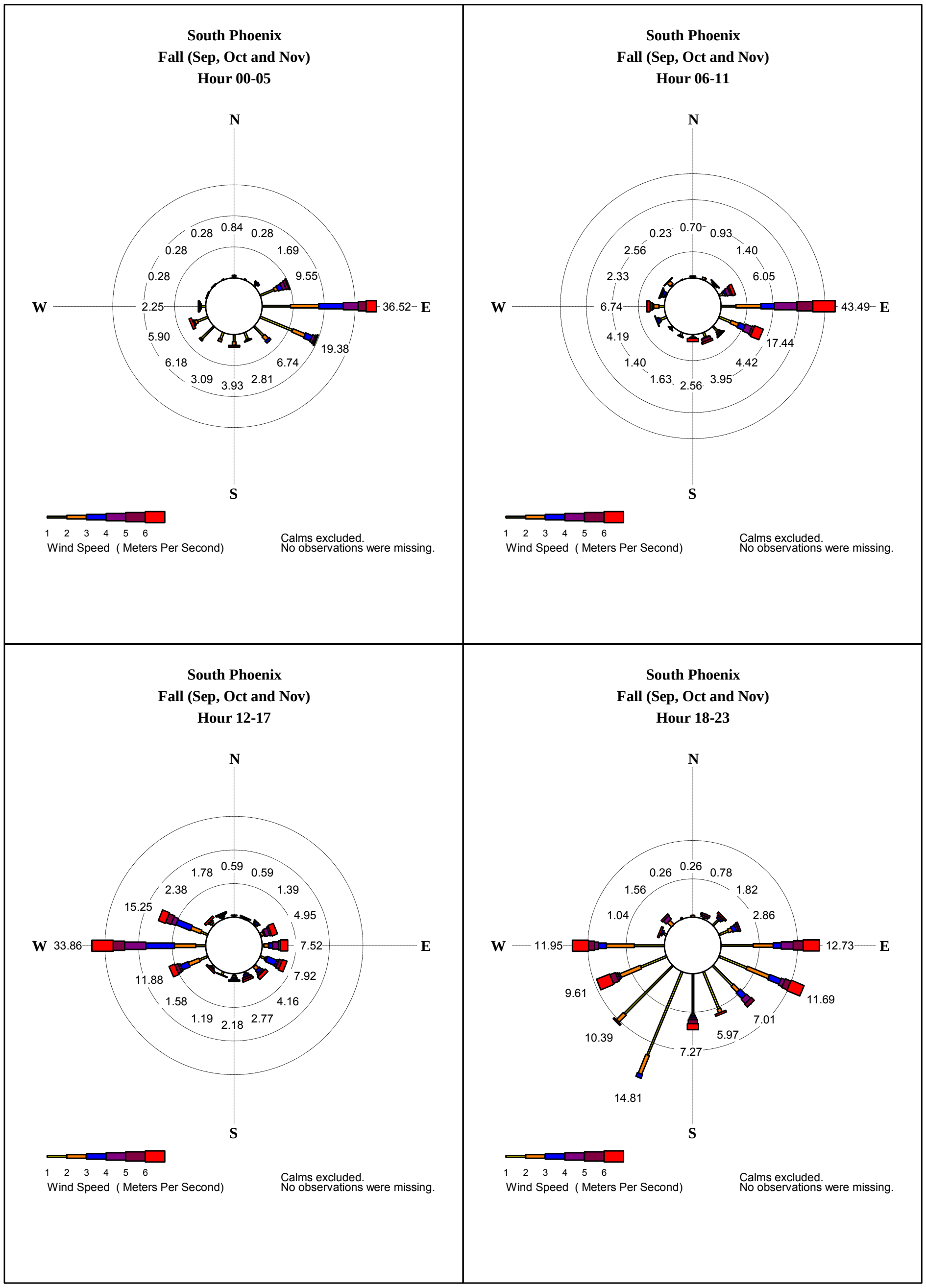


Figure N-8. South Phoenix Wind Rose: Fall, Six-Hour Blocks

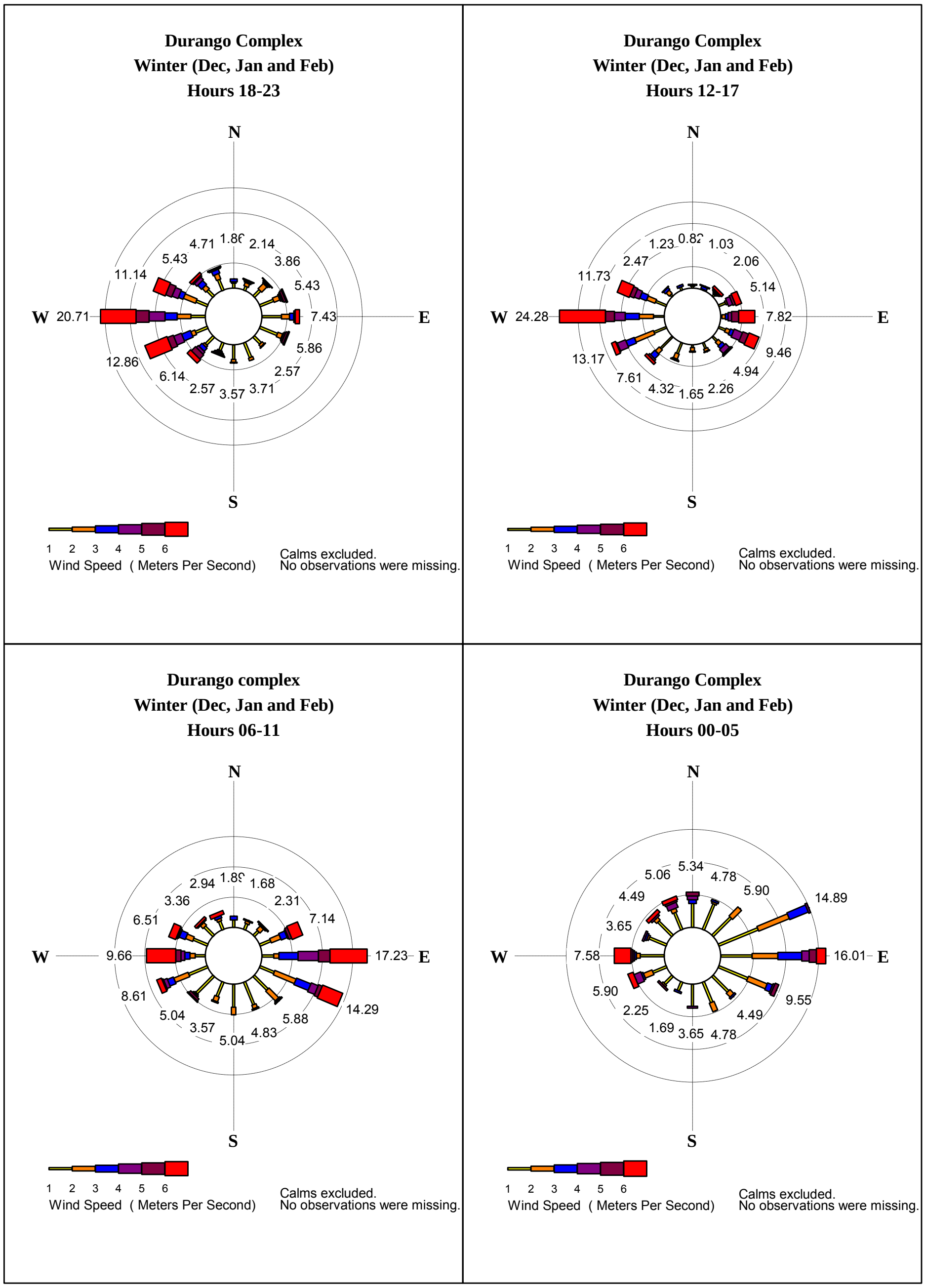


Figure N-9. Durango Wind Rose: Winter, Six-Hour Blocks

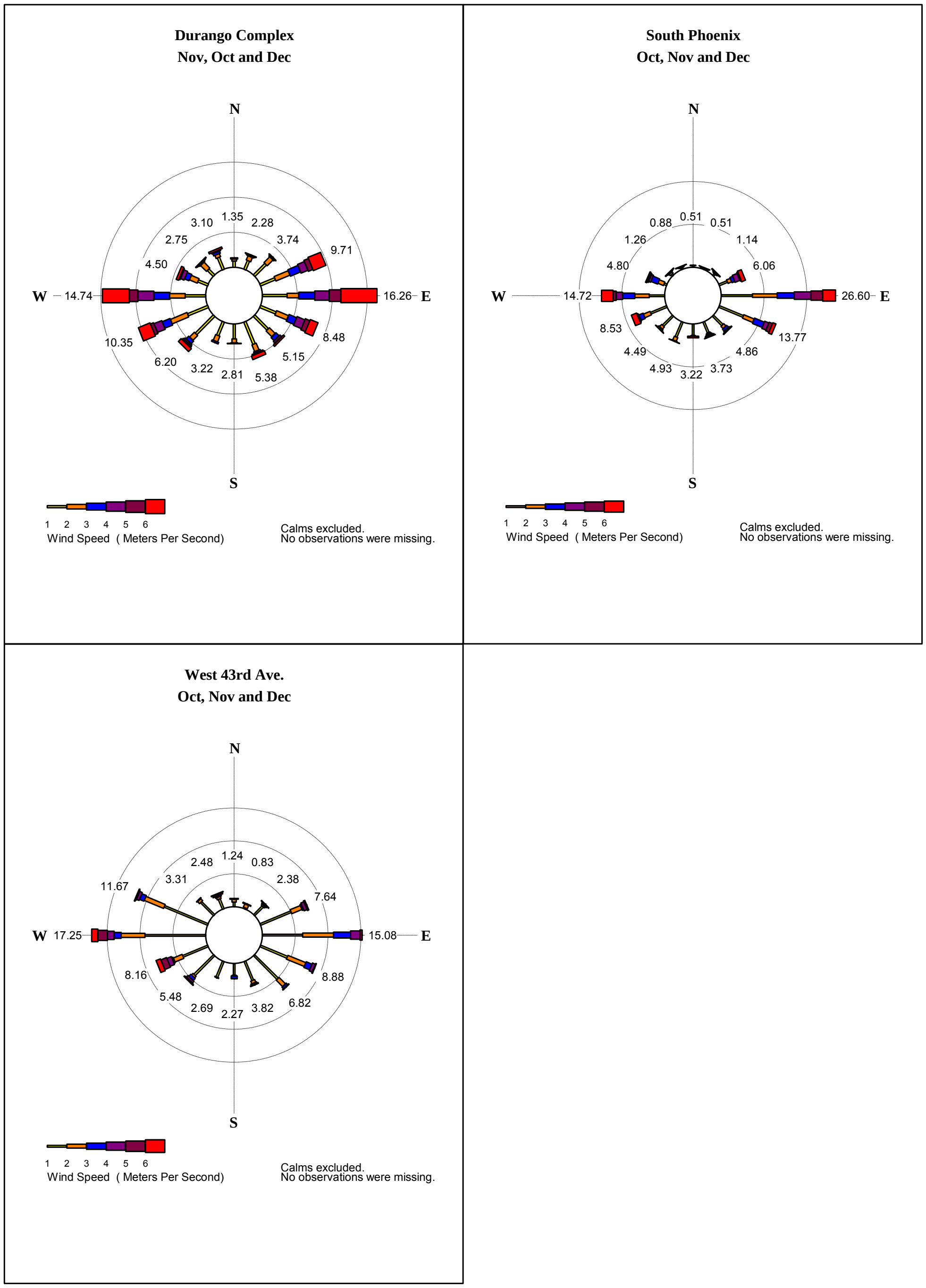


Figure N-10. Comparison of Three Sites: West 43rd Avenue, South Phoenix, and Durango for October through December

APPENDIX O - HOURLY MODEL MEASUREMENT COMPARISON

Model performance data presented here are for the high-wind day of April 15, 2002, and the low-wind day of December 16, 2002. All four sites are included.

Because the emissions inventory, air quality model, calculated background concentrations, and continuous PM_{10} measurements by TEOM are all done on an hourly basis, it's reasonable to discuss model performance on this time scale. In all of the graphs and tables to follow, the "prediction" is the sum of the Industrial Source Complex Model concentration and the background concentration. Most of the graphs show the prediction as "model + background" or "model + B." An hourly time series is an excellent way to gauge model performance. For each hour of the day along the x-axis, two lines progress through the 24 hours: one for the 'model + background", the other for the measurement. Eight such graphs now follow (Figures O-1 – O-8), for the four sites on the high-wind and low-wind days.

Figure O-1. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- High Wind Day of April 15, 2002 at South Phoenix

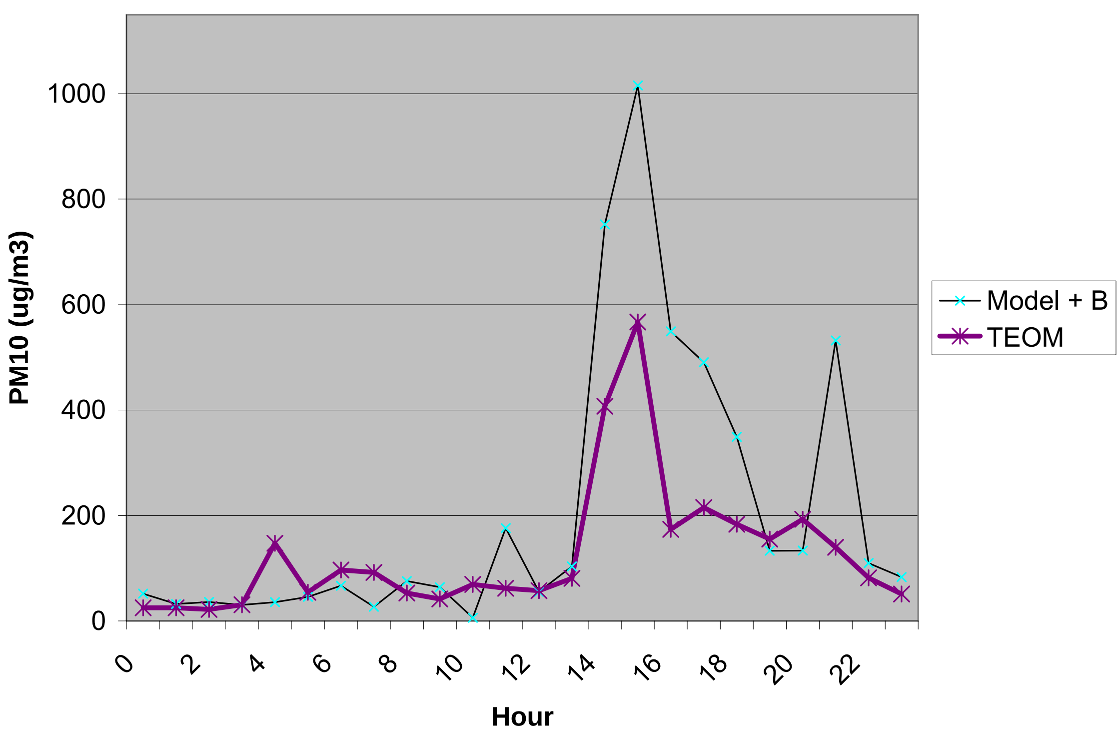


Figure O-2. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- High Wind Day of April 15, 2002 at West 43rd Avenue

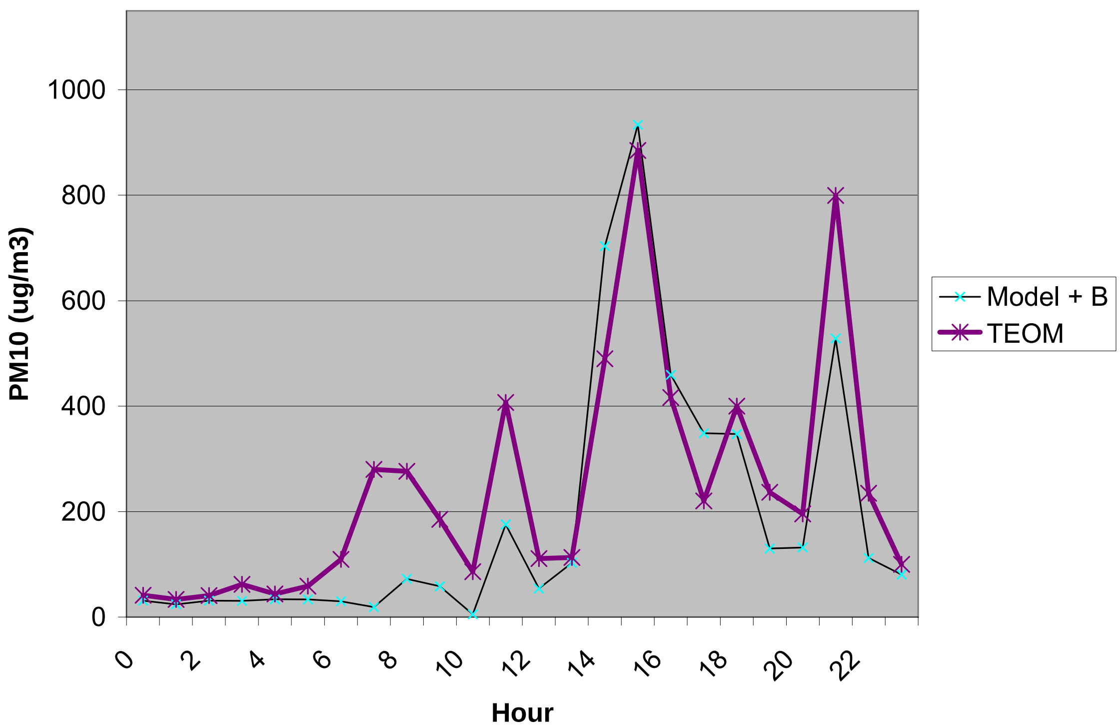


Figure O-3. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- High Wind Day of April 15, 2002 at the Salt River Site

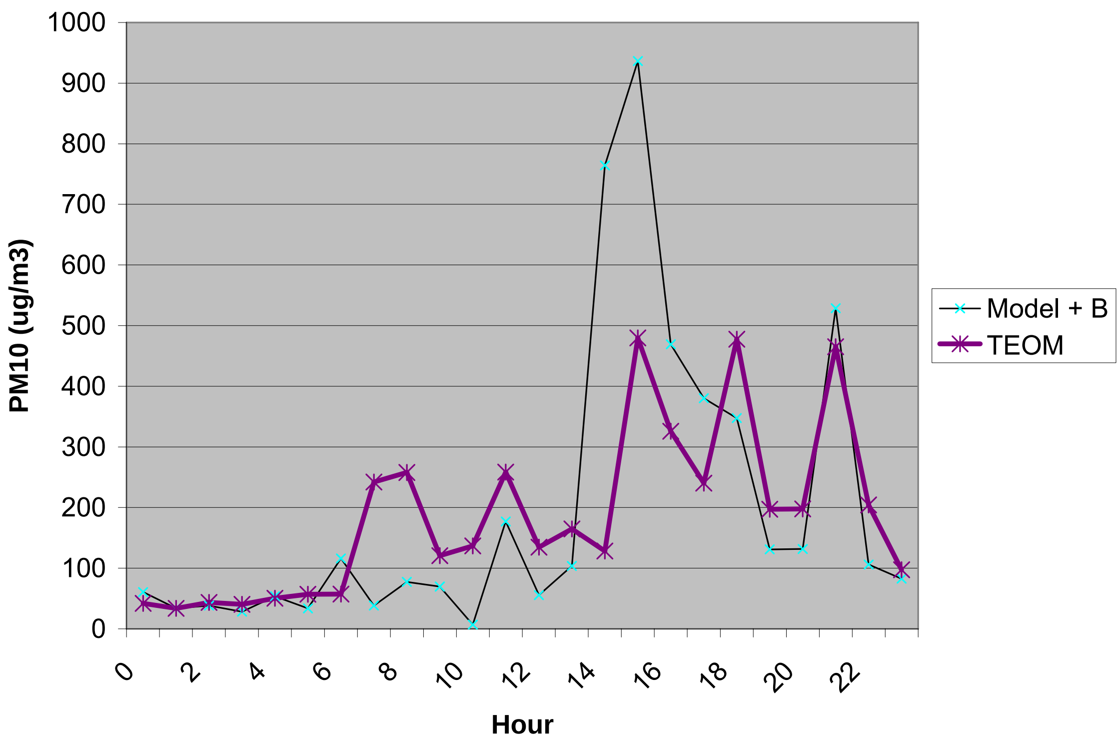


Figure O-4. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- High Wind Day of April 15, 2002 at Durango

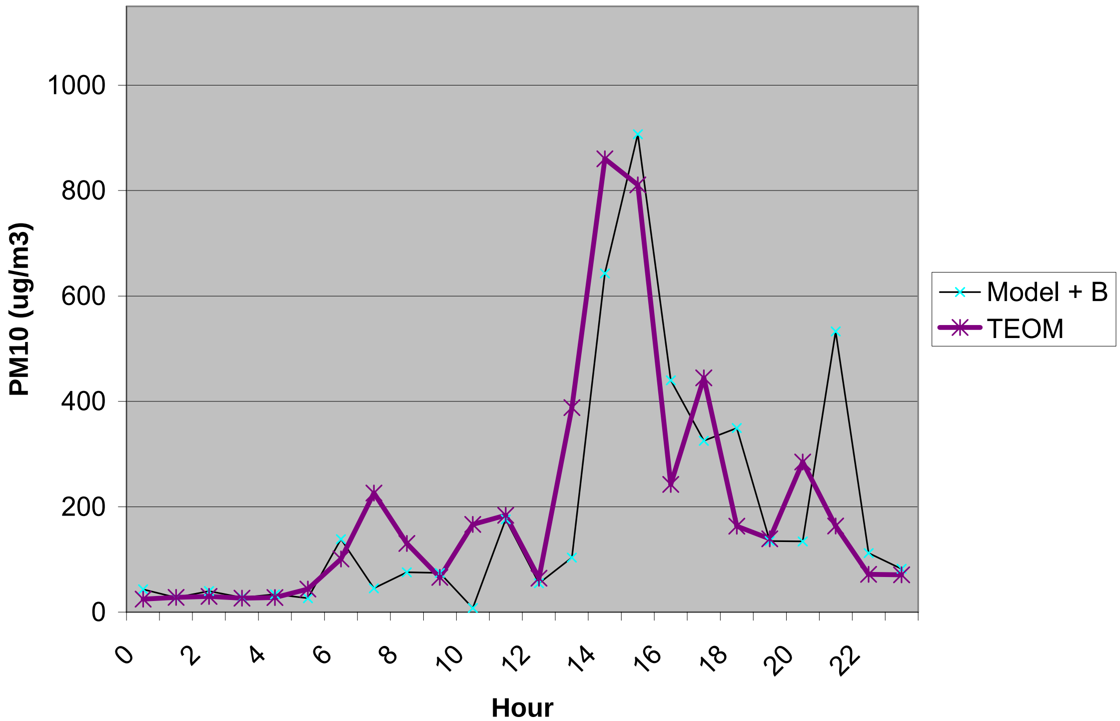


Figure O-5. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Low Wind Day of December 16, 2002 at South Phoenix

