Assessment of Qualification for Treatment under the Federal Exceptional Events Rule: High Particulate (PM_{10}) Concentration Events in the Phoenix and Yuma Areas on June 4, 2008

Air Quality Division

August 16, 2010

EXECUTIVE SUMMARY
Assessment of Qualification for Treatment under the Federal Exceptional Events Rule: High Particulate (PM_{10}) Concentration Events in the Phoenix and Yuma Areas on June 4, 2008

This document is a reengineering and repackaging of the information and data related to an exceptional event in order to assist the Environmental Protection Agency's (EPA) Region 9 staff and the public with better understanding of the nature of that exceptional event. The first example, using this format, was prepared for the event that occurred on June 4, 2008, as a comprehensive analysis of the documentation sent to EPA on November 17, 2009 The materials contained in this Report respond to feedback received from EPA beginning in May 2010 and to criticisms made in the EPA Region 9 May 21, 2010, finding that this exceedance did not qualify for treatment as an exceptional event under 40 CFR 51.14. The Arizona Department of Environmental Quality (ADEQ) contends, however, that the materials sent to EPA in 2009 were sufficient to meet all the requirements of the Exceptional Events Rule (EER) and make adequate demonstrations that all the events qualified under the Rule**.** A preliminary version of this document was submitted to EPA Region 9 on August 2, 2010 seeking feedback on the adequacy of new format to address specific open issues. Based on insight gained in developing documentation for three other events, areas for improvement were identified and incorporated into this version of the document.

Background

The ADEQ issues Dust Control Action Forecasts for the Yuma and Phoenix areas as part of their Natural Events Action Plans (NEAPS). On Tuesday, June 3, 2008, in response to a deepening upper level trough of low pressure and an approaching dry surface cold front, ADEQ air quality forecasters issued the Maricopa County Dust Control Action Forecast calling for a moderate risk of wind-blown dust for Wednesday, June 4th, in Maricopa County. Because the tightening pressure gradient and dry cold front was expected to impact the Yuma area as well, ADEQ air quality forecasters called for a high risk of wind-blown dust in their Yuma and Vicinity Dust Control Action Forecast for Wednesday, June 4th. This potential wind event equated to a significant risk of exceeding the PM_{10} National Ambient Air Quality Standards (NAAQS) in both Yuma and Maricopa Counties. On the morning of June 4th, weather models predicted local wind gusts to be even stronger than the previous day's model runs had anticipated, prompting ADEQ forecasters to issue a same day PM_{10} Health Watch for Maricopa County stating that "Blowing and suspended dust, contributed to by strong and gusty gradient winds, may cause concentrations of coarse particles to approach unhealthy levels this afternoon and evening." The forecasts and advisories satisfy the requirement in 40 CFR 51.930(a)(1).

While the initial forecast for June 4th for both Maricopa County and Yuma called for sustained winds of 15-25 mph with the possibility for gusts over 30 mph, subsequent forecasts the morning of June 4th called for even stronger winds. Beginning in the early afternoon and continuing throughout the evening hours, strong southwesterly winds in Phoenix and strong westerly winds in Yuma generated areas of blowing dust. A detailed review of inspections in the vicinity of the exceeding monitors in Maricopa County was performed (see Appendix P and Section 5.2). Aside from the minor exceptions noted near the West 43rd Ave. and Coyote Lakes monitors, all appropriate State Implementation Plan (SIP) control measures were in place during the event,

demonstrating, per 40 CFR 50.1(j), that the event "is not reasonably controllable or preventable." A discussion of commonly employed control measures for dust in Maricopa and Yuma Counties can be found in "High Wind Exceptional Events and Control Measures for PM_{10} Areas" (Appendix G, see also Section 5.2 and Appendix E).

The start of a wind-blown dust event is evident in the 2:00 - 3:00 p.m. Phoenix visible camera images (see Appendix N), as well as the Arizona Meteorological Network (AZMET), Maricopa County (MC), ADEQ, and National Weather Service (NWS) monitors. This significant wind event brought elevated ambient concentrations of PM10 to the Phoenix and Yuma areas that exceeded the NAAQS at the Yuma Courthouse, Buckeye, West 43rd Ave., and Coyote Lakes monitors. The fact that ambient concentrations exceeded the NAAQS satisfies the criteria in 40 CFR 50.1(j) that the event "affects air quality." Monitors in Central Phoenix experienced two events. The first began at 2:00 p.m. from dusts originating in the Salt River channel. The second was a region wide, uniform dust plume from eastern California and western Arizona that entered the area at approximately 11:00 p.m. The following table lists the most significant PM10 monitor readings for the monitors examined in this Report (the Phoenix monitors are organized from south of the Salt River to north of the Salt River in the order of distance from the Salt River, with the West 43rd Ave. monitor being on the bank of the Salt River channel). The PM10 concentration gradient emanating to the north and south from the Salt River channel is evident from the data presented in the table below.

Monitor (Operator/Type)	AQS ID	24-hr Avg PM_{10}	1-hr Max PM_{10}	Max Time	Flag**
YUMA AREA					
Yuma Courthouse (ADEQ/TEOM)	**04-027-0004**	**386**	**2241**	**2000**	**RJ**
BUCKEYE AREA					
Buckeye (MC/TEOM)	**04-013-4011**	**204**	**772**	**2300**	**RJ**
PHOENIX METRO AREA					
South Phoenix	04-013-4003	**82**	178/206*	14/23	None
West 43rd Ave. (MC/TEOM)	**04-013-4009**	**194**	**645/283***	**14/23**	**RJ**
Durango Complex (MC/TEOM)	04-013-9812	**93**	190/238*	14/23	None
Central Phoenix (MC/TEOM)	04-013-3002	**92**	164/304*	14/23	None
Greenwood (MC/TEOM)	04-013-3010	**97**	152/253*	14/23	None
West Phoenix (MC/TEOM)	04-013-0019	**83**	130/301*	14/23	None
JLG Supersite (ADEQ/TEOM)	04-013-9997	**65**	92/229*	14/23	None
Coyote Lakes (MC/TEOM)	**04-013-4014**	**187**	**656**	**2300**	**RJ**

*Central Phoenix monitors experienced two events. Data is presented for 2:00 p.m., the time of the maximum at the West 43rd Ave. monitor, and the monitor's true hourly maximum value.
**24-hr PM_{10} concentration influenced by natural or exceptional event to be flagged.
Type Abbreviations: TEOM – Tapered Element Oscillating Microbalance Monitor (Continuous monitor)

The preliminary findings from the original analysis of this event were presented at stakeholder meetings on November 19, 2008, and March 19, 2009, in Phoenix, Arizona. Following the stakeholder meetings, ADEQ supplemented and finalized the analysis and a public comment period was held from October 15, 2009, through November 13, 2009. No comments were

received during the public comment period. The final report and public process documentation were submitted to EPA on November 17, 2009, to satisfy the requirements in 40 CFR 50.14(c)(3)(i). This supplemental report will undergo a similar public process.

Assessment under the Federal Exceptional Events Rule

Procedural Requirements. A review of the procedural requirements described in EPA's *Treatment of Data Influenced by Exceptional Events* rule (codified in 40 CFR 50) can be found in Section 1.1 of this document. These procedural requirements include a public notification that an event was occurring, the placement of informational flags on data in the Air Quality System (AQS), the notification of EPA of the intent to flag through submission of initial event description, the documentation that the public comment process was followed, and the submittal of a demonstration supporting the exceptional events flag. All of these procedural requirements are covered in detail in Section 1.1 and are met, or will be met, with the submittal of this demonstration document.

Documentation Requirements. A description of the documentation requirements required by EPA's *Treatment of Data Influenced by Exceptional Events* rule (codified in 40 CFR 50) can be found in Section 1.2 of this document.

1. Evidence is provided to show that the event satisfies "exceptional event" criteria. These criteria are comprised of four main parts:

a. Affects air quality – Section 5.1 presents information demonstrating the event affected air quality;
b. Is not reasonably controllable or preventable – Section 5.2 presents an analysis of fugitive dust produced along the back trajectory of winds impacting the West 43rd Ave. monitor and shows that during high wind hours the anthropogenic sources contributing to the exceedance of the PM_{10} standard on June 4, 2008, were open space (60.3%), riverbeds (8.7%), sand and gravel operations (1.6%), and vacant areas (29.5%). Documentation is presented demonstrating the EPA-approved Serious Area PM_{10} Plan and the 2007 Five Percent Plan for PM_{10} control measures were in place for these sources. This confirms that the sources upwind of the West 43rd Ave. monitor were reasonably controlled during the high wind hours on June 4, 2008;
c. Is caused by either (1) human activity that is unlikely to recur at a particular location or (2) a natural event – Section 5.3 presents an analysis of wind speeds recorded on June 4, 2008, showing that both the gusts and averages recorded during the high wind hours equaled or exceeded the 95th percentile values recorded during both spring and summer months in 2005 – 2008 at the West 43rd Ave. monitoring site. This demonstrates the winds which caused the exceedance of the standard were unusually high and qualify as a natural event; and,
d. Is determined by EPA to be in accordance with 40 CFR 50.14 to be an exceptional event (pending EPA concurrence upon receipt of this document).

2. There is a clear, causal relationship between the measurement under consideration and the event (*40 CFR 50.14(c)(3)(iv)(B)*). The demonstration of a clear causal relationship is evident in the description of the meteorological setup over the southwestern U.S. as well as the various reports of high winds and associated windblown dust. Section 7 shows comparisons between

monitor-specific winds and the PM_{10} levels measured at those monitors. With the arrival of high winds came elevated PM_{10} levels.

In Section 4, the meteorology of the event is described and supplemented with data in Appendix M. Appendices I, J, and K contain numerous advisories and reports of high winds and blowing dust to show that there was a high wind event occurring throughout southeastern California and much of Arizona that produced areas of blowing dust/sand. Radar information from the Yuma area clearly demonstrated the source of emissions that contributed to the exceedance at the Yuma monitor originated from areas in California. The timing of the secondary event in Phoenix (11:00 p.m.) was consistent with transport from the massive dust storm that started in Yuma at 7:00 p.m. Section 7 demonstrates that high afternoon concentrations do not typically occur unless unusually high winds are present. Data presented in Section 5.2 demonstrate that unusually high winds were recorded on the afternoon of June 4, 2008, at the West 43rd Ave. monitoring site relative to the historical record for spring and summer months. Data presented in Section 7 show that PM_{10} concentrations recorded on the afternoon of June 4, 2008, were unusually high relative to the historical record for both spring and summer months. Collectively, this information demonstrates a clear causal relationship between elevated winds and elevated concentrations recorded on the day of the event. Further evidence of this relationship is available from time-lapse photographs of the area adjacent to the monitor documenting diminished visibility as the afternoon progresses and winds and concentrations increased.

3. Evidence is provided to show that the event was associated with a measured concentration in excess of normal, historical fluctuations (*40 CFR 50.14(c)(3)(iv)(C)*). ADEQ developed a "Historical Distribution" table to show that the 24-hour values fell above the 95th percentile of historical data encompassing the previous five years of data for each monitor. All flagged 24-hr PM_{10} values were well above the 95th percentile when considering both annual and seasonal (spring and summer) data. Further evidence of the severity of the concentrations recorded on this date are presented in an analysis of the average concentrations recorded during the high wind hours related to the historical record for 2005 – 2009. It shows the June 4, 2008, values for the West 43rd Ave. monitor ranked 3rd (99.6 percentile) relative to summer observations and 7th (98.9 percentile) relative to spring observations. An additional analysis was completed to compare the values recorded at other monitors in the network to their five year historical values. Nearly all monitors showed elevated PM_{10} levels falling generally around the 95th percentile or greater for both the day in question, June 4, 2008, as well as the following day, June 5, 2008. These data are described in more detail in Section 3 of this document and provide further evidence that the event was associated with concentrations in excess of normal historical fluctuations.

4. Evidence is provided to show that there would have been no exceedance or violation "but-for" the event (event contribution analysis) (*40 CFR 50.14(c)(3)(iv)(D)*). Section 6 presents an "Event Contribution Analysis" to show there would not have been an exceedance "but for" the event. Using local measurements of the threshold velocity at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area, the event day was divided into periods with low and high wind hours. Alternative estimates of the daily concentrations were made by substituting spring and summer averages and 95th percentile concentrations recorded during the high wind hours in 2005 – 2008. The resulting daily average concentrations were well below the ambient 24-hour PM_{10} standard, thus demonstrating that "but-for" the concentrations recorded during the high wind hours, the exceedance would not have occurred at

the West 43rd Ave., Buckeye, Coyote Lakes, or Yuma monitoring sites. A similar calculation using data available for days in 2003 – 2008 showed the resulting daily average concentrations on June 4, 2008, exceeded the 99th percentile for both the West 43rd Ave. and Buckeye monitoring sites, providing further evidence of the elevated nature of the concentrations recorded during the high wind hours on that date.

Additionally, descriptions of Air Pollution Control Programs both for the Phoenix and Yuma areas are included in Section 2.2 of this document. Section 5.2 discusses the inspections and violations that were reported during the period June 1–7, 2008, and documents the control measures that were in place during that period. The violations noted during June 1-7, 2008, were minor and insufficient to contribute to an exceedance of the PM_{10} NAAQS at the magnitude recorded for the June 4, 2008, event. Thus, despite a demonstration that control measures were in place for upwind anthropogenic sources impacting the West 43rd Ave. monitor on June 4, 2008, a high wind event caused the NAAQS exceedance.

Conclusion

The high wind event that caused elevated PM_{10} on June 4, 2008, in Yuma and Maricopa Counties caused the transport of dust and soils from winds that suspended natural soils and soils from areas where all control measures were in place, or from source areas outside Arizona. These exceedances should be flagged for air quality planning purposes. The “high wind” (RJ) flag should be applied to the monitor readings.

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Section 1: Meeting Federal Requirements for Exceptional Events

This document is a reengineering and repackaging of the information and data related to an exceptional event in order to assist the Environmental Protection Agency's (EPA) Region 9 staff and the public with better understanding of the nature of that exceptional event. This first example was prepared for the event that occurred on June 4, 2008, as a comprehensive analysis of the documentation sent to EPA on November 17, 2009. The materials contained in this Report respond to feedback received from EPA beginning in May 2010 and to criticisms made in the EPA Region 9 May 21, 2010, finding that this exceedance did not qualify for treatment as an exceptional event under 40 CFR 51.14. The Arizona Department of Environmental Quality (ADEQ) contends, however, that the materials sent to EPA in 2009 were sufficient to meet all the requirements of the Exceptional Events Rule and make adequate demonstrations that all the events qualified under the Rule. A preliminary version of this document was submitted to EPA Region 9 on August 2, 2010 seeking feedback on the adequacy of new format to address specific open issues. Based on insight gained in developing documentation for three other events using the preliminary version of this document as a guide, areas for improvement were identified and incorporated into this version of the document.

EPA's *Treatment of Data Influenced by Exceptional Events* rule (40 CFR 50.14) describes the requirements for exceptional events flagging and documentation. The Arizona Department of Environmental Quality (ADEQ) meets all of these procedural and documentation requirements.

1.1 Procedural Requirements

Public notification that event was occurring (40 CFR 50.14(c)):

ADEQ issues Dust Control Action Forecasts for the Yuma and Phoenix areas as part of their Natural Events Action Plans. On Tuesday, June 3, 2008, in response to a deepening upper level trough of low pressure and an approaching dry surface cold front, ADEQ air quality forecasters issued the Maricopa County Dust Control Action Forecast calling for a moderate risk of wind-blown dust for Wednesday, June 4th. Because the tightening pressure gradient and dry cold front was expected to impact the Yuma area as well, ADEQ air quality forecasters called for a high risk of wind-blown dust in their Yuma and Vicinity Dust Control Action Forecast for Wednesday, June 4th. This potential wind event equated to a significant risk of exceeding the PM10 National Ambient Air Quality Standards (NAAQS) in both Yuma and Maricopa Counties. On the morning of June 4th, weather models predicted local wind gusts to be even stronger than the previous day's model runs had anticipated, prompting ADEQ forecasters to issue a same day PM10 Health Watch for Maricopa County stating that "Blowing and suspended dust, contributed to by strong and gusty gradient winds, may cause concentrations of coarse particles to approach unhealthy levels this afternoon and evening." The forecasts and advisories satisfy the requirement in 40 CFR 51.930(a)(1). Copies of these advisories have been included in Appendix I.

Place informational flag on data in the Air Quality System (AQS) (40 CFR 50.14(c)(2)(i)):

ADEQ and other operating agencies in Arizona submit data into the U.S. Environmental Protection Agency (EPA) Air Quality System (AQS). Data from both filter-based and continuous monitors operated in Arizona are submitted to AQS.

When ADEQ or another agency operating monitors in Arizona suspects that data may be influenced by an exceptional event, ADEQ or the other operating agency expedites analysis of the filters collected from the potentially-affected, filter-based air monitoring instruments, quality assures the results and the agency submits the data into AQS. ADEQ and other operating agencies also submit data from continuous monitors into AQS after quality assurance is complete.

If ADEQ or the operating agency has determined a potential exists the monitor reading has been influenced by an exceptional event, a preliminary flag is submitted for the measurement in the AQS. The data are not official until they undergo more thorough quality assurance and quality control, leading to certification by July 1st (or starting in 2010 by May 1st) of the year following the calendar year in which the data were collected (40 CFR 58.15(a)(2)). The presence of the flag can be confirmed in AQS.

Notify EPA of intent to flag through submission of initial event description by July 1 of calendar year following event (40 CFR 50.14(c)(2)(iii)):

ADEQ submitted a letter to EPA on June 30, 2009, listing the days ADEQ and other operating agencies in Arizona intended to analyze under the Exceptional Events Rule. The June 4, 2008, PM_{10} high wind event was included on this list. Four monitors were identified as being qualified. These were the Yuma Courthouse monitor operated by ADEQ, and the Buckeye, Coyote Lakes, and West 43rd Ave. monitors operated by Maricopa County Air Quality Department (MCAQD). A copy of the transmittal letter and preliminary assessment report are included in Appendix Q.

Document that the public comment process was followed for event documentation (40 CFR 50.14(c)(3)(iv)):

ADEQ updated the assessment report and released it for a formal 30-day public comment period in October 2009. The updated document was submitted to EPA on November 17, 2009. A copy of the transmittal letter, public notice certification, and assessment report are included in Appendix R.

ADEQ is submitting this document in an effort to engage EPA in consultation about the June 4, 2008, event. This document is intended to add additional clarification requested by EPA on the event. This document will be available for a formal 30-day comment period and re-submitted to EPA, along with any comments received, consistent with the requirements of 40 CFR 50.14(c)(3)(iv).

Submit demonstration supporting exceptional event flag (40 CFR 50.14(a)(1-2)):

Prior documentation submitted on November 17, 2009, was intended to accomplish this. This supplemental report is intended to resolve any other outstanding issues.

1.2 Documentation Requirements

Provide evidence that the event satisfies "exceptional event" criteria set forth in 40 CFR 50.1(j) (40 CFR 50.14(c)(3)(iii)(A)):

See Section 5 of this document. According to 40 CFR 50.1(j) and Clean Air Act (CAA) Section 319, an exceptional event meets all of the following criteria:

a. Affects air quality (See Section 5.1 of this document);
b. Is not reasonably controllable or preventable (See Sections 5.2 of this document);
c. Is caused by either (1) human activity that is unlikely to recur at a particular location or (2) a natural event (See Section 5.3 of this document); and
d. Is determined by EPA to be in accordance with 40 CFR 50.14 to be an exceptional event (pending EPA concurrence upon receipt of this document).

There is a clear, causal relationship between the measurement under consideration and the event (40 CFR 50.14(c)(3)(iii)(B)):

See Section 7 of this document.

Provide evidence that the event is associated with a measured concentration in excess of normal, historical fluctuations (40 CFR 50.14(c)(3)(iii)(C)):

See Section 3 of this document.

Provide evidence that there would have been no exceedance or violation but for the event (event contribution analysis) (40 CFR 50.14(c)(3)(iii)(D)):

See Section 6 of this document.

Section 2: Background on Geographic Setting and Control Programs

This section describes the geographic and climatic setting of the monitors and the control programs in place to protect air quality in the area.

2.1 Geographic Setting of Monitors

<u>Phoenix</u>

Geographic Setting

Phoenix is located in the Salt River Valley in south-central Arizona (see Figure 2-1). It lies at a mean elevation of 1,090 feet above mean sea level (msl) in the northern reaches of the Sonoran Desert. Other than the mountains in and around the city, the topography of Phoenix is generally flat. The Phoenix area is surrounded by the McDowell Mountains (~4,200 ft msl) to the northeast, the foothills of the Bradshaw (~7,900 ft msl) and Mazataal (~7,900 ft msl) ranges to the north, the White Tank Mountains (~4,500 ft msl) to the west, the Sierra Estrella (~4,450 ft msl) to the southwest, and the Superstition Mountains (~5,000 ft msl) far to the east. Within the City are the Phoenix Mountains (~2,600 ft msl) and South Mountain (~2,600 ft msl). Current development is pushing north, west, and south into Pinal County.

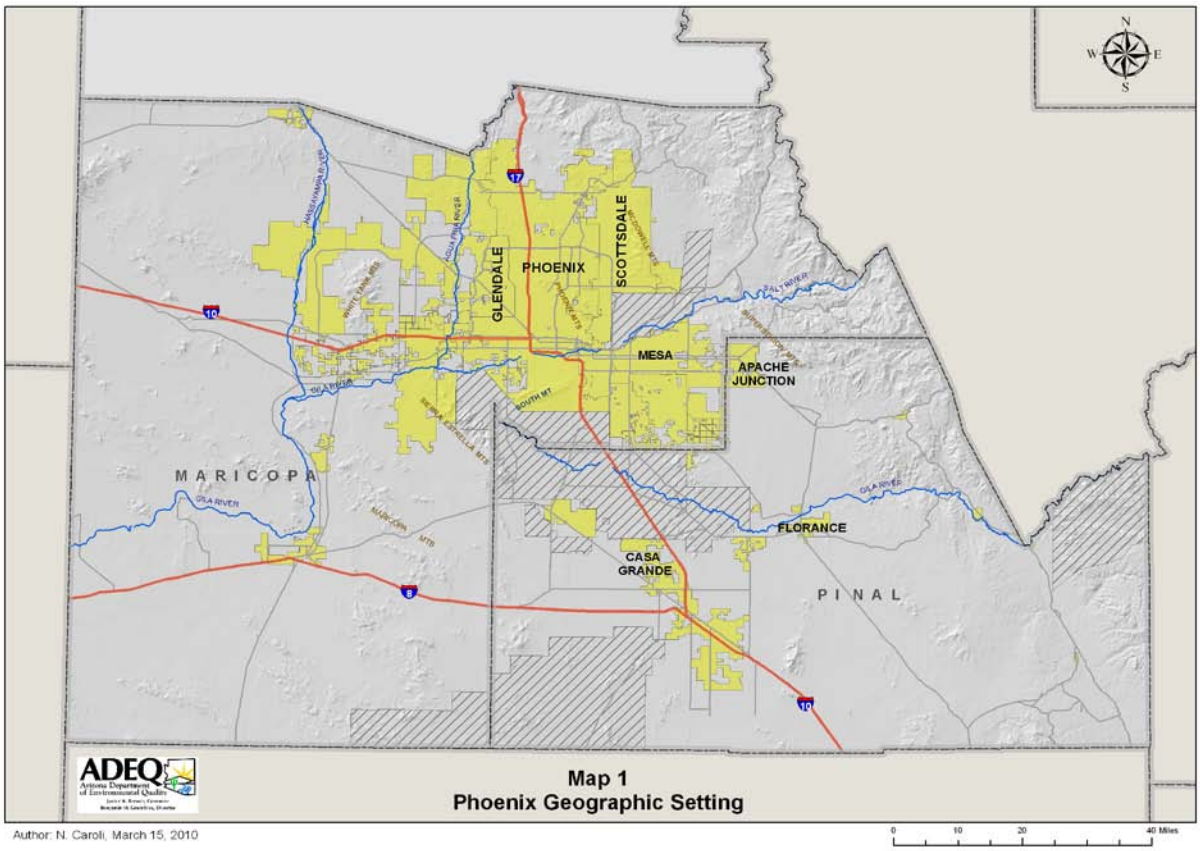


Figure 2-1. Map of Phoenix Geographic Setting

The 2000 census revealed that Phoenix had a population of 1,321,045 people and the Phoenix-Mesa-Scottsdale Metropolitan Statistical Area (MSA), comprised of Maricopa and Pinal counties, had a population of 3,251,876. The official 2008 estimate by the U.S. Bureau of the Census placed the population of Phoenix at 1,567,928 and the population of the MSA at 4,281,899.

Figure 2-2 depicts the drainage systems or watersheds for the State of Arizona. Many of the rivers that form Arizona's drainage system are dry for most of the year and, consequently, are sources of silt and fine soils that become suspended and add to regional PM_{10} loadings during high wind events. Much of this alluvial matter and fine soils have been deposited in the Valley of the Sun in the vicinity of the confluence of the Gila and Salt River channels and the confluence of the Gila and Agua Fria River channels.

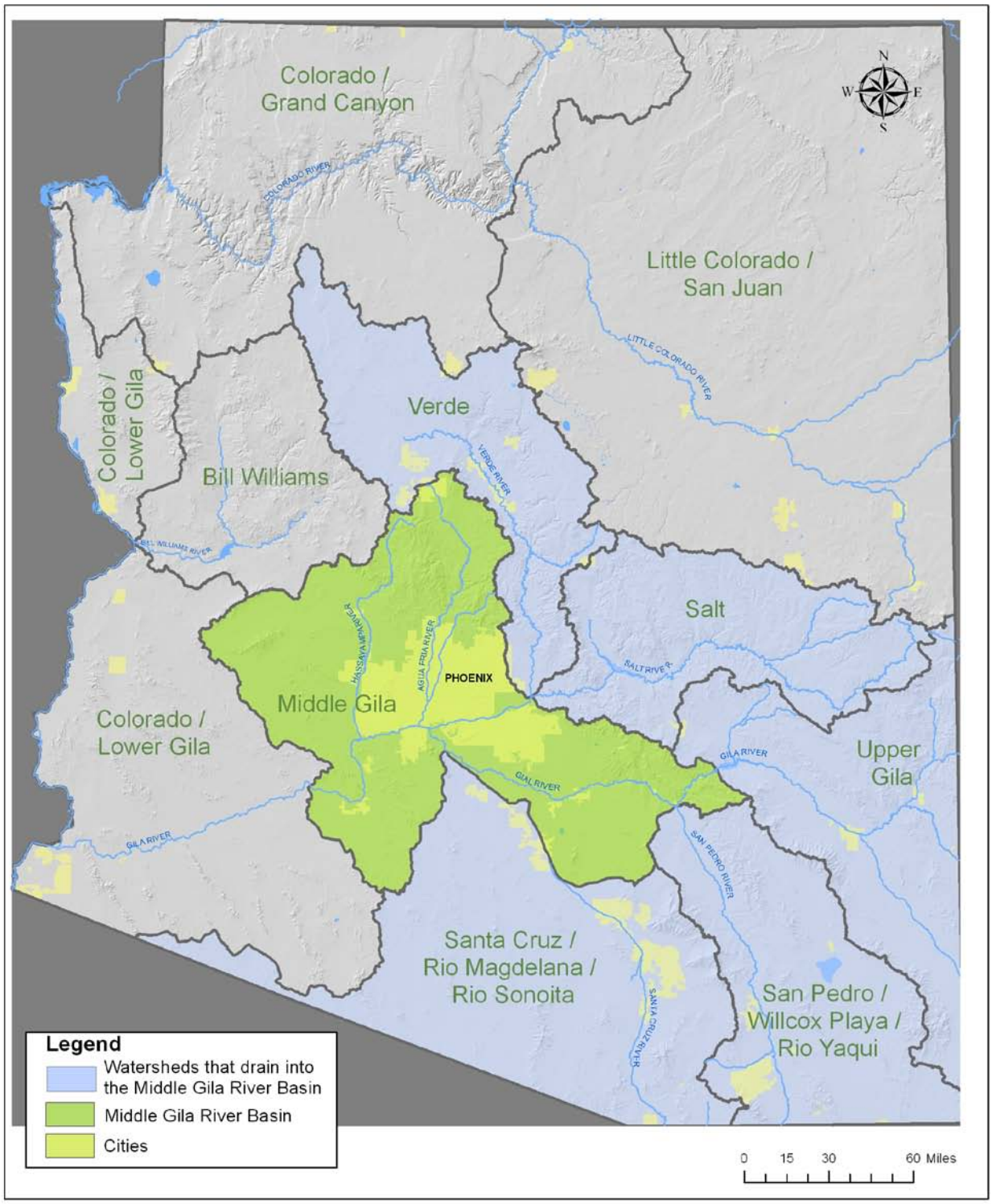
This alluvial material and these fine soils contribute significantly to the PM_{10} loading associated with elevated PM_{10} events at the West 43rd Ave. monitor in Phoenix when winds are being directed up the Gila and Salt River channels from the west during high wind events. This can also be true for the Buckeye and Coyote Lakes monitors, which are located adjacent to dry riverbeds.

