IN THE UNITED STATES COURT OF APPEALS
FOR THE NINTH CIRCUIT

Case No. 14-72327

SANDRA L. BAHR and DAVID MATUSOW,

Petitioners,

v.

GINA McCARTHY, Administrator, United States Environmental Protection Agency, JARED BLUMENFELD, Regional Administrator, United States Environmental Protection Agency, and the U. S. ENVIRONMENTAL PROTECTION AGENCY,

Respondents.

On Petition for Review of Final Action of the
United States Environmental Protection Agency

RESPONDENTS' SUPPLEMENTAL EXCERPTS OF RECORD

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INDEX TO SUPPLEMENTAL EXCERPTS OF RECORD

State of Arizona Exceptional Event Documentation for the Event of June 27, 2012, for the Phoenix PM_{10} Nonattainment Area

Produced by:

Sierra Research, Inc.
Arizona Department of Environmental Quality
Maricopa County Air Quality Department
Maricopa Association of Governments

Final Report
February 13, 2013

EXECUTIVE SUMMARY

In 2005, Congress identified a need to account for events that result in exceedances of the National Ambient Air Quality Standards (NAAQS) that are exceptional in nature[1] (e.g., not expected to reoccur or caused by acts of nature beyond man-made controls). In response, EPA promulgated the Exceptional Events Rule (EER) to address exceptional events in 40 CFR Parts 50 and 51 on March 22, 2007 (72 FR 13560). On May 2, 2011, in an attempt to clarify this rule, EPA released draft guidance documents on the implementation of the EER to State, tribal and local air agencies for review. Based on numerous comments EPA received on the May 2011 draft, EPA issued a revised draft guidance document in June 2012. The EER allows for states and tribes to "flag" air quality monitoring data as an exceptional event and exclude those data from use in determinations with respect to exceedances or violations of the NAAQS, if EPA concurs with the demonstration submitted by the flagging agency.

Due to the arid nature of the state, Arizona is highly susceptible to windblown dust events. These events are often captured by various air quality monitoring equipment throughout the state, sometimes resulting in exceedances or violations of the PM10 NAAQS. In the past, the Arizona Department of Environmental Quality (ADEQ) has submitted exceptional event documentation for these events. Due in part to issues within the EER, obtaining concurrence on these events has been a difficult task. The ADEQ is now taking a new approach and focusing exceptional event documentation on events that are believed to be clear-cut exceptional events that are not controllable by human intervention, such as the dust events that frequently occurred during the monsoon seasons of 2011 and 2012. This new approach was used for the exceptional event demonstration submitted in March 2012 by ADEQ for several PM10 events that occurred from July 2 – July 8, 2011, in the Phoenix region. In September 2012, EPA concurred that the July 2–8, 2011 events were indeed exceptional. As a result, this document is designed to follow the format used in the July 2–8, 2011 events submission.

This demonstration contains detailed information about the windblown dust event that affected the Phoenix PM10 nonattainment area on June 27, 2012. On that day, 13 exceedances of the PM10 NAAQS occurred at 12 monitoring sites within the nonattainment area. Additional exceedances occurred outside of the Phoenix PM10 nonattainment area on this date, and additional documentation may be submitted as a separate package at a later time. ADEQ contends that the exceedances that were measured on June 27, 2012, within the Phoenix PM10 nonattainment area were the result of natural events that were not reasonably controllable or preventable. This assessment report of the June 27, 2012, dust event was a collaborative effort involving staff from Sierra Research, Inc., the Arizona Department of Environmental Quality, Maricopa Association of Governments, Maricopa County Air Quality Department, and Pinal County Air Quality Control District.

Section I of this assessment provides a summary of the exceptional event rules and requirements and lays out how those rules are met within this specific assessment.

Section II of this assessment introduces the conceptual model of the thunderstorms and the subsequent dust storm that transpired on June 27, 2012, providing general information on the local Phoenix climate, monsoons, and the formation of thunderstorm outflows, as well as a background narrative of the exceptional event.

[1] Section 319 of the Clean Air Act (CAA), as amended by section 6013 of the Safe Accountable Flexible Efficient-Transportation Equity Act: A Legacy for Users (SAFE-TEA-LU of 2005), required EPA to propose the Federal Exceptional Events Rule (EER) no later than March 1, 2006.

Section III of this assessment provides data summaries and time series graphs that help illustrate that the event of June 27, 2012, produced PM10 concentrations in excess of normal historical fluctuations.

Section IV of this assessment details the existing area control measures and demonstrates that despite the presence and enforcement of these controls, the event on June 27, 2012, was not reasonably controllable or preventable.

Section V of this assessment establishes a clear causal connection between the natural events of June 27, 2012, and the exceedances of the 24-hour PM10 standard at the monitoring stations. The evidence in this section (and the previous section on historical fluctuations) also confirms that the event in question both affected air quality and was the result of natural events.

Section VI of this assessment builds upon the demonstration showing a clear causal connection between the natural events and the exceedances and concludes there would have been no exceedances on June 27, 2012, but for the presence of the natural events.

Section VII contains conclusions that summarize the exceptional event that occurred on June 27, 2012, and relates the requirements in the EER to the information within this document.

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Sonoma Technology, Inc.
Air Quality Research and Innovative Solutions

State of Arizona Exceptional Event Documentation for the Event of August 11, 2012, for the Phoenix PM_{10} Nonattainment Area

Final Report prepared for

Arizona Department of Environmental Quality
Phoenix, AZ

February 2013

State of Arizona Exceptional Event Documentation for the Event of August 11, 2012, for the Phoenix PM_{10} Nonattainment Area

Final Report
STI-912096-5569-FR

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February 13, 2013

Acknowledgments

The authors would like to acknowledge the Arizona Department of Environmental Quality for helpful discussion and feedback during the preparation of this document.

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1. Introduction

On August 11, 2012, two air quality monitors in the Phoenix PM_{10} nonattainment area recorded 24-hr average PM_{10} concentrations in excess of the National Ambient Air Quality Standard (NAAQS) for PM_{10} of 150 µg/m^3. The purpose of this report is to demonstrate that these exceedances were due to naturally occurring windblown dust, were not reasonably controllable or preventable, were historically unusual, and would not have occurred “but for” the windblown dust and that they therefore constitute an Exceptional Event as defined by the U.S. Environmental Protection Agency’s (EPA) Exceptional Events Rule (EER).

1.1 Report Contents

Section 2 of this assessment contains a conceptual model of the windblown dust event that transpired on August 11, 2012, providing a background narrative of the exceptional event and an overall explanation showing that the event affected air quality. Section 2 also provides evidence that the event was a natural event.

Section 3 of this assessment establishes a clear causal connection between the natural event on August 11, 2012, and the exceedances of the 24-hr PM_{10} standard at the monitoring stations. The evidence in this section also confirms that the event in question affected air quality and was the result of natural events.

Section 4 of this assessment illustrates that the event of August 11, 2012, produced PM_{10} concentrations in excess of normal historical fluctuations.

Section 5 of this assessment details the existing dust control measures and demonstrates that despite the presence and enforcement of these controls, the event of August 11, 2012, was not reasonably controllable or preventable.

Section 6 of this assessment builds upon the demonstrations made in the previous sections, showing a clear causal connection between the natural event and the exceedances, and concludes that the exceedances of the 24-hr PM_{10} standard on August 11, 2012, would not have occurred “but for” the event.

Appendix A contains time-series graphs and data tables to supplement Section 3. **Appendix B** contains links to videos, images, and media reports to supplement Section 3. **Appendix C** contains time-series graphs to supplement Section 4. **Appendix D** contains air quality forecasts issued by the Arizona Department of Environmental Quality (ADEQ) and weather statements and warnings issued by the National Weather Service (NWS). **Appendix E** contains a copy of the affidavit of public notice concerning this assessment report.

1.2 Exceptional Event Rule Requirements

In addition to the technical requirements that are contained within the EER, procedural requirements must also be met in order for the EPA to concur with the flagged air quality monitoring data. This section of the report lists the requirements of the EER and associated guidance and discusses how ADEQ addressed those requirements.

1.2.1 Public Notification that the Event Was Occurring (40 CFR 50.14(c)(1)(i))

ADEQ issued Dust Control Action Forecasts for Maricopa County on August 11, 2012, advising citizens of the potential for high wind dust events due to outflow from distant thunderstorms. More information on ADEQ's forecasts can be found in Section 5.2 of this report. The forecast products that were issued for August 11, 2012, are included in Appendix D.

1.2.2 Place Informal Flag on Data in AQS (40 CFR 50.14(c)(2)(ii))

ADEQ and other operating air quality agencies in Arizona submit data into the EPA's Air Quality System (AQS), the official repository of ambient air quality data. This data submittal to AQS includes particulate matter (PM) data from both filter-based and continuous monitors operated in Arizona.

When ADEQ and/or another agency operating monitors in Arizona suspect that data may be influenced by an exceptional event, ADEQ and/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 submits the data into AQS. ADEQ and/or other operating agencies also submit data from continuous monitors into AQS after quality assurance is complete.

If ADEQ and/or other operating air quality agencies have determined that the potential exists for a monitor's reading(s) to have been influenced by an exceptional event, a preliminary flag is submitted for the measurement in AQS. The data are not official until they undergo more thorough quality assurance and quality control, leading to certification by May 1 of the year following the calendar year in which the data were collected (40 CFR 58.15(a)(2)). The presence of the flag on the August 11, 2012, data can be confirmed in AQS.

1.2.3 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 notice to EPA on August 29, 2012 listing all days from calendar year 2012 that ADEQ intends to analyze under the Exceptional Events Rule. The PM_{10} exceedances that occurred on August 11, 2012, in the Phoenix PM_{10} nonattainment area were included on this list. This assessment report serves as demonstration supporting the flagging of these data.

1.2.4 Document that the Public Comment Process Was Followed for Event Documentation (40 CFR 50.14(c)(3)(iv))

ADEQ posted this assessment report on the ADEQ webpage and placed a hard copy of the report in the ADEQ Records Management Center for public review. ADEQ opened a 30-day public comment period on January 14, 2013. A copy of the public notice certification, along with any comments received, will be submitted to the EPA, consistent with the requirements of 40 CFR 50.14(c)(3)(iv). See Appendix E for a copy of the affidavit of public notice.

1.2.5 Submit Demonstration Supporting Exceptional Event Flag (40 CFR 50.14(a)(1-2))

At the close of the public comment period, and after ADEQ has had the opportunity to consider any comments submitted on this document, ADEQ will submit this document, the comments received, and ADEQ's responses to those comments to EPA Region 9 headquarters in San Francisco, California. The deadline for the submittal of this package is September 30, 2015.

1.2.6 Documentation Requirements (40 CFR 50.14(c)(3)(iii))

The EER states that in order to justify the exclusion of air quality monitoring data, evidence must be provided for the following elements:

1. The event satisfies the criteria set forth in 40 CFR 50.1(j) that
    a. the event affected air quality,
    b. the event was not reasonably controllable or preventable, and
    c. the event was caused by human activity unlikely to recur in a particular location or was a natural event;
2. There is a clear causal relationship between the measurement(s) under consideration and the event;
3. The event is associated with a measured concentration(s) in excess of normal historical fluctuations; and
4. There would have been no exceedance or violation but for the event.

2. Conceptual Model

This section provides a narrative background and summarizes the meteorological and air quality conditions in place on August 11, 2012, in the Phoenix area. Elements described in this section include

- A description and map of the geographic setting of the air quality and meteorological monitors.
- A description of Phoenix's climate.
- An overall description of meteorological and air quality conditions on the event day.

2.1 Geographic Setting and Monitor Locations

Phoenix is located in the Salt River Valley in south-central Arizona. It lies at an elevation of 1,090 feet above mean sea level (msl) in the northeastern part 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 above msl) to the northeast, the foothills of the Bradshaw (~7,900 ft above msl) and Mazataal (~7,900 ft above msl) ranges to the north, the White Tank Mountains (~4,500 ft above msl) to the west, the Sierra Estrella (~4,450 ft above msl) to the southwest, and the Superstition Mountains (~5,000 ft above msl) far to the east. Within the City are the Phoenix Mountains (~2,600 ft above msl) and South Mountain (~2,600 ft above msl). Current development is pushing north, west, and south into Pinal County.

A fairly dense network of air quality and meteorological monitors exists throughout the Phoenix area, with a much less dense network of monitors throughout the rest of Arizona. **Figure 2-1** shows the general geographic setting of Phoenix, as well as the locations of PM_{10} monitors that recorded exceedances on August 11, 2012. The monitors in the figure include AQS monitors, which measure air quality and meteorological data, and NWS monitors, which measure meteorological data only. Some of the AQS monitors in the Phoenix area are run by the Maricopa County Air Quality Department (MCAQD), while others are run by ADEQ. The PM_{10} exceedances on August 11, 2012, were recorded at the Higley and West Chandler monitors. The primary NWS sites used in this demonstration package were the Phoenix Sky Harbor International Airport (KPHX) and the Chandler Municipal Airport (KCHD) sites because of those sites' high data quality, data completeness, proximity to the air quality monitors with high PM_{10} concentrations, and representativeness of meteorological conditions in the Phoenix area. **Figure 2-2** shows the locations of PM_{10} monitors statewide on August 11, 2012.

