FINAL

Salt River PM_{10} State Implementation Plan Revision

Technical Support Document

AIR QUALITY DIVISION

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1.0 CHAPTER 1 - SALT RIVER PM_{10} ANALYSIS - INTRODUCTION

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 of mass of particles per volume of air: specifically, as micrograms per cubic meter (µg/m3), are 150 µg/m3 for 24 hours and 50 µg/m3 for annual.

Metropolitan Phoenix, which has not attained the annual standard PM_{10} all monitoring sites, is under a State Implementation Plan to achieve this standard by 2006 (MAG 1999). This plan 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 in 1994, the Salt River PM_{10} monitoring site near 19th Avenue and Lower Buckeye Road has recorded violations of the 24-hour PM_{10} standard every year. The site was supposed to attain the standard by 1998, as detailed in the above mentioned technical analysis. That it did not achieve the standard has led the EPA to take action. This action came in the form of a State Implementation Plan (SIP) call in December 2001. This “SIP call” means that the State must submit within 18 months a demonstration that the 24-hour PM_{10} standard can be attained by the end of 2006. This entire report constitutes 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. Efforts to find a suitable replacement site with comparable PM_{10} concentrations and industrial emissions were conducted 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 kinds of work were done:

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. Following this is a brief description of PM_{10} concentrations throughout the metropolitan area, whose intent is 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're 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 show three sites exceeded the 24-hour standard of 150 µg/m3; and that most sites are well within the standards. 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:

	µg/m3
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

(units are in µg/m3)

Site or City	Method	24-Hour Average	
		Max Value	2nd High
Phoenix – Salt River *	Hi-Vol	**243**	**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/m3 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/m3 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}

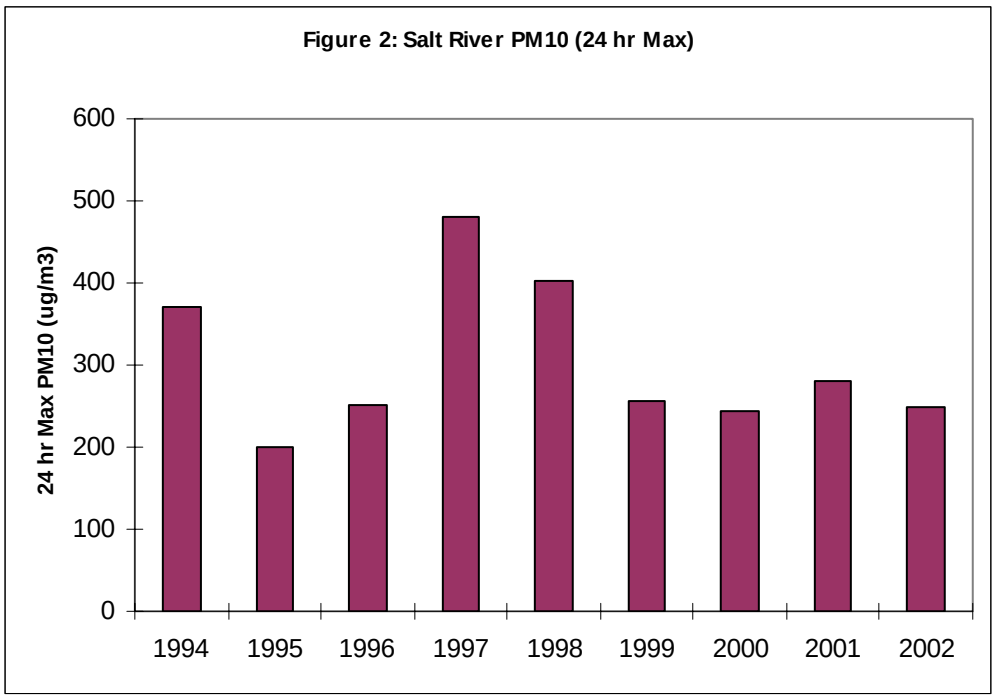
Study area. The longer-term considerations speak to the duration of the elevated PM_{10} concentrations in the area.

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



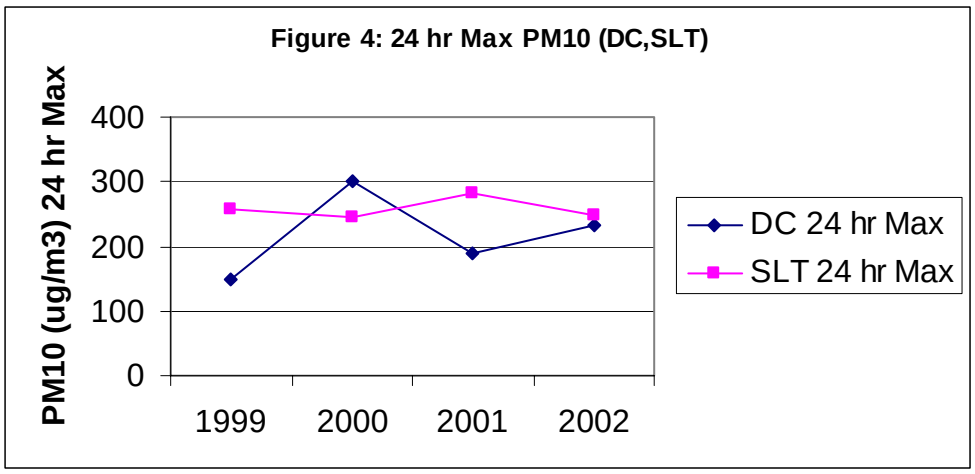
The 24-hour maximums are high in 1997 and 1998 (400 g/m3 and higher), but they are significantly lower from 1999 through 2002 . However, all of the 24-hour maximums exceed the 150 g/m3 requirement. When compared with other sites in this area (Durango and South Phoenix), as in Table 1-2 the Salt River 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



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/m3. 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)

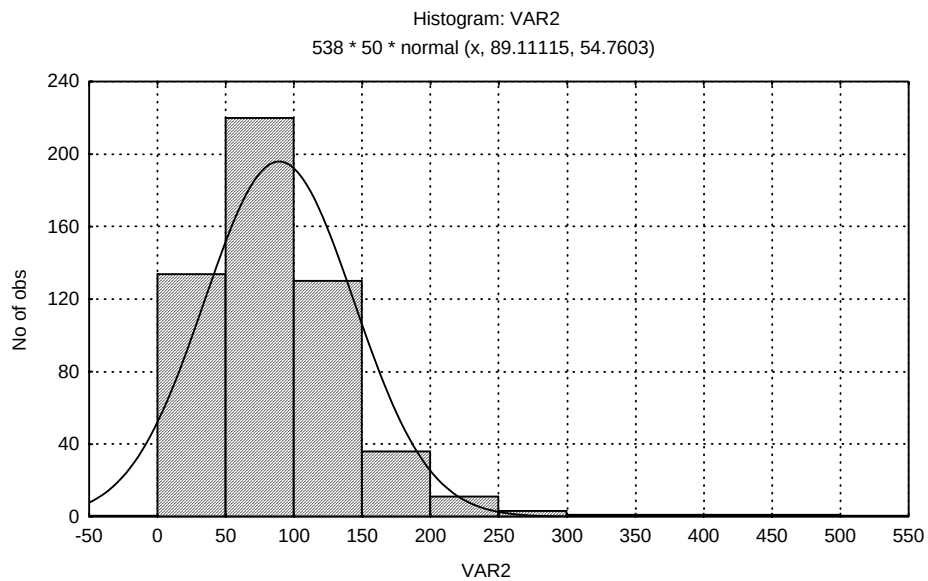
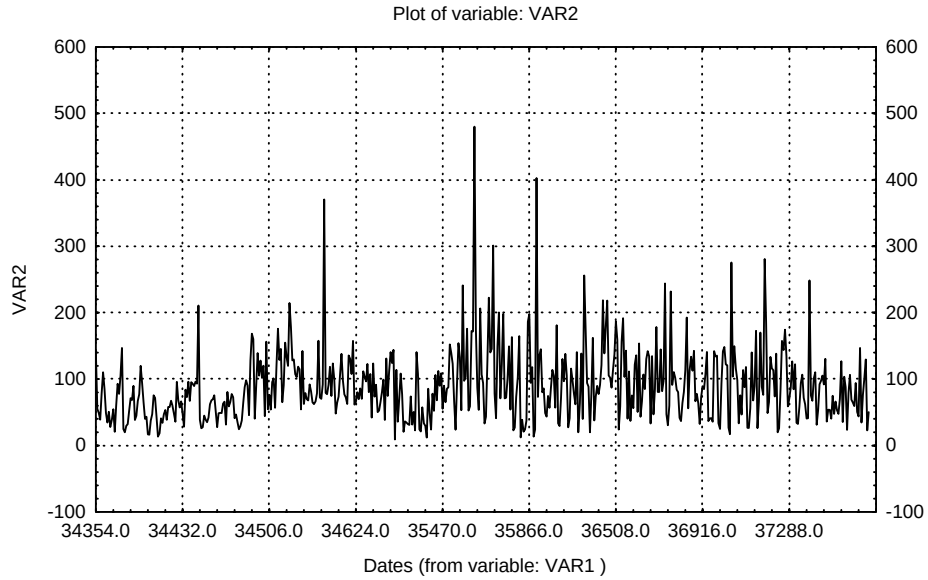


Figure 1-4 24 hour average PM_{10} trends 1994-2002 at Salt River Site



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/m3 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

[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/m3 – 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 PM10 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/m3.

Table 2-3. Study-period PM10 statistics

statistic	Salt River	West 43rd	Durango	South Phoenx
9-mon 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/m3.

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

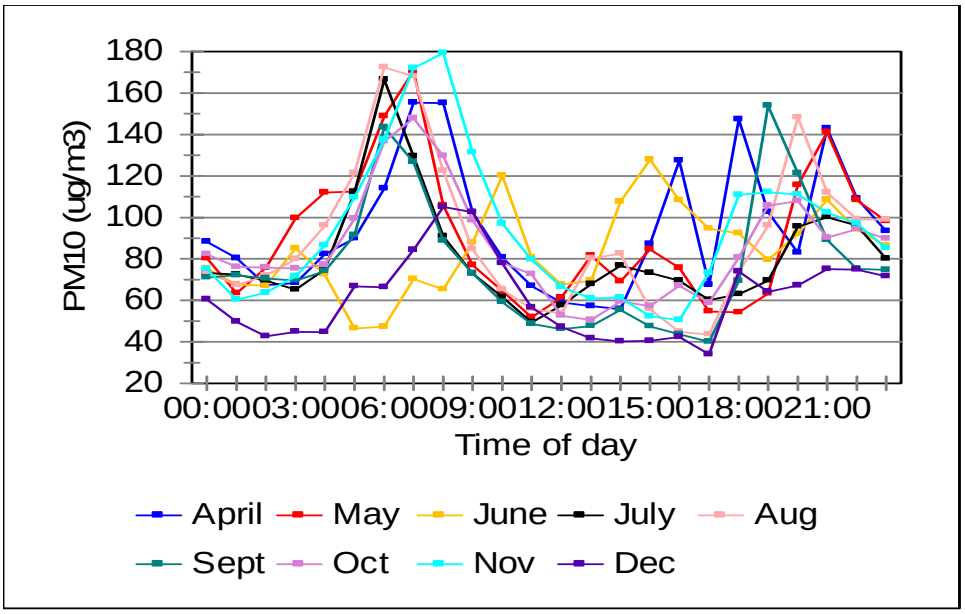


Figure 2-2: Diurnal Variation of PM_{10} at Durango Complex Monitor May-December 2002

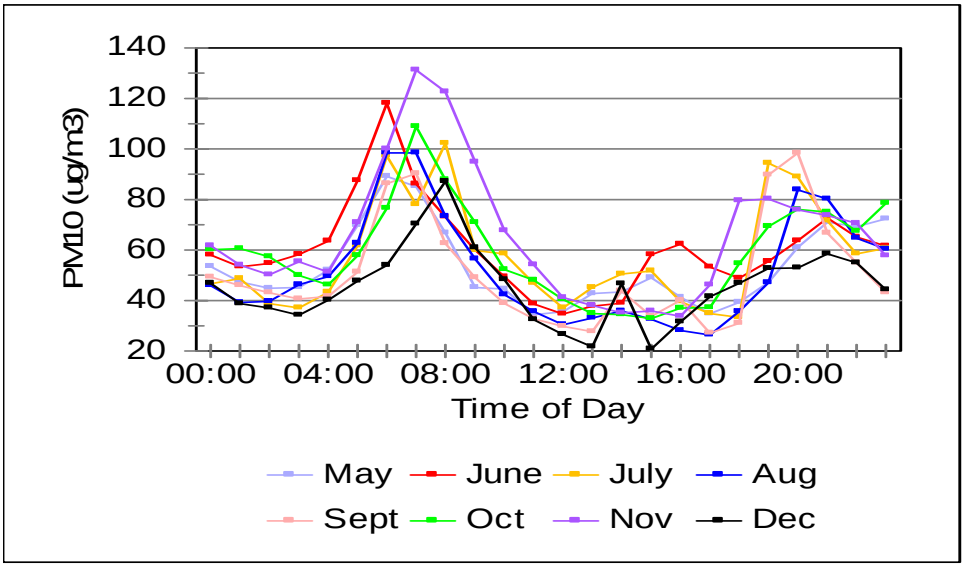


Figure 2-3 Diurnal Variation of PM_{10} at South Phoenix Monitor

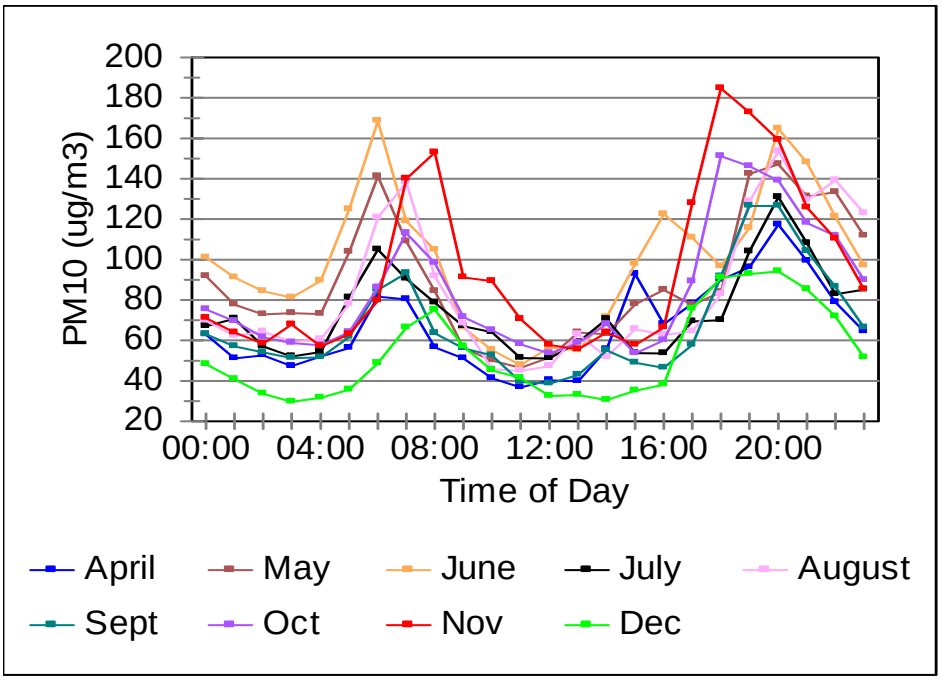


Figure 2-4 Diurnal Variation of PM_{10} at West 43rd Avenue Monitor April-December 2002

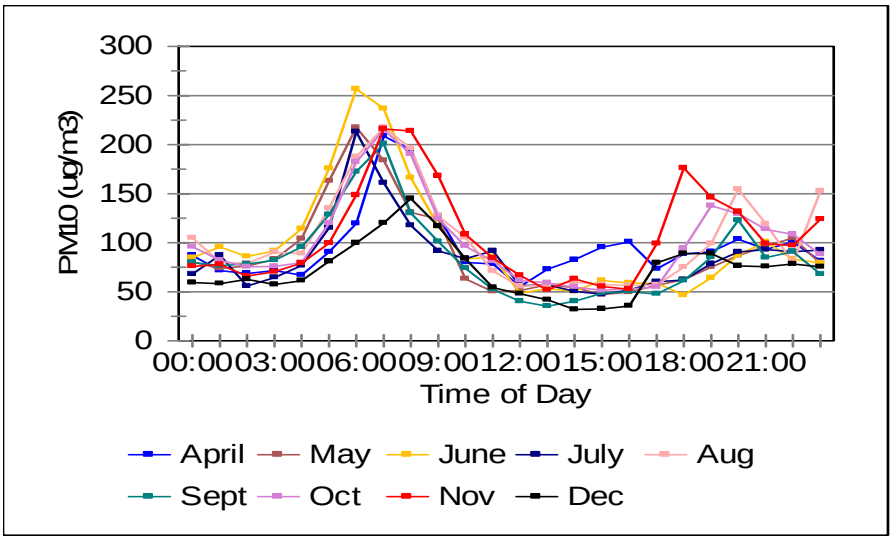
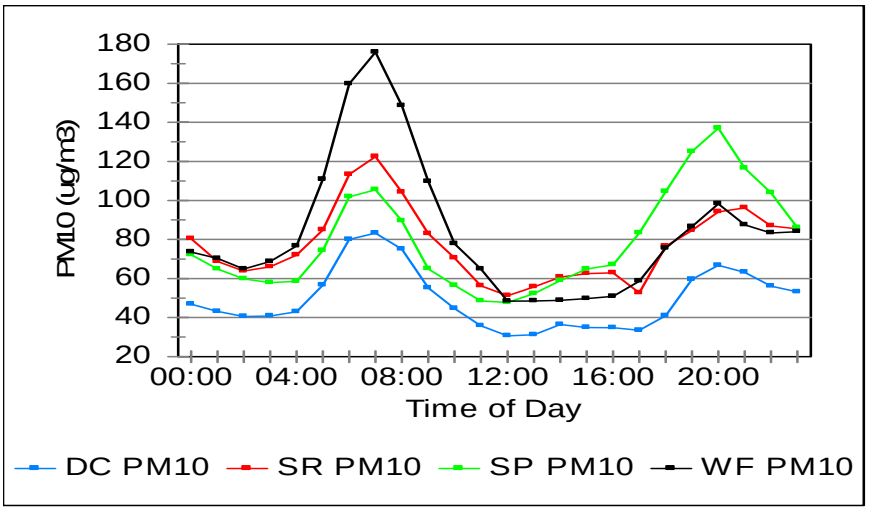


Figure 2-5: Diurnal Variation Comparison of 4 Sites



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 Peak values and times of day at Salt River Study area sites during the study period (μg/m3)

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

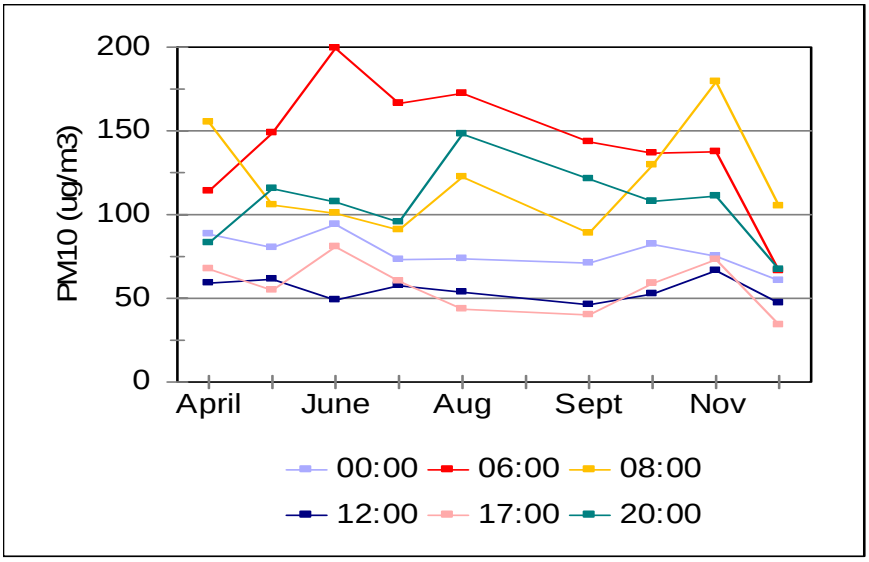


Figure 2-7 Monthly Variation of PM_{10} Values for Durango Monitor by Time of Day

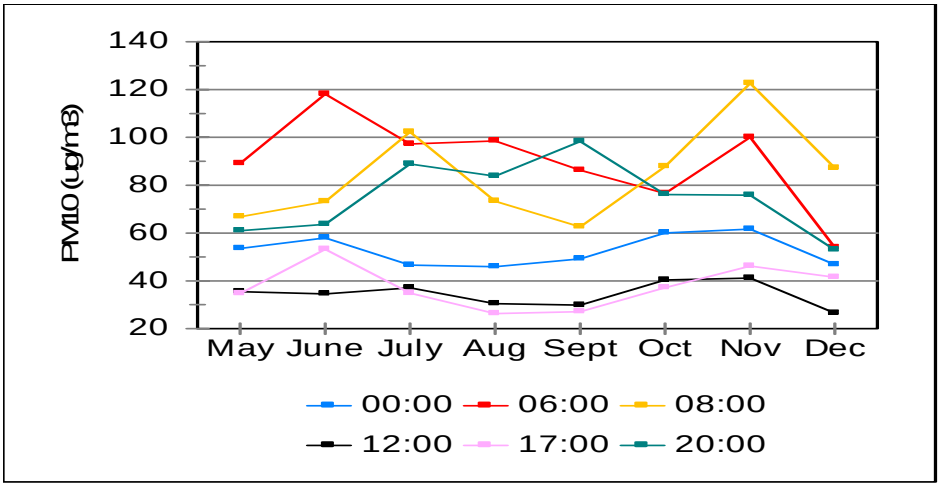


Figure 2-8 Monthly Variation of PM_{10} for West 43rd Avenue Monitor by Time of Day