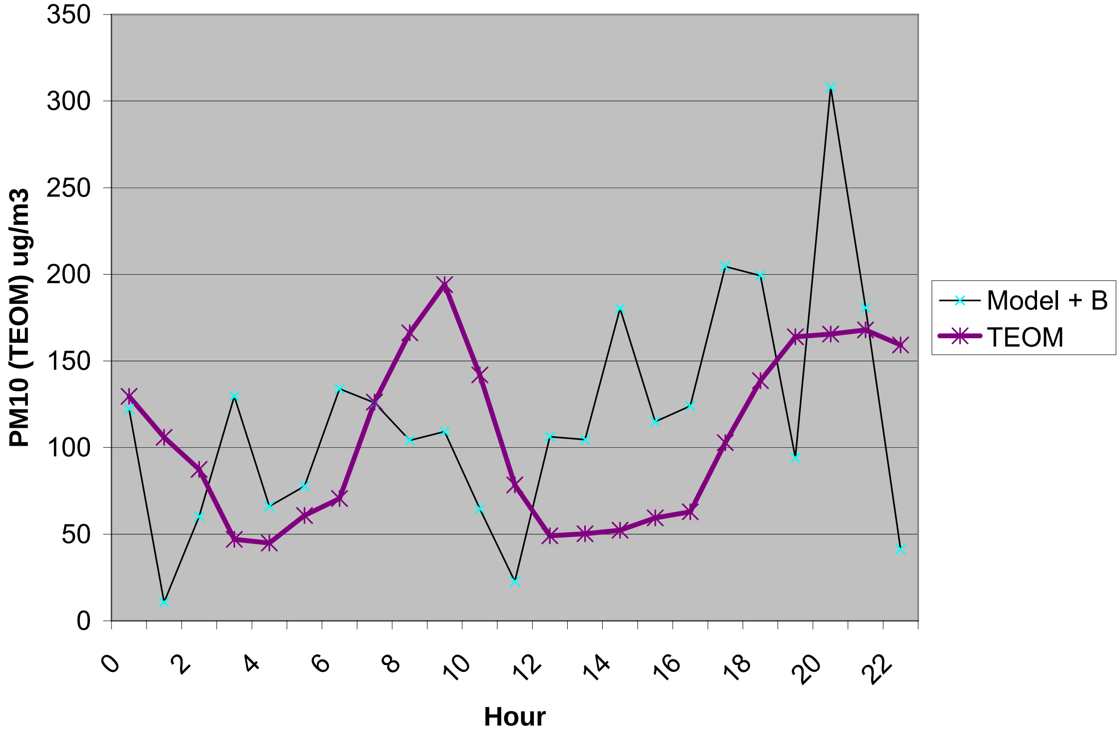


Figure O-6. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Low Wind Day of December 16, 2002 at West 43rd Avenue

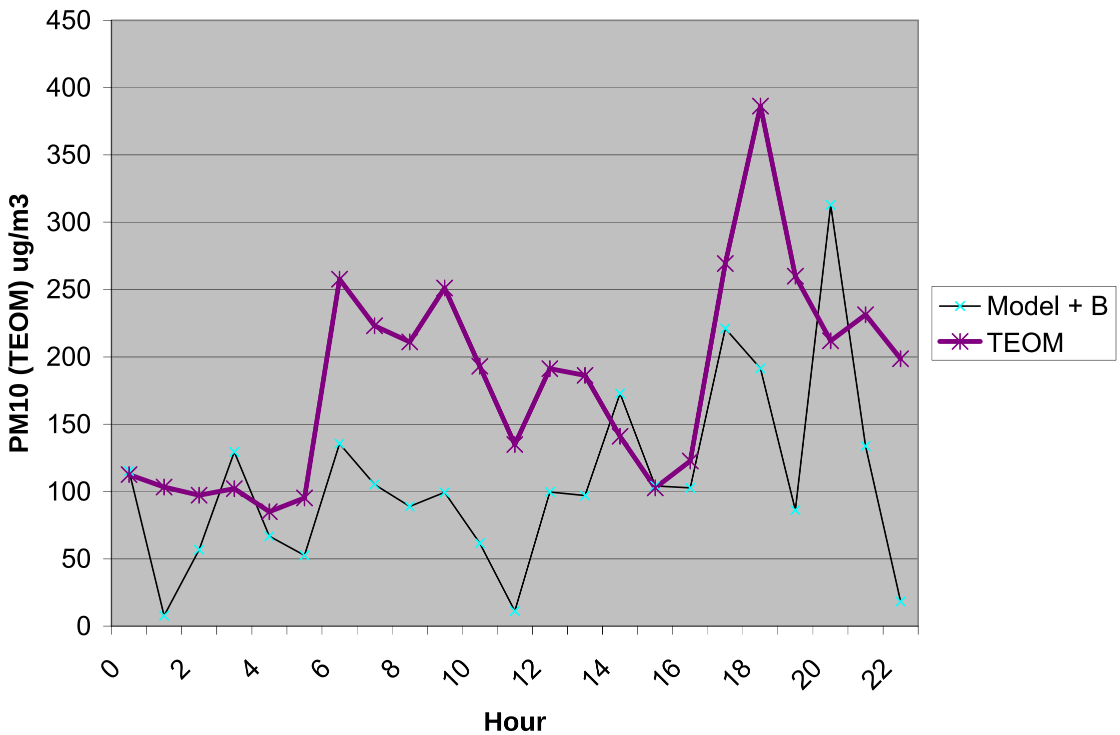


Figure O-7. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Low Wind Day of December 16, 2002 at the Salt River Site

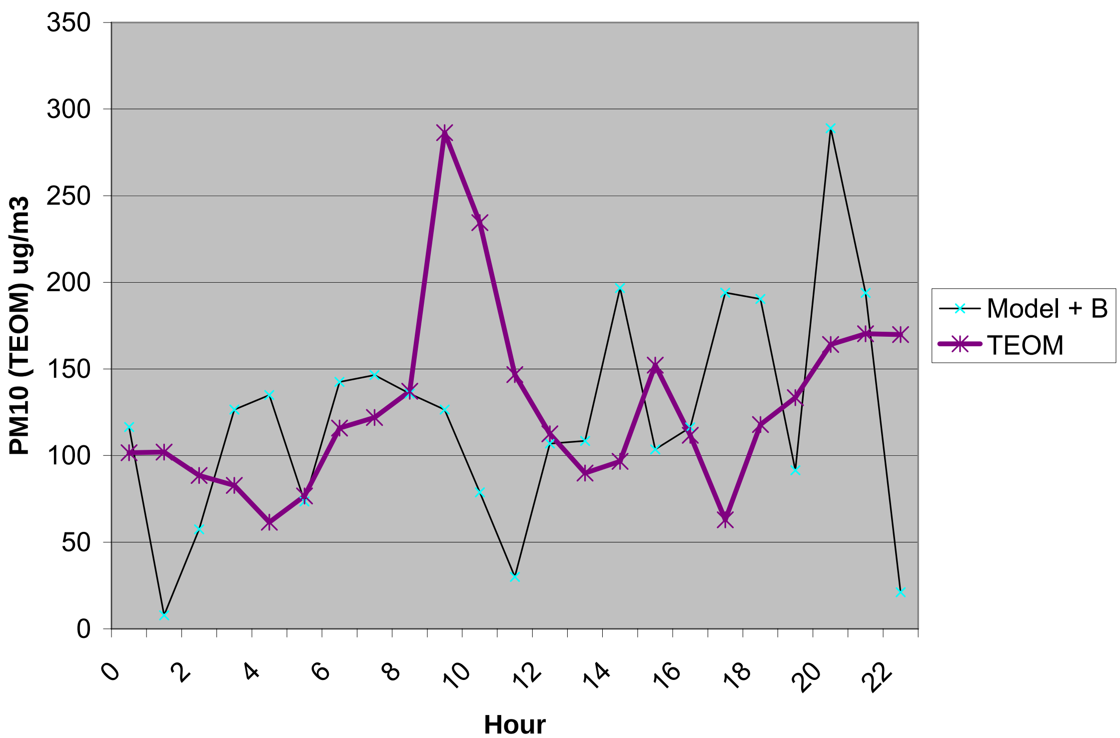
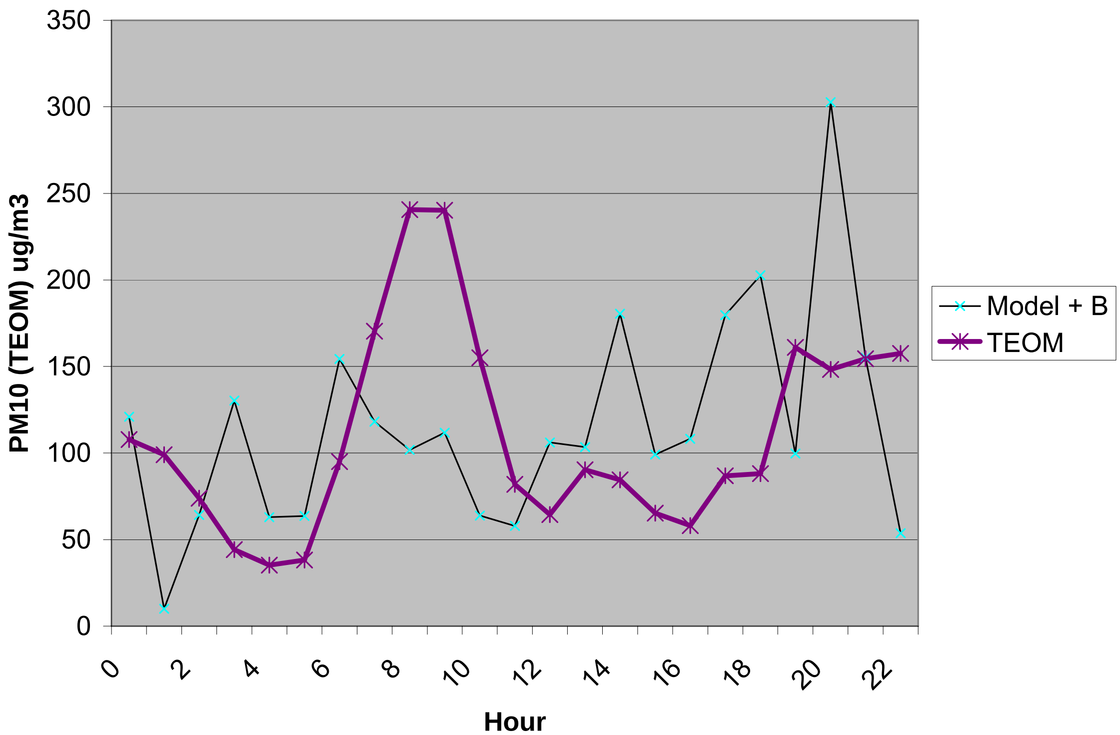


Figure O-8. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Low Wind Day of December 16, 2002 at Durango



Model performance on April 15, 2002, must be viewed in the context of the high winds that occurred in hours 14 – 17. For these four afternoon hours, the average wind speed exceeded 15 miles per hour, the threshold for dust resuspension. In constructing the emissions inventory, only these hours had windblown dust emissions. Although the measurements reflect the dust storm, there are the usual ambiguities. For example, all four sites show an extremely elevated measured peak at hour 14 or 15: 480, 567, 860, and 887 µg/m3. But the peak does not last the entire four hours, as one might think it should. Furthermore, two of the sites, West 43rd Avenue and the Salt River site, have sharp peaks at hour 21 (465 and 800 µg/m3, respectively). The model, consisting of the Industrial Source Complex prediction added to the background concentration, did rather well on this day, simulating most of the peaks at most of the sites. The model failed to reproduce the hour 7-8 peak at the three sites where it occurred, predicted an hour 21 peak at two sites that lacked one, and over predicted the hour 14-15 wind gust peak at two sites. At West 43rd Avenue and Durango, however, the simulation of this afternoon high-wind peak was nearly perfect. What's puzzling is that the shape of the model-predicted peak mimicked the measured peak, instead of being flat for four hours as the equal doses of windblown emissions would suggest.

In contrast to its performance on a gusty April day, the model had trouble getting the shape, the duration, the timing, and the magnitude of the measured variations right on a stagnant December day. Measurements on December 16, 2002, are dominated by a sharp, high morning peak and a lower, late evening plateau, separated by low, constant values in the afternoon. Magnitudes of the morning peaks varied from 194 to 258 µg/m^3, while the evening plateaus ranged from 168 to 231 µg/m^3. In the model simulations, false peaks and valleys appear throughout the time series. The model failed dismally in simulating the morning peaks, under predicting them at each site. For this low-wind day, the model didn't work well.

The next two figures present these data in a different fashion. Here, all sites are combined for each of the two days, with the model + background plotted against the measurement in traditional x-y scatter graphs.

Figure O-9. Model + Background vs. Measured (TEOM): High Wind Day of April 15, 2002: Four Sites, Hourly

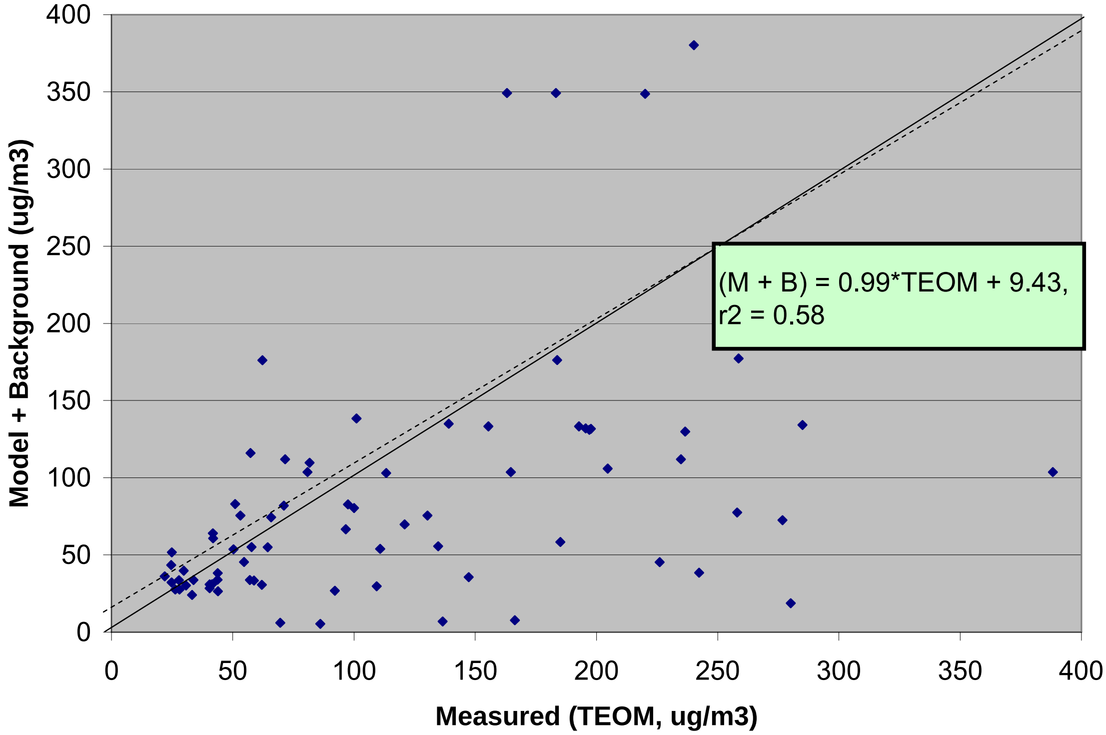
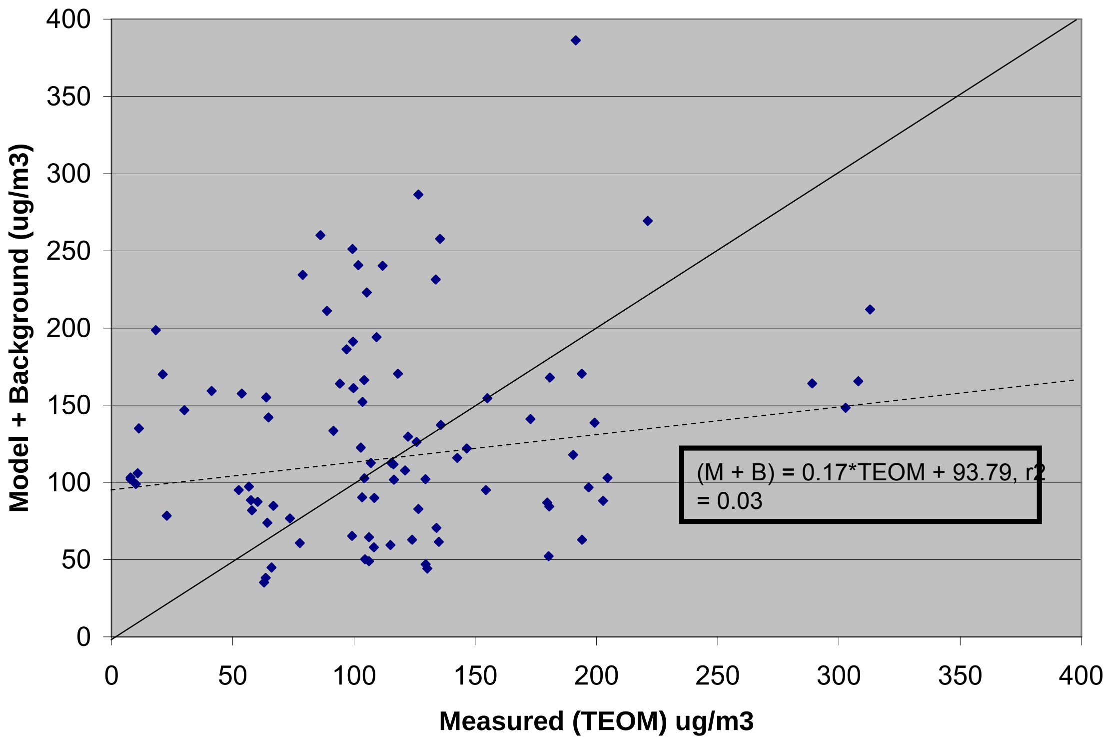


Figure O-10. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Four Sites, December 16, 2002



In these two figures, each point represents a paired model prediction (model + background) and measurement, averaged for one hour. The scatter of the points, diverging in many cases far from the 1:1 line, indicates that the model is not simulating the measurements accurately, especially for the December 16 case.

Another way to present these data is to plot the measurements from their highest to lowest value as a single line, and to plot the paired model prediction as a separate line. The index number of the x-axis is the rank of the hourly TEOM measurement: number 1 is the highest; number 91 (or 94) is the lowest. These two figures are given below.

Figure O-11. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Four Sites, High Wind, April 15, 2002, Ranked by TEOM Reading

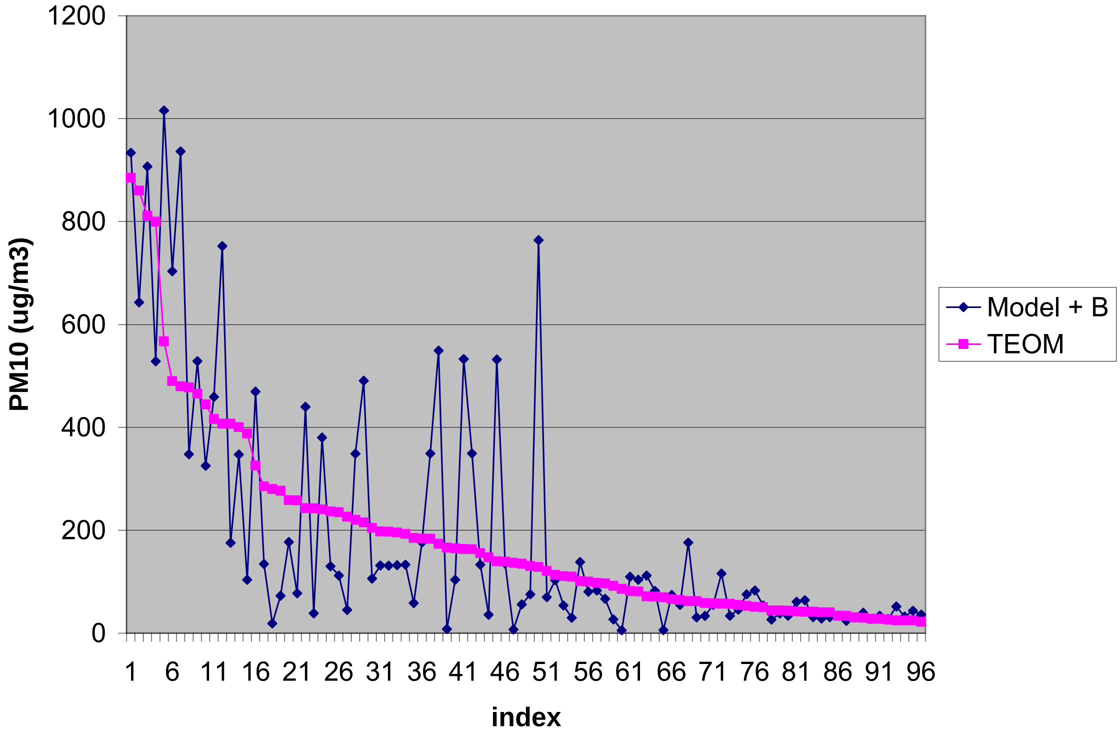
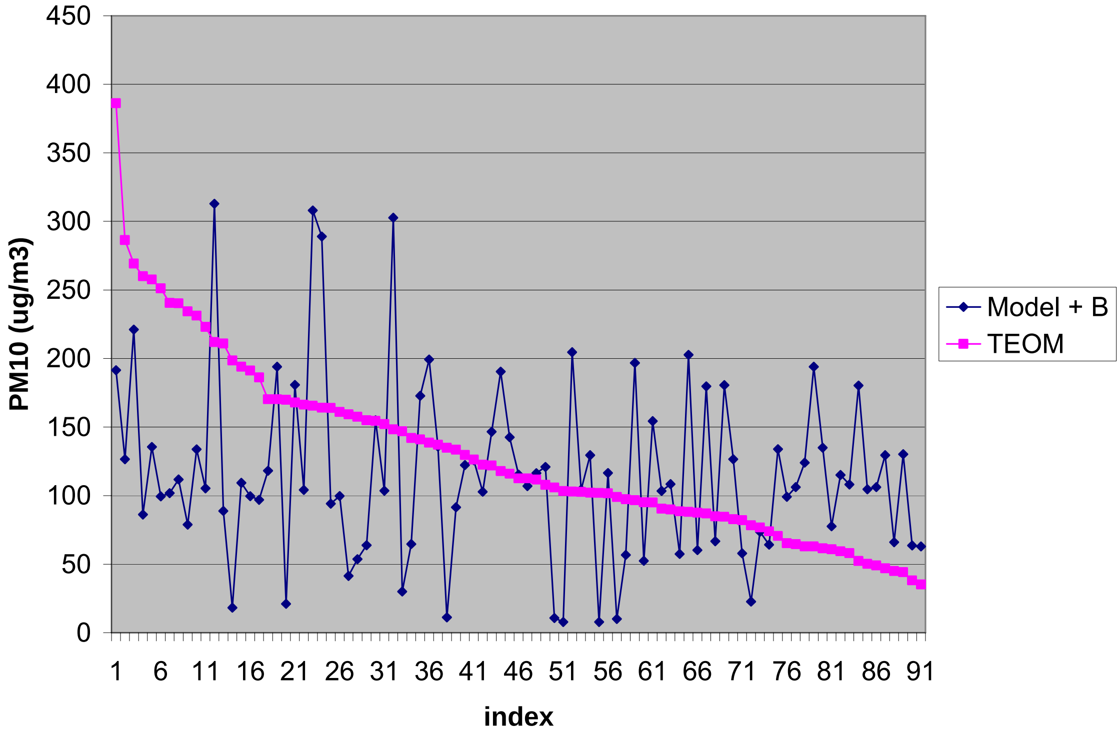


Figure O-12. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Four Sites, Low Wind, December 16, 2002, Ranked by TEOM Reading



These two figures suggest that on April 15, the model is faithfully reproducing the lower range of measured concentrations, but that from the mid-range to the highest concentrations, the model is diverging widely for most of the predictions. On December 16 the model is under predicting all but one of the highest 18 observations. As the concentrations decrease to their lowest value, the model under and over predicts equally until about the 65th value, after which a decided over prediction sets in.