Figure 2-3 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 soil is deposited in the low-lying areas of central and southern Arizona, with larger depositional areas focused in and around the confluences of dry river channels.

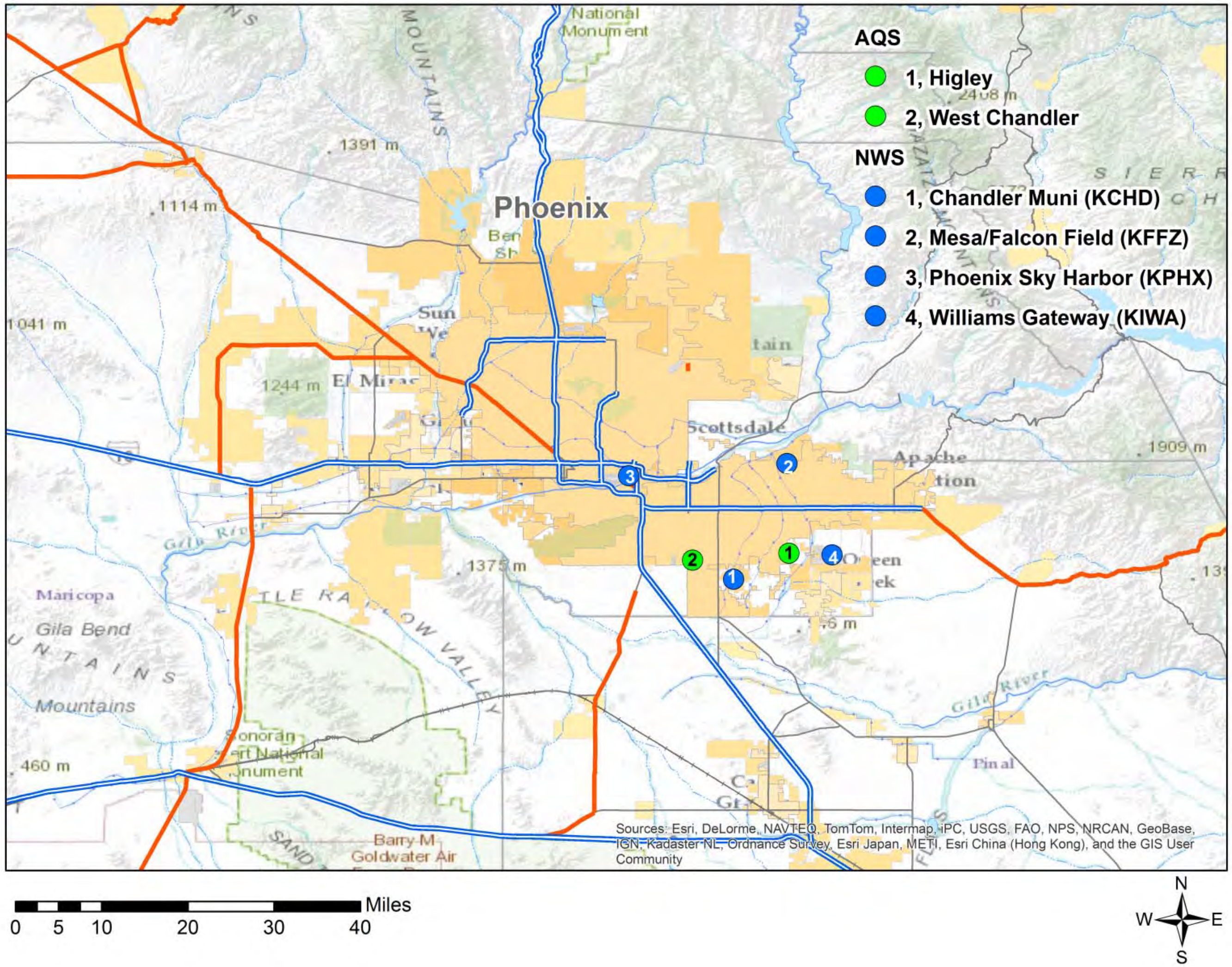


Figure 2-1. Locations of air quality monitors that recorded exceedances of the 24-hr PM_{10} NAAQS and NWS monitors primarily used in this report.

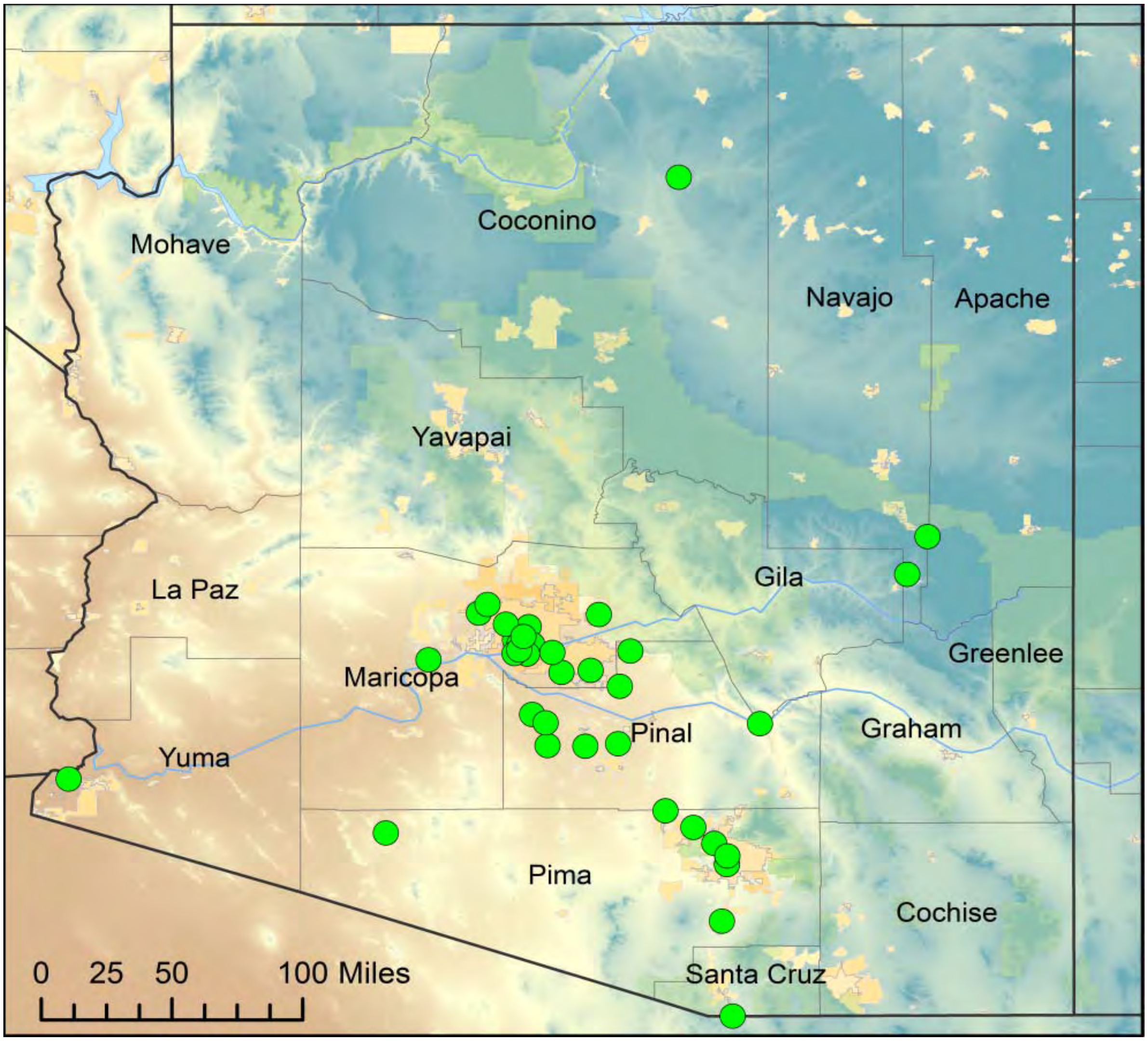


Figure 2-2. Location of sites monitoring PM_{10} in Arizona on August 11, 2012.

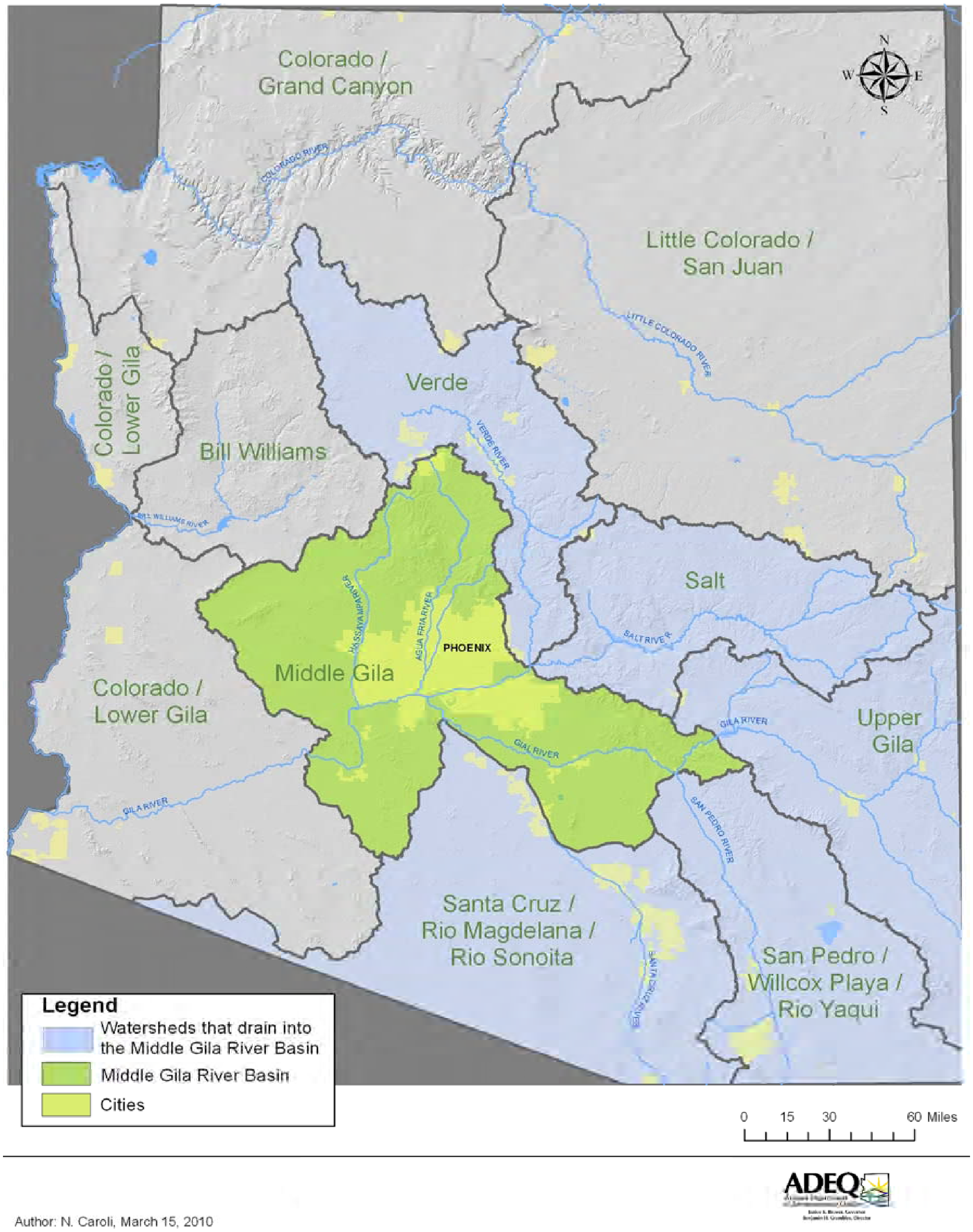


Figure 2-3. Drainage system of Phoenix, Arizona.

2.2 Climate

Phoenix has an arid climate, with very hot summers and temperate winters. The average summer high temperatures are among the hottest of any populated area in the United

States (**Figure 2-4**). Temperatures reach or exceed 100°F an average of 110 days annually, and reach or exceed 110°F an average of 18 days annually. Phoenix receives an average of 7.66 inches of rain per year. The bulk of this rain usually falls during the December through March and July through August time periods. During the December through March period, winter storms originating from the Pacific Ocean can produce significant rains in southwestern Arizona. During the mid- to late-summer time period, monsoonal moisture originating from the Gulf of California, Gulf of Mexico, and large thunderstorm complexes over the Sierra Madre Occidental Mountains in Mexico move northward into Arizona.