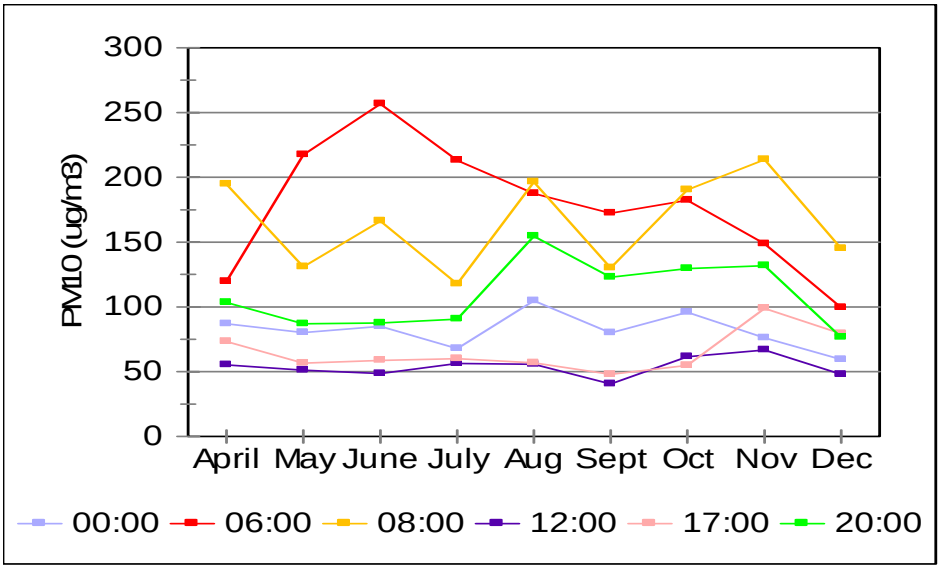
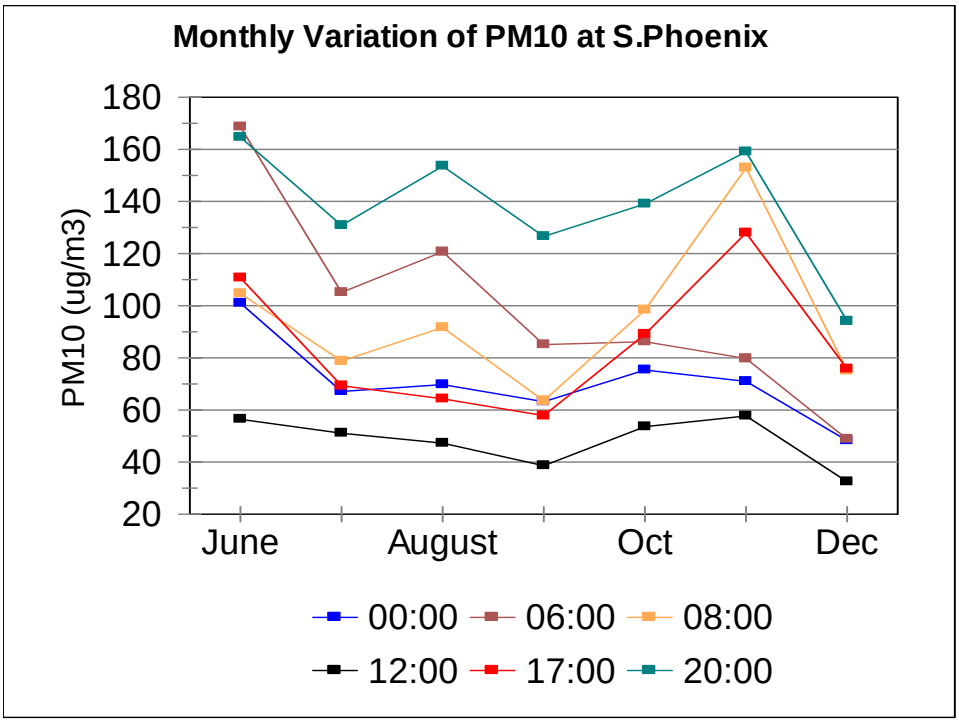


Figure 2-9 Monthly Variation of PM_{10} Values at South Phoenix Monitor by Time of Day



2.6 CONCLUSIONS

PM10 concentrations in the Salt River PM10 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/m3 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

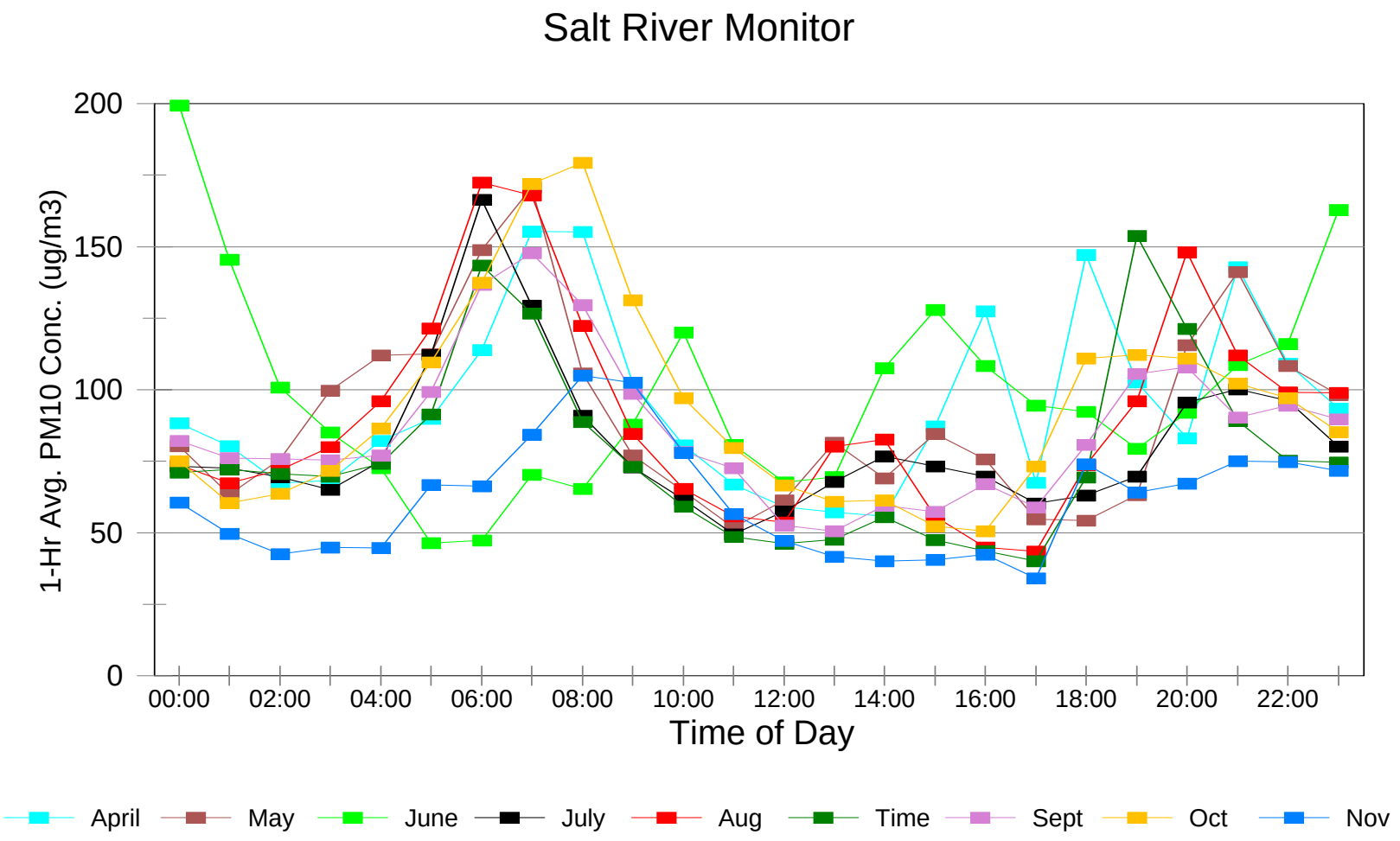
PM_{10} concentrations measured at the Salt River site were discussed in the previous chapter. What follows here are a table of the maximum 24-hour averages through the years and a figure that shows the diurnal variation of PM_{10} by month.

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)



PM10 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 PM10 measured in the Salt River PM10 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 PM10 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 PM10 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 PM10 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

PM10 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 43rd Avenue Monitor, April – Dec 2002

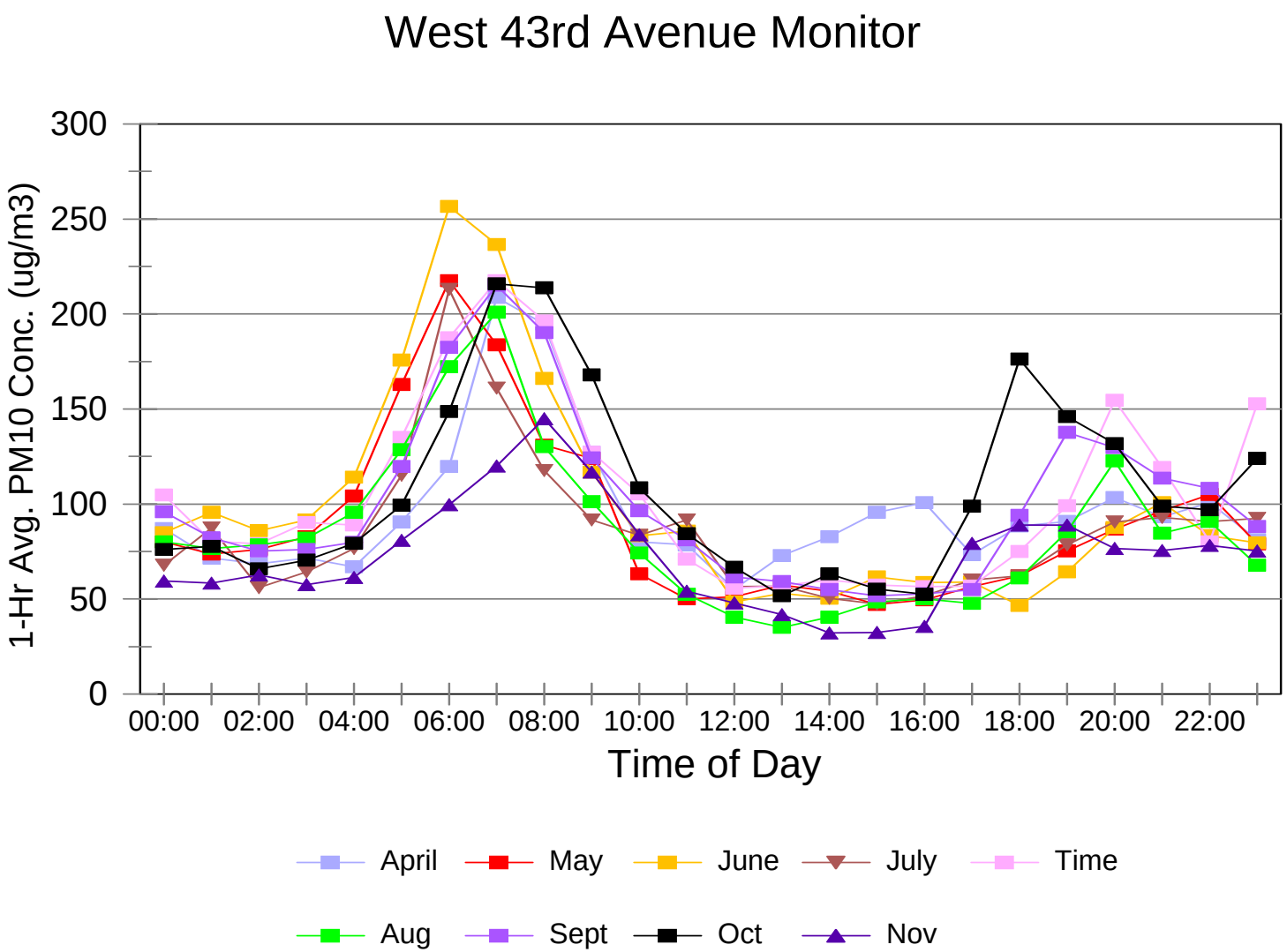


Figure 3-4 IKONOS Satellite Photograph of the Area Showing the Location of the W. 43rd Avenue Monitor

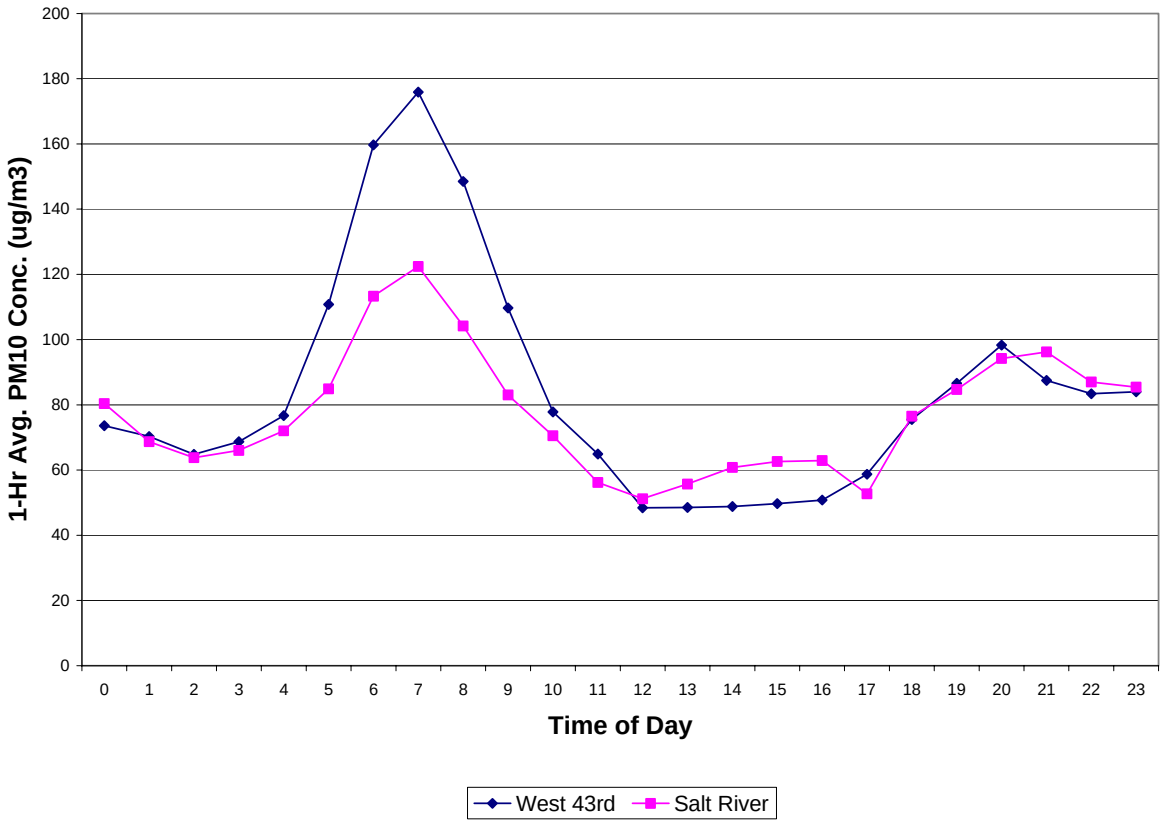
Similar to Figure 3-2, Figure 3-3 shows the land use around the West 43rd Avenue site. Broadway Road with an average daily traffic count of 4,500 vehicles per day, curves across the lower part of the image. Residential housing is in the lower right; bare land that extends north to the bed of the Salt 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 PM10 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 PM10 concentrations throughout the Salt River PM10 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 PM10 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 PM10 maximum concentrations were 249, 184, and 174 ug/m3, with the first two under high wind conditions. At West 43rd Avenue, the highest PM10 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 PM10 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 future year 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.

Following are the four major anthropogenic PM_{10} emission categories that were investigated:

- 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 3-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
- 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

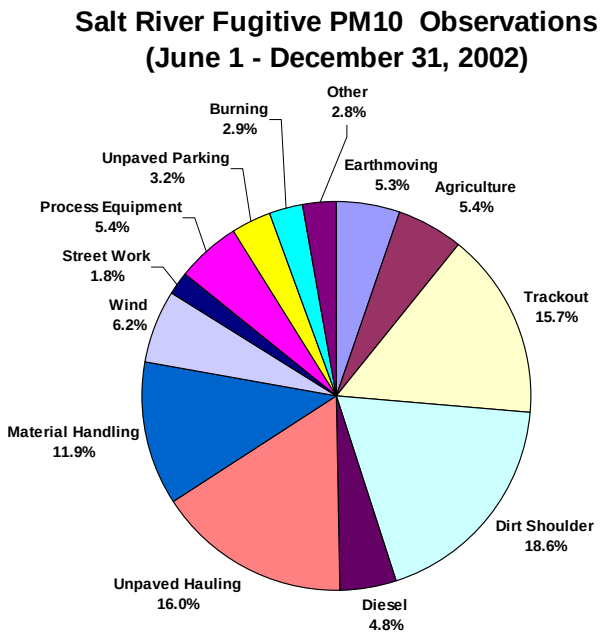


Figure 4-2

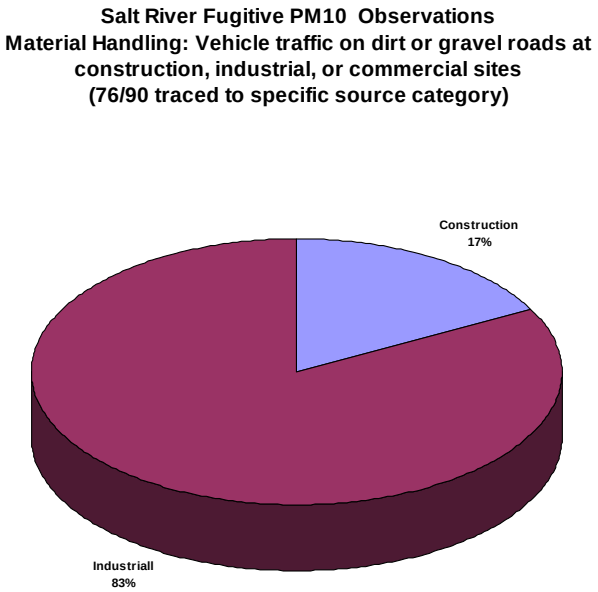


Figure 4-3

Salt River Fugitive Dust Observations
Trackout: Any evidence of bulk material on paved street surface
(50/113 traced to specific source)

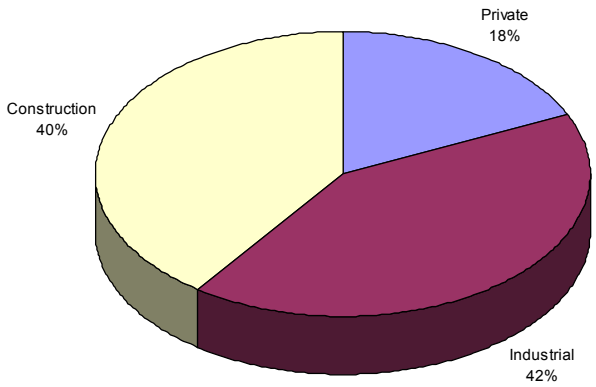
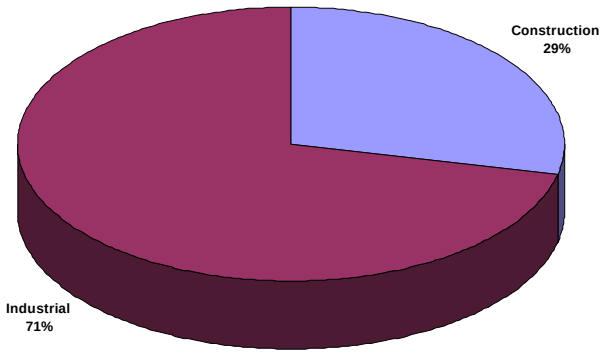


Figure 4-4

Salt River Fugitive PM10 Observations
Unpaved Hauling:Vehicle traffic on dirt or gravel roads at construction, industrial, or commercial sites
(84/121 traced to specific source category)



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. Following are the road locations that 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):

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

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

$$E_{pri} = (EF_{paved\ road}) / (1{,}600\ m/mi)\ x\ L)\ x\ (Veh/hr / 3{,}600\ sec/hr)$$

where:

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

EF = Paved road emission factor in g/VMT = 2.13 g/VMT

L = Length of primary paved road (meters)

Veh/hr = Vehicles per hour

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:

$$E_{road\ shoulder} = (EF) / (1{,}600\ m/mi) \times L_t) \times (Veh/hr / 3{,}600\ s/hr)$$

where:

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

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

L_t = Total length of unpaved shoulders in grid cell (meters).

Veh/hr = Total number of vehicles per hour (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). Based on an earlier ADEQ construction trackout study and the data from ADEQ's site visits, it was estimated that long-term trackout increased the paved road emission factor by 25% for the section of 43rd Avenue south of Lower Buckeye Road**.**

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.