Figure 2-2 also reveals that the Phoenix airshed and the Yuma airshed are linked by the Gila River channel. The alluvial material and fine soils in the Gila River channel can provide a source of particulate matter to the Greater Phoenix Area, especially to the West Valley if the winds are oriented along the direction of the channel.

Climate

Phoenix has an arid climate, with very hot summers and temperate winters. The average summer high temperature is among the hottest of any populated area in the United States. The temperature reaches or exceeds 100ºF an average of 110 days during the year and highs top 110ºF an average of 18 days during the year. Phoenix receives an average of 7.66 inches of rain per year.

Precipitation is sparse during a large part of the summer, but the influx of monsoonal moisture, which generally begins in early July and lasts until mid-September, raises humidity levels and can cause heavy localized precipitation and flooding. March is the wettest month of the year with June being the driest. Although thunderstorms are possible at any time of the year, they are most common during the monsoon season from July to mid-September as humid air surges in from the Gulf of California. These can bring strong winds, large hail, or rarely, tornadoes. Winter storms moving inland from the Pacific Ocean occasionally produce significant rains but occur less frequently.



Map 2
Drainage System Phoenix, Arizona

Author: N. Caroli, March 15, 2010

Figure 2-2. Map of Drainage System in Arizona

Yuma

Geographic Setting
Yuma is the county seat of Yuma County. It has of area of 106.7 square miles. Yuma is located in the Lower Colorado River Valley at an elevation of 138 feet above sea level. It is near the borders of California to the west and Mexico to the south, and just west of the confluence of the Colorado and Gila Rivers (see Figure 2-3). Most of the city lies in the part of the Colorado River Floodplain known as the Yuma Valley. Some of the City is built on the Yuma Mesa, another prominent land feature found to the east. The Yuma Mesa extends eastward to the Gila Mountains. The Valley follows the course of the Colorado River to the north and is open all the way to the Sea of Cortez to the south.

According to the U.S. Census, Yuma had 77,515 residents in 2000 and the Yuma MSA, comprised of Yuma County, had a population of 160,026. The U.S. Census Bureau's official estimates place the population of the City of Yuma at 90,041 and the population of the Yuma MSA at 194,322 in 2008, though more than 85,000 winter visitors make Yuma their seasonal residence.

Climate
Yuma is one of the hottest cities of any size in the United States, with average July high temperatures of 107°F. Average January highs are around 70°F. Of the possible 4,456 hours of daylight each year, the sun shines in Yuma for roughly 4,050 hours, or about 90 percent of the time. On average, Yuma receives about 3 inches of rain annually.

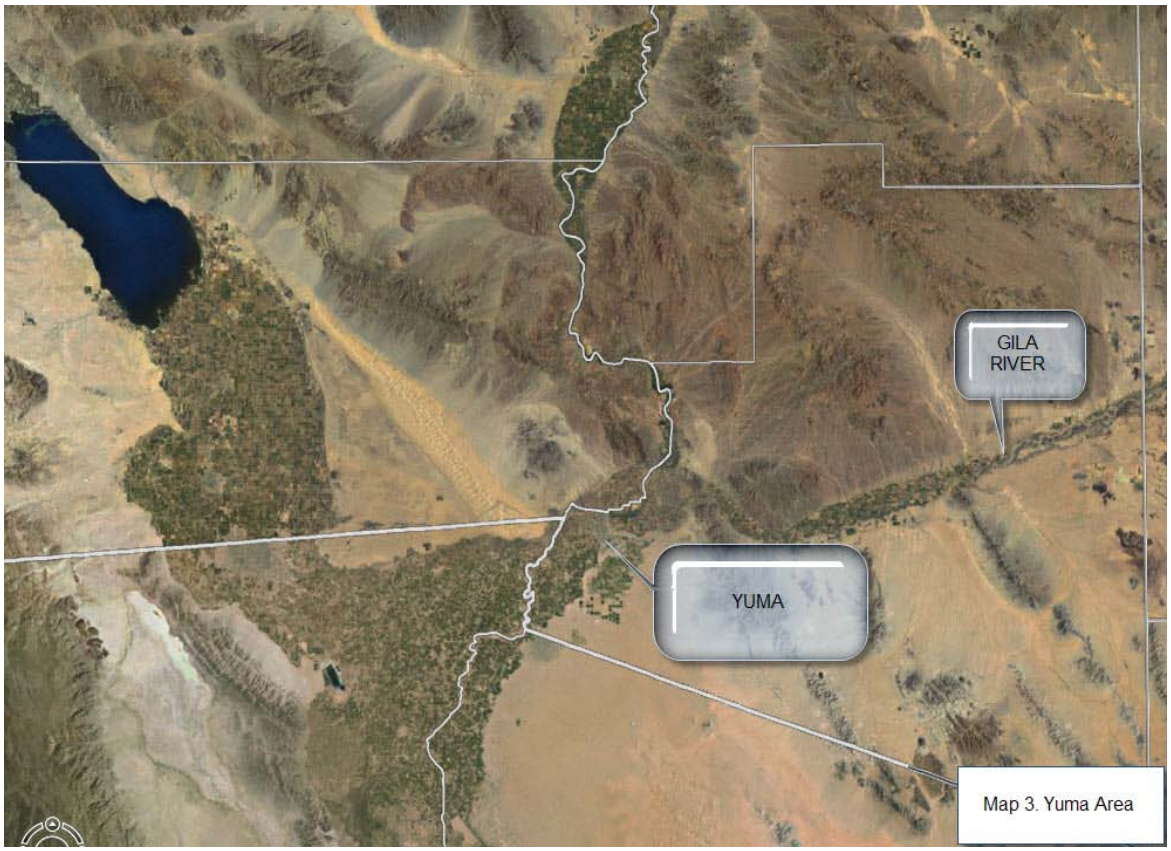


Figure 2-3. Map of Yuma Area

2.2 Air Pollution Control Programs

Phoenix Area

Two programs provide air pollution control measures for the Phoenix area:

- ADEQ Agricultural Best Management Program or AgBMP (http://www.azdeq.gov/environ/air/prevent/pcp.html#bmp) under Arizona Administrative Code R18-2-610 and 611 (http://www.azsos.gov/public_services/Title_18/18-02.htm#Article_6) and
- Maricopa County Air Quality Department, which implements a suite of rules listed in Table 2-1.

In addition to routine inspections and inspections driven by complaints, inspections are often increased when a pollution advisory, high wind advisory, or dust forecast is issued. For June 4, 2008, a PM_{10} health watch was issued and the Dust Control Action Forecast identified a moderate potential for blowing dust.

Upon the flagging of an event that could be classified as exceptional, a control measures report is completed. The report contains any complaints or inquiries made, any inspections conducted, and any enforcement actions issued for a period of 72 hours prior to the day of the event, the day of the event, and 72 hours after the event within a two mile radius of the monitor (see Appendix P). Upon the issuance of an advisory, additional inspections are often conducted, particularly in areas where reduced compliance or PM_{10} generating activities have historically been an issue.

Table 2-1. Rules Regulating Particulate Matter Emissions in Maricopa County

Rule Number and Title	Rule Description
Rule 300: Visible Emissions	Establishes standards for visible emissions and opacity.
Rule 310: Fugitive Dust from Dust-Generating Operations	Establishes limits for the emissions of particulate matter into the ambient air from any property, operations, or activity that may serve as a fugitive dust source.
Rule 310.01: Fugitive Dust from Non-Traditional Sources of Fugitive Dust	Establishes limits for the emissions 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 and which are not required to have either a permit or a dust control plan.
Rule 311: Particulate Matter from Process Industries	Establishes emission rates based on process weight applicable to any affected operations not subject to Rule 316.
Rule 312: Abrasive Blasting	Establishes limits for particulate emissions from abrasive blasting operations.
Rule 313: Incinerators, Burn-Off Ovens, and Crematories	Establishes standards for incinerators that are used for refuse disposal and limits particulate emissions from incinerator burning.
Rule 314: Open Outdoor Fires and Indoor Fireplaces at Commercial and Institutional Establishments	Establishes limits for the emissions of air contaminants produced from open burning.
Rule 315: Spray Coating Operations	Establishes limits for the emissions of particulate matter to the atmosphere from spray coating operations.

Table 2-1. Rules Regulating Particulate Matter Emissions in Maricopa County	
Rule Number and Title	**Rule Description**
Rule 316: Nonmetallic Mineral Processing	Establishes limits for the emissions of particulate matter into the ambient air from any nonmetallic mining operation or rock product processing plant.
Rule 317: Hospital/Medical/Infectious Waste Incinerators	Establishes limits for the emissions of air pollutants from medical waste incinerators.
Rule 318: Approval of Residential Woodburning Devices	Establishes standards for approval of residential woodburning devices.
Rule 319: Ginning Operations	Establishes limits for the emissions of particulate matter from ginning operations.
Rule 322: Power Plant Operations	Establishes limits for the emissions of nitrogen oxides, sulfur oxides, carbon monoxide and particulate matter from existing power plants and cogeneration plants.
Rule 323: Fuel Burning Equipment from Industrial/Commercial/Institutional (ICI) Sources	Establishes limits for the emissions of nitrogen oxides, sulfur oxides, carbon monoxide and particulate matter from ICI sources.
Rule 324: Stationary Internal Combustion (IC) Engines	Establishes limits for the emissions of carbon monoxide, nitrogen oxides, sulfur oxides, volatile organic compounds, and particulate matter from stationary internal combustion engines, including stationary IC engines used in cogeneration.
Rule 325: Brick and Structural Clay Products (BSCP) Manufacturing	Establishes limits for particulate matter emissions from the use of tunnel kilns for curing in the brick and structural clay product (BSCP) manufacturing processes.
P-25: Leaf Blower Restriction Ordinance	Establishes restrictions for leaf blowers in incorporated and unincorporated sections of Area A in Maricopa County.
P-26: Residential Woodburning Restriction Ordinance	Establishes restrictions for residential woodburning.
P-27: Vehicle Parking and Use on Unstabilized Vacant Lots Ordinance	Establishes restrictions for vehicle parking and use on unstabilized vacant lots in unincorporated sections of Area A in Maricopa County.
P-28: Off-Road Vehicle Use in Unincorporated Areas of Maricopa County Ordinance	Establishes restrictions for operating vehicles on unpaved property in unincorporated areas of Maricopa County.

Dust Control Information:
http://www.maricopa.gov/aq/divisions/compliance/dust/Default.aspx

Rule 310, Rule 310.01, Rule 316:
http://www.maricopa.gov/aq/divisions/planning_analysis/AdoptedRules.aspx

Additional Information Rule 316:
http://www.maricopa.gov/aq/divisions/compliance/dust/implementation_resources.aspx

Yuma Area

Two regulatory provisions contain control measures for the Yuma planning area:

- The Yuma Agricultural Best Management Program (AgBMP) under Arizona Administrative Code R18-2-612 and 613[1] and
- The Yuma PM_{10} Maintenance Plan[2].

In August 2002, Yuma was impacted by an exceptional event. Under the natural and exceptional events regulations at the time, the area qualified for a National Events Action Plan (NEAP). The NEAP allowed for the development of specific measures that are put in place upon the issuance of a Dust Control Action Forecast. A Dust Control Action Forecast was issued for the Yuma area on June 3, 2008, indicating a high potential for blowing dust.

It would be possible, in addition, to confirm the status of the existing control measures within the regional transport area of an event to determine if any enforcement actions are on record. A review of all control measures is completed every five years for PM_{10} areas under maintenance plans.

[1] http://www.azsos.gov/public_services/Title_18/18-02.htm#Article_6
[2] http://www.azdeq.gov/environ/air/plan/notmeet.html#yuma

Section 3: Concentrations Were In Excess of Normal, Historical Fluctuations

In order to qualify as an exceptional event, the concentration must be shown to be in excess of the normal, historical fluctuation of measurements at the site. This section examines this issue and provides the basis that this criterion has been met for the monitors.

The historical concentration and meteorological data used in this Section (and in Sections 5 through 7) is limited by the availability of data at each particular monitoring site. Due to different data collection parameters at each site (i.e., hourly data vs. filter data vs. 5-minute data) historical time periods vary between sections depending on the type of analysis being conducted, monitoring sites being considered and/or compared, and the availability of quality assured data.

3.1 Flagged Monitors

The Federal Register Notice[3] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration.

> *The final rule permits a case-by-case evaluation, without prescribed threshold criteria, to demonstrate that an event affected air quality. This demonstration would be based on the weight of available evidence, but must consider the historical frequency of such measured concentrations. While a State may determine the specific approach to use for such analysis, it must compare contemporary concentrations with the distribution of all measured data during the past several years. The evidence that an event affected air quality may be presented on a seasonal or other temporal basis to best compare contemporary concentrations with the distribution of historical values. For consistency with data reporting and computation of NAAQS statistics, a calendar quarter basis is suggested.*

To address this requirement, ADEQ has assembled data for both spring (March, April and May) and summer (June, July and August) seasons, as defined by the National Weather Service (NWS). The reason for selecting two seasons is that while June 4th falls within the summer season, conditions early in the month can be more like the high wind spring months and a more convincing demonstration will be apparent from comparisons with both seasons. To further support a demonstration that concentrations were in excess of normal, historical fluctuations, comparisons have been prepared using both 24-hour Federal Reference Method (FRM) measurements and hourly measurements during high wind hours.

A summary of the frequency distribution of the previous five years of certified data (2003-2007) is contrasted with the June 4, 2008, value for the Buckeye, West 43rd Ave., Coyote Lakes and Yuma monitors in Table 3-1. Historical distributions are presented for each monitor for both the entire 5-year dataset and for the summer season.

All four monitoring sites listed above recorded concentrations over the 95th percentile values for each monitor location. The Buckeye, West 43rd Ave., and Coyote Lakes monitored

[3] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

concentrations on June 4th all fell between the 99.0 and 99.5percentile of historical data and the Yuma concentration exceeded the maximum value of PM_{10} recorded during the previous five year period. All four flagged 24-hr average values for June 4, 2008, were found to be greater than the 95th percentile when compared both to the entire 5-year dataset and to the 5-year summer seasonal dataset. Thus, given the recorded values and using similar methodology to the one accepted by EPA, it is clear that the PM_{10} levels on June 4, 2008, were outside of normal historical fluctuations.

Table 3-1. Historical Distribution Summer Season only

Historical Distribution 5-Yr. Distribution of Values (µg/m³)						
MONITORS: 1-BUCKEYE 2-WEST 43RD AVE. 3-COYOTE LAKES			Column Index Yr - All Data (5-Yrs) Sea - Data for Summer season only (5-Yrs)			
Cumulative Frequency	Buckeye		West 43rd		Coyote Lakes	
	Yr	Sea	Yr	Sea	Yr	Sea
Min	5	14	5	16	7	10
0.5%	7	15	9	18	7	14
1.0%	9	15	11	18	9	17
2.5%	13	17	15	20	10	19
5%	16	21	19	24	14	19
10%	22	25	29	31	19	21
25%	33	34	44	40	30	31
50%	48	49	65	61	44	46
75%	67	68	91	82	58	62
90%	83	86	121	102	77	77
95%	98	101	139	127	91	102
97.5%	120	115	157	157	109	119
99.0%	159	131	192	251	122	138
99.5%	260	155	227	251	219	206
Max	289	195	313	251	313	273
Flagged Value	204		194		186	

Historical Distribution 5-Yr. Distribution of Values (µg/m³)						
MONITORS: 4- YUMA COURTHOUSE			Column Index Yr - All Data (5-Yrs) Sea - Data for Summer season only (5-Yrs)			
Cumulative Frequency	Yuma Courthouse					
	Yr	Sea				
Min	8	13				
0.5%	12	16				
1.0%	14	16				
2.5%	16	20				
5%	19	20				
10%	23	25				
25%	31	34				
50%	42	43				
75%	57	62				
90%	77	85				
95%	96	102				
97.5%	127	132				
99.0%	186	165				
99.5%	211	193				
Max	349	224				
Flagged Value	386					

Further evidence that 24-hour concentrations recorded on June 4, 2008, were outside of historical fluctuations is presented in Table 3-2. It shows that all monitors recorded values that either equaled or exceeded the 99th percentile for the spring season.

Additional insight into the unusual nature of concentrations recorded on June 4, 2008, can be gained from a historical examination of concentrations recorded during the high wind hours. As discussed further in Section 5.1, high wind hours were defined to be those in which 5-minute vector average measurements exceeded 13 mph, the lowest threshold speed at which winds can initiate entrainment of PM_{10} impacting local monitors in Maricopa County (see Appendix H).

Using this criterion, the high wind hours for the West 43rd Ave. monitor were determined to be 1:00 p.m. to midnight (the period of average for the high wind hours for this event).

Table 3-2. Historical Distribution Spring Season only

Historical Distribution 5-Yr. Distribution of Values (µg/m³)						
MONITORS: 1-BUCKEYE 2-WEST 43RD AVE. 3-COYOTE LAKES			Column Index Yr - All Data (5-Yrs) Sea - Data for Spring season only (5-Yrs)			
Cumulative Frequency	Buckeye		West 43rd		Coyote Lakes	
	Yr	Sea	Yr	Sea	Yr	Sea
Min	5	7	5	8	7	15
0.5%	7	9	9	9	7	15
1.0%	9	10	11	11	9	16
2.5%	13	13	15	13	10	17
5%	16	16	19	19	14	20
10%	22	24	29	28	19	27
25%	33	32	44	46	30	34
50%	48	45	65	63	44	47
75%	67	59	91	82	58	57
90%	83	75	121	107	77	78
95%	98	83	139	125	91	86
97.5%	120	98	157	134	109	93
99.0%	159	122	192	194	122	107
99.5%	260	143	227	220	219	113
Max	289	212	313	313	313	118
Flagged Value	204		194		186	

Historical Distribution 5-Yr. Distribution of Values (µg/m³)						
MONITORS: 4- YUMA COURTHOUSE			Column Index Yr - All Data (5-Yrs) Sea - Data for Spring season only (5-Yrs)			
Cumulative Frequency	Yuma Courthouse					
	Yr	Sea				
Min	8	8				
0.5%	12	9				
1.0%	14	14				
2.5%	16	16				
5%	19	19				
10%	23	22				
25%	31	29				
50%	42	40				
75%	57	51				
90%	77	76				
95%	96	109				
97.5%	127	182				
99.0%	186	210				
99.5%	211	212				
Max	349	349				
Flagged Value	386					

The additional analysis used the available hourly dataset (2005-2009) for the seasons. The severity of concentrations recorded during those hours on June 4, 2008, is illustrated in Figures 3-1 and 3-2. They display the average concentration recorded during those high wind hours at the West 43rd Ave. monitoring site relative to the same period of time in the available hourly dataset (2005 – 2009) for the summer and spring seasons, respectively. Figure 3-1 shows that June 4, 2008, ranked 3rd (99.6th percentile) out of the available data for the summer season. Figure 3-2 shows a ranking of 7th (98.9th percentile) for the spring season. Similar analyses were also prepared for high wind hours at the Buckeye and Coyote Lakes monitors. The results for Buckeye, which addressed the same time period (2005 – 2009) showed a ranking of 3rd (99.6th percentile) for the summer and 2nd (99.9th percentile) for the spring. While Coyote Lakes had a shorter historical dataset (2007 - 2008), the results showed a ranking 2nd (99.6th percentile) for the summer and 1st (100.0th percentile) for the spring.

In summary, an examination of the historical record of 24-hour concentrations over annual and relevant seasonal periods demonstrates that concentrations recorded on June 4, 2008, were well outside of normal, historical fluctuations. A similar examination of concentrations recorded

during high wind hours at the three Maricopa County monitors further demonstrates the severity of concentrations recorded on June 4, 2008.

Figure 3-1. Distribution of Average PM_{10} Concentrations During High Wind Hours (1:00 p.m. – Midnight) at West 43rd Ave. Monitor Summer Months (2005 – 2009)

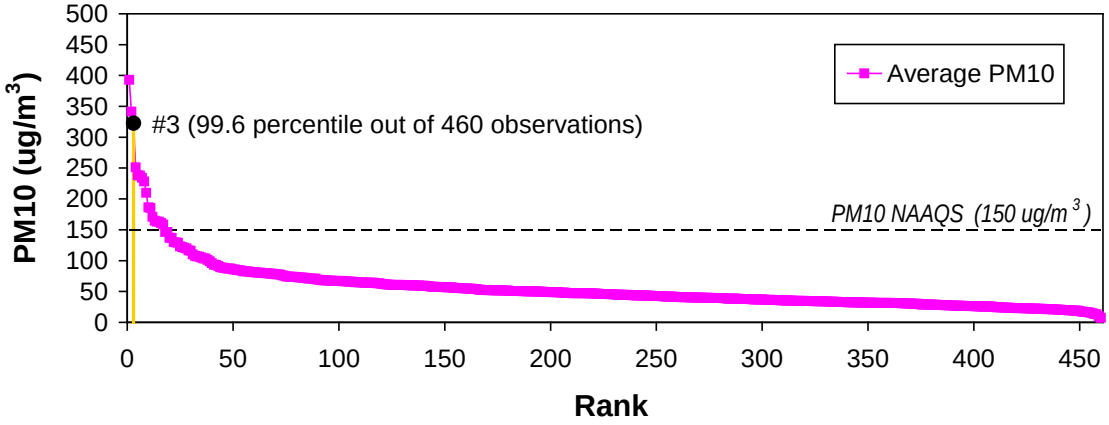
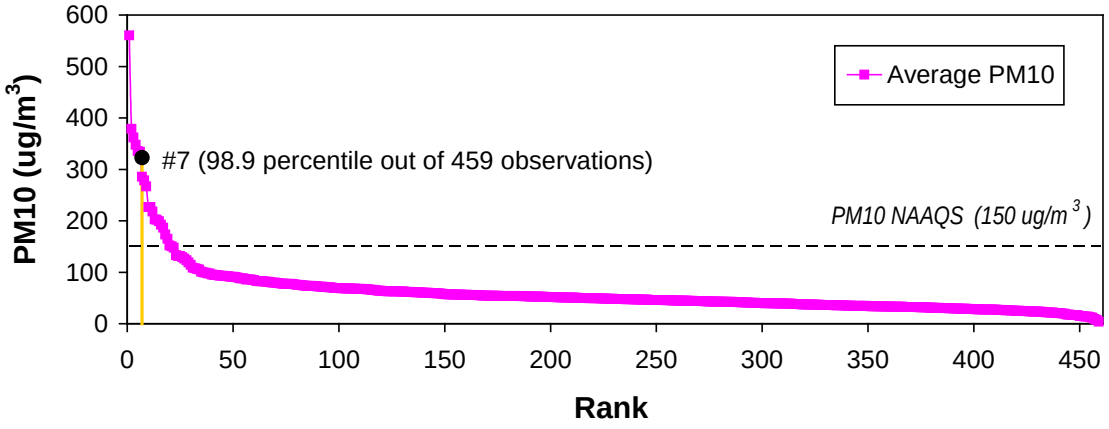


Figure 3-2. Distribution of Average PM_{10} Concentrations During High Wind Hours (1:00 p.m. – Midnight) at West 43rd Ave. Monitor Spring Months (2005 – 2009)



3.2 Other Non-Flagged Monitors

The complete Phoenix Metropolitan Area 24-hr Average PM_{10} data are summarized in Table 3-3 for the period June 3rd – June 6th. It is interesting to note that most of the monitors exceeded the 95th percentile on June 4th, and the residual dust from the major storm described in Section 4 below continued to affect all the monitors on June 5th, although it did not cause exceedances of the NAAQS on that date.

Table 3-3. Historical Analysis of Maricopa County PM_{10} Network Data

Site ID – Name	June 3rd	June 4th	June 5th	June 6th	June-August 95th Percentile	June-August 75th Percentile	June-August 50th Percentile
4011 – Buckeye	40	203	114	42	101	68	49
4003 – South Phx	37	82	113	42	93	65	48
4009 – West 43rd	58	193	131	55	127	82	61
9812 – Durango	42	93	116	42	119	68	51
3002 – Central Phx	33	92	116	30	79	48	38
3010 – Greenwood	43	97	123	35	84	53	41
0019 – West Phx	35	83	113	31	77	50	38
9997 – JLG	27	65	101	27	60	38	30
4014 – Coyote Lakes	97	186	86	71	102	62	46
4006 – Higley	47	83	94	54	138	71	54

The data from June 3rd and June 6th were closer to the median values (50th Percentile), further confirming that the event was wide-spread over most of the Phoenix area.

Section 4: Description of June 4, 2008, Exceptional Event

On June 3rd, 2008, an upper level low pressure system began to develop off the Pacific Northwest Coast (Figure 4-1). By the early morning hours of June 4th, the upper level low was located over northeastern California and northwestern Nevada. By the late afternoon and early evening hours of June 4th, the upper level trough axis was centered along the Nevada / Utah and California / Arizona borders with a strong upper level jet located along the western periphery and at the base of the trough. At the 300 mb level, wind speeds exceeded 100 mph within this jet stream. At the 500 mb level, wind speeds ranged from 60 – 80 knots throughout California and Arizona and at 700 mb, wind speeds ranged from 35 – 45 knots throughout California and Arizona (Figure 4-2). Abundant sunshine and daytime temperatures around 100° F in the deserts of southeastern California and Arizona allowed for a well mixed atmosphere, which enabled the upper level winds to mix down to the surface, as evidenced by the numerous reports of high winds by the NWS. Additionally, local topography likely increased surface winds at certain locations.

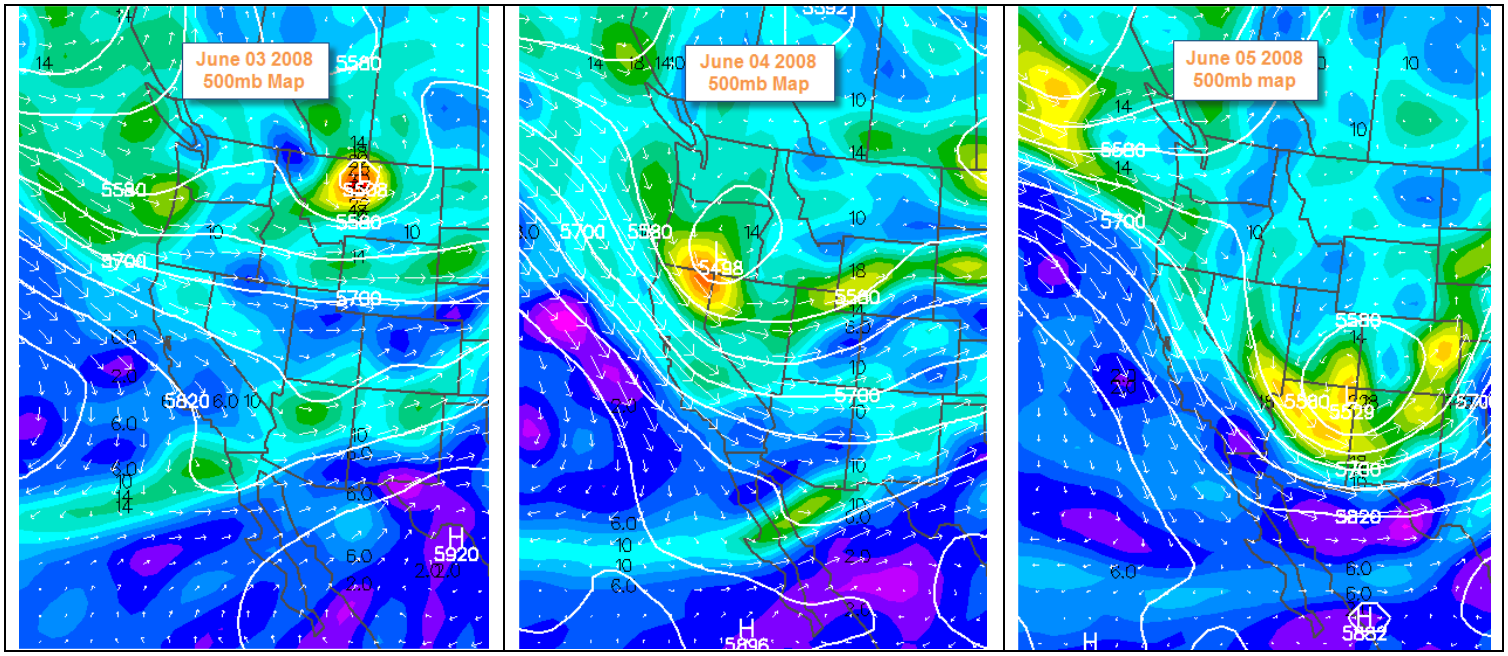


Figure 4-1. Progression of Low Pressure Trough Over a 2 Day Period (solid white lines are geopotential height contours and bright colors show areas of positive vorticity and upward vertical motion).