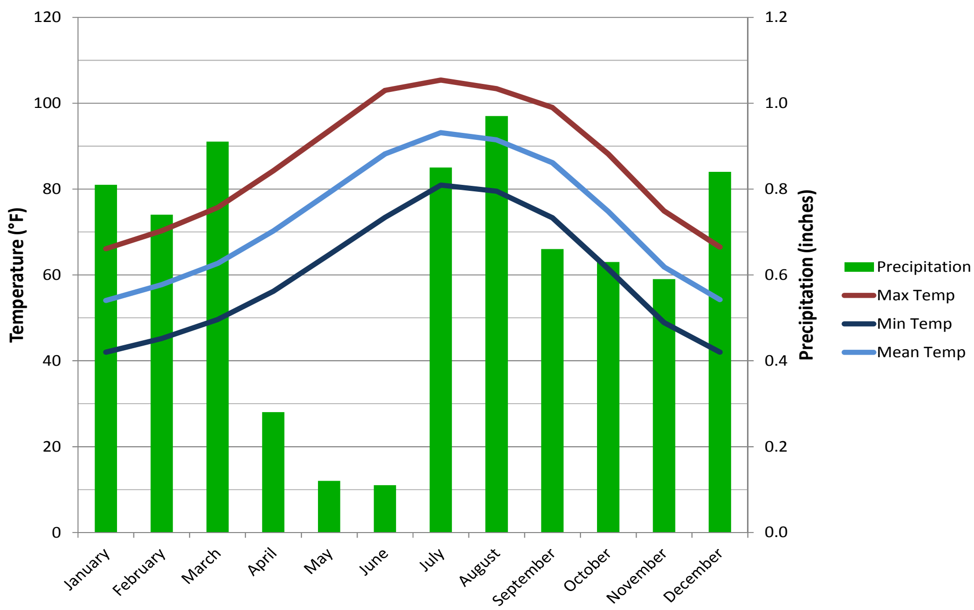
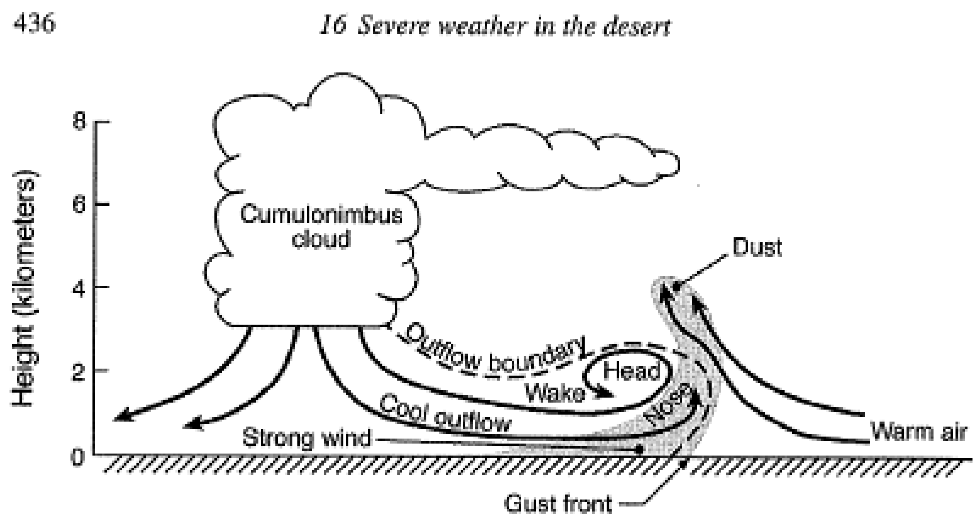


Figure 2-4. Average monthly temperatures and precipitation for Phoenix, 1981-2010.

The influx of moisture associated with the monsoon, combined with strong solar heating, can result in unstable atmospheric conditions that are favorable for the development of thunderstorms. Heavy precipitation associated with thunderstorms, and the eventual collapse or dissipation of thunderstorms, can generate what are known as downbursts. Downbursts are the rapid descent of rain-cooled air in a thunderstorm. Upon reaching the surface, this air rapidly disperses horizontally away from the storm as the outflow boundary (also called gust fronts), as shown in **Figure 2-5**. The high winds associated with outflow boundaries can efficiently loft dust into the air and transport the dust over long distances, resulting in dust storms (also called haboobs) with high PM_{10} concentrations and low visibilities.



Cross-section schematic of a haboob caused by the cool outflow from a thunderstorm, with the leading edge that is propagating ahead of the storm called an outflow boundary. The strong, gusty winds that prevail at the boundary are defined as a gust front. The leading edge of the cool air is called the nose, and the upward-protruding part of the features is referred to as the head. Behind the roll in the windfield at the leading edge is a turbulent wake. The rapidly moving cool air and the gustiness at the gust front raise dust (shaded) high into the atmosphere.

Figure 2-5. Cross-section of a thunderstorm creating an outflow boundary and haboob[1].

Dust storms associated with these thunderstorms typically occur in the early part of the monsoon season (July) before subsequent rains moisten the soil and limit potential lofting of soil into the air. However, depending on the amount and frequency of precipitation received during the monsoon season, the extremely hot temperatures can dry the surface soils very quickly; thus, dust storms can occur at any time during the year. Specific PM_{10} source regions are difficult to determine during thunderstorm-driven dust storms because the thunderstorm outflow can carry dust over long distances that encompass many possible sources of dust. Instead, we consider general PM_{10} source regions, which are typically identified based on the locations of the thunderstorms that are believed to have generated the dust-laden outflow winds.

2.3 Event Day Summary

On the afternoon of August 11, 2012, thunderstorms developed over Pima and Pinal counties. These storms moved north and weakened, but generated an outflow boundary with gusty winds that transported dust northward into the Phoenix area (**Figure 2-6**). The windblown dust resulted in 24-hr average PM_{10} concentrations in exceedance of the NAAQS at the two southernmost air quality monitors in the Phoenix PM_{10} nonattainment area (**Table 2-1**). The PM_{10} concentrations measured at these monitors were in excess of normal historical fluctuations. The dust was naturally occurring and likely originated over undeveloped lands south of Maricopa County, and wind gusts in excess of 30 mph overwhelmed reasonable dust

[1] Image source: Warner T.T. (2004) *Desert meteorology*, Cambridge University Press, ISBN-10: 0521817986, ISBN-13: 978-0521817981, February 9.

control measures. While only two monitors in Maricopa County recorded PM_{10} concentrations in exceedance of the NAAQS, several monitors across Maricopa and Pinal counties recorded elevated PM_{10} concentrations during this dust storm.

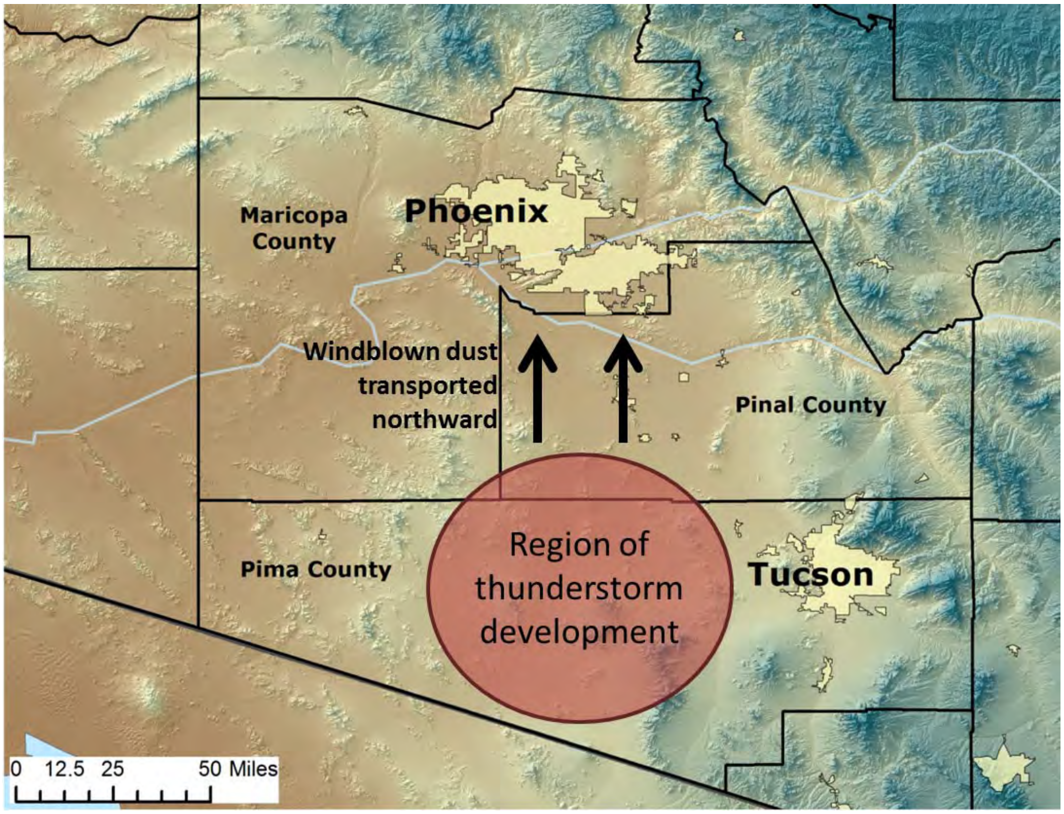


Figure 2-6. Thunderstorms over Pima and Pinal counties produced an outflow boundary that transported dust northward to the Phoenix area on August 11, 2012.

Table 2-1. Arizona PM_{10} measurements on August 11, 2012. The exceedance monitors discussed in this report are shown in bold.

Page 1 of 3

Monitor	Monitor Type	Operator	AQS Monitor ID	24-hr Avg PM_{10} (µg/m^3)	1-hr Max PM_{10} (µg/m^3)	Time of Max 1-hr PM_{10} (LST)	AQS Qualifier Flag
Apache County							
N/A	TEOM	WMAT	04-001-1003-81102-1	17	24	600	
Coconino County							
N/A	N/A	ADEQ	04-005-1237-81102-1	N/A	N/A	N/A	
Gila County							
Hayden Old Jail	TEOM	ADEQ	04-007-1001-81102-3	46	129	2300	

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Table 2-1. Arizona PM_{10} measurements on August 11, 2012. The exceedance monitors discussed in this report are shown in bold.

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Monitor	Monitor Type	Operator	AQS Monitor ID	24-hr Avg PM_{10} ($\mu g/m^3$)	1-hr Max PM_{10} ($\mu g/m^3$)	Time of Max 1-hr PM_{10} (LST)	AQS Qualifier Flag
Maricopa County							
West Phoenix	BAM	MC	04-013-0019-81102-1	102	1026	1800	
North Phoenix	BAM	MC	04-013-1004-81102-1	127	1479	1800	
Glendale	TEOM	MC	04-013-2001-81102-1	76	309	1800	
Central Phoenix	TEOM	MC	04-013-3002-81102-4	120	1224	1800	
Greenwood	TEOM	MC	04-013-3010-81102-1	101	939	1800	
South Phoenix	TEOM	MC	04-013-4003-81102-1	132	891	1700	
West Chandler	**TEOM**	**MC**	**04-013-4004-81102-1**	**219**	**3351**	**1700**	**RJ**
Tempe	TEOM	MC	04-013-4005-81102-1	146	1588	1700	
Higley	**TEOM**	**MC**	**04-013-4006-81102-1**	**159**	**1534**	**1700**	**RJ**
West 43rd Ave	TEOM	MC	04-013-4009-81102-1	93	518	1800	
Dysart	TEOM	MC	04-013-4010-81102-1	85	232	700	
Buckeye	TEOM	MC	04-013-4011-81102-1	77	286	300	
Zuni Hills	TEOM	MC	04-013-4016-81102-1	84	193	700	
Fort McDowell/Yuma Frank	TEOM	FMIR	04-013-5100-81102-3	125	N/A	N/A	
Durango Complex	TEOM	MC	04-013-9812-81102-1	113	933	1800	
JLG Supersite	BAM	ADEQ	04-013-9997-81102-3	95	902	1800	
JLG Supersite	TEOM	ADEQ	04-013-9997-81102-4	N/A	N/A	N/A	
Navajo County							
N/A	TEOM	WMAT	04-017-1002-81102-1	12	68	1900	
Pima County							
Ajo	TEOM	ADEQ	04-019-0001-81102-3	N/A	N/A	N/A	
Rillito	TEOM	ADEQ	04-019-0020-81102-3	32	53	0000	
Orange Grove	FRM	PCDEQ	04-019-0011-81102-2	22	N/A	N/A	
South Tucson	FRM	PCDEQ	04-019-1001-81102-1	24	N/A	N/A	
Green Valley	TEOM	PCDEQ	04-019-1030-81102-1	15	26	1900	
Geronimo	TEOM	PCDEQ	04-019-1113-81102-1	20	36	1800	
Pinal County							
Apache Junction Fire Station	FRM	PCAQCD	04-021-3002-81102-3	54	540	1800	
Casa Grande Downtown	TEOM	PCAQCD	04-021-0001-81102-3	128	2118	1600	
Stanfield	TEOM	PCAQCD	04-021-3008-81102-3	169	2915	1600	RJ
Combs School	TEOM	PCAQCD	04-021-3009-81102-3	61	536	1700	
Maricopa	TEOM	PCAQCD	04-021-3010-81102-3	86	1075	1700	

Table 2-1. Arizona PM_{10} measurements on August 11, 2012. The exceedance monitors discussed in this report are shown in bold.

