

State of Arizona Exceptional Event Documentation for August 26, 2013, for the Maricopa PM10 Nonattainment Area

Produced by:

Arizona Department of Environmental Quality
Maricopa County Air Quality Department
Maricopa Association of Governments

FINAL Report
December, 2013

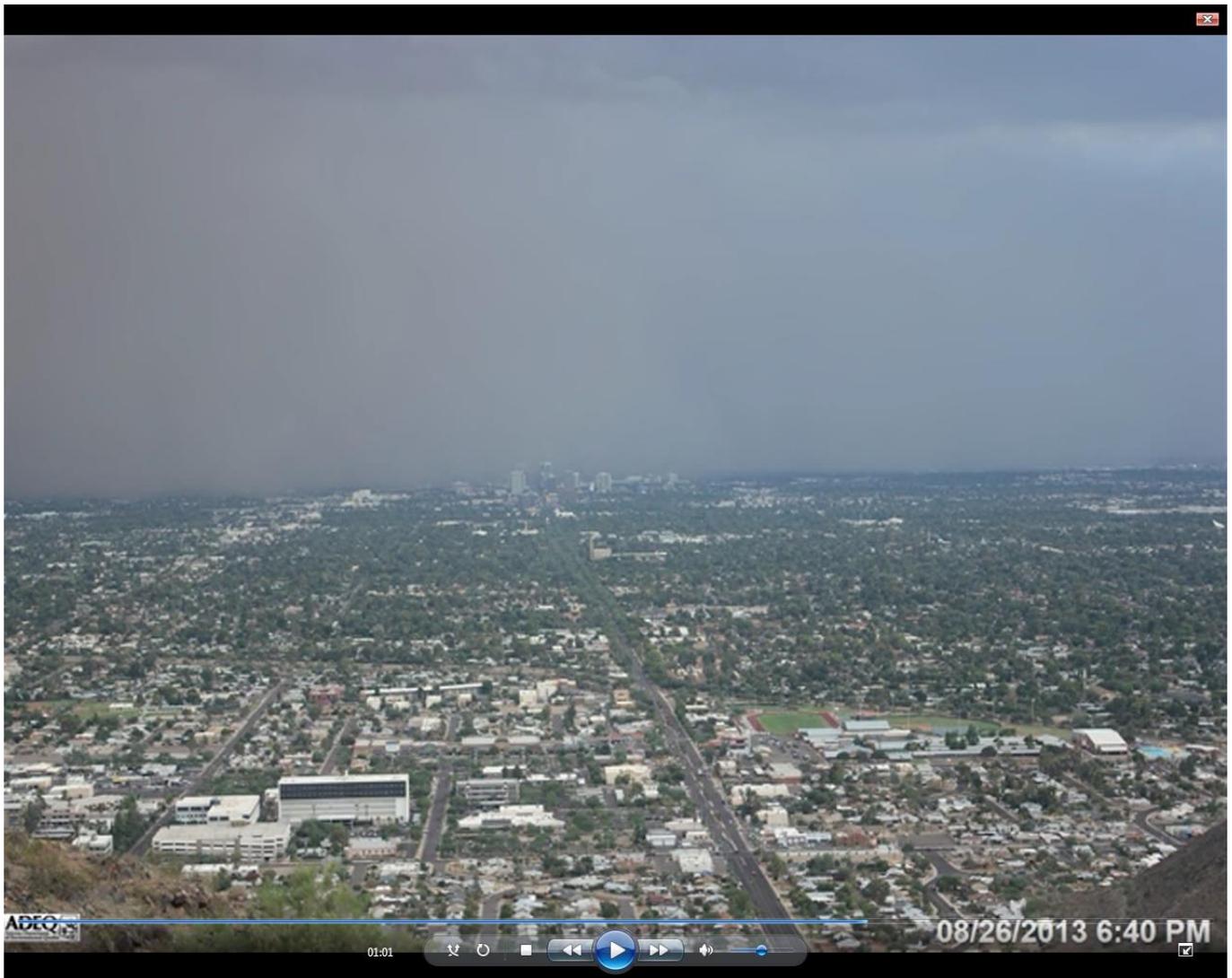


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I. EXCEPTIONAL EVENT RULE (EER) REQUIREMENTS

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

Procedural Requirements

This section presents a review of the procedural requirements of the EER as required by 40 CFR 50.14 (Treatment of Air Quality Monitoring Data Influenced by Exceptional Events) and explains how ADEQ fulfills them. The Federal EER requirements include public notification that an event was occurring, the placement of informational flags on data in EPA's 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. ADEQ has addressed all of these procedural and documentation requirements.

Public notification that event was occurring (40 CFR 50.14(c)(1)(i))

ADEQ issued Dust Control Action Forecasts and Ensemble Forecasts for the Greater Phoenix area advising citizens of the potential for high wind / dust events on August 26, 2013. More information on ADEQ's forecasting program can be found in Section IV. The forecast products that were issued for August 26, 2013 are included in Appendix A.

Place informational flag on data in AQS (40 CFR 50.14(c)(2)(ii))

ADEQ and other operating agencies in Arizona submit data into EPA's AQS. Data from both filter-based and continuous monitors operated in Arizona are submitted to AQS.

When ADEQ and/or another agency operating monitors in Arizona suspects 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 the operating agency have determined a potential exists that 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 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 Region 9 Air Division Director, Deborah Jordan, on September 11, 2013, notifying EPA of ADEQ's intent to flag data in AQS and submit documentation to EPA by February 2014 for multiple exceptional events. EPA was later notified with subsequent communication

via email that the August 26, 2013, exceptional event would be added to the other exceptional events specified in the September 11, 2013, letter. This assessment report serves as the demonstration supporting the flagging of these data. Four Maricopa County monitors have been flagged as exceeding the 24-hour PM10 standard as a result of the high wind exceptional event:

Durango Complex (04-013-9812-81102-1), Greenwood (04-013-3010-81102-1), West 43rd Avenue (04-013-4009-81102-1), and West Phoenix (04-013-0019-81102-1).

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 hardcopy of the report in the ADEQ Records Management Center for public review. ADEQ opened a 30-day public comment period on 01/13/2014. A copy of the public notice certification, along with any comments received, will be submitted to EPA, consistent with the requirements of 40 CFR 50.14(c)(3)(iv). See Appendix C for a copy of the affidavit of public notice.

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

At the close of the 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 IX headquarters in San Francisco, California. The deadline for the submittal of this demonstration package is September 30, 2016.

Documentation Requirements

Section 50.14(c)(3)(iii) of the EER states that in order to justify excluding air quality monitoring data, evidence must be provided for the following elements:

- a. The event satisfies the criteria set forth in 40 CFR 501(j) that:
 - (1) The event affected air quality,
 - (2) The event was not reasonably controllable or preventable, and
 - (3) The event was caused by human activity unlikely to recur in a particular location or was a natural event;
- b. There is a clear causal relationship between the measurement under consideration and the event;
- c. The event is associated with a measured concentration in excess of normal historical fluctuations; and
- d. There would have been no exceedance or violation but for the event.

Section II of this assessment introduces the conceptual model of a thunderstorm outflow wind event that transpired on August 26, 2013, providing a background narrative of the exceptional event and an overall explanation that ‘the event affected air quality’. Further evidence that ‘the event affected air quality’ is provided in Section V.

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 August 26, 2013, was not reasonably controllable or preventable.

Section V of this assessment establishes a clear causal connection between the natural event on August 26, 2013, and the exceedances of the 24-hour PM10 standard. 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 a natural event.

Section III of this assessment provides data summaries and time series graphs which help illustrate that the event on August 26, 2013, produced PM10 concentrations in excess of normal historical fluctuations.

Section VI of this assessment builds upon the demonstration showing a clear causal connection between the natural event and the exceedance and concludes there would have been no exceedance on August 26, 2013, but for the presence of the natural event.

II. CONCEPTUAL MODEL

Geographic Setting and Climate

Geographic Setting

Phoenix is located in the Salt River Valley in south-central Arizona. It lies at a mean 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 msl) to the northeast, the foothills of the Bradshaw (~7,900 ft msl) and Mazatzal (~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. The Phoenix metropolitan area contains a fairly dense network of PM10 monitors throughout the area, with a much less dense network of monitors located throughout the rest of the state. Figure 2–1 shows the general geographic setting of Phoenix, as well as the locations of PM10 monitors throughout the state. It should be noted that some of the monitors shown in Figure 2-1 are filter-based monitors; therefore, monitoring data from all locations may only be available for select days (i.e. 1-in-6 run days).

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 PM10 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.

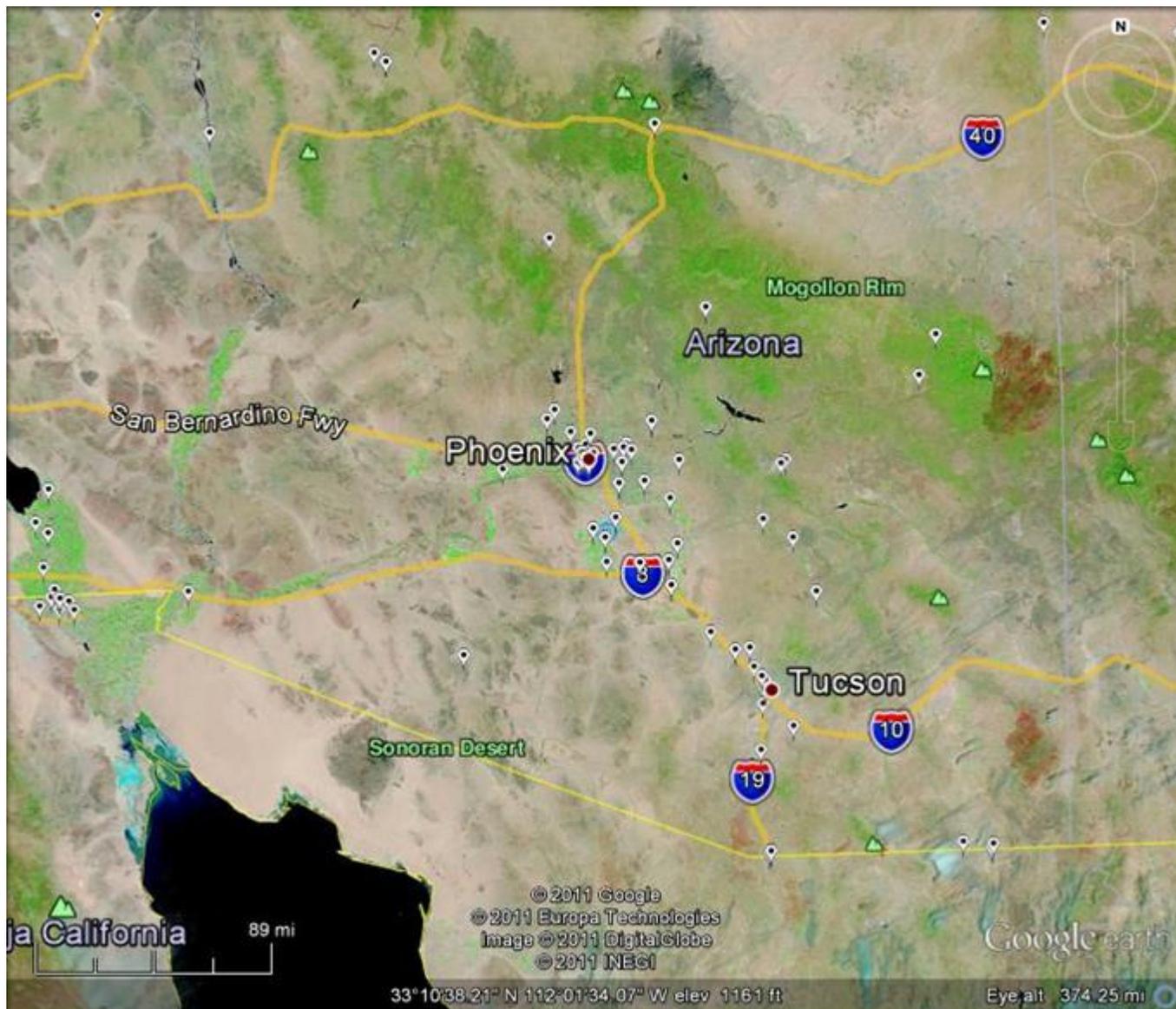


Figure 2-1. Phoenix Geographic Setting and PM10 Monitor Locations (source: EPA AQS DataMart, NASA MODIS Satellite, and Google Earth). PM10 monitor locations are indicated by white markers.