Supporting materials for this analysis are contained in the appendices of this report. Appendix J contains the NWS advisories and event reports. Appendix K contains any related news articles. Appendix L contains graphic and tabular summaries of all PM_{10} measurements and local winds at the air quality monitor locations. Appendix M contains a comprehensive archive of all relevant hourly meteorological (and air quality) data for all stations in the region archived by ADEQ. Information in these appendices should be reviewed to add context to the weather discussion.

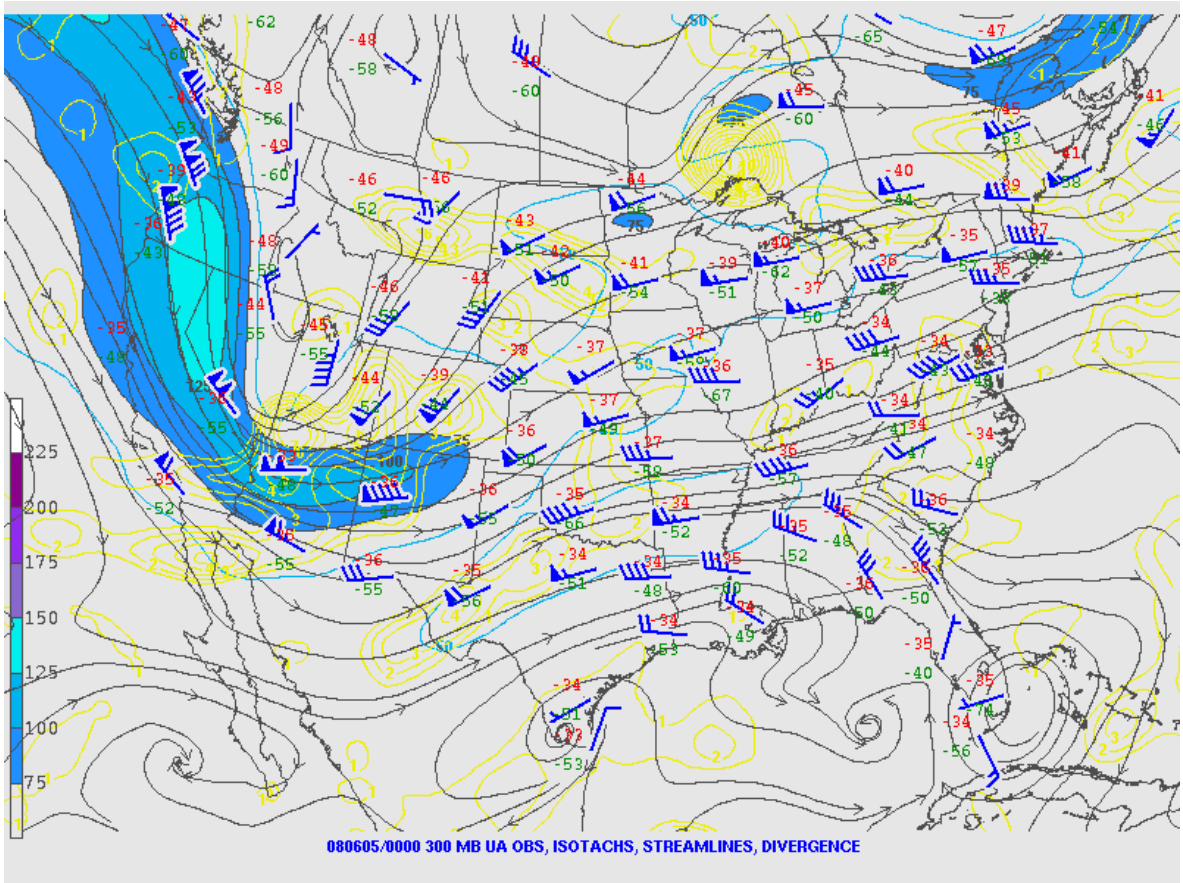


Figure 4-2. Wind Field at 300 mb During the Evening of June 4th (strong jet maximum was in place along the western periphery of the trough and at the base of the trough over much of California and Arizona).

Radar data from Yuma, Arizona, showed apparent returns from blowing dust starting around 11:30 a.m. MST (Figure 4-3). The Yuma radar was in 'clear air mode' during this high wind / blowing dust event. The radar is typically in this mode when no precipitation is occurring, therefore, the returns can be assumed to be something other than precipitation. The point source nature of these returns would suggest sources of blowing dust (other possibilities would include potential smoke sources from fires, though this is unlikely given all the reports of blowing dust at NWS locations). The location of this blowing dust was in southeastern California, just southwest of the southern perimeter of the Salton Sea. The exact coordinates of this area was centered at 32.9439°N and 115.8984°W. This area appears to be a low lying and flat depositional area. Regardless, the blowing dust from this area, beyond the jurisdiction of Arizona, was highly likely the source of what was impacting the visual conditions that were reported at Imperial County Airport and the NAF El Centro. Observations of reduced visibility, haze, and blowing dust at El Centro and Imperial County Airport occurred at times when the strongest radar echoes were located over the above mentioned locations. For example, at 3:49 p.m. MST, radar data indicated relatively strong echoes over Imperial County Airport. Additionally at 2:53 p.m. PDT, Imperial County Airport reported visibility down to 1 mile. This is further evidence that the returns from the radar data were an indication of suspended dust in the lower atmosphere.

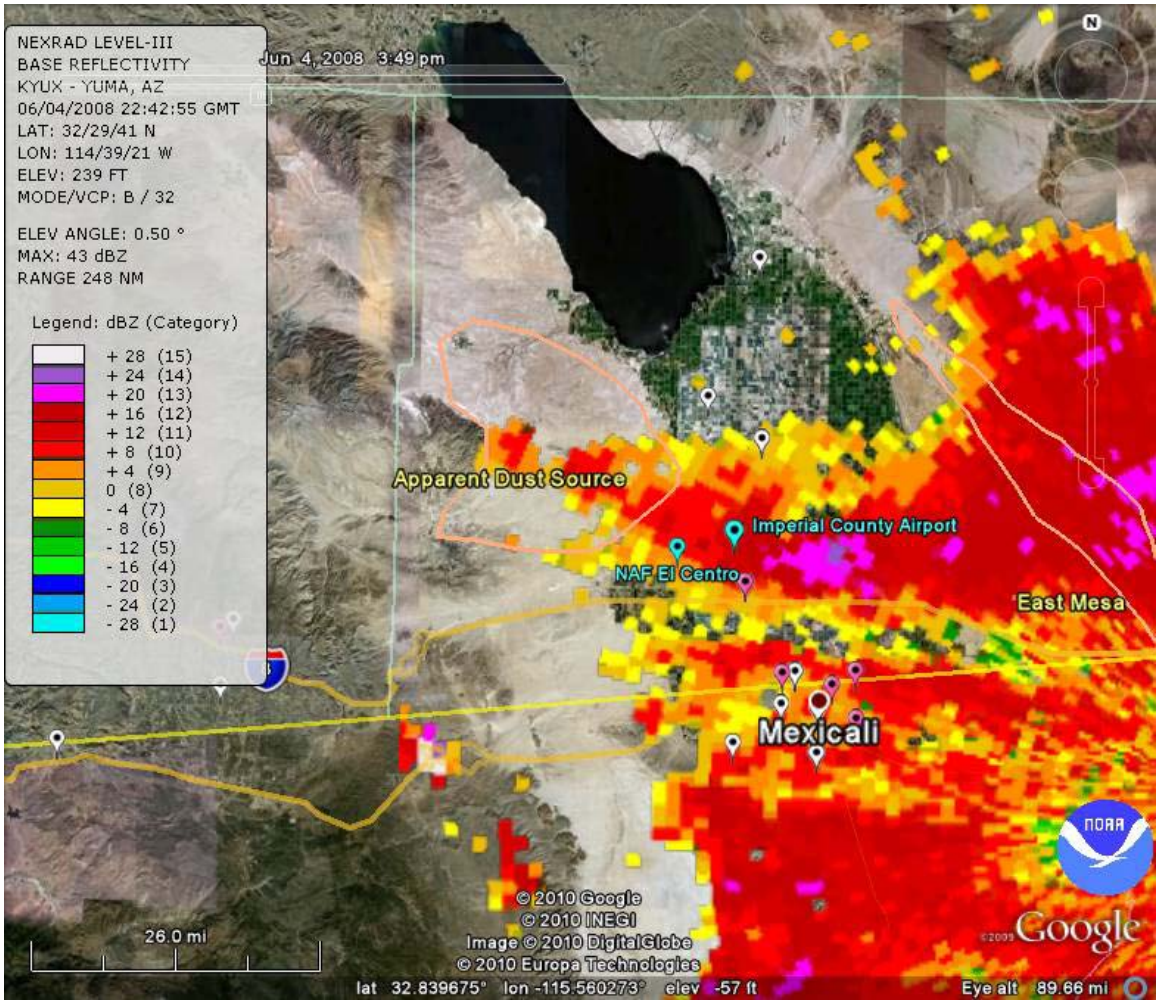


Figure 4-3. 'Clear Air Mode' Radar Reflectivity from the Yuma, AZ Radar, 11:30 a.m.. (while not easily interpreted, data suggest dust sources in southeastern California).

While there is inherent noise included in the radar data, the strongest returns appeared to be associated with higher concentrations of suspended dust. When looping the radar data, it appeared that the suspended dust associated with the previously mentioned dust source travelled significant distances; up to 50+ miles. Whether this suspended dust was the dust being measured as PM_{10} in Yuma is unclear. It does appear that additional dust was being suspended in the vicinity of the Algodones Dunes in California, just to the west / northwest of Yuma. Extremely strong radar returns originated in the southeastern portion of the Algodones Dunes area (~ 6:57 p.m. MST). This dune area is outlined in Figure 4-4 and the pink, purple, and white colors are associated with strong radar echoes. While the strong radar echoes were presumed to be associated with blowing dust from the Algodones Dunes, previous literature also suggested that the East Mesa area in California was a potential dust source under high wind conditions. The suspended dust from the source to the southwest of the Salton Sea made it difficult to determine the exact source(s) in far southeastern California.

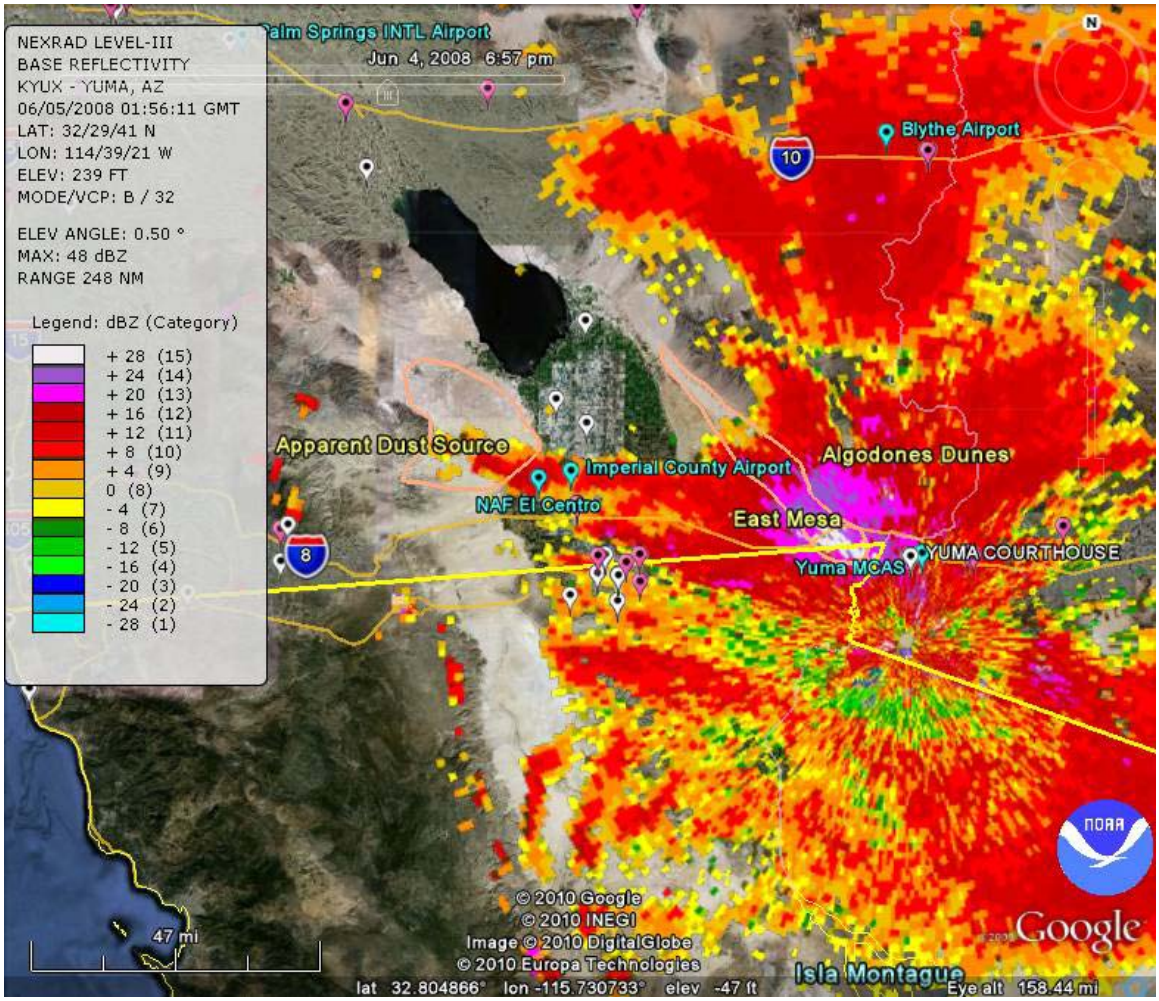


Figure 4-4. 'Clear Air Mode' Radar Reflectivity from the Yuma, AZ Radar, 7:00 p.m. (the strong echoes over the Algodones Dunes suggest it as a possible dust source)..

A short time later, these strong radar returns were located in the vicinity of the Yuma Courthouse monitor and the Yuma Marine Corp Air Station (MCAS). During the 7:00 p.m. and 8:00 p.m. hours, the radar data showed pink and purple colors (20-24 dBz) very near the Yuma Courthouse and Yuma MCAS. This was an indication of high concentrations of suspended dust, which correspond with reports of reduced visibility at Yuma MCAS and extremely high PM_{10} concentrations (~ 2000 $\mu g/m^3$) measured by the Yuma Courthouse PM_{10} Tapered Element Oscillating (TEOM) monitor. In addition to the exceedance measured at Yuma Courthouse on June 4th, exceedances of the PM_{10} NAAQS were also measured in Riverside County and San Bernardino County in California and Nye County in Nevada. California and Nevada are also seeking exemption from the PM_{10} NAAQS under the Exceptional Event Rule for these exceedances.

During the same time that Yuma and southeastern California were experiencing strong winds and blowing dust, much of Arizona was experiencing pre-frontal southwesterly winds. Winds were on the increase over southern Arizona by 10:00 a.m. and were gusting out of the south / southwest to 25 mph at Nogales, Sierra Vista, and Douglas. By noon, winds were southwesterly

and gusting to 39 mph at Sierra Vista and 37 mph at Douglas. Over the northern part of the state, five sites had southwesterly winds gusting over 40 mph by 2:00 p.m. From 1:00 p.m. through 6:00 p.m., showers and thunderstorms increased in coverage over northern Arizona, especially the northwest portion and wind-blow dust increased over the south. From 1:00 p.m. through 6:00 p.m., winds continued to increase and by 2:00 p.m., blowing and suspended dust was on the increase, as evidenced by the Phoenix visibility network and NWS reports of dust and haze. At 1:00 p.m., winds were southwesterly and gusting to 33 mph (at Chandler), and at 2:00 p.m. were southwesterly and gusting to 32 mph (at Luke AFB). At 3:00 p.m., Scottsdale had eight miles visibility due to blowing dust and winds valley-wide were southwesterly to westerly and gusting from 29 - 36 mph. At 4:00 p.m., winds were southwesterly and gusting to 38 mph (at Glendale). By 5:00 p.m., blowing dust was evident valley-wide and winds remained southwesterly, gusting between 23 – 40 mph. From 7:00 p.m. thru 12:00 a.m. on June 5th, blowing and suspended dust became even thicker with time. At 7:00 p.m., winds were gusting to 36 mph at Luke AFB and visibility was four miles. Meanwhile, Goodyear had five miles visibility with southwesterly winds gusting to 35 mph. At 8:00 p.m., winds were gusting to 37 mph and the visibility at Luke AFB was six miles. By midnight, winds were west / southwest, gusting to 26 mph and the visibility was six miles at Luke AFB and seven miles at Deer Valley.

The NWS weather observations and the Maricopa County meteorological data indicated that while strong winds were occurring throughout the entire Valley, suspended dust was occurring more frequently in the western portion of the Phoenix Metro Area. Phoenix radar data were analyzed in an attempt to determine if specific dust sources could be identified; however, this was not easily accomplished due to excessive noise in the data. There was an indication, however, that stronger echoes occurred in the western part of the Valley, which corresponded to the NWS weather observations and the Maricopa County PM_{10} data.

While the three PM_{10} exceedances in the Phoenix Metro Area occurred on June 4th, the majority of the monitors actually contained greater 24-hr averages on the following day. The reason for this was that the suspended dust event actually straddled the two days, but it appeared as though a more homogenous dust plume affected the area just after midnight on the following day. As can be seen in Table 3-3 on Page 15 of this report, most Phoenix area PM_{10} monitors recorded June 4th 24-hr average concentrations between 65 $\mu g/m^3$ and 97 $\mu g/m^3$. These concentrations were approximately twice that of each monitor's respective median concentration for the April through June time frame (based on 5 years of data). The case for the Buckeye, West 43rd, and Coyote Lakes monitors was even stronger, where June 4th 24-hr concentrations were approximately 3 - 4 times their median values for the April through June time frame. This suggests that the western part of the Valley was influenced by a greater concentration of dust particles compared to the rest of the Phoenix metro monitors. It is also entirely possible that the urbanized core of the Phoenix Metro Area acted to reduce the amount of blowing dust compared to the western periphery due to increased surface roughness.

As mentioned above, the entire Phoenix Metro Area was affected by what appeared to be a more homogeneous dust plume that affected the area just after midnight on June 5th. During this time, many Phoenix area PM_{10} monitors recorded their highest hourly concentrations between 11:00 p.m. on June 4th and 3:00 a.m. on June 5th that ranged from 300 – 600 $\mu g/m^3$. While there were no PM_{10} exceedances on June 5th, it can be seen in Table 3-3 that the event was unusual as nearly

all Phoenix area PM_{10} monitors exceeded their respective 95th percentile values**.** Additionally, most of the 24-hr average PM_{10} concentrations for June 4th were near or exceeded their respective 95th percentile values. These were presented in Table 3-3 on Page 16 of this report.

The meteorological phenomena associated with this event were regional in nature, as evidenced by the numerous reports of strong surface winds throughout California, Arizona, and Nevada. Additionally, the synoptic scale weather maps showed the large upper level trough and the extent to which it affected the southwestern United States. While the meteorological aspect of this event covered a large geographical area, the blowing dust that was generated from these high winds occurred at sporadic locations, though these locations also covered a wide geographic area. Essentially, high concentrations of blowing dust only occurred where dust sources were located. In the arid southwest, these dust sources are typically located in depositional areas where fine and coarse particles are deposited during times of precipitation.

Section 5: Event Analysis

In this section, the Exceptional Events Criteria are examined. 40 CFR 50.1(j) of the Exceptional Events Regulation defines an exceptional event as an event that:

- Affects air quality;
- Is not reasonably controllable or preventable;
- Is either an event caused by human activity that is unlikely to recur at a particular location or a natural event; and
- Is determined by the EPA Administrator in accordance with the Exceptional Events Rule to be an exceptional event.

Sections 5.1 to 5.3 describe how the first three criteria are met for the June 4, 2008, high wind exceptional events in Phoenix, and Yuma areas. In addition, Section 5.4 is a re-statement that all reasonable measures were taken to protect public health.

5.1 Affects Air Quality

For an event to qualify as an exceptional event, it is necessary to show that the event affected air quality. This criterion can be met by establishing that the event is associated with a measured exceedance in excess of normal historical fluctuations, including background. The demonstration of a clear causal relationship is necessary to establish that the event affected air quality and is also a separate requirement.

The documentation provided herein for the June 4, 2008, natural event that affected southeastern California and much of Arizona provides the required information to establish a causal connection between the high winds and the high concentrations measured at the Yuma Courthouse, Buckeye, Coyote Lakes, and West 43rd PM_{10} monitors. The measured 24-hour PM_{10} concentrations at these monitors show that air quality was affected. Concentrations were lower on the days before and after the high wind event, as is shown in Table 3-3 on Page 16. The hourly PM_{10} concentrations increased rapidly as the winds peaked, as is shown in Section 5.2. As was shown previously in Section 3, in the last five years of analyzed data, high PM_{10} concentrations exceeding the 24-hour NAAQS do not often occur and fall above the 95th percentile of the data. Section 7 includes meteorological and particulate data showing a clear correlation between strong, gusty winds and increased hourly PM_{10}. The supporting documentation also includes NWS forecasts and advisories of high winds and windblown dust (see Appendix J), as well as storm damage reports in the media (see Appendix K). The measured exceedances on June 4th, 2008, were in excess of normal fluctuations.

5.2 Is Not Reasonably Controllable or Preventable

The Federal Register Notice[4] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration:

[4] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

The EPA's final rule concerning high wind events states that ambient particulate matter concentrations due to dust being raised by unusually high winds will be treated as due to uncontrollable natural events where (1) the dust originated from nonanthropogenic sources, or (2) the dust originated from anthropogenic sources within the State, that are determined to have been reasonably well-controlled at the time that the event occurred, or from anthropogenic sources outside the State.

The analytical steps required to prepare this demonstration include selecting high wind hours, plotting a back trajectory during high wind hours, determination of the land use along the trajectory, estimation of emissions, determination of anthropogenic and nonanthropogenic source contributions and documentation that identified anthropogenic sources were "reasonably well controlled." Presented below is a summary of the approach used to complete each of these steps.

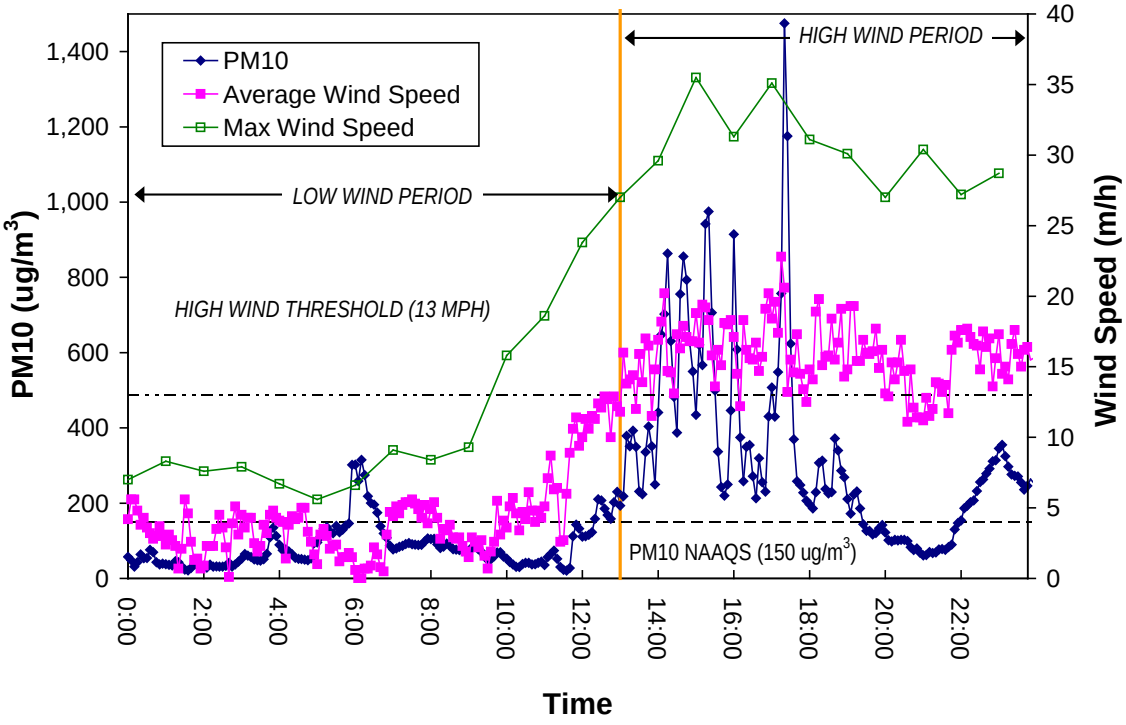
Select High Wind Hours

As discussed in the Unusual Winds White paper[5], hours containing one or more 5-minute periods with an average wind speed of 13 mph or higher were designated as high wind hours. Generally, these hours are found to group together in a continuous period. In some cases, however, wind speeds tailed off after the initial weather front moved through the region, fell below the 13 mph threshold, and then again rose above the 13 mph threshold. In these cases, a second criterion can be used to determine if the hour was to be designated a high wind hour, which was whether PM_{10} concentrations continued to exceed the ambient 24-hour standard. If concentrations remained below the standard, the conclusion was that the reservoir of erodible soil was exhausted by elevated winds in previous hours and that even though the 5-minute threshold had been exceeded; there was no significant impact at the monitor. This second criterion did not apply to June 4, 2008.

A summary of the diurnal profile of 5-minute average wind speeds and PM_{10} concentrations and maximum hourly wind gusts recorded at the West 43rd Ave. monitor for June 4, 2008, is displayed in Figure 5-1. It shows the 13 mph threshold divides the day into a low wind period from midnight to 1:00 p.m. and a high wind period from 1:00 p.m. to the end of the day. It also shows that PM_{10} concentrations began increasing prior to 1:00 p.m. but increased significantly beyond that hour and stayed elevated through most of the day before dipping around 8:00 p.m. and then increasing again as wind speeds increased beyond 10:00 p.m. It also shows that the maximum hourly gusts during the high wind hours uniformly exceeded 25 mph.

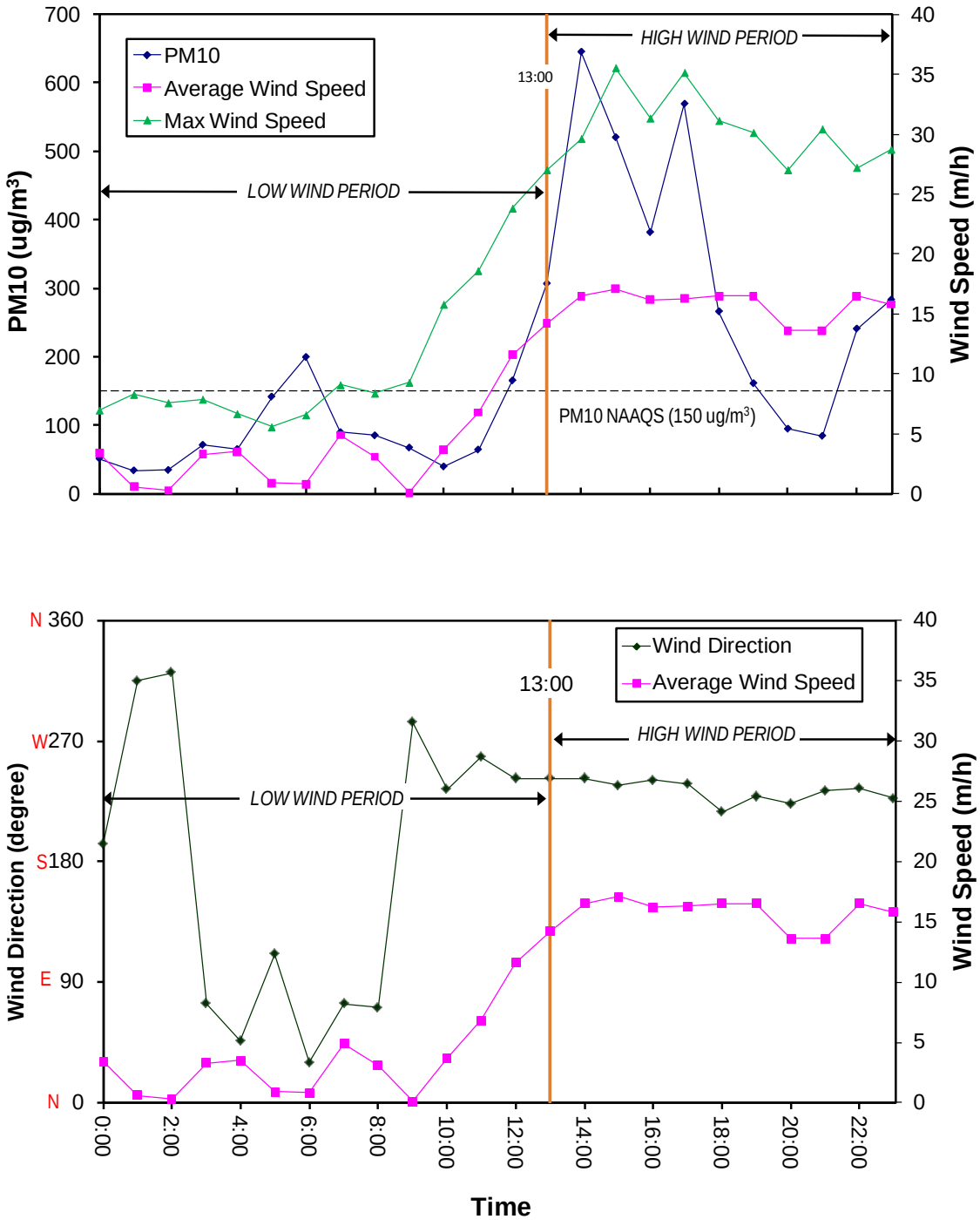
[5] The Impact of Exceptional Events 'Unusual Winds' on PM_{10} Concentrations in Arizona, ADEQ, Appendix H

Figure 5-1. Diurnal Profile of 5-Minute Average PM_{10} Concentrations and Wind Speed and 1-Hour Average Max Wind Speed at West 43rd Ave. Monitor (6/4/2008)



A similar plot of one-hour average values, along with the maximum hourly wind speeds, is presented in the top panel of Figure 5-2; hourly average wind speed and wind direction are presented in the bottom panel. As can be seen, the plots of the average hourly values significantly smooth the spikes and do not offer the insight provided by the 5-minute data. They also show that the maximum wind speed remained well above the 13 mph threshold after 10:00 a.m. Figure 5-2 also shows that the wind direction shifted during the early low wind hours of the day. Starting about 9:00 a.m., however, the wind shifted to the southwest and remained from that direction for the remainder of the day. Once the wind shifted to that course, the speeds and PM_{10} concentrations began to increase, reaching a peak at about 2:00 p.m. While the wind speed and wind direction remained relatively stable for the remainder of the day, the PM_{10} concentrations were somewhat more erratic as they dropped between 5:00 p.m. and 9:00 p.m. and increased for the remaining hours of the day.