Page 2 of 3

Monitor	Monitor Type	Operator	AQS Monitor ID	24-hr Avg PM_{10} ($\mu g/m^3$)	1-hr Max PM_{10} ($\mu g/m^3$)	Time of Max 1-hr PM_{10} (LST)	AQS Qualifier Flag
Pinal County Housing	TEOM	PCAQCD	04-021-3011-81102-3	80	626	1600	
Cowtown	TEOM	PCAQCD	04-021-3013-81102-3	199	2561	1600	RJ
Santa Cruz County							
Nogales Post Office	BAM	ADEQ	04-023-0004-81102-3	33	129	2300	
Yuma County							
Yuma Supersite	TEOM	ADEQ	04-027-8011-81102-3	41	118	0600	

TEOM: Tapered Element Oscillating Microbalance monitor
BAM: Beta Attenuation Monitor
FRM: Federal Reference Method
WMAT: White Mountain Apache Tribe of Fort Apache Reservation, AZ
MC: Maricopa County Air Quality Department
FMIR: Fort McDowell Indian Reservation
PCDEQ: Pima County Department of Environmental Quality
PCAQCD: Pinal County Air Quality Control District
RJ: qualifier flag for high winds

3. Causal Relationship

3.1 Discussion

Meteorological and air quality observations indicate that dust carried by thunderstorm outflow was directly responsible for the high PM_{10} concentrations observed in the Phoenix area on August 11, 2012. On the afternoon of August 11, thunderstorms developed over Pima and Pinal counties, south of the Phoenix area (**Figure 3-1**). These thunderstorms generated a dust-carrying outflow boundary that propagated northward into the Phoenix area. The outflow boundary most strongly affected the southeast side of the Phoenix PM_{10} nonattainment area. As stated in Section 2.2, thunderstorms associated with the summer monsoon season can generate strong winds and blow dust across Arizona. The likely source region for PM_{10} during the August 11, 2012, event was the deserts south of Maricopa County. This region largely consists of natural, undisturbed desert. In addition, the weeks leading up to the event were dry in the Phoenix area, with the last measureable rainfall at KPHX occurring on July 28 and 29. This combination of geography and lack of rainfall preceding the event resulted in a large fetch of soils that were particularly vulnerable to particulate suspension.

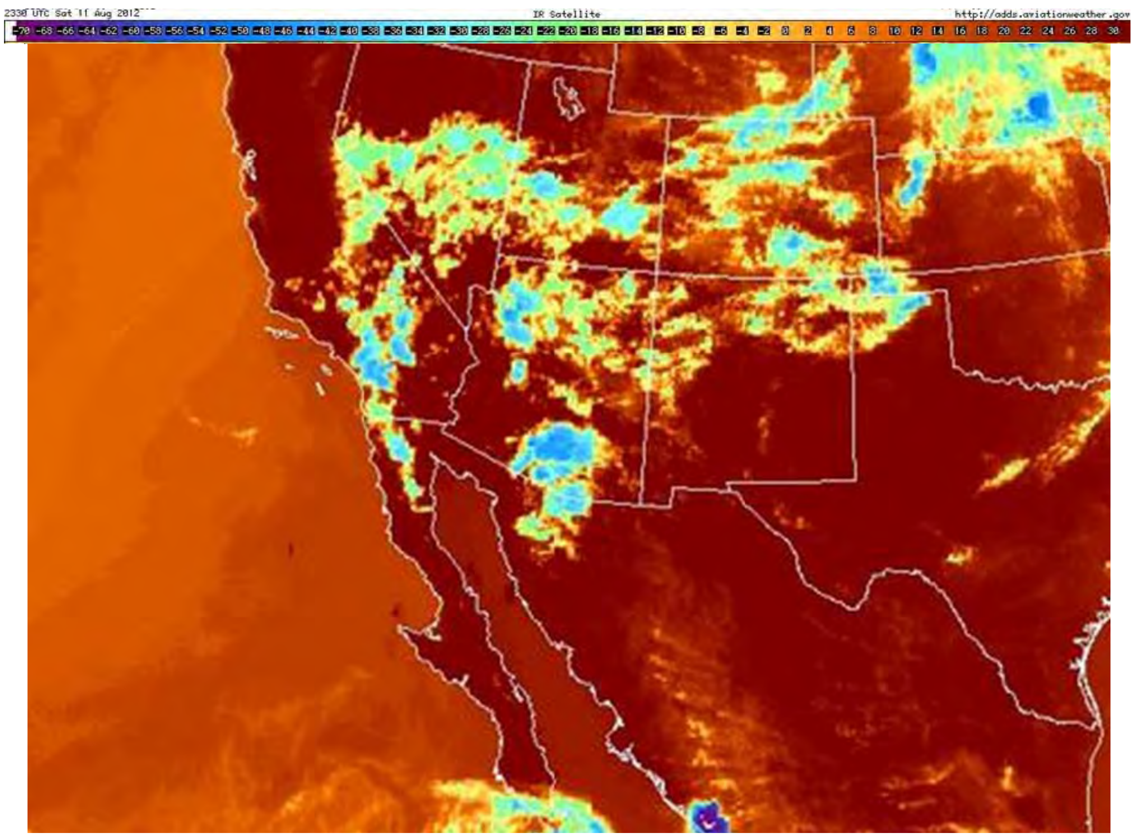

Figure 3-1. Infrared satellite image from 1630 LST on August 11, 2012 (GOES-West). Colder temperatures (blues, purples, and white) indicate tall, convective (thunderstorm) clouds. Thunderstorms over south-central Arizona generated an outflow boundary that carried dust northward into Arizona.

The first effects of the thunderstorm outflow and associated windblown dust were evident at Pinal County monitors during the 1600 LST hour on August 11, 2012, with sharp increases in PM_{10} at several monitors (**Figure 3-2**). The dust-laden outflow continued northward and arrived in the Phoenix area with significant reductions in visibility at KCHD about one hour later (**Figure 3-3**). PM_{10} concentrations at the West Chandler (**Figure 3-4**) and Higley (**Figure 3-5**) monitors increased sharply over this time period, with 1-hr PM_{10} concentrations exceeding 3,000 µg/m^3 at the West Chandler and 1,500 µg/m^3 at Higley. Collocated wind observations showed wind gusts in excess of 30 mph coincident with the high PM_{10} concentrations. Several other wind monitors in the Phoenix area reported strong winds at the same time as the high PM_{10} concentrations, including sustained winds of 32 mph and a wind gust of 41 mph at KCHD (Appendix A). Visibility cameras in the Phoenix area also clearly showed a significant reduction in visibility and blowing dust as the outflow arrived around 1700 LST on August 11, 2012 (**Figure 3-6**). Links to these videos and other media coverage and images pertaining to this windblown dust event are shown in Appendix B. It is also important to note that before the abrupt increase in PM_{10} in the Phoenix area, winds were lighter and PM_{10} concentrations were much lower, illustrating a correlation between the high winds and the dust. In response to the approaching thunderstorm outflow and associated dust and low visibilities, the NWS office in Phoenix issued a Dust Storm Warning (Appendix D). Local storm spotters also reported visibilities below one quarter mile, coincident with the high PM_{10} concentrations.

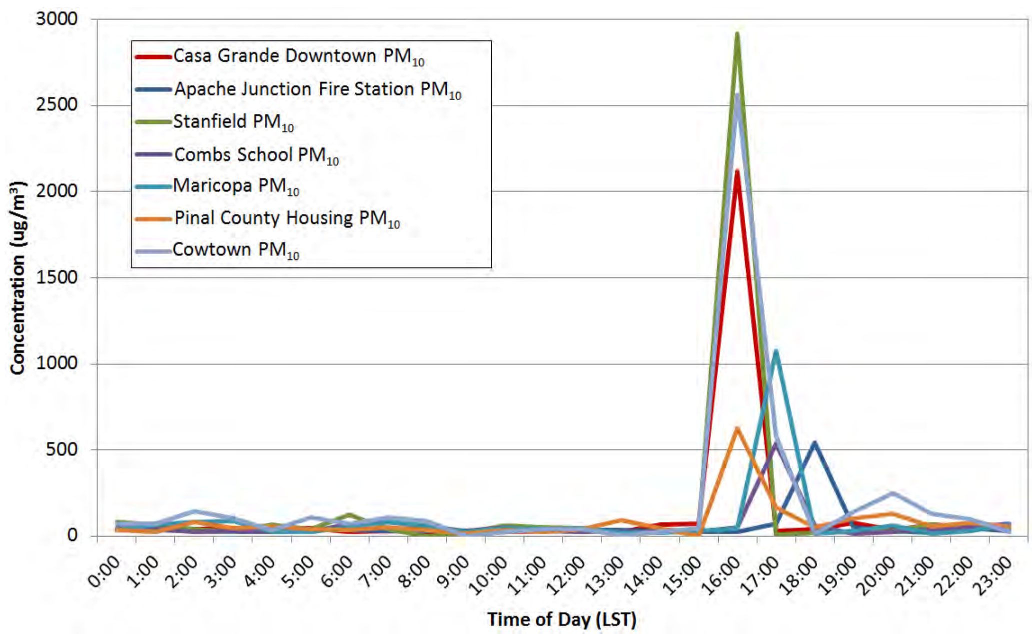

Figure 3-2. Hourly PM_{10} concentrations at Pinal County monitors on August 11, 2012. PM_{10} concentrations sharply increased between 1600 and 1800 LST coinciding with the arrival of windblown dust.

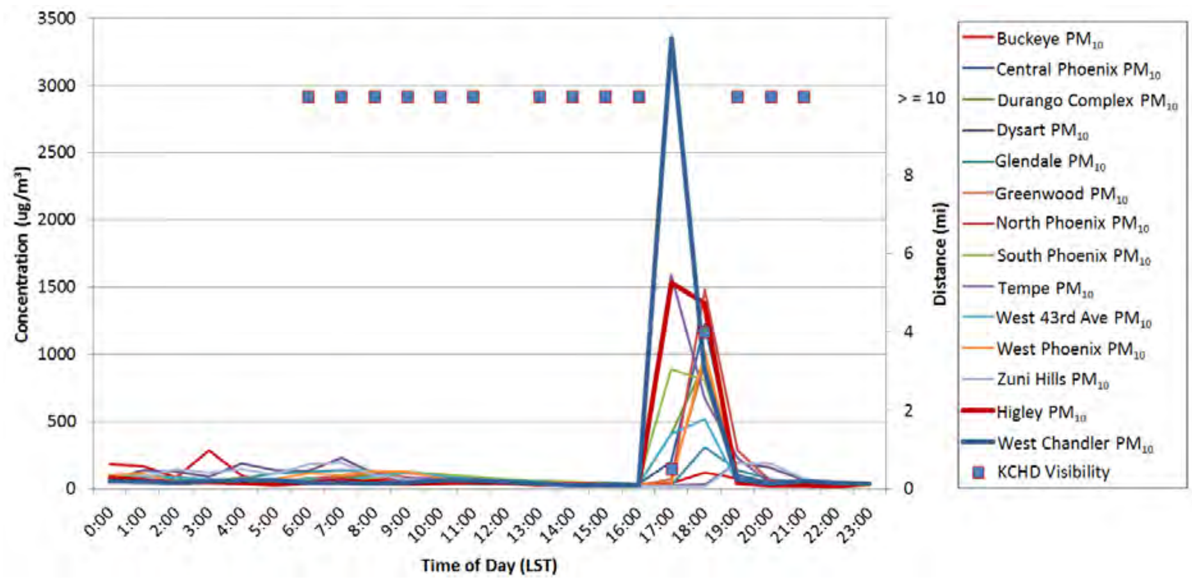

Figure 3-3. Hourly PM_{10} concentrations at Maricopa County monitors and visibility at KCHD on August 11, 2012. Monitors that measured PM_{10} exceedances on August 11, 2012 are highlighted by a thicker line. Visibility was greatly reduced between 1700 and 1900 LST coinciding with the sharp increase in PM_{10} concentrations at Phoenix area monitors, indicating the arrival of windblown dust.

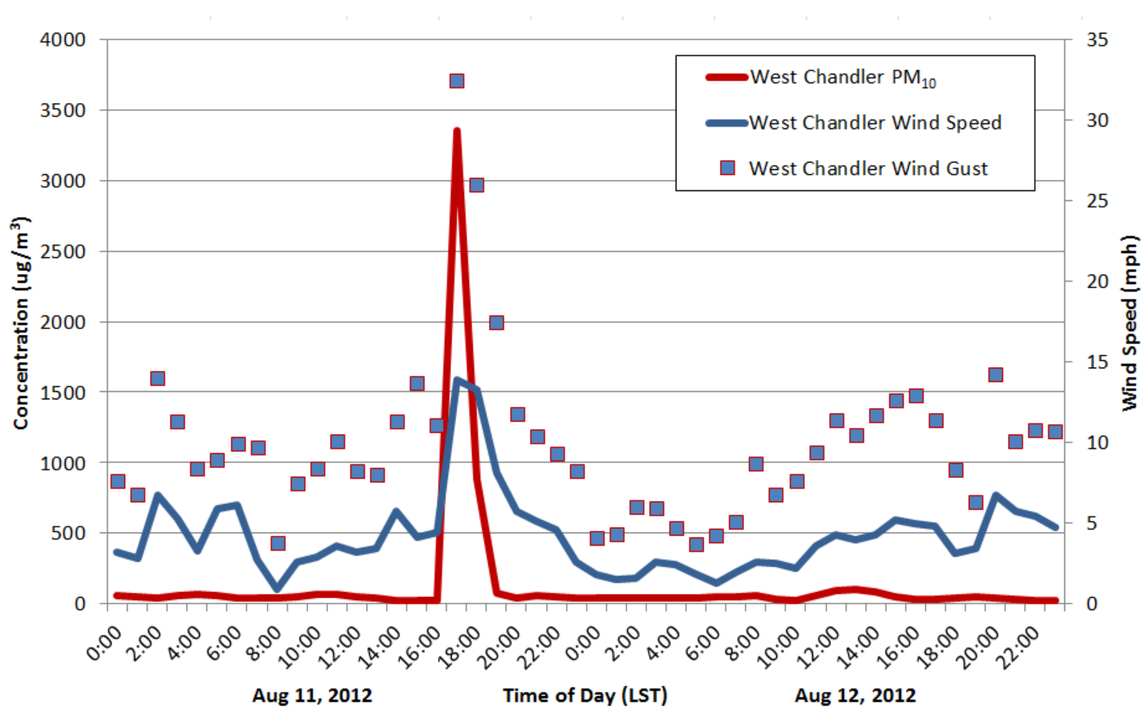

Figure 3-4. Hourly PM_{10} concentrations and wind speeds at the West Chandler monitor on August 11 and 12, 2012. PM_{10} concentrations and wind speeds sharply increased at 1700 LST on August 11, 2012, indicating the arrival of windblown dust.