Since the model appears to be more reliable under high-wind conditions than low wind, it's instructive to segregate the hours into high and low wind categories. Even though that leaves only 16 high-wind hours, the two figures below present the data with this division.

Figure O-13. Salt River PM_{10} -- Model + Background vs. Measured (TEOM) -- Four High-Wind Hours of April 15, 2002, All Sites

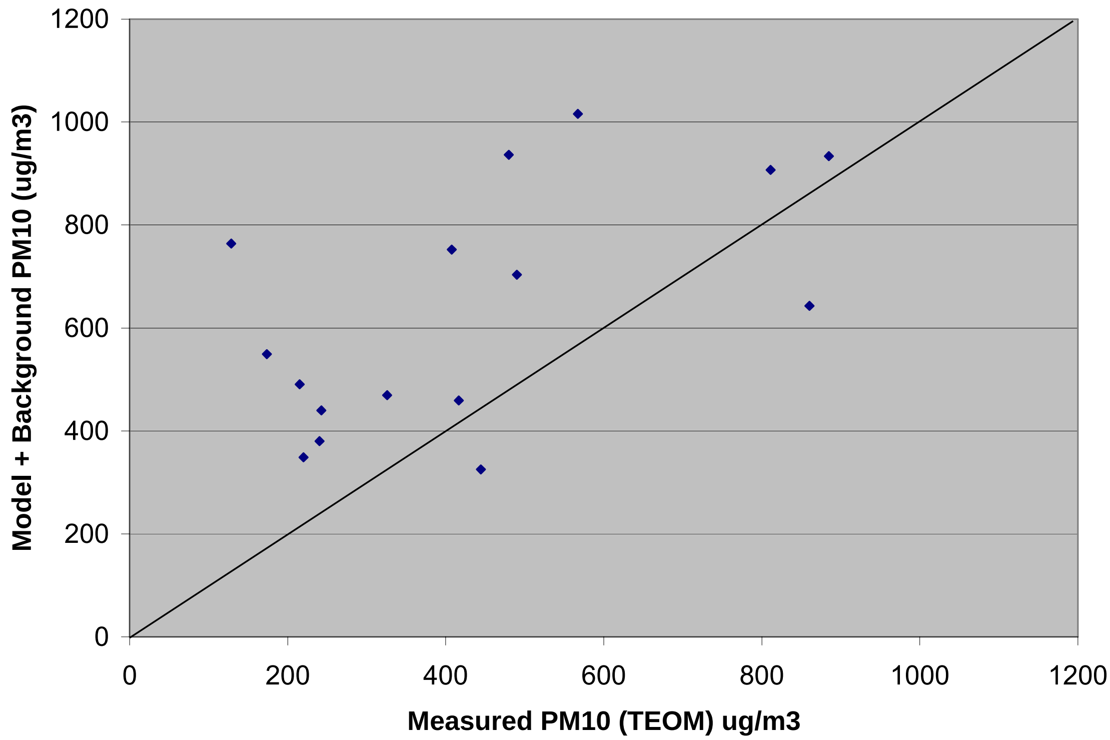
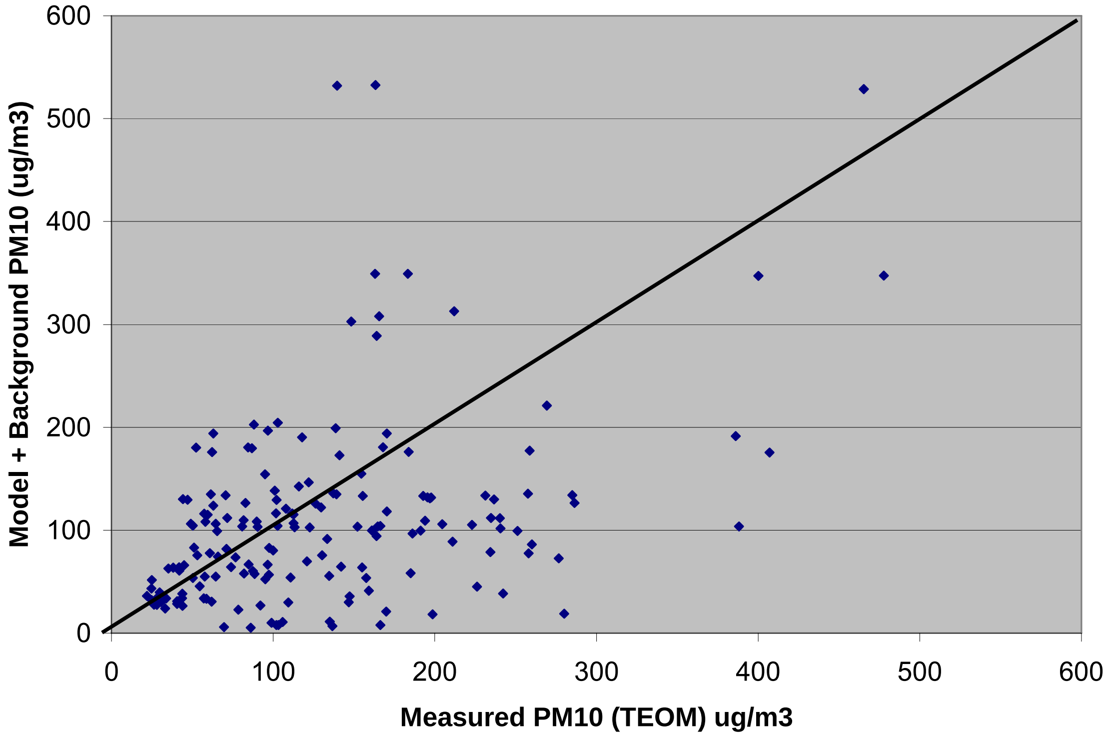


Figure O-14. Salt River PM_{10} – Model + Background vs. Measured (TEOM) – All Low-Wind Hours, All Sites, April 15 and December 16, 2002



The high-wind concentrations are consistently over predicted, while the low-wind predictions show the wide scatter seen on many of the earlier figures.

Table O-1 presents regression statistics for the various graphs. In all of these statistics, the model + background is being regressed against the measurement. Recall that an intercept near zero, a slope near 1.0, and a regression coefficient squared close to 1.0 mean that there's a strong correlation with similar overall distributions.

TABLE O-1 Regression Statistics					
Figure	**Description**	**N**	**R^2**	**Slope**	**Intercept**
	South Phoenix, April 15	24	0.81	1.87	-31.46
	Durango, April 15	24	0.66	0.83	24.57
	Salt River, April 15	24	0.44	1.19	-21.31
	West 43rd Avenue, April 15	24	0.79	0.95	-44.05
	All sites, April 15	96	0.58	0.99	9.43
	South Phoenix, December 16	23	0.04	0.27	88.47
	Durango, December 16	23	0.01	0.11	103.08
	Salt River, December 16	23	0.00	-0.02	124.26
	West 43rd Avenue, December 16	23	0.21	0.41	32.59
	All sites, December 16	92	0.03	0.17	93.79
	All sites, low wind hours, both days	171	0.27	0.49	45.50
	All sites, high wind hours, April 15	16	0.33	0.54	397.13

As the graphs have already indicated, for only three individual cases does the model display much predictive ability: South Phoenix, Durango, and West 43rd Avenue for April 15, 2002. The intercepts for these three cases are actually close to zero, since the scale on the y-axis is 1000 µg/m3. In addition, for Durango and West 43rd Avenue, the slopes are close to 1.0. All sites on April 15, with its regression coefficient of 0.58, slope of 0.99, and low intercept might also be put into the acceptable category of model performance.

To understand exactly why a modeling system doesn't predict any better than this is difficult. This system consists of three parts: an emissions inventory, an air quality model that uses the emissions and measured meteorological variables, and a set of calculated background concentrations. Uncertainties are present in all three components. This discussion cannot cover all three in great detail, but will present some possibilities.

Emissions need to be considered separately for low and high wind hours. For low wind hours, the dominant sources of PM_{10} in the Salt River Area are roads and trackout (70%), construction (14%), and industrial sources (12%). Construction and industrial sources are easy to place accurately in the modeling domain, but are almost impossible to specify the right day and hour. Emission estimates are based on annual or monthly activity levels. On a specific day it is unknown how much activity is taking place at construction or industrial sites. So one quarter of the emissions (26%) has an unknown time element. Roads and trackout have the advantage of excellent temporal accuracy, thanks to traffic counts and generally repeatable traffic patterns. But since roadway PM_{10} emissions are dominated by reentrained dust, and since its driving variable of silt loading is not measured frequently (five measurements during the 2002 study), large uncertainties crop in. Trackout is even more uncertain, as accurate measurements of its length, silt loading, and location are generally not available. Emissions on high-wind days, completely dominated by the high-wind hours, depend on getting the land surfaces right: that is, in the right place and categorized into an accurate depiction of soil surfaces of different erodible potential. This part of the inventory is generally done quite well; although, as the post-February 2004 reexamination of alluvial soils demonstrated, there's always room for improvement. The tricky part in estimating windblown emissions comes from finding the right emission factor, that itself is coupled to the right threshold wind speed to resuspend dust. In this arena, the empirical data are sparse (there are some) and the variation of land surface within a category is substantial. The net result is an estimate with a high degree of uncertainty.

The air quality model (Industrial Source Complex) has been tested many times in its 30 years of use with voluminous field measurements. The problem with these tests is that this field work concentrated on tall stack emissions of mostly gaseous pollutants. In the Salt River Area virtually all the emissions are surface emissions of the fugitive particulate type, whose mass is two thirds in the coarse particle size (2.5 to 10 microns). The model was used nearly exclusively in the "area" sense. This means that all emissions except for registered stacks and the 36 largest industrial process areas were homogenously distributed throughout each modeling grid (400x400 meters). This model's performance under these conditions has really gone unchecked, except for studies such as this one. Another aspect of unknown model performance concerns high-wind emissions of mostly coarse particles. Although equipped with a deposition algorithm, this was not used because it has been shown to make little difference, increases the computational time by a factor of ten, and has never received EPA sanction. The over prediction of the high-wind concentrations, as shown in Figure O-13 , could very well be due to the model's treatment of these mostly coarse particles as a gas.

The last part of the system is background. On average the background concentrations are about four times the ISC model predictions. The model is contributing only 20% of the total prediction. This varies by hour and site, of course, but, on average, 20% is model and 80% is background. This suggests that given the degree of under and over predictions, the background uncertainty is going to swamp the model's. As described in the TSD, the background values are based on two sets of paired measurements: TEOM PM_{10} at West 43rd Ave and at a site two miles west of the western boundary; and, separately, in different months, at West 43rd and at a site one mile east of the eastern boundary of the modeling domain. Relationships were calculated between the east and west boundary sites and West 43rd Avenue. Done on an hourly basis, those hours when the wind was blowing out of the Salt River Study Area towards the boundary monitors were discarded. Since the wind comes from all directions, South and North boundary concentrations had to be estimated and expressed as a fraction of the east and west values. This was done, based on TEOM data for

Supersite and Durango for the North boundary, and on emission inventory considerations for the South boundary.

Finally, for each hour of each design day a background concentration based primarily on the hourly TEOM concentration at West 43rd Avenue was calculated. With this concentration as an anchor, a north, south, east, or west boundary fraction consistent with the wind direction was applied. For example a northwest wind was given both a north and west boundary value. Averaging these provided the "background" concentration. This calculated value was applied uniformly throughout the modeling domain. An example is given in Table O-2.

TABLE O-2
Background Concentrations for April 15, 2002

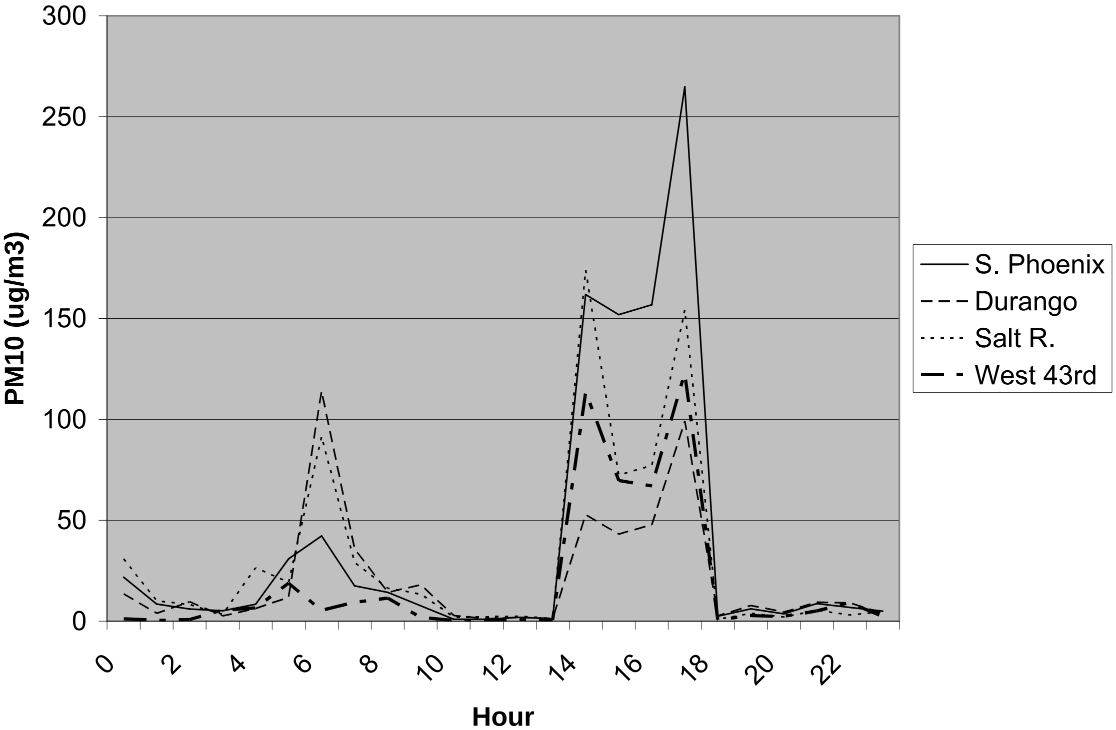
Hour	PM_{10}-WF	Wind Direction		Boundary Concentrations				Avg
		Degrees	Dir	NB	EB	WB	SB	
0:00	41.5	295	NW	18.0		41.8		29.9
1:00	33.2	298	NW	14.5		32.8		23.6
2:00	40.5	283	W			30.1		30.1
3:00	62.0	20	N	25.1				25.1
4:00	43.7	36	NE	14.5	40.1			27.3
5:00	58.7	15	N	14.6				14.6
6:00	109.4	148	SE		45.7		3.1	24.4
7:00	280.1	178	S				9.4	9.4
8:00	276.7	230	SW			109.9	12.5	61.2
9:00	185.1	139	SE		104.0		8.8	56.4
10:00	86.1	179	S				5.0	5.0
11:00	407.0	207	SW			328.3	21.9	175.1
12:00	110.8	228	SW			97.6	8.7	53.2
13:00	113.3	250	W			102.4		102.4
14:00	490.0	258	W			590.1		590.1
15:00	884.9	254	W			864.0		864.0
16:00	416.5	250	W			392.3		392.3
17:00	220.1	255	W			226.0		226.0
18:00	400.2	249	W			346.6		346.6
19:00	236.6	258	W			127.1		127.1
20:00	195.5	265	W			129.7		129.7
21:00	799.7	261	W			523.3		523.3
22:00	234.8	224	SW			191.3	14.4	102.9
23:00	100.0	238	SW			133.3	5.6	69.5

What's important to note here is that each direction boundary concentration, NB, EB, WB, and SB, is the result of applying a direction-specific fraction to the measured PM_{10} concentration on the far left. Each hour has its own set of boundary concentration fractions.

Although this method would appear empirically sound, with ample measurements to form the basis of the hour-and-direction specific fractions, something isn't working right. Implicit in this method is the assumption that the monitored concentrations at West 43rd Avenue are generally representative of the entire domain, or, at least those portions of the domain with the other three monitors. The other built-in assumption is that the PM_{10} concentrations monitored at the east and west boundary sites were representative of the PM_{10} concentrations prevailing in these areas outside the modeling domain. Neither site had evidence of strong localized PM_{10} emissions. Nonetheless, this method could be improved upon, most likely by using wind direction averages of five or 15 minutes, instead of hourly, and by using the boundary layer winds as measured by Sodar.

As a final aspect of model performance, it's worth taking a look at how the ISC model did in tracking the temporal variation of the measured concentrations at the four monitors. This last series of graphs, three for each day, consists of the ISC-predicted concentrations at each site, of the same concentrations with the background added, and of the model predictions and measurements averaged for the four sites along with the background.

Figure O-15. Salt River PM_{10} – ISC Model-Predicted Concentrations (No Background) – April 15, 2002



Recall that the high-wind hours are 14 – 17. The shape of the four peaks is nearly identical, but why South Phoenix should be so much higher than the other three is an open question. Note that the model has failed to find a morning peak at West 43rd Avenue.

Figure O-16. Salt River PM_{10} – ISC Model Predictions and Background for April 15, 2002

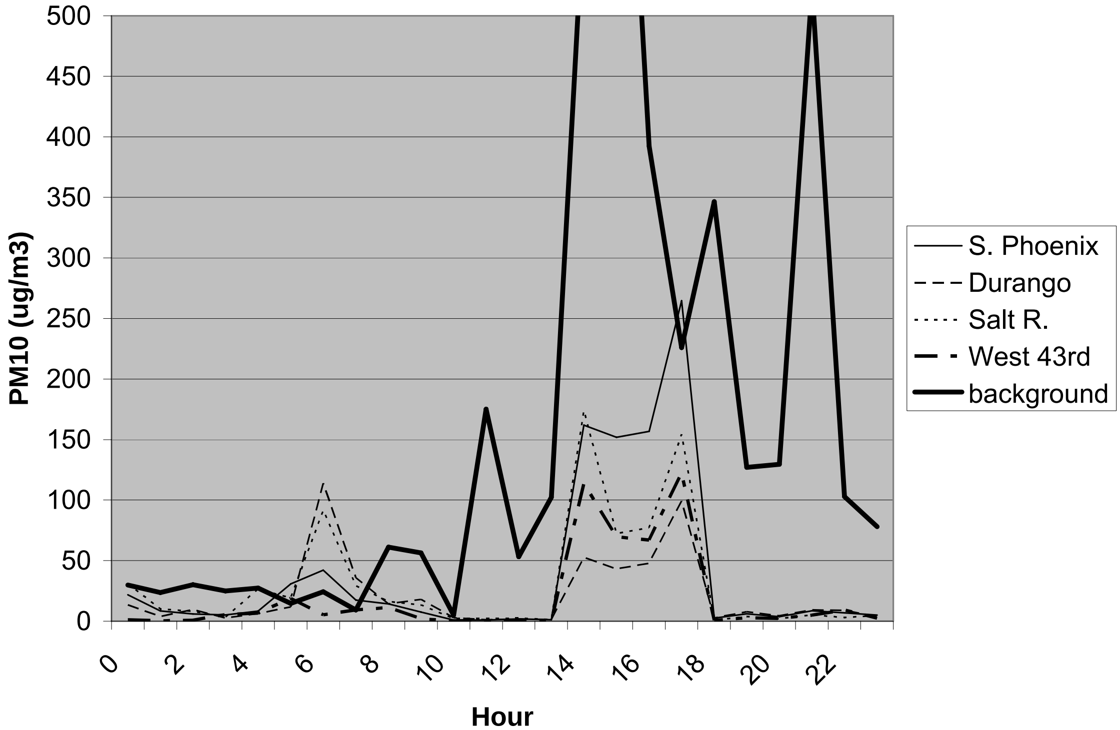
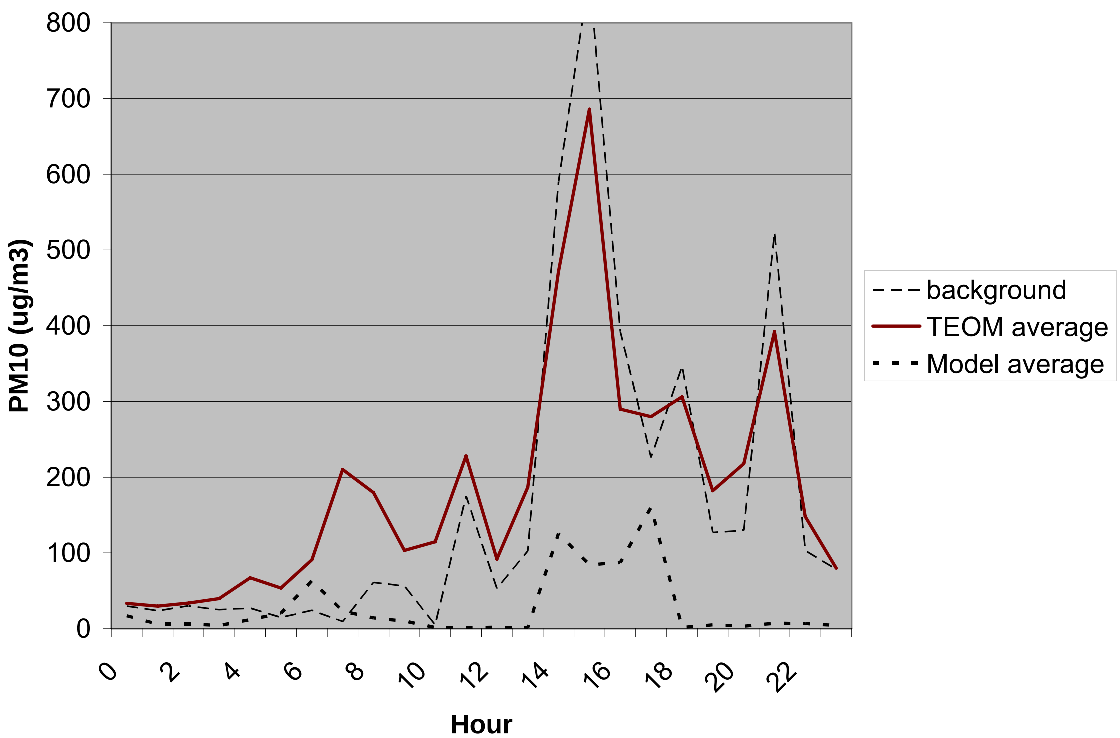