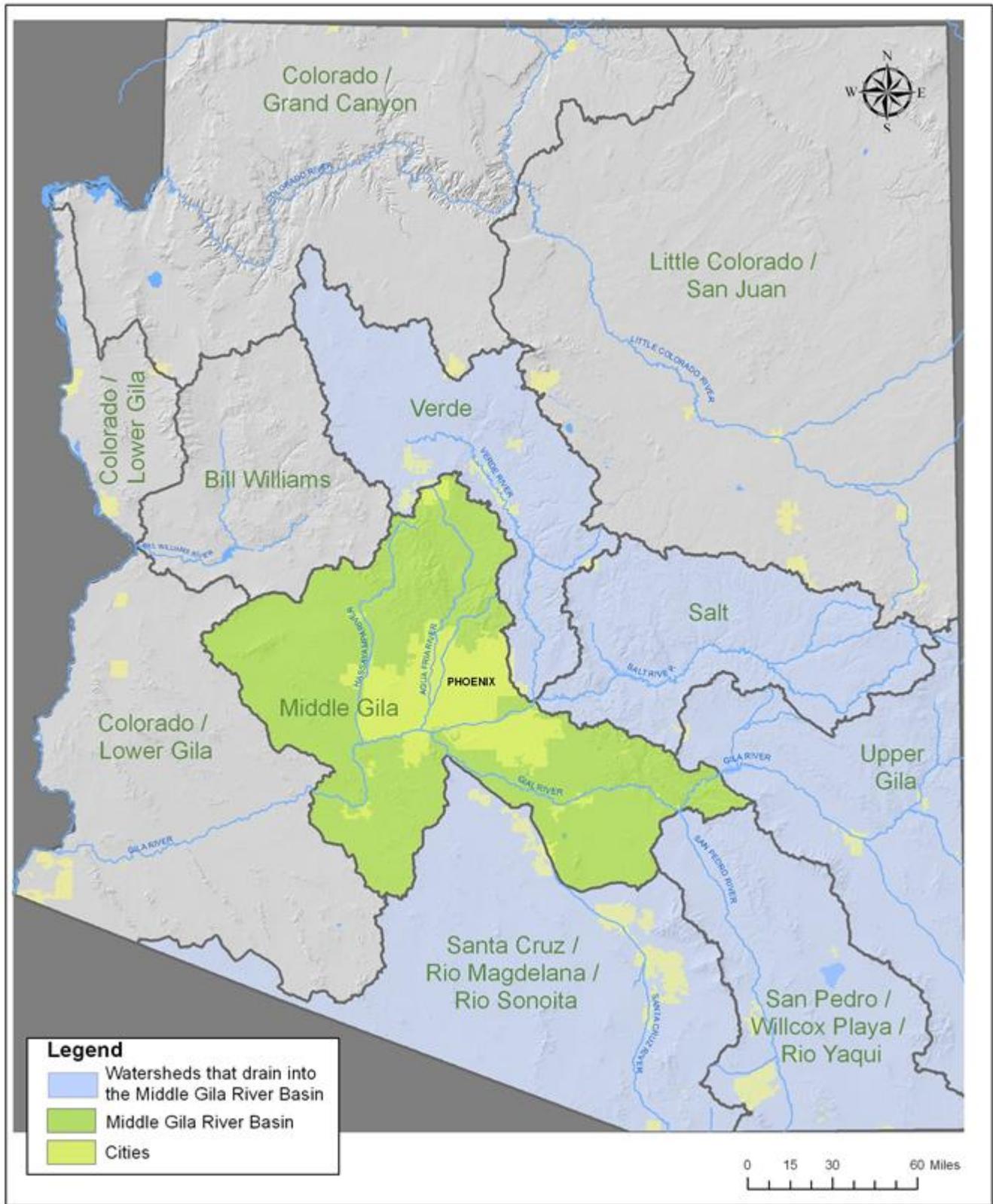


Figure 2-2. Drainage System of Phoenix, Arizona.

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 100°F an average of 110 days during the year and highs top 110°F an average of 18 days during the year. Phoenix receives an average of 7.66 inches of rain per year.

Precipitation is sparse during the first 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. 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 is advected from the Gulf of California, Gulf of Mexico, and large thunderstorm complexes from the Sierra Madre Occidental Mountains in Mexico. This influx in moisture, combined with intense solar heating, often creates a very unstable environment that is ripe for thunderstorm development. These thunderstorms can bring strong winds and blowing dust, large hail, and heavy rain. Dust storms associated with these thunderstorms typically occur in the early part of the monsoon season (July) before soaking rains help keep soil particles bound to one another. However, depending on the amount of precipitation received during the monsoon season, extremely hot temperatures act to dry out the surface quickly, and dust storms can occur at any time. During the December through March period, winter storms moving inland from the Pacific Ocean can bring strong winds, blowing dust and significant rains throughout Arizona. This December – March time period, and July – August time period are typically the wettest parts of the year. Meanwhile, a distinct dry season occurs during the period April through June for Phoenix and the rest of Arizona. While these weather patterns describe the general climatology for the Phoenix area over a long period of time, Phoenix and the entire state of Arizona is also prone to a high degree of variability in these weather patterns from year to year.

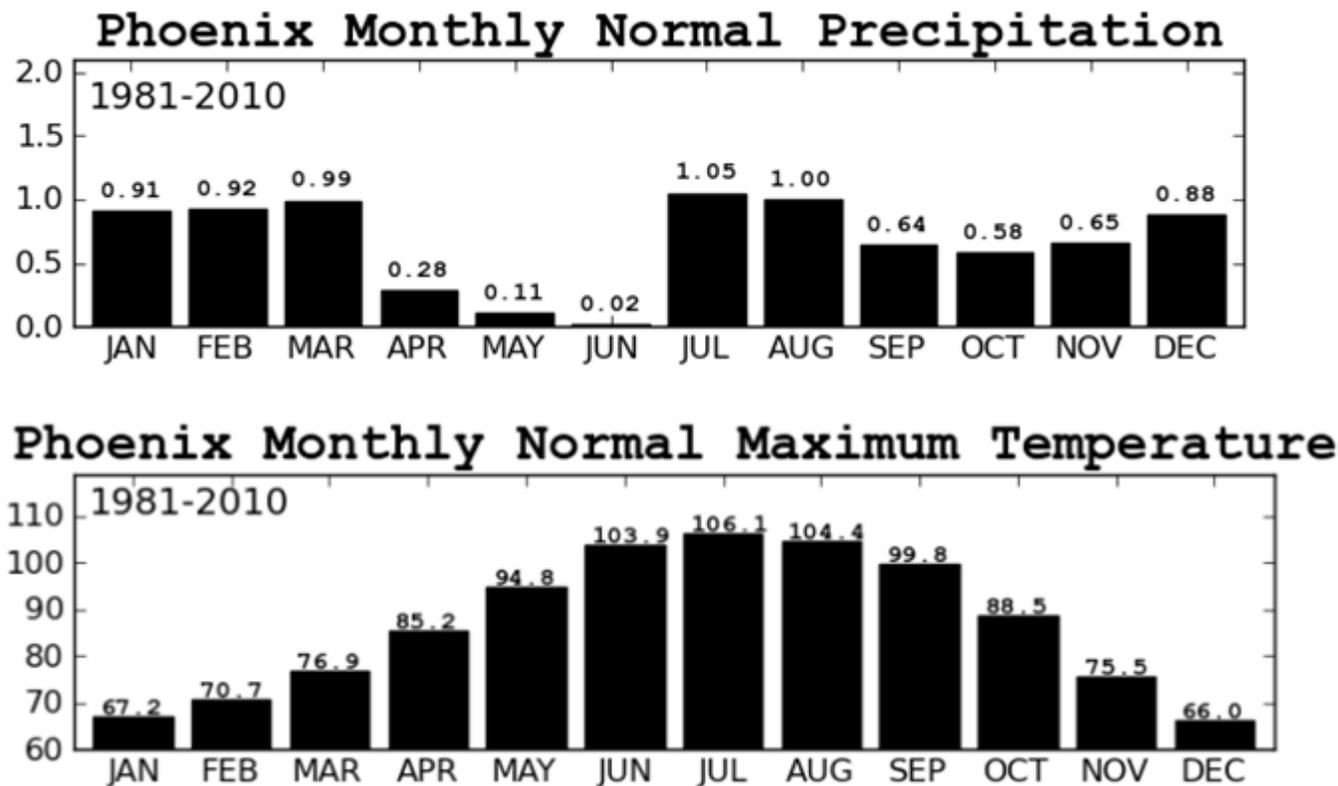


Figure 2-3 Phoenix Monthly Precipitation (top) and Maximum Temperature (bottom) Climatology (source: National Weather Service).

Monsoon Season Thunderstorm Outflow Dust Storm Event Summary

The North American Monsoon is a shift in wind patterns in the summer which occurs as Mexico and the southwest U.S. warm under intense solar heating. As this happens, low level moisture is transported primarily from the Gulf of California and eastern Pacific Ocean into the southwestern U.S. Mid and upper level moisture is also transported into the region, mainly from the Gulf of Mexico by easterly winds aloft. This combination causes a distinct rainy season over large portions of western North America, which develops rather quickly and sometimes dramatically. There are usually distinct “burst” periods of heavy rain during the monsoon, and “break” periods with little or no rain. Even during active monsoon periods, some areas can go without receiving any significant precipitation while other nearby areas experience heavy rains and flooding.

In addition to bringing precipitation, active thunderstorms can produce downbursts, or sometimes more concentrated and severe microbursts, which are rapidly descending bursts of air spreading away from the thunderstorm clouds. These downward bursts of air hit the ground and then disperse away from the storms as areas of outflow. These outflow boundaries from the thunderstorms can generate large walls of dust, sometimes called haboobs, and transport that dust for long distances from the initiating thunderstorms (see Figure 2–4).

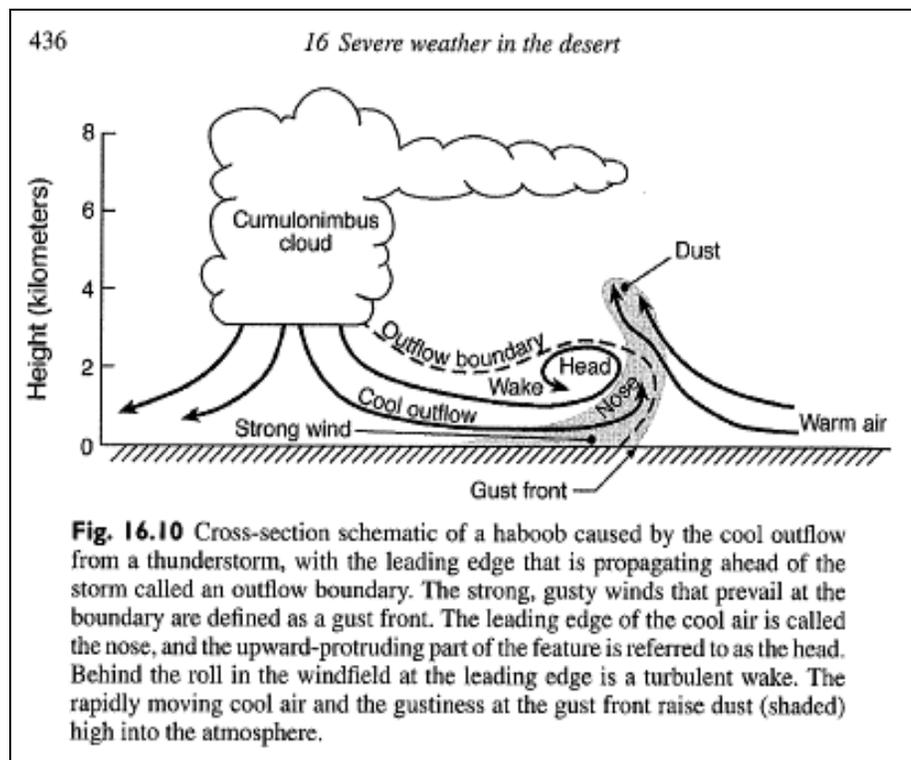


Figure 2-4. Cross-section of a thunderstorm creating an outflow boundary and haboob (Source: Desert Meteorology. Thomas T. Warner. 2004.)

In the early evening of August 26, 2013, a significant thunderstorm outflow developed over the northwestern deserts of Pinal County, trailing a large dust storm in its wake. The thunderstorm outflow and dust storm progressed north-northwest towards Maricopa County and the PM10 nonattainment area and began impacting Maricopa County PM10 monitors around 6:00 pm local time. The thunderstorm outflow generated wind gusts up to 68 mph, sustained winds as high as 46 mph, and reduced visibilities to as low as 0.25 miles at Sky Harbor International Airport. Precipitation was significant in scattered areas across the nonattainment area, helping to prevent some monitoring locations in Maricopa and Pinal counties from exceeding the PM10 standard. The outflow winds were brief but intense as they progressed northwest across Maricopa County, easily overwhelming control measures designed to reduce PM10 from high winds.