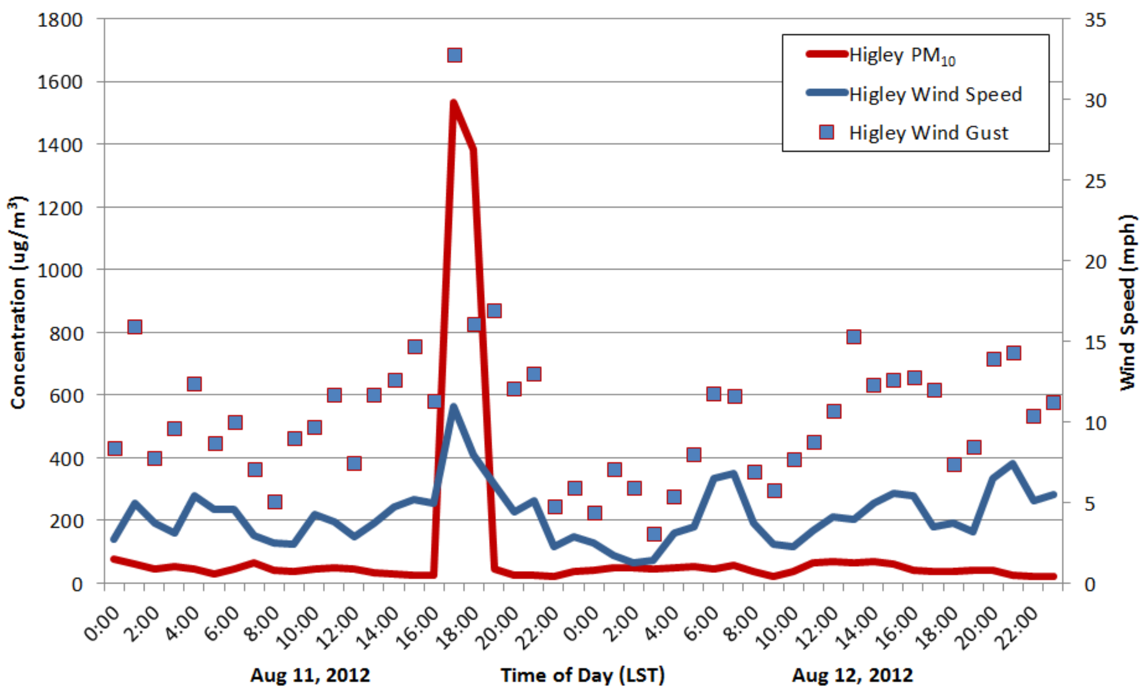

Figure 3-5. Hourly PM_{10} concentrations and wind speeds at the Higley monitor on August 11 and 12, 2012. PM_{10} concentrations and wind speeds sharply increased at 1700 LST on August 11, 2012, indicating the arrival of windblown dust.

Figure 3-6. Image from an ADEQ visibility camera on North Mountain facing south toward downtown Phoenix and the South Mountains. Windblown dust associated with thunderstorm outflow caused reduced visibilities in the Phoenix area, obscuring the downtown skyline and South mountains.

The progression of the thunderstorm outflow and windblown dust through the Phoenix area is summarized by the radar velocity and wind vector spatial plots below (**Figures 3-7 through 3-10**).

1630-1700 LST (Figure 3-7)

Between 1630 and 1700 LST, the outflow boundary was located over western Pinal County, south of the Phoenix area. South of the outflow boundary, PM_{10} concentrations exceeded 1500 µg/m^3 at some Pinal County monitors with wind gusts over 30 mph. In addition, visibility was reduced to 2 miles at Casa Grande in Pinal County near the outflow boundary with wind gusts in the area were over 30 mph. Monitors throughout Maricopa County, which were yet unaffected by the thunderstorm outflow, reported higher visibilities, lighter winds, and lower PM_{10} concentrations compared to monitors in western Pinal County.

1730-1800 LST (Figure 3-8)

Doppler radar clearly showed the outflow boundary advancing northward into Maricopa County during the 1700 hour. By 1730 LST, the boundary had moved through and north of the West Chandler and Higley monitors, where PM_{10} concentrations exceeded 1,500 µg/m^3 and gusty south to southwesterly winds were reported. Nearby airports also reported significant reductions in visibility, including 0.75 miles at KCHD. PM_{10} concentrations also increased at monitors in central and eastern portions of Phoenix as the outflow boundary moved through. However, concentrations were highest at the West Chandler and Higley monitors due to their closer proximity to the source of the outflow boundary and associated dust (outside the Phoenix PM_{10} nonattainment area). Thus, these monitors were subject to greater quantities of transported PM_{10} compared to other monitors in Maricopa County. As the outflow and associated dust moved away from Pinal County monitors, PM_{10} concentrations and wind speeds decreased and visibilities improved.

1830-1900 LST (Figure 3-9)

By 1830 LST, Doppler radar showed that the outflow boundary continued to move north of Phoenix. As the boundary moved north, visibilities decreased and south to southwesterly winds increased in areas of north Phoenix while visibilities increased and winds diminished in areas of south and southeast of Phoenix. PM_{10} concentrations at the West Chandler and Higley monitors also sharply decreased as the outflow moved north out of the area, illustrating that relationship between the location of the outflow boundary and the high PM_{10} concentrations.

1930-2000 LST (Figure 3-10)

By 1930 LST, the outflow boundary had moved well north of Phoenix. PM_{10} concentrations and wind speeds were much lower and visibilities had improved across most of the PM_{10} nonattainment area.

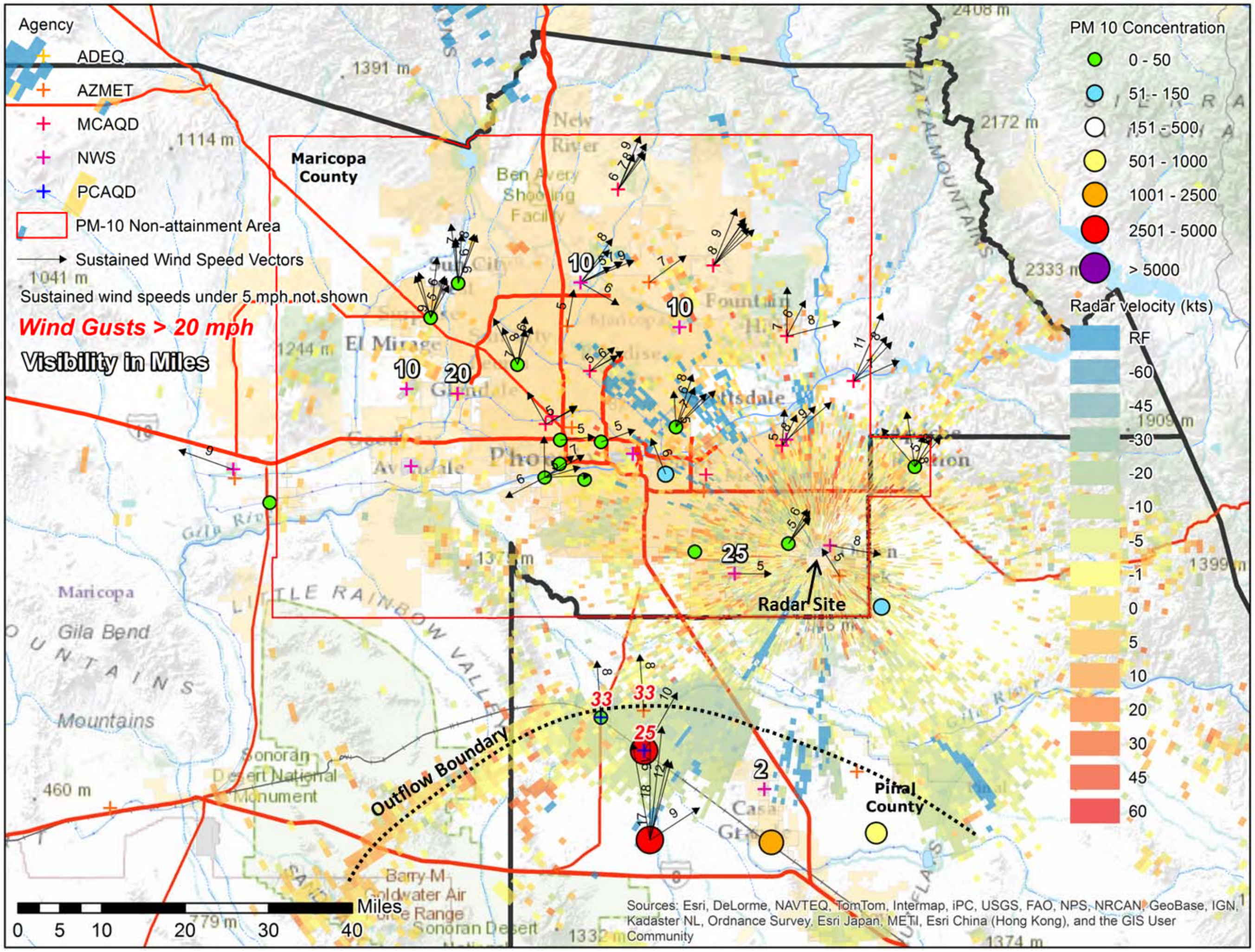

Figure 3-7. Maximum 5-minute PM_{10} concentrations (colored circles), 5-minute wind speed and direction, maximum wind gusts, and minimum visibility observations at Maricopa and Pinal County monitors between 1630 and 1700 LST on August 11, 2012. Where 5-minute data are not available (e.g., PM_{10} concentrations in Pinal County), 1-hr data are used. Underlying are Doppler radar velocity data at 1645 LST, where greens indicate motion toward the radar and oranges/reds indicate motion away from the radar.

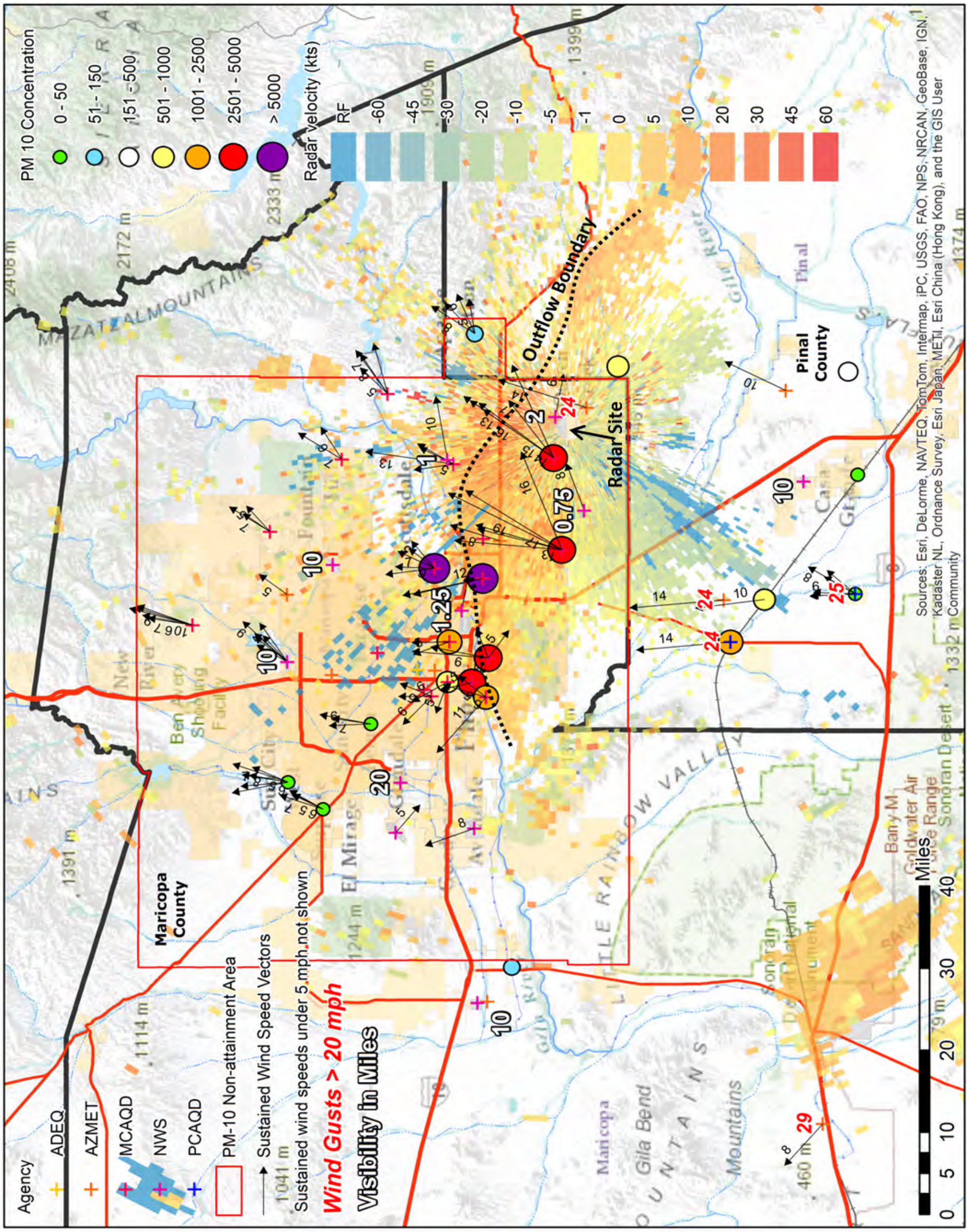

Figure 3-8. Similar to Figure 3-7, but representing observations from 1730 to 1800 LST. Doppler radar data are from 1736 LST.