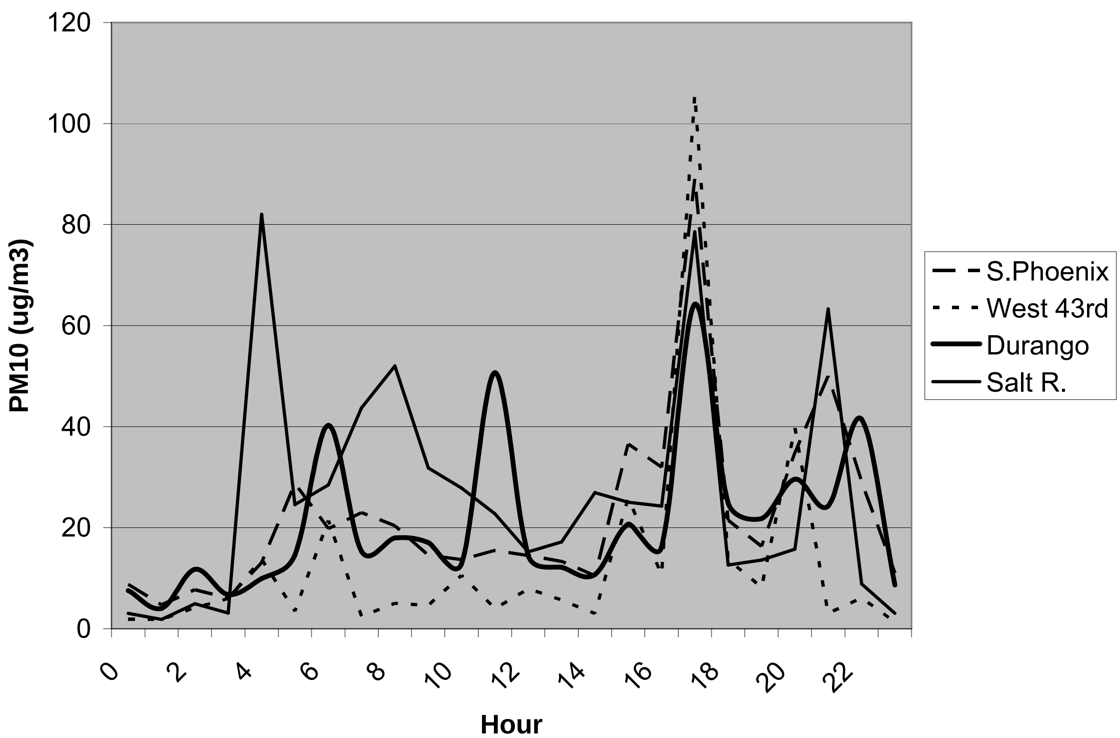
Figure O-17. Salt River PM_{10} -- ISC Model Predicted Average, Measured Average, and Background -- April 15, 2002



In Figure O-17 the background value at hour 15 is 864 µg/m3, with the scale lowered to improve the clarity of the modeling results. What the background trace shows is a pattern coincident with the modeling prediction for the high wind hours, but which is radically different for many of the low wind hours. In Figure O-17 the background trace mirrors the four-site TEOM average quite well, as it ought to, since it's based on the West 43rd Avenue measurements. At this scale the average modeling concentrations are at or near zero for all but the four high-wind hours.

In the next three figures, similar concentrations are shown for December 16, 2002. Unlike April 15, these figures show considerable unexplained patterns. First shown are the ISC model predictions (Figure O-18).

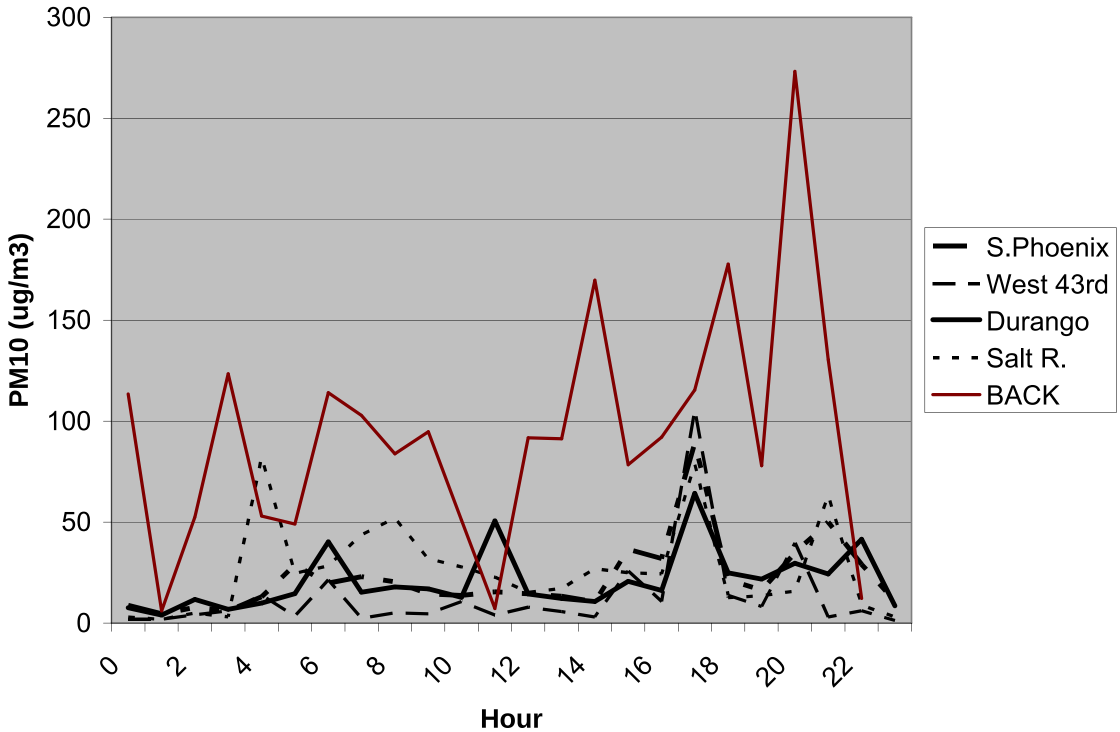
Figure O-18. Salt River PM_{10} -- ISC Model-Predicted Concentrations (No Background) December 16, 2002



Predictions at the four sites coincide for most low and most peaking hours, the exceptions being Salt River at hours 4 and 8, and Durango at hour 11. The coincidence of the four peaks at hour 17 is remarkable.

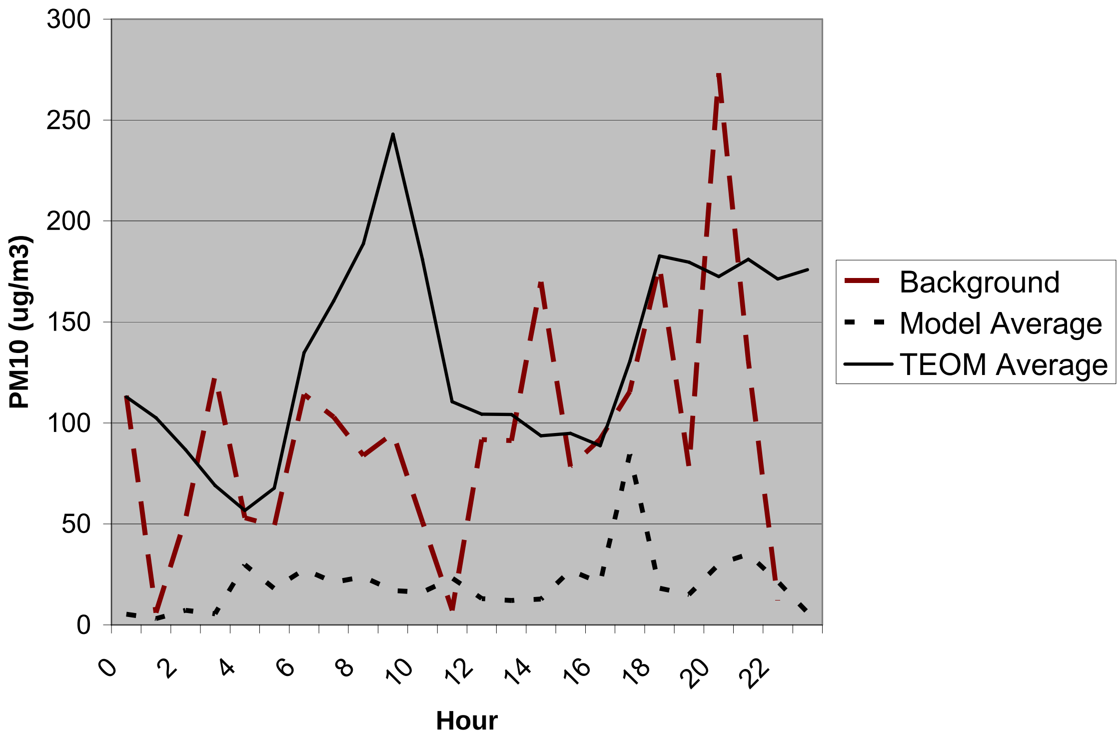
Adding the background line to the graph (Figure O-19) demonstrates that the background concentrations do not vary in sync with the modeled concentrations (and, for the most part, they shouldn't).

Figure O-19. Salt River PM_{10} -- ISC Model Predictions and Background -- December 16, 2002



In the last figure the model predictions and measurements are averaged for the four sites, with the background included.

Figure O-20. Salt River PM_{10} -- ISC Model Predicted Average of Four Sites, Measured Average, and Background – December 16, 2002



This figure shows that the model is mostly unresponsive to the emissions, except for hour 17. The shape of its trace bears no resemblance to the measurement line. The zigzag presence of the background is inconsistent with the more gradual changes expected in this kind of regional concentration. All in all, this graph points out weaknesses in both the modeling and the background calculations.

APPENDIX P – MAPPING WEIGHTED TRACKOUT EMISSIONS INTO PREDICTED CONCENTRATIONS

Appendix K explained how the six categories of trackout emissions were weighted to account for their relative length and severity. In the Industrial Source Complex modeling, however, time constraints made it impossible to rebuild the trackout inventories and to perform the modeling again. Instead, the base-case, unweighted trackout emissions were used to produce predicted trackout concentrations. These concentrations were in turn modified to reflect the weighting results of Appendix K. How this was done is the subject of this appendix.

First, the final table from Appendix K is presented below, which shows the relative weightings of the six trackout categories.

TABLE P-1
Trackout from Six Source Categories Weighted by Length and Severity

Category	Relative Emission Rate
Industrial	1.00
Construction	0.66
Agricultural	0.36
Unpaved shoulders	0.14
Commercial	0.12
Private	0.09

Second, the predicted concentrations from ISC for the various trackout categories for the eight exceedances are taken from the model (Table P-2). These predictions are

TABLE P-2
Industrial Source Complex Predicted Concentrations of PM_{10} from Six Types of Trackout for the Eight Exceedances in 2002 in the Salt River Study Area (µg/m3)

		Agricultural	Construction	Industrial	Private	Commercial	Unpaved	Total
8-Jan	SALT RIVER	0.130	0.061	0.831	0.002	0.067	0.303	1.394
15-Apr	DURANGO	0.372	0.176	0.238	0.000	0.131	0.334	1.251
	SALT RIVER	0.104	0.046	0.192	0.000	0.035	0.127	0.504
	WEST 43	0.014	0.029	0.280	0.000	0.052	0.106	0.480
26-Apr	DURANGO	0.217	0.187	0.229	0.001	0.168	0.376	1.178
	SALT RIVER	0.077	0.104	0.263	0.002	0.122	0.228	0.796
	WEST 43rd	0.012	0.017	0.218	0.000	0.021	0.148	0.417
16-Dec	WEST 43rd	0.086	0.113	1.401	0.001	0.262	0.533	2.396

Third, these concentrations are multiplied by the weighting factors, given in Table P-1 and shown below as the first numeric row in Table P-3.

TABLE P-3
Industrial Source Complex Predicted Concentrations of PM_{10} from Six Types of Trackout for the Eight Exceedances in 2002 in the Salt River Study Area – Weighted by Length and Severity (µg/m3)

		Agricultural	Construction	Industrial	Private	Commercial	Unpaved	Total
Weighting Factor/Site		**0.36**	**0.66**	**1.00**	**0.09**	**0.12**	**0.14**	
8-Jan	SALT RIVER	0.047	0.040	0.831	0.000	0.008	0.042	0.968
15-Apr	DURANGO	0.134	0.116	0.238	0.000	0.016	0.047	0.551
	SALT RIVER	0.037	0.030	0.192	0.000	0.004	0.018	0.281
	WEST 43rd	0.005	0.019	0.280	0.000	0.006	0.015	0.325
26-Apr	DURANGO	0.078	0.123	0.229	0.000	0.020	0.053	0.504
	SALT RIVER	0.028	0.069	0.263	0.000	0.015	0.032	0.406
	WEST 43rd	0.004	0.011	0.218	0.000	0.003	0.021	0.257
16-Dec	WEST 43rd	0.031	0.074	1.401	0.000	0.031	0.075	1.613

These weighted and unweighted concentrations are portrayed in the subsequent figures.

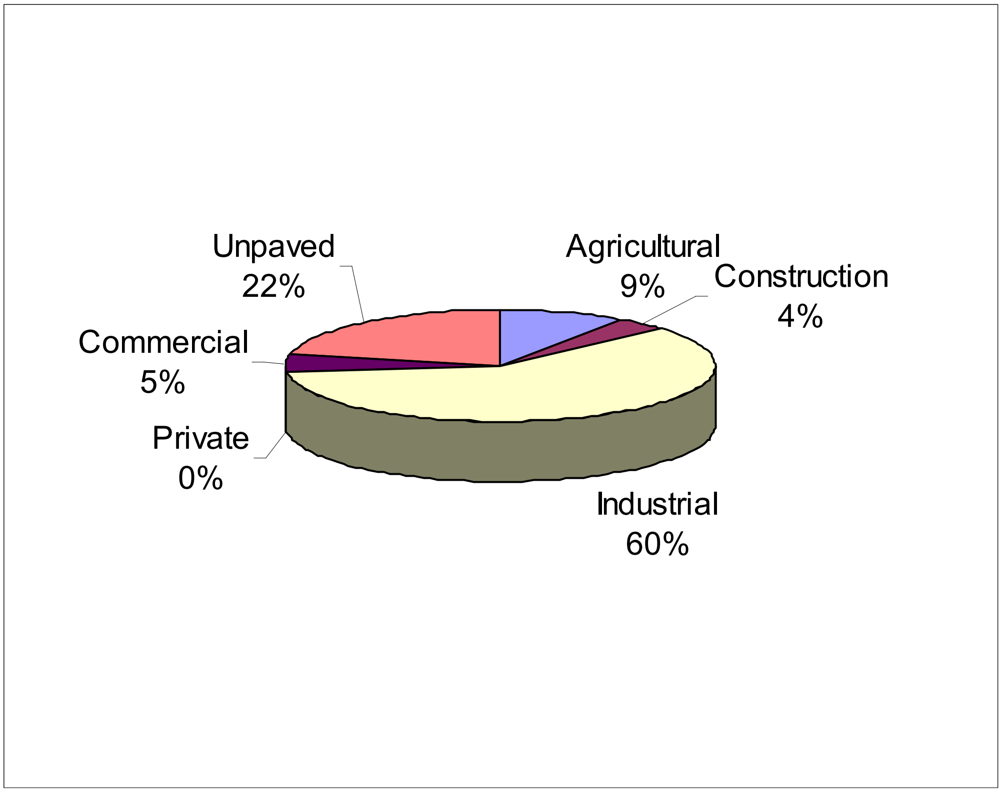


Figure P-1. Unweighted Relative Trackout Contributions to PM_{10} at the Salt River Site on January 8, 2002

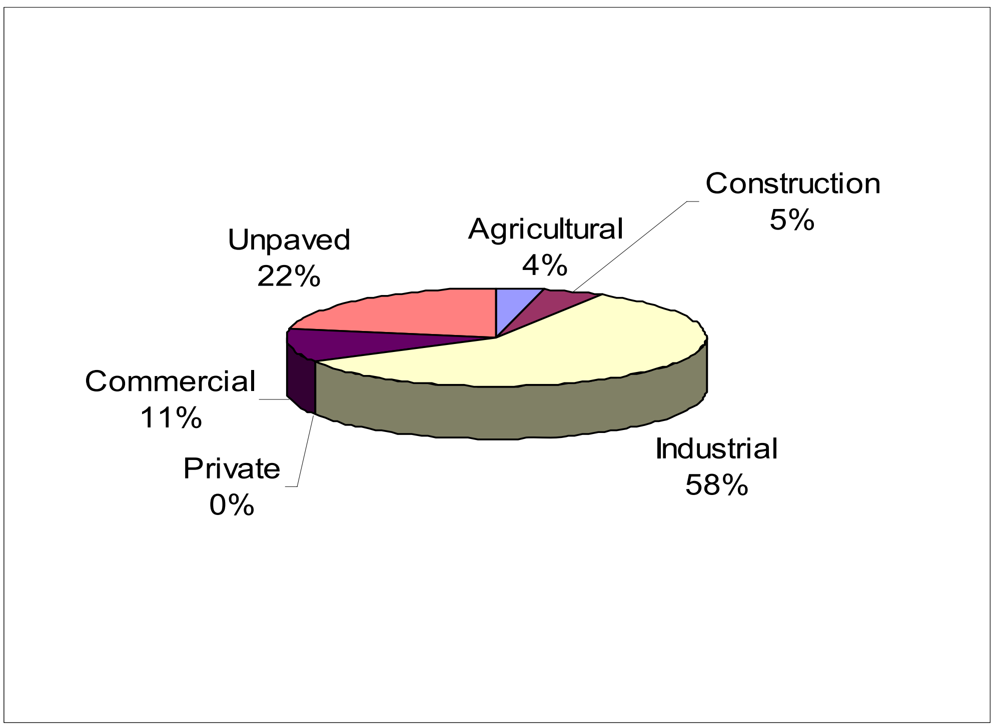


Figure P-2. Weighted Relative Trackout Contributions to PM_{10} at the Salt River Site on January 8, 2002

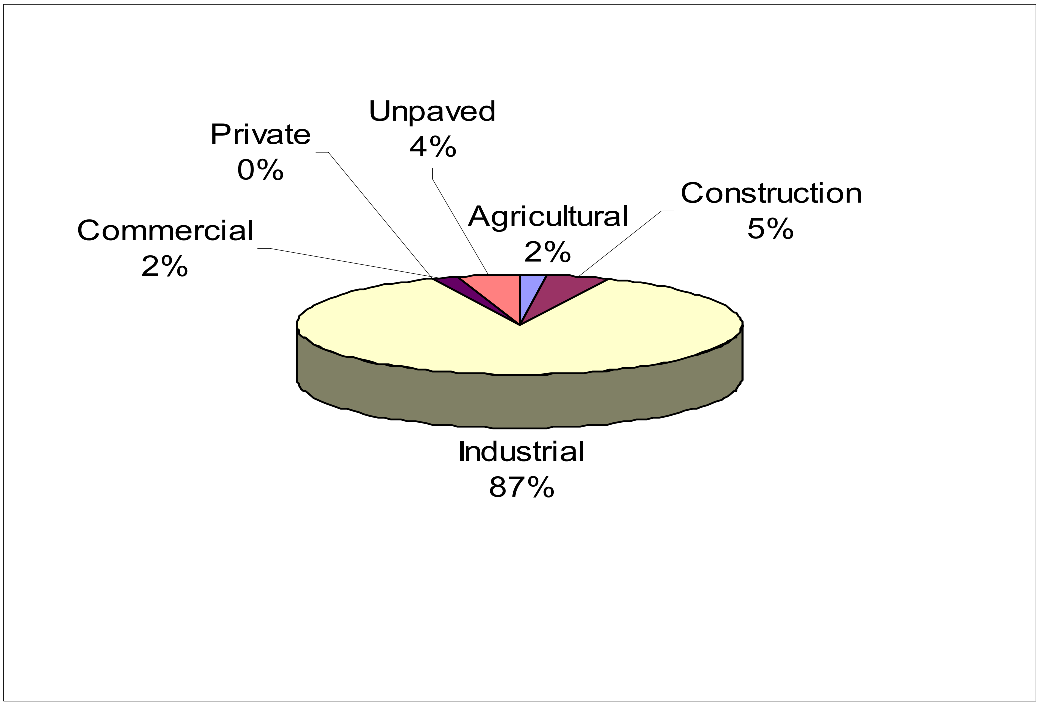


Figure P-3. Unweighted Relative Trackout Contributions to PM_{10} at West 43rd Avenue on December 16, 2002

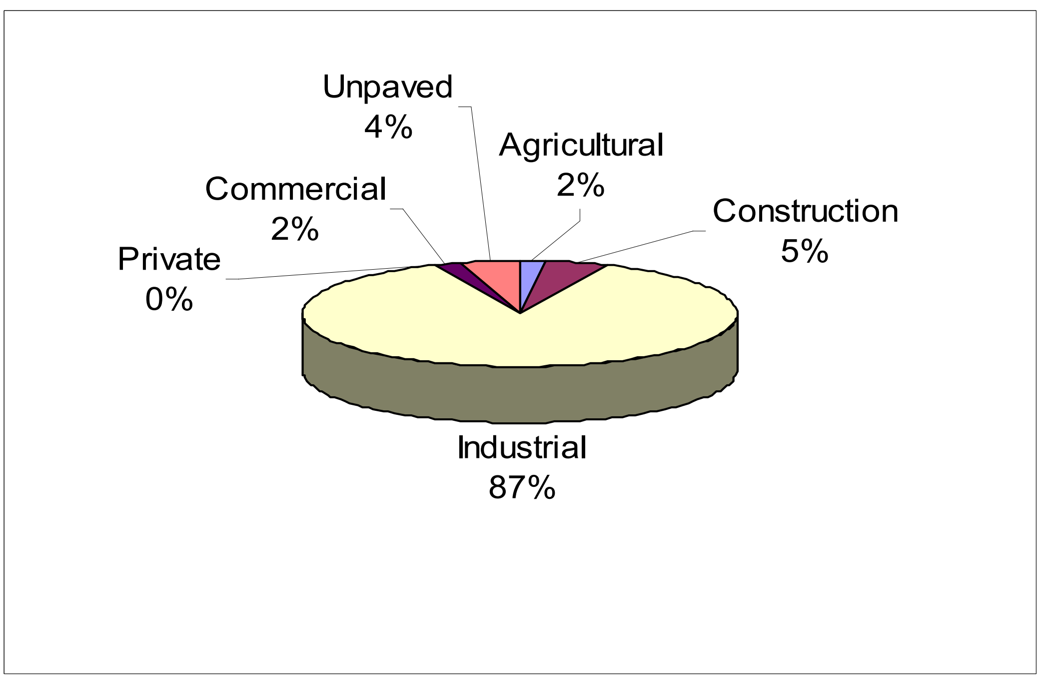


Figure P-4. Weighted Relative Trackout Contributions to PM_{10} at West 43rd Avenue on December 16, 2002