Originating in the open and natural desert areas of Pinal County, this thunderstorm produced intense outflow winds that generated and transported significant quantities of blowing dust north-northwest towards the Maricopa County nonattainment area. The outflow generated dust continued on prevailing winds towards the nonattainment area, first impacting the southeastern monitors in Maricopa County between 6:00 pm – 6:30 pm, and then impacting the central and northern portions of Maricopa County between 6:30 pm – 8:00 pm. Precipitation as high as 0.48 inches over a half hour period helped to prevent monitors in the southeastern, western and northern portions of Maricopa County from exceeding the PM10 standard. Although some precipitation was recorded in the central area of Maricopa County where the exceeding monitors are located, it is unclear if precipitation fell directly at the monitoring stations that recorded the exceedances. Also, at approximately 8:00 pm, wind speeds in the central portion of Maricopa County fell to near zero, causing suspended dust from the thunderstorm outflow to remain trapped in the central portions of Maricopa County. Wind shifts from the west in later hours, also pushed suspended PM10 back across centrally located monitors from western and northern portions of Maricopa County. The dust storm generated and transported extremely high concentrations of PM10 with the centrally located monitors recording five-minute average PM10 concentrations as high as 8,407 $\mu\text{g}/\text{m}^3$. The PM10 from the dust storm ultimately caused four Maricopa County monitors to exceed the 24-hour PM10 standard on August 26, 2013.

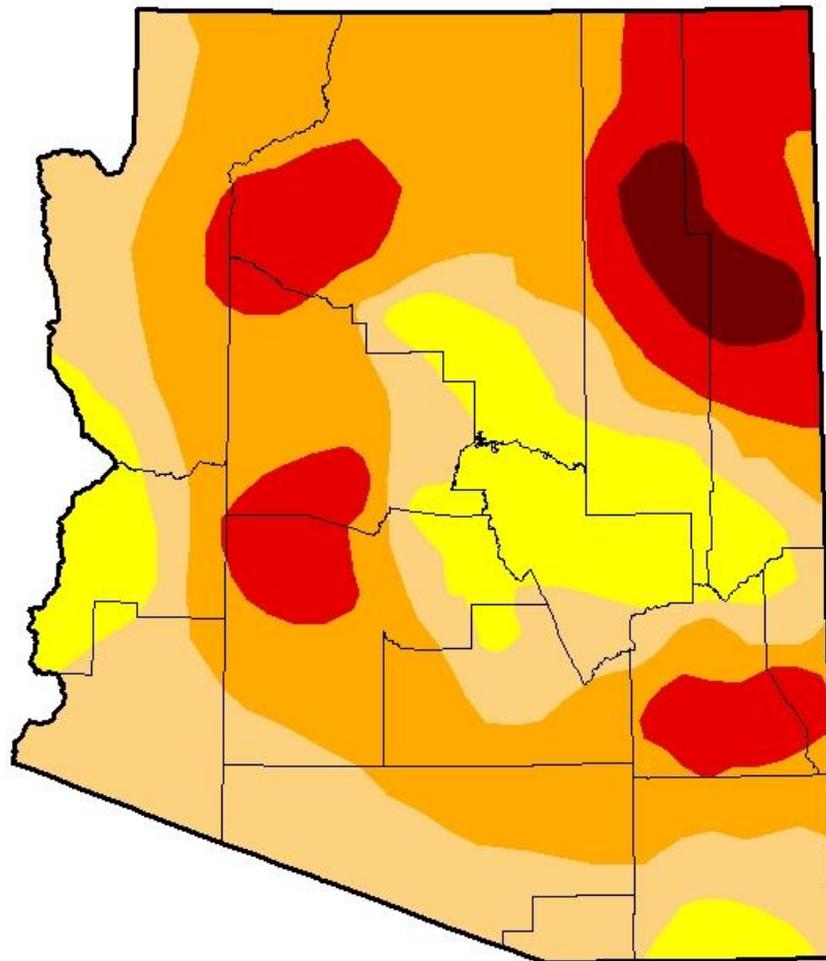
A contributing factor that led to this dust storm was the on-going drought across the region. The U.S. Drought Monitor as of August 20, 2013, categorized the source area of the thunderstorm winds as either D1 (Moderate) drought level or D2 (Severe) drought level. This level of drought helps to show how the natural desert areas of Pinal and Maricopa County are vulnerable to dust storms generated by thunderstorm outflow winds.

A more detailed explanation and time series visualization of the thunderstorm outflow dust storm event is available in Section V, describing the clear causal connection between the approaching outflow and the exceeding PM10 concentrations recorded in the nonattainment area.

As a summary of the event, Figure 2–6 displays an hourly graph of the PM10 concentrations throughout Maricopa County and the nonattainment area. Table 2–1 contains PM10 concentration data from all recorded monitors throughout the State of Arizona.

U.S. Drought Monitor Arizona

August 20, 2013
(Released Thursday, Aug. 22, 2013)
Valid 7 a.m. EST



Intensity:

-  D0 Abnormally Dry
-  D1 Moderate Drought
-  D2 Severe Drought
-  D3 Extreme Drought
-  D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Michael Brewer
NCDC/NOAA



<http://droughtmonitor.unl.edu/>

Figure 2-5. U.S. Drought Monitor analysis of Arizona released around the time period of the exceedance described in this report.

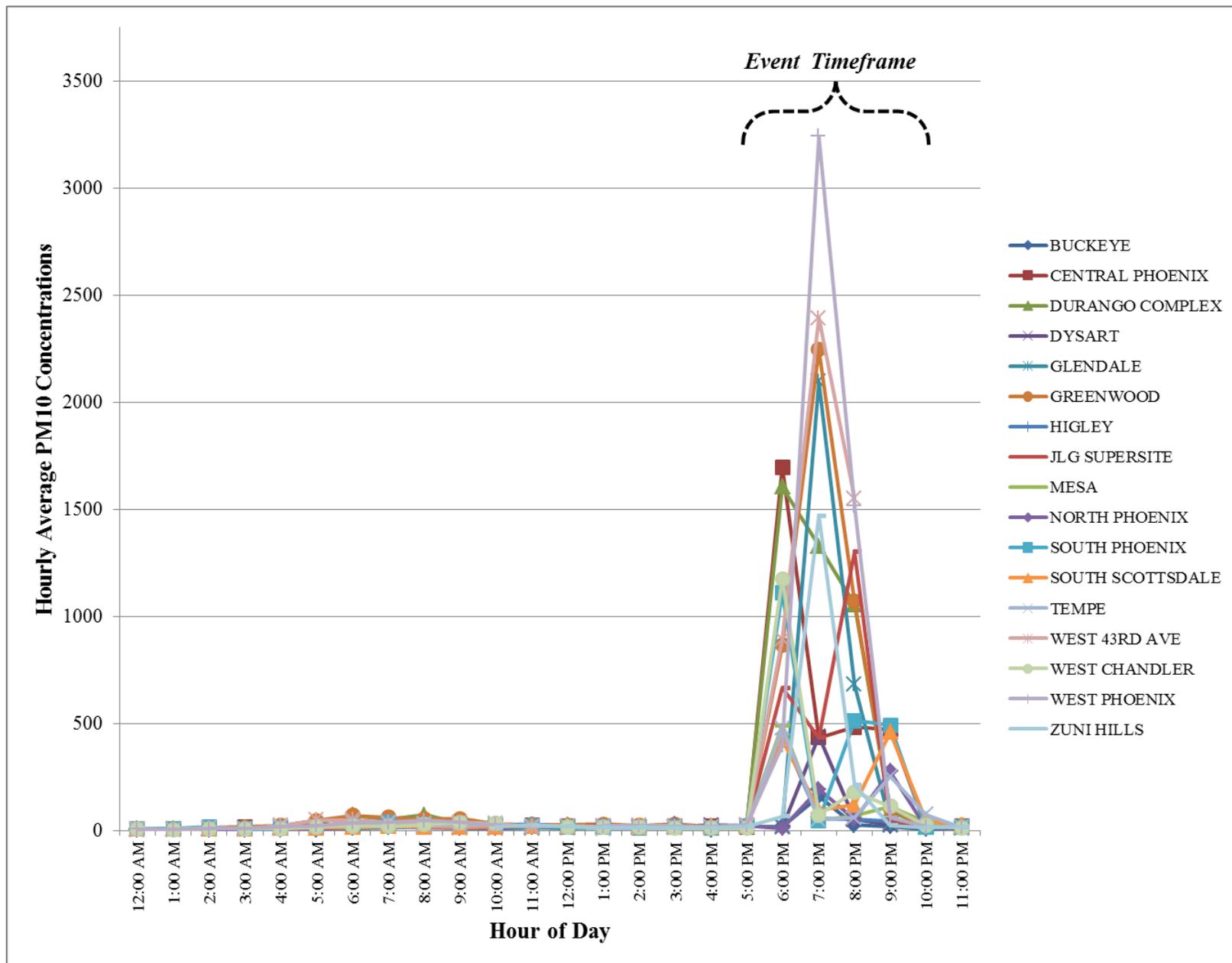


Figure 2-6. Timeline of PM10 concentrations at monitors in Maricopa County and the PM10 nonattainment area on August 26, 2013.

Table 2-1. Summary of Statewide PM10 Measurements for August 26, 2013.

Monitor	Monitor Type	Operator	AQS Monitor ID	24-hr Avg PM10 (µg/m ³)	1-hr Max PM10 (µg/m ³)	Max Time	AQS Qualifier Flag
Apache County¹							
N/A	N/A	WMAT	04-001-1003-81102-1	9	16	0800	
Coconino County							
N/A	N/A	ADEQ	04-005-1237-81102-1	N/A	N/A	N/A	
Gila County²							
Hayden Old Jail	TEOM	ADEQ	04-007-1001-81102-3	36	95	2100	
Maricopa County¹							
Buckeye	TEOM	MC	04-013-4011-81102-1	19	157	1900	
Central Phoenix	TEOM	MC	04-013-3002-81102-4	144	1,697	1800	
Durango Complex	TEOM	MC	04-013-9812-81102-1	190	1,604	1800	RJ
Dysart	TEOM	MC	04-013-4010-81102-1	35	440	1900	
Fort McDowell/ Yuma Frank	TEOM	FMR	04-013-5100-81102-3	N/A	N/A	N/A	
Glendale	TEOM	MC	04-013-2001-81102-1	N/A	2,096	1900	
Greenwood	TEOM	MC	04-013-3010-81102-1	203	2,246	1900	RJ
Higley	TEOM	MC	04-013-4006-81102-1	42	445	1800	
JLG Supersite	BAM	ADEQ	04-013-9997-81102-3	117	1,301	2000	
JLG Supersite	TEOM	ADEQ	04-013-9997-81102-4	N/A	N/A	N/A	
Lehi Air Monitoring Station	N/A	SRP-MIC	04-013-7022-81102-1	N/A	N/A	N/A	
Mesa	TEOM	MC	04-013-1003-81102-1	44	491	1800	
North Phoenix	BAM	MC	04-013-1004-81102-1	33	275	2100	
Senior Center Air Monitoring Station	N/A	SRP-MIC	04-013-7020-81102-1	N/A	N/A	N/A	
Senior Center Air Monitoring Station	N/A	SRP-MIC	04-013-7020-81102-2	N/A	N/A	N/A	
South Phoenix	TEOM	MC	04-013-4003-81102-1	103	1,110	1800	
South Scottsdale	TEOM	MC	04-013-3003-81102-1	61	460	2100	
Tempe	TEOM	MC	04-013-4005-81102-1	52	479	1800	
West Chandler	TEOM	MC	04-013-4004-81102-1	80	1,175	1800	
West Forty Third	TEOM	MC	04-013-4009-81102-1	250	2,393	1900	RJ
West Phoenix	TEOM	MC	04-013-0019-81102-1	255	3,242	1900	RJ
Zuni Hills	TEOM	MC	04-013-4016-81102-1	N/A	1,469	1900	
Navajo County¹							
N/A	N/A	WMAT	04-017-1002-81102-1	15	39	2000	
Pima County²							
Ajo	TEOM	ADEQ	04-019-0001-81102-3	9	24	1600	
Orange Grove	FRM	PCDEQ	04-019-0011-81102-2	N/A	N/A	N/A	
Prince Road	FRM	PCDEQ	04-019-1009-81102-1	N/A	N/A	N/A	
Rillito	TEOM	ADEQ	04-019-0020-81102-3	28	68	2300	
Santa Clara	FRM	PCDEQ	04-019-1026-81102-1	N/A	N/A	N/A	
Tangerine	FRM	PCDEQ	04-019-1018-81102-1	N/A	N/A	N/A	
Pinal County³							
Apache Junction Fire Station	FRM	PCAQCD	04-021-3002-81102-1	N/A	N/A	N/A	
Bapchule	FRM	GRIC	04-021-7004-81102-1	N/A	N/A	N/A	
Bapchule	FRM	GRIC	04-021-7004-81102-2	N/A	N/A	N/A	
Casa Grande Downtown	TEOM	PCAQCD	04-021-0001-81102-3	66	1,127	1700	
Combs School	TEOM	PCAQCD	04-021-3009-81102-3	32	223	1800	
Cowtown	TEOM	PCAQCD	04-021-3013-81102-3	206	3,328	1700	
Maricopa	TEOM	PCAQCD	04-021-3010-81102-3	81	849	1700	
Pinal Air Park	TEOM	PCAQCD	04-021-3007-81102-1	16	36	0800	
Pinal County Housing	TEOM	PCAQCD	04-021-3011-81102-3	132	2,579	1700	
Stanfield	TEOM	PCAQCD	04-021-3008-81102-3	171	3,126	1700	
Santa Cruz County²							

Monitor	Monitor Type	Operator	AQS Monitor ID	24-hr Avg PM10 ($\mu\text{g}/\text{m}^3$)	1-hr Max PM10 ($\mu\text{g}/\text{m}^3$)	Max Time	AQS Qualifier Flag
Nogales Post Office	BAM	ADEQ	04-023-0004-81102-3	13	26	2300	
Yuma County²							
Yuma Supersite	TEOM	ADEQ	04-027-8011-81102-3	12	35	2300	

SOURCE: ¹EPA's Air Quality System (AQS) database. ²ADEQ's AZURITE database. ³Pinal County Air Quality Control District (PCAQCD). AZURITE and PCAQCD data are preliminary and should not be considered final until entered into AQS.