Figure 5-2. Diurnal Profile of One-Hour Average PM_{10} Concentrations and Wind Speed at West 43rd Monitor (6/4/2008)



Plotting a Back Trajectory During High Wind Hours

Several factors were considered in the selection of hours used in the back trajectory calculations, including:

- Hours when peak concentrations occurred at the West 43rd Ave. monitoring site – both the hourly and 5-minute data suggest 2:00 p.m. – 5:00 p.m.; and,
- Identifying anthropogenic sources impacting the West 43rd Ave. monitoring site – the distance from the West 43rd Ave. monitor to the edge of the desert depends on wind speed and direction, but as shown in Figure 5-2, both are stable during the period from 2:00 p.m. – 7:00 p.m.

Since concentrations generally declined after 7:00 p.m. through the end of the day, it was selected as the starting hour for the back trajectory. The duration of the trajectory was set at six hours (7:00 p.m. to 1:00 p.m.) to ensure that all high wind/high concentration activity was captured. Given the wind speeds measured during those hours, the trajectory extended far out into the desert. Because land use within the desert provides no insight into the anthropogenic sources impacting the monitor, the analysis focused on land use during the first 2-hours of the back trajectory, which is roughly equivalent to the distance from the West 43rd Ave. monitor to the desert along a southwest trajectory. A plot of the selected back trajectory is presented in Figure 5-3. As can be seen, the trajectory traverses an extended desert area in which there is no anthropogenic activity.

Figure 5-3. Back Trajectory of Wind Impacting the West 43rd Ave. Monitor Starting at 7:00 p.m. June 6, 2008

Determination of Land Use Along the Back Trajectory

Maricopa Association of Governments (MAG) staff used land use GIS files to determine the zoned uses of all lands within ½ mile of each back-trajectory track over which wind parcels traveled during the two hours prior to delivering the peak PM_{10} concentration to the W. 43rd Ave. monitor. Lands under active construction on each exceedance day were identified from MCAQD earthmoving permit records. Parcel areas were aggregated within seven general categories for which limited emission factor data were available: vacant, agriculture, construction, open/restricted access, riverbed, landfill/sand and gravel, and other lands. The uses of these land categories are generally defined as follows:

- Vacant – represents undeveloped land to which public access is not restricted;
- Agriculture – represents lands under agricultural cultivation;
- Construction – represents lands being developed for long term use that will include ground coverage elements such as pavement, structures, or landscaping that will prevent the generation of windblown dust;
- Passive/restricted open space – represents undeveloped or partially developed lands to which public vehicular access is restricted (these lands include public parks, national forests, military posts, and Indian reservations);
- Riverbed – represents riverbed channels of the Salt and Gila River branches;
- Landfill/sand and gravel – represents lands being used for mineral extraction or waste deposit;
- Other – represents developed lands that are protected from windblown dust generation by elements such as paving, structures, and landscaping.

These categories correspond to those used in the windblown dust emission inventory published in the MCAQD's 2008 Periodic PM_{10} Emission Inventory[6] with the exception of the riverbed category, which was split out from the passive/restricted open space category and reported separately. The separate reporting and analysis of windblown emissions from riverbed lands was deemed necessary because of the finer soil texture and higher emission rate in comparison to other restricted open space lands, and because of the high prevalence of riverbed lands in the zones along the mapped back-trajectories.

A summary of the total acreages reported within each of the seven land use categories within a ½ mile of the wind back trajectory for the West 43rd Ave. monitoring site on June 4, 2008, is presented in Table 5-1. It shows that while the distribution of the source-specific acreage varies

[6] 2008 PM_{10} Periodic Emissions Inventory for the Maricopa County, Arizona, Nonattainment Area, Appendix 4. Windblown Dust Emission Estimates Methodology, Final Draft, Maricopa County Air Quality Department, June 2010

by hour, the total acreage is very similar confirming that there is little difference in the wind speed between the two hours.

Table 5-1.
Total Acreage Within ½ Mile of Back Trajectory by Land Use Category
West 43rd Ave. Monitor – June 4, 2008

Land Use Category	1st Hour (7:00 p.m.)	2nd Hour (6:00 p.m.)
Vacant	1,410	3,779
Agriculture	1,633	112
Construction	96	0
Passive/Restricted	3,885	6,742
Riverbed	1,829	20
Sand & Gravel/Landfill	279	0
Other	1,323	1
Total	10,456	10,654

Estimation of Anthropogenic and Nonanthropogenic Emissions

A detailed discussion of the methodology used to prepare source specific emission estimates is presented in Appendix O. In addition to the source specific acreage values listed above, it details the rule effectiveness rates extracted from the 2008 Periodic Emissions Inventory (PEI), information on crop specific agricultural activity, the Nickling and Gillies emission factors applied to each land use category, determination of the portion of land use which is disturbed and undisturbed and the method used to allocate related emission estimates into anthropogenic and nonanthropogenic estimates. A summary of the resulting emission estimates for the combined two hour period is presented in Table 5-2. It shows that anthropogenic emissions are estimated to account for roughly 80% of the mass impacting the West 43rd Ave. monitor on June 4, 2008. One significant finding is that agricultural emissions are estimated to have no impact on the West 43rd Ave. monitor during that period. As shown below, this is because interviews with local farmers, farming organizations, and inspection of 2008 crop distribution aerial images, showed that much of the land within the back trajectory zone was being used to cultivate alfalfa and hay (Bermuda grass), and other actively growing crops, which fully protected these lands from wind erosion and greatly reduced emissions from agricultural lands. The principal reason other sources were estimated to have no emissions impacting the West 43rd Ave. monitor on June 4, 2008, is that the winds recorded during the two hour period did not exceed the threshold friction velocities based on the Nickling & Gillies data.

Table 5-2. Anthropogenic and Nonanthropogenic Windblown PM_{10} Emissions From W. 43rd Ave. Monitor Back-Trajectory Lands on June 4, 2008			
Land Use Category	**PM_{10} Emissions (lb)**		**% of Anthropogenic**
	Anthropogenic	**Nonanthropogenic**	
Vacant/Undisturbed	-	0	
Vacant/Disturbed	3,794	-	29.5%
Agriculture/Undisturbed	0	-	0.0%
Agriculture/Disturbed	0	-	0.0%
Construction/Undisturbed	0	-	0.0%
Construction/Disturbed	25	-	0.0%
Passive-Restricted/Undisturbed	-	0	
Passive-Restricted/Disturbed	7,762	-	60.3%
Riverbed/Undisturbed	-	3,255	
Riverbed/Disturbed	1,123	-	8.7%
Sand & Gravel Landfill/Undisturbed	0	-	0.0%
Sand & Gravel Landfill/Disturbed	202	-	1.6%
Other	0	-	
Total	12,906	3,255	100%
% of Grand Total	79.9%	20.1%	

Table 5-1 indicates significant differences in land use between hour 1 and hour 2 of the back trajectory. Despite these differences, there is little difference in the anthropogenic emission distributions between the hours. This is largely the result of the selected threshold friction velocities.

Documentation that Identified Anthropogenic Sources Were "Reasonably Well Controlled"

Table 5-2 identifies the sources of PM_{10} emissions located upwind of the West 43rd Ave. monitor. This section describes the measures that were in place on June 4, 2008, to control PM_{10} emissions from these sources. The control measures in the EPA-approved Serious Area PM_{10} Plan and the 2007 Five Percent Plan for PM_{10} are legally binding commitments that must be implemented by the sponsoring agency. The control measures that were implemented for the major sources upwind of the West 43rd Ave. monitor on June 4, 2008, are discussed below.

Agriculture

Although Table 5-2 indicates that agricultural emissions did not contribute to the exceedance at the West 43rd Ave. monitor on June 4th, agricultural land uses represent eight percent of the acreage along the back trajectory for the West 43rd Ave. monitor. The State of Arizona has implemented Agricultural Best Management Practices in Area A, which includes the back trajectory area for June 4th. The Serious Area PM_{10} Plan requires farmers to implement at least

one best management practice (BMP) for tilling and harvesting, cropland, and non-cropland. The Five Percent Plan required farmers to implement a second BMP for each of these agricultural activities. The four committed control measures in the Serious Area and Five Percent Plans are described below.

Serious Area Plan Measure

Measure 49, Agricultural Best Management Practices – The Arizona Legislature passed S.B. 1427 in 1998 which includes Best Management Practices for Agriculture to reduce particulate emissions. The legislation established a Best Management Practices Committee for Regulated Agricultural Activities appointed by the Governor.

By June 10, 2000, the Best Management Practices Committee adopted by rule an agricultural general permit specifying best management practices for regulated agricultural activities to reduce PM_{10} emissions. The ADEQ Director submitted the rule to the U.S. Environmental Protection Agency as a revision to the State Implementation Plan.

As defined by state law, an agricultural general permit means best management practices that reduce PM_{10} particulate emissions from tillage practices and from harvesting on a commercial farm; from those areas of a commercial farm that are not normally in crop production; and from those areas of a commercial farm that are normally in crop production including prior to plant emergence and when the land is not in crop production. Best management practices are defined as techniques verified by scientific research, that on a case-by-case basis are practical, economically feasible and effective in reducing PM_{10} emissions from a regulated agricultural activity.

The Best Management Practices Committee adopted by rule a list of best management practices, at least one of which was used to demonstrate compliance with the agricultural general permit.

A person engaged in a regulated agricultural activity on the effective date of this act (August 21, 1998) was required to comply with the agricultural general permit by December 31, 2001. A person who begins a regulated agricultural activity after December 31, 2000 is required to comply with the general permit within eighteen months of beginning the activity.

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.[7]

Measure 41, Forward to the Governor's Agricultural Best Management Practices Committee that cessation of tilling be required on high wind days and that agricultural best management practices be required in existing Area A – *Agricultural Best Management Practices required in Area A by S.B. 1552; on September 25, 2007, the Governor's Agricultural Best Management*

[7] MAG, 2008 Implementation Status of Committed Measures in the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area, January 2010.

Practices (BMP) Committee revised its rule to double the number of BMPs that farmers must implement, added 5 BMP choices (including cessation of tilling on High Pollution Advisory Days) and expanded the land area in which BMPs must be applied.

Measure 50, Require two agricultural best management practices, Required by SB 1552 – *The Legislature adopted a requirement that expanded the regulated area for Agricultural BMPs to include the portion of Area A in Maricopa County and increased the number of required Ag BMPs from one to two for each category by December 31, 2007.*

Construction

Table 5-1 indicates that construction activity was negligible (less than one percent of the acreage) along the June 4th back trajectory and Table 5-2 indicates that construction sources did not contribute to the exceedance at the West 43rd Ave. monitor on June 4th. However, there were fourteen measures in place to control construction activities on June 4, 2008: three from the Serious Area Plan and eleven from the Five Percent Plan, as described below. For the Five Percent Plan, the implementation status of the measures on June 4, 2008, is also described. Detailed descriptions of these measures are contained in Chapter Seven of the Serious Area Plan and Chapter Six of the Five Percent Plan.

Serious Area Plan Measures

Measure 30, Encourage the Use of Temporary Electrical Power Lines Rather than Portable Generators at Construction Sites – Seventeen cities and towns and Maricopa County committed to implement this measure.

Measure 39, Strengthening and Better Enforcement of Fugitive Dust Control Rules – Maricopa County indicates that this measure involves achieving improved compliance with existing air pollution rules through the provision of additional inspection and enforcement personnel. In addition, it involves evaluating the effectiveness of rules and improving clarity.

January to February 2001	Draft rule revisions, if necessary.
March to May 2001	Workshop draft rule, if rule revisions are necessary.
June to September 2001	Board consideration of rule revision, if necessary.

The Maricopa County schedules for implementation of increases in inspection frequency and Rule 310 revisions are shown below.

Inspection Frequency Part II--Sources Requiring Permits:

June 1997	Scheduled weekend inspections randomly at least once a month.
July 1999	Proactively inspect sites larger than 10 acres 3 to 6 times per year. Proactively inspect sites less than 10 acres once within 30 days of project start date listed on the permit application form.
January 2000	Develop inspection priorities for permitted sources.
March 2000	Revise Standard Operating Procedure and checklists for fugitive dust inspections to be consistent with revised rules.
March 2000	Provide a shortened complaint response time with a goal of 8 hours for high priority complaints. Maintain the current goal of 24 hours for all others.
September 2000	Conduct mid-year review of program to evaluate its progress and future needs.
September to January 2001	Draft Fugitive Dust Operating Plan to track progress and identify future needs.
March 2001	Review program to evaluate its effectiveness and potential future needs.

Evaluate and Revise Rule 310:

December 1999 to February 2000	Revise earth moving application forms and dust control plans to be consistent with the revised rule and to improve program effectiveness.
December 1999 to July 2001	Research and develop a standard(s) and test method(s) for earth moving sources, considering field research sponsored by EPA, designed to be enforceable and meet BACM requirements as to stringency and the number of sources that it applies to. If research reveals problems with the existing opacity standard's enforceability, feasibility or stringency for some or all earthmoving operations, revise rule by June-September 2001 to modify the existing opacity test method to address the problems as warranted and adopt a new standard(s) and test method(s) to deal with any problems that cannot be addressed by modifying the opacity test method.
January 2000 to July 2001	Research, develop and incorporate additional requirement for dust suppression practices/equipment into dust control plans and/or Rule 310 by June - September 2001.

June 2000 to June 2001	Revise the sample daily recordkeeping logs for new and renewed Rule 310 permits to be consistent with rule revisions and to provide sufficient detail documenting the implementation of dust control measures required by Rule 310 and contained in the dust control plan. Distribute sample log sheets with issued permits and conduct outreach to sources by June 2000.

Measure 47, Dust Control Plans for Construction/Land Clearing and Industrial Sites (Including Active Landfills), With Elements Addressing Trackout Prevention, Site and Material Maintenance, Construction Staging, and High Wind Operating Restrictions– Maricopa County indicates that this measure involves requiring dust control plans for construction, demolition, land clearing, and industrial projects. Dust control plans are an element of Maricopa County's fugitive dust program described in the measure, Strengthening and Better Enforcement of Fugitive Dust Control Rules 97-DC-1. Credit for the fugitive dust program including dust control plans will be taken under Measure 22, Strengthening and Better Enforcement of Fugitive Dust Control Rules.

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.

Measure 2, Extensive Dust Control Training Program – *In March 2008, Maricopa County hired 2 dust control compliance and 2 administrative personnel to coordinate and conduct the training program. During 2008, 11,100 individuals completed County-certified dust control training classes.*

Measure 3, Dust managers required at construction Sites of 50 acres or more – *Dust Managers were required by SB 1552. In March 2008, Maricopa County adopted Rules 310 and Rule 316 revisions in regard to dust managers.*

Measure 6, Better tarping requirements in Rule 310 to include enclosure of the bed – *In March 2008, Maricopa County adopted Rule 310 and Rule 310.01 revisions in regard to tarping*.

Measure 8, Conduct nighttime and weekend consistent inspections – *Nighttime and weekend inspections conducted in 2008 included complaint inspections and targeted inspections of specific industries that operate at night and on weekends.*

Measure 9, Increase consistent inspection frequency of permitted sources – *In March 2008, Maricopa County adopted Rule 280 revisions in regard to inspection frequency. In 2008, Maricopa County hired 32 inspectors, 13 administrative and permit technicians, 6 inspector supervisors and 4 administrative supervisors for the Dust Control Compliance Program. Maricopa County issued 4,355 permits for dust control sources (Rule 310) and conducted 12,303 inspections of dust control permitted sources (Rule 310).*

Measure 11, Notify violators more rapidly to promote immediate compliance – *Maricopa County continued the standard practice of dust compliance inspectors who observe potential violations making reasonable efforts to inform a person on-site or call the permit holder so that measure can be taken to prevent, reduce or mitigate dust generation before a violation occurs.*

Measure 13, Develop a program for subcontractors – *Required by SB 1552; In March 2008, Maricopa County adopted Rule 200 and Rule 280 revisions in regard to the subcontractor registration program. In 2008, Maricopa County hired 4 permit technicians to administer the subcontractor registration program and registered 4,882 subcontractors.*

Measure 16, Require dust coordinators at earthmoving sites of 5-50 acres – *Dust coordinator required by SB 1552; In March 2008, Maricopa County adopted Rule 310 and Rule 316 revisions in regard to dust coordinators.*

Measure 36, Require barriers in addition to Rule 310 stabilization requirements for construction activities where all activity has ceased, except for sites in compliance with storm water permits – *In March 2008, Maricopa County adopted Rule 310 revisions in regard to barriers. Maricopa County revised long-term stabilization control measures to reduce the period of inactivity to 30 days and added the requirement for barriers, if water is chosen as the control option*.

Measure 37, Reduce the tolerance of trackout to 25 feet before immediate cleanup is required for construction sites be placed in Maricopa County Rule 310 – *In March 2008, Maricopa County adopted Rule 310 revisions in regard to the trackout requirements by reducing the toleration of trackout to 25 feet before cleanup is required.*

Measure 38, No visible emission across the property line be placed in Maricopa County Rule 310 and 310.01, and in local ordinances for nonpermitted sources as appropriate – *In March 2008, Maricopa County adopted Rule 310 and Rule 310.01 in regard to visible emissions.*

Open Space, Riverbeds and Vacant Areas

Table 5-1 shows that more than half of the land in the back trajectory for June 4 was passive, restricted open space, which has not been disturbed by human activity. An additional nine percent of the land is located in the dry riverbeds of the Salt River and the Gila River, while another twenty-five percent is vacant land. Together, these land uses represent nearly 84 percent of the area of the June 4 back trajectory. The measures that were in place on June 4, 2008, to control emissions from these sources are legally binding commitments in the Serious Area and Five Percent Plans. These twelve measures are described below. For the Five Percent Plan, the implementation status of the measures on June 4, 2008, is also provided.

Serious Area Plan Measures

Measure 39, Strengthening and Better Enforcement of Fugitive Dust Control Rule~~s~~ Maricopa County indicates that this measure involves achieving improved compliance with existing air pollution rules through the provision of additional inspection and enforcement personnel. In addition, it involves evaluating the effectiveness of rules and improving clarity. Maricopa

County's schedule for increasing the frequency of inspections for nonpermitted sources is shown below.

Increase Inspection Frequency Part I--Sources Not Requiring a Permit:

June 1999	Board adopted Rule 310.01 that addressed vacant lots, unpaved parking lots and public unpaved roads.
April 2000	Develop inspection priorities for vacant lot and unpaved parking lot inspections considering lot size and number of sources. Larger lots will be inspected first and smaller lots in succeeding years. Department resources will be directed initially to areas that lack municipal programs.
January 2000	Department obtains copies of local government plans developed pursuant to A.R.S. Section 9-500.04 or 49-474.01 to stabilize targeted unpaved roads, alleys and stabilize unpaved shoulders on targeted arterials.
Annually thereafter	Review reports filed on those plans.

Measure 46, Reduce Particulate Emissions from Vacant Disturbed Lots – Eighteen cities and towns, Maricopa County and the Arizona Department of Transportation made commitments to implement this measure.

Measure 48, Dust Abatement and Management Plan for State Lands – The Arizona Legislature passed S.B. 1427 in 1998 which appropriated $200,000 from the State General Fund to the State Land Department for implementing a Dust Abatement and Management Plan to include measures to control particulate pollution on State Trust Lands in Area A. The plan may include measures to close areas to illegal use by off-highway vehicles, closing roads that are unused or illegal, and increasing the enforcement of no trespassing areas (Section 36 of S.B. 1427).

Measure 77, Additional Dust Control Measures – The City of Tempe, in 1997, indicates that earlier this year, construction began on the Rio Salado Development, which will ultimately improve approximately 4.5 miles of the dry Salt Riverbed and adjacent properties. Included in this project is the construction of a two mile long lake, which is due to be completed in 1999. The Salt River and the properties adjoining its banks constitute the largest unimproved portion of land remaining within Tempe.

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.

Measure 4, Dedicated enforcement coordinator for unpaved roads, unpaved parking, and vacant lots – *In 2008, Maricopa County assigned a supervisor to oversee the vacant lot program.*

Measure 8, Conduct nighttime and weekend consistent inspections – *Nighttime and weekend inspections conducted in 2008 included complaint inspections and targeted inspections of specific industries that operate at night and on weekends.*

Measure 11, Notify violators more rapidly to promote immediate compliance – *Maricopa County continued the standard practice of dust compliance inspectors who observe potential violations making reasonable efforts to inform a person on-site or call the permit holder so that measure can be taken to prevent, reduce or mitigate dust generation before a violation occurs.*

Measure 14, Reduce dragout and trackout emissions from nonpermitted sources – *In March 2008, Maricopa County adopted Rule 310.01 revisions in regard to dragout and trackout. Maricopa County added the requirement to install a trackout control device to sections covering unpaved parking lots and off-site hauling of bulk materials by livestock operations. Also, in Rule 310.01, Maricopa County added the definitions of "trackout/carryout" and "trackout control device."*

Measure 30, Strengthen and increase enforcement of Rule 310.01 for vacant lots – *Maricopa County hired a supervisor to oversee the vacant lot program. In 2008, Maricopa County conducted 5,005 vacant lot inspections.*

Measure 31, Restrict vehicular use and parking on vacant lots – *Ordinance required by SB 1552; In February 2008, Maricopa County adopted the P-27 Vehicle Parking and Use on Unstabilized Vacant Lots Ordinance. In addition, 23 local governments have new or existing ordinances to prohibit vehicle trespass on vacant land.*

Measure 32, Enhanced enforcement of trespass ordinances and codes – *In February 2008, Maricopa County adopted the P-28 Off-Road Vehicle Use in Unincorporated Areas of Maricopa County and P-27 Vehicle Parking and Use on Unstabilized Vacant Lots Ordinance. In addition, 18 local governments report increased enforcement of vehicle trespass ordinances and codes for vacant lots.*

Measure 33, Ability to assess liens on parcels to cover the costs of stabilizing them – *SB 1552 requires rule revisions for stabilization of disturbed surfaces of vacant lots. Maricopa County adopted Rule 310.01 revisions in March 2008 to allow the County to recover stabilization costs through the penalty process.*

Sand and Gravel Operations

Table 5-1 indicates that less than two percent of the land area in the back trajectory was devoted to sand and gravel operations. Table 5-2 shows that these operations were responsible for roughly two percent of the emissions contributing to the exceedance of the PM_{10} standard at the West 43rd Ave. monitor. The measures that controlled these sources on June 4, 2008, were

implemented as part of the Serious Area and Five Percent Plans. These nine measures are described below; for the Five Percent Plan measures, the implementation status is also addressed.

Serious Area Plan Measures

Measure 38, PM_{10} Best Available Control Technology (BACT) Determinations for Stationary Sources – Maricopa County indicates that this measure involves an industry-by-industry study of the major point sources that could be made to determine the best types of control technologies that are available to yield emission reductions.

Most stationary sources already have BACT controls. In analyzing the sources, incremental benefits may be obtained from revising Rule 316-Nonmetallic Mineral Mining and Processing. Several provisions need to be clarified to improve its effectiveness. Maricopa County's implementation schedule for this measure is shown below:

May to August 1997	Research and draft revision
September to October 1997	Workshop draft revision
November to December 1997	Consideration by Board of Supervisors

Five Percent Plan Measures and Implementation Status

The following measures are included in Chapter Six of the MAG 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The implementation status of each measure in calendar year 2008 is shown in italics after the measure.

Measure 8, Conduct nighttime and weekend consistent inspections – *Nighttime and weekend inspections conducted in 2008 included complaint inspections and targeted inspections of specific industries that operate at night and on weekends.*

Measure 9, Increase consistent inspection frequency of permitted sources – *In March 2008, Maricopa County adopted Rule 280 revisions in regard to inspection frequency. In 2008, Maricopa County hired 5 inspectors and issued 117 permits for nonmetallic mineral processing facilities. Maricopa County also conducted 443 inspections of nonmetallic mineral processing facilities (Rule 316).*

Measure 11, Notify violators more rapidly to promote immediate compliance – *Maricopa County continued the standard practice of dust compliance inspectors who observe potential violations making reasonable efforts to inform a person on-site or call the permit holder so that measure can be taken to prevent, reduce or mitigate dust generation before a violation occurs.*

Measure 17, Fully implement Rule 316 – *The Rule 316 litigation was settled on June 20, 2007. In 2008, Maricopa County is enforcing the provision of Rule 316 for nonmetallic mineral processing sources of PM_{10}.*

Other Sources

Other sources of PM_{10} emissions along the June 4 back trajectory include industrial sources (other than sand and gravel) and fugitive dust from paved and unpaved roads. There are numerous control measures from the Serious Area and Five Percent Plans that have been implemented to control PM_{10} emissions from these sources. Since Table 5-1 indicates these sources represent roughly six percent of the land in the back trajectory and Table 5-2 indicates that these sources did not contribute to the exceedance at the West 43rd Ave. monitor on June 4, 2008, the measures that control these sources are not described here. However, a complete list of measures is provided in Appendix E, Table 1 and detailed descriptions of the committed control measures are included in Chapter Seven of the Serious Area Plan and Chapter Six of the Five Percent Plan.

Inspection Records − Agriculture

Agricultural Dust Inquiries / Complaints in 2008

Air Quality Compliance staff of the Arizona Department of Environmental Quality (ADEQ) reviewed their records of agricultural dust inquires / complaints received in 2008. According to their records, no dust inquires / complaints were received for the high wind PM_{10} exceedance day of June 4, 2008, in Maricopa County.

Agricultural Best Management Practices in 2008

In June 2010, ADEQ Air Quality Compliance staff conducted a telephone survey of farmers in the agricultural area bounded by the West 43rd Ave. PM_{10} monitor on the east and the Buckeye PM_{10} monitor on the west. This agricultural area is the largest agricultural area upwind of the West 43rd Ave. PM_{10} monitor.

Fourteen farmers responded to ADEQ's telephone survey of the Agricultural Best Management Practices (BMPs) that had been implemented on their farms in 2008. According to ADEQ Air Quality Compliance staff, these farmers have the bulk of the field operations in the agricultural area bounded by the West 43rd Ave. PM_{10} monitor on the east and the Buckeye PM_{10} monitor on the west.

Table 5-3 summarizes the results of the telephone survey of the Agricultural BMPs that were in place in 2008 for the agricultural area bounded on the east by the West 43rd Ave. PM_{10} monitor and the Buckeye PM_{10} monitor on the west. This table lists the percentage of farmers that implemented the Agricultural BMPs contained in the "Guide to Agricultural Best Management Practices, Governor's Agricultural Best Management Practices Committee," Second Edition, 2008.[8] The BMPs are ranked from largest percentage implemented to smallest percentage implemented for the three categories of Agricultural BMPs – Tilling and Harvest BMPs, Non-Cropland BMPs, and Cropland BMPs. The percentage of farmers that selected more than two Agricultural BMPs for the three categories ranged from 64 percent to 43 percent.