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

Photos taken September 22, 2003

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. 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 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. Following is the wind erosion emission factor equation.

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 above 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 threshold for wind erosion is an important factor in estimating emissions for a windblown dust episode. As previously discussed, there have been portable wind tunnel studies conducted in Arizona that report 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 = 18.7614 metric tons / day

(See Table 4-4 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 D 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 Count 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

[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.

practices, gives this measure a midpoint control efficiency of 9.3%. However, this 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 emissions reduction from this control measure was 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 D) 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:

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

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 PM10 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 D) 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 D 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 metric tons PM_{10} / 2,355,900 people) x 1,000,000 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 g / person / day $\times$ 100 people = 2.76 g PM_{10}

Due to the very small amount of emissions from this source (2.43×10^{-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. Eighty-one industrial sources were identified as operating in the study area during 2002. See Appendix A for a satellite image showing the locations of the eighty-one 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 eighty-one 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 eighty-one 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, thirty-six sources were selected to be modeled separately in the ISCST3 model (see Chapter 5 for modeling discussion) and the remaining forty-five sources had their emissions added to the grid cell where the source was located. See Appendix E 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 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

MCESD Year 2001 emissions data for industrial sources were used to select which industrial sources in the Salt River PM10 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 thirty-six industrial sources that ADEQ had selected for separate modeling. Thus, ADEQ used Year 2002 emissions data for the thirty-six sources and Year 2001 emissions data for the remaining small sources in their modeling. Emissions from the thirty-four sources (Year 2002 data) are approximately 98% of the emissions in the study area, and emissions from the remaining forty-five 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 wind blown 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 (AP-42) of 18.8 lbs/acre/hour.

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 wind blown 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

Following is a summary of the PM_{10} emissions in the Salt River PM_{10} Study Area for the Year 2002. 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.

Table 4.2 lists the land use totals for emission sources that are not industrial sources.

TABLE 4-2 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**	**31,761,426 m^2**	**31,761,426 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		2,123,040 m^2	2,123,040 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 4-2 Salt River PM_{10} Emissions Inventory - YEAR 2002 Land Use Totals (meters or meters^2)				
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 4.3 lists the emission factors and rule effectiveness for applicable emission source categories. See Appendix G for MCESD's rule effectiveness study.

TABLE 4-3
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
• misc. disturbed areas	6.22 * 10-8 gm / (cm^2 – sec)	55%	MCESD Rule 310
Wind Erosion – Alluvial Channels	6.22 * 10-8 gm / (cm^2 – sec)	None	None

TABLE 4-3 Salt River PM_{10} Emissions Inventory - Year 2002 Emission Factors and Rule Effectiveness			
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
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
Unpaved Shoulders & Lots			
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

Table 4-4 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, and 4-8 depict these PM_{10} source categories by percent. As can be seen from Table 4-4 and the pie graphs in Figures 4-6 through 4-8, 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 4-4
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**	**123.55**	**123.55**	
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		19.02	19.02	
2. INDUSTRIAL SOURCES	**0.75**	**0.75**	**0.75**	**0.75**
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
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

TABLE 4-4 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
4. ONROAD MOBILE SOURCES	**3.88**	**3.88**	**3.88**	**3.88**
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**
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	**5.72**	**129.02**	**129.02**	**5.61**

Figure 4-6

Salt River PM10 Emissions

Low Wind Day - December 16, 2002

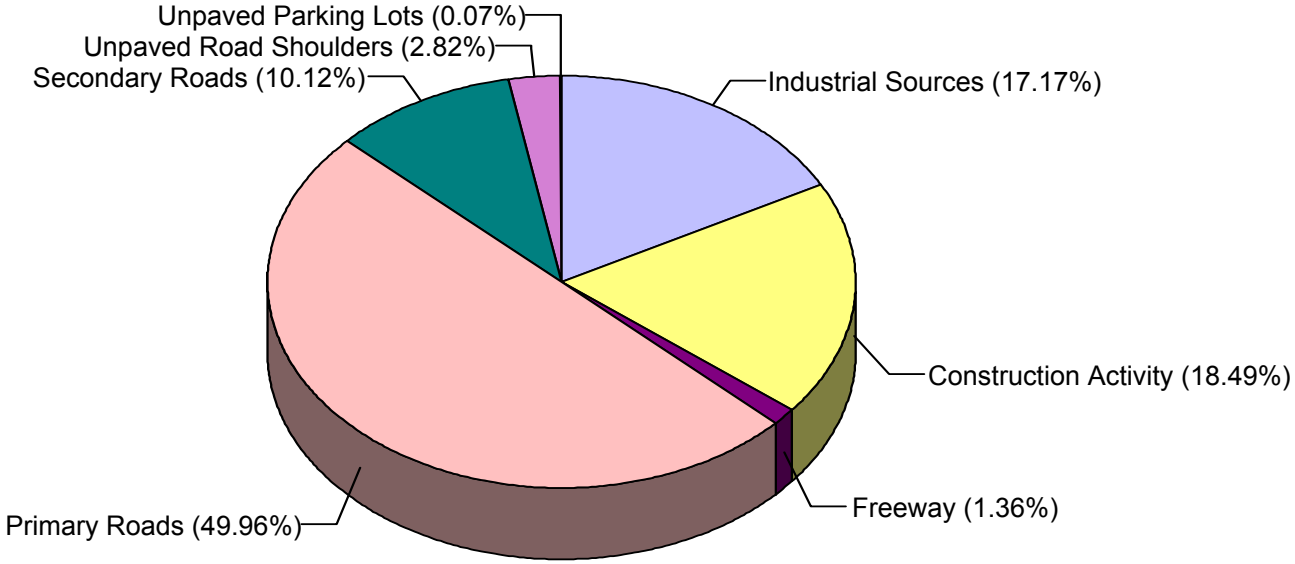
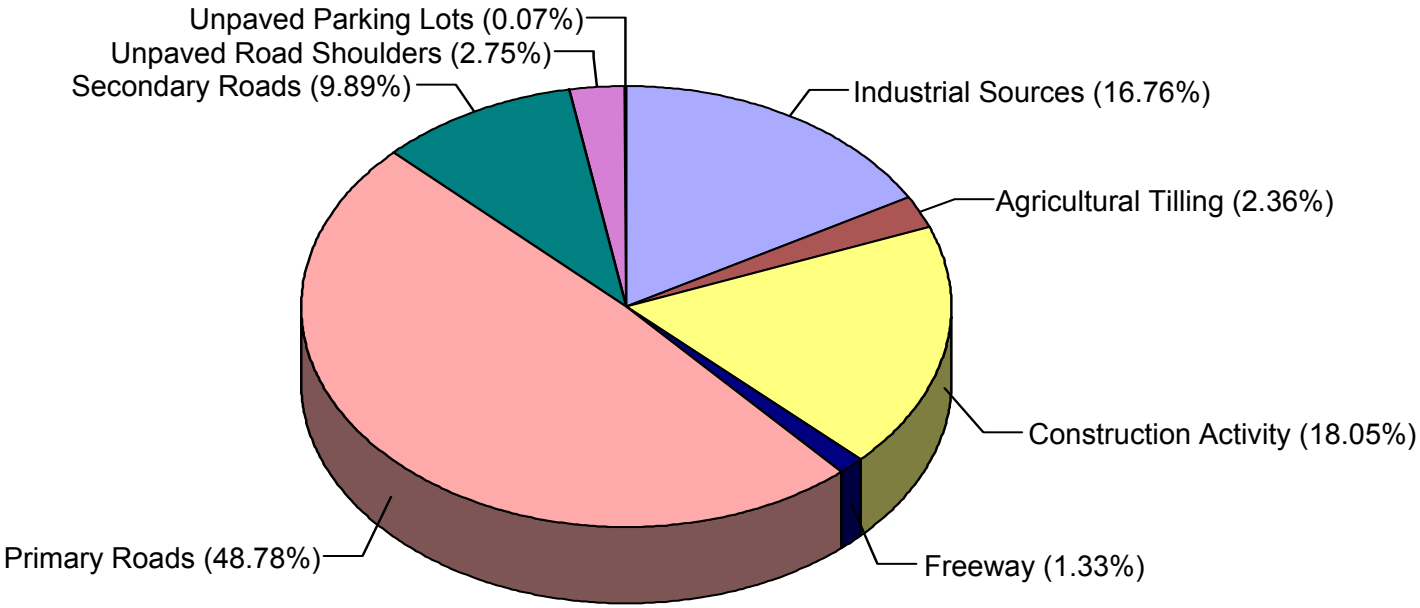


Figure 4-7

Salt River PM10 Emissions

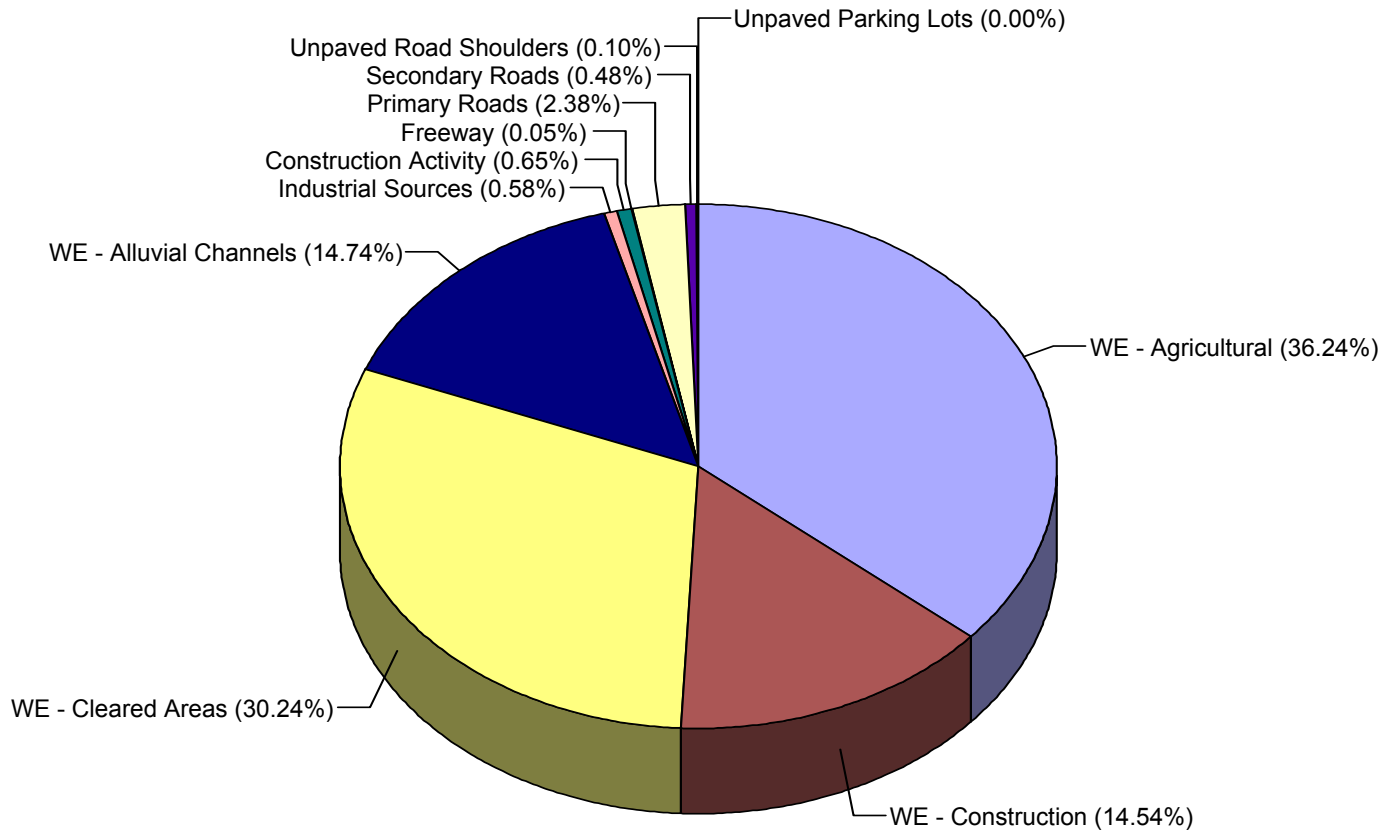
Low Wind Day - January 8, 2002



Salt River PM10 Emissions

High Wind Days - April 15 & 26, 2002

Figure 4-8



WE = Wind Erosion

4.5 PROJECTED YEAR 2006 EMISSIONS

The following emissions 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:

- *Agricultural Tillage.* The amount of agricultural land, and emissions from agricultural tillage, are projected to decrease 75% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003 and ADEQ analysis – see Appendix D).

- *Construction Activity.* Emissions from construction activity are projected to decrease due to MCESD strengthening Rule 310 to increase the rule effectiveness for this category from 56% to 72%.

- *Roads – Freeway, Primary, and Secondary.* Traffic is projected to increase 8% based on a modification of the MAG's 2003 Conformity Analysis. The conformity analysis estimates an increase of approximately 4% increase in VMT per year. This includes all road building projects and the projected population increase in Maricopa County. Since there are no plans for major road building projects in the Salt River PM_{10} Study Area, it is assumed that the increase in the study area's VMT will primarily result from population growth in the study area due to infilling and urban development.

- *Unpaved Parking Lots.* Emissions from unpaved parking lots greater than 0.10 acres are projected to decrease due to MCESD strengthening Rule 310 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 have 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 75% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003 and ADEQ analysis – see Appendix D).

- *Wind Erosion – Construction*. Emissions from wind erosion of disturbed areas due to construction are projected to decrease due to MCESD strengthening Rule 310 to increase the rule effectiveness for this category from 63% to 70%.

- *Wind Erosion – Vacant Lots and Misc. Disturbed Areas*. The amount of vacant lots and misc. disturbed areas is projected to decrease 13.6% due to conversion of vacant lots and misc. disturbed areas to residential and commercial uses. ADEQ estimated the decrease in vacant lots and misc. disturbed areas would parallel the conversion of agricultural land to residential and commercial uses (URS and ERG, 2001). In addition, MCESD is strengthening Rule 310 to increase the rule effectiveness for this category from 55% to 71%.

Following is 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 wind erosion control measure.

Example of Percent Reduction Emission Calculation:
MCESD strengthened Rule 310 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 or 36%

Table 4-5 lists the emission categories that showed a change in emissions between Year 2002 and Year 2006.

TABLE 4-5 Percent Change in Emissions Between Year 2002 and 2006		
Emission Category	**Percent Change in Emissions**	**Reason For Change**
AREA SOURCES		
Ag Tilling (Land Preparation)	-75%	Agricultural land projected to decrease 75% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003)
Wind Erosion – Agricultural	-75%	Agricultural land projected to decrease 75% due to conversion of agricultural land to residential and commercial uses (Maricopa County Farm Bureau, 2003)
Wind Erosion – Construction	-19%	MCESD strengthening Rule 310 to increase the rule effectiveness for this category from 63% to 70%.
Wind Erosion – Cleared Areas:		
• vacant lots	-36% -13.6%	MCESD strengthening Rule 310 to increase the rule effectiveness for this category from 55% to 71%. Projected building of residential and commercial areas.
• misc. disturbed areas	-36% -13.6%	MCESD strengthening Rule 310 to increase the rule effectiveness for this category from 55% to 71%. Projected building of residential and commercial areas
NONROAD MOBILE SOURCES		
Construction Activity	-36%	MCESD strengthening Rule 310 to increase the rule effectiveness for this category from 56% to 72%.
ONROAD MOBILE SOURCES		
Paved Roads		
Freeway - Interstate 17 Durango Curve	+8%	Traffic is projected to increase 8% based on the Maricopa Association Government's estimate of traffic increasing 2% per year (MAG, 1999
Primary Roads	+8%	Traffic is projected to increase 8% based on the Maricopa Association Government's estimate of traffic increasing 2% per year (MAG, 1999)
Secondary Roads	+8%	Traffic is projected to increase 8% based on the Maricopa Association Government's estimate of traffic increasing 2% per year (MAG, 1999)
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 Rule 310 to increase the rule effectiveness for this category from 55% to 71%.

Table 4-6 lists the major PM_{10} source categories in the Salt River PM_{10} Study Area for the four future design days in Year 2006. Figures 4-9 and 4-11 depict these PM_{10} source categories by percent. As can be seen from Table 4-6 and the pie graphs in Figures 4-9 through 4-11, 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 4-6
Salt River PM_{10} Emissions Inventory - Year 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	**0.03**	**67.48**	**67.48**	
Ag Tilling (Land Preparation)	0.03			
Wind Erosion – Agricultural		11.69	11.69	
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		19.02	19.02	
2. INDUSTRIAL SOURCES	**0.75**	**0.75**	**0.75**	**0.75**
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
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

TABLE 4-6 Salt River PM_{10} Emissions Inventory - Year 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*
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**
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

TABLE 4-6 Salt River PM_{10} Emissions Inventory - Year 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*
PM_{10} EMISSIONS - GRAND TOTAL	**5.51**	**72.96**	**72.96**	**5.48**
*** 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 4-7

Salt River PM10 Emissions

Low Wind Day - January 2006

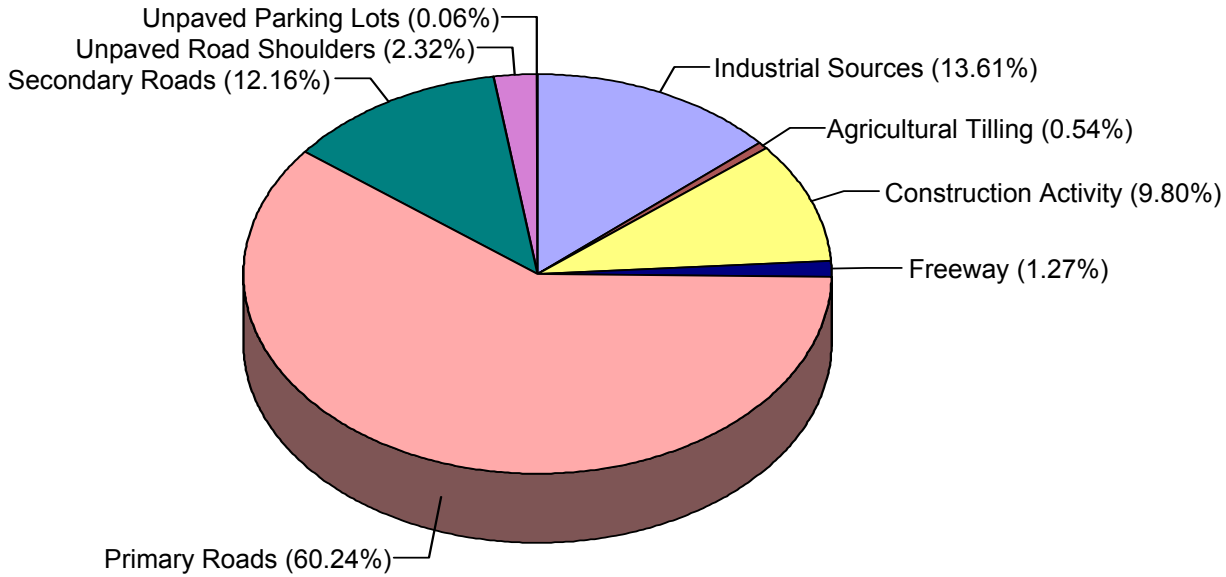
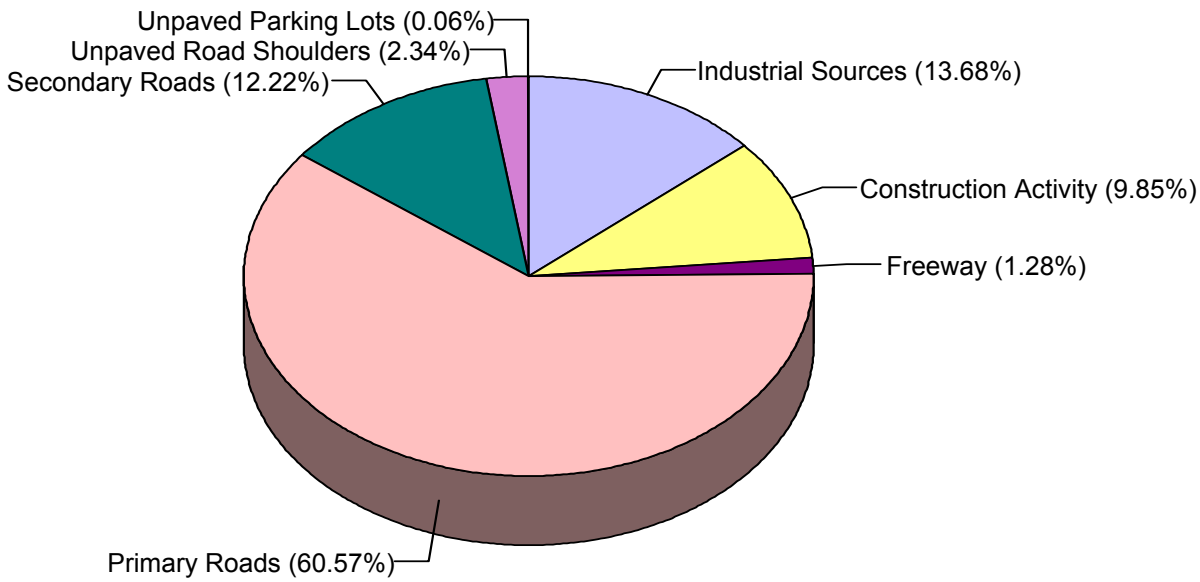