TEOM: Tapered Element Oscillating Microbalance monitor

FRM: Federal Reference Method

WMAT: White Mountain Apache Tribe of Fort Apache Reservation, AZ

SRP-MIC: Salt River Pima-Maricopa Indian Community of Salt River Reservation, AZ

PCDEQ: Pima County Department of Environmental Quality

PCAQCD: Pinal County Air Quality Control District

GRIC: Gila River Indian Community

RJ: qualifier flag for high winds

III. HISTORICAL FLUCTUATIONS

PM10 concentrations measured at Maricopa County monitors on August 26, 2013, were unusual and in excess of normal historical fluctuations. Figure 3–1 displays a time series plot of the 24-hour PM10 concentrations for the period of January 1, 2008 through September 30, 2013 for the West Phoenix monitor; the monitor that recorded the highest 24-hour average PM10 concentration during the August 26, 2013 exceptional event. The figure indicates that the PM10 concentrations seen at the West Phoenix monitor on August 26, 2013, were in excess of normal historical fluctuations. Figures 3–2 through 3–4 show the historical fluctuations for the other monitors in Maricopa County that exceeded the PM10 standard on August 26, 2013.

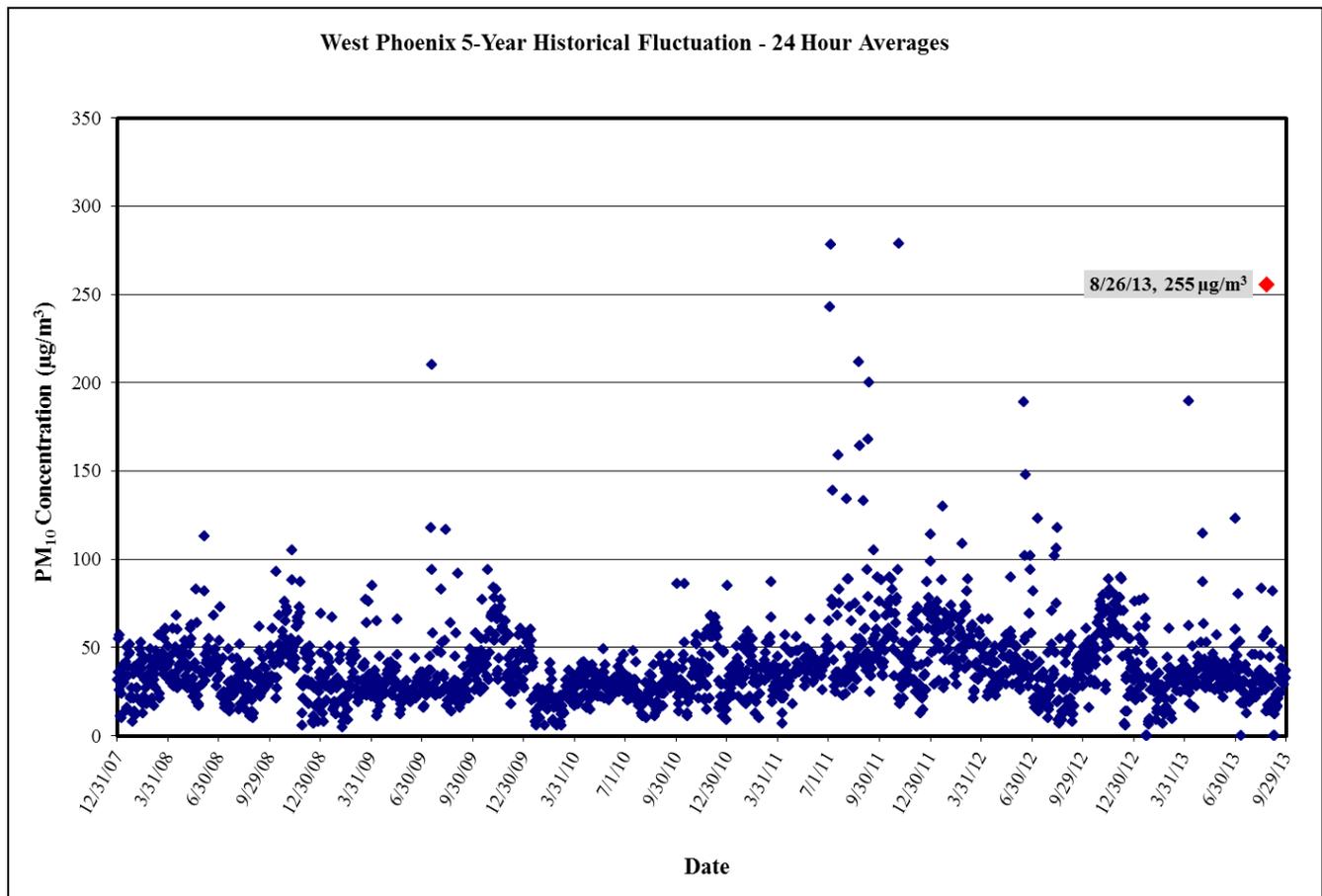


Figure 3-1. Plot of 24-hour average PM10 concentrations (2008 – September 2013) at the West Phoenix monitor.

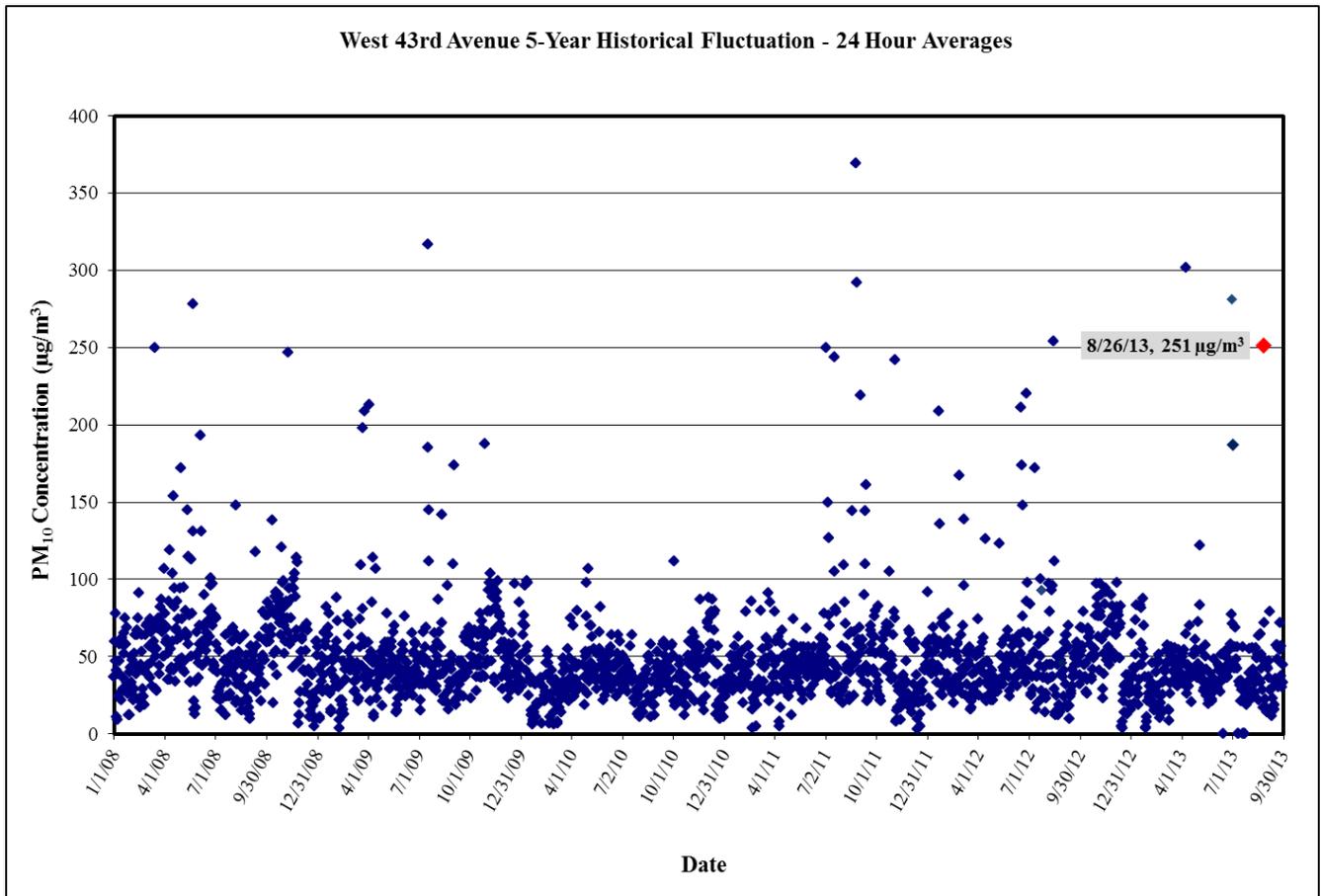


Figure 3-2. Plot of 24-hour average PM10 concentrations (2008 – September 2013) at the West 43rd Avenue monitor.

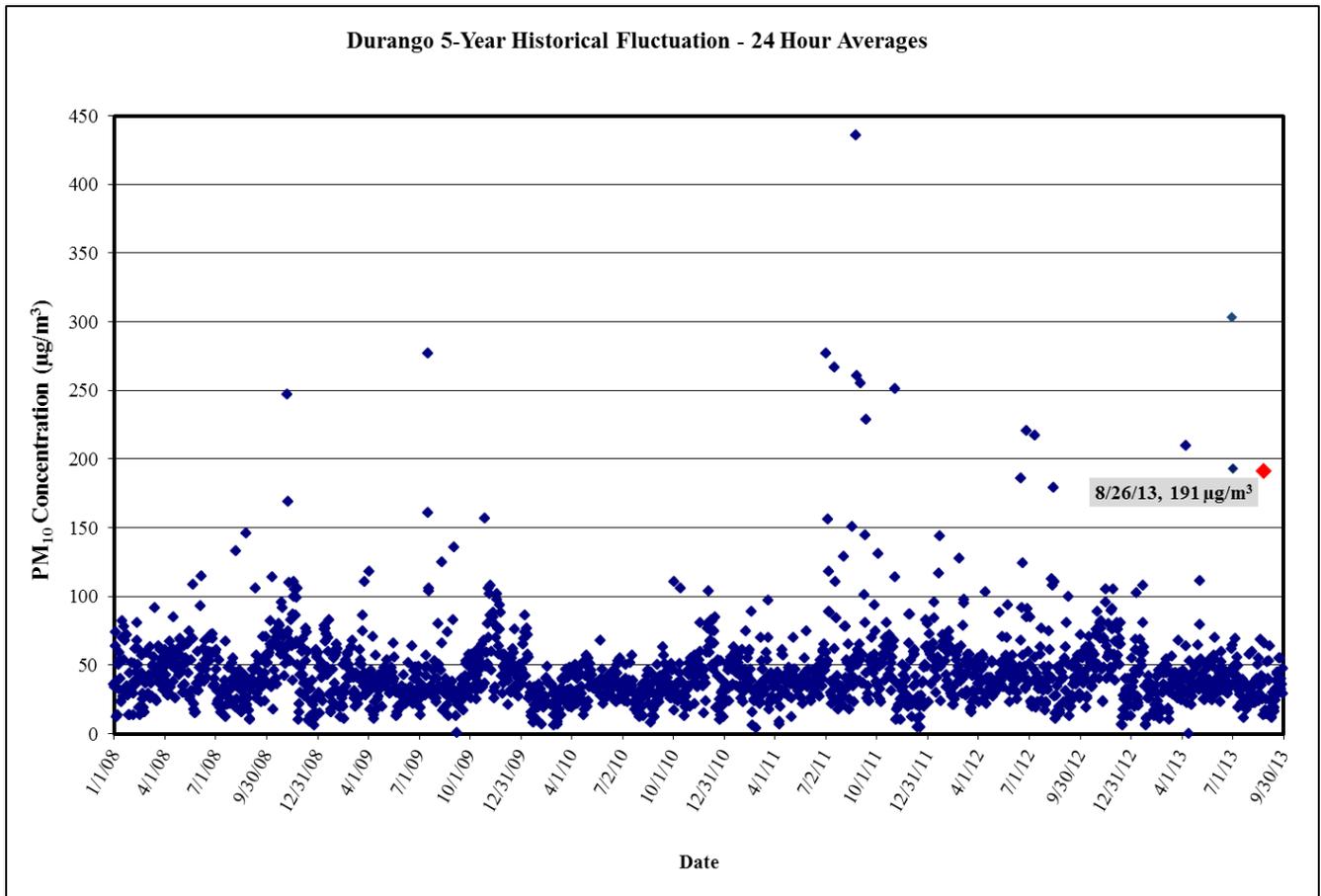


Figure 3-3. Plot of 24-hour average PM₁₀ concentrations (2008 – September 2013) at the Durango Complex monitor.