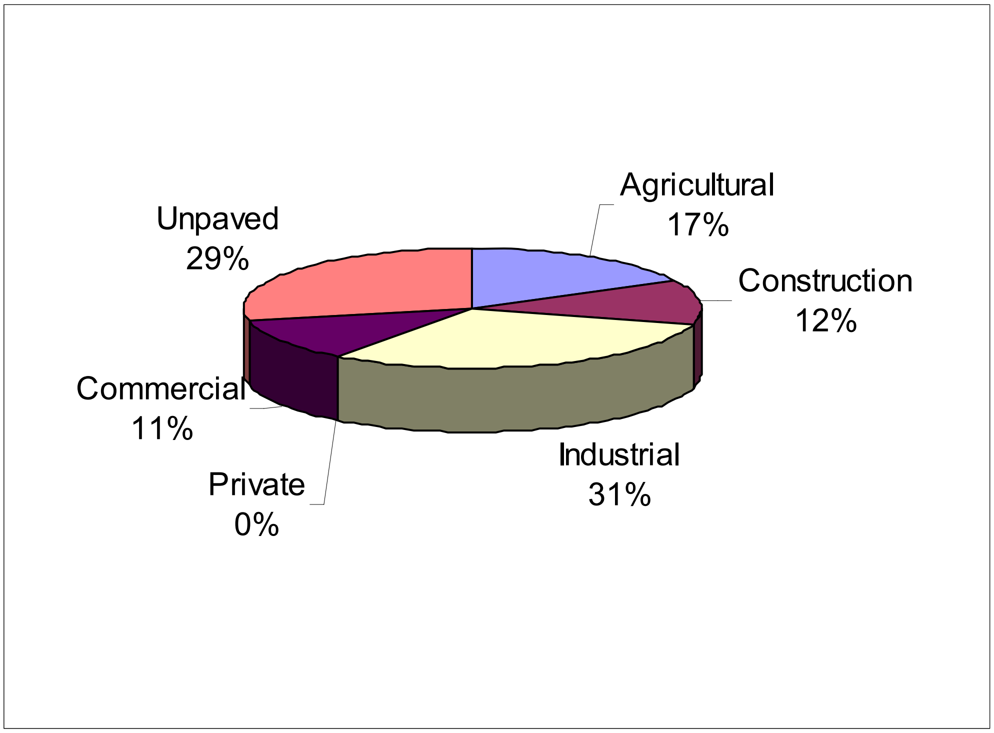


Figure P-5. Unweighted Relative Trackout Contributions to PM_{10} for Six High-Wind Exceedances

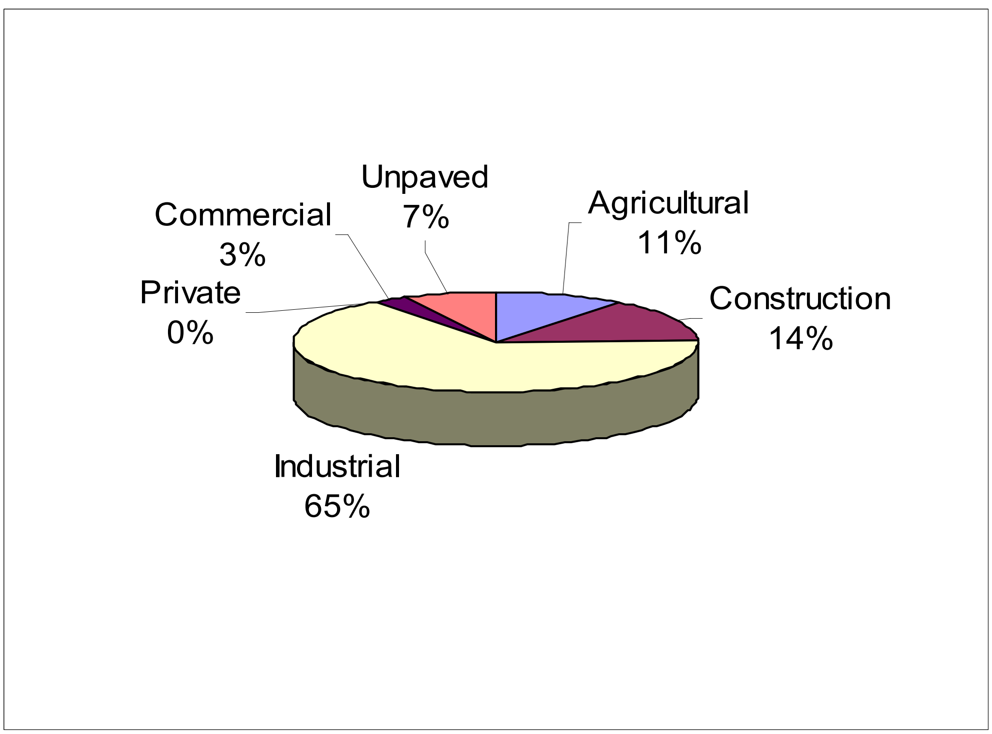


Figure P-6. Weighted Relative Trackout Contributions to PM_{10} for Six High-Wind Exceedances

In interpreting these figures, the concept of an emission contribution to a predicted concentration must be kept in mind. The prediction is for one of four monitoring sites and depends on both the wind direction and the location of the trackout emissions with respect to both the wind and the monitoring site. The three pairs of pie charts have the unweighted contributions as the top figure and the weighted contributions below. The first pair, for the low-wind day of January 8, 2002, at the Salt River site (exceedance of 174 µg/m3), shows that the largest change is for unpaved shoulder emissions. This contribution is reduced to 4% from 22%, a five-fold decrease. Industrial shows a marked increase from 60% to 86%.

A second low-wind exceedance, that of West 43rd Avenue on December 16, 2002 (exceedance of 181 µg/m3), is shown in Figures P-3 and P-4. The changes at this site from the weighted trackout emissions are nearly identical to those of the Salt River site in January.

Trackout emissions and virtually all other “process”, as opposed to wind blown emissions, don’t make a large impact on high-wind days. It’s instructive to see whether the weighting produces compositional changes in the category contributions that are comparable to the low-wind days. The set of unweighted and weighted trackout emission contributions, as shown in Figures P-5 and P-6, reveals that the changes are just as pronounced: industrial trackout doubles and unpaved shoulders go down by a factor of four. Note that these last two figures, as opposed to the first four, are an average of three monitoring sites for the two high-wind April 2002 exceedance days.

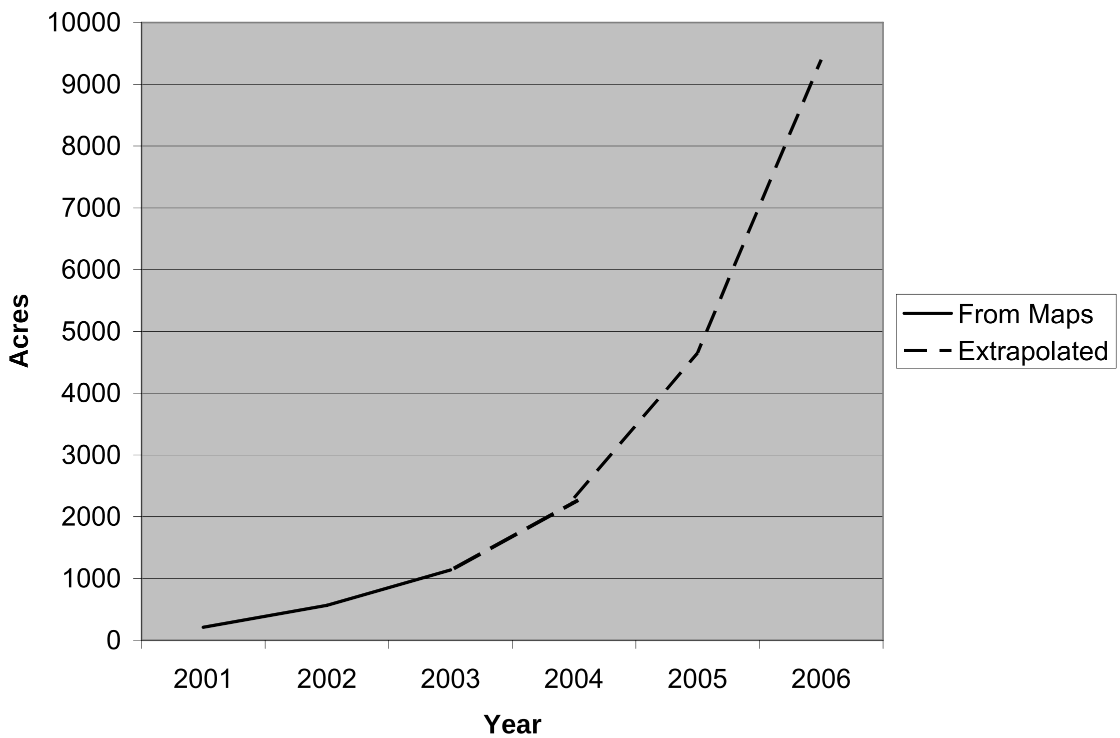
In summary, trackout emissions went through a developmental process in this State Implementation Plan. The first results did not even have trackout as a source category. The second results treated trackout rather simplistically. The third results assigned better locations and source category types (six in all) to trackout. Finally, the weighting method of Appendix K and its application to predicted concentrations of trackout, explained in this Appendix P, bring an added infusion of rigor into a difficult and important emissions problem.

APPENDIX Q - PROJECTED CONSTRUCTION ACTIVITY

The following is a summary of how ADEQ projected construction activity in the Salt River PM_{10} Study Area for the Year 2006.

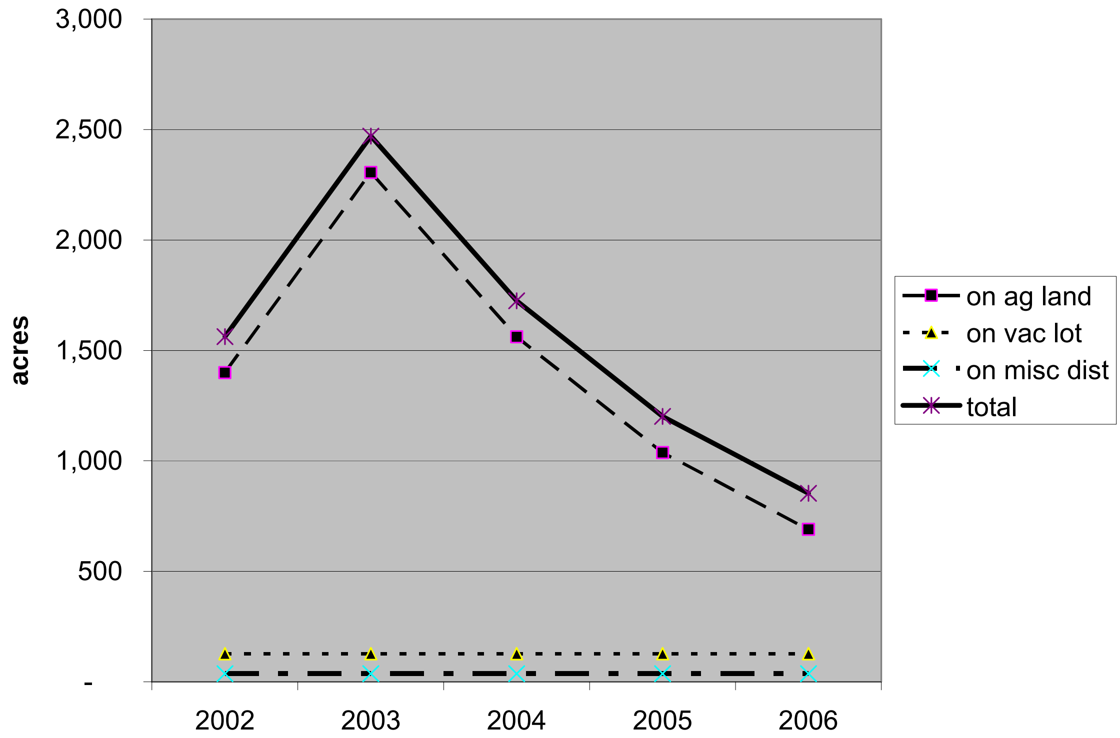
If construction activity were to increase significantly between 2002 and 2006, then the 2006 emission figures for construction activity, windblown construction, and construction trackout should be increased accordingly. To answer this question, land under construction in the Salt River PM_{10} Study Area has been determined for years 2001, 2002, and 2003 by reviewing quarterly and annual aerial photograph books of the Phoenix metropolitan area focusing on the Salt River PM_{10} Study Area. These photographs have, among other land uses, active and planned construction. ADEQ determined the total number of active construction acres in the first quarter of 2001, 2002, and 2003 and projected a trend (Figure Q-1).

Figure Q-1. Salt River PM_{10} Study Area Construction Acreage



Examination of Figure Q-1 would suggest a drastic increase in construction in the four year period. However, the actual change in construction activity from 2002 to 2006 for the Salt River PM_{10} Study Area is quite different. The reason for this difference has to do with what kinds of land are going into construction and what their extent is. Almost all the construction in the Salt River PM_{10} Study Area has and will take place on retired agricultural land. Given the conversion rates of miscellaneous disturbed areas (13.6% in the four years) and vacant lots (39.6% in the four years), and given their respective 2002 acreages, only 15% of new construction in 2002 – 2006 could take place on these lands. The other 85% will occur on agricultural land. As there is only a finite amount of agricultural land in the Salt River PM_{10} Study Area, and as the four-year retirement rate is 80%, the actual change in land being affected by construction activity is more accurately shown in Figure Q-2.

Figure Q-2. Salt River Area Construction by Land Type



Examination of Figure Q-2 shows that conversion of vacant lots and miscellaneous disturbed areas contributes a small, but constant amount, to construction acreage. In contrast, the construction on agricultural land increases in the first year and decreases thereafter. This decrease comes about from the dwindling supply of agricultural land available in the Salt River PM_{10} Study Area as shown in Figure Q-3.

Figure Q-3. Available Agricultural Land in the Salt River Study Area and Construction Acreage

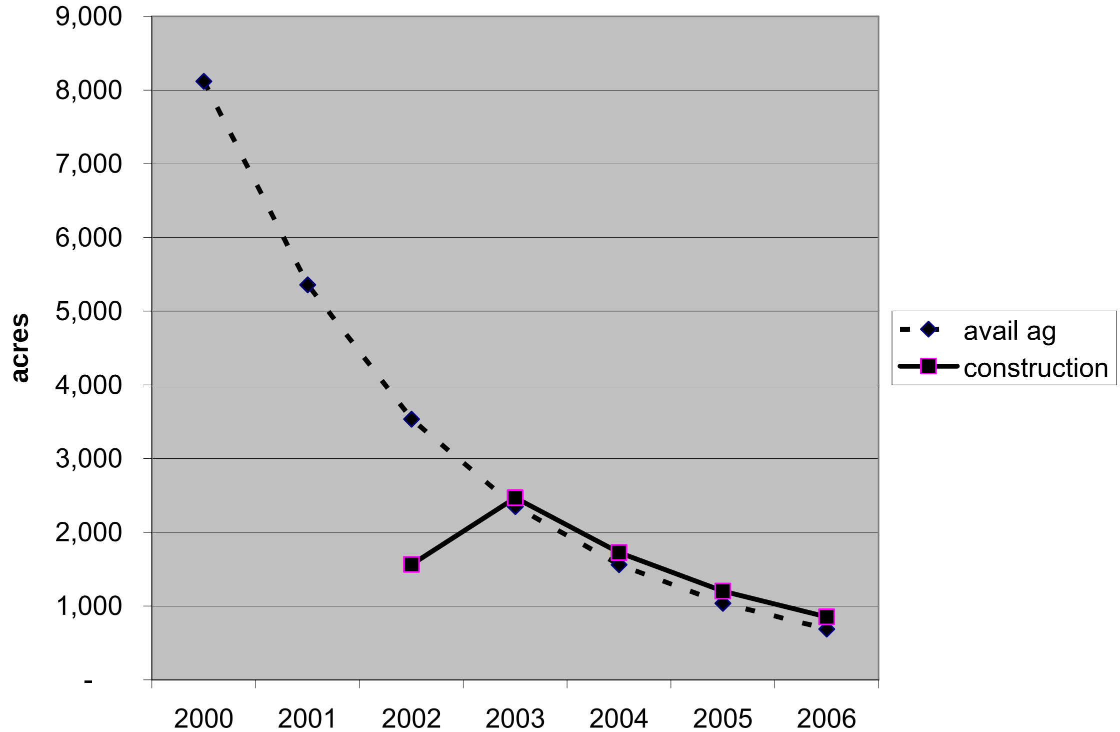


Figure Q-3 shows that the conversion of agricultural land into commercial and residential uses by construction activity is limited by the land that's available in the Salt River PM_{10} Study Area. The construction line in Figure Q-3 rides slightly above the available agricultural land line because of the 15% contribution to construction from vacant lots and miscellaneous disturbed areas. However, the exponential increase in construction activity between 2002 and 2006 inferred from Figure Q-1 cannot happen because there's not that much land available to build on in the Salt River PM_{10} Study Area. Thus, instead of a projected increase in construction activity in this four-year period, there is a sizeable decrease -- from about 1,550 acres in 2002 to 850 acres in 2006, a net decrease of 45%. This decrease means that 2006 construction emissions stated in ADEQ's "Revised PM_{10} State Implementation Plan for the Salt River Area, Technical Support Document, July 2004", have been over estimated, not under estimated, as has been suggested.

APPENDIX R - VACANT LOT SURVEY

Percentage of Vacant Lots Converted to Residential and Commercial Use
A summary of the survey that ADEQ conducted to determine the percentage of vacant lots that had been converted to residential and commercial use for the time period between July 2003 and May 2004 in the Salt River PM10 Study Area appears below.

ADEQ staff used two sets of identifiers, dust potential and size, to classify the vacant lots found during the field study. These are listed in Table R-1 and Table R-2.

TABLE R-1 Dust Potential
1 = low dust potential
2 = low to medium dust potential
3 = medium dust potential
4 = medium to high dust potential
5 = high dust potential
6 = extreme dust potential

TABLE R-2 Size of Vacant Lot (Grid Cell = 400 x 400 m^2)
1 = less than 1/8 grid cell size
2 = 1/8 to 1/4 grid cell size
3 = 1/4 to 1/2 grid cell size
4 = occupies more than 1/2 of grid cell

Table R-3 lists the dust potential, size, and comments for the 171 vacant lots that were surveyed in the ADEQ's field study in 2004.

TABLE R-3 Vacant Lot Field Survey			
Grid Cell ID #	**Dust Potential Rating**	**Size Rating**	**Comments**
1	3	1	3 palm trees, gravel, weeds, glass/trash.
2	2	1	sandy, grainy
3	2	1	gravel, weeds, tires, car seat, trash
4	4	1	dirt, weeds, trash, vehicle tracks
5	2	1	half of 2 front lots paved, back lot dirt, weeds
6	2	1	dirt, weeds, glass, trash
7	4	2	dirt, weeds, glass
8	3	1	dirt, weeds, some trash/glass
8	3	1	"
9	4	2	dirt mound across lot from E-W. some weeds & trash. New buildings on N-W corner & S-W corner. N-W corner is being constructed.
9	4	3	"
9	4	4	"
10	4	2	sandy, grainy, some weeds.
11	4	2	sand, weeds.
11	4	1	"
11	4	1	"
12		3	West side of 43rd Avenue is under construction.
12	6	2	East side of 43'rd Avenue has truck parking and trackout.
13	2	2	Covered pretty well with weeds & gravel.
14	3	1	ag field in back, industrial.
15	3	1	all dirt, very little gravel, & weeds. Industrial area.
15	3	1	"
16	4	2	industrial area. Dirt & gravel lots mostly fenced.
16	4	2	industrial area. Dirt & gravel lots mostly fenced.
16	4	2	industrial area. Dirt & gravel lots mostly fenced.
16	4	1	industrial area. Dirt & gravel lots mostly fenced.
17	5	2	industrial area. Dirt and weeds
17	5	2	"
18	5	1	industrial area. Dirt and weeds
19	4	3	industrial area. construction on SE portion
20	2	2	industrial area. Dirt & dried weeds.
21	2	3	industrial area.
21	2	3	
22	1	3	dried weeds.
22	1	2	"
23	1	2	walled area mostly gravel, fenced area covered with weeds.
23	1	2	"
24	1	4	area covered with weeds & rock.
24	1	4	"
24	1	2	"
24	1	3	"
25	4	2	adjacent to and/or part of Rio Salado project.
25	4	4	"
26		1	fenced field area under construction. Soil wet at time of visit.

TABLE R-3 Vacant Lot Field Survey			
Grid Cell ID #	**Dust Potential Rating**	**Size Rating**	**Comments**
27	3	1	field has been scraped.
27	3	1	"
28	3	1	
29	1	1	weeds & rocks
30	2	1	
31	1	3	
31	1	1	
31	1	1	
32	2	1	access difficult
33	3	1	
33	3	1	
34	6	2	horse run area. Soil powder like.
34	6	1	"
35		3	new home construction
35		3	
36	3	1	
36	3	1	
37	2	1	
37	2	1	
38		2	new home construction in progress.
39		1	new home construction.
39		1	"
40	1	2	fence removed. Weeds. Along canal.
41	3	1	along canal
41	3	3	
42	1	1	field weeds
43	1	1	field weeds
44	5	1	north of CIGNA Health Clinic
45		1	Commercial construction: Family Dollar Store
45		1	
46	2	2	both sides of canal
47	3	1	east side of lot has newly constructed storage rental units.
48	3	3	weeds, rocks, dirt.
49		4	new home construction.
50	3	1	open lot
51	5	1	south part now bus station. North part still dirt lot. No fence, tire tracks, no weed cover
51		1	"
52	3	1	some weeds, wind break
53	1	1	wind break, weeds
54	3	1	
55	3	1	
55	3	1	
56	2	1	some grass
57	3	2	some tire tracks (few). Some fence.
58	4	2	3 separate lots(1 large, 2 small) some berm (big lot) & curbing (middle lot)
59		2	new home construction.