[8] *http://www.azdeq.gov/environ/air/plan/download/webguide.pdf*

Table 5-3. Survey of Agricultural BMPs Implemented in 2008	
Tilling & Harvest BMPs	
• Limited Activity During a High-Wind Event	86%
• Multi-Year Crop	64%
• Combining Tractor Operations	57%
• Reduced Tillage System	36%
• Equipment Modification	29%
• Planting Based on Soil Moisture	21%
• Chemical Irrigation	14%
• Precision Farming	14%
• Timing of a Tillage Operation	14%
• Green Chop	7%
• Integrated Pest Management	7%
• Reduced Harvest Activity	7%
• Tillage Based on Soil Moisture	7%
• Cessation of Night Tillage	0%
• Transgenic Crops	0%
• Farmers Selecting More than 2 Tillage & Harvest BMPs	64%
Non-Cropland BMPs	
• Reduce Vehicle Speed	86%
• Watering	57%
• Access Restriction	43%
• Manure Application	21%
• Aggregate Cover	14%
• Track-Out Control System	14%
• Synthetic Particulate Suppressant	7%
• Artificial Wind Barrier	0%
• Critical Area Planting	0%
• Tree, Shrub, or Windbreak Planting	0%
• Farmers Selecting More than 2 Non-Cropland BMPs	43%
Cropland BMPs	
• Multi-Year Crop	64%
• Cross-Wind Ridges	29%
• Manure Application	29%
• Cover Crop	21%
• Mulching	21%
• Residue Management	21%

Table 5-3. Survey of Agricultural BMPs Implemented in 2008	
Cropland BMPs - Continued	
• Sequential Cropping	21%
• Surface Roughening	21%
• Integrated Pest Management	14%
• Planting Based on Soil Moisture	14%
• Artificial Wind Barrier	0%
• Cross-Wind Strip-Cropping	0%
• Cross Wind Vegetative Strips	0%
• Permanent Cover	0%
• Transgenic Crops	0%
• Tree, Shrub, or Windbreak Planting	0%
• Farmers Selecting More than 2 Cropland BMPs	43%

Agricultural Field Operations on June 4, 2008

A crop calendar of usual field activities by month and crop for Maricopa County was developed from the "Usual Planting and Harvesting Dates for U.S. Crops," Agricultural Handbook Number 628, USDA, ARS, NASS, December 1997 and from consultation with Maricopa County Farm Bureau staff and University of Arizona Cooperative Extension staff for farming practices specific to Maricopa County.[9] This crop calendar is contained in Table 5-4. According to Table 5-4, grain harvesting is the only typical field operation that may have occurred on the high wind PM_{10} exceedance day of June 4, 2008.

The crop calendar in Table 5-4 does not list any months for the planting of alfalfa, hay (Bermuda Grass) or orchards because these crops are multi-year crops which maintain an established plant cover for a number of years. According to Maricopa County Farm Bureau staff, the ideal months for planting and establishing a new stand of alfalfa is September through November, and hay (Bermuda Grass) is typically planted in June. Citrus is usually planted either March through April or October through November.[10] ADEQ Air Quality Compliance staff also reviewed their notes for new alfalfa, hay (Bermuda Grass) fields or orchards that may have been established in 2008. According to their notes, no alfalfa, hay (Bermuda Grass) or orchards were established in June 2008 in the agricultural area bounded on the east by the West 43rd Ave. PM_{10} monitor and the west by the Buckeye PM_{10} monitor.

Crop distribution data in GIS format for 2008 were provided by the Arizona Cotton Research and Protection Council with assistance from the Arizona Cotton Growers Association. The 2008 crop distribution data were overlain on the June 4, 2008, back trajectory developed by Sierra Research (see Figures 5-4 - 5-7). The solid red line on these maps is the June 4, 2008, back trajectory and the dashed red lines are the boundaries of the 1-mile wide buffer area (1-mile on each side of the back trajectory) around the back trajectory.

[9] *http://usda.mannlib.cornell.edu/usda/nass/planting/uph97.pdf*
[10] *http://ag.arizona.edu/hypermail/arid_gardener/4062.html*

Table 5-4. Crop Calendar for Maricopa County, Usual Field Activity by Month and Crop

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Alfalfa[1]												
Corn - Silage[1]												
Cotton[1]												
Grain[2]												
Hay (Bermuda Grass)[3]												
Orchard												
Sorghum - Grain[3]												
Sorghum - Silage[3]												
Days of Interest			3/14/08	4/30/08	5/21/08	6/4/08						

Field Activities Legend	
• Tilling =	
• Planting =	
• Irrigated =	
• Crop Growing =	
• Harvest =	
• No Activity =	

Notes

1. "Revised PM10 State Implementation Plan for the Salt River Area, Technical Support Document", ADEQ, June 2005. http://www.azdeq.gov/environ/air/plan/download/tsdrevised.pdf. (See crop calendar in Appendix F which is based on 2003 meetings with Maricopa County Farm Bureau and University of Arizona Cooperative Extension.)
2. "Usual Planting and Harvesting Dates for U.S. Crops", Agricultural Handbook Number 628, USDA, ARS, NASS, December 1997. http://usda.mannlib.cornell.edu/usda/nass/planting/uph97.pdf.
3. Communication with Maricopa County Farm Bureau, May 11, 2010 and July 16, 2010. In 2008, a majority of the sorghum was sorghum was grown for grain instead of silage. Common practice is to plant sorghum in July in the same field that field that corn had been harvested from in July, with minimum tillage in the transition between corn and sorghum. Hay (Bermuda Grass) is a multi-year crop.
4. Cotton fields must be plowed down by February 15th and cannot be irrigated until March 15th as required by the Pink Bollworm Program. Most cotton farmers now plant into fields with moisture (May 17, 2010 communication with Maricopa County Farm Bureau and University of Arizona Cooperative Extension).
5. Planting - fields are either irrigated prior to planting or shortly after planting. Wind erosion during planting months is reduced due to irrigation keeping topsoil moist.
6. Harvesting crop as silage (haylage) produces minimal emissions since crop is harvested green.
7. Typically, there are no agricultural fields being disced or ripped in April in Maricopa County (May 17, 2010 communication with Maricopa County Farm Bureau).

Inspection of the June 4, 2008, back trajectory and crop distribution maps (with a comparison of the crops present on these maps with the crop calendar in Table 5-4) indicate that: (1) Majority of the agricultural land along the June 4, 2008, back trajectory had actively growing/established crops that would produce minimum PM_{10} emissions, (2) Grain fields had the potential for producing PM_{10} emissions due to grain harvesting which usually occurs in June (approximately 18 percent of the agricultural fields in June 2008 were grain fields), and (3) Fallow fields have the potential for windblown PM_{10} emissions (approximately 17 percent of the agricultural fields in June 2008 were fallow fields). The fallow fields were approximately 46 miles southwest of the West 43rd Ave. PM_{10} Monitor and will have a lesser impact on the West 43rd Ave. PM_{10} monitor than closer emission sources.

ADEQ Air Quality Compliance staff contacted farmers whose grain fields were along the June 4, 2008 back trajectory buffer area for information on possible grain harvesting operations on June 4, 2008. Two of the four grain farmers indicated that in 2008 it was likely that they were harvesting wheat on June 4, 2008, because their grain harvesting season extends from late May through June (see Table 5-4).

Inspection Records − Other Anthropogenic Sources

The Maricopa County inspection records for June 1-7, 2008, indicate that there were 236 inspections of construction sites (i.e., Rule 310) on June 1-7, 2008; 23 of which resulted in notices of violation. Sixteen of the Rule 310 inspections were conducted in the area upwind of the West 43rd Ave. monitor; only one, on June 4, 2008, resulted in the issuance of a notice of violation.

In addition, Maricopa County conducted eight inspections of nonmetallic mineral processing facilities (i.e., Rule 316) on June 1-7, 2008. Only one of these inspections, conducted on June 5, resulted in the issuance of a notice of violation in the area upwind of the West 43rd Ave. monitor.

Maricopa County records also indicate that there were 15 vacant lot inspections (i.e., Rule 310.01) during June 1-7, 2008, two of which resulted in notices of violation. Neither of these Rule 310.01 violations occurred in the area upwind of the West 43rd Ave. monitor.

There were a total of 259 inspections of construction sites, nonmetallic mineral processing facilities, and vacant lots conducted by Maricopa County on June 1-7, 2008; twenty-six of these (10 percent) resulted in notices of violation. Only two of these twenty-six (8 percent) occurred in the area upwind of the West 43rd Ave. monitor.

In summary, the Maricopa County inspection records indicate that there was no unusual anthropogenic dust-generating activity in the area upwind of the West 43rd Ave. monitor during the seven-day period that included June 4, 2008. This provides conclusive evidence that the anthropogenic sources upwind of the West 43rd Ave. monitor were reasonably controlled during the high wind conditions on June 4, 2008.

Summary

According to Table 5-2, the sources contributing to the exceedance of the PM_{10} standard at the West 43rd Ave. monitor on June 4, 2008, were open space (60.3%), riverbeds (8.7%), sand and gravel operations (1.6%), and vacant areas (29.5%). The previous discussion demonstrates that there were fourteen unique and legally binding measures in place to control these sources on June 4, 2008. The large number of measures implemented and the strengthened enforcement of Rules 316 and 310.01 by Maricopa County in March 2008 confirm that the sources upwind of the West 43rd Ave. monitor were reasonably controlled during the high winds on June 4, 2008.

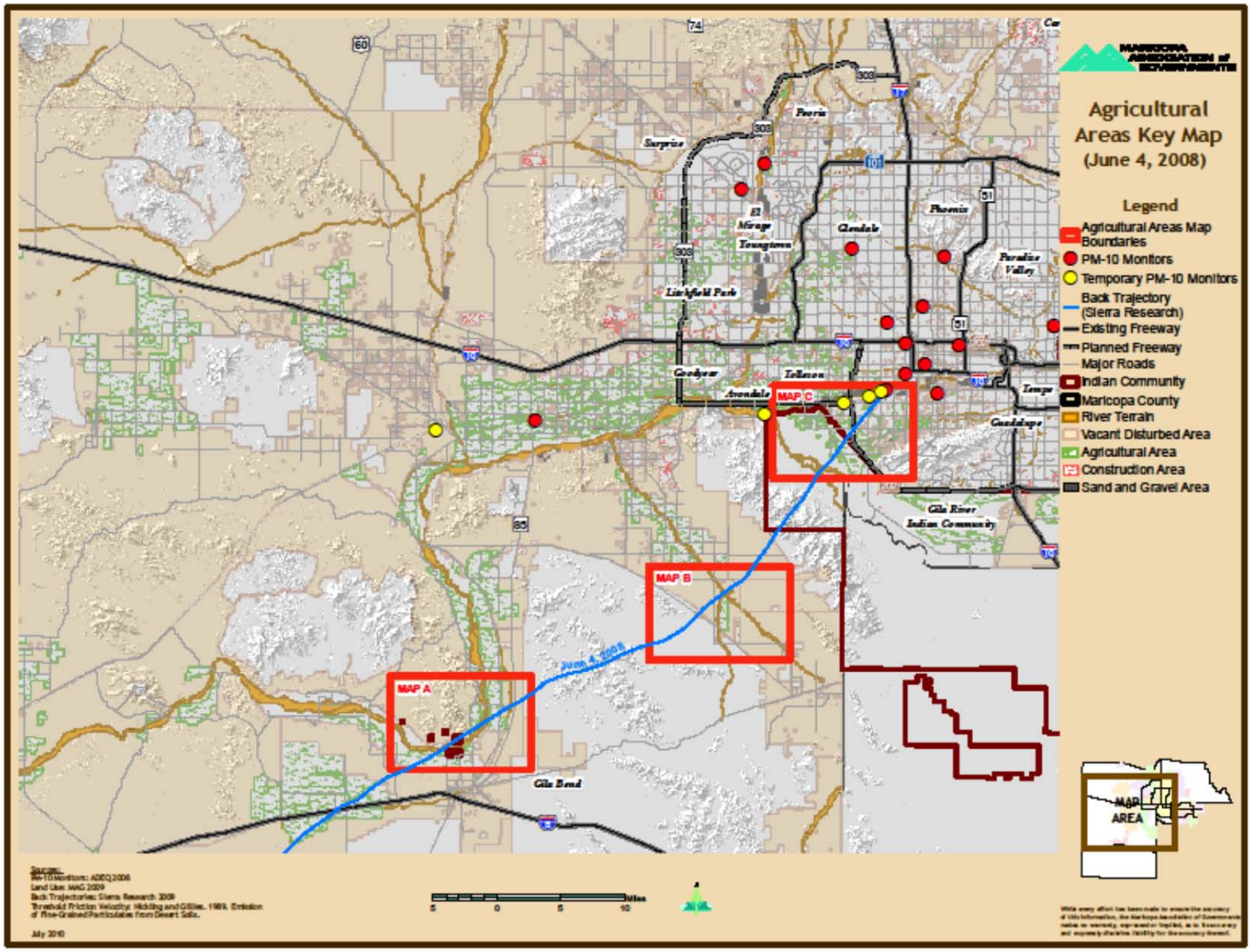


Figure 5-4. Agricultural Areas Key Map for June 4, 2008 Back Trajectory

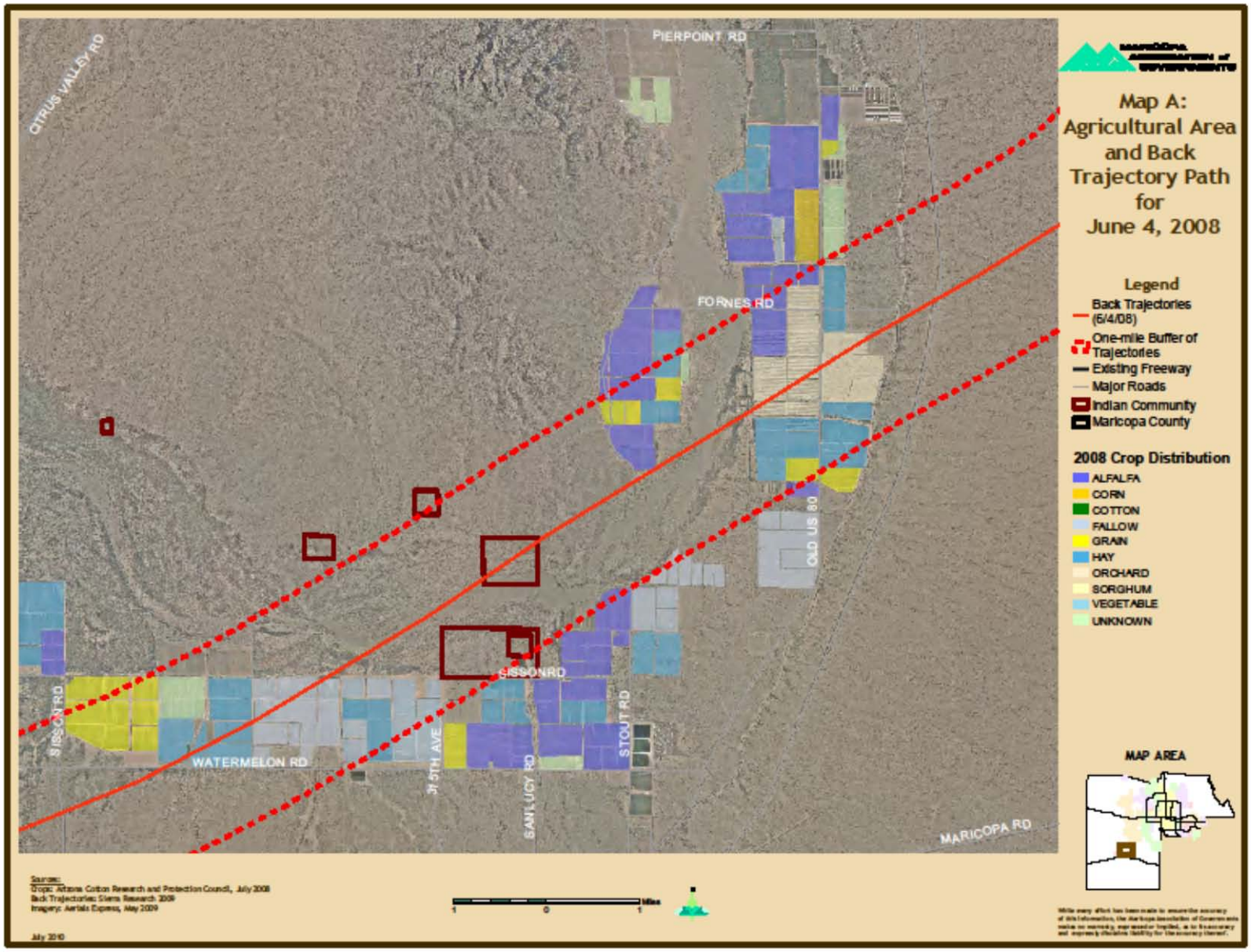


Figure 5-5. Agricultural Area A Map for June 4, 2008 Back Trajectory

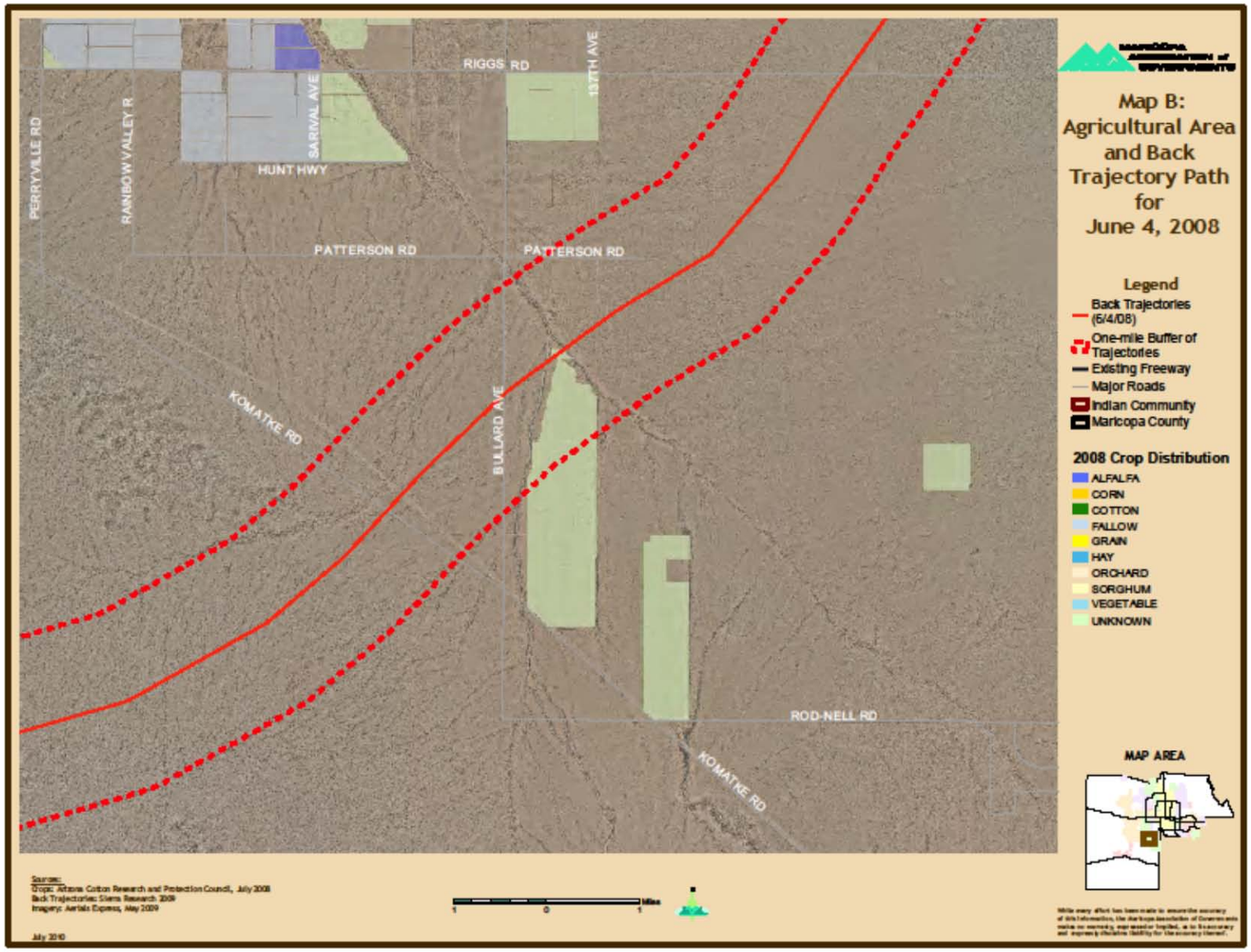


Figure 5-6. Agricultural Area B Map for June 4, 2008 Back Trajectory

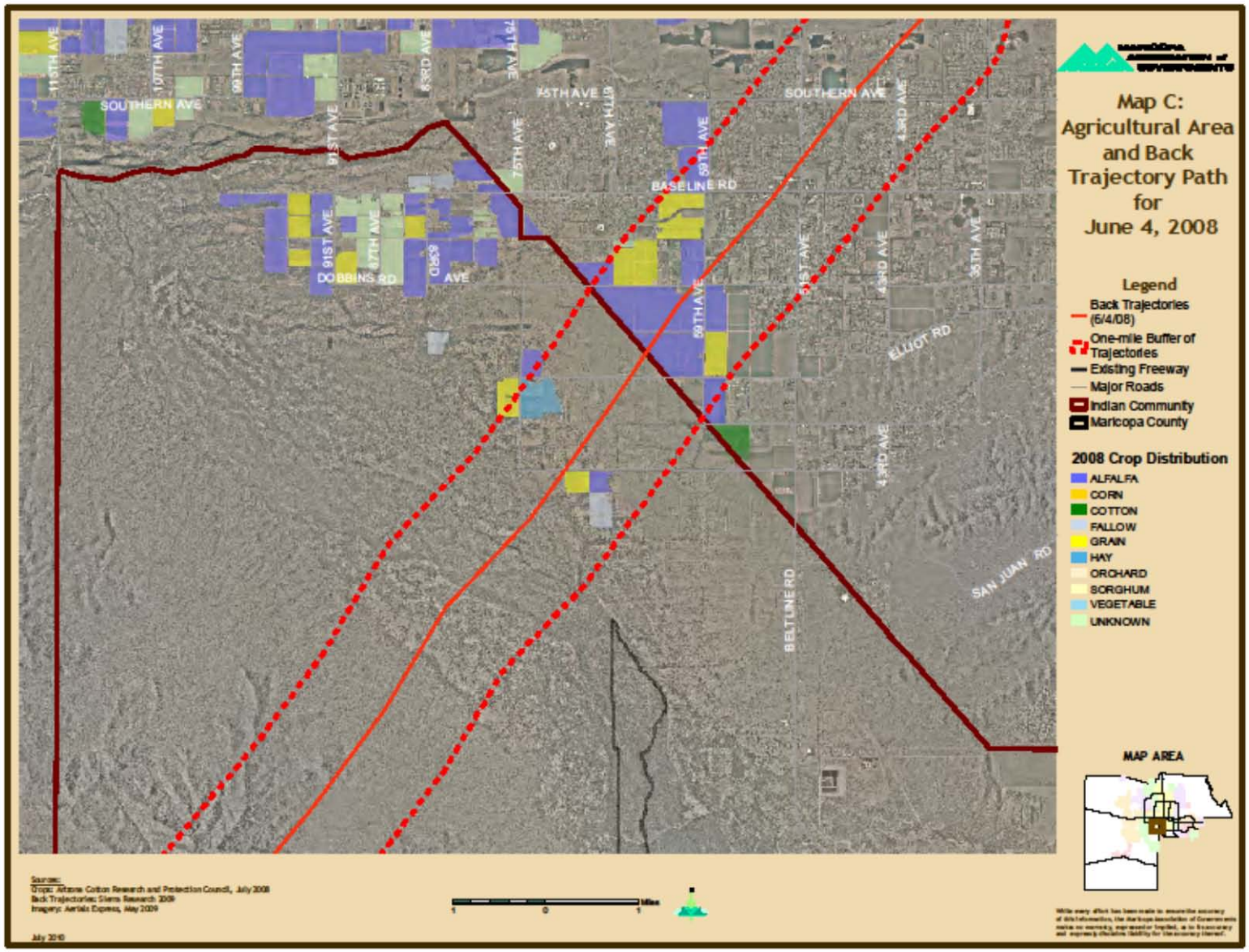


Figure 5-7. Agricultural Area C Map for June 4, 2008 Back Trajectory

5.3 Was a Natural Event

The Federal Register Notice[11] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration

> *The EPA is retaining the term ''high wind'' event because it accurately connotes the type of natural event that should be excluded under this rule, as well as the action which caused the exceedance or violation of the standard. The term also serves as an indicator concerning the level of wind which caused the exceedance or violation of the standard and indicates that it was unusually high for the affected area during the time period that the event occurred. Therefore, States must provide appropriate documentation to substantiate why the level of wind speed associated with the event in question should be considered unusual for the affected area during the time of year that the event occurred. The EPA will evaluate such instances on a case-by-case basis, including factors such as historically typical wind speed levels for the season of the year that the event is claimed.*

The steps required to prepare a demonstration that June 4, 2008, was a "high wind" event include assembly of the historical wind measurements at each of the monitoring sites and analysis of historic distribution of winds during individual hours. Since multiple measurements of winds are available at several of the sites, an analysis of the historic distributions is prepared for both average hourly wind speeds and hourly wind gusts. In addition, separate analyses are prepared for the spring and summer seasons to demonstrate that winds were not only unusual in the season in which the event occurred, but also during the spring season when high winds typically occur.

<u>West 43rd Ave. Monitor</u>

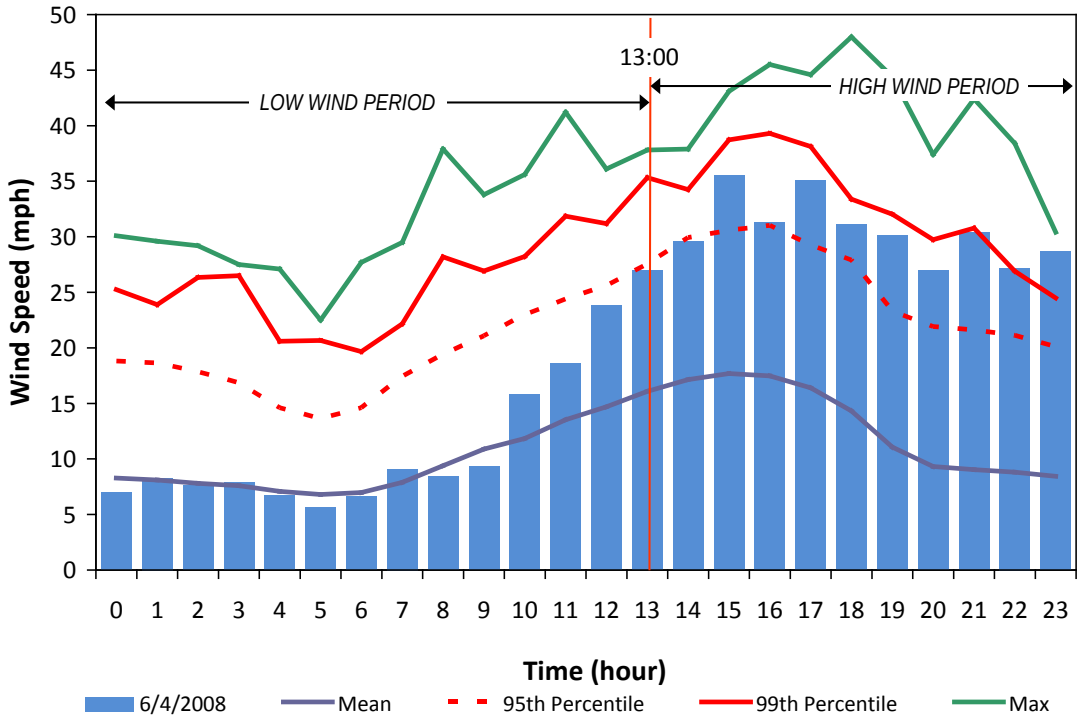
The analysis of hourly wind distributions contrasted event specific values with average values, 95th and 99th percentile values recorded during each season for the period 2005 – 2008. A summary of the results for spring months is presented in Figure 5-8; summer values are presented in Figure 5-9. It is clear using either metric (gusts or averages) that many hours had wind speeds in excess of the 95th and even 99th percentile in both seasons, thus demonstrating that unusual wind speeds occurred on June 4, 2008.

Further evidence of the unusual wind speeds comes from a historical examination of average wind speeds during high wind hours. A description of the process used to select high wind hours is presented in Section 5.2. A threshold of 13 mph was selected as the threshold speed at which winds could initiate the entrainment of PM_{10} impacting monitors in the Salt River Area. Each hour containing one or more 5-minute periods with an average wind speed of 13 mph or higher was designated as a high wind hour. The 13 mph threshold divided the day into a low wind period from midnight to 13:00 and a high wind period from 13:00 to the end of the day. A summary of the diurnal profile of 5-minute average wind speeds and the different periods of the day is presented in Figure 5-1 of Section 5.2.