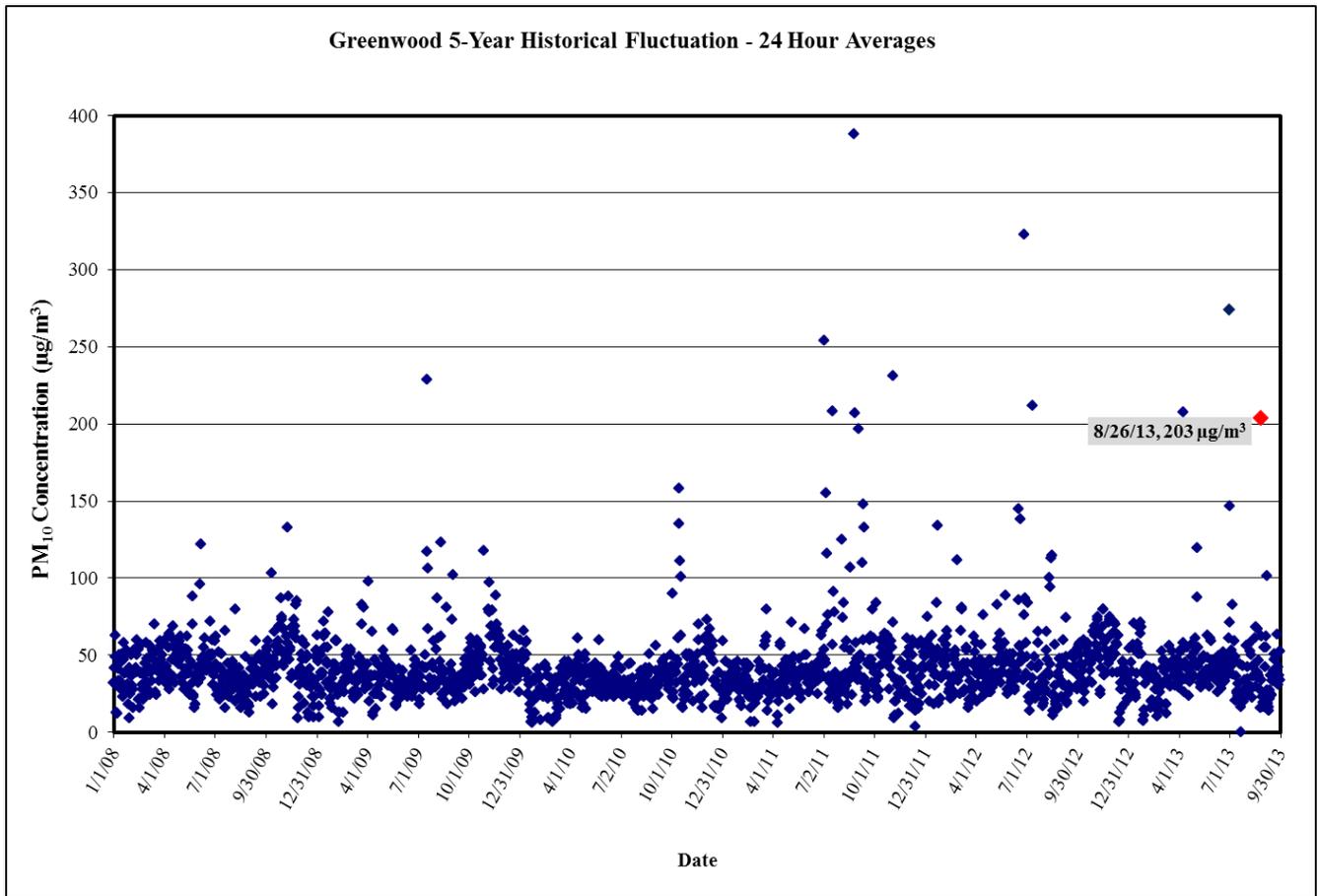


Figure 3-4. Plot of 24-hour average PM₁₀ concentrations (2008 – September 2013) at the Greenwood monitor.

IV. NOT REASONABLY CONTROLLABLE OR PREVENTABLE

Section 50.1(j) of Title 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 and the PM10 nonattainment area, high wind conditions overwhelmed all reasonably available controls. The event occurring on August 26, 2013, was directly related to turbulent winds generated by thunderstorm outflows, producing wind gusts up to 68 mph, sustained winds as high as 46 mph, and reduced visibilities as low as 0.25 miles at Sky Harbor International Airport. The gusty outflow winds overwhelmed all reasonably available controls, and were also responsible for the transport of PM into the Maricopa County PM10 nonattainment area from areas outside of the nonattainment area. As shown in Section V, the source region for the thunderstorm outflows and associated transported dust on August 26, 2013, came from the desert areas of Pinal County. While it is likely that PM10 was generated within the nonattainment area as gusts from the thunderstorm outflows passed through the area, the transport of dust from the source regions outside the nonattainment area contributed heavily to the elevated and exceeding concentrations of PM10 within the nonattainment area. Strict controls on local sources of fugitive dust were in place and enforced during the event on August 26, 2013, but were not capable of controlling dust and PM10 generated and transported by the gusty and turbulent thunderstorm outflow winds on this date.

The following sections describe the BACM- and MSM-level PM10 control measures in place on August 26, 2013, and the robustness of the programs designed to enforce these measures. Inspections of local sources performed before, during, and after August 26, 2013, confirmed that no unusual anthropogenic PM10-producing activities contributed to the exceedances on August 26, 2013.

Regulatory Measures and Control Programs

The Arizona Department of Environmental Quality (ADEQ) and the Maricopa County Air Quality Department (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 (AgBMP)
- 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 PM10 emissions. In addition to routine inspections and inspections driven by complaints, inspections are often increased when 1.) ADEQ forecasters issue a High Risk for the Maricopa County Dust Control Forecast, 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 that are 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 PM10 plan for the Maricopa County portion of the metropolitan Phoenix PM10 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 approved into the Arizona Administrative Code as R18-2-610 and R18-2-611 pursuant to Arizona Revised Statutes § 49-457¹. Maricopa County regulations of PM10 emissions are listed in Table 4-1.

Table 4-1. Rules and Ordinances Regulating Particulate Matter 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.

¹ Updates to the AgBMP program in December, 2011, clarified BMPs for crop and added BMPs for animal operations. Effective 12/29/2011, R18-2-611 was renumbered to R18-2-610.0,1 **Agricultural PM10 General Permit for Crop Operations** and R18-2-611.01, **Animal Operations PM10 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.

Rule/Ordinance Number & Title	Description
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.
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 Woodburning Restriction	Establishes restrictions for residential woodburning.
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.
Arizona Administrative Code R18-2-611 & 610: Agricultural PM10 General permit	Establishes a requirement for commercial farmers to implement best management practices and maintain a record demonstrating compliance

In addition to the rules and regulations listed in the above table, other PM10 reducing control measures (e.g., paving of unpaved roads, PM10 certified street sweepers, controlling unpaved parking lots, etc.) have been committed to, and implemented by, local jurisdictions throughout the PM10 nonattainment area, and incorporated into the Arizona SIP through PM10 plans such as the Revised MAG 1999 Serious Area Particulate Plan for PM10 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 4-2). Additionally, the PCAQCD implements specific nonattainment rules for that part of the Phoenix PM10 nonattainment area that resides in Pinal County (see Table 4-3).

Table 4-2. 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 4-3. Pinal County Rules Regulating Fugitive Dust in Pinal County Portion of MC PM10 NAA.

Article Number & Title	Description
Article 4: Nonattainment Area Rules; Dustproofing for Commercial Parking, Drives and Yards	Establishes rules to avoid violations of the prevailing PM10 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 unstabilized vacant lots

Article Number & Title	Description
Article 7: Construction Sites in Nonattainment Areas – Fugitive Dust	Establishes rules to avoid violations of the prevailing PM10 standard and additionally minimize nuisance impacts by improving control of excessive fugitive dust emissions from activities associated with construction, earthwork, or land development.
Article 8: Nonattainment Area Rules, Requirement for Stabilization of Disturbed Areas at Vacant Lots	Establishes rules for stabilizing disturbed areas at vacant lots

PM10 Rule Effectiveness

MCAQD analyzed the effectiveness of its fugitive dust rules (Rules 310, 310.01 and 316) in terms of source compliance rates. The rule effectiveness study was designed to assess how many sources regulated by MCAQD during the subject time period received no PM10 emissions-related violations. As a basis for comparison, the percentage of sources that did not receive a PM10 emissions-related violation during calendar year 2007 was 76% for sources subject to Rule 310, 85% for sources subject to Rule 310.01, and 40% for sources subject to Rule 316. 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 PM10 State Implementation Plan for the Salt River Area and the Maricopa Association of Governments (MAG) 2007 Five Percent Plan for PM10 for the Maricopa County Nonattainment Area. 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.

Rule effectiveness 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, to 95% (from 85%) for Rule 310.01 sources, and to 65% (from 40%) for Rule 316 sources. These improvements continued into calendar year 2010 with rule effectiveness rates of 94% for Rule 310 sources, 96% for Rule 310.01, and 73% for Rule 316 sources.

Additional rule effectiveness increases were observed for Rule 310.01 and Rule 316 in calendar year 2012. The increase in rule effectiveness for Rule 310.01 was attributed to ADEQ’s Dust Action General Permit, which was a new dust measure contained in the 2012 Five Percent Plan for PM10 for the Maricopa County Nonattainment Area. The rule effectiveness for Rule 310.01 was 98%, an increase of 2% in 2012. The rule effectiveness for Rule 316 had a considerable increase to 83%, which is an increase of 10% compared to 2010.

The timeline below illustrates the improvements in rule effectiveness over the last several years, and also points out significant revisions to previous rules, as well as newly adopted rules, ordinances and measures. Since the first study of 2007, the rule effectiveness has increased for Rule 310, Rule 310.01, and Rule 316 by 17%, 13%, and 43%, respectively.

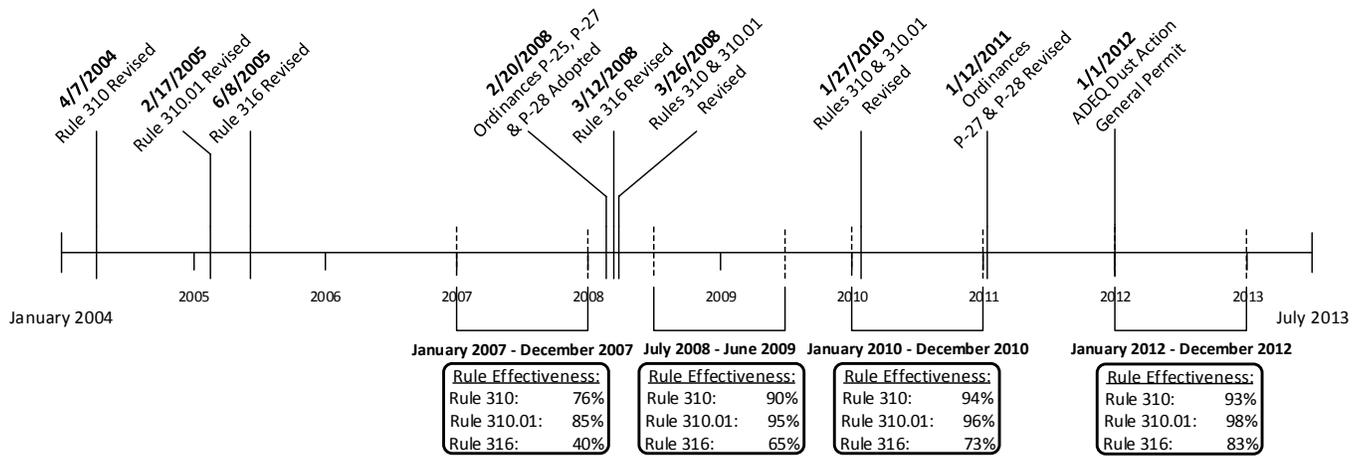


Figure 4-1. Timeline of Maricopa County fugitive dust rules and ordinances.

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: routine proactive inspections, as well as surveillance inspections, conducted both during and after significant events. MCAQD routinely inspects dust control-permitted sites and increases the frequency of inspections for permits covering areas of 10 acres or more. Non-metallic surface mining sources under Rule 316 are also regularly inspected multiple times every year. Maricopa County also responds to the majority of air quality complaints within 24 hours.