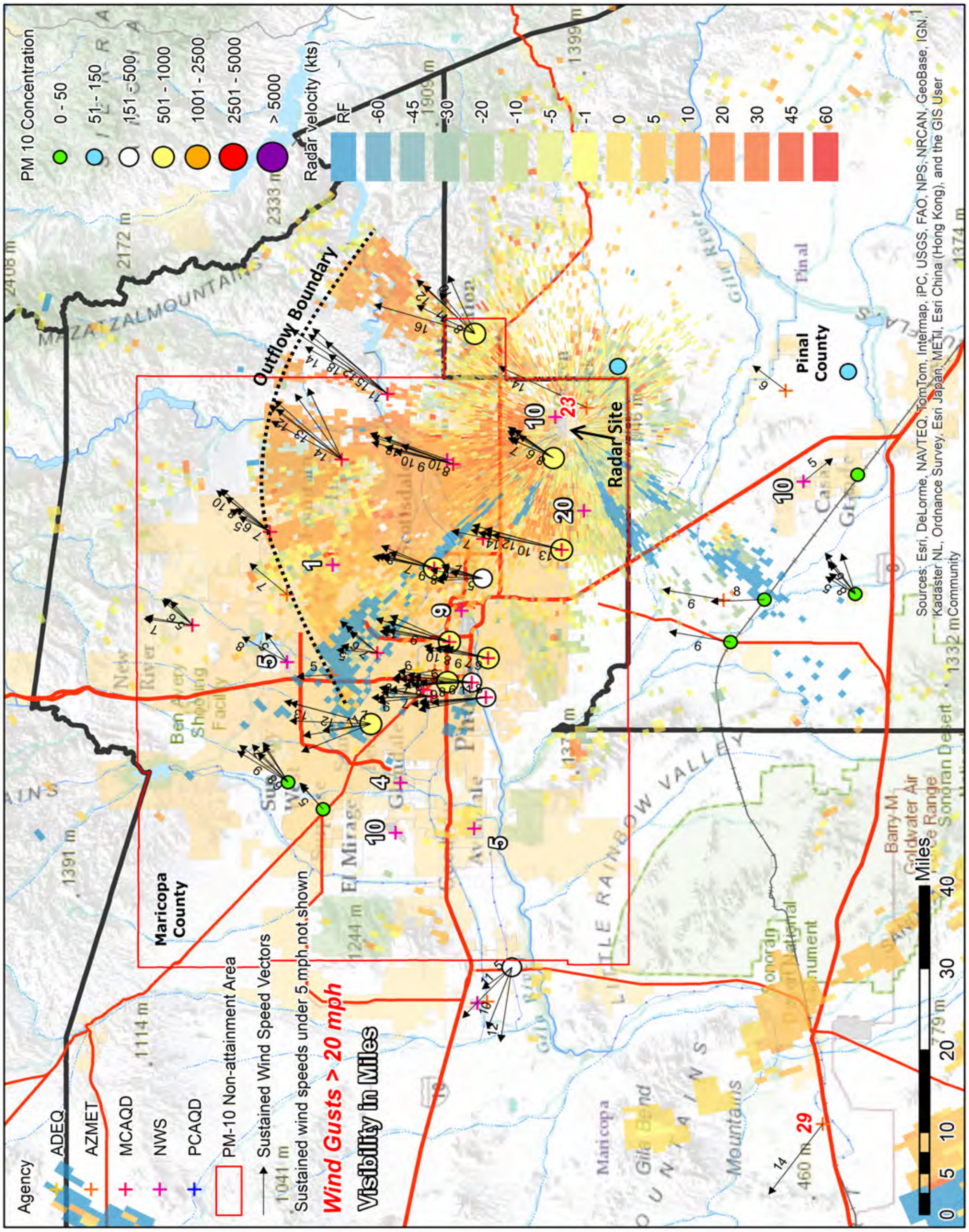

Figure 3-9. Similar to Figure 3-7, but representing observations from 1830 to 1900 LST. Doppler radar data are from 1830 LST.

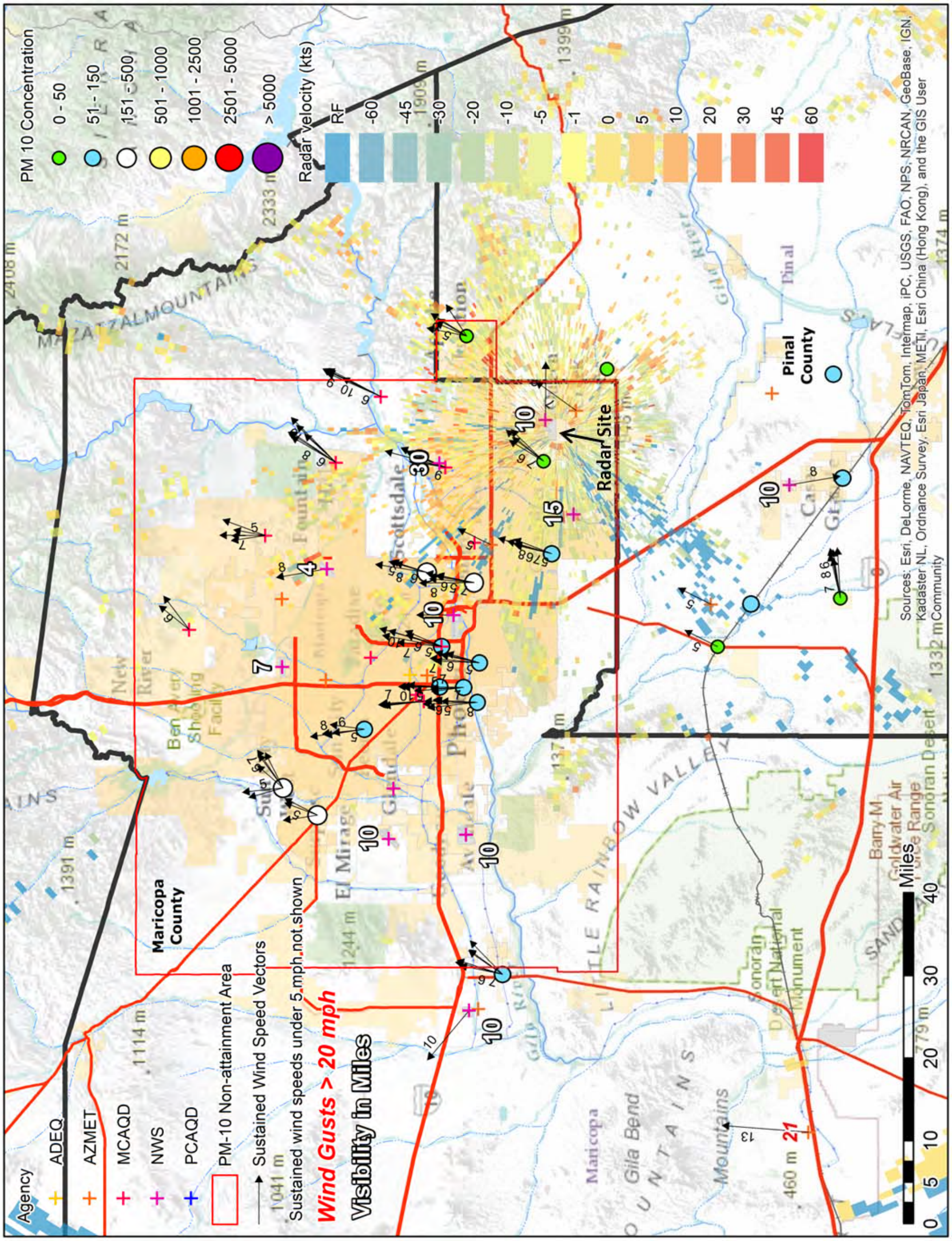

Figure 3-10. Similar to Figure 3-7, but representing observations from 1930 to 2000 LST. Doppler radar data are from 1931 LST.

3.2 Summary

The information presented in this section demonstrates a clear causal relationship between the windblown dust and the PM_{10} exceedances measured in the Phoenix PM_{10} nonattainment area on August 11, 2012. The wind, visibility, PM_{10}, and radar data shown in this section illustrate the spatial and temporal extent of the dust storm as it moved through Maricopa County. In addition, meteorological data tables found in Appendix A show that the sharp increase in PM_{10} concentrations coincided with gusty winds, low visibilities, and airport observer reports of blowing dust. The fact that PM_{10} concentrations in Pinal County peaked prior to PM_{10} concentrations peaking in Maricopa County illustrates that a vast majority of the dust that impacted the nonattainment area monitors originated outside of Maricopa County and was transported into the Phoenix PM_{10} nonattainment area. The proximity of the exceeding monitors (Higley and West Chandler) to open and desert areas of Pinal County provide solid evidence as to why only two monitors within the Maricopa County nonattainment area recorded an exceedance.

4. Historical Norm

4.1 Analysis

PM_{10} concentrations measured at Phoenix-area monitors on August 11, 2012, were unusual and in excess of normal historical fluctuations. To establish the severity of this event, PM_{10} concentrations measured on August 11, 2012, were compared to a historical 2007-2012 six-year annual data set at each monitor. The PM_{10} concentrations measured at the West Chandler monitor on August 11, 2012, resulted in some of the highest 24-hr averages (**Figure 4-1**) and daily maximum hourly averages (**Figure 4-2**) measured over the five-year period. Similar time-series plots for the other monitors are shown in Appendix C.

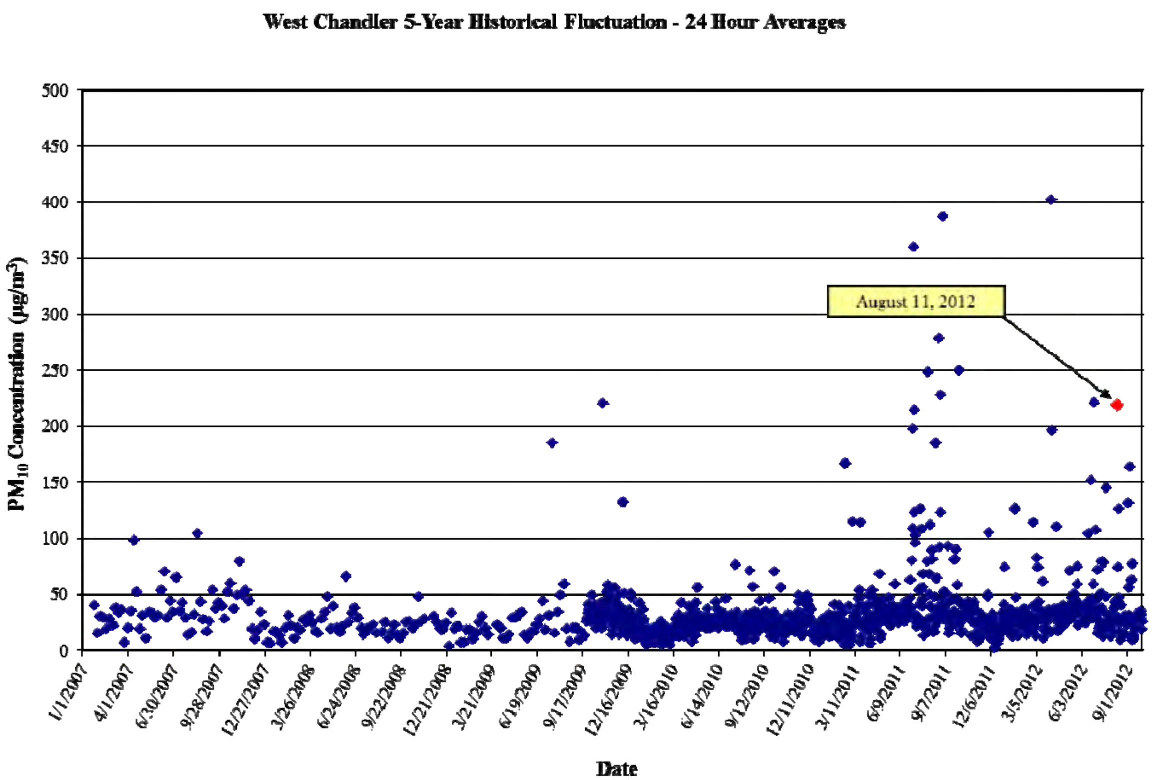

Figure 4-1. 24-hr average PM_{10} concentrations at the West Chandler monitor (2007-2011). The 24-hr average PM_{10} concentration on August 11, 2012, is shown in red and highlighted by the arrow.