TABLE R-3 Vacant Lot Field Survey			
Grid Cell ID #	**Dust Potential Rating**	**Size Rating**	**Comments**
60	3	3	tire tracks, some grass.
61	5	2	part berm and part fence. Horse property.
62		4	construction in progress on most of lot. New houses (?)
62		3	"
63	2	2	west end has commercial bldg. now. Some berm, some grass & weeds.
63	2	1	
64	1	4	
65		2	under construction (row houses or multi family units?)
66	1	1	
67	1	1	berm (partial) fence & sign NT
68	3	2	(misc. disturbed)
68	3	3	"
68	3	4	"
69	1	1	radio tower area, grass
70	2	4	berm not complete fence
71	2	2	grass and a few trees
72	3	1	fence poles (no fence) plenty of tire tracks.
73	3	4	
74	3	4	home construction on part.
75	1	4	grass/veg.
76		4	construction (retention basin?)
77	1	2	much grass
78	1	2	much grass
79	3	1	some grass, tire tracks, parking, some gravel for parking.
80	3	1	some gravel, tire tracks, some grass.
81	4	1	clear lot
82	3	1	some gravel/stone and dead grass on lot.
83	4	1	dirt crusted, some grass, some tire tracks.
84	2	1	
85	6	2	semi truck trailers parked on lot. Saw truck-trailer combination drive across this lot causing much dust.
86	3	2	parking lot with some gravel and oil coating
87	3	2	along RR tracks. Some weeds & grass. No (?) vehicle access.
88	1	1	weeds/grass cover
89	3	1	some dead grass/weeds
90	4	2	dirt piles, some dead grass/weeds.
91		1	large warehouse type bldg. here now.
91		1	
92	2	1	dead grass & weeds.
93	1	2	lots of weeds.
93	1	1	"
94	3	2	truck-trailer parking on south part of lot. Some dead grass, weeds, berm north part of lot.
95	4	1	storage of large dumpsters and vehicle parking on south and east part of lot
95	4	2	"
95	4	1	
95	4	1	
96	4	1	pipeline construction lot now.

TABLE R-3
Vacant Lot Field Survey

Grid Cell ID #	Dust Potential Rating	Size Rating	Comments
97	3	2	some pipeline storage now
98	2	1	dead grass & weeds.
98	2	1	"
99	3	1	some dead grass/weeds
99	3	1	
100	4	1	walled in industrial storage area.
101	4	1	dirt road across, some dead grass & weeds.
101	4	1	
101	4	1	
101	4	1	
102	2	1	
102	1	1	
103	1	1	
104	3	1	
104	3	1	
105	3	1	utility easement
105	3	1	utility easement
106	1	1	
107	5	2	
107	5	1	
108	1	1	weeds & rocks
109	1	1	
110	1	1	
110	1	1	
111	3	1	
112		1	new home construction
113	3	1	fence poles but no fencing
114	3	1	west side of lot has new Family Dollar Store
114	3	1	
115	3	1	
116	3	1	
117	1	1	
118	3	1	middle of lot has one new home
119	3	1	
120	1	1	
Total number of vacant lots in survey = 171			
Total Number of Vacant Lots Converted	**Total Number of Vacant Lots**	**Fraction Of Vacant Lots Converted**	
14	**171**	**0.08187**	**In ten months: July 2003 to May 2004**
		0.09825	**Annual conversion rate**
		0.39298	**Four year (2002 to 2006) conversion rate**

Number of Vacant Lots & Misc. Disturbed Areas Less Than 1/10 Acre

ADEQ staff also did an analysis of the number of vacant lots and miscellaneous disturbed areas that were less than 1/10 of an acre in the Salt River PM10 Study Area. Following is a description of the analysis and results.

1. Obtain the original land use classification files that were developed using GIS digitizing of satellite images (IKONOS, March 2002) of the data from field surveys of the Salt River PM10 Study Area.

2. Import the data files from GIS analysis into an Excel spreadsheet.

3. Sort the land use files into two land use categories:
    a. Miscellaneous Disturbed (Category 540)
    b. Vacant Lots (Category 550)

4. Total the number and surface area of miscellaneous disturbed areas and vacant lots that are less than 1/10 acre.

Table R-4 summarizes the results of the analysis and shows that the extent of miscellaneous disturbed areas and vacant lots less than 1/10 acre is minimal in the Salt River PM10 Study Area.

Table R-4
Number of Vacant Lots and Misc. Disturbed Areas Less Than 1/10 Acre

Land Use Type	Total Number	Total Surface Area (Acres)	Total Number Less than 1/10 Acre	Total Surface Area of Areas Less than 1/10 Acre (Acres)	Percent Less than 1/10 Acre
Misc. Disturbed	220	1,627	13	0.7	0.04%
Vacant Lots	902	1,303	74	3.7	0.29%

APPENDIX S - INDUSTRIAL AREA EMISSIONS

Industrial area PM_{10} emissions in the Salt River PM_{10} Study Area are important, especially their reductions from 2002 to 2006 which, among several other source categories, are necessary to demonstrate attainment. Given this importance, this appendix provides justification for the use of the 2002 emissions for the 2006 base case. It also presents further rationale for the reductions and an analysis of the sensitivity of the predicted concentrations to three levels of 2002 emissions.

I. Rationale for the 2006 Base Case Emissions Being Equal to the 2002 Emissions

Throughput and emission statistics for each emission point for each Salt River Area facility provide enough information to infer emission trends from 2002 to 2006. This inference can be made by looking at only 12 of the 36 major facilities, as many others are quite small, and several do not have any industrial area emissions. In Table S-1 the 2002 throughput statistics are given for all the major facilities with industrial emissions. This table shows that 95% of the total throughput comes from the top 12 or 13 facilities.

Table S-1 Salt River Study Area Throughput for Large Stationary Sources in 2002			
Company	Throughput (Tons/year)	% Total	Cum %
PHX 23rd Ave Wastewater Treatment Plant	NA		
Proctor & Gamble	NA		
APS West Phoenix Power Plant	NA		
Marlam Industries Inc	NA		
Road Machinery Co Inc	NA		
City of Phoenix 27th Ave Landfill	NA		
Chevron	NA		
United Metro Materials	2,221,057	39.1	39.1
Vulcan	1,046,351	18.4	57.5
Rockland Materials	754,279	13.3	70.7
Quality Block (35th Ave)	321,081	5.6	76.4
Metal Management (35th Ave)	202,418	3.6	80.0
Hanson Aggregates 51st Ave	198,852	3.5	83.4
TPAC	153,822	2.7	86.2
Western Block Co.	126,335	2.2	88.4
Western Organics 27th Ave	109,714	1.9	90.3
Coreslab Structures, Inc.	82,878	1.5	91.8
Western Organics 51th Ave	81,850	1.4	93.2
Ameron International	69,088	1.2	94.4
Weinberger Topsoil	65,410	1.2	95.6
Phoenix Brick Yard	58,108	1.0	96.6
MCP Industries Inc.	45,985	0.8	97.4
Olson Precast	42,328	0.7	98.1
Smith Precast	35,050	0.6	98.8
VAW Of America, Inc.	34,875	0.6	99.4
South Mountain Farmers' Gin	19,947	0.4	99.7
Universal Entech Llc	6,546	0.1	99.8
Ajax Sand & Rock	3,500	0.1	99.9
Trendwood, Inc.	2,274	0.0	99.9
Southwest Forest Products	1,300	0.0	100.0
Schuff Steel	1,012	0.0	100.0
Woodstuff Mfg	879	0.0	100.0
ATC Phoenix	48	0.0	100.0

NA: No industrial area emissions

%Total: The percentage that each facility contributes to the total

Cum%: The cumulative percentage that each set of facilities contributes to the total

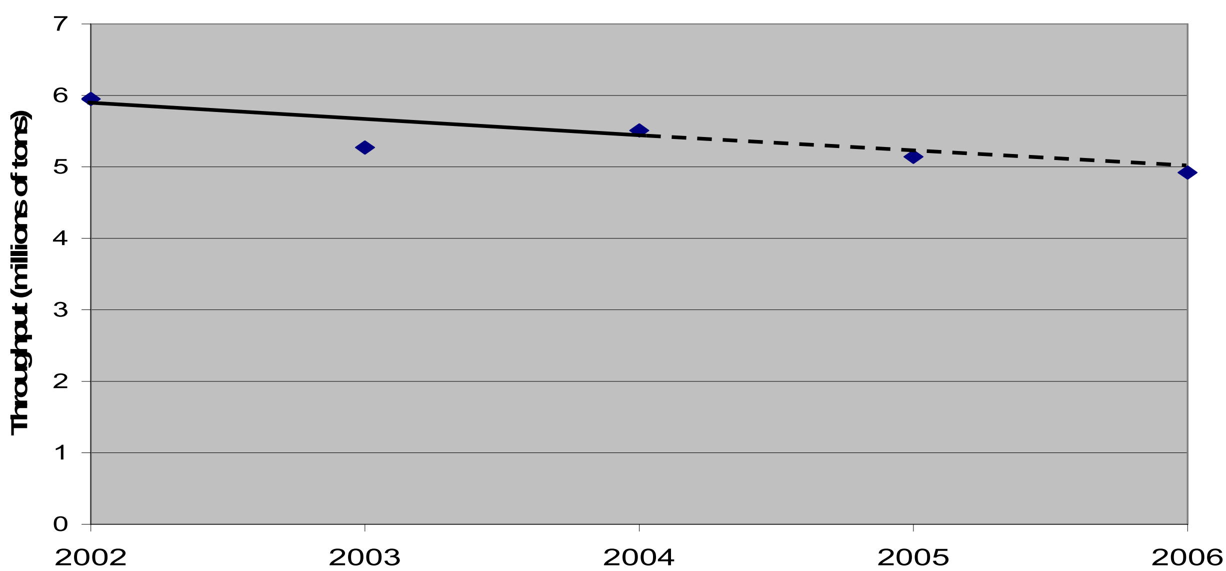
Throughput statistics from these largest twelve facilities have been collected from their annual emission reports for 2002, 2003, and 2004. Projected throughput levels for 2005 and 2006 have been extrapolated linearly. Shown in Table S-2 and Figure S-1, the overall throughput trend for those facilities with industrial area emissions is slightly down, justifying the use of 2002 emissions in the 2006 base case.

Table S-2
Salt River PM_{10} Area Throughput for the 12 Largest Facilities: 2002 - 2004

Company	Annual Throughput in Tons		
	2002	2003	2004
United Metro Materials (19th Ave) [Now Rinker]	2,268,745	1,458,549	1,296,184
Vulcan (43rd Ave)	1,046,351	1,381,919	1,456,110
Hanson Aggregates (51st Ave)	953,269	944,846	1,322,700
Rockland Materials (43rd) [Now Arizona Materials]	656,407	533,051	371,914
Metal Management (35th Ave)	202,418	270,182	**270,182**
Quality Block (35th Ave)	198,852	198,512	226,199
TPAC (19th Ave)	153,822	67,775	92,702
Western Block Co. (19th Ave)	126,335	**126,335**	**126,335**
Western Organics Inc (27th Ave)	109,714	78,080	80,531
Western Organics Inc (51st Ave)	81,850	50,311	47,050
Coreslab Structures, Inc. (43rd Ave)	81,041	90,170	107,183
Ameron International (7th St)	69,088	73,234	111,611
Totals:	5,947,892	5,272,964	5,508,701

Bold values: No data were available, so the value from the previous year was used.

Figure S-1. Salt River PM10 Study Area Throughput for Facilities with Industrial Area Emissions: 2002 – 2004 from Survey Data, Linearly Extrapolated to 2006



II. Rationale for the 60% Reductions

The primary question here is what level of control was being achieved in 2002. While the MCESD Rule Effectiveness Study (see Appendix I) claims an impressively high figure of 88% for Rule 316 facilities (industrial and/or earthmoving) and 80% for Rule 310 facilities (earthmoving only), a less sanguine view may be in order. The rule effectiveness survey did inspect a suitable number of facilities: Twelve of the Rule 316 type and thirty-two of the Rule 310 type. But this kind of survey may have overestimated rule effectiveness because it: 1) was conducted under normal inspection conditions and not during high winds; 2) estimated compliance based on a numerical point system and did not correlate observed noncompliance to PM_{10} emissions; and 3) for Rule 316 sources, focused on process equipment and activities and may not have always verified stabilization in other less active areas of the site. It would be prudent to consider these high effectiveness figures as upper bounds, with the actual effectiveness being considerably lower.

How much lower, exactly, is unknown, but the ambient record would suggest that far less than 80% of PM_{10} emissions were being controlled. At the West 43rd Avenue site, for example, of 189 24-hour averages of PM_{10} by TEOM, 10% of the concentrations exceeded 150 $\mu g/m^3$ and 43% exceeded 100 $\mu g/m^3$. At the Salt River site with every sixth day sampling by high-volume samplers, 4% of the 24-hour averages exceeded 150 $\mu g/m^3$ and 28% exceeded 100 $\mu g/m^3$. Shown in Figures S-2 and S-3, these distributions of PM_{10}, and their elevated concentrations in particular, suggest that industrial emissions and trackout, which comprise 22% of the total emissions on low-wind days, were not being effectively controlled.

Figure S-2. PM_{10} Concentrations (24-Hour Averages) at West 43rd Avenue in 2002: 189 TEOM Observations

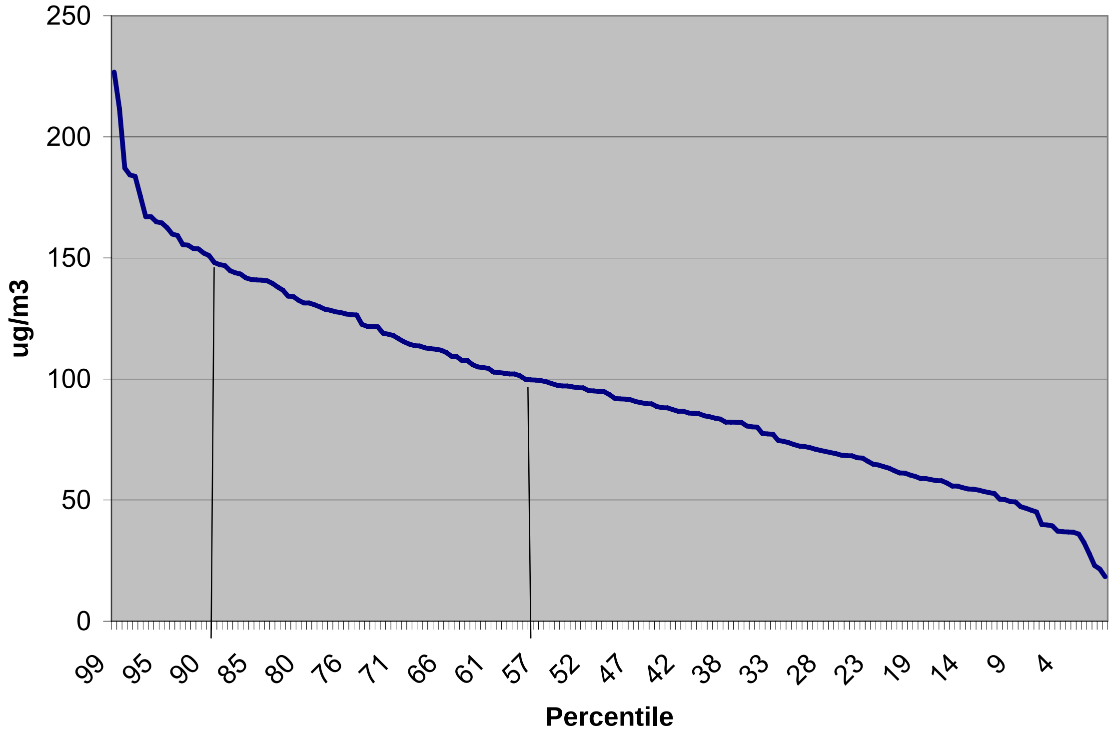
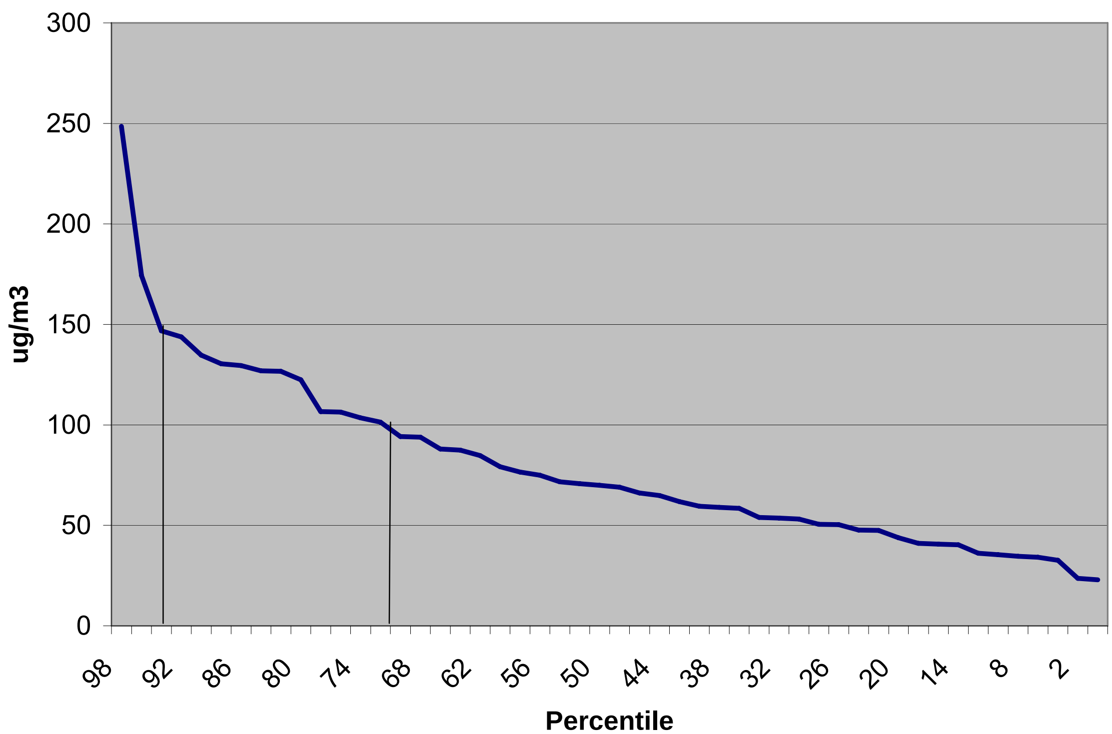


Figure S-3. PM_{10} Concentrations (24-Hour Averages) at the Salt River Site in 2002: 50 High-Volume Observations



III. Sensitivity Analysis

The largest four categories in the industrial area source group comprise 90% of its total emissions (Table S-3). In the demonstration of attainment in the Salt River PM_{10} Technical Support Document, these emissions have been reduced between 65 and 70% from 2002 to 2006. These reductions were based on the engineering effectiveness of more stringent controls and on the assumption that actual 2002 controls were less than the rule effectiveness study showed. With considerable uncertainty about the degree of control in 2002, this paper calculates modeled concentrations on the two low-wind design days with four sets of industrial area emissions: base case, plus 23%, plus 45%, and plus 68%. These figures translate into increases of 25%, 50%, and 75% for the top four categories: haul roads, material transfer, pile forming/loading, and crushing/screening.

TABLE S-3
Base Case Industrial Area Emissions of PM_{10} in 2002

Activity	Lbs/year	% Total
Haul Roads	200,904	56.17
Material Transfer	72,890	20.38
Pile Forming/Loading	29,644	8.29
Crushing/Screening	21,718	6.07
Combustion	11,648	3.26
Cooling Towers	10,346	2.89
Sand Blasting	6,563	1.83
Other	2,288	0.64
Conveyor Transfer	1,683	0.47
Total	357,684	100

In Tables S-4 through S-7, the predicted concentrations are presented for the base case and the three increases. Table S-8 summarizes the results of the four previous tables. Figures S-4 through S-11 present the same data in pie charts. The percentage contribution of industrial area sources increases from 52 to 65% for January 18, 2002, at the Salt River site; and from 24 to 36% on December 16, 2002, at West 43rd Avenue, as their base case values are increased by 68%. If the degree of control of these four industrial area source activities in 2002 was less than the 80% claimed in the rule effectiveness study, then this range of concentrations provides a plausible contribution from this source category that is consistent with the 65 – 70% reductions taken in the Salt River PM_{10} Technical Support Document.

TABLE S-4
Predicted Concentrations in µg/m³ from All Emission Source Categories to the Two Low-wind Exceedances of PM_{10} in the Salt River Study Area in 2002 with Base Case Industrial Area Emissions

Source category	January 8	December 16
	Salt River	West 43rd Avenue
Primary Roads	26.66	57.92
Large Industrial Area	55.81	35.22
Trackout	6.85	27.33
Unpaved Shoulders	2.97	9.34
Secondary Roads	2.73	8.94
Construction	6.14	4.45
Industrial Point Sources	5.42	1.90
Unpaved Parking Lots	0.27	1.00

TABLE S-5
Predicted Concentrations in µg/m³ from All Emission Source Categories to the Two Low-wind Exceedances of PM_{10} in the Salt River Study Area in 2002 with Industrial Area Emissions Increased 23%

Source category	January 8	December 16
	Salt River	West 43rd Avenue
Primary Roads	26.66	57.92
Large Industrial Area	68.65	43.32
Trackout	6.85	27.33
Unpaved Shoulders	2.97	9.34
Secondary Roads	2.73	8.94
Construction	6.14	4.45
Industrial Point Sources	5.42	1.90
Unpaved Parking Lots	0.27	1.00

TABLE S-6 Predicted Concentrations in µg/m^3 from All Emission Source Categories to the Two Low-wind Exceedances of PM_{10} in the Salt River Study Area in 2002 with Industrial Area Emissions Increased 45%		
Source category	January 8	December 16
	Salt River	West 43rd Avenue
Primary Roads	26.66	57.92
Large Industrial Area	80.92	51.07
Trackout	6.85	27.33
Unpaved Shoulders	2.97	9.34
Secondary Roads	2.73	8.94
Construction	6.14	4.45
Industrial Point Sources	5.42	1.90
Unpaved Parking Lots	0.27	1.00

TABLE S-7 Predicted Concentrations in µg/m^3 from All Emission Source Categories to the Two Low-wind Exceedances of PM_{10} in the Salt River Study Area in 2002 with Industrial Area Emissions Increased 68%		
Source category	January 8	December 16
	Salt River	West 43rd Avenue
Primary Roads	26.66	57.92
Large Industrial Area	93.76	59.17
Trackout	6.85	27.33
Unpaved Shoulders	2.97	9.34
Secondary Roads	2.73	8.94
Construction	6.14	4.45
Industrial Point Sources	5.42	1.90
Unpaved Parking Lots	0.27	1.00

TABLE S-8
Summary of Industrial Area Source Concentrations and Percentages of the Total Concentration for the Base Case Emissions and Increases of 23, 45, and 68% on Two Low-Wind Days in Salt River Study Area in 2002

Emissions	Concentrations ($\mu g/m^3$)		Percentages of Total	
	January 8	December 16	January 8	December 16
	Salt River	West 43rd Ave	Salt River	West 43rd Ave
Base Case	56	35	52%	24%
Plus 23%	69	43	58%	28%
Plus 45%	81	51	62%	31%
Plus 68%	94	59	65%	36%

Figure S-4. Salt River PM_{10} Concentrations by Source Contribution: January 8, 2002, Salt River Site – Large Industrial Area Emissions at Base Case Levels