Maricopa County monitors the ADEQ Five-Day Dust Control Forecast to identify the potential for elevated PM10 pollution levels due to high winds or stagnant conditions. When a High Pollution Advisory (HPA) is issued for Maricopa County, MCAQD conducts additional increased surveillance before, during, and after the forecast event(s). MCAQD also conducts event surveillance and post-event activities after an exceptional event 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 within two business days of receiving a violation, and an internal MCAQD debriefing of event activities.

Currently, a total of 16 MCAQD air monitoring sites were upgraded with new equipment to allow the monitoring sites to automatically report monitored readings at 5-minute intervals. Previously, hourly readings were only available. The real-time data reporting system includes a mechanism to alert MCAQD inspectors when PM10 concentrations are elevated. The system allows MCAQD inspectors to review concentrations at the monitor 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 PM10 concentrations.

For August 26, 2013, a Maricopa County Dust Control Forecast was issued indicating a low risk level for unhealthy PM₁₀. The Dust Control Forecast indicated southeasterly winds of 5-10 mph.

An evaluation of all inspection reports, air quality complaints, compliance reports, and other documentation indicate no evidence of unusual anthropogenic-based PM₁₀ emissions. During the time period of August 23 through August 29, 2013, MCAQD inspectors conducted a total of 287 inspections of permitted facilities, of which 229 were at fugitive dust sources. Additionally, MCAQD conducted 270 inspections on vacant lots and unpaved parking lots during this period.

During this 7-day period, a total of 35 violations were issued county-wide for PM₁₀ and non-PM₁₀-related violations. One violation was issued for PM₁₀ emissions within a 4-mile radius of the Durango Complex and West 43rd Ave. monitors.

MCAQD issued a violation to a custom home building project on August 29, 2013 for unstable surface areas. The total amount of the unstable area was relatively small and measure roughly 0.29 acre. The source location was approximately 2.42 miles southeast of the Durango Complex monitor and 3.06 miles east of the West 43rd Ave. monitor. The violation would not have impacted the exceeding monitors during the regional exceptional event of August 26, 2013 because of the small violation size and distance from the monitors.

MCAQD was prepared for any complaints received due to the high wind event. During the 7 day period from August 23 through August 29, 2013, MCAQD received 6 complaints, of which none were windblown dust or PM10 related.

In addition to MCAQD's efforts in pre-event surveillance and proactive inspections, ADEQ's Agricultural Best Management Practice Program (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 PM10 readings at a MCAQD air monitoring site show notable increases, the ADEQ Ag BMP inspector is dispatched to contact the owners and operators of agriculture fields in the area to discern if 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 or significant PM10 emissions. From August 23 through August 29, 2013, the ADEQ Ag BMP inspector received no complaints and no site inspections occurred in the areas surrounding the exceeding monitors.

Conclusions

The thunderstorm outflow event on August 26, 2013, produced strong gusts and turbulent wakes that transported and generated dust and PM10 into the Maricopa County PM10 nonattainment area. The source region of the outflow winds that caused the exceedances was largely located in areas outside the nonattainment area, primarily the deserts of Pinal County. The Maricopa County area is designated as a serious nonattainment area for PM10 and is required to have BACM for all significant sources of PM10. BACM-approved control measures on significant anthropogenic sources were in place and enforced during the events, and pro-active 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 thunderstorms and thunderstorm outflow winds brought high concentrations of PM10 emissions into, and also overwhelmed controls within, the nonattainment area. Strong thunderstorm outflows with gusts as high as 68 mph, and sustained winds as high as 46 mph, were more than enough to overwhelm all available efforts to limit PM10 concentrations from the event. The fact that this was a natural event involving strong thunderstorm outflow winds that transported and generated PM10 emissions into Maricopa County from source regions outside of the nonattainment area provides strong evidence that the event and exceedances of August 26, 2013, recorded at four Maricopa County monitors, were not reasonably controllable or preventable.

V. CLEAR CAUSAL RELATIONSHIP

Introduction

A demonstration of the clear causal connection between windblown dust generated and transported by thunderstorm outflow winds and the exceedances at the four Maricopa County monitors on August 26, 2013, is provided in this section. Around 5:00 pm on August 26, 2013, a very strong thunderstorm outflow developed in the deserts of northern Pinal County and began transporting dust northward towards the nonattainment area. Strong winds heading north-northwest from the thunderstorm outflow continued across Maricopa County, with gusts as high 68 mph and sustained winds as high as 46 mph, depositing and generating five-minute average PM10 concentrations over 5,000 $\mu\text{g}/\text{m}^3$ along the way. Precipitation was significant in scattered areas across the nonattainment area, helping to prevent some monitoring locations in Maricopa and Pinal counties from exceeding the PM10 standard. In all, four Maricopa County monitors exceeded the 24-hour PM10 standard as a result of the PM10 transported and generated by the thunderstorm outflow winds. Drought conditions in Pinal County and southern Maricopa County likely exacerbated the amount of the dust the thunderstorm outflow was able to entrain.

A detailed description of the meteorology that caused the natural windblown dust exceedance event at the Maricopa County monitors is described below in a series of time-stamped maps. Time series videos of visibility photos on the day of the high wind dust event provide additional evidence of the dust storm impacts on Maricopa County monitors. The weight of evidence presented in this section provides the clear causal connection between the windblown dust generated and transported by thunderstorm outflow winds and the exceedances at the Maricopa County monitors on August 26, 2013.

Time Series Maps and Visibility Photos

Figures 5–1 through 5–13 provide a time series GIS-based visualization of the meteorology and PM10 concentrations associated with the thunderstorm outflows. The data displayed in the following maps were gathered from five data sources. All available meteorological and air quality data was used in order to present the most complete story of the event. Table 5–1 displays the types of data used from each agency in creating the maps.

Table 5-1. Data Sets Used in the Creation of Time Series GIS Maps.

Agency	Data Sets
Arizona Department of Environmental Quality (ADEQ)	Hourly PM10 Concentrations, Wind Speed, Wind Direction and Wind Gusts
Arizona Meteorological Network (AZMET)	Hourly Wind Speed, Wind Direction and Wind Gusts
Maricopa County Air Quality Department (MCAQD)	5-Minute PM10 Concentrations, Wind Speed, Wind Direction, and Wind Gusts (hourly data used when 5-minute was unavailable)
Pinal County Air Quality Control District (PCAQCD)	Hourly PM10 Concentrations, 5-Minute and Hourly Wind Speed, Wind Direction and Wind Gusts
National Weather Service (NWS)	Point in Time Wind Speed, Wind Direction, Wind Gusts, Visibility and Base Reflectivity Radar

Map Description

A description of each time series map is provided to highlight important data in each map and explain the progression of the meteorology and PM10 concentrations through time. Taken as a whole, the maps and associated explanatory text describe the clear causal connection between the windblown dust generated and transported by the thunderstorm outflow winds and the PM10 exceedances at the Maricopa County monitors.

August 26, 4:30 PM – 5:00 PM

This map portrays the calm conditions prior to the generation and approach of the thunderstorm outflow from Pinal County. PM10 concentrations are less than or equal to $50 \mu\text{g}/\text{m}^3$ across the entire Maricopa County nonattainment area.

August 26, 5:00 PM – 5:30 PM

The thunderstorm outflow in Pinal County is visible on base reflectivity radar. The dust storm generated by the thunderstorm outflow has raised hourly average PM10 concentrations above $2,500 \mu\text{g}/\text{m}^3$ at three Pinal County monitors. Gusts as high as 44 mph and sustained winds as high as 27 mph are recorded in the region. Light precipitation is recorded at the Casa Grande Airport, which helps to reduce PM10 generation from the desert areas around the airport.

August 26, 5:30 PM – 6:00 PM

The outflow grows in strength and intensity as it approaches the nonattainment area boundary under gusts as high as 52 mph and sustained winds as high as 36 mph. Precipitation continues to fall at the Casa Grande Airport, which will likely lessen the impact of the dust storm on the southeastern monitors in Maricopa County.

August 26, 6:00 PM – 6:30 PM

The thunderstorm outflow dust storm impacts the southeastern Maricopa County monitors, reducing visibilities to as low as 1.0 miles at the Chandler Municipal Airport and 2.0 miles at the Williams Gateway Airport. Precipitation is reported at the Mesa AZMET site, which likely results in reduced PM10 concentrations in the eastern portions of Maricopa County. Winds from the outflow remain intense with gusts of 52 mph and sustained winds of 39 mph.

August 26, 6:30 PM – 7:00 PM

The thunderstorm outflow slams into the central portion of Maricopa County under gusts of 55 mph and sustained winds of 46 mph. Five-minute average concentrations over $8,400 \mu\text{g}/\text{m}^3$ are recorded during this period at the Greenwood monitor. Visibility is reduced to near zero (0.25 miles) at the Sky Harbor International Airport. Moderate precipitation is reported at Sky Harbor International Airport and Mesa AZMET monitoring station as well. While PM10 concentrations are still very high in the eastern portion of Maricopa County, it is likely that precipitation in those areas prevented exceedances of the PM10 standard. In the areas located west of Sky Harbor International Airport where precipitation has not yet been recorded, PM10 concentrations are more than double of those reported in the eastern portion of Maricopa County.

August 26, 7:00 PM – 7:30 PM

The outflow progress rapidly across Maricopa County impacting the northern- and western-most monitoring stations. The Buckeye monitor records the highest wind gust of 63 mph and sustained winds of 35 mph. Heavy rain recorded at the Buckeye AZMET monitor likely prohibited the Buckeye monitor from recording an exceedance of the PM10 standard. Luke Air Force Base reports reduced visibilities down to 0.5 miles under sustained winds as high as 40 mph. Significant precipitation is also recorded at Luke Air Force Base and the Phoenix Greenway AZMET monitoring station. PM10 concentrations remain very high at the exceeding central Maricopa County monitors, with some precipitation recorded at the Phoenix Encanto Golf Course. Although near the exceeding central monitors, it is unclear if this precipitation fell at the monitoring locations. PM10 concentrations in the eastern portions of Maricopa County have returned quickly to near normal levels.

August 26, 7:30 PM – 8:00 PM

The thunderstorm outflow exits Maricopa County to the west and north during this period. The highest gusts produced by the outflow (68 mph) are recorded at the Buckeye Municipal Airport during this period. Heavy rain in the area has prevented the western-most Buckeye monitor from exceeding the PM10 standard despite the extremely high wind speeds. PM10 concentrations begin to decrease in the central portion of Maricopa County under light, but gusty winds. Wind direction has shifted to a predominantly eastward flow. Scattered precipitation is recorded throughout the central and western portions of Maricopa County.

August 26, 8:00 PM – 8:30 PM

Wind speeds have been reduced to near zero in the central portions of Maricopa County, which has suspended lingering dust over the central monitors, raising PM10 concentrations to over 1,000 $\mu\text{g}/\text{m}^3$ at five locations. Light precipitation is still being recorded in the western and eastern portions of Maricopa County, but not in the center of Maricopa County where PM10 concentrations are the highest.

August 26, 8:30 PM – 9:00 PM

Winds from the west pick up during this period, and begin to push some of the suspended dust east across the nonattainment area. Visibility drops back to 6.0 miles at Sky Harbor International Airport as a resulting of the arrival of suspended dust from the west.

August 26, 9:00 PM – 9:30 PM

Stronger winds from the west, with gusts of 24 mph and sustained winds of 14 mph have finally largely pushed most of the dust east, out of the area around the exceeding monitors. PM10 concentrations at some of the more eastern monitors rise in response to the arrival of dust from the west under moderately high winds.

August 26, 9:30 PM – 10:00 PM

Any remaining suspended dust continues to be pushed east under prevailing winds. PM10 concentrations at western, northern and central monitors have largely returned to pre-dust storm levels.

August 26, 10:00 PM – 10:30 PM

Only two eastern monitors record elevated PM10 concentrations in response to lingering dust from the evening's earlier dust storm. Prevailing winds now are largely from the northwest and continue to push suspended dust to the southeast.

August 26, 10:30 PM – 11:00 PM

PM10 concentrations have returned to normal levels throughout the nonattainment area under prevailing winds from the northwest. Concentrations will remain low for the remainder of August 26, 2013.