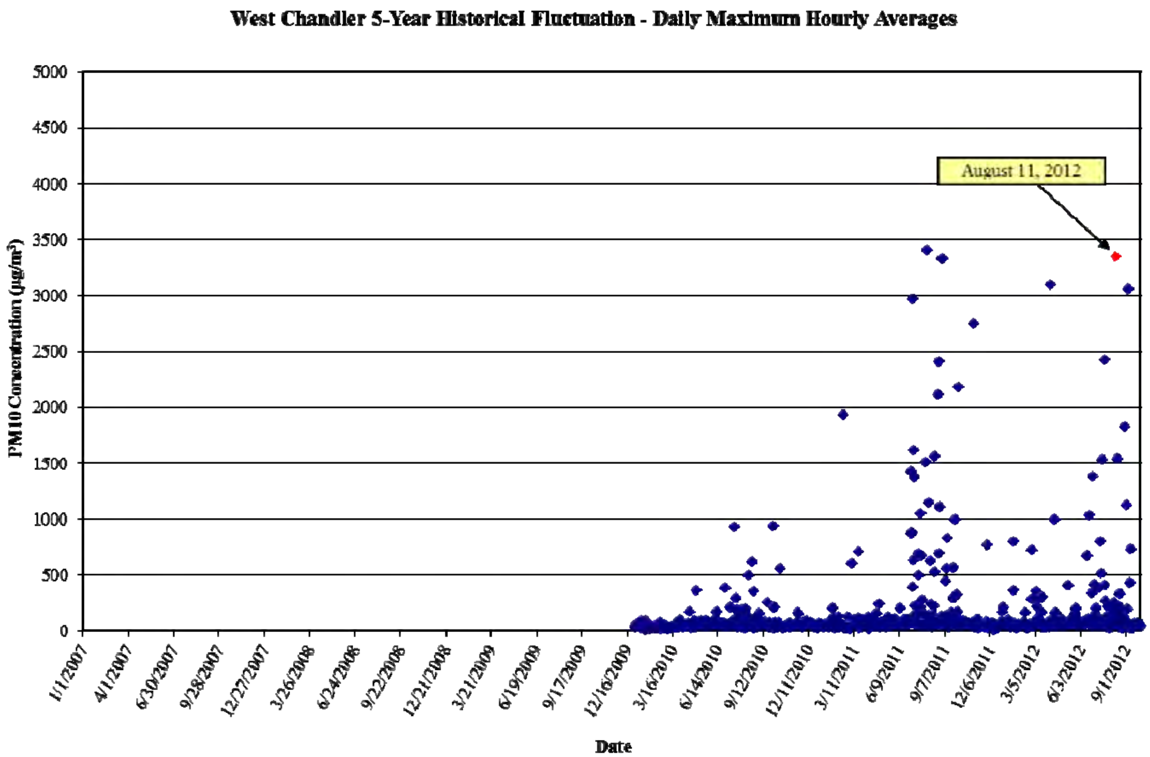

Figure 4-2. Daily maximum hourly average PM_{10} concentrations at the West Chandler monitor (2007-2011). The daily maximum hourly average PM_{10} concentration on August 11, 2012, is shown in red and highlighted by the arrow.

4.2 Summary

Given the recorded values and using a methodology similar to the one accepted by EPA, it is clear that the PM_{10} levels on August 11, 2012, were outside normal historical fluctuations. This analysis provides evidence that the event affected air quality on a historic scale.

5. Not Reasonably Controllable or Preventable

5.1 Background

ADEQ and MCAQD are responsible for implementing regulatory measures to control emissions from agricultural sources, stationary sources, fugitive dust sources, and open burning within Maricopa County. Three major programs provide or contribute to air pollution control measures for the Greater Phoenix area. These programs include

1. ADEQ's Agricultural Best Management Program (Ag BMP)
2. Maricopa County's Inspection and Compliance Program
3. ADEQ's Air Quality Forecasting Program

Specifically, ADEQ is responsible for compliance assistance and enforcement of Agricultural Best Management Practices developed by the Governor's Agricultural Best Management Practices Committee, while MCAQD is responsible for compliance assurance for all other significant sources of PM_{10} emissions. In addition to routine inspections and inspections driven by complaints, inspections are often increased when (1) ADEQ forecasters issue a Maricopa County Dust Control Forecast of "High Risk", (2) ADEQ forecasters issue a High Pollution Advisory, or (3) near-real-time monitoring data indicate unique activity via high PM concentrations. The forecasting program and inspection/compliance programs work together so that resources can be best utilized during days of greatest risk for elevated PM emissions.

On July 25, 2002, EPA took initial action to finalize approval of the Best Available Control Measure (BACM) and the Most Stringent Measure (MSM) demonstrations in the Serious Area PM_{10} plan for the Maricopa County portion of the metropolitan Phoenix PM_{10} nonattainment area (67 FR 48718). These BACM and MSM demonstrations were again approved by EPA on July 14, 2006 (71 FR 43979). The Agricultural Best Management Practices General Permit rule and related definitions have been adopted into the Arizona Administrative Code as R18-2-610 and R18-2-611, pursuant to Arizona Revised Statutes §49-457[2].

5.1.1 Control Measures

Maricopa County regulations of PM_{10} emissions are listed in **Table 5-1**.

[2] Updates to the AgBMP program in December, 2011, clarified BMPs for crops and added BMPs for animal operations. Effective 12/29/2011, R18-2-611 was renumbered to R18-2-610.01 **Agricultural PM_{10} General Permit for Crop Operations** and R18-2-611.01 **Animal Operations PM_{10} General Permit** was added. Definitions for Crop Operations were revised at R18-2-610 and new definitions for Animal Operations were added at R18-2-611.

Table 5-1. Rules and ordinances regulating PM emissions in Maricopa County.

Rule/Ordinance Number & Title	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 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 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 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 BSCP manufacturing processes.
Ordinance P-25: Leaf blower restriction	Establishes restrictions for leaf blowers in incorporated and unincorporated sections of Area A in Maricopa County.
Ordinance P-26: Residential wood burning restriction	Establishes restrictions for residential wood burning.
Ordinance P-27: Vehicle parking and use on unstabilized vacant lots	Establishes restrictions for vehicle parking and use on unstabilized vacant lots in unincorporated sections of Area A in Maricopa County.
Ordinance P-28: Off-road vehicle use in unincorporated areas of Maricopa County	Establishes restrictions for operating vehicles on unpaved property in unincorporated areas of Maricopa County.

Rule/Ordinance Number & Title	Description
Arizona Administrative Code R18-2-611 & 610: Agricultural PM_{10} general permit	Establishes a requirement for commercial farmers to implement best management practices and maintain a record demonstrating compliance.

5.1.2 Additional Measures

In addition to the rules and regulations listed in **Table 5-1**, other PM_{10}-reducing control measures (e.g., paving unpaved roads, PM_{10}-certified street sweepers, controlling unpaved parking lots, etc.) have been committed to and implemented by local jurisdictions throughout the PM_{10} nonattainment area and incorporated into the Arizona state implementation plan (SIP) through PM_{10} plans such as the Revised Maricopa Association of Governments' (MAG) 1999 Serious Area Particulate Plan for PM_{10} for the Maricopa County Nonattainment Area. The Pinal County Air Quality Control District (PCAQCD) also implements regulatory control measures on emissions from existing and new non-point sources within Pinal County (see **Table 5-2**). Additionally, the PCAQCD implements specific nonattainment rules for that part of the Phoenix PM_{10} nonattainment area that resides in Pinal County (see **Table 5-3**).

Table 5-2. Pinal County rules regulating existing and new non-point sources in Pinal County.

Article Number & Title	Description
Article 2: Fugitive dust	Provides a mechanism to reasonably regulate operations which periodically may cause fugitive dust emissions into the atmosphere.
Article 3: Construction sites – fugitive dust	Improves the control of excessive fugitive dust emissions that have been traditionally associated with construction, earthwork, and land development, and thereby minimize nuisance impacts.

Table 5-3. Pinal County rules regulating fugitive dust in Pinal County portion of the Phoenix PM_{10} Nonattainment Area.

Article Number & Title	Description
Article 4: Nonattainment area rules; dustproofing for commercial parking, drives, and yards	Establishes rules to avoid violations of the prevailing PM_{10} standard and additionally minimize nuisance impacts by improving control of excessive fugitive dust emissions from unpaved parking lots.
Article 5: Nonattainment area rules; stabilization for residential parking and drives	Establishes rules for stabilizing residential properties.
Article 6: Restrictions on vehicle parking and use on vacant lots	Establishes rules for unpaved or unstable vacant lots.
Article 7: Construction sites in nonattainment areas – fugitive dust	Establishes rules to avoid violations of the prevailing PM_{10} standard and additionally minimize nuisance impacts by improving control of excessive fugitive dust emissions from activities associated with construction, earthwork, or land development.

Article Number & Title	Description
Article 8: Nonattainment area rules, requirement for stabilization of disturbed areas at vacant lots	Establishes rules for stabilizing disturbed areas at vacant lots.

5.1.3 PM_{10} Rule Effectiveness

MCAQD analyzed the effectiveness of its fugitive dust rules (Rules 310, 310.01 and 316) in terms of permit compliance rates. This rule effectiveness (RE) study was designed to assess how many sources regulated by MCAQD during the subject time period received no PM_{10} emissions-related violations. As a basis for comparison, the percentage of permitted sources in compliance during calendar year 2007 was 76% for sources subject to Rule 310, 85% for Rule 310.01 sources, and 40% for Rule 316 sources. In early 2008, Rules 310, 310.01, and 316 were strengthened, and new ordinances (covering additional source categories such as leaf blowers, vacant lots, and off-road vehicles) were adopted. These enhancements resulted from MCAQD's obligations under such agreements as the 2005 Revised PM_{10} State Implementation Plan for the Salt River Area and the Maricopa Association of Governments 2007 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area to reduce PM_{10} emissions throughout the county. Three major areas that contributed to increased compliance were an increase in departmental staffing (especially inspectors), a robust training program, and regulatory changes that broadened and strengthened control measures under Rules 310, 310.01, and 316.

Source compliance rates were re-assessed for FY 2009 (July 2008–June 2009), a period that allowed time for the new and revised regulations to take effect. The results showed significant increases in compliance compared with the earlier period: to 90% (from 76%) for Rule 310 sources, 95% compliance (from 85%) for Rule 310.01 sources, and 65% (from 40%) for Rule 316 sources. These improvements continued into calendar year 2010 with compliance rates of 94% for Rule 310 sources, 96% for Rule 310.01 sources, and 73% for Rule 316 sources. The timeline below (**Figure 5-1**) illustrates the improvements in RE over the last several years; it also points out significant revisions to previous rules, as well as newly adopted rules and ordinances.

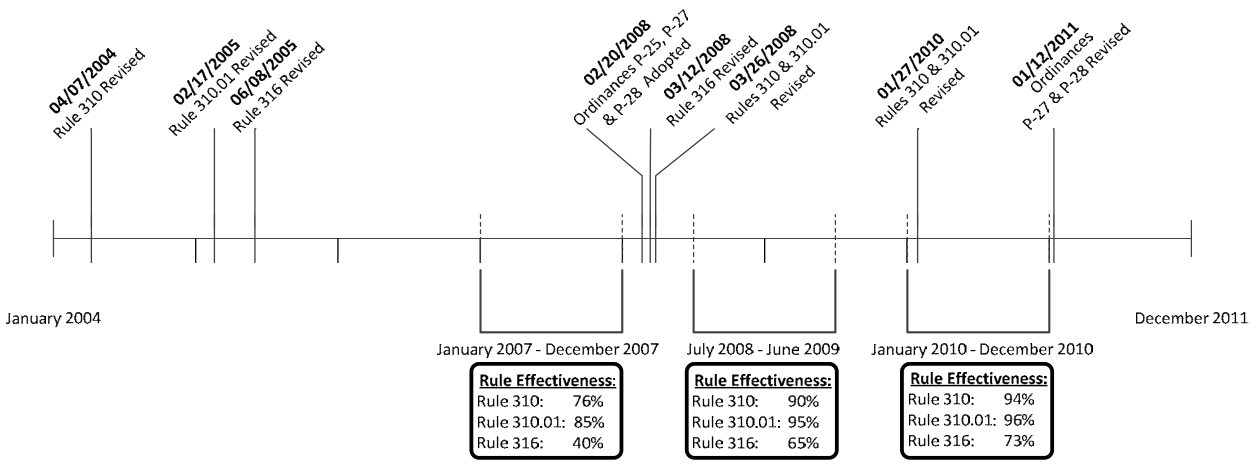

Figure 5-1. Timeline of Maricopa County fugitive dust rules and ordinances.

5.1.4 Compliance and Enforcement Activities

MCAQD is prepared to proactively respond to high wind events and protect human health and well-being. MCAQD 's approach consists of two primary components: proactive inspections conducted routinely, as well as surveillance inspections conducted during and after significant air quality events. MCAQD routinely inspects dust control-permitted sites and increases the frequency of inspections for permits covering areas of 10 acres or more. Rule 316 sources are also regularly inspected multiple times every year. Maricopa County responds to the majority of complaints within 24 hours.