[11] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

Figure 5-8. Relationship of Wind Speeds on June 4, 2008, to Historical Values Recorded During the Spring Months at West 43rd Ave. Monitor

Hourly Gusts



Average Hour

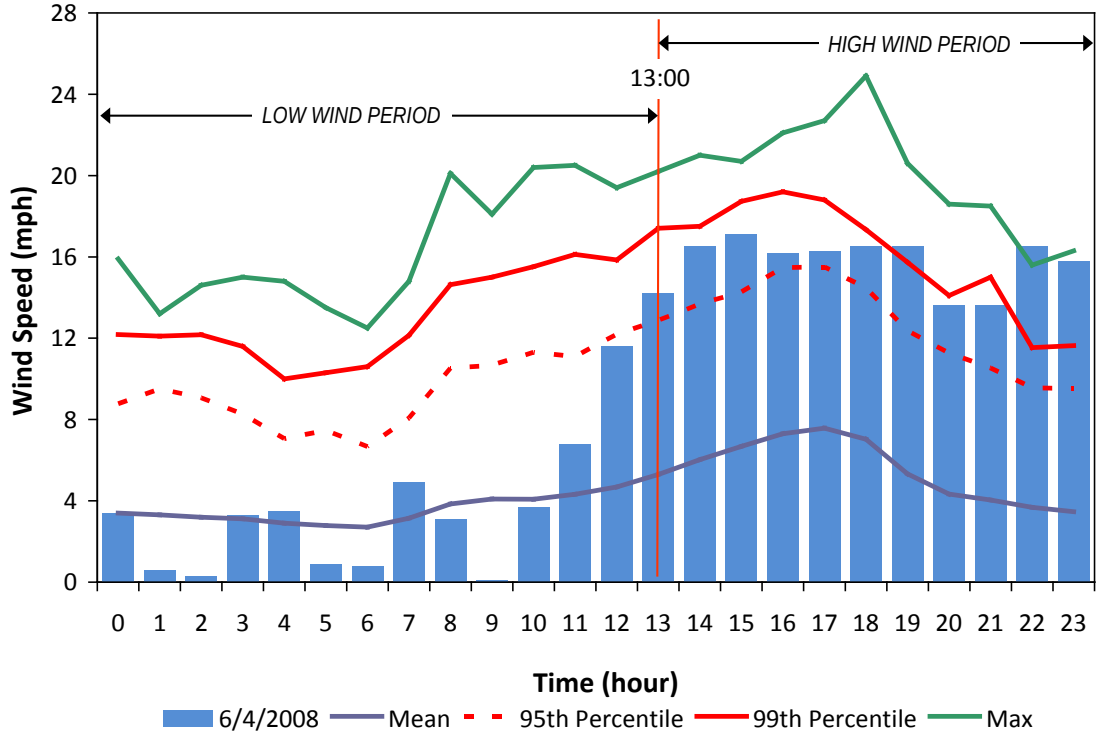
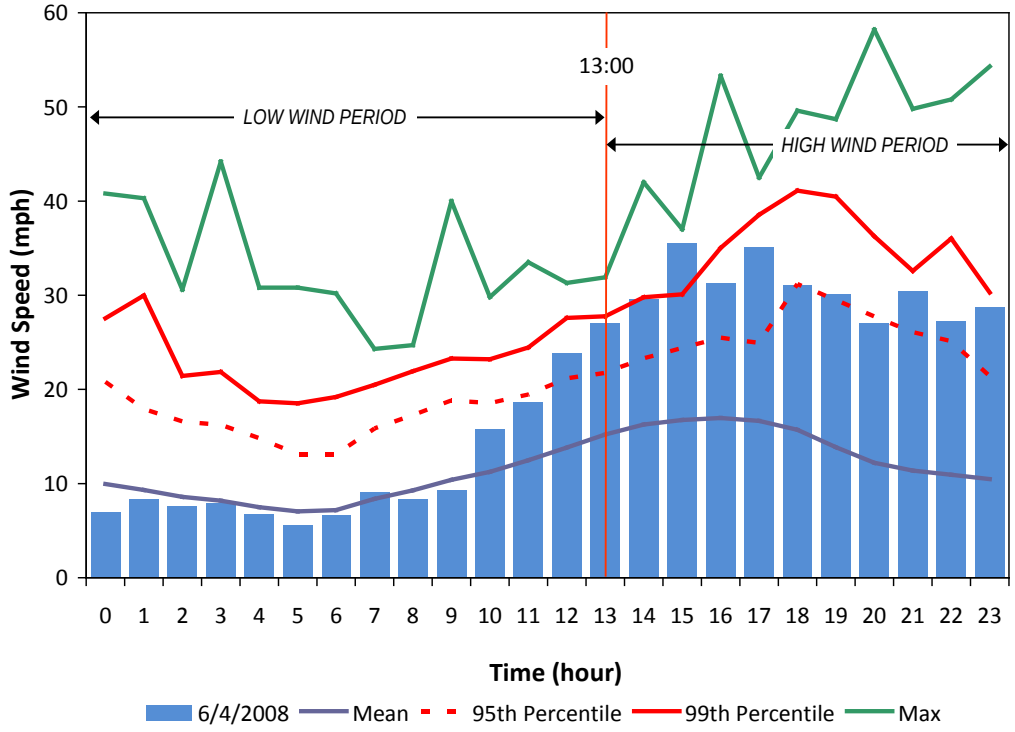
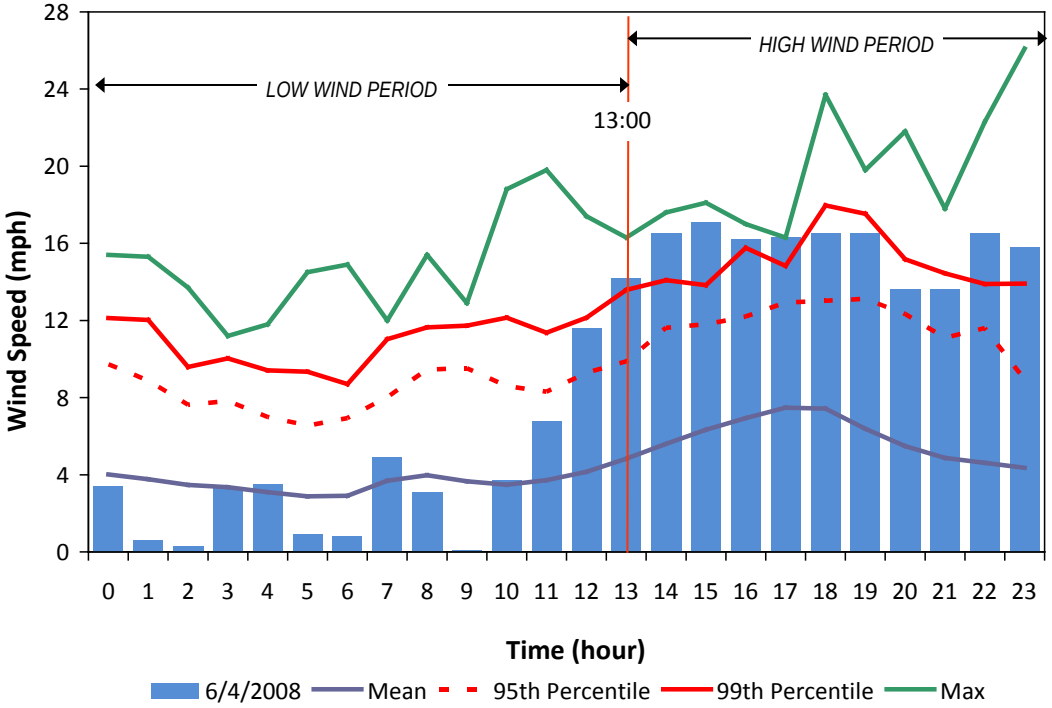


Figure 5-9. Relationship of Wind Speeds on June 4, 2008, to Historical Values Recorded During the Summer Months at West 43rd Ave. Monitor

Hourly Gusts



Average Hour



A summary of the relative severity of wind speeds during the high wind hours on June 4, 2008, in comparison to the history of hourly average and hourly gusts for both the spring and summer seasons is presented in Figures 5-10 – 5-13. They show that for the period between 2005 – 2009, the wind speeds recorded during the high wind hours exceeded the 99th percentile in both seasons using both measurements. This information clearly demonstrates that wind speed levels on June 4, 2008, recorded at the West 43rd Ave. monitor were unusual from a historical perspective.

Figure 5-10. Distribution of Average Wind Speed During High Wind Hours (1:00 p.m. – Midnight) at West 43rd Monitor, Spring Season Only (2005 – 2009)

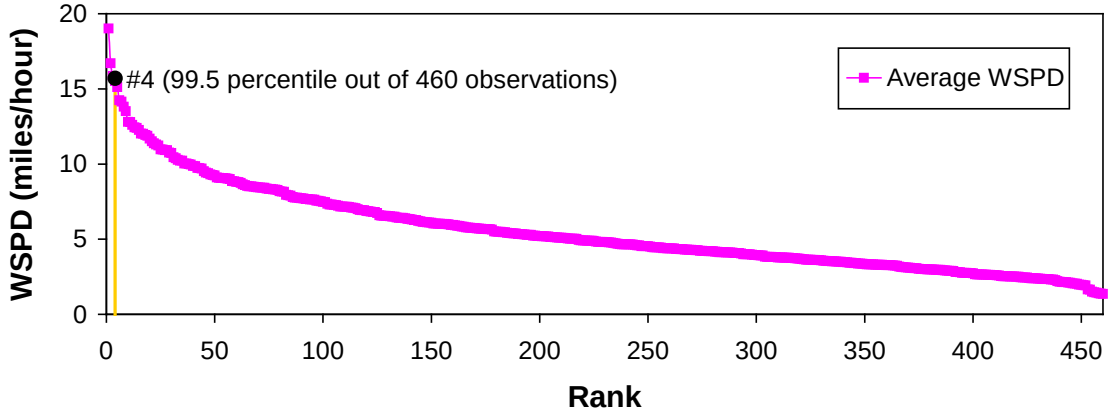


Figure 5-11. Distribution of Average Wind Speed During High Wind Hours (1:00 p.m. – Midnight) at West 43rd Monitor, Summer Season Only (2005 – 2009)

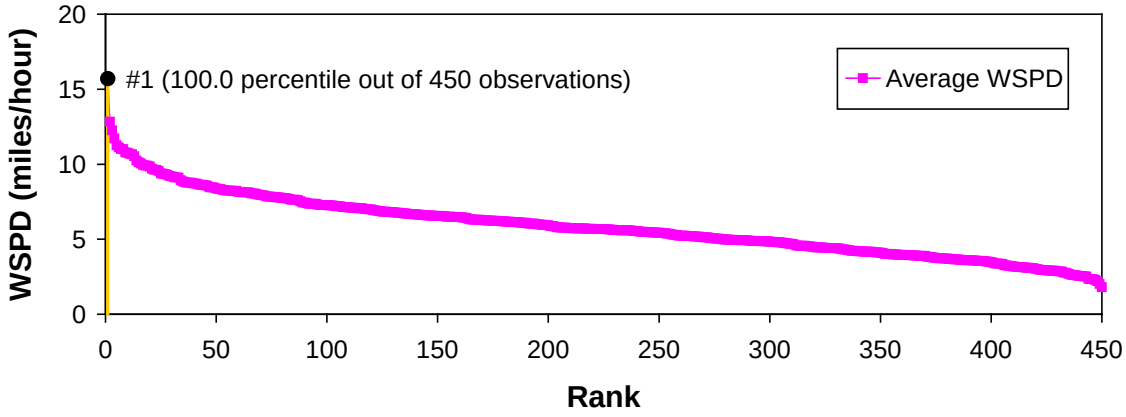


Figure 5-12. Distribution of Average Wind Gusts During High Wind Hours (1:00 p.m. – Midnight) at West 43rd Monitor, Spring Season Only (2005 – 2009)

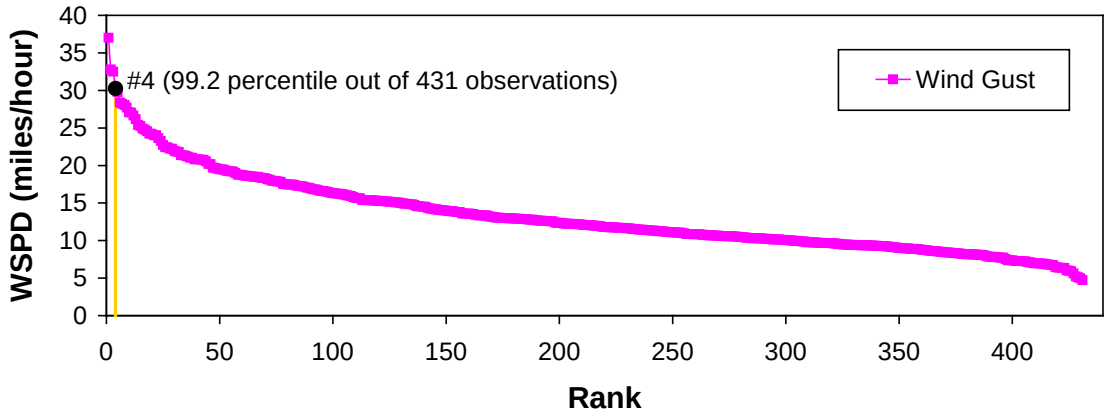
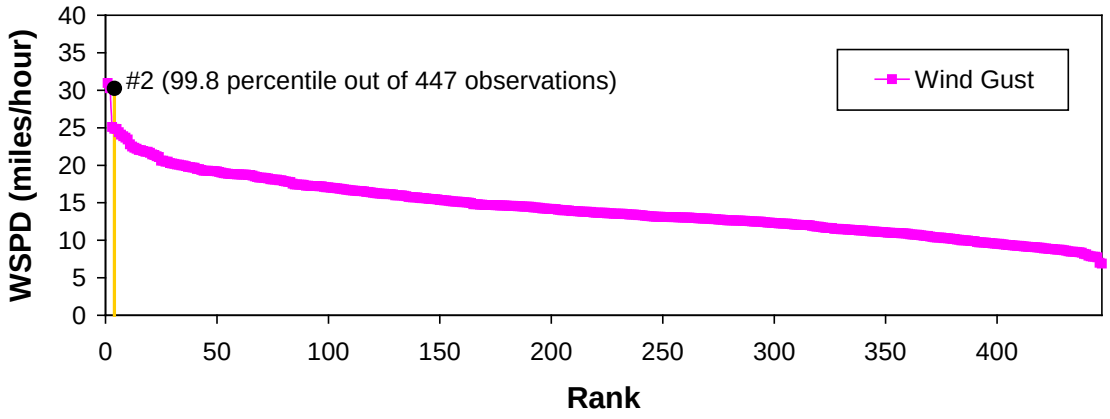


Figure 5-13. Distribution of Average Wind Gusts During High Wind Hours (1:00 p.m. – Midnight) at West 43rd Monitor, Summer Season Only (2005 – 2009)



Buckeye Monitor

The application of the 13 mph threshold to the Buckeye wind measurements on June 4, 2008, divided the day into a low wind period from midnight to 11:00 a.m. and a high wind period from 11:00 a.m. to the end of the day. A summary of the diurnal profile of hourly average wind speeds and the different periods of the day is presented in Figure 5-14.

A summary of the relative severity of wind speeds during the high wind hours on June 4, 2008, in comparison to the history of hourly average and hourly gusts for both the spring and summer seasons is presented in Figures 5-15 – 5-18. They show that for the period between 2005 – 2009, the wind speeds recorded during the high wind hours exceeded the 99th percentile in both seasons using both measurements. This information clearly demonstrates that wind speed levels on June 4, 2008, recorded at the Buckeye Monitor were unusual from a historical perspective.

Figure 5-14. Diurnal Profile of 1-Hour Average PM_{10} Concentrations and Wind Speed at Buckeye Monitor (6/4/2008)

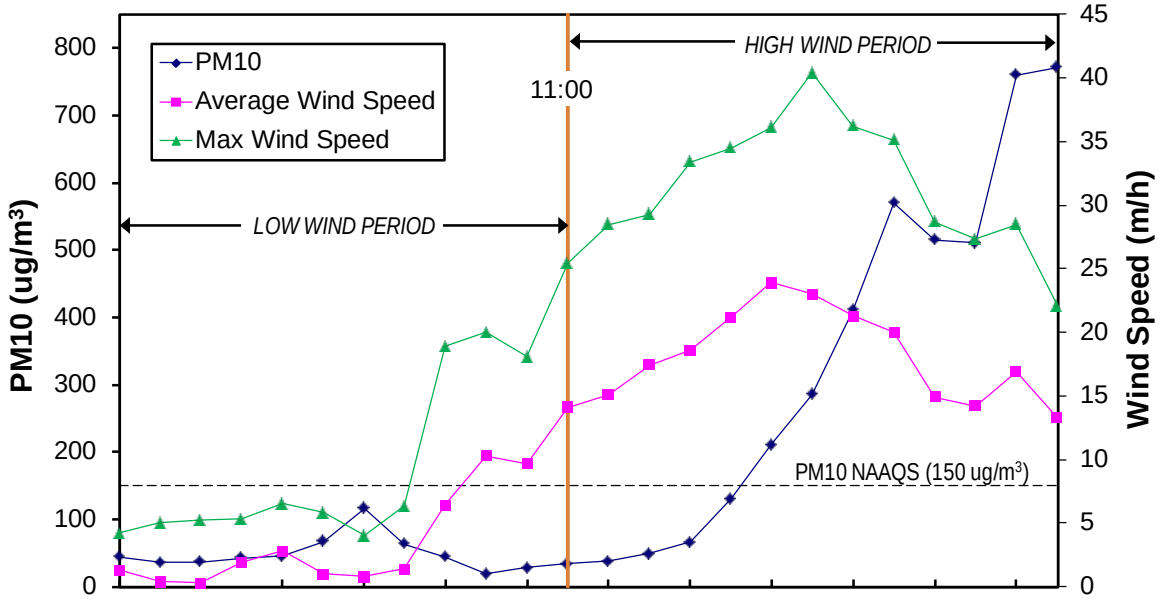


Figure 5-15. Distribution of Average Wind Speed During High Wind Hours (11:00 a.m. – Midnight) at Buckeye Monitor, Summer Season Only (2005 – 2009)

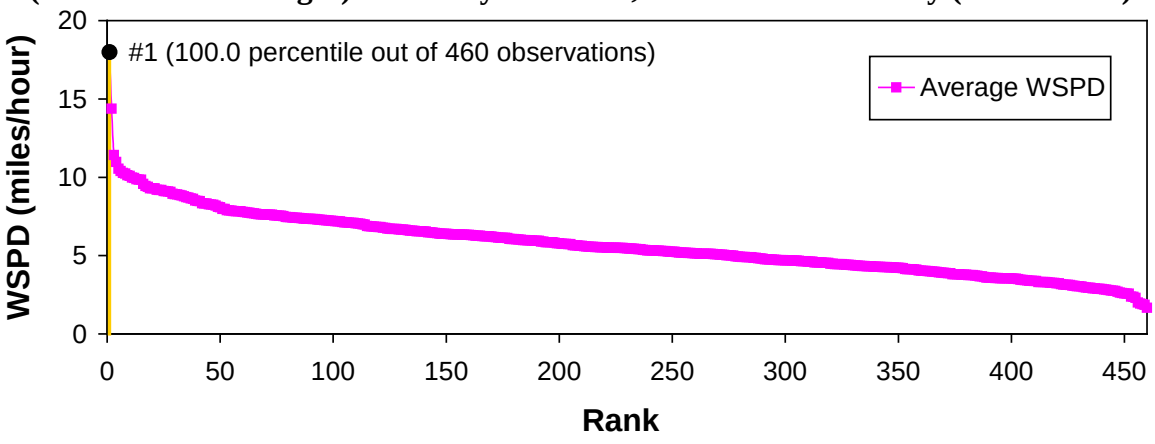


Figure 5-16. Distribution of Average Wind Speed During High Wind Hours (11:00 a.m. – Midnight) at Buckeye Monitor, Spring Season Only (2005 – 2009)

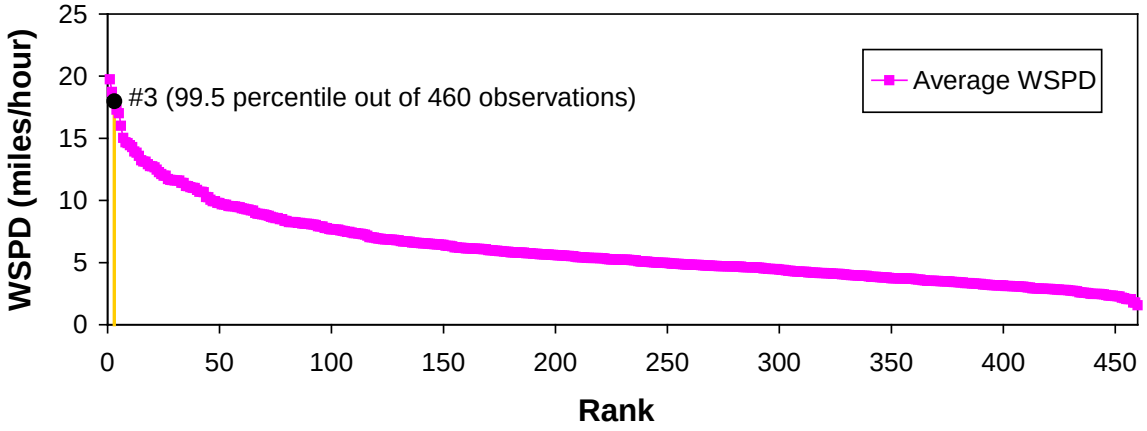


Figure 5-17. Distribution of Average Wind Gusts During High Wind Hours (11:00 a.m. – Midnight) at Buckeye Monitor, Summer Season Only (2005 – 2009)

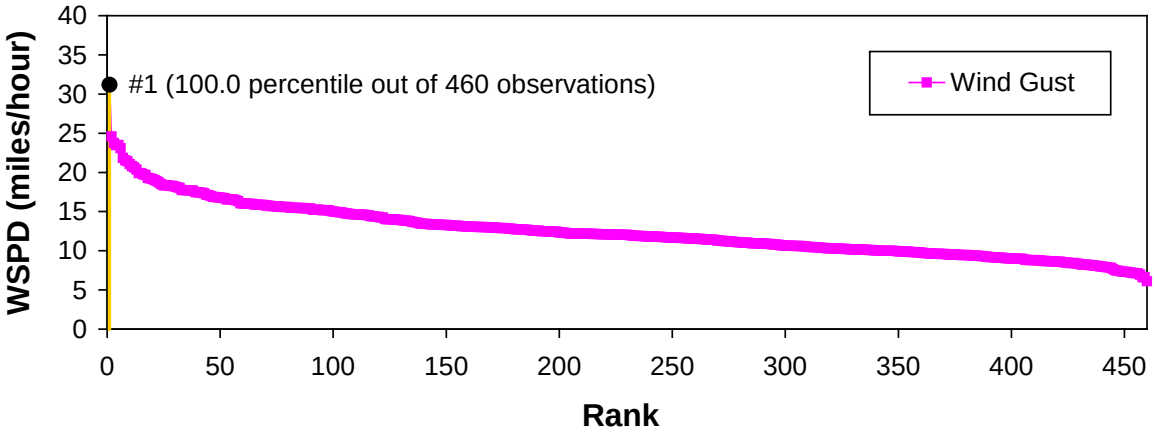
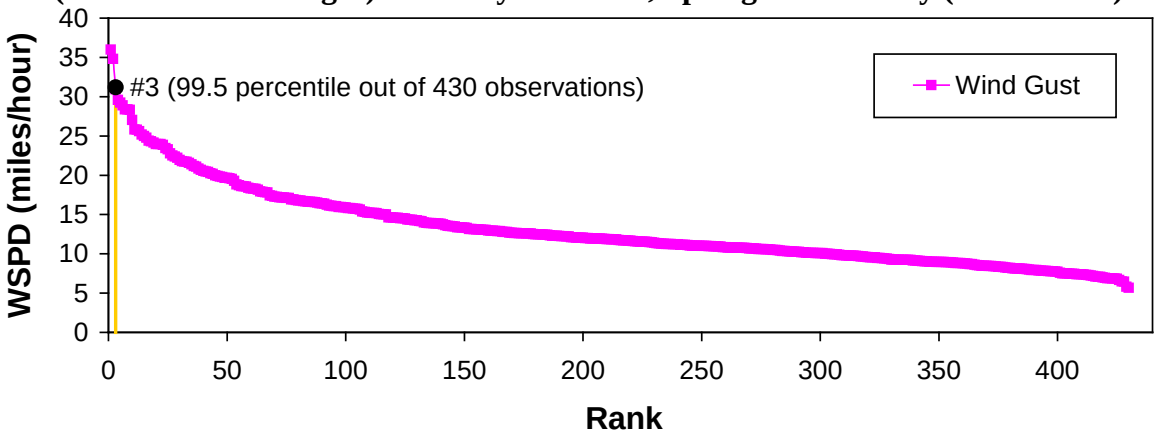


Figure 5-18. Distribution of Average Wind Gusts During High Wind Hours (11:00 a.m. – Midnight)at Buckeye Monitor, Spring Season Only (2005 – 2009)



Coyote Lakes

A strict application of the 13 mph threshold could not be applied to Coyote Lakes because (a) no wind measurements are available from the site and (b) no 5-minute measurements were available at the nearby Dysart monitor. An additional limitation of the Dysart monitoring site is that no gust measurements were recorded and data are only available for 2007 – 2008. Despite these limitations, a similar analysis of the available Dysart data was prepared. The application of the 11-13 mph threshold for average hourly winds, as discussed in appendix H, divided the day into a low wind period from midnight to 2:00 p.m. and a high wind period from 2:00 p.m. to the end of the day. A summary of the diurnal profile of hourly average wind speeds and the different periods of the day is presented in Figure 5-19.

The elevated PM_{10} concentrations recorded during the early morning hours at Coyote Lakes are part of a late night stagnation episode which started at 22:00 on June 3rd when the wind speeds recorded at the nearby Dysart monitor dropped below the measurement threshold of the instrument. At that point, the hourly concentrations rapidly increased to levels in excess of 400 $\mu g/m^3$. The low wind speed conditions and high concentrations carried over into the early morning hours on June 4, 2008. These conditions are clearly unrelated to the unusual high wind conditions which occurred later in the day and are the subject of this analysis.

A summary of the relative severity of wind speeds during the high wind hours on June 4, 2008, in comparison to the history of hourly average values for both the spring and summer seasons is presented in Figures 5-20 – 5-21. They show that for the period between 2007 – 2008, the wind speeds recorded during the high wind hours exceeded the 99th percentile in both seasons. This information clearly demonstrates that wind speed levels on June 4, 2008, recorded at the Dysart Monitor were unusual from a historical perspective.