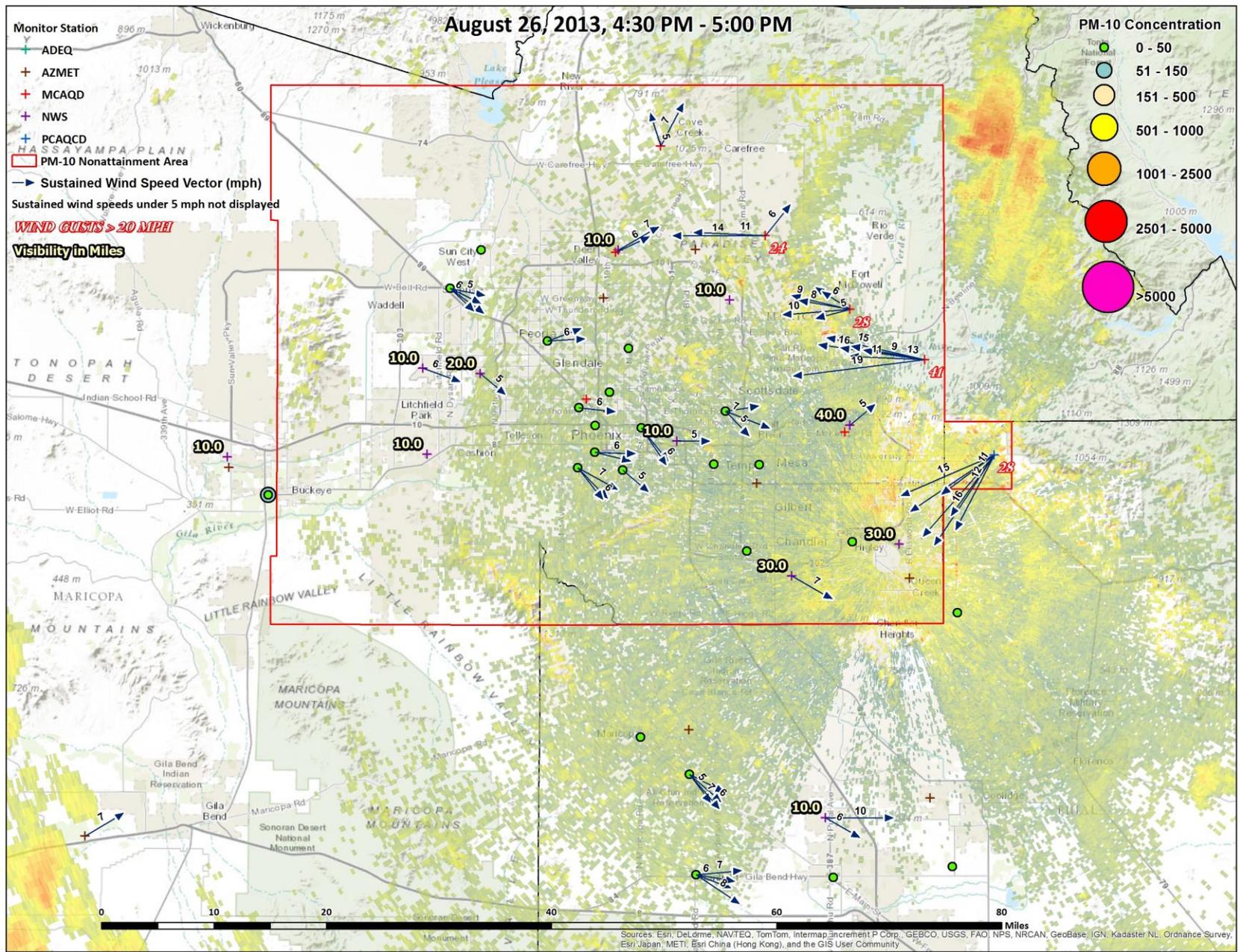


Figure 5-1. August 26, 2013, 4:30 PM – 5:00 PM.

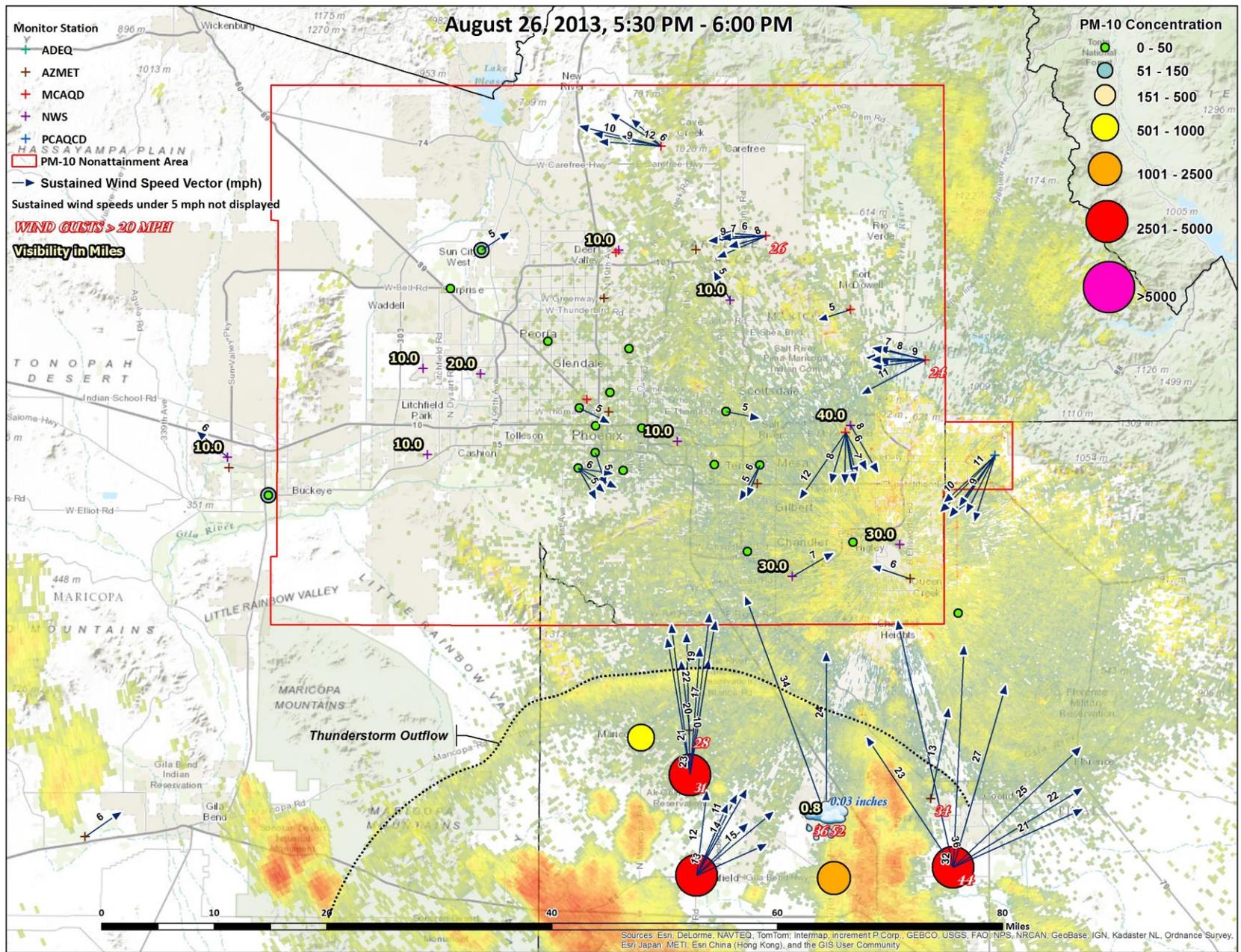


Figure 5-3. August 26, 2013, 5:30 PM – 6:00 PM.

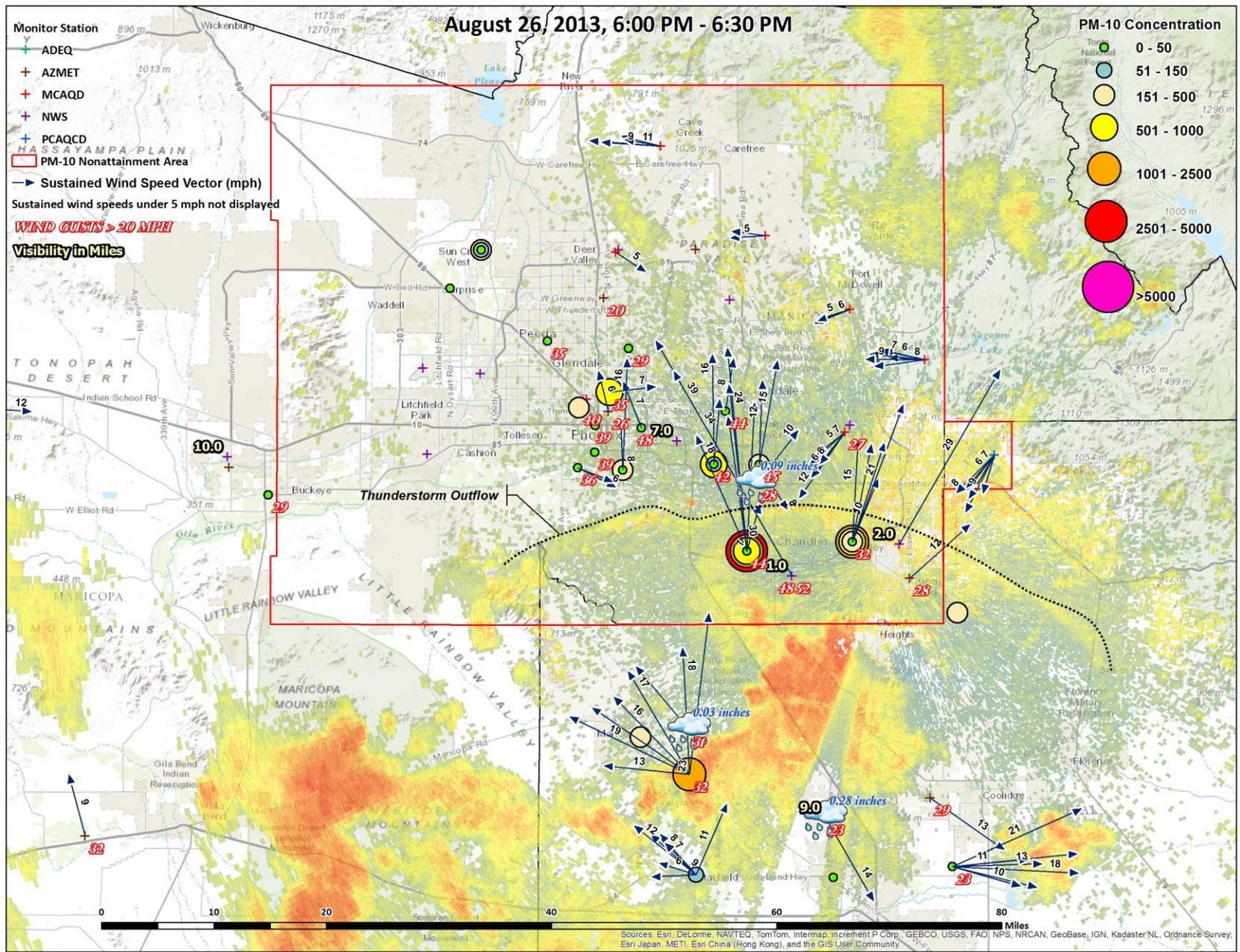


Figure 5-4. August 26, 2013, 6:00 PM – 6:30 PM.

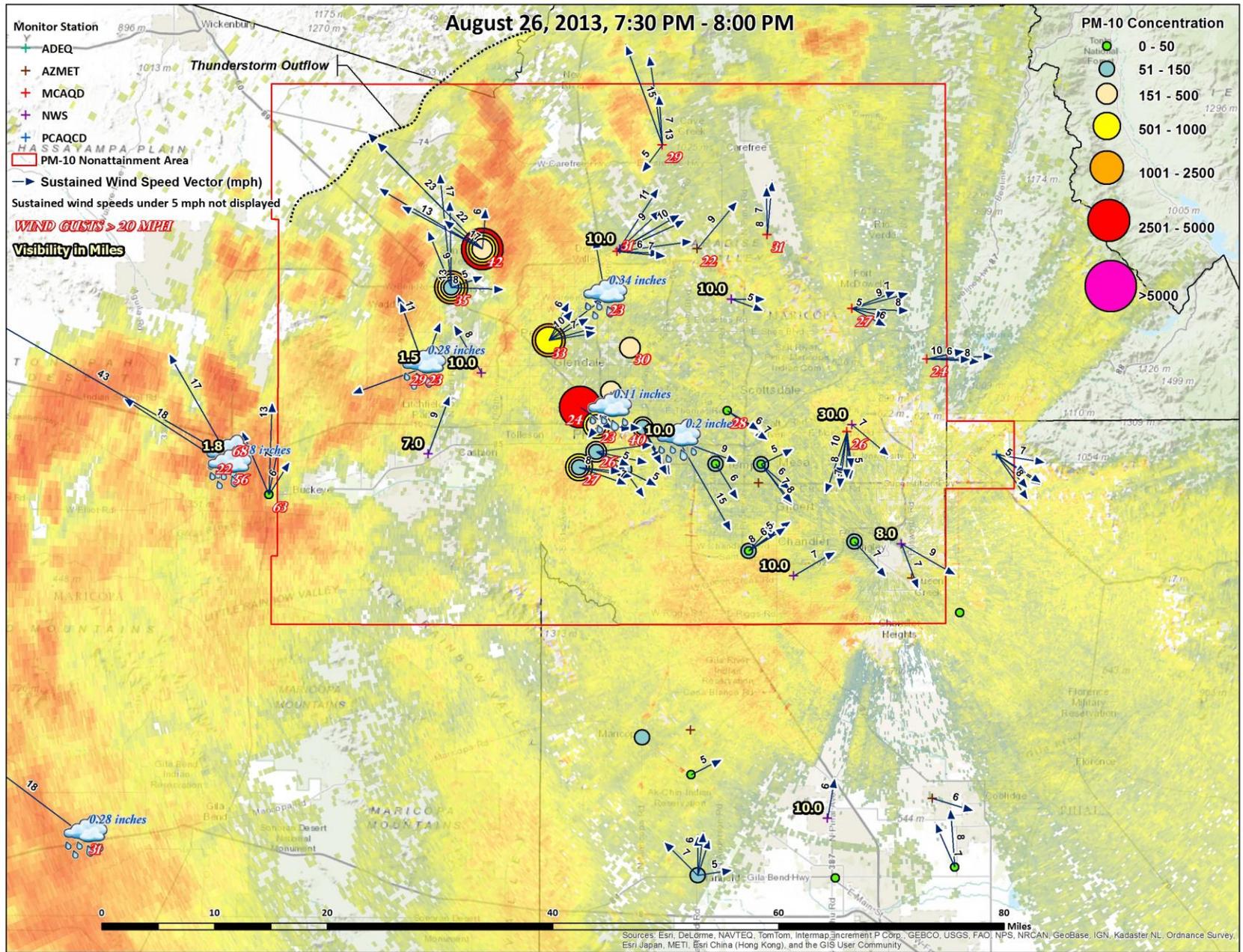


Figure 5-7. August 26, 2013, 7:30 PM – 8:00 PM.