Figure 4- 8

Salt River PM10 Emissions

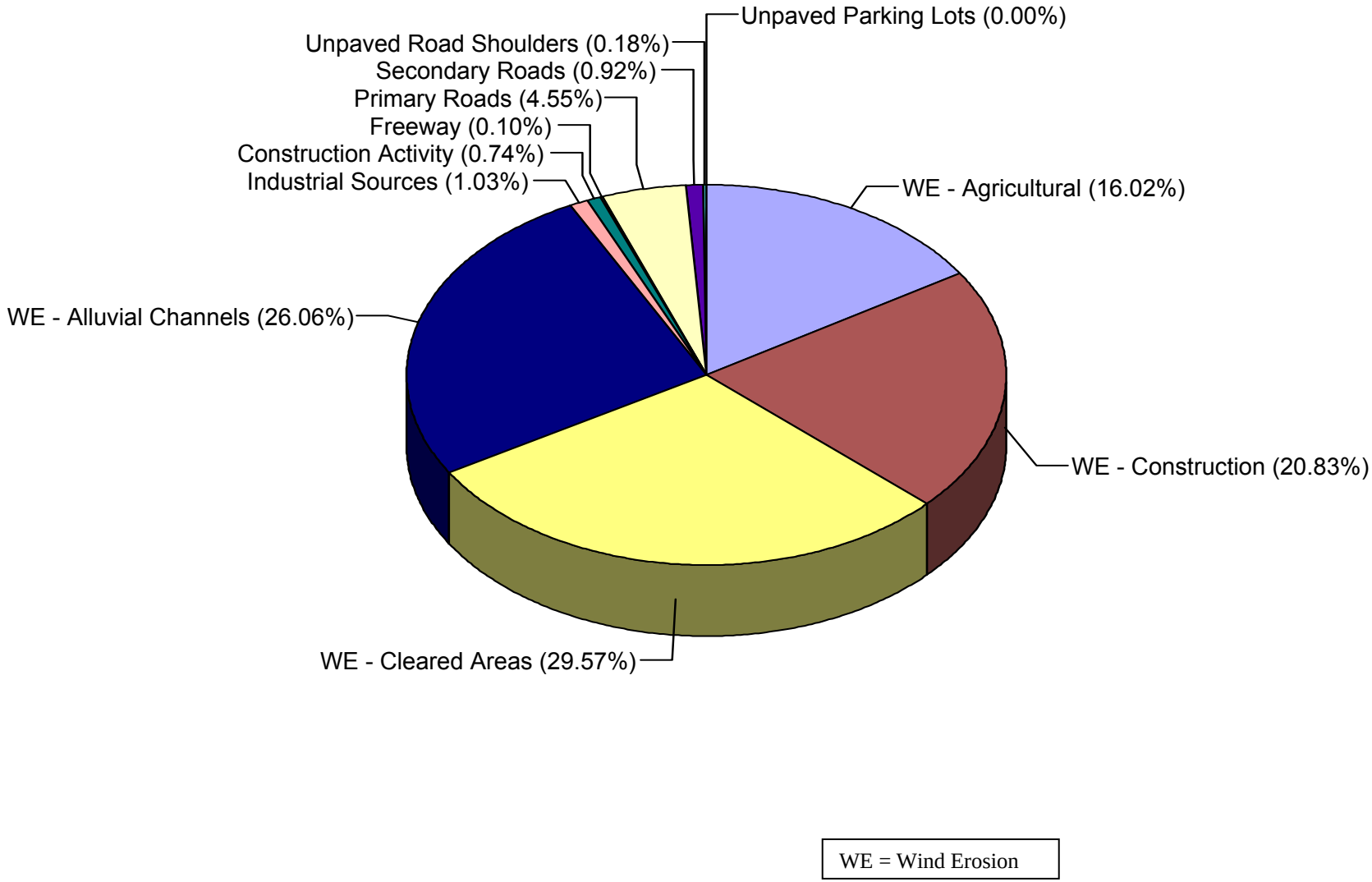
Low Wind Day - December 2006



Salt River PM10 Emissions

High Wind Days - April 2006

Figure 4-9



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 on the low wind design days were Primary Paved Roads (60.57%), Construction Activity (9.85%), Industrial Sources (13.68%), and Secondary Paved Roads (12.22%) with total daily PM_{10} emissions in the range of 6 tons PM_{10}. The major emission source categories on the high wind design days were Wind Erosion – Cleared Areas (29.57%), Wind Erosion – Alluvial Channels (26.06%), Wind Erosion – Construction (20.83%), and Wind Erosion – Agricultural (16.02%) with total daily PM_{10} emissions in the range of 73 tons, which is more than twelve 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.

4.8 REFERENCES

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5.0 CHAPTER 5 -- AIR QUALITY MODELING

5.1.1 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.

5.1.2 SUMMARY OF RESULTS

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, wind blown dust contributes 83% of the total concentration of $PM_{10;}$ while on the low–moderate wind days there is no one dominant source, with roadways contributing 63%, construction 7% and industrial processes 30% 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.

Figure 5-1 Modeled Source Contributions for High Wind Exceedances

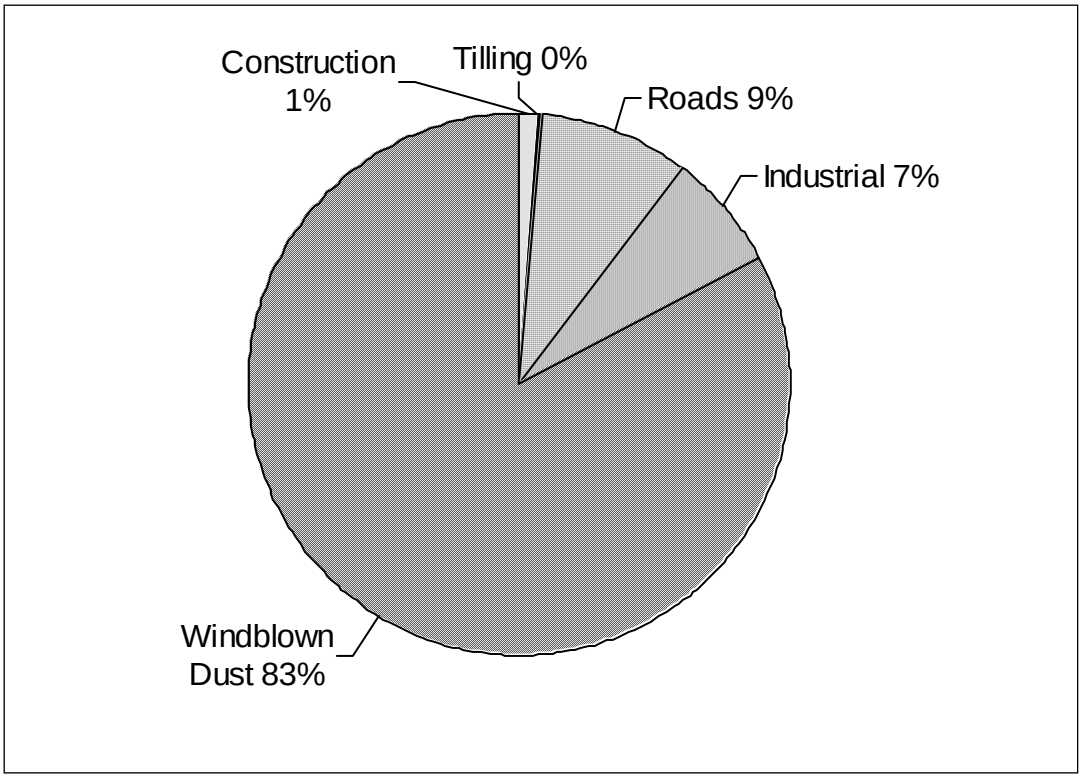
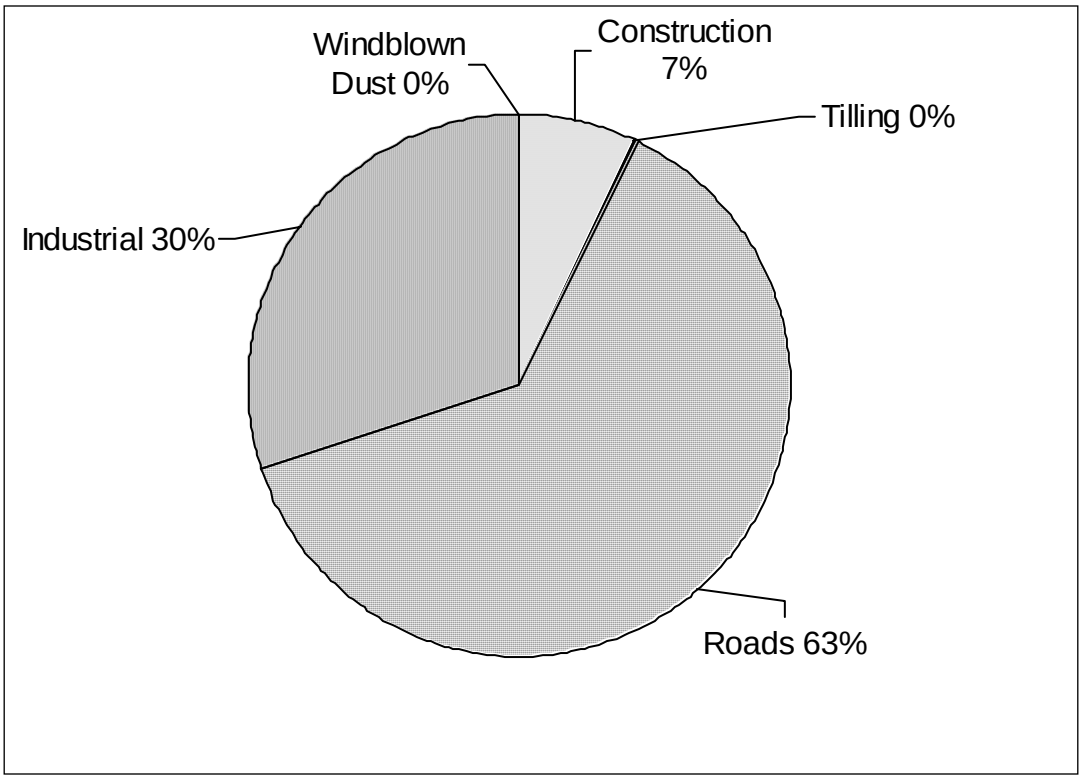


Figure 5-2 Modeled Source Contributions for Low-Moderate Wind Exceedances



5.2 Design Day Selection

Four design days on which exceedances of the PM_{10} standard were measured in 2002 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 only one site for each day, and were 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 Maricopa PM_{10} nonattainment area.

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 dependant files and required that each emissions category be modeled discreetly, which 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 Maricopa PM10 Nonattainment 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. Mixing height was calculated using soundings from the Tucson Airport taken at 5:00 am and 5:00 pm 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 8th 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 8th, April 15th, April 26th and December 16th 2002. April 15th and

26th 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 15th and 26th 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 8th	April 15th	April 26th	Dec 16th
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

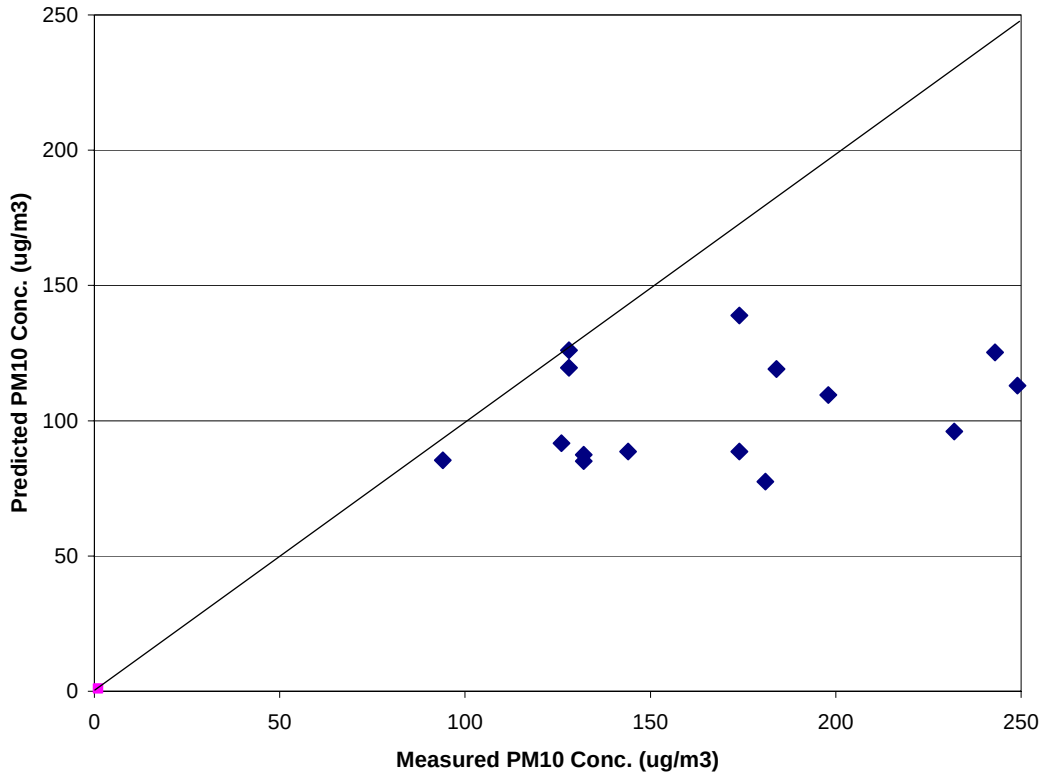
were the actual monitoring sites in the domain, so, the predicted concentrations can be directly compared to the measured value at each site for each day. µg/m³

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 relative site.

Table 5–4, illustrates the total predicted concentration, in µg/m³ at each receptor (monitoring site) in the Salt River Industrial Area domain, excluding background. Figure 5-3 illustrates the ISCST-3 model performance for the Salt River Industrial Area. Background values have been added to these results.

TABLE 5-4 Predicted Concentrations for Monitoring Sites				
Total Predicted PM_{10} Concentration (µg/m³)				
	8-Jan	15-Apr	26-Apr	16-Dec
SOUTH PHOENIX	17	38	48	20
DURANGO	21	21	24	18
SALT RIVER	21	31	41	25
WEST 43	8	37	67	11

FIGURE 5-3 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 predicted-measurement pairs, three predictions are within 10% of the measurements, two are within 30%, five are within 40%, two are within 50%, and three are within 60%.

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

TABLE 5-5 Model Performance: Average Predicted PM_{10} Concentrations ($\mu g/m^3$)

	Low Wind	High Wind
Total average ISCST-3 predicted	18.9	38.4
Calculated Background	67.4	80.0
Sum (Background + Predicted)	86.3	118.4
Measured	140.4	192.0
% Deviation from measured	-38.5	-38.3

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 PM10 emissions from roads, windblown dust, and industrial sources such as sand and gravel. Within the Salt River PM10 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 PM10 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.

That the dispersion model under predicted the measurements does not muddy the waters. The predictions varied in their degree of being below the measurements, from site to site and exceedance to exceedance. For a given exceedance, however, the mix

of sources in the inventory was accurate, and the dispersion model accurately reflected the wind speed and direction and transport of emissions to the monitoring site. Use of the model in a relative sense ensures the solidity of this analytical approach.

5.6 Boundary concentrations and urban background

5.6.1 PM_{10} measurements at the boundaries:

Monitors were set up at Mule stables (67thAvenue), Battery shop (16th Street) 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 6 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*NB conc/60) 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.

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 5th, 2003, the wind directions for West 43rd Avenue were available. For the remainder of February and March, wind data at Mule stables were used.

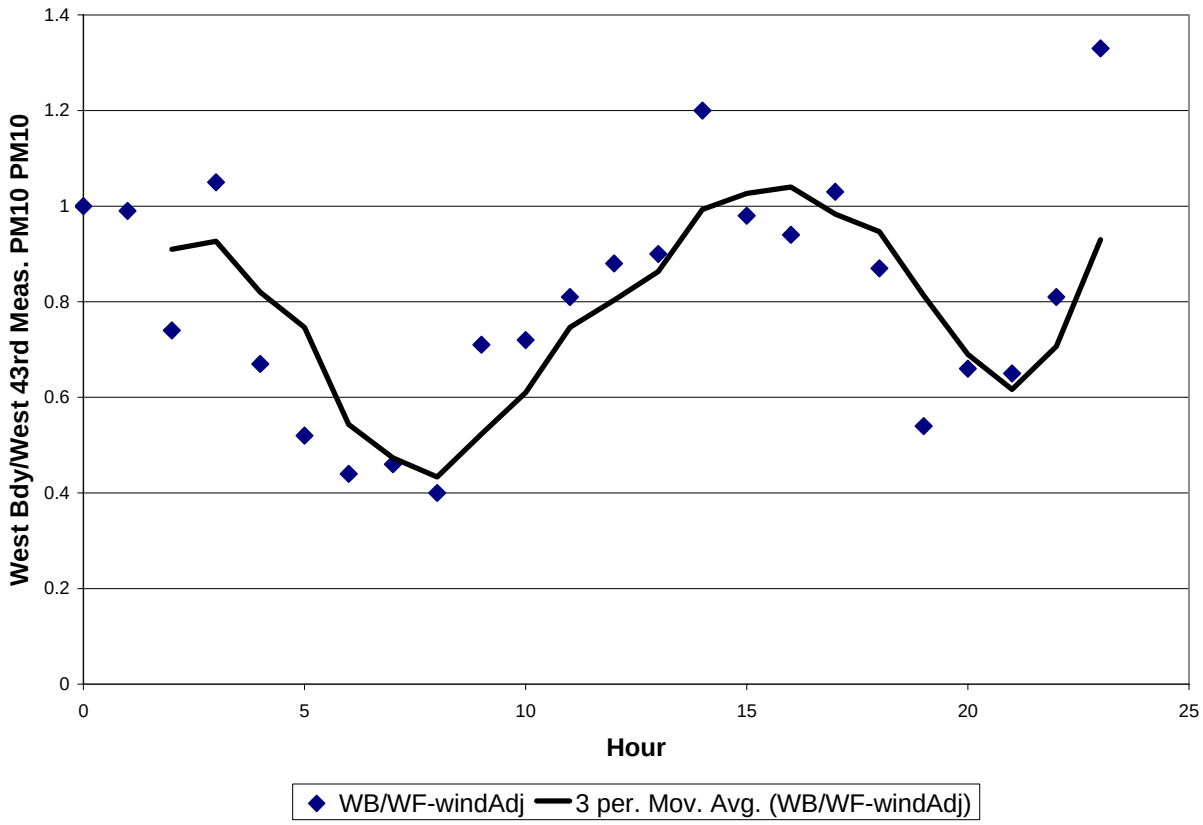
In the calculations of the west boundary fraction with respect to the West 43rd Avenue PM_{10} concentrations, diurnal distributions were calculated using the data from January 2003-March 2003, and the selected wind directions. The fraction at 2 pm was very high (1.2) compared to those around it. It was due to a very high reading (725.7) at Mule stables, and only a moderately high (334.6) reading at West 43rd Avenue, on February 2nd, 2003. The concentrations before and after 2 pm 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 pm 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 vs. 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 particles. This was particularly evident for the data point at 2 pm (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 (65.96) and standard deviation (166.07), it was decided to use a moving average of 3 points (See Figures 5-4 and 5-5) 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.

Figure 5-4 Moving Averages for West Boundary/West 43rd Avenue Ratio



Boundary concentrations are displayed in the figure below. They are calculated as fractions of West 43rd Avenue monitor concentrations, which are known from measurements taken as 24 hour averages from the high volume sampler. Table 5-6 presents these data and the ratio calculations.