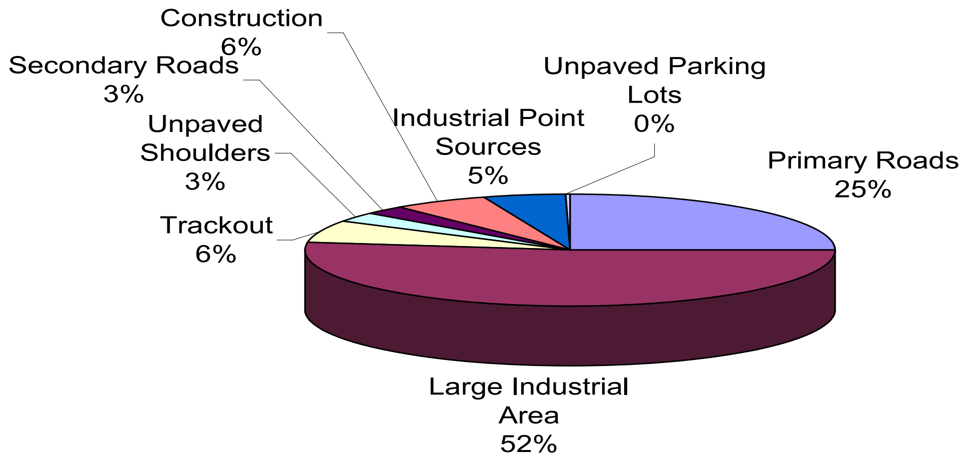


Figure S-5. Salt River PM_{10} Concentrations by Source Contribution: December 16, 2002, West 43rd Avenue – Large Industrial Area Emissions at Base Case Levels

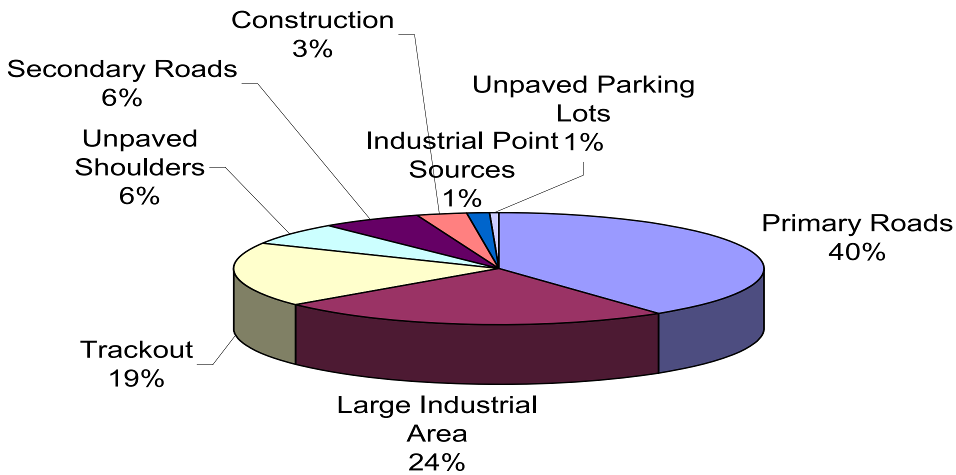


Figure S-6. Salt River PM_{10} Concentrations by Source Contribution: January 8, 2002, Salt River Site – Large Industrial Area Emissions Increased 23%

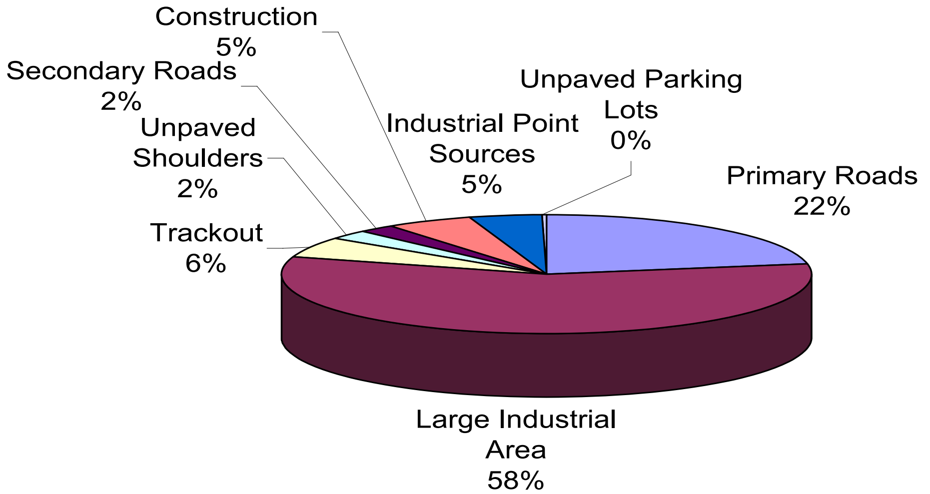


Figure S-7. Salt River PM_{10} Concentrations by Source Contribution: December 16, 2002, West 43rd Avenue – Large Industrial Area Emissions Increased 23%

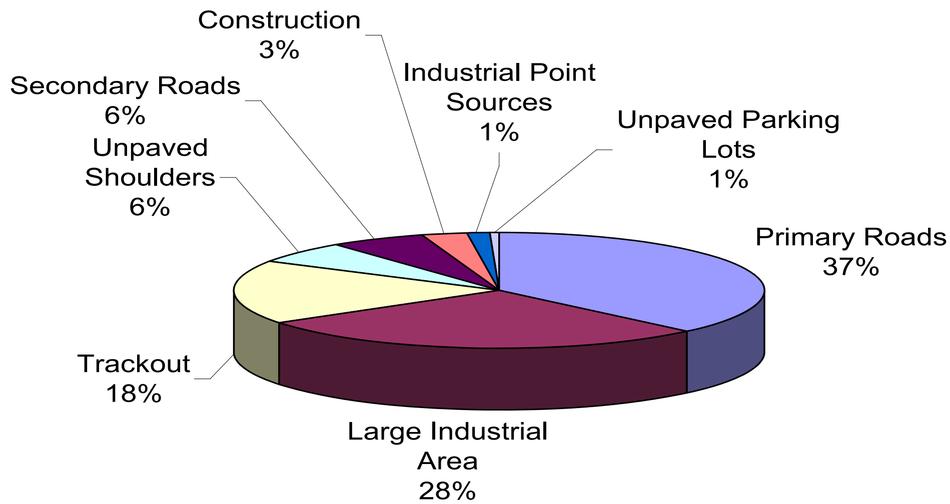


Figure S-8. Salt River PM_{10} Concentrations by Source Contribution: January 8, 2002, Salt River Site – Large Industrial Area Emissions Increased 45%

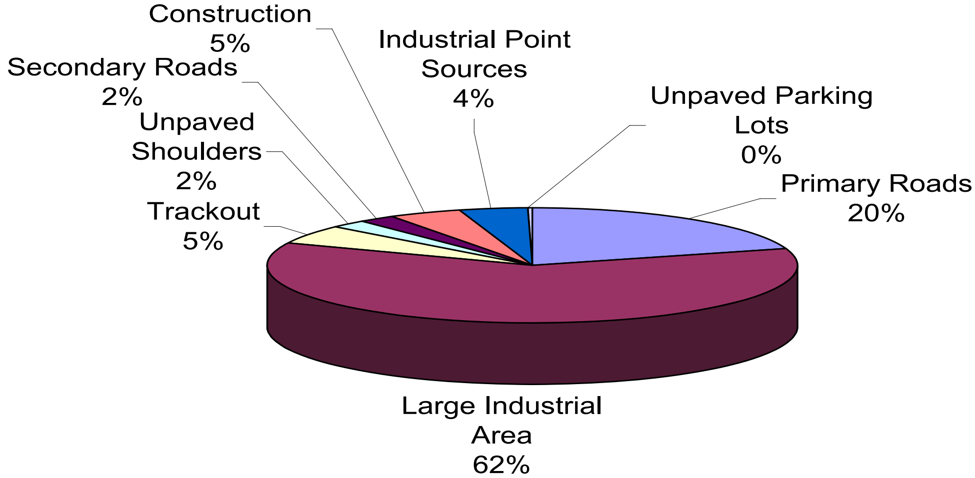


Figure S-9. Salt River PM_{10} Concentrations by Source Contribution: December 16, 2002, West 43rd Avenue – Large Industrial Area Emissions Increased 45%

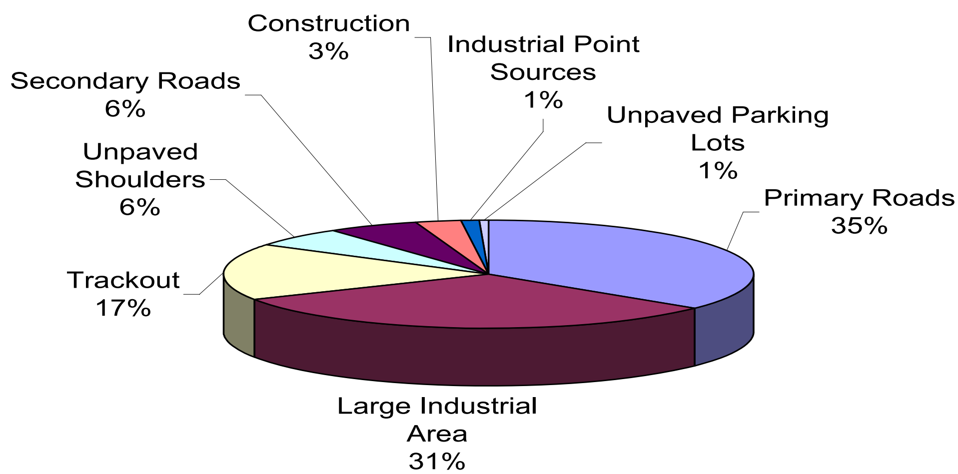


Figure S-10. Salt River PM_{10} Concentrations by Source Contribution: January 8, 2002, Salt River Site – Large Industrial Area Emissions Increased 68%

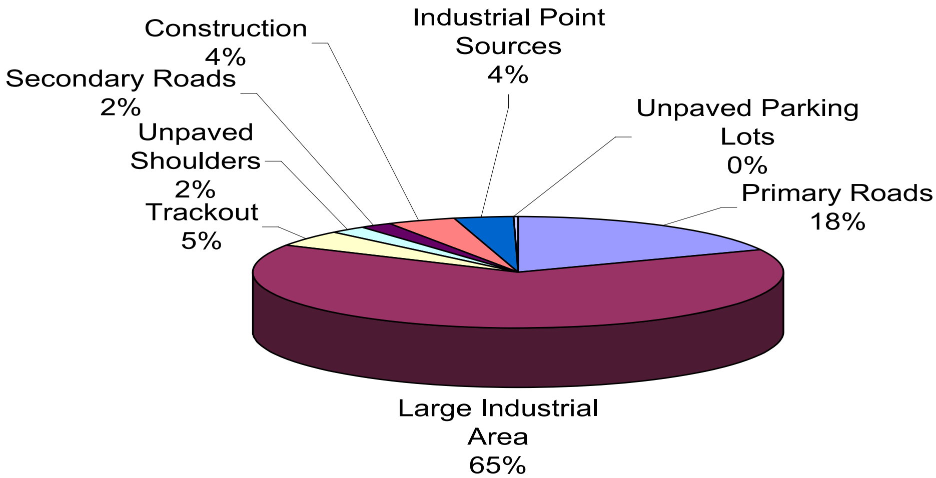
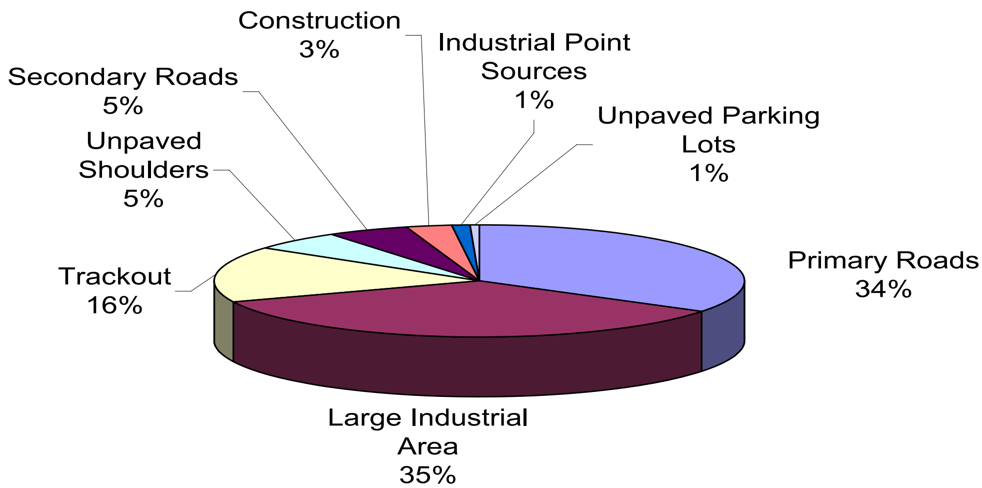


Figure S-11. Salt River PM_{10} Concentrations by Source Contribution: December 16, 2002, West 43rd Avenue – Large Industrial Area Emissions Increased 68%



The effect of increasing the 2002 industrial area emissions on the overall predicted air quality concentrations can be seen in the following set of tables, Tables S-9 through S-12. The predicted concentrations from the industrial area sources increase, as the concentrations from the other sources decrease. This balancing increase and decrease arises from the fact that the ambient concentration and its background contribution remain constant, so increasing one source leads to decreases in the others.

The chief contributor to the low-wind concentrations other than industrial area is primary roads. Because primary road emissions from 2002 to 2006 decrease seven percent with more frequent sweeping, but the industrial area source emissions decrease 60% with more stringent rules and better enforcement, the overall change is a net decrease in the total predicted concentrations on the low-wind days. In Table S-13 the four previous tables are summarized, with the total predicted PM_{10} concentrations decreasing from 130 to 124 $\mu g/m^3$ for the January 8 exceedance and from 142 to 138 $\mu g/m^3$ for the December 16 exceedance.

This exercise demonstrates that increasing the industrial area source emissions in 2002 – on anecdotal and ambient air evidence that the overall control efficiencies were lower than the rule effectiveness study indicated – does not jeopardize the demonstration of attainment.

TABLE S-9 **Predicted Concentrations in μg/m³ from All Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2006 -- Attainment case, Corrected on November 22, 2004**								
Source Category	Jan. 8	April 15			April 26			Dec. 16
	Salt River	Durango	Salt River	West 43rd Avenue	Durango	Salt River	West 43rd Avenue	West 43rd Avenue
Windblown Agricultural		**5.23**	0.94	1.17	**17.51**	**8.46**	0.67	
Windblown Alluvial		1.03	4.98	**17.36**	0.14	1.81	**23.36**	
Large Industrial Area	**22.15**	4.94	**7.70**	2.92	1.08	**11.86**	1.75	**11.00**
Primary Roads	**24.71**	**32.80**	**10.04**	**8.08**	**15.86**	**7.42**	2.06	**42.23**
Windblown Vacant Lots		2.37	2.48	0.00	1.57	**15.88**	0.03	
Windblown Industrial		1.55	3.52	**8.71**	0.67	**7.41**	1.09	
Windblown Disturbed		**4.88**	3.23	1.16	**14.71**	**6.79**	2.16	
Trackout	1.36	1.35	0.33	0.81	1.55	0.71	0.34	4.27
Windblown Construction		0.48	1.61	**11.80**	0.05	0.33	1.06	
Windblown Stockpiles		0.84	**6.01**	4.90	4.17	3.02	0.61	
Unpaved Shoulders	2.65	0.67	0.37	1.59	0.00	0.00	0.00	**6.56**
Secondary Roads	2.68	1.60	1.26	1.27	1.22	0.67	0.28	**6.89**
Construction	3.90	0.79	0.58	2.91	0.30	0.34	0.31	2.22
Industrial Point Sources	4.46	2.34	2.66	2.53	2.59	0.52	0.04	1.23
Unpaved Parking Lots	0.17	0.94	0.05	0.03	0.91	0.05	0.00	0.50
Freeway	0.47	0.27	0.30	0.09	0.40	0.31	0.08	0.75
Sum of Contributions	63	62	46	65	63	66	34	76
Background	67	82	82	82	67	67	67	66
Background + Sum	130	144	128	147	130	133	101	142

Shaded concentrations exceed 5 μg/m³, the threshold for significance for potential controls.

TABLE S-10
Predicted Concentrations in μg/m³ from All Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2006 -- Attainment Case corrected on November 22, 2004, with 23% increase in Large Industrial Area Emissions

Source Category	Jan. 8	April 15			April 26			Dec. 16
	Salt River	Durango	Salt River	West 43rd Avenue	Durango	Salt River	West 43rd Avenue	West 43rd Avenue
Windblown Agricultural		**5.11**	0.90	1.16	**17.45**	**8.15**	0.66	
Windblown Alluvial		1.01	4.77	**17.18**	0.14	1.75	**23.14**	
Large Industrial Area	**24.35**	**5.93**	**9.08**	3.55	1.32	**14.06**	2.13	**12.82**
Primary Roads	**22.08**	**32.02**	**9.63**	**8.00**	**15.80**	**7.15**	2.04	**40.03**
Windblown Vacant Lots		2.31	2.38	0.00	1.56	**15.31**	0.03	
Windblown Industrial		1.52	3.37	**8.62**	0.67	**7.15**	1.08	
Windblown Disturbed		4.77	3.10	1.15	**14.65**	**6.55**	2.14	
Trackout	1.21	1.31	0.31	0.80	1.55	0.69	0.34	4.04
Windblown Construction		0.47	1.54	**11.68**	0.05	0.31	1.05	
Windblown Stockpiles		0.82	**5.76**	4.85	4.15	2.91	0.60	
Unpaved Shoulders	2.37	0.65	0.36	1.57	0.00	0.00	0.00	**6.22**
Secondary Roads	2.40	1.56	1.21	1.26	1.22	0.64	0.28	**6.54**
Construction	3.49	0.77	0.56	2.88	0.29	0.33	0.31	2.11
Industrial Point Sources	3.99	2.29	2.55	2.50	2.58	0.50	0.04	1.17
Unpaved Parking Lots	0.15	0.92	0.04	0.03	0.91	0.05	0.00	0.48
Freeway	0.42	0.26	0.29	0.09	0.40	0.30	0.08	0.71
Sum of Contributions	60	62	46	65	63	66	34	74
Background	67	82	82	82	67	67	67	66
Background + Sum	127	144	128	147	130	133	101	140

Shaded concentrations exceed 5 μg/m³, the threshold for significance for potential controls.

TABLE S-11
Predicted Concentrations in µg/m^3 from All Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2006 -- Attainment case Corrected on November 22, 2004, with a 45% increase in Industrial Area Emissions

Source Category	Jan. 8	April 15			April 26			Dec. 16
	Salt River	Durango	Salt River	West 43rd Avenue	Durango	Salt River	West 43rd Avenue	West 43rd Avenue
Windblown Agricultural		4.99	0.86	1.15	**17.38**	**7.88**	0.66	
Windblown Alluvial		0.98	4.59	**17.01**	0.14	1.69	**22.94**	
Large Industrial Area	**26.05**	**6.84**	**10.29**	4.14	1.55	**16.02**	2.49	**14.40**
Primary Roads	**20.05**	**31.30**	**9.26**	**7.92**	**15.75**	**6.91**	2.02	**38.13**
Windblown Vacant Lots		2.26	2.29	0.00	1.56	**14.79**	0.03	
Windblown Industrial		1.48	3.24	**8.54**	0.67	**6.91**	1.07	
Windblown Disturbed		4.66	2.98	1.13	**14.60**	**6.33**	2.12	
Trackout	1.10	1.28	0.30	0.79	1.54	0.66	0.34	3.85
Windblown Construction		0.46	1.48	**11.56**	0.05	0.30	1.04	
Windblown Stockpiles		0.80	**5.54**	4.80	4.14	2.81	0.60	
Unpaved Shoulders	2.15	0.63	0.34	1.56	0.00	0.00	0.00	**5.93**
Secondary Roads	2.17	1.53	1.16	1.25	1.21	0.62	0.28	**6.22**
Construction	3.16	0.76	0.54	2.85	0.29	0.32	0.31	2.01
Industrial Point Sources	3.62	2.24	2.45	2.48	2.57	0.48	0.04	1.11
Unpaved Parking Lots	0.14	0.90	0.04	0.03	0.90	0.05	0.00	0.45
Freeway	0.38	0.26	0.28	0.09	0.40	0.29	0.08	0.68
Sum of Contributions	59	61	46	65	63	66	34	73
Background	67	82	82	82	67	67	67	66
Background + Sum	126	143	128	147	130	133	101	139

Shaded concentrations exceed 5 µg/m^3, the threshold for significance for potential controls.

TABLE S-12 **Predicted Concentrations in µg/m³ from All Emission Source Categories to the Eight Exceedances of PM_{10} in the Salt River Study Area in 2006 -- Attainment Case Corrected on November 22, 2004, with a 68% Increase in Industrial Area Emissions**								
Source Category	Jan. 8	April 15			April 26			Dec. 16
	Salt River	Durango	Salt River	West 43rd Avenue	Durango	Salt River	West 43rd Avenue	West 43rd Avenue
Windblown Agricultural		4.88	0.83	1.14	**17.32**	**7.61**	0.65	
Windblown Alluvial		0.96	4.41	**16.84**	0.13	1.63	**22.73**	
Large Industrial Area	**27.52**	**7.74**	**11.47**	4.75	1.79	**17.94**	2.86	**15.89**
Primary Roads	**18.28**	**30.59**	**8.90**	**7.84**	**15.69**	**6.68**	2.01	**36.33**
Windblown Vacant Lots		2.21	2.20	0.00	1.55	**14.30**	0.03	
Windblown Industrial		1.45	3.12	**8.45**	0.67	**6.67**	1.06	
Windblown Disturbed		4.55	2.87	1.12	**14.55**	**6.11**	2.10	
Trackout	1.01	1.26	0.29	0.78	1.54	0.64	0.33	3.67
Windblown Construction		0.45	1.42	**11.45**	0.05	0.29	1.03	
Windblown Stockpiles		0.78	**5.33**	4.75	4.12	2.71	0.59	
Unpaved Shoulders	1.96	0.62	0.33	1.54	0.00	0.00	0.00	**5.65**
Secondary Roads	1.98	1.49	1.12	1.24	1.21	0.60	0.27	**5.93**
Construction	2.88	0.74	0.52	2.82	0.29	0.31	0.31	1.91
Industrial Point Sources	3.30	2.19	2.36	2.45	2.56	0.47	0.04	1.06
Unpaved Parking Lots	0.13	0.87	0.04	0.03	0.90	0.05	0.00	0.43
Freeway	0.35	0.25	0.27	0.08	0.40	0.28	0.08	0.64
Sum of Contributions	57	61	45	65	63	66	34	72
Background	67	82	82	82	67	67	67	66
Background + Sum	124	143	127	147	130	133	101	138

Shaded concentrations exceed 5 µg/m³, the threshold for significance for potential controls.