Figure 5-19. Diurnal Profile of 1-Hour Average PM_{10} Concentrations at Coyote Lake Monitor and 1-Hour Average Wind Speed at Dysart Monitor (6/4/2008)

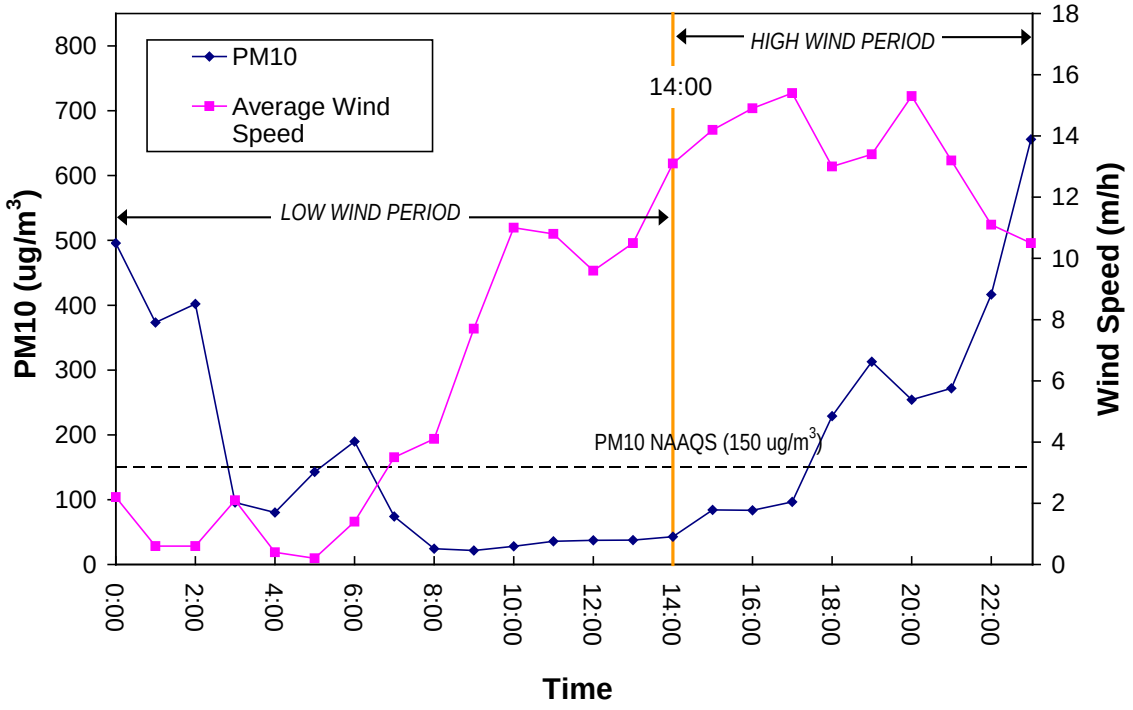


Figure 5-20. Distribution of Average Wind Speed During High Wind Hours (2:00 p.m. – Midnight)at Dysart Monitor, Summer Season Only (2007 – 2008)

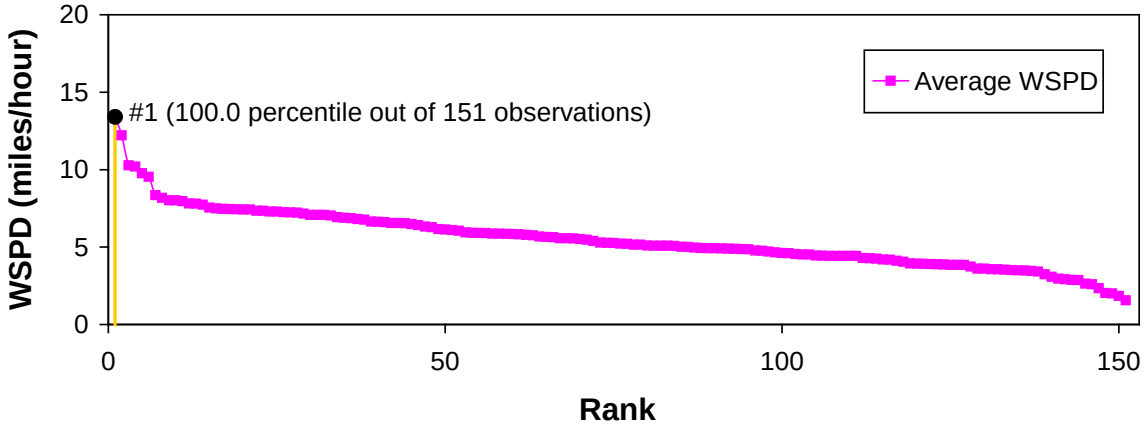
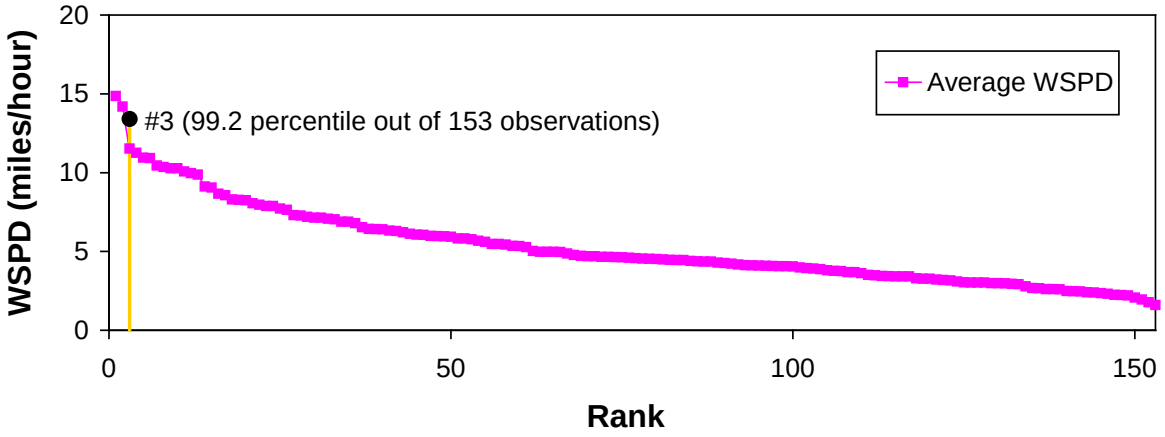


Figure 5-21. Distribution of Average Wind Speed During High Wind Hours (2:00 p.m. – Midnight)at Dysart Monitor, Spring Season Only (2007 – 2008)



As discussed in section 4, wind speeds throughout southeastern California, Nevada, and Arizona were extremely high on this day. Strong wind gusts that were recorded at NWS stations include: 44 mph at El Centro NAF; 43 mph at Imperial County Airport; 37 mph at Yuma Marine Corp Air Station; and 37 mph at Phoenix Sky Harbor International Airport. Significantly higher wind gusts were also measured at other NWS RAWS sites throughout California, Nevada and Arizona. The NWS recorded 18 events with winds in excess of 50 knots in California, 10 in Nevada, and 5 in Arizona. In addition to these measurements of high winds, observations of blowing dust, blowing sand, and reduced visibilities were also reported across the California desert and in Arizona.

All of these observations support the presence of windblown dust at the Phoenix and Yuma area monitors on June 4, 2008. In addition, NWS forecast discussions, wind advisories, and National Climate Data Center (NCDC) storm event record reports also describe strong winds and blowing dust throughout California, Nevada, and Arizona, providing substantial weight-of-evidence for the sequence of events.

5.4 Reasonable Measures

Section 2.2 describes the air pollution control programs in place in the Phoenix and Yuma areas to control anthropogenic sources of PM_{10}. Section 5.2 described the increased enforcement and inspection programs that were implemented in the days surrounding the event. These show that BACM were in place during the event.

ADEQ issued Dust Control Action Forecasts for the Yuma and Phoenix areas and an Air Quality Forecast in Maricopa County as discussed in Section 1.1. All available measures were taken to advise the public that a potential existed for elevated PM_{10} levels from windblown dust. The forecasts/advisories satisfy the requirement in 40 CFR 51.930(a)(1). Copies of these advisories have been included in Appendix I.

Section 6: Event Contribution Analysis

The Federal Register Notice[12] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration

> *The EPA will maintain the proposed ''but-for'' requirement that air quality data may not be excluded except where States, Tribes, or local agencies show that exceedances or violations of applicable standards would not have occurred ''but for'' the influence of exceptional events. Through analyses, it is possible to demonstrate that an exceedance or violation would not have occurred but for the event… This analysis does not require a precise estimate of the estimated air quality impact from the event. The weight of evidence demonstration can present a range of possible concentrations which is not as technically demanding as justifying a specific adjustment to a measured value.*

The steps required to prepare a demonstration that "but-for" the influence of the exceptional events exceedances or violations of the applicable standards would not have occurred, include assembly of historical wind and concentration measurements, selection of high wind hours, substitution of historical values for high wind hours, recalculation of daily average concentrations using actual low wind values and substituted high wind values and assessment relative to the ambient standard and historical performance.

Separate analyses were prepared for West 43rd Ave., Buckeye and Yuma monitors for the 2005 – 2008 period. Although a limited historical PM_{10} concentration record exists for Coyote Lakes (i.e., 2007 – 2008) and the winds were from the nearest quality assured monitor (Dysart) analysis was performed for this site as well.

6.1 West 43rd Ave. Monitor

The methodology used to select high wind hours on the event day is presented in Section 5.2 and discussed in Appendix H. Using the 13 mph threshold speed at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area, June 4, 2008, was divided into two periods: low wind (midnight – 12:00 noon) and high wind (1:00 p.m. through the end of the day). To address the "but-for" requirement, the concentrations recorded during the low wind hours were kept constant; substitutions of average and 95th percentile concentrations recorded during the period from 2005 – 2008 were prepared. The daily average concentrations were computed with the substituted values to assess the influence of the high wind hours on the event. The results of the analysis are presented in Tables 6-1 and 6-2 for the spring and summer seasons respectively. Table 6-1 shows the use of the spring average hourly concentrations during the high wind hours significantly depressed the 24-hour average concentration relative to the event value. It also shows that use of the 95th percentile average hourly concentration during the high wind hours did not cause the 24-hour concentration to exceed the ambient standard. Table 6-2 presents a similar analysis using summer average and 95th percentile concentrations. The results parallel those seen for the spring months.

[12] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

The information presented in Tables 6-1 and 6-2 clearly demonstrate that concentrations recorded on June 4, 2008, would not have exceeded the standard "but-for" the concentrations recorded during the high wind hours.

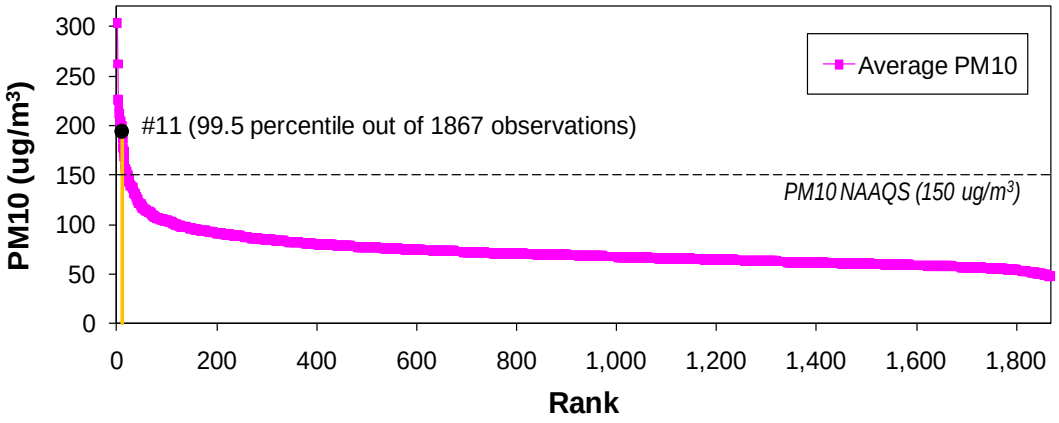
Table 6-1.
"But-For" Analysis of West 43rd Ave. Monitor
June 4, 2008, PM_{10} Concentrations – Using Spring Values

Hour	Average Wind Speed (mph)	Max Wind Speed (mph)	Event PM_{10} ($\mu g/m^3$)	Mean PM_{10} ($\mu g/m^3$)	95th Percentile PM_{10} ($\mu g/m^3$)
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	3	7	52	52	52
1	1	8	34	34	34
2	0	8	35	35	35
3	3	8	71	71	71
4	4	7	65	65	65
5	1	6	142	142	142
6	1	7	199	199	199
7	5	9	90	90	90
8	3	8	85	85	85
9	0	9	67	67	67
10	4	16	40	40	40
11	7	19	64	64	64
12	12	24	165	165	165
High Wind Hours *(with mean & 95th percentile substitutions)*					
13	14	27	307	60	183
14	17	30	645	65	227
15	17	36	520	64	231
16	16	31	382	65	213
17	16	35	569	58	186
18	17	31	266	57	154
19	17	30	161	66	169
20	14	27	95	72	153
21	14	30	84	75	163
22	17	27	241	63	138
23	16	29	283	62	141
Average Daily Concentration:	N/A	N/A	194	76	128

Table 6-2. "But-For" Analysis of West 43rd Ave. Monitor June 4, 2008, PM_{10} Concentrations – Using Summer Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	3	7	52	52	52
1	1	8	34	34	34
2	0	8	35	35	35
3	3	8	71	71	71
4	4	7	65	65	65
5	1	6	142	142	142
6	1	7	199	199	199
7	5	9	90	90	90
8	3	8	85	85	85
9	0	9	67	67	67
10	4	16	40	40	40
11	7	19	64	64	64
12	12	24	165	165	165
High Wind Hours *(with mean & 95th percentile substitutions)*					
13	14	27	307	41	83
14	17	30	645	44	103
15	17	36	520	42	98
16	16	31	382	44	110
17	16	35	569	51	115
18	17	31	266	59	190
19	17	30	161	61	144
20	14	27	95	80	151
21	14	30	84	71	204
22	17	27	241	67	169
23	16	29	283	63	137
Average Daily Concentration:	N/A	N/A	194	72	109

A further demonstration of the unusual concentrations recorded during the high wind hours was prepared by again holding the concentrations recorded during the low wind hours on the event constant and substituting concentrations recorded during high wind hours from all days with data available in 2003 – 2009. The results are displayed in Figure 6-1 and show that June 4, 2008, ranked 11th out of the 1,867 calculated days for a 99.5 percentile value. This ranking from measurements collected over a seven-year period clearly demonstrates that unusually high concentrations were recorded during the high wind hours on June 4, 2008.

Figure 6-1. Distribution of Composite 24-Hour Average PM_{10} Concentrations at West 43rd Ave. Monitor Using Actual Low Wind Values from 6/4/2008 with High Wind Hour Values for All Days (2003 – 2009)



6.2 Buckeye Monitor

The methodology used to select high wind hours on the event day is presented in Section 5.2 and discussed in Appendix H. Using the 13 mph threshold speed at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area, June 4, 2008, was divided into two periods: low wind (midnight – 11:00 a.m.) and high wind (11:00 a.m. through the end of the day). To address the "but-for" requirement, the concentrations recorded during the low wind hours were kept constant; substitutions of average and 95th percentile concentrations recorded during the period from 2005 – 2008 were prepared. The daily average concentrations were computed with the substituted values to assess the influence of the high wind hours on the event. The results of the analysis are presented in Tables 6-3 and 6-4 for the spring and summer seasons respectively. Table 6-3 shows the use of the spring average hourly concentrations during the high wind hours significantly depressed the 24-hour average concentration relative to the event value. It also shows that use of the 95th percentile average hourly concentration during the high wind hours did not cause the 24-hour concentration to exceed the ambient standard. Table 6-4 presents a similar analysis using summer average and 95th percentile concentrations. The results parallel those seen for the spring months.

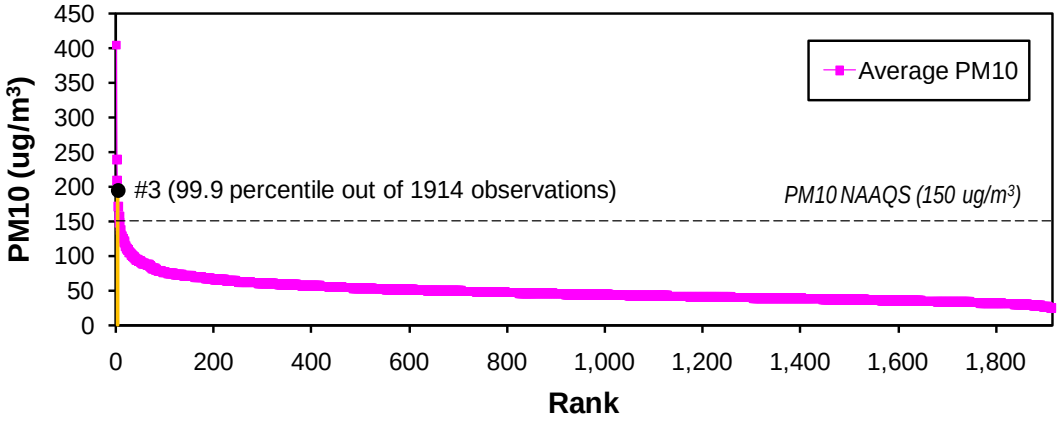
The information presented in Tables 6-3 and 6-4 clearly demonstrate that concentrations recorded on June 4, 2008, would not have exceeded the standard "but-for" the concentrations recorded during the high wind hours.

Table 6-3. "But-For" Analysis of Buckeye Monitor June 4, 2008, PM_{10} Concentrations – Using Spring Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	1	4	45	45	45
1	0	5	36	36	36
2	0	5	37	37	37
3	2	5	43	43	43
4	3	6	45	45	45
5	1	6	67	67	67
6	1	4	117	117	117
7	1	6	63	63	63
8	6	19	44	44	44
9	10	20	19	19	19
10	10	18	28	28	28
High Wind Hours *(with mean & 95th percentile substitutions)*					
11	14	26	34	43	86
12	15	28	38	44	100
13	17	29	49	39	97
14	19	33	66	44	146
15	21	34	131	47	139
16	24	36	210	43	116
17	23	40	285	46	129
18	21	36	411	54	150
19	20	35	570	61	135
20	15	29	515	63	158
21	14	27	511	57	119
22	17	28	760	48	99
23	13	22	772	45	80
Average Daily Concentration:	N/A	N/A	204	49	87

Table 6-4. "But-For" Analysis of Buckeye Monitor June 4, 2008, PM_{10} Concentrations – Using Summer Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	1	4	45	45	45
1	0	5	36	36	36
2	0	5	37	37	37
3	2	5	43	43	43
4	3	6	45	45	45
5	1	6	67	67	67
6	1	4	117	117	117
7	1	6	63	63	63
8	6	19	44	44	44
9	10	20	19	19	19
10	10	18	28	28	28
High Wind Hours *(with mean & 95th percentile substitutions)*					
11	14	26	34	35	80
12	15	28	38	34	79
13	17	29	49	31	69
14	19	33	66	34	95
15	21	34	131	32	76
16	24	36	210	32	70
17	23	40	285	43	87
18	21	36	411	64	134
19	20	35	570	75	254
20	15	29	515	75	176
21	14	27	511	72	175
22	17	28	760	61	140
23	13	22	772	56	121
Average Daily Concentration:	N/A	N/A	204	50	88

Another demonstration of the unusual concentrations recorded during the high wind hours was prepared by again holding the concentrations recorded during the low wind hours on the event constant and substituting concentrations recorded during high wind hours from all days with data available in 2003 – 2009. The results are displayed in Figure 6-2 and show that June 4, 2008, ranked 3rd out of the 1,914 calculated days for a 99.9 percentile value. This ranking from measurements collected over a seven-year period clearly demonstrates that unusually high concentrations were recorded during the high wind hours on June 4, 2008.

Figure 6-2. Distribution of Composite 24-Hour Average PM_{10} Concentrations at Buckeye Monitor Using Actual Low Wind Hour Values from 6/4/2008 with High Wind Hour Values for All Days (2003 – 2009)



6.3 Yuma Monitor

The methodology used to select high wind hours on the event day is presented in Section 5.2 and discussed in Appendix H. Using the alternate 17-21 mph maximum wind threshold speed (since 5-minute data is not available) at which winds could initiate entrainment of PM_{10}, June 4, 2008, was divided into two periods: low wind (midnight – 11:00 a.m.) and high wind (11:00 a.m. through the end of the day). To address the "but-for" requirement, the concentrations recorded during the low wind hours were kept constant; substitutions of average and 95th percentile concentrations recorded during the period from 2005 – 2008 were prepared. The daily average concentrations were computed with the substituted values to assess the influence of the high wind hours on the event. The results of the analysis are presented in Tables 6-5 and 6-6 for the spring and summer seasons respectively. Table 6-5 shows the use of the spring average hourly concentrations during the high wind hours significantly depressed the 24-hour average concentration relative to the event value. It also shows that use of the 95th percentile average hourly concentration during the high wind hours did not cause the 24-hour concentration to exceed the ambient standard. Table 6-6 presents a similar analysis using summer average and 95th percentile concentrations. The results parallel those seen for the spring months.

The information presented in Tables 6-5 and 6-6 clearly demonstrate that concentrations recorded on June 4, 2008, would not have exceeded the standard "but-for" the concentrations recorded during the high wind hours.

Table 6-5. "But-For" Analysis of Yuma Monitor June 4, 2008 PM_{10} Concentrations – Using Spring Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	2	8	49	49	49
1	2	9	45	45	45
2	4	8	44	44	44
3	3	7	105	105	105
4	4	9	18	18	18
5	3	5	38	38	38
6	2	6	33	33	33
7	5	12	46	46	46
8	6	11	42	42	42
9	8	15	69	69	69
10	9	16	42	42	42
High Wind Hours *(with mean & 95th percentile substitutions)*					
11	11	20	51	44	102
12	12	21	76	40	91
13	16	28	119	41	107
14	18	34	183	43	117
15	20	33	570	48	136
16	19	32	301	53	179
17	15	26	547	57	191
18	18	29	570	63	188
19	26	38	2163	75	215
20	25	40	2341	71	160
21	26	40	965	64	143
22	21	29	523	56	117
23	15	28	343	49	101
Average Daily Concentration:	N/A	N/A	386	51	99

Table 6-6. "But-For" Analysis of Yuma Monitor June 4, 2008 PM_{10} Concentrations – Using Summer Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	2	8	49	49	49
1	2	9	45	45	45
2	4	8	44	44	44
3	3	7	105	105	105
4	4	9	18	18	18
5	3	5	38	38	38
6	2	6	33	33	33
7	5	12	46	46	46
8	6	11	42	42	42
9	8	15	69	69	69
10	9	16	42	42	42
High Wind Hours *(with mean & 95th percentile substitutions)*					
11	11	20	51	91	39
12	12	21	76	75	33
13	16	28	119	34	85
14	18	34	183	35	79
15	20	33	570	36	78
16	19	32	301	39	89
17	15	26	547	47	95
18	18	29	570	57	139
19	26	38	2163	78	167
20	25	40	2341	87	180
21	26	40	965	91	232
22	21	29	523	70	171
23	15	28	343	61	145
Average Daily Concentration:	N/A	N/A	386	56	86

6.4 Coyote Lakes Monitor

The methodology used to select high wind hours on the event day is presented in Section 5.2 and discussed in Appendix H. Using the alternate 11-13 mph threshold speed (since 5-minute data is not available) at which winds could initiate entrainment of PM_{10}, June 4, 2008, was divided into two periods: low wind (midnight – 2:00 p.m.) and high wind (2:00 p.m. through the end of the day). To address the "but-for" requirement, the concentrations recorded during the low wind hours were kept constant; substitutions of average and 95th percentile concentrations recorded during the period from 2007 – 2008 were prepared (limited historical record exists for Coyote Lakes monitor). The daily average concentrations were computed with the substituted values to assess the influence of the high wind hours on the event. The results of the analysis are presented in Tables 6-7 and 6-8 for the spring and summer seasons respectively. Table 6-7 shows the use of the spring average hourly concentrations during the high wind hours significantly depressed the 24-hour average concentration relative to the event value. It also shows that use of the 95th percentile average hourly concentration during the high wind hours did not cause the 24-hour concentration to exceed the ambient standard. Table 6-8 presents a similar analysis using summer average and 95th percentile concentrations. The results parallel those seen for the spring months.

The information presented in Tables 6-7 and 6-8 clearly demonstrate that concentrations recorded on June 4, 2008, would not have exceeded the standard "but-for" the concentrations recorded during the high wind hours.

Table 6-7. "But-For" Analysis of Coyote Lakes Monitor June 4, 2008 PM_{10} Concentrations – Using Spring Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	2	5	496	496	496
1	1	5	373	373	373
2	1	5	402	402	402
3	2	4	96	96	96
4	0	4	80	80	80
5	0	5	143	143	143
6	1	5	190	190	190
7	4	4	74	74	74
8	4	6	25	25	25
9	8	16	22	22	22
10	11	20	28	28	28
11	11	21	36	36	36
12	10	26	37	37	37
13	10	26	38	38	38
High Wind Hours *(with mean & 95th percentile substitutions)*					
14	13	27	43	27	61
15	14	32	84	26	50
16	15	34	84	32	70
17	15	30	97	26	57
18	13	37	229	27	59
19	13	30	313	34	74
20	15	26	254	45	123
21	13	25	272	54	144
22	11	22	417	64	172
23	11	24	656	54	143
Average Daily Concentration:	N/A	N/A	186	101	125

Table 6-8. "But-For" Analysis of Coyote Lakes Monitor June 4, 2008 PM_{10} Concentrations – Using Summer Values					
Hour	**Average Wind Speed (mph)**	**Max Wind Speed (mph)**	**Event PM_{10} ($\mu g/m^3$)**	**Mean PM_{10} ($\mu g/m^3$)**	**95th Percentile PM_{10} ($\mu g/m^3$)**
Low Wind Hours *(no substitutions performed for mean & 95th percentile)*					
0	2	5	496	496	496
1	1	5	373	373	373
2	1	5	402	402	402
3	2	4	96	96	96
4	0	4	80	80	80
5	0	5	143	143	143
6	1	5	190	190	190
7	4	4	74	74	74
8	4	6	25	25	25
9	8	16	22	22	22
10	11	20	28	28	28
11	11	21	36	36	36
12	10	26	37	37	37
13	10	26	38	38	38
High Wind Hours *(with mean & 95th percentile substitutions)*					
14	13	27	43	26	46
15	14	32	84	27	49
16	15	34	84	32	72
17	15	30	97	27	55
18	13	37	229	39	73
19	13	30	313	52	87
20	15	26	254	39	67
21	13	25	272	38	74
22	11	22	417	57	149
23	11	24	656	81	170
Average Daily Concentration:	N/A	N/A	186	102	120

6.5 Summary

Using local measurements of the threshold velocity at which winds could initiate entrainment of PM_{10} impacting monitors in the Salt River area, the event day was divided into periods with low and high wind hours. Alternative estimates of the daily concentrations were made by substituting spring and summer average and 95th percentile concentrations recorded during the high wind hours in 2005 – 2008. The resulting daily average concentrations were well below the ambient 24-hour PM_{10} standard, thus demonstrating that "but-for" the concentrations recorded during the high wind hours the exceedance would not have occurred at either the West 43rd Ave., Buckeye, Yuma or Coyote Lakes monitoring sites. A similar calculation using data available for days in 2003 – 2008 showed the resulting daily average concentrations on June 4, 2008, exceeded the 99th percentile for West 43rd and Buckeye monitoring sites, providing further evidence of the severity of the concentrations recorded during the high wind hours on that date.

Section 7: Clear Causal Connection

The Federal Register Notice[13] promulgating the final rule for exceptional events included the following guidance for preparing this demonstration

> *Section 319 requires that, in order to have a flagged value excluded from regulatory determinations, a State must make an affirmative demonstration that an event occurred (as shown by reliable and accurate data that are promptly produced) and that there is a clear causal relationship between measured exceedances or violations of a standard and the exceptional event in question to ''demonstrate that the exceptional event caused a specific air pollution concentration''*

The steps required to prepare a demonstration that there is a clear causal relationship between the observed elevated winds and the exceedance at the West 43rd Ave. monitor on June 4, 2008, include assembly of historical wind and concentration measurements and photographic records of the area and analysis of historic distributions of winds and concentrations and photographic records during the course of the event day. Separate analyses of the historical data were prepared for the spring and summer seasons using both maximum hourly gusts and hourly average wind speed. In the interest of brevity, only the results of the analysis of the maximum hourly gusts and PM_{10} concentrations are presented. The analysis of the average hourly wind speeds and PM_{10} concentrations, which show substantially similar results, is presented in Appendix O.

7.1 Historical Analysis

An analysis of hourly concentrations and hourly maximum wind speeds was prepared for the period 2005 – 2008. A comparison of hourly mean PM_{10} concentrations and hourly mean wind gust speeds is presented in Figure 7-1 for spring months. It shows the hours of highest concentrations typically occurred in early morning hours when winds speeds were lowest. It also shows that elevated afternoon concentrations were not common. Figure 7-2 displays the hourly PM_{10} concentrations when gusts were at their lowest 5th percentile. The highest PM_{10} concentrations occurred during morning hours when wind gusts are lowest. A different picture emerges with the display of concentrations associated with the 95th percentile wind gusts presented in Figure 7-3. It shows that when wind gusts were near their highest levels the morning concentrations were the lowest and the afternoon concentrations were highest. When contrasted with the mean values presented in Figure 7-1 it becomes clear that elevated afternoon concentrations are not a common occurrence unless high winds are present. A more dramatic illustration of this relationship is presented in Figure 7-4. It displays PM_{10} concentrations when winds gusts were at the 99th percentile and shows the highest concentrations continue to occur in the afternoon hours when wind gusts were at their highest levels.

Figures 7-5 through 7-8 present a series of hourly concentration and wind gust comparisons for summer months. A similar relationship between wind gusts and PM_{10} concentrations appears. Overall the information presented in these figures demonstrated a clear causal relationship between elevated PM_{10} concentrations and elevated winds.