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

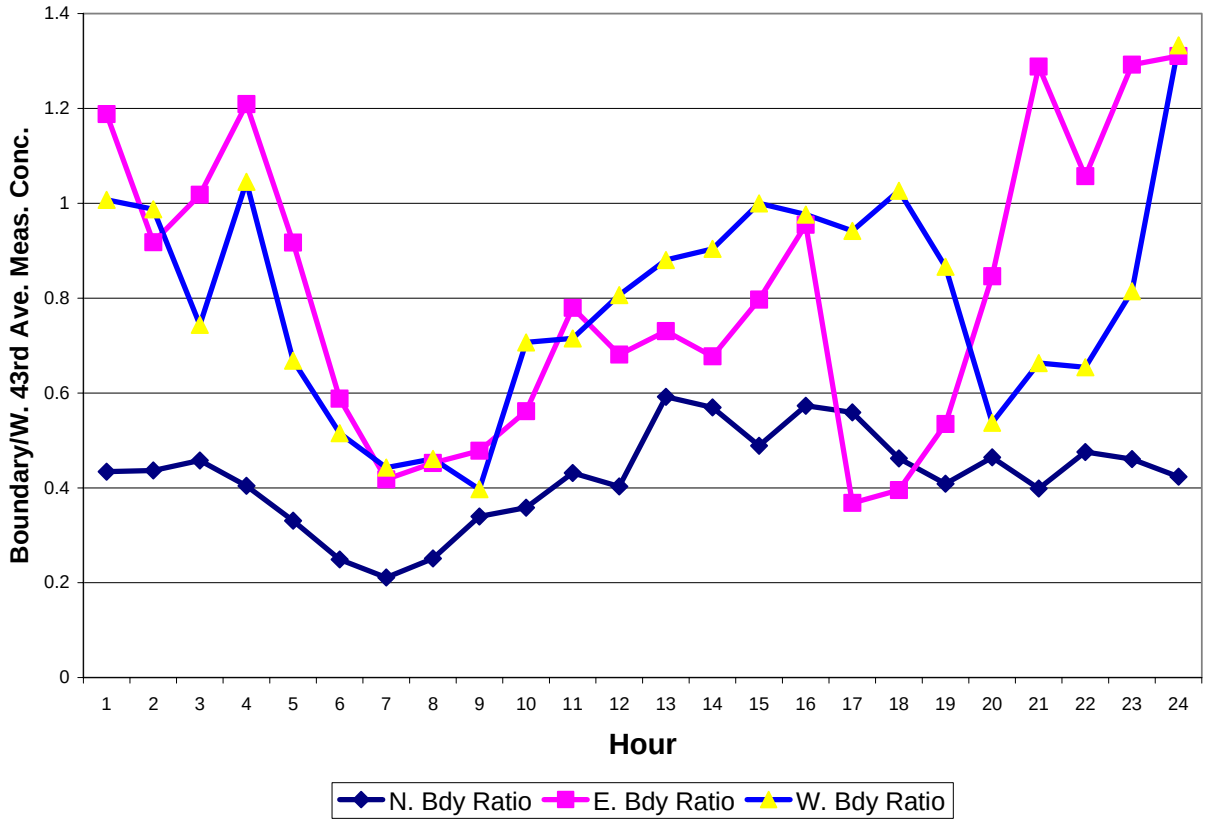


TABLE 5-6 Boundary PM_{10} Concentrations Ratioed with West 43rd Avenue PM_{10} Concentrations							
				Ratio with W. 43rd Avenue PM_{10} Concentration			
Hour	**W. 43rd PM_{10} conc.**	**N. Bdry PM_{10} conc.**	**S. Bdry PM_{10} conc.**	**N. Bdry**	**E. Bdry**	**W. Bdry**	**S. Bdry**
0	99	43	5.73	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**

CHAPTER 6 – 2006 PREDICTED CONCENTRATIONS AND CONTROLS

Chapter 4 includes an in-depth accounting of the predicted emission reductions to take place between 2002 and 2006. To predict future air quality, these 2006 emissions are put into the Industrial Source Complex model, with the same meteorology as the 2002 design dates. These model predictions reflect the best estimates of future PM_{10} concentrations in the Salt River PM_{10} Study Area. Of particular interest is whether the predicted air pollution concentrations are within the health standards. As the reader will see, six out of the eight exceedances can be shown to meet the standard, given sufficient controls. Two cannot.

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

Because Chapter 4 reviews the predicted changes in PM_{10} emissions in considerable detail, they will only be summarized in this chapter. Emission reductions will be forthcoming from enhanced controls to be placed on four 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 and pile forming and material transfer being the principal sources; and

3. vehicular traffic on paved roads, principally the reentrained dust that vehicles generate.

4. windblown dust from such surfaces as vacant lots, miscellaneous disturbed areas, industrial stockpiles, and industrial surface areas.

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 of them has some effect on the four monitors within the study area, and the emissions inventory and air quality model has quantified their “source category contributions.” In the following section, each of the eight exceedances is examined in light of the base case and future emissions.

6.2 ACHIEVEMENT OF THE AIR QUALITY STANDARD THROUGH EMISSION CONTROLS

In this section, the first subsection (6.2.1) explains the extent to which emissions need to be reduced to meet the 24-hour PM_{10} standard at each site. Independent of the emissions inventory and air quality modeling, this reduction depends on the site-specific PM_{10} measurements and the background PM_{10} concentrations. The second subsection (6.2.2) is an analysis of each of the eight exceedances. The source category contributions in the base year to each exceedance are presented. Then, the predicted modeled air quality improvement is expressed as a percentage of the base year air quality. Next, this percentage improvement is compared with the necessary improvement to meet the standard. Finally, this improved air quality is interpreted in light of the site-specific emission changes expected to occur by 2006. The last subsection (6.3.1) is a more general discussion of the potential controls and the regulatory ramifications of not demonstrating attainment at one site.

6.2.1 Necessary Emission Reductions To Meet The Standard

Any air quality measurement above a standard suggests that the emissions of air pollution need to be reduced to meet the standard. In the Salt River PM_{10} Study Area in 2002, eight such measurements were recorded. Each measurement, termed an "exceedance", can be compared with the standard and its percentage above the standard calculated. This percentage above the standard, or "% above std", has been calculated by dividing the difference between the $[PM_{10}]$max, or maximum PM_{10} concentration, and the value of the standard, 150 µm3, by the $[PM_{10}]$max, and multiplying by 100

% above std = { { $[PM_{10}]$max – 150 } / $[PM_{10}]$max } * 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 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 from a certain study area, or it responds very little. A reasonable example is given by the air pollutant ozone, whose eight-hour natural background concentrations are on the order of 40 – 60 parts per billion (ppb). The air quality standard is 84 ppb. 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 an appreciable fraction of the elevated concentrations measured within the Study Area.

The study area is a small fraction of the metropolitan total, and its emissions are a small percentage of the total (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 rest of the metropolitan area's emissions 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.

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

As Table 6-1 shows, these 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 60% -- 1.6 times the percentage above the standard.

TABLE 6-1
Reductions of emissions necessary to meet the standard for eight Salt River PM_{10} exceedances (Units are µg/m³and percent)

Date	Site	Winds	Measured PM_{10} (µg/m³)	% Above Std	2002 Background (µg/m³)	%Reduction to Meet the Standard
26-Apr-02	SR	high	249	40	72	56
15-Apr-02	WF		243	38	88	60
26-Apr-02	DC		232	35	72	51
15-Apr-02	DC		198	24	88	44
15-Apr-02	SR		184	18	88	35
26-Apr-02	WF		174	14	72	24
16-Dec-02	WF	low/mod	181	17	67	27
8-Jan-02	SR		174	14	68	23

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. In the following section, these background reductions are calculated; but, 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 in the following way. 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)). 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. 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 comes from a one over r squared (1/r2) treatment that effectively assigns a 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 6-2.

TABLE 6-2
Salt River PM_{10} Study Area Background Reductions From Area Wide Controls

Source Category	**PM_{10} Emissions tons/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 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%. 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% (25% of 50%). 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 Salt River PM_{10} Study Area background concentrations presented in Table 6-3 reflect the anticipated controls between 2002 and 2006 from Table 4-5. These background values also include the effects of urban-wide reductions of additional street sweeping and more stringent industrial controls discussed later in this subsection.

TABLE 6-3
Salt River PM_{10} Study Area Background PM_{10} Concentrations and their Response to Anticipated Urban-wide Emission Reductions by 2006
(Units are µg/m³, 24-hour averages)

Exceedance Date	2002	2006
15-Apr-02	88	81
26-Apr-02	72	66
16-Dec-02	67	65
8-Jan-02	68	66

6.2.2 Exceedances, Source Contributions, Emission Reductions, and the Air Quality Standard

After the following summary, each exceedance will be discussed in detail. Table 6-4 answers the exceedance question with a yes/no answer. For each of the eight exceedances, the measured concentration is followed by the percentage reduction necessary to achieve the standard, which includes the urban adjustment to background concentrations. This is followed by the YES or NO, for attainment of, or lack of attainment of, the standard. Notice that with stringent industrial source controls, Rule 310 enhancements, and increased street sweeping, six of eight exceedances meet the standard; the two high-wind exceedances at West 43rd Avenue do not show attainment of the standard.

Table 6-4
Salt River PM_{10} Study Area Exceedances and Attainment Status in 2006

Date	Site	Winds	[PM_{10}] (µg/m³)	% Reduction Needed	Is the Standard Attained?
26-Apr-02	SR	high	249	54	YES
15-Apr-02	WF		243	58	NO
26-Apr-02	DC		232	50	YES
15-Apr-02	DC		198	41	YES
15-Apr-02	SR		184	33	YES
26-Apr-02	WF		174	22	NO
16-Dec-02	WF	low/mod	181	27	YES
8-Jan-02	SR		174	22	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 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. 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 (Table 6-4).

The emission changes from 2002 to 2006, discussed in chapter 4 are shown in Table 6-5, with some important modifications. It is these changes in emissions, most of which are reductions, that enable attainment in 2006. Each of the differences is explained below the table. These emission reductions result from more stringent controls, all of which should be considered hypothetical (but reasonable) controls for modeling purposes. In no way do they constitute an actual rule revision or commitment from an affected agency.

TABLE 6-5. PM_{10} Emission Changes In The Salt River Study Area From 2002 to 2006 (a negative sign means a reduction; positive means an increase)	
Emission Category	**Percent Change in Emissions**
Wind Erosion – Agricultural	-75
Wind Erosion – Construction	-19
Wind Erosion -- vacant lots*	-45
Wind Erosion --misc. disturbed areas*	-45
Wind Erosion – industrial stockpiles**	-72
Wind Erosion – industrial surface***	-56
Agricultural Tillage (Land Preparation)	-75
Construction Activity	-36
Freeway - Interstate 17 Durango	+8
Primary Roads****	-31
Secondary Roads**	-11
Unpaved Road Shoulders	-10
Unpaved Parking Lots – re-entrained dust	-36
Industrial area sources*****	-68

* Wind erosion from vacant lots and disturbed areas: The 44.7% figure is a combination of the 36% emission decrease from enhanced controls and the 13.6% decrease in land surface. 13.6% of the emissions are first removed and the 36% enhancement is applied to the remaining.

** Wind erosion from industrial stockpiles: This 72% reduction would entail partial or full enclosure of piles.

*** Wind erosion from industrial surfaces: This 56% reduction would entail such measures as wetting the surface areas prone to erosion when high winds are forecast.

**** Reentrained dust from paved roads, freeway, primary, and secondary, all shown to increase, which is caused by the 8% increase in VMT as shown in Chapter 4, are modified here. Freeway emissions remain the same. Primary

roads have a net decrease of 31% -- a combination of the 8% VMT increase and a 36% emission decrease from treating all 2002 sweepers as conventional, all 2006 (Salt River Study Area only) sweepers are assumed to be PM_{10} efficient, and doubling the road cleaning frequency from once every two weeks in 2002 to once a week in 2006. Secondary roads have a net decrease of 11% which is caused by the combination of the 8% VMT increase and an 18% decrease in emissions from doubling the frequency of sweeping from once every four weeks to once every two weeks (again with conventional sweepers in 2002 and PM_{10} efficient sweepers in 2006).

***** Industrial area emission reductions of a net 68% come from a variety of controls on specific aspects of these operations:

pile forming & material transfer	77% reduction
sand blasting	90% reduction
haul roads	76% reduction
other	36% reduction

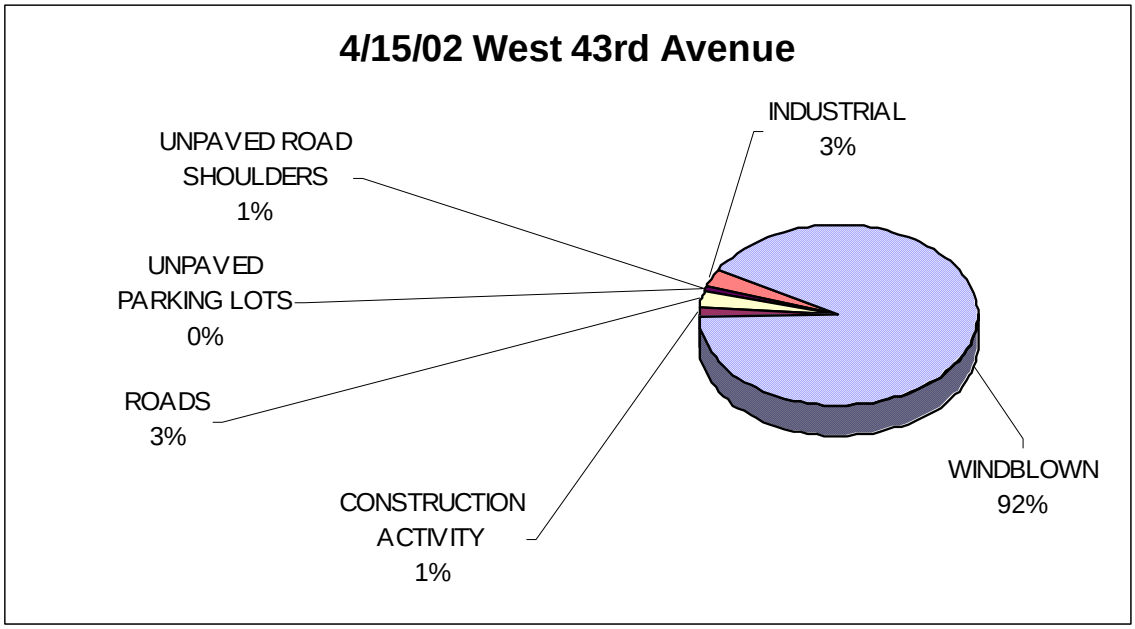
No additional controls were invoked for conveyor transfer, combustion, crushing and screening, and cooling towers. Industrial stack emissions are the same for 2002 and 2006.

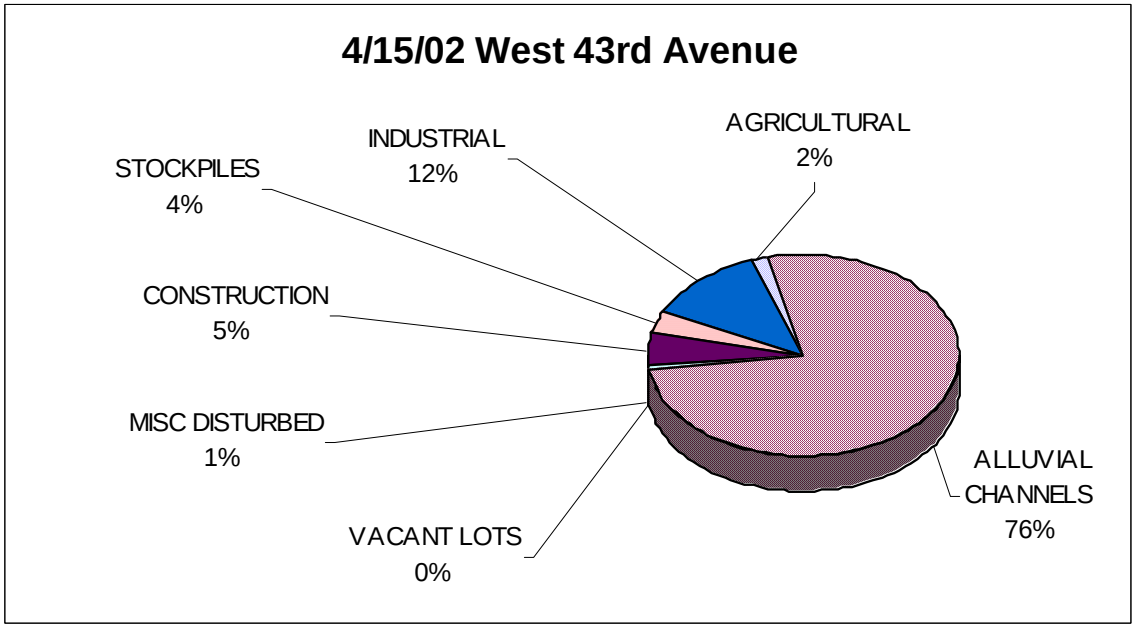
In the discussions of future air quality to follow, these percentage emission reductions by source category are applied to the 2002 predicted concentrations to produce 2006 air quality concentrations.

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

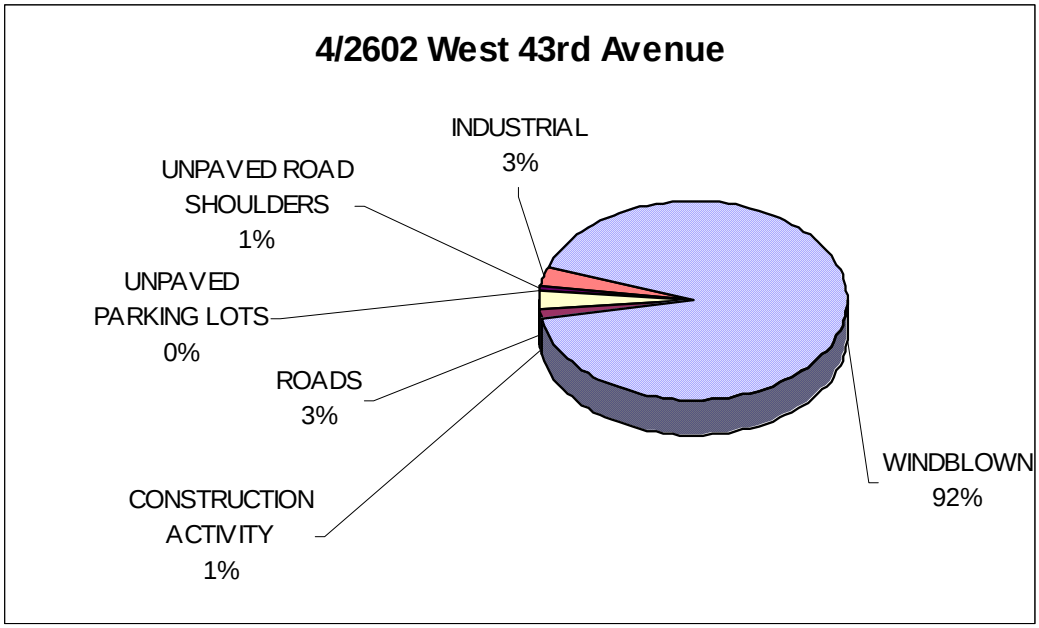
These are the two exceedances that cannot be shown to meet the standard. The principal reasons for this lack of attainment are two. First, the measured concentrations were high, especially for April 15 (243 µg/m³) and less so for April 26 (174 µg/m³). Values this high require large emission reductions to meet the standard. Second, one emissions source category dominates the high concentrations at West 43rd Avenue on these two days. This monitoring site on these two windy days, with each day having four afternoon hours of high west winds (greater than 15 mph) capable of re-suspending dust, lay downwind of a large expanse of alluvial channels of the Salt River. As the figures below show, windblown dust in general dominates the PM_{10} concentrations on these dates, and alluvial is by far the most important contributor within the windblown category. Because no control strategies are envisioned for alluvial dust, the predicted concentrations in 2006 are highly resistant to the changes of the other sources, because their contributions are relatively small (less than 10%). For the April 15 exceedance, a reduction in model-predicted air quality of 58% is needed to show attainment; only 13% is obtained from the predicted controls. For the April 26

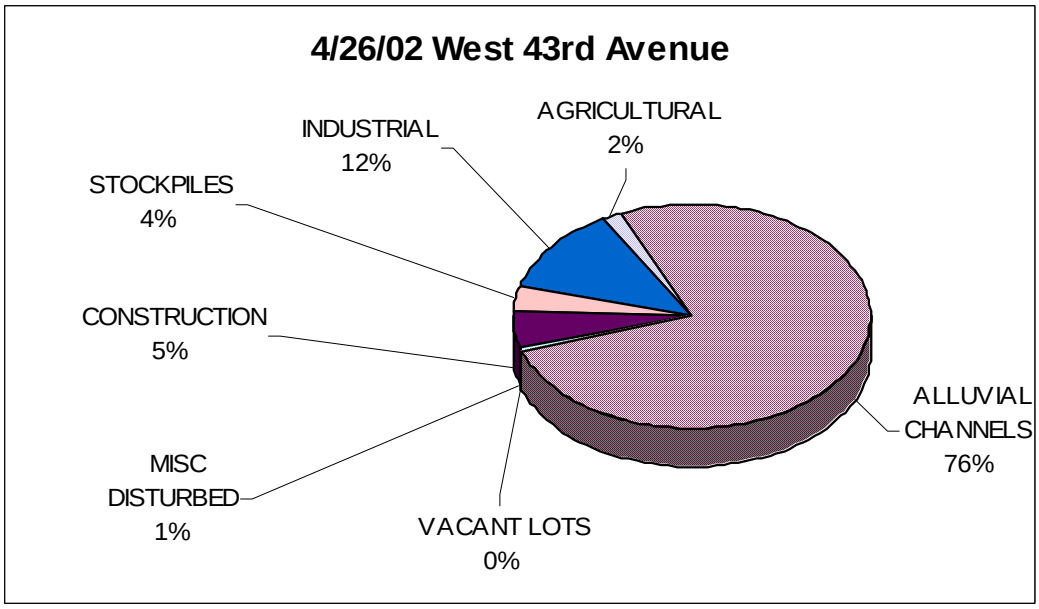
exceedance, a reduction in model-predicted air quality of 22% is needed to show attainment; only 4% is obtained from the predicted controls.





Figures 6-1a (top) and b. Source contributions to PM_{10} at West 43rd Avenue on April 15, 2002, showing that the exceedance (243 µg/m³) was caused by windblown dust (top) and that of the windblown contributors, alluvial channels dominated.





Figures 6-2a (top) and b. Source contributions to PM_{10} at West 43rd Avenue on April 26, 2002, showing that the exceedance (174 µg/m³) was caused by windblown dust (top) and that of the windblown contributors, alluvial channels dominated.

A test of the sensitivity of these two exceedances to reductions of alluvial emissions was performed. By reducing the emissions of alluvial in 2006, but retaining the full 2002 amount, the two exceedances can be remedied. The reductions necessary to do this, however, are substantial: Table 6-5 presents the necessary and realized reductions to meet the standard with the full inventory and with major reductions in the alluvial dust.