TABLE S-13 **Predicted PM_{10} Concentrations for the 2006 Attainment Case, with Three Increases in the 2002 Industrial Area Emissions**									
Percent Increase in Emissions	Source category	Jan 8	April 15			April 26			Dec16
		Salt River	Durango	Salt River	West 43rd Ave.	Durango	Salt River	West 43rd Ave.	West 43rd Ave.
Base **+0%**	Large Industrial Area	22.15	4.94	7.70	2.92	1.08	11.86	1.75	11.00
	Sum of Contributions	63	62	46	65	63	66	34	76
	Background	67	82	82	82	67	67	67	66
	Background + Sum	**130**	**144**	**128**	**147**	**130**	**133**	**101**	**142**
Industrial Area **+23%**	Large Industrial Area	24.35	5.93	9.08	3.55	1.32	14.06	2.13	12.82
	Sum of Contributions	60	62	46	65	63	66	34	74
	Background	67	82	82	82	67	67	67	66
	Background + Sum	**127**	**144**	**128**	**147**	**130**	**133**	**101**	**140**
Industrial Area **+45%**	Large Industrial Area	26.05	6.84	10.29	4.14	1.55	16.02	2.49	14.40
	Sum of Contributions	59	61	46	65	63	66	34	73
	Background	67	82	82	82	67	67	67	66
	Background + Sum	**126**	**143**	**128**	**147**	**130**	**133**	**101**	**139**
Industrial Area **+68%**	Large Industrial Area	27.52	7.74	11.47	4.75	1.79	17.94	2.86	15.89
	Sum of Contributions	57	61	45	65	63	66	34	72
	Background	67	82	82	82	67	67	67	66
	Background + Sum	**124**	**143**	**127**	**147**	**130**	**133**	**101**	**138**

Potential Control Measures for Area Sources for Salt River SIP

Source Category	Potential Enhancement	Comments
1. Open areas and vacant lots[1] – stabilization standards	Clarify Rule 310 and 310.01 subsection 302 stabilization standards by including text from Appendix C 2.2.	Difficult to enforce stabilization requirements as currently written Clark Co. AQR 90.4.1
2. Open areas and vacant lots – compliance and inspection program	Enhance vacant lot enforcement and compliance program by hiring inspection and enforcement staff dedicated to open areas and vacant lots.	Clark Co. has one inspector in each regional office dedicated to vacant lot inspections. Per Rodney Langston, Clark Co.
3. Unpaved parking lots – stabilization requirements[2]	Revise 310.01 subsection 303 "For the purpose of this rule, the owner and/or operator of an unpaved parking lot on which vehicles are parked no more than 35 days per year, excluding days on which ten or fewer vehicles enter, shall implement … for the duration of time that over 100 vehicles enter and/or park on such unpaved parking lot" so that it is similar to Clark Co. AQR 92, "For unpaved parking lots that are utilized intermittently, for a period of 35 days or less during the calendar year, the owner and/or operator shall implement one of the control measures described in …during the period that the unpaved parking lot is utilized for vehicle parking"	More understandable and more enforceable. Clark Co. MSM analysis 6.3.2.1
4. Dust generating operation – requirement to have water application system on site	Rule 310 subsection 308.7 (Soil Moisture) lower the requirement to have a water application system on site during earthmoving operations from 1 acre to ½ acre.	Being proposed in new Rule 310 revisions.
5. Construction activities[3] - requirement for dust monitor at large construction sites	Require trained "dust control monitor" on site for construction projects with 10 acres or greater of active, disturbed area and all sand and gravel operations who would direct dust control activities to maintain compliance with a 20% opacity limit.	Clark Co. AQR 94.7.5 Clark Co. MSM analysis 6.3.3.2

[1] 1999 MAG Serious Area Plan (p. V-21) - MAG assumed that 76 percent of the disturbed vacant land in the nonattainment area is disturbed vacant lots. Assumptions related to the effectiveness of control measures (local govt and Rule 310 commitments) on the emissions from disturbed vacant lots were based on the effectiveness reported in the ADEQ microscale plan. It assumed that an equal number of vacant disturbed lots would be treated with mulch or vegetative cover, treated with gravel, and treated with chemical stabilizers. Emissions from vacant disturbed lots were assumed to be 71 percent controlled in 2006. Since vacant disturbed lots comprise 76 percent of disturbed vacant land, the 71 percent control level only applies to 76 percent of the disturbed vacant land emissions. A 100 percent rule penetration was assumed to be reasonable for Rule 310 application to vacant lots.

[2] 1999 MAG Serious Area Plan (p. V-17) assumed that an equal number of parking lots would be paved, treated with gravel, and treated with chemical stabilizers. Emissions from vehicular travel on unpaved parking lots were assumed to be 60 percent controlled in 2006. Windblown dust from unpaved parking lots was assumed to be 71 percent controlled in 2006. It was also assumed that unpaved parking lots comprise 24 percent of the disturbed vacant land and therefore the 71 percent level only applies to 24 percent of the disturbed vacant land emissions. A 100 percent rule penetration was assumed to be reasonable for Rule 310 application to unpaved parking lots.

Source Category	Potential Enhancement	Comments
6. Dust generating operation – trackout prevention[4] [5]	Revise Rule 310 requirement for the use of track out control devices from projects with > five acres of disturbed area to projects with > one acre of disturbed area (subsection 308.3 a.1).	Clark Co. limit is 0.25 acres. Clark Co. MSM analysis 6.3.3.9 This change will require trackout controls on 98% of earthmoving acreage from 94% before the revision (based on 2002-2003 earth moving permits 1 acre or larger vs. earthmoving permits 5 acres or larger in 2002 – 2003). 4.3% increase in sites required to control trackout. Being proposed in new Rule 310 revisions.
7. Dust generating operation – hauling and transporting	Revise Rule 310 subsection 308.6(b) (Open Storage Piles) and Bulk Material Hauling/Transporting (Table 11) to include the following: Requirement to "empty loader bucket slowly and keep loader bucket close to the truck to minimize the drop height".	Clark Co. has similar requirements for construction activity truck loading. Clark Co. MSM analysis 6.3.3.10 and dust control handbook BMP 23; SCAQMD Rule 403 Being proposed in new Rule 310 revisions.

[3] 1999 MAG Serious Area Plan (V-9) assumed PM10 emissions from construction activities are 72% (90% CE x 80% CE) controlled in 2006 (66 % reduction from base case emissions.).

[4] 1999 MAG Serious Area Plan (p.V-9) assumed that methods used to remove and/or control trackout from construction sites resulted in 72% control in 2006 (because the base case emissions were assumed to be 18 percent controlled, raising the control to 72 % for 2006 will provide 66 % reduction from base case emissions.). (DK1 assuming the 72% = 80% Control Efficiency * 90% Compliance Rate). The 1999 MAG Serious Area Plan also assumed a rule penetration of 100 percent for Rule 310 with regard to construction activities.

[5] Final BACM Technological and Economic Feasibility Analysis, Sierra Research, March 21, 2003, p. 22: The pipe grid trackout control device was estimated to reduce trackout by 80%. This estimate is based on the data reported in the 2002 MRI report for gravel and paved interior road control devices, and an estimate provided by a construction inspector for the Maricopa County SBAP. p. 23 – The control efficiency of a gravel bed trackout control device has been shown in the 2001 MRI study to average 46%. P. 24 – The average control efficiency of interior paved roads in reducing trackout was 43% as reported in the 2001 MRI study.

Source Category	Potential Enhancement	Comments
8. Fugitive dust sources (unpaved parking lots, disturbed surface areas, bulk material hauling/transporting, weed abatement) - limit vehicle speeds to 15 mph	Revise Rule 310 to include "Limit vehicle speeds to 15 m.p.h. on the work site as a suggested additional control measure for contingency plans in Table 2 (unpaved parking lots), Table 6 (Disturbed Surface Areas – Work Practices During Operations), Table 13 (Bulk Material Hauling/Transporting – Within the Boundaries of the Work Site when Crossing a Paved Area Accessible to the Public While Construction is Underway), and Table 18 (Weed abatement by discing or blading).	Because this is a contingency measure and stationary sources report average vehicle speeds of ≈ 7 – 10 mph, the reductions are difficult to quantify and possibly minimal. Clark Co. MSM analysis 6.3.3.11 and Dust Control Handbook BMP 13 Sierra Research estimated that use of a radar gun on unannounced inspection basis would produce 50% compliance with the proposed measure to limit on-site vehicle speeds to 15 mph San Joaquin Rule 8021 requires that vehicle travel over unpaved surfaces at construction sites not produce visible dust plumes with opacities greater than 20%. They also proposed vehicle speeds on unpaved surfaces would be limited to 15 mph to guarantee low emission rates. Being proposed in new Rule 310 revisions.
9. Dust generating operations – visible emission limits	Revise Rule 310 to include revisions to the fugitive dust test methods contained in Rule 310, Appendix C and other improvements including a 50% opacity limit at any given time as observed in a single opacity reading (Subsection 301).	In addition to the 20 % opacity limit based on 12 or 24 time-averaged readings, Clark Co. AQR Section 94 limits visible emissions from construction activities to a 50% opacity using the instantaneous method. Clark Co. MSM analysis 6.3.3.4; AQR 94.6.8(d); AQR 94.6.8(b) Being proposed in new Rule 310 revisions.
10. Unpaved haul road and trackout controls[6]	Strengthen and better enforcement of fugitive dust control rules at stationary sources.	

[6] The large majority of industrial sources reporting emissions from unpaved haul roads report control efficiency of 70% and control capture of 100%. The rule effectiveness study conducted in 2003, estimated the compliance rate for Rule 316 at 89.7% and for Rule 310 at 77.3%, Bob Downing will adjust the industrial source emission estimates for modeling purposes accordingly.

Potential Reductions from MCESD Control Measures

1. **WIND EROSION – CONSTRUCTION**

BACKGROUND INFORMATION:

Per Phil Denee 10/6/03 no controls included in 10/1/03 Emissions Summary by Category. xls

1999 MAG Serious Area Plan (p. V-10) – Assumptions related to the control of windblown emissions from construction sites were revised to be consistent with the assumptions related to control of construction-activity generated fugitive dust. It was assumed that construction sites on the regional scale used the following control measures equally: wind fences, chemical stabilizers, gravel, and watering. It was assumed that windblown emissions from construction sites were **70 percent controlled in 2006.** Because the base case emissions were assumed to be 20 percent controlled, raising the control to 70 percent for 2006 will provide 62.4 percent control of the base case emissions for 2006. The acreage of construction activity that was used to estimate total construction emissions in the MAG Serious Area Plan was based on the permitted acres of construction. Therefore, only emissions from permitted construction activities appear in the Serious Area Plan inventory and a rule penetration of 100 percent was used for Rule 310 with regard to construction activities.

Evaluation for Compliance with the 24-hour PM10 Standard for the West Chandler and Gilbert Microscale Sites, ADEQ, June 1999, p.3-5 – Road and Housing Construction – Control measures for reducing PM10 emissions from disturbed areas that are a result of road and housing construction include: 1) chemical stabilizers, which have a control efficiency of 82 to 90%; 2) watering to maintain adequate soil moisture, with a control efficiency of 90%; and 3) watering to maintain a crust on the surface of the soil when and area is inactive, with a control efficiency of 90%. To be effective, the soil crust should be at least 0.6 cm thick and not easily crumble between the fingers. A control efficiency of 90% was used in modeling this type of measure.

Salt River Inspection Results for earthmoving dated 10/2/03 – showed average rule effectiveness "compliance rate" of 80.0%.

PROPOSED CONTROL MEASURE:

- Change requirement for water application system on site from 1 acre to 0.50 acres.

PROPOSED CONTROL EFFECTIVENESS:
Proposed 2002 control effectiveness – 90% control efficiency * 70% = 63% overall control effectiveness
2006 control effectiveness - 90% control efficiency * 78% compliance rate = 70% overall control effectiveness

Example:
2002 Wind Erosion Construction uncontrolled = 50.71 mtpd
2002 Wind Erosion Construction 63% controlled = 18.76 mtpd
2006 Wind Erosion Construction 70% controlled = 15.21 mtpd

2. **WIND EROSION - VACANT LOTS**

BACKGROUND INFORMATION:

Per Phil Denee 10/6/03 no controls included in 10/1/03 Emissions Summary by Category.xls

1999 MAG Serious Area Plan (p. V-21) – MAG assumed that 76 percent of the disturbed vacant land in the nonattainment area is disturbed vacant lots. Assumptions related to the effectiveness of control measures (local govt and Rule 310 commitments) on the emissions from disturbed vacant lots were based on the effectiveness reported in the ADEQ microscale plan. It assumed that an equal number of vacant disturbed lots would be treated with mulch or vegetative cover, treated with gravel, and treated with chemical stabilizers. **Emissions from vacant disturbed lots were assumed to be 71 percent controlled in 2006**. Since vacant disturbed lots comprise 76 percent of disturbed vacant land, the 71 percent control level only applies to 76 percent of the disturbed vacant land emissions. A 100 percent rule penetration was assumed to be reasonable for Rule 310 application to vacant lots.

Clark Co. PM10 State Implementation Plan, June 2001, p. L-11 – Clark Co. has committed to hiring ten new enforcement department staff members to implement enforcement for wind erosions – vacant land, unpaved parking and race tracks. A 80% rule compliance will be in place by Jan. 1, 2002. Rule compliance will be "ramping up" during 2001 and a rule compliance of 40 percent was used as a default prior to 2002. For construction – activities, wind erosions and trackout, Clark Co. committed to a similar increase in enforcement staff. Currently, there are seven enforcement officers that inspect construction sites. Clark Co. AQD committed to hiring three additional enforcement officers to enforce the new Section 94 regulation. Due to the current 30 percent deficit in enforcement officers, the default rule effectiveness was reduced 24 percent (30 percent reduction of 80 percent) in 2001 to 56 percent due to lack of sufficient enforcement.

Salt River Inspection Results for vacant lots dated 10/2/03 – showed average rule effectiveness "compliance rate" value of 62.1%.

PROPOSED CONTROL MEASURES:

- Clarify Rule 310 and 310.01 subsection 302 stabilization standards by including text from Appendix C 2.2.
- Enhance vacant lot enforcement and compliance program by hiring inspection and enforcement staff dedicated to open areas and vacant lots.

PROPOSED CONTROL EFFECTIVENESS:

Proposed 2002 control effectiveness - 90% control efficiency * 62 % compliance rate = 55% overall control effectiveness

- Adding 4 additional inspectors would allow inspection of 20% of the vacant lots. And focused inspections during wind events over 15 mph per national weather service bulletin.

2006 control effectiveness - 90% control efficiency * 79% compliance rate = 71% overall control effectiveness

Example:
2002 Vacant Lots uncontrolled = 106.27 mtpd
2002 Vacant Lots 55% controlled = 47.82 mtpd
2006 Vacant Lots 71% controlled = 30.82 mtpd

3. CONSTRUCTION ACTIVITY TOTAL - RESIDENTIAL AND INDUSTRIAL CONSTRUCTION

BACKGROUND INFORMATION:

Salt River EI Methodology, Rough Draft – September 30, 2003, p. 11

Controlled PM10 = Uncontrolled PM10 emission x 90% x 90%
Uncontrolled PM10 emission x 0.80 (round-off)

1999 MAG Serious Area Plan (p. V-10) The effect of Rule 310 on general construction emissions, those resulting from active construction processes, is based on an assumed compliance rate of 80% and the effectiveness reported in the ADEQ microscale plan for earth moving (water to the depth of cut 90%). It was assumed that PM10 emissions resulting from **construction activities are 72 percent controlled in 2006**. Because the base case emissions were assumed to be 18 percent controlled, raising the control to 72 percent for 2006 will provide a 66 percent control of the base case emissions for 2006.

Clark County estimated that the improved test methods we are in the process of implementing should improve their rule's effectiveness by 16% (20% X 80%).

PROPOSED CONTROL MEASURES:

- Lower the requirement to have a water application system on site from 1 acre to ½ acre (Rule 310 subsection 308.7). Being proposed in new Rule 310 revisions.
- Require trained "dust control monitor" on site for construction projects with 10 acres or greater of active, disturbed area and all sand and gravel operations who would direct dust control activities to maintain compliance with a 20% opacity limit.[7]
- Revise Rule 310 requirement for the use of track out control devices from projects with > five acres of disturbed area to projects with > one acre of disturbed area (subsection 308.4 a.1). Being proposed in new Rule 310 revisions.[8]
- Revise Rule 310 bulk material hauling/transporting (Table 11) to include the following a requirement to "empty loader bucket slowly and keep loader bucket close to the truck to minimize the drop height". Being proposed in new Rule 310 revisions.
- Revise Rule 310 table 2, 6, 13, and 18 (during construction) to include as a contingency measure "limiting vehicle speeds to 15 mph on the work site" Being proposed in new Rule 310 revisions.
- Revise Rule 310 to include revisions to test methods and other improvements including a 50% opacity limit using the instantaneous method or no single reading over 50% opacity. Being proposed in new Rule 310 revisions.

PROPOSED CONTROL EFFECTIVENESS:

Proposed 2002 control effectiveness = Reduce the 72% by 16% = 56% overall rule effectiveness
2006 control effectiveness = 90% control efficiency * 80% compliance rate = 72% overall rule effectiveness

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[7] Final BACM Technological and Economic Feasibility Analysis, Sierra Research, March 21, 2003, p. 41-43:
San Joaquin Valley assumed that monitoring would demonstrate the need for additional dust control effectiveness, which would be satisfied by the operation of an additional water truck on a continuous basis to reduce emissions from all fugitive PM10 sources. days. The control efficiency of construction dust control measures implemented under an apporved dust control plan were estimated from data reported by the Bay Area power plan construction inspectors and data collected by MRI. Base on the data provided in the Bay Area construction reports, Sierra Research estimated that a 50-acre residential construction project would use two 4,000 gallon water trucks operating continuously to water 30% of the construction site (15 acres) that would be actively disturbed due to earthmoving operations on any one day. Operating continuously, these water trucks would cover the 15 acres every 3.2 hours. The MRI study indicates that the average control efficiency provided by watering actively disturbed areas on this frequency would be 60.6%. The use of one additional water truck would reduce the watering frequency to every 2.1 hours. At this frequency, the MRI report indicates that the average control efficiency would be 73.7%. The emission reduction that would occur on 5% of the days on which the monitoring system would record exceedances of the PM10 concentration increment would be 0.29 tons or 586 pounds of PM10. These latter values, then, represent the emission reduction benefits of conducting monitoring at a 50-acre residential construction sites.

[8] 1999 MAG Serious Area Plan (p.V-9) assumed that methods used to remove and/or control trackout from construction sites resulted in 72% control in 2006 (because the base case emissions were assumed to be 18 percent controlled, raising the control to 72 % for 2006 will provide 66 % reduction from base case emissions.).

Example:
2002 Construction Activity Total – 80% controlled = 1.91 mtpd
2002 Construction Activity Total – uncontrolled = 9.55 mtpd
Proposed 2002 control effectiveness – 56% controlled ([1-.56] * 9.55)= 4.20
2006 Construction Activity Total – 72 % controlled ([1-.28] * 9.55) = 2.67

4. INDUSTRIAL SOURCE EMISSIONS – AREA/POINT

BACKGROUND INFORMATION:
According to Bob Downing industrial source emissions inventory report 70% control efficiency and 100% capture efficiency.

Revise capture efficiency to be consistent with rule effectiveness study.

Rule effectiveness study results show 89.7% compliance rate for Rule 316 and 77.3% control efficiency for Rule 310.

PROPOSED CONTROL MEASURES

- Strengthen and better enforcement of fugitive dust control rules at stationary sources.

PROPOSED CONTROL EFFECTIVENESS:
Proposed 2002 control effectiveness for Rule 310 = 77% compliance rate * 70% control efficiency = 54% overall rule effectiveness
2006 control effectiveness = 70% control efficiency * 80% compliance rate = 56% overall rule effectiveness

Proposed 2002 control effectiveness for Rule 316 = 80% compliance rate * 70% control efficiency = 56% overall rule effectiveness
2006 control effectiveness = ???

APPENDIX U – UNPAVED ROAD SHOULDER EMISSIONS

The contribution of wake effects and trackout from unpaved road shoulders were accounted for in the Salt River PM_{10} Emissions Inventory. However, the contribution of parking and driving on unpaved road shoulders, and wind erosion of unpaved road shoulders were not included in the inventory due to their very small contribution.

The predicted impacts on ambient PM_{10} levels if the emissions from parking and driving on unpaved road shoulders, and wind erosion of unpaved road shoulders had been included in the inventory is included below.

I. Change in PM_{10} Emissions

Table 1 lists the predicted emissions from unpaved road shoulders for the above five categories for high-wind and low-wind days.

TABLE U-1 Unpaved Road Shoulder Emissions (Metric Tons PM_{10} / Day)		
Category	**High-Wind Day**	**Low-Wind Day**
Included in Inventory:		
Wake Effects	0.13	0.13
Trackout	0.04	0.04
Total	0.17	0.17
Not Included in Inventory:		
Parking	0.003	0.003
Driving	0.016	0.016
Wind Erosion	0.280	--
Total	0.299	0.019

Thus, the emissions from unpaved road shoulders would increase by only 0.299 tons per day for high-wind days and 0.019 tons per day for low wind days if the emissions from parking and driving on unpaved road shoulders, and wind erosion had been included in the inventory. For comparison, the total PM_{10} emissions on the April 15, 2002 high-wind day were 168.43 metric tons /day and the total PM_{10} emissions on the January 8, 2002 low-wind day were 6.25 metric tons/day. This translates to a 0.18% increase in total PM_{10} emissions for high-wind days and a 0.30% increase in total PM_{10} emissions for low-wind days.

II. Change in Predicted Ambient PM_{10} Levels

Tables U-2 and U-3 show the change in predicted ambient PM_{10} levels for high-wind days and low-wind days for the Year 2006 out year when the PM_{10} emissions from parking and driving on unpaved road shoulders, and wind erosion of unpaved road shoulders are included. (Note: design days correspond to PM_{10} exceedance days recorded during Salt River monitoring study)

TABLE U-2
Comparison of Predicted Ambient PM_{10} Levels ($\mu g/m^3$)
Before and After Including Additional Emissions
from Unpaved Road Shoulders on Low-Wind Days

Emissions Inventory	January 8, 2006 Low-Wind Design Day	December 16, 2006 Low-Wind Design Day
	Salt River Monitor	West 43rd Avenue Monitor
2006 PM_{10} Emissions Inventory – Original	129	138
2006 PM_{10} Emissions Inventory – Revised*	129.03	138.51
Increase in Ambient PM_{10} Levels	0.03	0.51

* Revised emissions inventory includes additional emissions from parking and driving on unpaved road shoulders, and wind erosion of unpaved road shoulders

TABLE U-3
Comparison of Predicted Ambient PM_{10} Levels ($\mu g/m^3$)
Before and After Including Additional Emissions
from Unpaved Road Shoulders on High-Wind Days

Emissions Inventory	April 15, 2006 High-Wind Design Day			April 26, 2006 High-Wind Design Day		
	Durango Complex Monitor	Salt River Monitor	W. 43rd Avenue Monitor	Durango Complex Monitor	Salt River Monitor	W. 43rd Avenue Monitor
2006 PM_{10} Emissions Inventory – Original	144	128	141	130	140	94
2006 PM_{10} Emissions – Revised*	144.86	128.01	141.79	130.27	140	94
Increase in Ambient PM_{10} Levels	0.86	0.01	0.79	0.27	0	0

* Revised emissions inventory includes additional emissions from parking and driving on unpaved road shoulders, and wind erosion of unpaved road shoulders

In conclusion, Appendix U demonstrates that the contribution of parking and driving on unpaved road shoulders, and wind erosion of unpaved road shoulders to ambient PM_{10} levels in the Salt River PM_{10} Study Area is negligible.