[13] Federal Register/ Vol. 72, No. 55, Thursday, March 22, 2007 / Rules and Regulations, Environmental Protection Agency, 40 CFR Parts 50 and 51, Treatment of Data Influenced by Exceptional Events, Final Rule

Figure 7-1. Comparison of Hourly Mean PM_{10} Concentrations & Mean Wind Gusts Spring Months at West 43rd Ave. Monitor

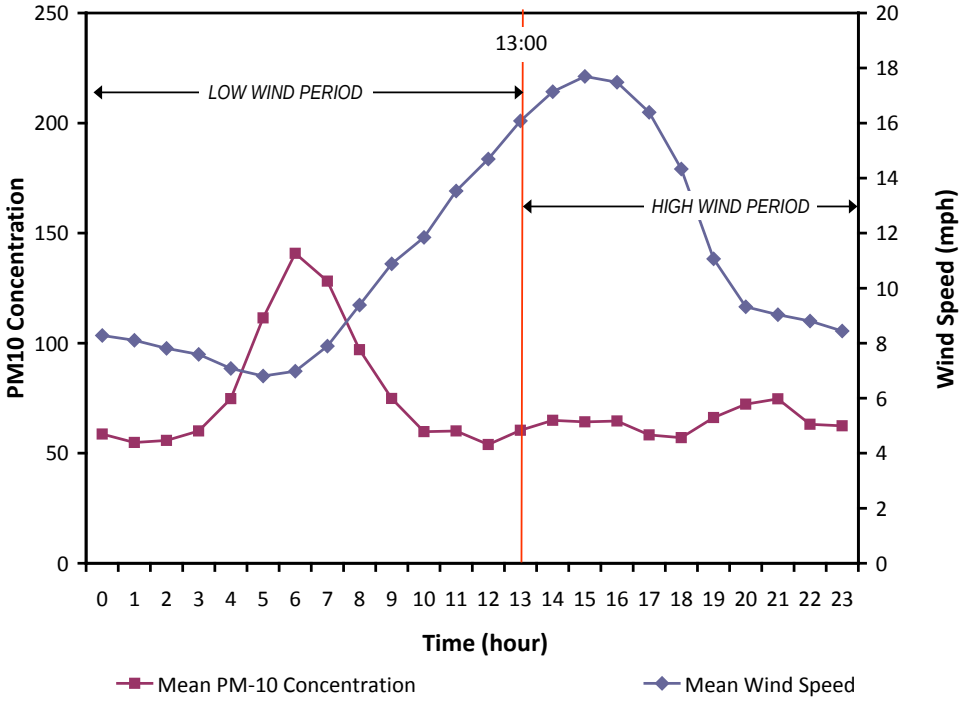


Figure 7-2. Hourly PM_{10} Concentrations at 5th Percentile Wind Gusts Spring Months at West 43rd Ave. Monitor

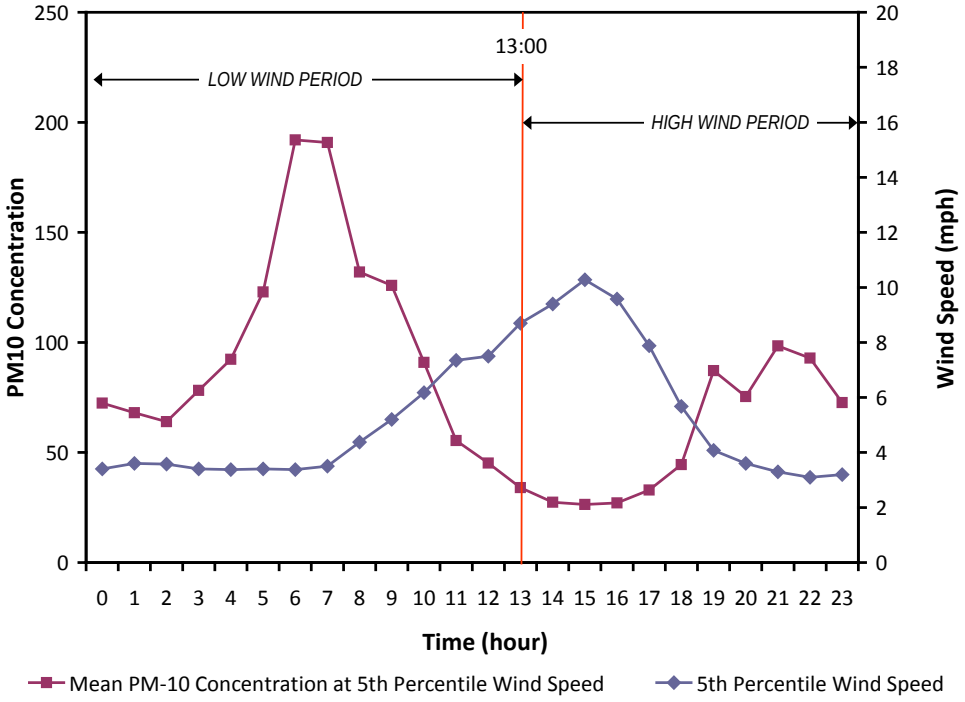


Figure 7-3. Hourly PM_{10} Concentrations at 95th Percentile Wind Gusts

Spring Months at West 43rd Ave. Monitor

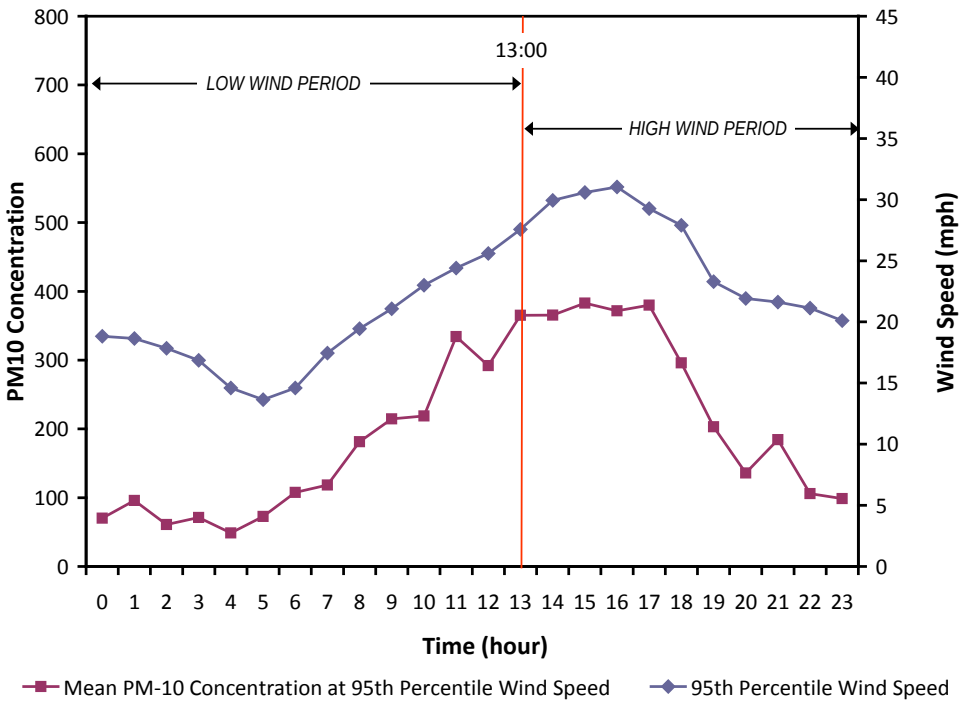


Figure 7-4. Hourly PM_{10} Concentrations at 99th Percentile Wind Gusts
Spring Months at West 43rd Ave. Monitor

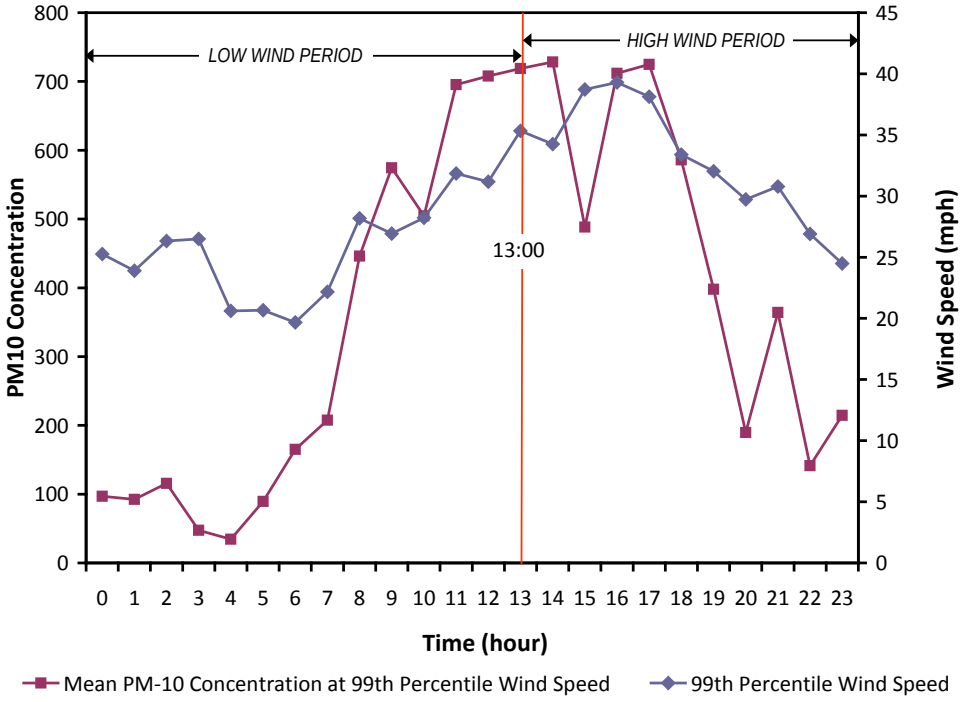


Figure 7-5. Comparison of Hourly Mean PM_{10} Concentrations & Mean Wind Gusts Summer Months at West 43rd Ave. Monitor

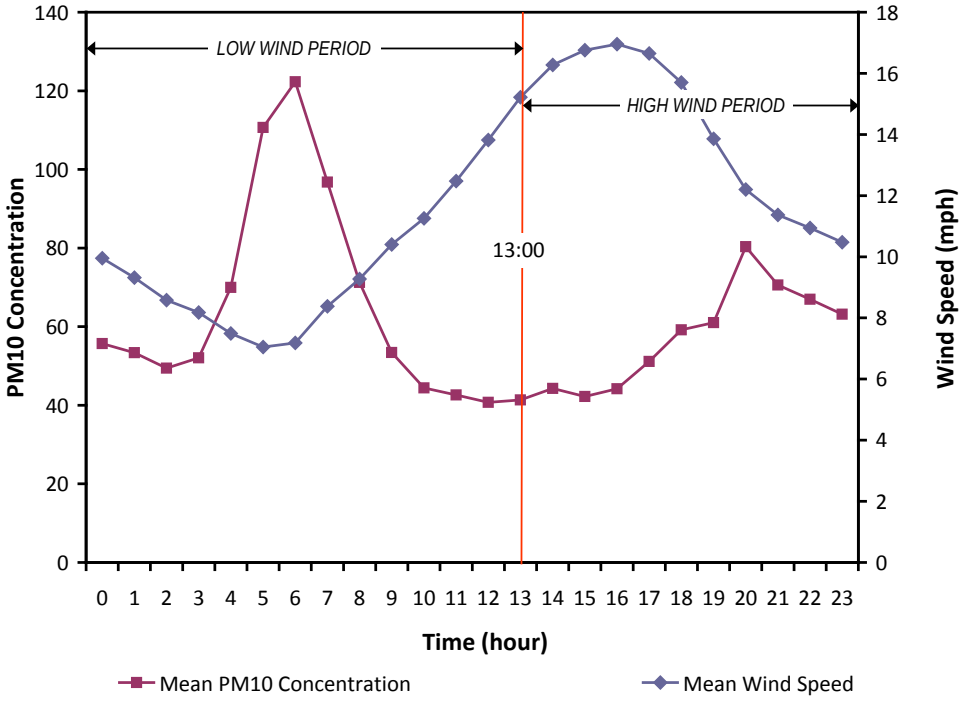


Figure 7-6. Hourly PM_{10} Concentrations at 5th Percentile Wind Gusts Summer Months at West 43rd Ave. Monitor

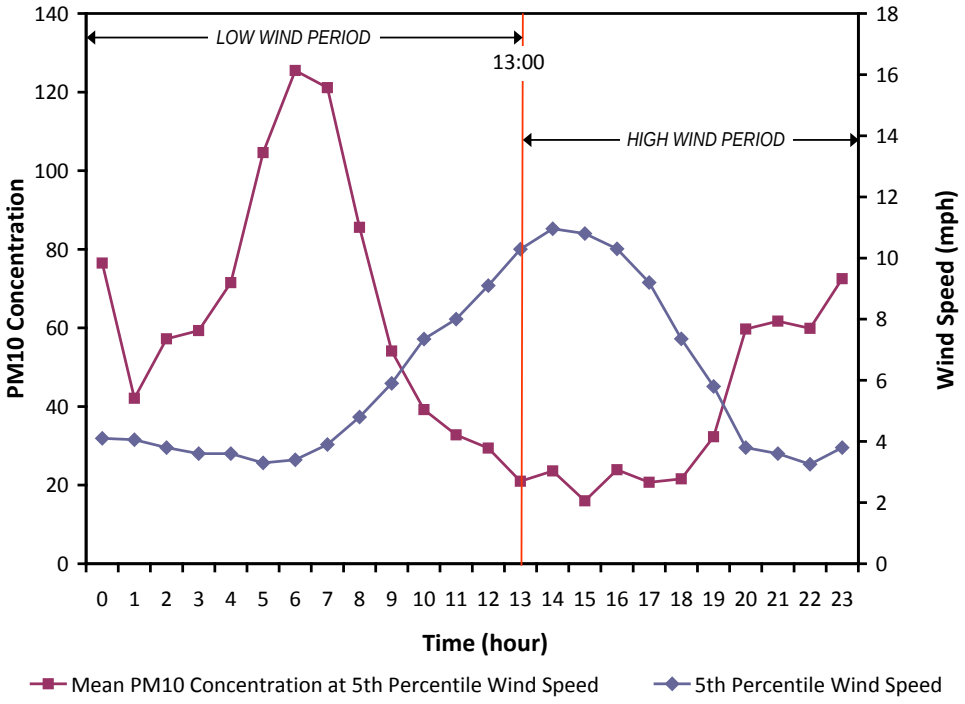


Figure 7-7. Hourly PM_{10} Concentrations at 95th Percentile Wind Gusts Summer Months at West 43rd Ave. Monitor

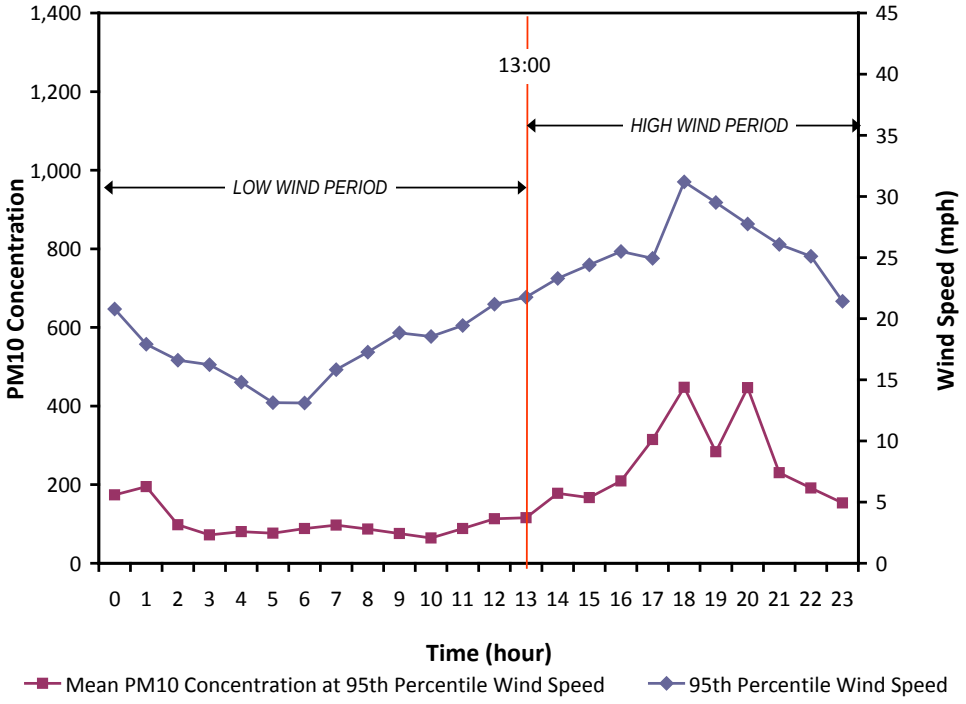
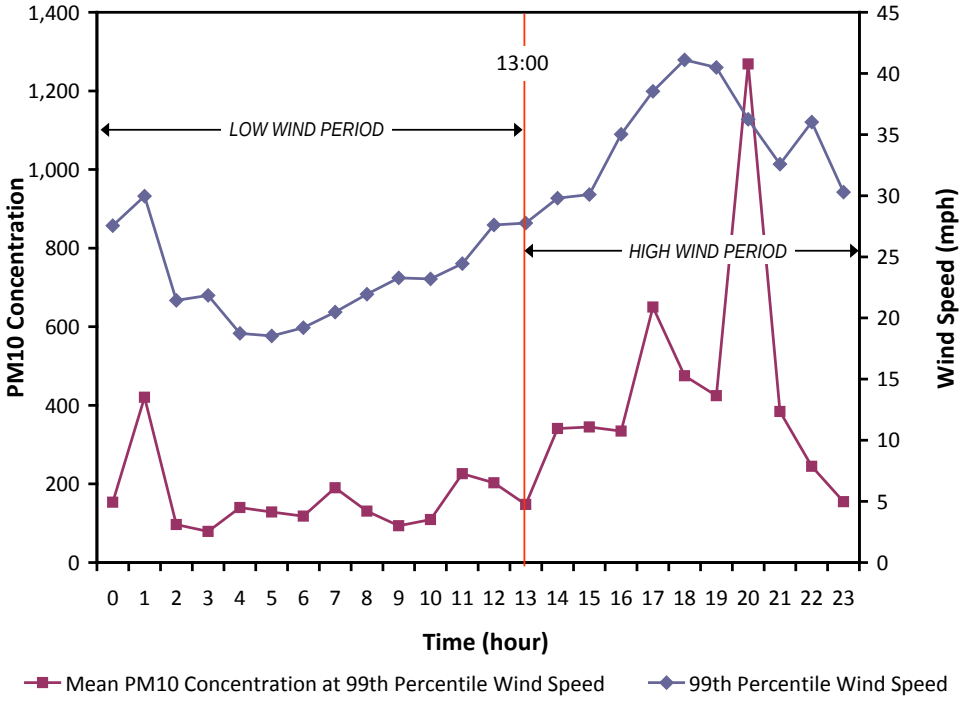


Figure 7-8. Hourly PM_{10} Concentrations at 99th Percentile Wind Gusts Summer Months at West 43rd Ave. Monitor



An examination of the hourly distribution of PM_{10} concentrations recorded on June 4, 2008, relative to the historical values recorded at the West 43rd Ave. monitor is presented in Figure 7-9 for spring and for summer months separately. The hourly values were contrasted with average, 95th, 99th and maximum values recorded during each season for the period 2005 – 2008. While the scale of concentrations is different for the two seasons, the pattern of exceptionally high afternoon concentrations, consistent with those of unusually high winds, is evident. Nine afternoon event hours exceed the 95th percentile spring concentration; two of those hours exceed the 99th percentile concentration. Similar findings were seen for the summer comparison: ten afternoon event hours exceed the 95th percentile concentration; two of those hours exceed the 99th percentile concentration. This information is entirely consistent with the clear causal relationship between elevated concentrations and elevated winds presented in Figures 7-1 – 7-8.

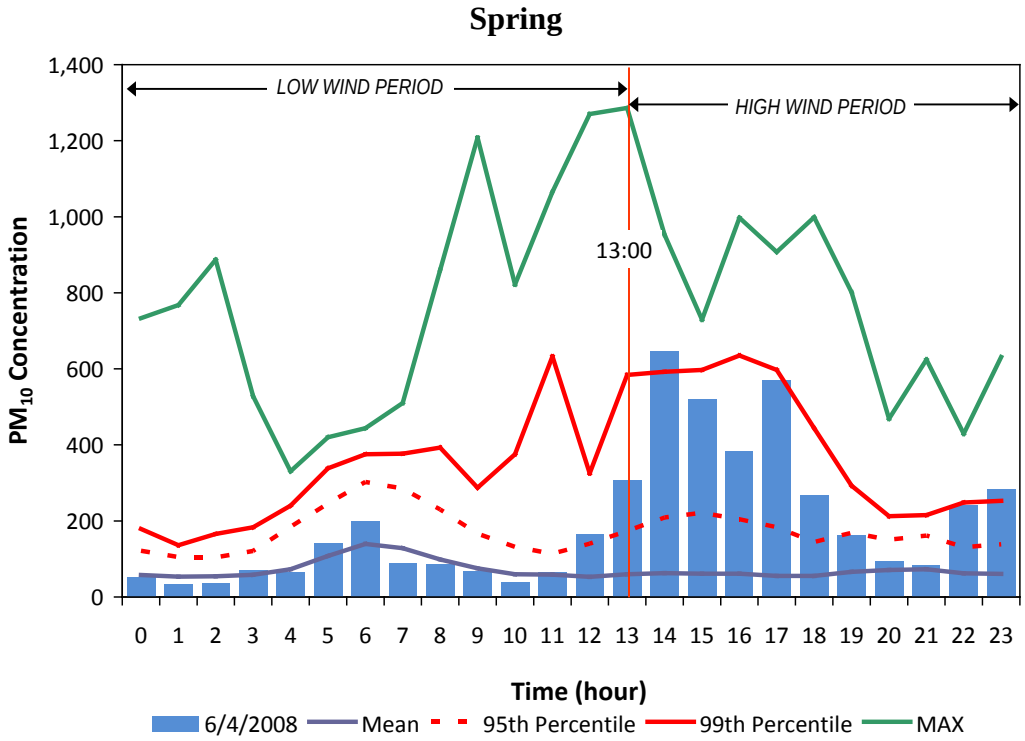
7.2 Visibility

Further evidence of the relationship between elevated winds and elevated concentrations is presented in Figure 7-10. It displays time-lapse photographs from the South Mountain Camera (zoomed view) located on North Mountain looking south. A map of the field of view is included in the figure and shows that it covers the area just east of the West 43rd Ave. monitoring site. Also included in the figure is a view of pristine conditions in the frame of South Mountain and Estrella Mountain. The peak in the far ground, visible in the photograph, is in the Estrella range. The south end of the Estrella range is 26.1 miles from the camera and is not visible on the map. South Mountain is at a range of 17 to 20 miles. The time sequence of photographs starting at noon shows progressively less visibility as the afternoon progressed, which is entirely consistent with the concentrations displayed in Figure 7-9 and the pattern of elevated afternoon winds displayed in Section 5.3. A more complete presentation of the time-lapse photography is presented in Appendix N.

7.3 Summary

The information presented in this section demonstrated that high afternoon concentrations do not typically occur unless unusually high winds are present. Data presented in Section 5.2 demonstrated that unusually high winds were recorded on the afternoon of June 4, 2008, at the West 43rd Ave. monitoring site relative to the historical record for spring and summer months. Information presented in Figure 7-9 shows that PM_{10} concentrations recorded on the afternoon of June 4, 2008, were unusually high relative to the historical record for both spring and summer months. Collectively, this information demonstrated a clear causal relationship between elevated winds and elevated concentrations recorded on the day of the event. Further evidence of this relationship is available from time-lapse photographs of the area adjacent to the monitor documenting diminished visibility as the afternoon progressed and winds and concentrations increased.

Figure 7-9. Relationship of PM_{10} Concentrations on June 4, 2008 to Historical Values Recorded During the Spring and Summer Months at West 43rd Ave. Monitor



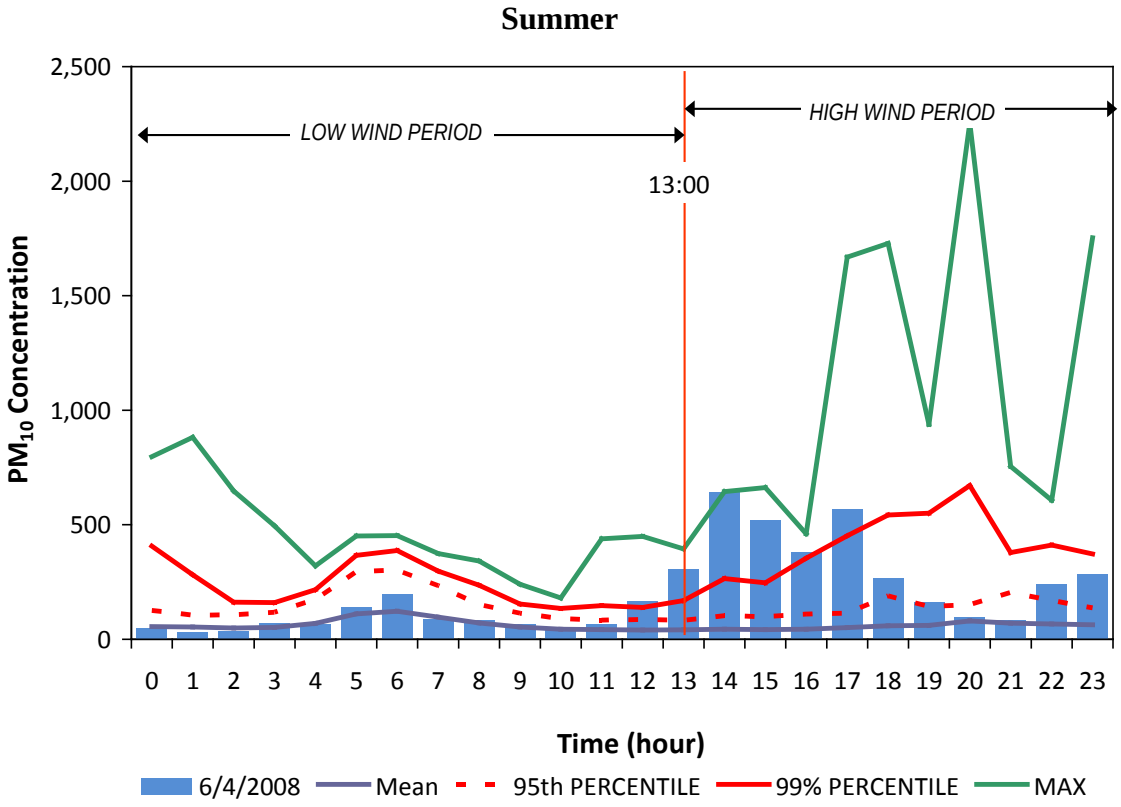
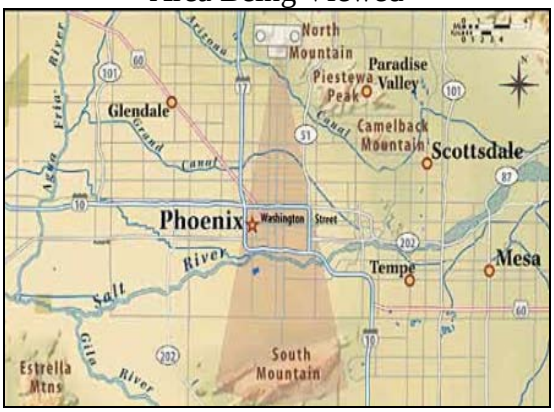


Figure 7-10. Photographs of June 4th Event Obscuring Visibility of South Mountain as Captured by North Mountain Camera

Pristine Conditions

Area Being Viewed



12:00 p.m.

1:15 p.m.

2:30 p.m.

3:45 p.m.

Section 8: Conclusions

High winds on June 4, 2008, caused severe dust storms and sand storms in the California and Arizona desert areas which significantly impact air quality in Yuma, and in the Phoenix area.

The following specific conclusions can be drawn from the analysis in this report:

- The 24-hour concentrations at the West 43rd Ave., Buckeye, Coyote Lakes and Yuma monitors exceeded "historical fluctuations" during spring and summer months.

- The average concentration during high wind hours at the West 43rd Ave. monitor exceeded "historical fluctuations" during spring and summer months.

- All reasonable controls were in place for anthropogenic sources impacting the West 43rd Ave. monitor during high wind hours.

- The winds were "unusual."

- No exceedance of the ambient PM_{10} standard would have occurred "but-for" the influence of concentrations recorded during the high wind hours.

- There is a "clear causal relationship" between high winds and increased concentrations at the West 43rd Ave. monitor.

- The exceedance of the NAAQS measured in Yuma was a direct result of dust-storms originating in California.

The regional high wind event that caused elevated PM_{10} events on June 4, 2008, in Yuma and Maricopa Counties caused the transport of dust and soils from winds that suspended natural soils and soils from areas where all control measures were in place, or were from source areas outside Arizona, and should be flagged for air quality planning purposes. The "high wind" (RJ) flag should be applied to the monitor readings.

ADEQ has demonstrated that the air quality readings addressed in this report were influenced by an exceptional event, and requests EPA's concurrence with ADEQ's findings in accordance with the Exceptional Events Rule. This report clearly delineated the requirements of the Rule in Section 1 of this report, and the report and Appendices, which supplement the assessment submitted on November 17, 2009, have satisfied those requirements.