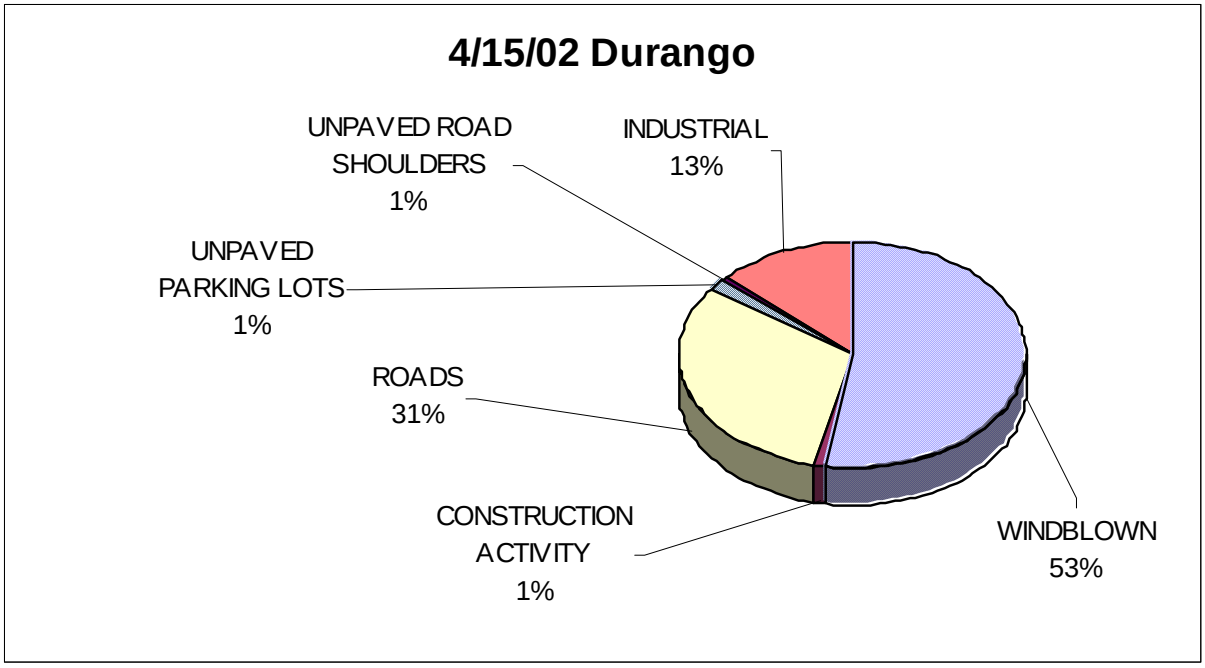
TABLE 6-6
High Wind Exceedances at West 43rd With and Without Alluvial Dust

Date	% Reduction to Meet the Standard	% Reduction Realized Through Air Quality Modeling		% Alluvial Emissions Reduction Needed to Meet the Standard
		Full Alluvial	Reduced Alluvial	
April 15, 2002	58	13.19	58.51	65
April 26, 2002	22	4.21	22.55	20

These figures suggest that any reasonable over-estimate or under-estimate of alluvial emissions in the 2002 inventory, when carried through to the 2006 inventory, would not appreciably change the outcome. On April 26, alluvial emissions in both the base and future years would have to be reduced by 88% in order for the other control strategies to bring about attainment. On April 15, even reducing these alluvial emissions to zero fails to show attainment: the net reduction in predicted concentrations between 2002 and 2006 would be 44% under these conditions. For attainment, a 58% reduction is necessary. For the West 43rd Avenue high-wind exceedances, only by reducing these emissions between 2002 and 2006 can attainment be demonstrated.

6.2.2.2 Other high wind exceedances, Salt River and Durango Complex on April 15 and April 26, 2002

In contrast with the West 43rd Avenue high-wind exceedances, the four other high-wind exceedances can be shown to meet the standard in 2006. At these sites, attainment has been demonstrated because of the different mix of source category contributions and in the degree of emission reduction necessary to meet the standard. Of particular note here is the exceedance of April 26 at Durango. Its PM_{10} concentration that day was 232 µg/m³, with a 50% reduction in emissions necessary to meet the standard. The first difference between these source contributions and those of West 43rd on the same day, is that the windblown contribution is less (52% vs. 92%) (Figures 6-3a,b).



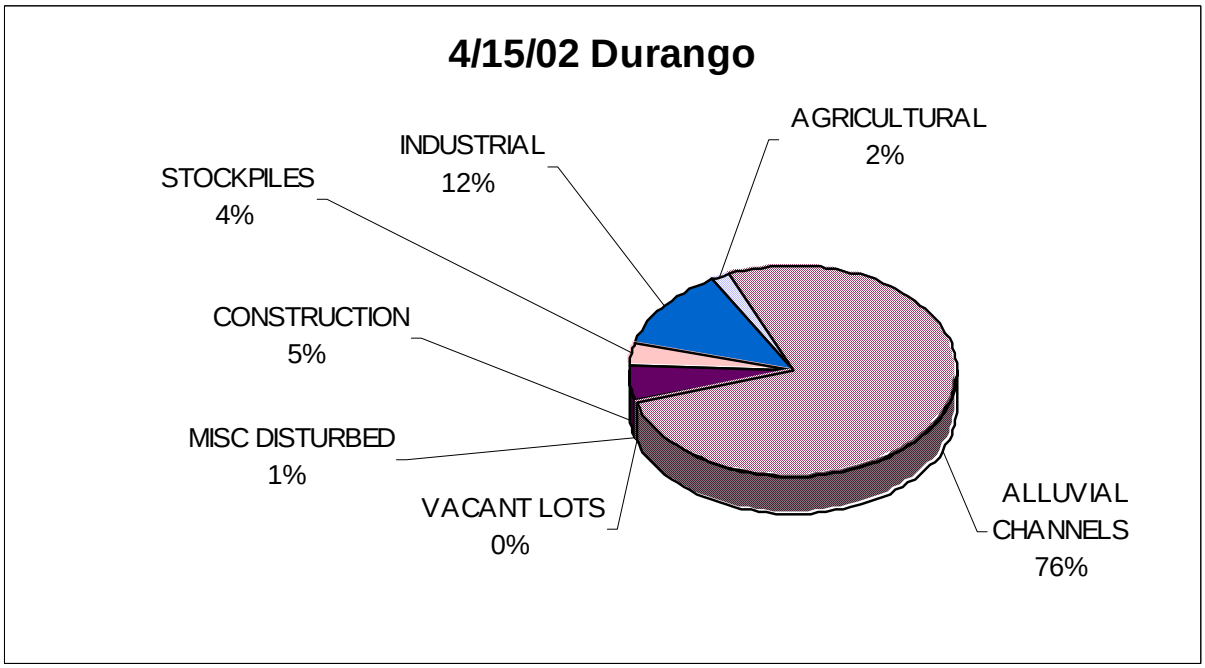
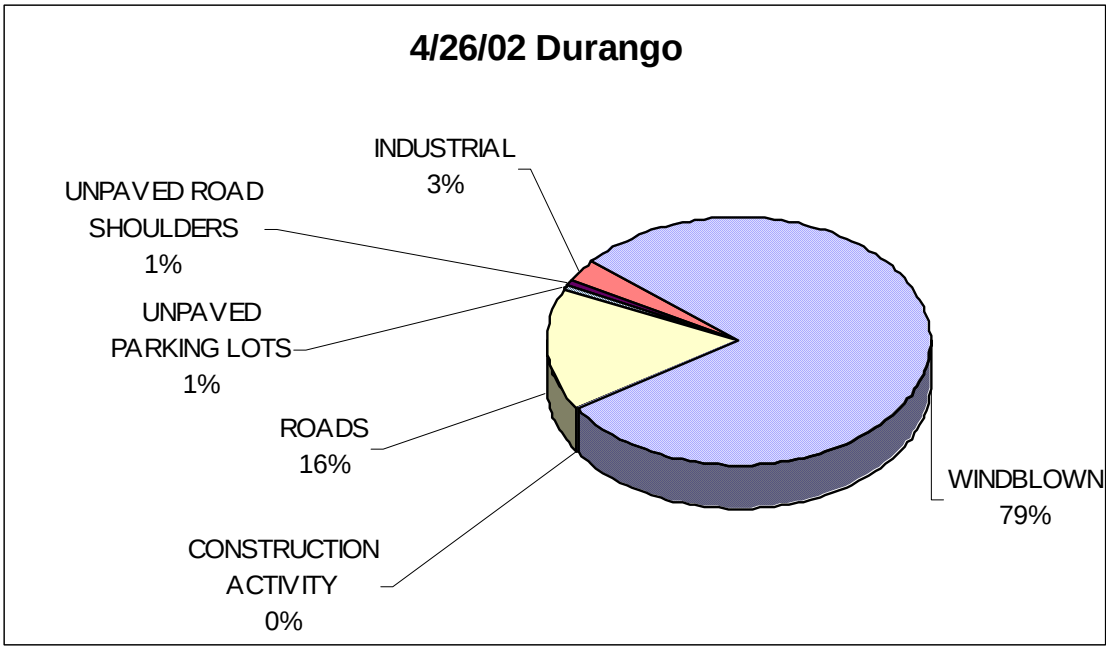


Figure 6-3a (top) and b. Source contributions to PM_{10} at Durango on April 15, 2002, showing that only about half the exceedance (198 µg/m³) was caused by windblown dust (top) and that of the windblown contributors, alluvial channels dominated.



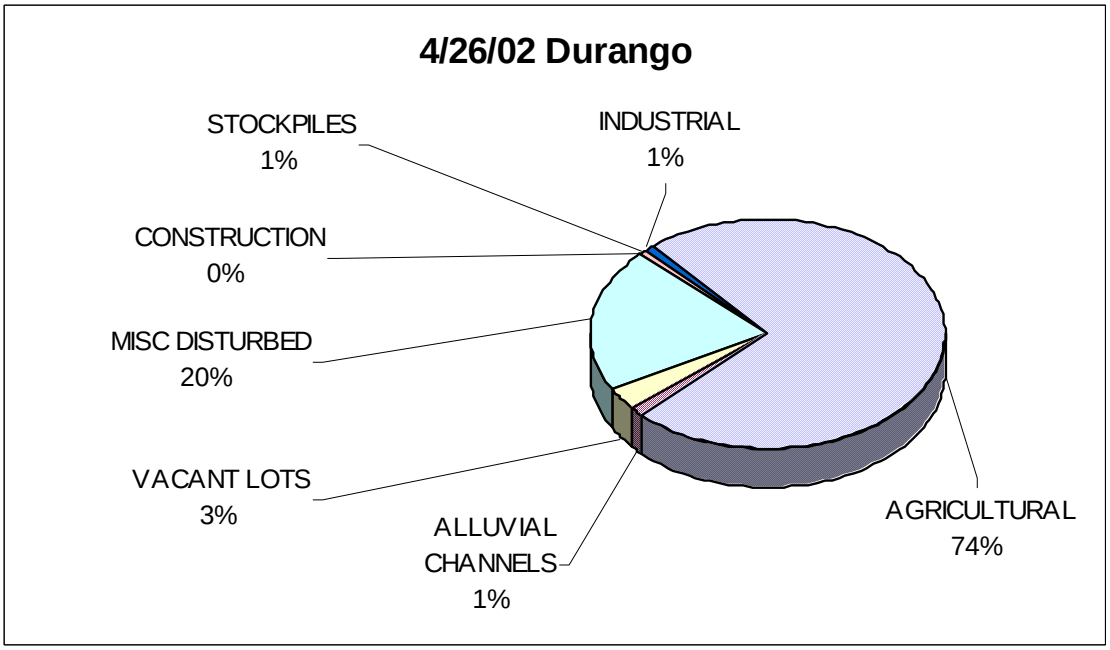


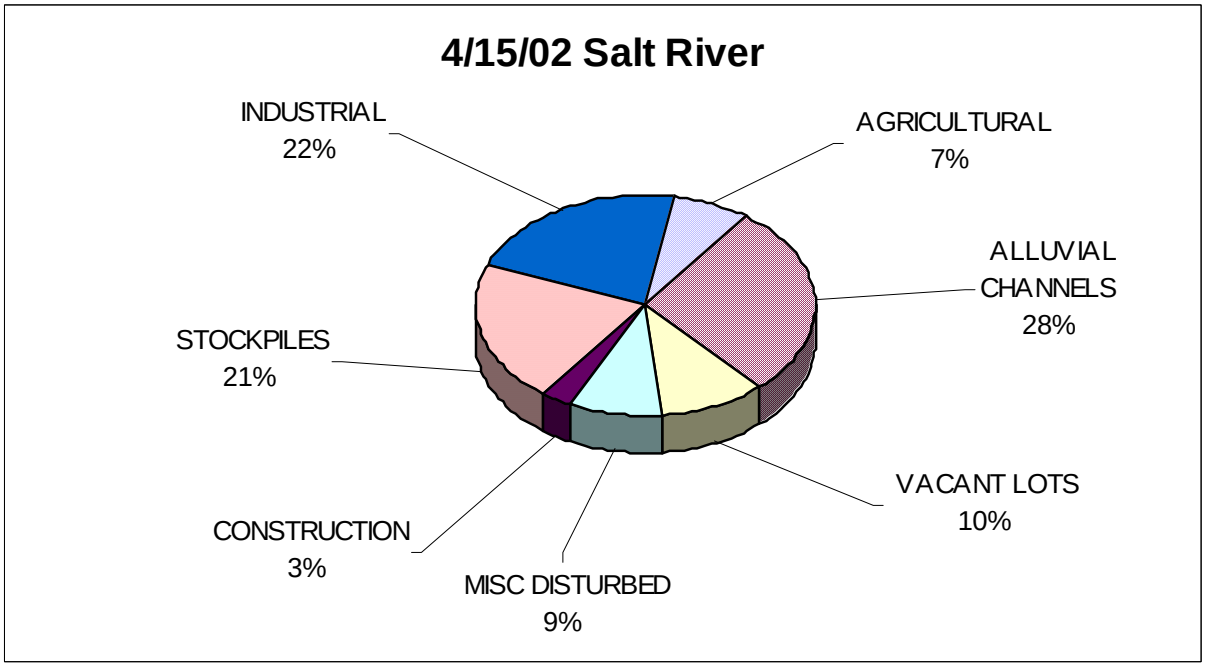
Figure 6-4a (top) and b. Source contributions to PM_{10} at Durango on April 26, 2002, showing that about three quarters of the exceedance (232 µg/m³) was caused by windblown dust (top) and that of the windblown contributors, agricultural dominated.

The Salt River alluvial materials that lie to the west and west-southwest of Durango do make the most significant contribution to the elevated PM_{10} concentration there. Because anthropogenic emission sources comprise nearly half of the exceedance, and because these sources have reduced emissions in 2006 (Table 6-5), the standard can be attained. A net emission reduction of 41% is necessary; 46% is achieved through the reductions of both windblown and anthropogenic emissions.

The Durango exceedance of April 26, whose sources are shown in Figure 6-4, would appear to as unlikely to meet the standard as April 15 at West 43rd Avenue. At least two important differences between the source mix at Durango and that of West 43rd Avenue. are evident in these charts. In the top chart, just like on April 15 at West 43rd Avenue, wind erosion contributes most of the problem: 80%, not far below 90%. Of the anthropogenic contributors, both roads (15%) and industrial sources (3%) are the strongest, in contrast to the West 43rd Avenue exceedance, where roads contributed only 3% (and industrial sources were similar). Reentrained road dust is a more important factor at Durango on April 26, and these emissions do decrease by about one third from 2002 to 2006. The more significant difference lies in the windblown composition: alluvial channels approaches zero (1%), and agricultural wind erosion, which accounted for 2% of the West 43rd Avenue April 15 exceedance rises to nearly 60% of the total predicted PM_{10} concentration. As agricultural land is retired – and the estimate is 75% within the Salt River Study Area between 2002 and 2006 -- these emissions disappear. Two thirds of the net reduction in PM_{10} concentrations for this exceedance comes from the removal of agricultural land. Without this emission reduction, Durango (on April 26) does not meet the standard.

Having examined four high-wind exceedances so far, two at West 43rd Avenue and two at Durango, the two at the Salt River monitor remain. Recall from Table 6-4 that the two Salt River exceedances can be shown to achieve the standard in 2006. Recall also that the PM_{10} monitoring beginning at this site in 1994 has furnished the ambient air data that clearly shows the area doesn't meet the standards. And recall, finally, that no PM_{10} monitoring will be conducted at this site in the future. Therefore it would seem important to demonstrate attainment at the very site that has led to State Implementation Plan revision in the first place.

The two high-wind exceedance days at the Salt River site were on April 15 and April 26, 2002, with 24-hour average PM_{10} concentrations of 184 and 249 µg/m³, respectively. Emission reductions needed to meet the standard are 29 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 6-5 illustrates, this source mixture is quite different than that at Durango, and is quite receptive to emission reductions.



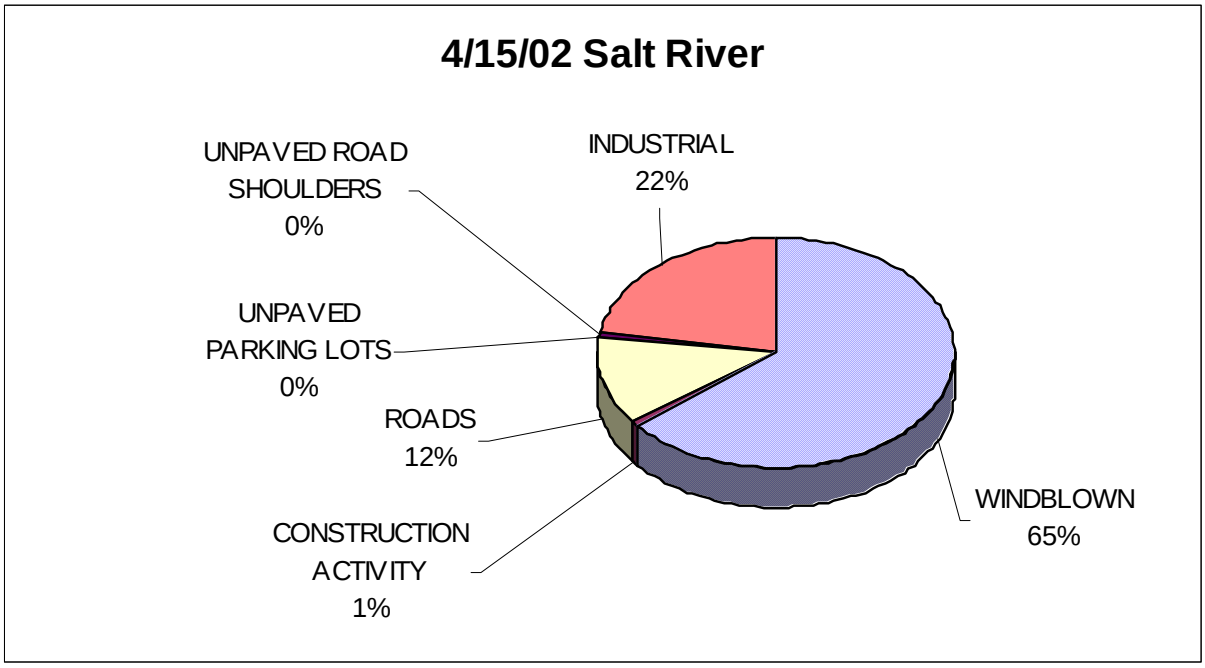
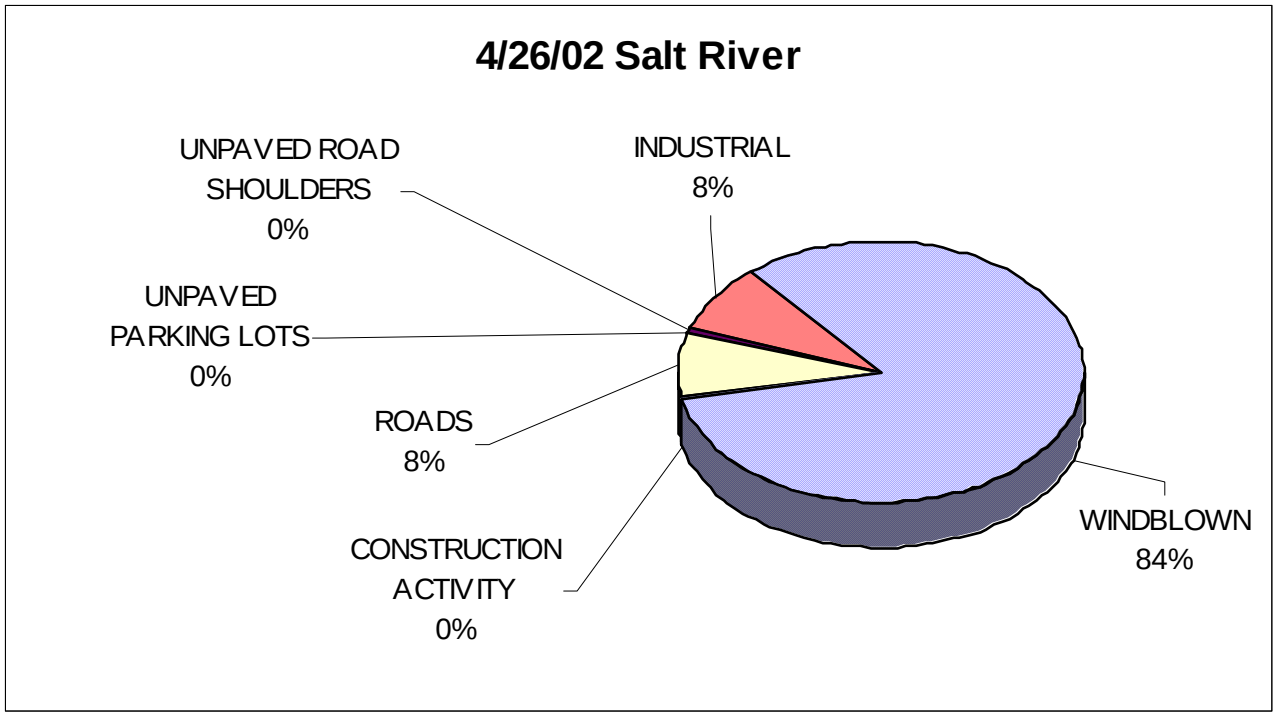


Figure 6-5a (top) and b. Source contributions to PM_{10} at Salt River on April 15, 2002, showing that two thirds of the exceedance (184 µg/m³) was caused by windblown dust (top) and that the windblown contributors were more equally divided among several sources than was the case for exceedances at West 43rd Avenue and Durango.