Maricopa County monitors the ADEQ Five-Day Dust Control Forecast to identify the potential for elevated PM_{10} pollution levels due to high winds or stagnant conditions. When a High Pollution Advisory (HPA) is issued for Maricopa County, MCAQD conducts increased surveillance before, during, and after the forecast event(s). MCAQD also conducts event surveillance and post-event activities during exceedance days that had not been forecast (i.e., those instances in which an HPA had not been issued).

Pre-event surveillance consists of surveying high-risk areas for any dust-generating activities, educating sources of the impending HPA event, and issuing violations for failure to comply with local, state, or federal regulations. During the event, MCAQD inspectors survey high-risk areas to confirm that control measures are in place, document any violations, and contact other regulatory agencies if necessary. Post-event activities include continued surveys of high-risk areas, re-inspecting sources that had incurred violations within two business days, and an internal MCAQD debriefing of event activities.

During 2011 and 2012, a total of 17 MCAQD air monitoring sites were upgraded with new equipment that allows the monitoring sites to automatically report measured readings at 5-minute intervals. Previously, only hourly readings were available. The real-time data reporting system includes a mechanism to alert MCAQD field staff when PM concentrations are elevated. The system allows MCAQD responders to review concentrations at the monitors and to consult the National Weather Service website to check for weather event activity. This capability allows the MCAQD responder to identify regional events and monitor specific issues. If necessary, the MCAQD responders can inform nearby stakeholders and local governments of the elevated PM_{10} concentrations.

5.1.5 Review of Source-Permitted Inspections and Public Complaints

ADEQ's Arizona Unified Repository for Information Tracking of the Environment (AZURITE) database and Maricopa County's Environmental Management System were queried to compile a list of inspections for the permitted sources in the Maricopa area around the time of the August 11, 2012, PM_{10} exceedances. An evaluation of all inspection reports, air quality complaints, compliance reports, and other documentation did not indicate any evidence of unusual anthropogenic-based PM_{10} emissions. During the period of August 8-14, 2012, MCAQD inspectors conducted a total of 213 inspections of permitted facilities, of which 142 were at fugitive dust sources. Additionally, MCAQD conducted 209 inspections on vacant lots and unpaved parking lots. During this seven-day period, a total of 43 violations were issued countywide for PM_{10} and non-PM_{10} related violations. One violation was issued for PM_{10} emissions within a four-mile radius of an exceedance monitor (Higley).

On August 9, 2012, a violation was issued to a permitted earthmoving site for being underpermitted by 0.14 acres. No unstable areas were observed during the routine inspection on August 9, 2012. A permit acreage increase was completed on August 15, 2012, to bring the total permitted area to 13.00 acres. The site is located 0.4 miles northeast of the Higley monitor. No unstable areas were observed during the inspection, and southerly winds during the thunderstorm outflow event on August 11, 2012, would have transported any PM_{10} emissions away from the Higley monitor. Therefore, the violation would not have contributed to the exceedance on August 11, 2012.

MCAQD was prepared for any complaints received due to the high wind event. During the seven-day period from August 8-14, 2012, MCAQD received 36 complaints, of which 22 were related to windblown dust. Each complaint was assigned to, and investigated by, a MCAQD inspector. A review of all pertinent records from this period indicates that MCAQD inspectors did not observe any PM_{10} violations of local, state, or federal regulations within a four-mile radius of the exceeding monitors.

In addition to MCAQD's efforts in pre-event surveillance and proactive inspections, ADEQ's Ag BMP inspector also monitors the ADEQ Five-Day Dust Control Forecast and the MCAQD air monitoring sites that include real-time data. The ADEQ Ag BMP inspector uses specific knowledge of seasonal activities and associations with the local growers and dairymen to communicate the importance of limiting dust-generating activities, especially during high wind events. Additional outreach is conducted with facility representatives prior to forecast high wind alert days. Should the PM_{10} readings at a MCAQD air monitoring site show a notable increase, the ADEQ Ag BMP inspector is dispatched to contact the owners and operators of agricultural fields in the area to discern whether their activities are causing negative impacts. The Ag BMP inspector is prepared to respond to most agriculture complaints within 24 hours.

Based on a review of the inspection reports and site visit documentation, there is no evidence to suggest that agricultural activities produced unusual PM_{10} emissions on August 11,

2012. The ADEQ Ag BMP inspector received one dust complaint on August 9 in the area of Citrus Road and Northern Avenue. The complaint was determined to be a normal agricultural operation after discussion with facility representatives.

5.2 Forecasts and Warnings

Dust forecasts and statements were released prior to the event by both ADEQ and the NWS office in Phoenix (Appendix D). On August 10, 2012, ADEQ issued a Maricopa County Dust Control Forecast for August 11, 2012, indicating a low risk level for unhealthy PM_{10}. The Dust Control Forecast stated that light winds were expected, but that “during the active summer monsoon period, strong outflow winds from even distant thunderstorms can generate periods of dense blowing dust.”

At 1622 LST, the NWS office in Phoenix issued a Dust Storm Warning for portions of Pinal and Maricopa counties during the period of gusty outflow winds and high PM_{10} concentrations in the Phoenix area. These advisories warned residents of the potential for gusty winds of 40 mph and visibilities reduced below one quarter mile due to blowing dust. Local storm reports issued by the NWS also indicated dust storm activity in Maricopa and Pinal counties coincident with the high PM_{10} concentrations.

5.3 Wind Observations

Wind data during the event (Figure 3-3, Figure 3-4, and Appendix A) showed winds gusts of over 30 mph coincident with the high PM_{10} concentrations.

5.4 Summary

The thunderstorm outflow event of August 11, 2012, produced strong winds that transported dust and PM_{10} into the Phoenix PM_{10} Nonattainment Area. The source region of the outflows that caused the exceedances was largely located in areas outside the Phoenix PM_{10} nonattainment area, primarily the deserts south of Maricopa County. The Phoenix area is designated as a serious nonattainment area for PM_{10} and is required to have BACM for all significant sources of PM_{10}. BACM on significant anthropogenic sources were in place and enforced during the events, and proactive tracking and response to the events by regulatory agencies and local governments confirmed the uncontrollable nature of the dust emissions; therefore, these pre-existing prior-approved required controls are adequate for meeting the requirements of an exceptional event and should be considered “reasonable” for these purposes.

Despite the deployment of comprehensive control measures and sophisticated response programs, high wind conditions associated with the thunderstorm outflow transported high concentrations of PM_{10} into, and also overwhelmed controls within, the Phoenix PM_{10} nonattainment area. Widespread sustained winds in excess of 20 mph with gusts over 30 mph were strong enough to overwhelm available efforts to limit PM_{10} concentrations during the event. The fact that these were natural events involving strong winds that transported PM_{10} emissions into and across Maricopa County, with a majority of the PM_{10} emissions recorded by

Maricopa County area monitors coming from sources outside of the Phoenix PM_{10} nonattainment area, provides strong evidence that the exceedances of August 11, 2012, recorded within the Phoenix PM_{10} nonattainment area were not reasonably controllable or preventable.

6. But-For Analysis

6.1 Discussion

Section 50.14(c)(3)(iv)(D) in 40 CFR Part 50 requires that an exceptional event demonstration satisfy the condition that "[t]here would have been no exceedance or violation but for the event." The prior sections of this submittal have provided detailed information that, in regard to the PM_{10} exceedances at Phoenix area monitors on August 11, 2012,

- the exceedance was not reasonably controllable or preventable, and
- there was a clear causal relationship between PM_{10} transported strong winds originating in desert areas outside the Phoenix PM_{10} nonattainment area and the measured PM_{10} exceedances in the Phoenix PM_{10} nonattainment area.

The weight of evidence in these sections demonstrates that, but for the existence of dust emissions generated by strong winds and the associated transport of PM_{10}, there would have been no exceedance of the NAAQS for 24-hr average PM_{10}.

As shown in Section 3, maps and time-series plots of PM_{10} and wind speeds establish a clear causal relationship between windblown dust due to thunderstorm outflow and elevated PM_{10} concentrations at Phoenix-area monitors. Multiple independent measurements of wind speed, wind direction, and visibility point to the presence of gusty winds generated by thunderstorm outflow as the mechanism for transport of PM_{10} into the Phoenix nonattainment area. In addition, PM_{10} concentrations were well below the NAAQS on days immediately before and after the windblown dust event. The source region for the PM_{10} is clearly identified as desert areas south of the Phoenix PM_{10} nonattainment area. The weight of evidence presented in this submittal provides no alternative that could tie the exceedance of August 11, 2012, to any causal source except PM_{10} transported by strong winds, confirming that there would have been no exceedance but for the presence of this uncontrollable natural event.

As detailed in Section 5, all reasonable control measures were in place and/or implemented on a continual basis. Air quality-related inspection and compliance data revealed one violation with 4 miles of an exceedance monitor and one dust complaint within three days before and after the time of the event; however, the sources behind the violation and complaint do not explain and could not have resulted in the very high PM_{10} concentrations observed on August 11, 2012. Local regulatory agencies, industry, and the general public were alerted to the possibility of dust storms due to strong winds via daily forecasts and media reports.

6.2 Summary

The weight of evidence presented in this submittal provides no alternative that could tie the exceedance of August 11, 2012, to any causal source other than PM_{10} transported by gusty winds due to thunderstorm outflow, confirming that there would have been no exceedance but for the presence of this uncontrollable natural event.

7. Conclusions

The PM_{10} exceedances that occurred on August 11, 2012, satisfy the criteria of the EER, which states that in order to justify the exclusion of air quality monitoring data, evidence must be provided for the following elements:

- The event satisfies the criteria set forth in 40 CFR 50.1 (j) that
  a. the event affected air quality,
  b. the event was not reasonably controllable or preventable, and
  c. the event was caused by human activity unlikely to recur in a particular location or was a natural event;
- There is a clear causal relationship between the measurement(s) under consideration and the event;
- The event is associated with a measured concentration(s) in excess of normal historical fluctuations; and
- There would have been no exceedance or violation but for the event.

7.1 Affects Air Quality

As stated in the preamble to the EER, the event in question is considered to have affected air quality if it can be shown that there is a clear causal relationship between the monitored exceedances and the event, and that the event is associated with a measured concentration in excess of normal historical fluctuations. Given the information presented in Sections 2, 3, 4, and 5, we can reasonably conclude that the event in question affected air quality.

7.2 Not Reasonably Controllable or Preventable

Section 50.1(j) of 40 CFR Part 50 requires that an event must be “not reasonably controllable or preventable” in order to be defined as an exceptional event. This requirement is met by demonstrating that despite reasonable control measures in place within Maricopa County, high winds overwhelmed all reasonably available controls (Section 5). The PM_{10} exceedances discussed in this report were caused by naturally occurring gusty winds associated with thunderstorm outflow that transported dust into the Phoenix area from areas largely outside the Phoenix PM_{10} nonattainment area. Visibility camera images also help to illustrate the magnitude and scale of this event. These facts provide strong evidence that the PM_{10} exceedances on August 11, 2012, were not reasonably controllable or preventable.

7.3 Natural Event

As discussed above, the PM_{10} exceedances in the Phoenix area on August 11, 2012, were shown to be caused by transport of PM_{10} into the Phoenix area from gusty winds associated with thunderstorm outflow. The event therefore qualifies as a natural event.

7.4 Clear Causal Relationship

The following points demonstrate that the high PM_{10} concentrations were caused by windblown dust:

- Time-series graphs of PM_{10} concentrations show that the timing of high PM_{10} at Phoenix area monitors was consistent with gusty winds and low visibilities at Phoenix-area meteorological stations (Section 3).
- High PM_{10} concentrations and gusty winds were reported at several monitors throughout the Phoenix metropolitan area (Sections 3 and 5).
- PM_{10} concentrations were well below the NAAQS on days and hours immediately before and after the windblown dust event (Section 3).
- Dry conditions preceding the event resulted in soils that were particularly susceptible to particulate suspension by high winds (Section 3).
- Wind directions, thunderstorm generated outflow boundary propagation, and concentration patterns showing elevated levels of PM_{10} in Pinal County prior to levels increasing in Maricopa County illustrate that a vast majority of the dust that impacted the nonattainment area monitors originated outside of Maricopa County and was transported to the nonattainment area. The particular wind magnitudes and wind direction, and the proximity of the exceeding monitors to open and desert areas of Pinal County provide solid evidence as to why only two monitors within the Maricopa County nonattainment area recorded an exceedance (Section 3).
- Visibility cameras clearly illustrate the arrival of dust and significant reductions in visibility in the Phoenix area coinciding with the sharp increases in PM_{10} concentrations.

7.5 Historical Norm

The 24-hr average PM_{10} and daily maximum hourly average PM_{10} values measured at the exceedance monitors were historically unusual compared to a multi-year data set (Section 4).

7.6 But For

On the basis of the weight of evidence described above and in Section 6, the exceedances of the federal 24-hr PM_{10} standard on August 11, 2012, in the Phoenix PM_{10} nonattainment area would not have occurred but for the high winds and transport of dust from areas largely outside the Phoenix PM_{10} nonattainment area.