In comparison with the high-wind exceedances already discussed, the April 15 Salt River exceedance has a similar windblown contribution (64%). 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 29% is significantly surpassed with the 48% predicted reduction.

Demonstrating attainment for the last of the six high-wind exceedances – that at the Salt River on April 26, 2002 – would seem more difficult than demonstrating it for the April 15 exceedance. Windblown emissions contribute more on the April 26 date, 83% versus 64% 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 29%. The influence of industrial windblown emissions decreases from 26 to 8% from the first to the second April high-wind exceedance. These stockpile and surface area emission reductions from 2002 to 2006 are quite high. The main difference on this latter April date can be found in the agricultural windblown category, which on April 15 was 5% of the total PM_{10} concentration, but which rises to 30% on April 26 (Figure 6-6). As was seen in the Durango exceedances, because of the 75% 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. For illustrative purposes, and in a modeling sense only, emission reductions from Table 6-5 (page 6-7) were applied to the 2002 emissions. With additional industrial controls, enhanced Rule 310, increased street sweeping, and the retirement of agricultural land, the predicted concentration is reduced by 57% in 2006 – just enough to meet the standard.



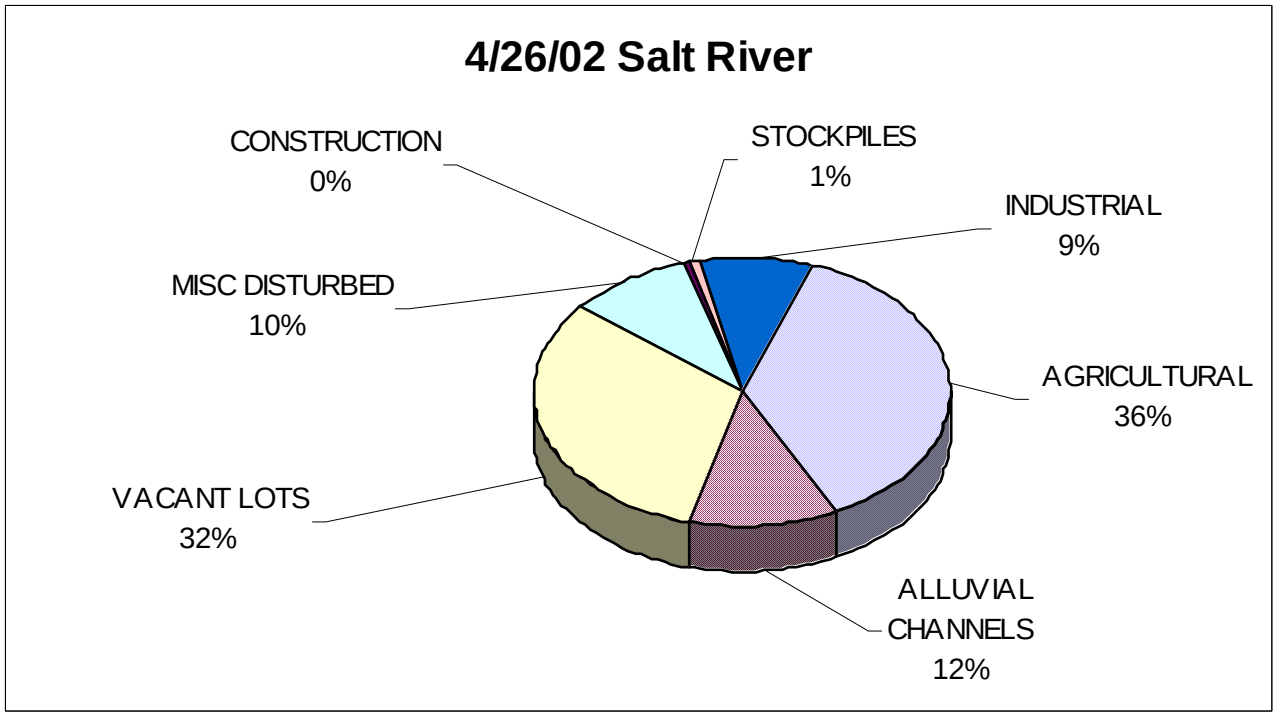
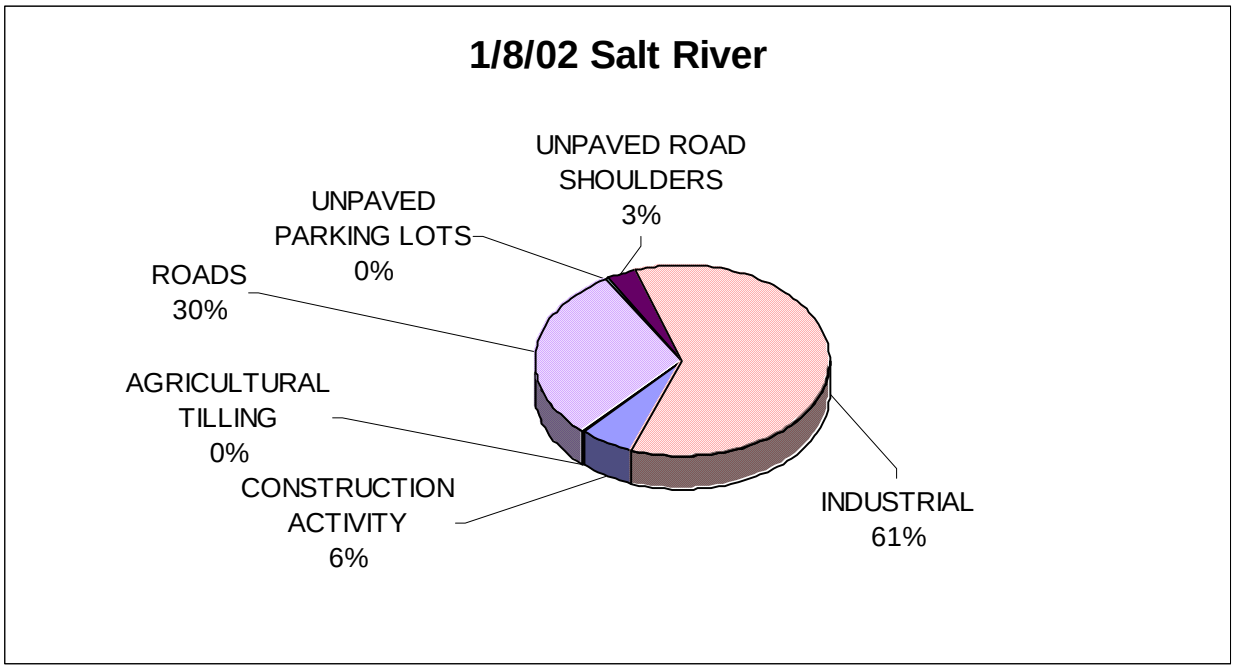


Figure 6-6a (top) and b. Source contributions to PM_{10} at Salt River on April 26, 2002, showing that 85% of the exceedance (174 µg/m³) was caused by windblown dust (top) and that the windblown contributors were equally divided among several sources as in the Salt River exceedance of April 15.

6.2.2.3 Low Wind Exceedances on January 8, on December 16, 2002

In sections 6.2.2.1-2 six high-wind exceedances were discussed and explained. Attainment in 2006 was shown for four of these six exceedances. The outcome of whether the standard could be obtained depended on what emission sources were close to and/or upwind of which monitor and to what degree these emissions were predicted to decrease by 2006. Pivotal roles were played, in one exceedance or another, by windblown dust from alluvial channels, from agricultural fields, and from industrial properties. Just as working and living in a dusty area is much easier without the high winds, constructing emissions inventories and simulating PM_{10} concentrations with numerical models is much easier, as well. In the entire calendar year of 2002, only two low-wind exceedances were recorded. January 8, 2002, at Salt River, and December 16, 2002, at West 43rd Avenue recorded PM_{10} concentrations above the standard: 174 µg/m³ in January; 181 µg/m³ in December. For these exceedances the seven categories of windblown dust are gone, leaving the nine anthropogenic categories. Of these categories, the combined "roads category" and combined "industrial" category prove to be the most influential.

On January 8, 2002, at Salt River, the source contributions to the predicted PM_{10} concentration are led by industrial and roads, which together account for 90% of the total, with roughly twice as much from the industrial as from the roads. On December 16, 2002, at West 43rd Avenue, the two sources still comprise 90% of the total. In this case, the roads have twice the impact as the industrial. In both cases, the remaining 10% is construction dust and unpaved road shoulders (Figure 6-7). Attainment is shown for both exceedances, with January 8 at Salt River needing a 22% emission reduction, against a predicted reduction in ambient concentrations of 50%, or more than twice the needed amount. For December 16, 2002 at West 43rd Avenue, attainment is slightly more difficult to show. A needed reduction of 27% is surpassed by a predicted reduction of 40%. Attainment for these two exceedances is fairly easy because they're dominated by road and industrial emissions, the former of which decrease by roughly 30% and the latter by 70% from 2002 to 2006.



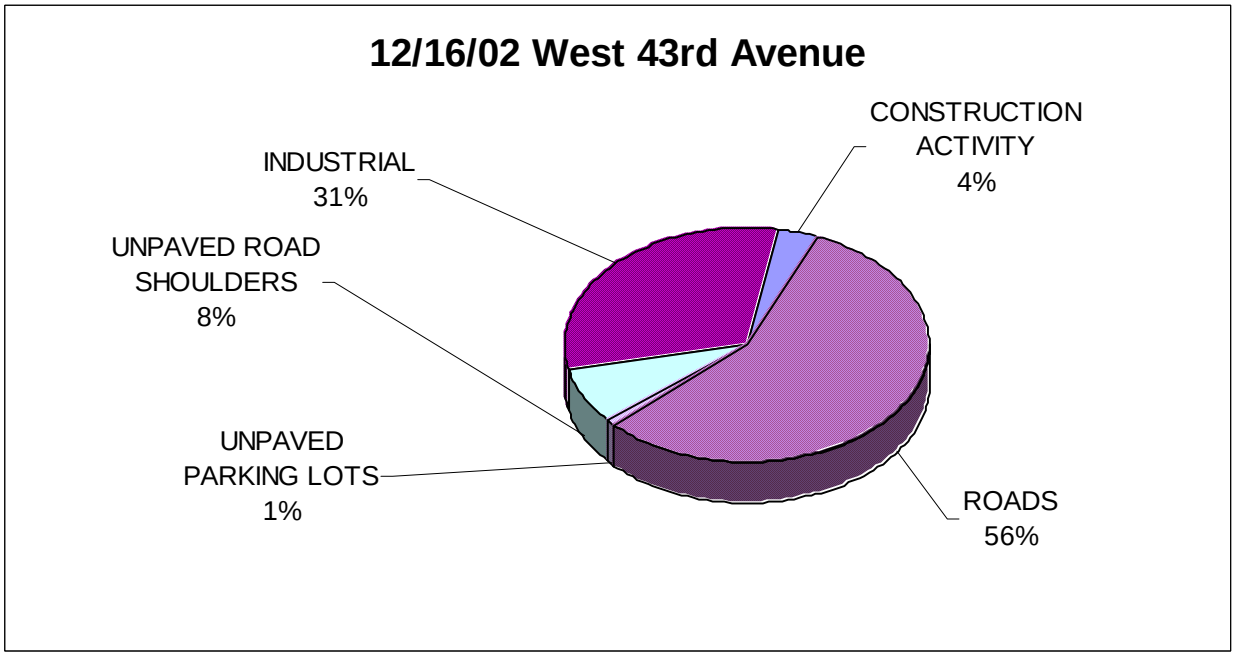


Figure 6-7a (top) and b. Low-wind source contributions to PM_{10} at Salt River on January 8, 2002, showing that 61% of the exceedance (174 µg/m³) was caused by industrial emissions (top). Low-wind source contributions to PM_{10} at West 43rd Avenue on December 16, 2002, showing that 56% of the exceedance (181 µg/m³) was caused by dust reentrained from paved roads.

6.3 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 air-shed does not meet the 24-hour National Ambient Air Quality Standard for PM_{10}. This is not a contestable fact. Various sections of this Technical Support Document provide ample supporting evidence for this conclusion, but the bulk of it can be found in
Chapter 2: Ambient Air Quality.

What are the prospects for attaining this standard in the near future? 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 called, appropriately enough, Industrial Source Complex, have produced the results discussed in Section 6.2.2. These results were 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. 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 concern earthmoving and related activities; industrial activities, principally materials handling and haul roads; additional street sweeping to reduce reentrained road dust; and the continued retirement of agricultural land in the Salt River area (75% by 2006). Explained in detail in Chapter 4 and summarized in Table 6-5, these emission reductions are essential for six of the eight exceedances to be shown in attainment by 2006. Commitments will have to be obtained from the appropriate cities and agencies in the year following the date of this submittal, February 2, 2004, to amend rules and practices and enforcement efforts in such a way to realize all of these potential emission reductions. With assertive efforts by these agencies and, more importantly, by the regulated communities that would be affected by these new rules, 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 standard will be achieved on all low-wind days and on high-wind days except for those areas immediately downwind of alluvial channels.

The same technical work has also shown, in Chapter 6, that the two high-wind exceedances at West 43rd Avenue cannot be shown to meet the standard in 2006. At the root of these elevated PM_{10} concentrations are high winds and wide expanses of alluvial soil prone to erosion in and around the bed of the Salt River. In 2002 this combination led to the exceedances. The apparent lack of any viable, cost-effective controls of this source leads to the non-attainment status of this monitoring site in 2006. In such cases as the Salt River PM_{10} Study Area, where attainment of the standard cannot be shown by the specified date, the Clean Air Act requires emission reductions

of five percent per year from all contributing sources. All of the projected 2002 – 2006 emission reductions (Table 6-5) are already in excess of this five percent figure.

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

- 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 10th Street on the east to 55th 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 43rd 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.

- Six of the eight exceedances could be shown to meet the standard in 2006, with a hypothetical 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 in 2003.

- Two of the eight exceedances could not be shown to meet the standard. The inability to lower these concentrations sufficiently lay in their principal cause being windblown dust from alluvial channels – a source for which no controls have yet been developed.

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

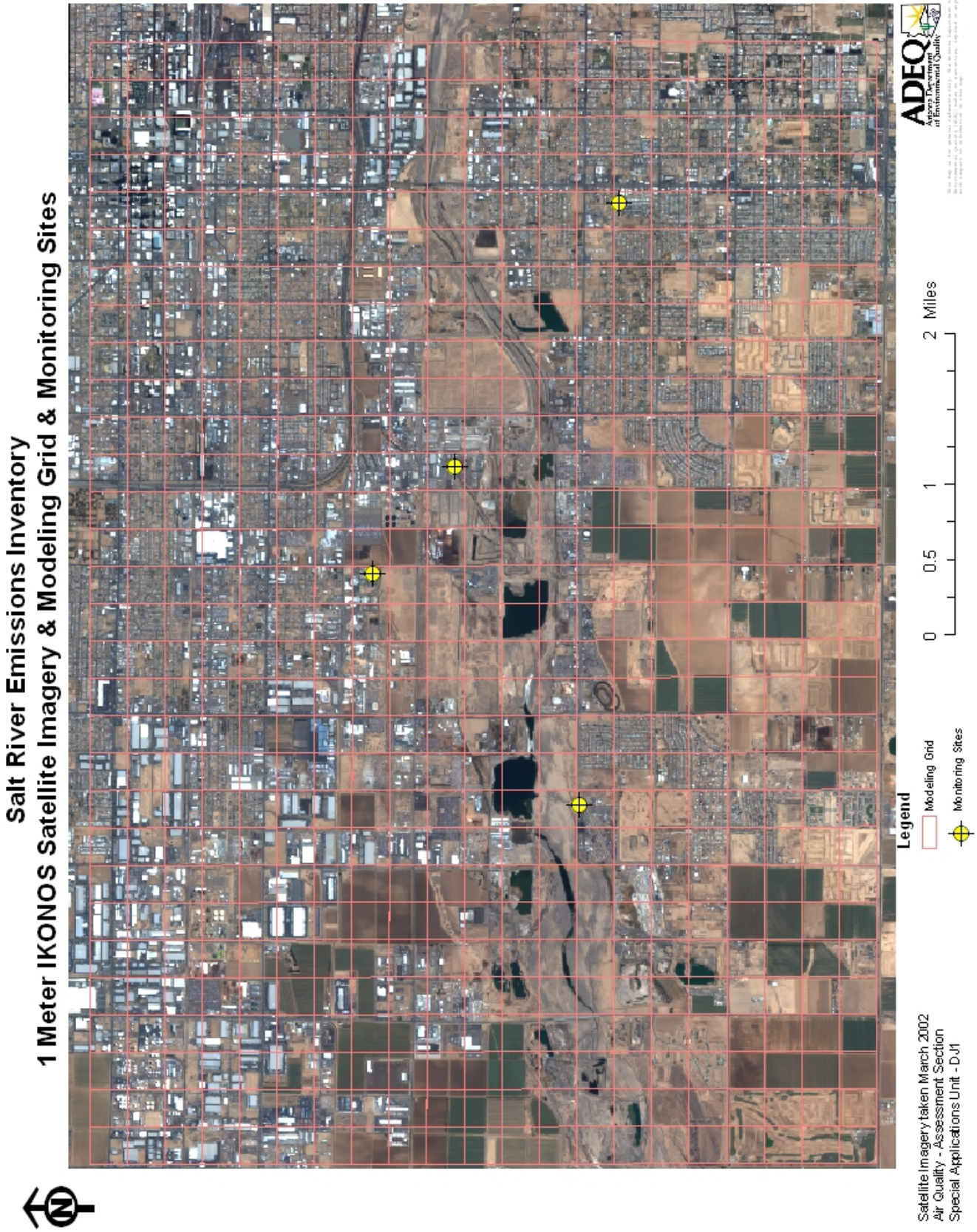
Map A-3
Fugitive dust study

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

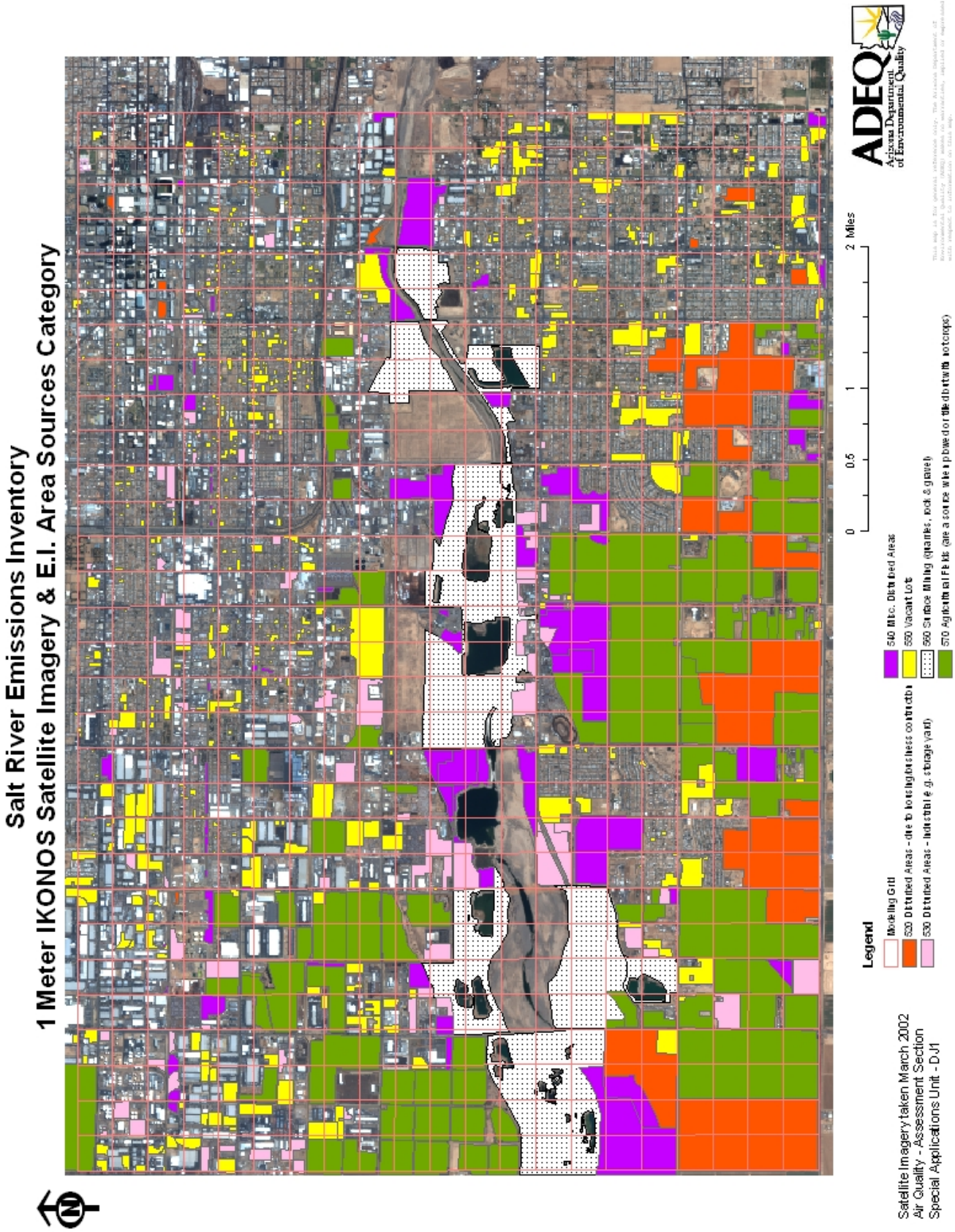
Map A-5
- Approximate boundaries of industrial sources, such as rock products, near the Salt River

These maps are on the following pages.

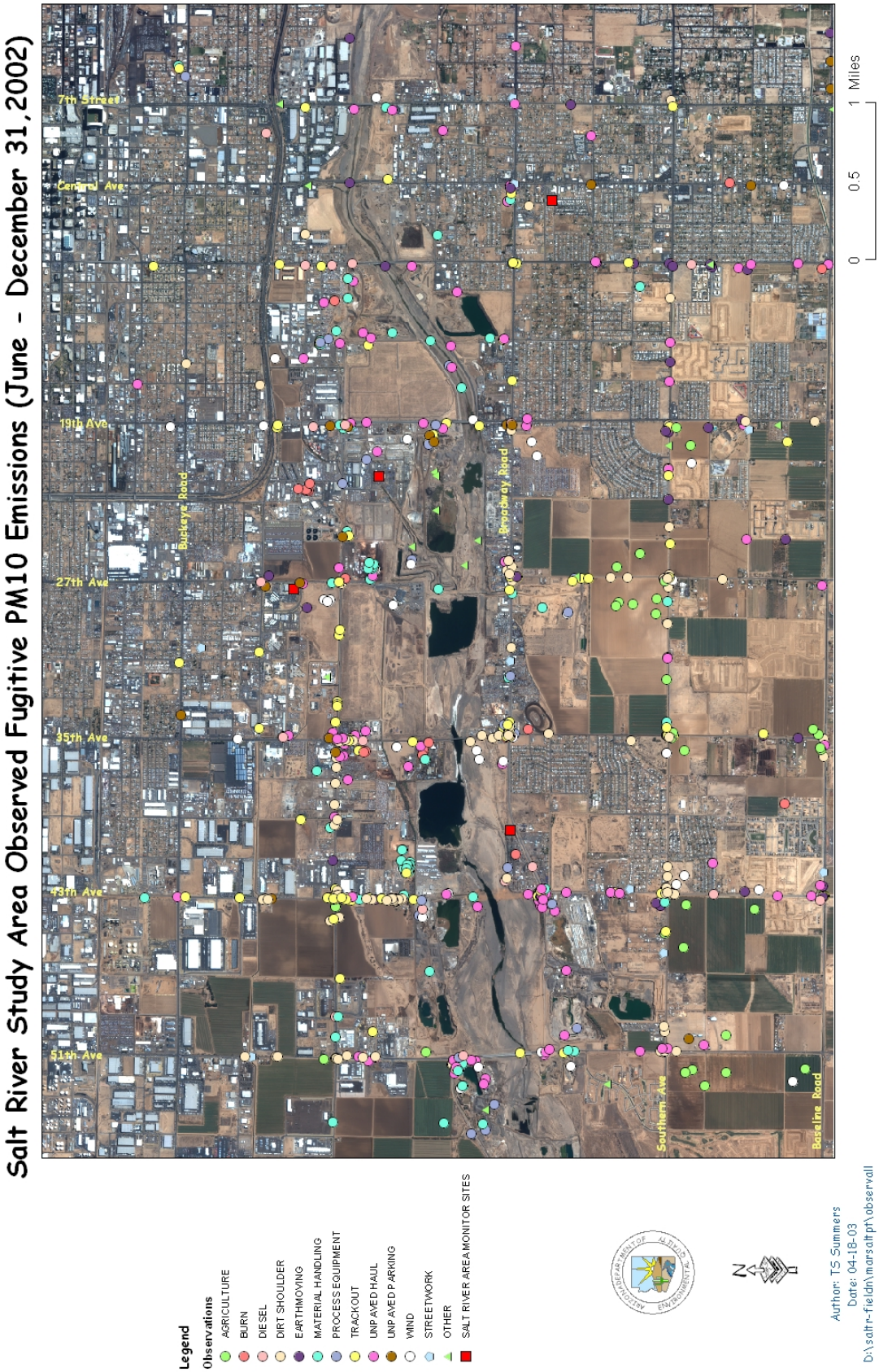
Map A-1 Gridded satellite image with locations of air quality monitors



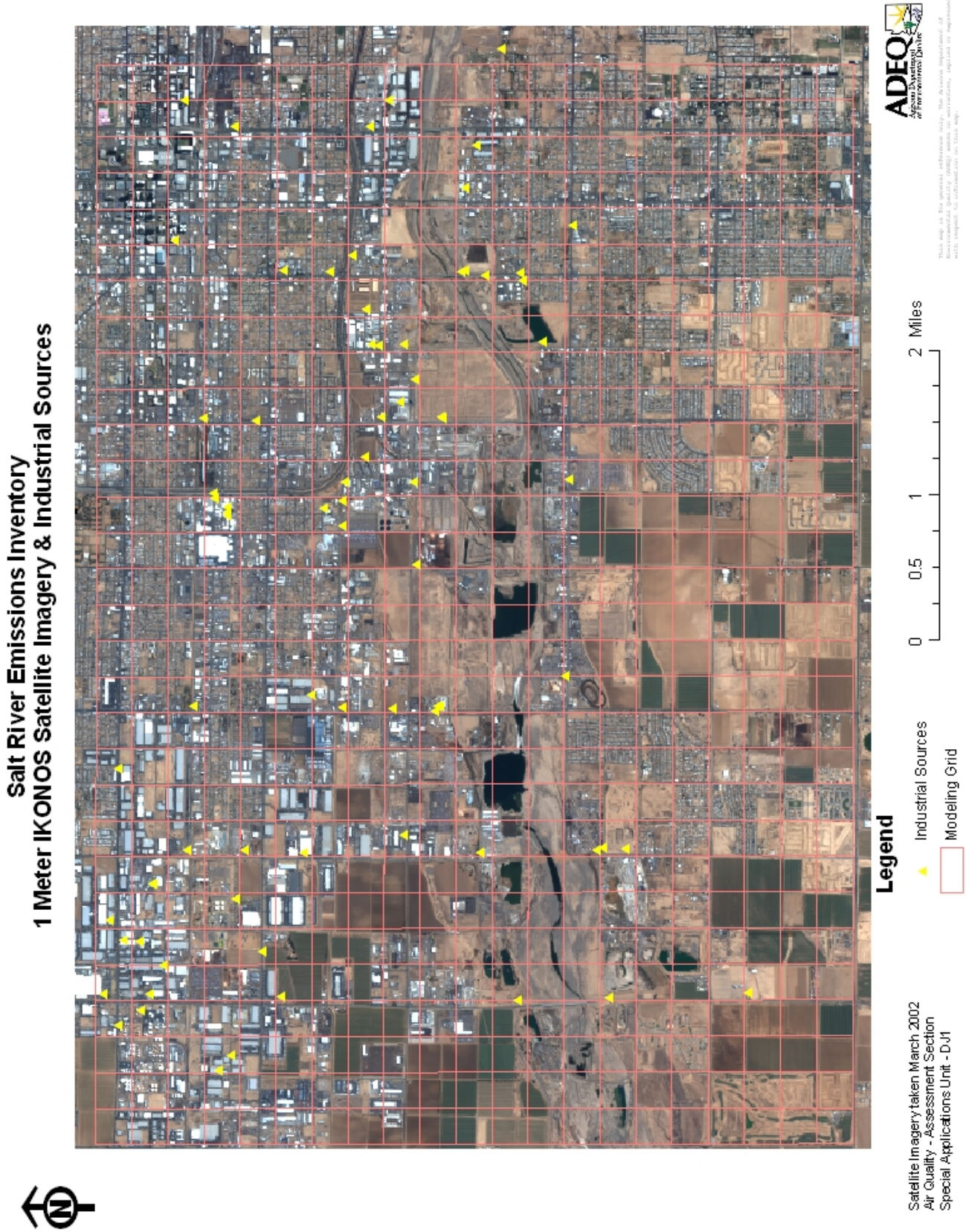
Map A-2 Land Use / Area Sources



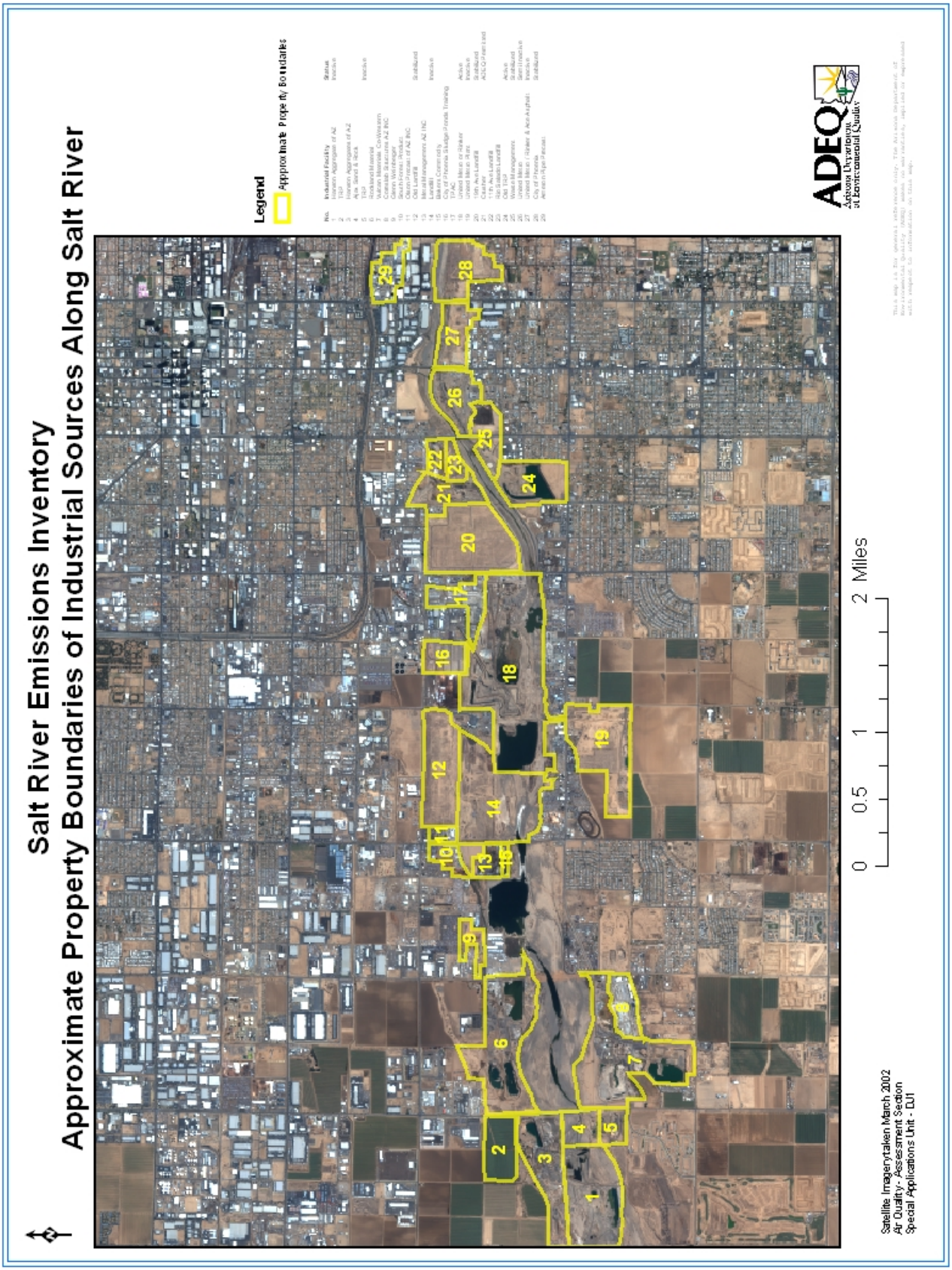
Map A-3 Fugitive Dust



Map A-4 Locations of industrial sources



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



Appendix A-1

REGULATION III - CONTROL OF AIR CONTAMINANTS
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FUGITIVE DUST SOURCES
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Revised 09/20/94
Revised 06/16/99

Revised 02/16/00

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

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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

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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 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 - 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 D-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.

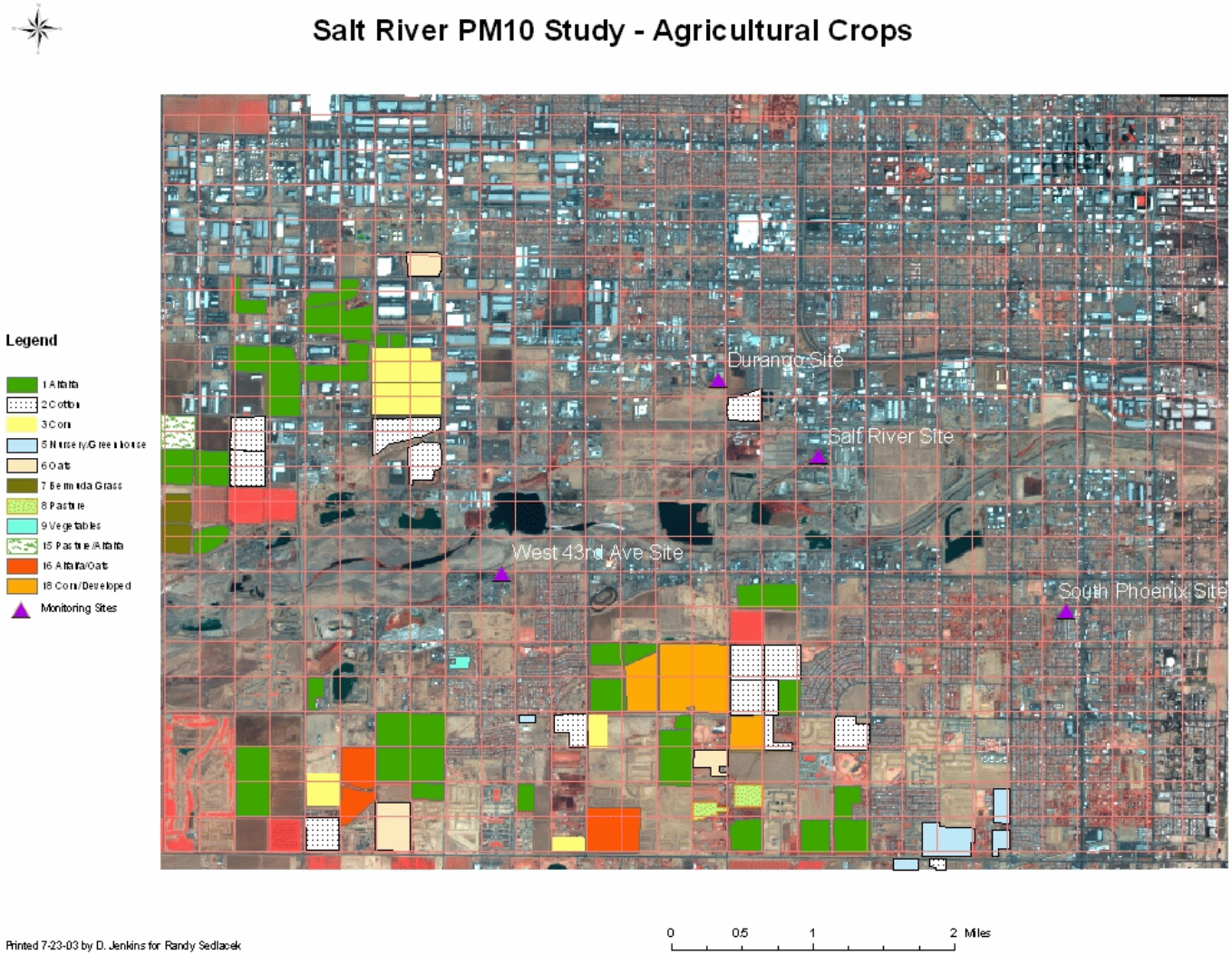

Figure D-1 Agricultural Crops in Salt River PM10 Study Area

Crop Calendar

A crop calendar (see Table D-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 D-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 D-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)												
Corn / Developing/Developed												
Cotton												
Oats (Haylage)												
Pasture/Corn/Milo												
Pasture/Alfalfa												
Alfalfa/Oats												
Vegetables												
Alfalfa												
Bermuda Grass												
Nursery/Greenhouse												
Pasture												
Design Days (red = high wind day)	1/8/03			4/15/02 4/26/02								12/16/02
Design Days – Optional					5/9/02	6/25/02	7/2/02	8/26/02			11/9/02 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 =		Planting =		Crop in Field =		Harvest =	

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 D-2 lists the calculations used to determine the percent tilling activity per day for corn (haylage) and cotton.

Table D-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 D-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:

$Tillage_{Cotton\ \&\ BMP}$ = 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:

$Tillage_{Corn\ \&\ BMP}$ = 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:

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

$$= \mathbf{0.00105 \text{ g PM10 / sq. meter of cotton field}}$$

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 seventy-five 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 D-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 D-3 Conversion of Agricultural Land to Residential and Commercial Uses

March 2002	March 2002		December 2003	December 2003		2002 - 2003 Change*	2002 - 2003 Change*
North of Salt River	**South of Salt River**		**North of Salt River**	**South of Salt River**		**North of Salt River**	**South of Salt River**
Ag Land	Ag Land		Ag Land	Ag Land		Ag Land	Ag Land
(Square Meters)	(Square Meters)		(Square Meters)	(Square Meters)		(Square Meters)	(Square Meters)
5,161,678	9,144,532		4,734,478	4,771,732		-427,200	-4,372,800
North of Salt River**	South of Salt River**		North of Salt River	South of Salt River			
Annual Change	Annual Change		% Annual Change	% Annual Change			
(Square Meters)	(Square Meters)		(Square Meters)	(Square Meters)			
-569,600	-5,830,400		-11.04%	-63.76%			
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 2005	Year 2006			
North of Salt River	**North of Salt River**		**North of Salt River**	**North of Salt River**			
Ag Land	Ag Land		Ag Land	Ag Land			
(Square Meters)	(Square Meters)		(Square Meters)	(Square Meters)			
5,161,678	4,591,829		3,633,919	3,232,734			
Year 2002	Year 2003		Year 2005	Year 2006			
South of Salt River	**South of Salt River**		**South of Salt River**	**South of Salt River**			
Ag Land	Ag Land		Ag Land	Ag Land			
(Square Meters)	(Square Meters)		(Square Meters)	(Square Meters)			
9,144,532	3,313,978		425,237	157,730			
Total Percent Conversion of Ag Land to Residential / Commercial between Years 2002 and 2006 = -76.30%							

Notes:
* 9 month change between March 2002 and December 2003
** Annual Change based on ratio of 9 months / 12 months

Sources of Data:
March 2002 surface area of agricultural land from March 2002 IKONOS satellite image digitized by ADEQ
December 2003 surface area of agricultural land from December 12, 2003 field trip by ADEQ

References

ARB, 1997. *Methods for Assessing Area Source Emissions*. California Environmental Protection Agency, Air Resources Board. October

Arizona Agricultural Statistics Service, 2001. *2001 Arizona Agricultural Statistics Bulletin,* July 2002. (http://www.nass.usda.gov/az/)

Fish and Clay, 2003. Meeting with Jeannette Fish, Maricopa County Farm Bureau, and Patrick Clay, University of Arizona Cooperative Extension, with Randy Sedlacek, Phil DeNee, Darlene Jenkins, ADEQ. May 21, 2003.

URS and ERG. *Technical Support Document for Quantification of Agricultural Best Management Practices.* June 18, 2001, 2001. Prepared for Arizona Department of Environmental Quality, ADEQ Contract No. 98-0159-BF, Task Assignment No. 00-0210-01.

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APPENDIX E – 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 E-1 through E-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 E-1 Durango PM10 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 E-2 Salt River PM10 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 T-Pac Prestressed Concrete Manufacturing	 **Already included as a point source based on 1 - 31 size ranking**	Yes 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 E-3 South Phoenix PM10 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 E-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 E-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 E-6 contains information on the industrial sources that were be considered as area sources.

Table E-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 E-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 E-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 E-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

Table E-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)
528	51	PACIFIC DESIGNS	2425 W SHERMAN ST	PHOENIX	85043	146	0.07	0.40	0.05
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

Table E-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)
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
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 F - SITE VISITS

Following are field notes by ADEQ staff of their site visits to the Salt River PM10 Study Area.

2.8.1 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.

2.8.3 Land Use Around Monitoring Sites Survey

West 43rd Avenue Monitoring Site

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).

Durango Monitoring Site

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).

South Phoenix Monitoring Site

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 .

Salt River Monitoring Site

West of 19th Avenue in grid cell 320 is a large dirt area used by United Metro (AKA 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.

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

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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.

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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%.