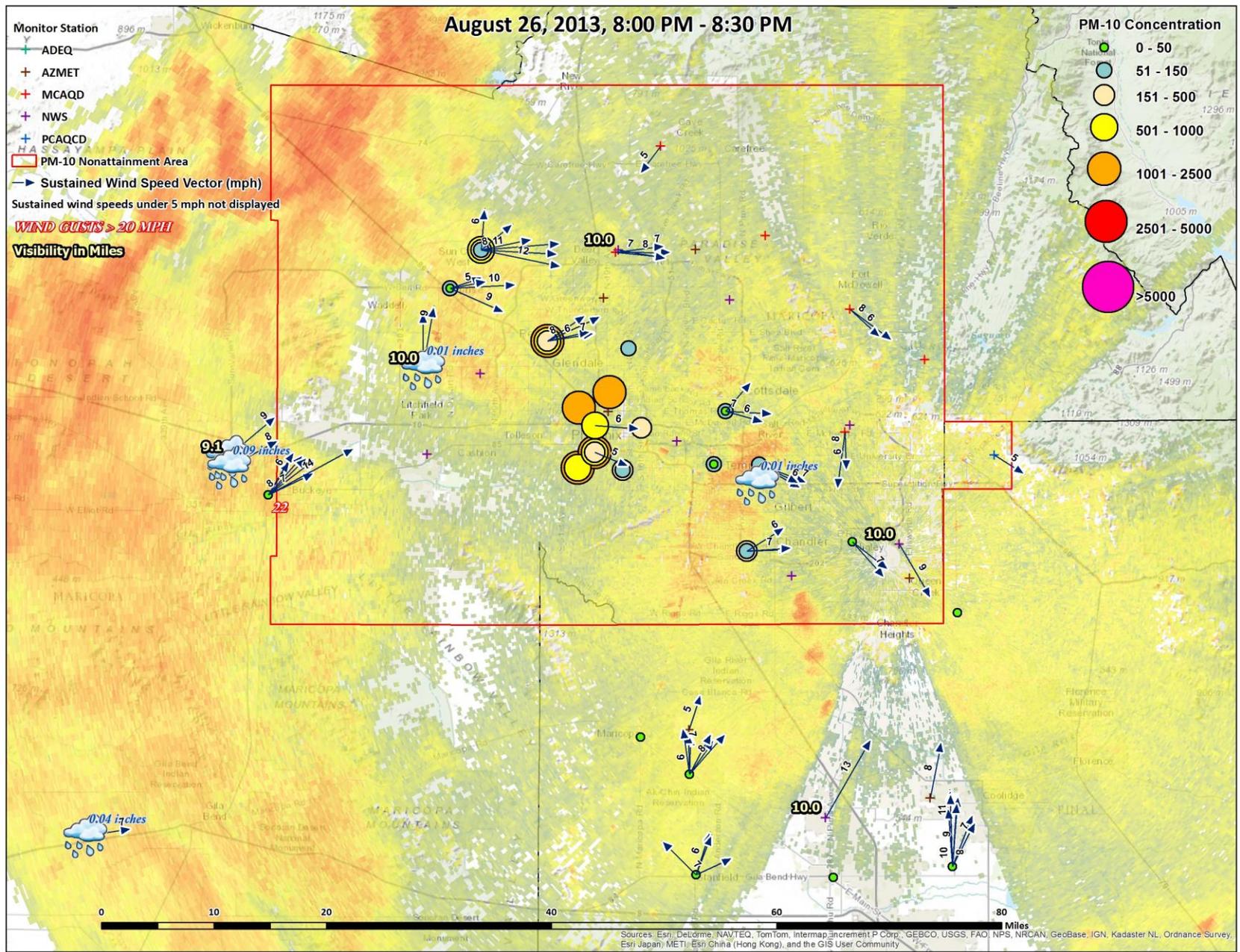


Figure 5-8. August 26, 2013, 8:00 PM – 8:30 PM.

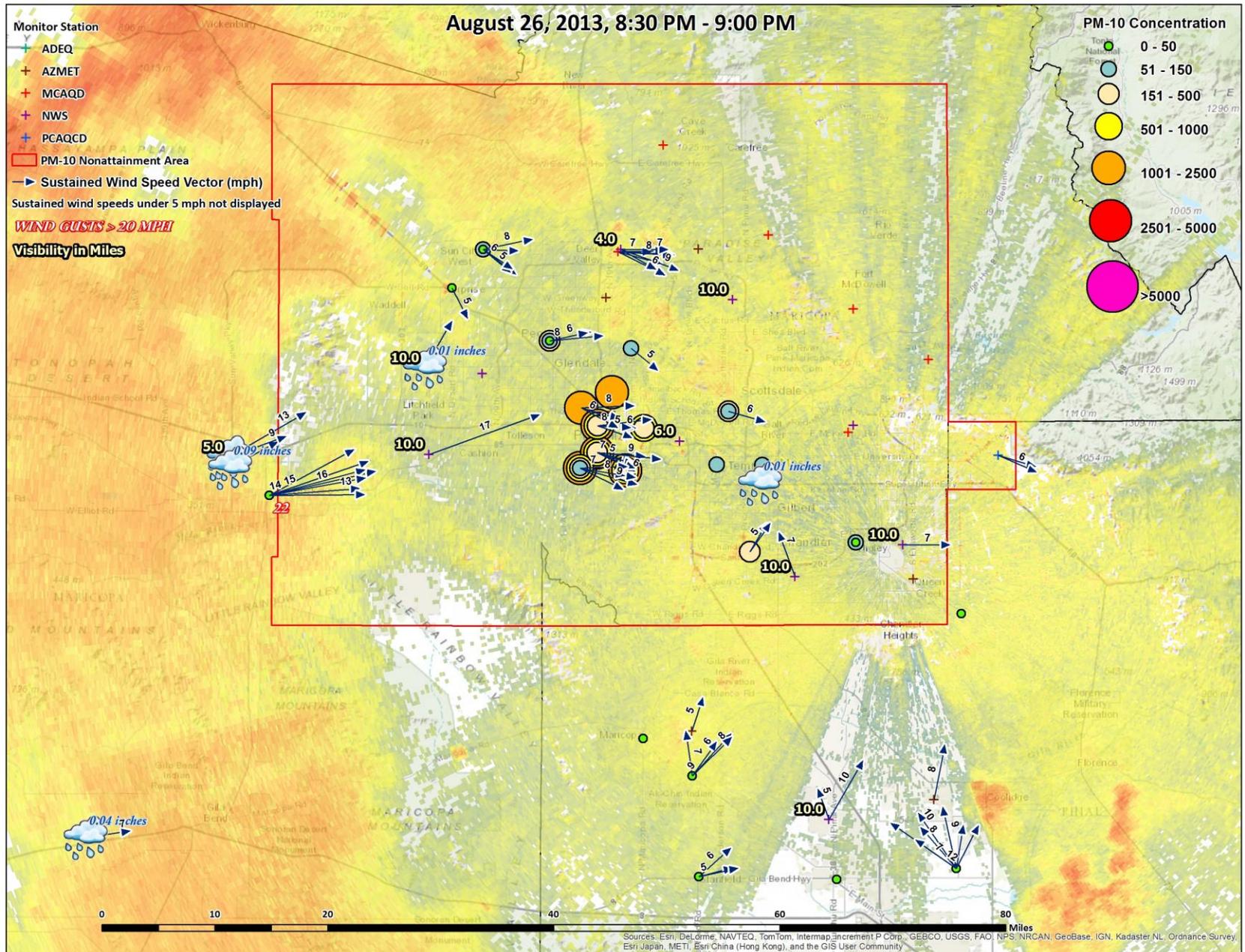


Figure 5-9. August 26, 2013, 8:30 PM – 9:00 PM.

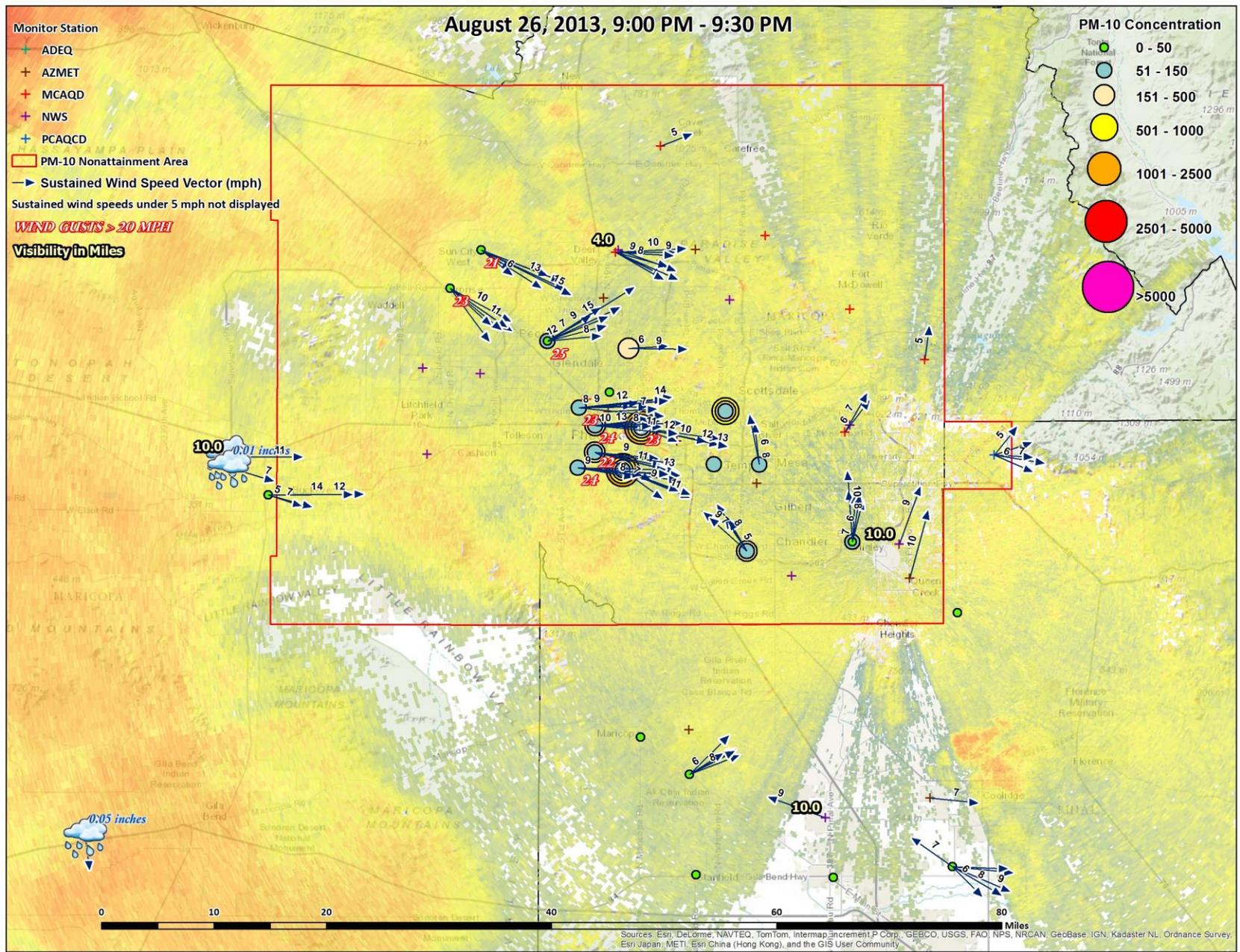


Figure 5-10. August 26, 2013, 9:00 PM – 9:30 PM.

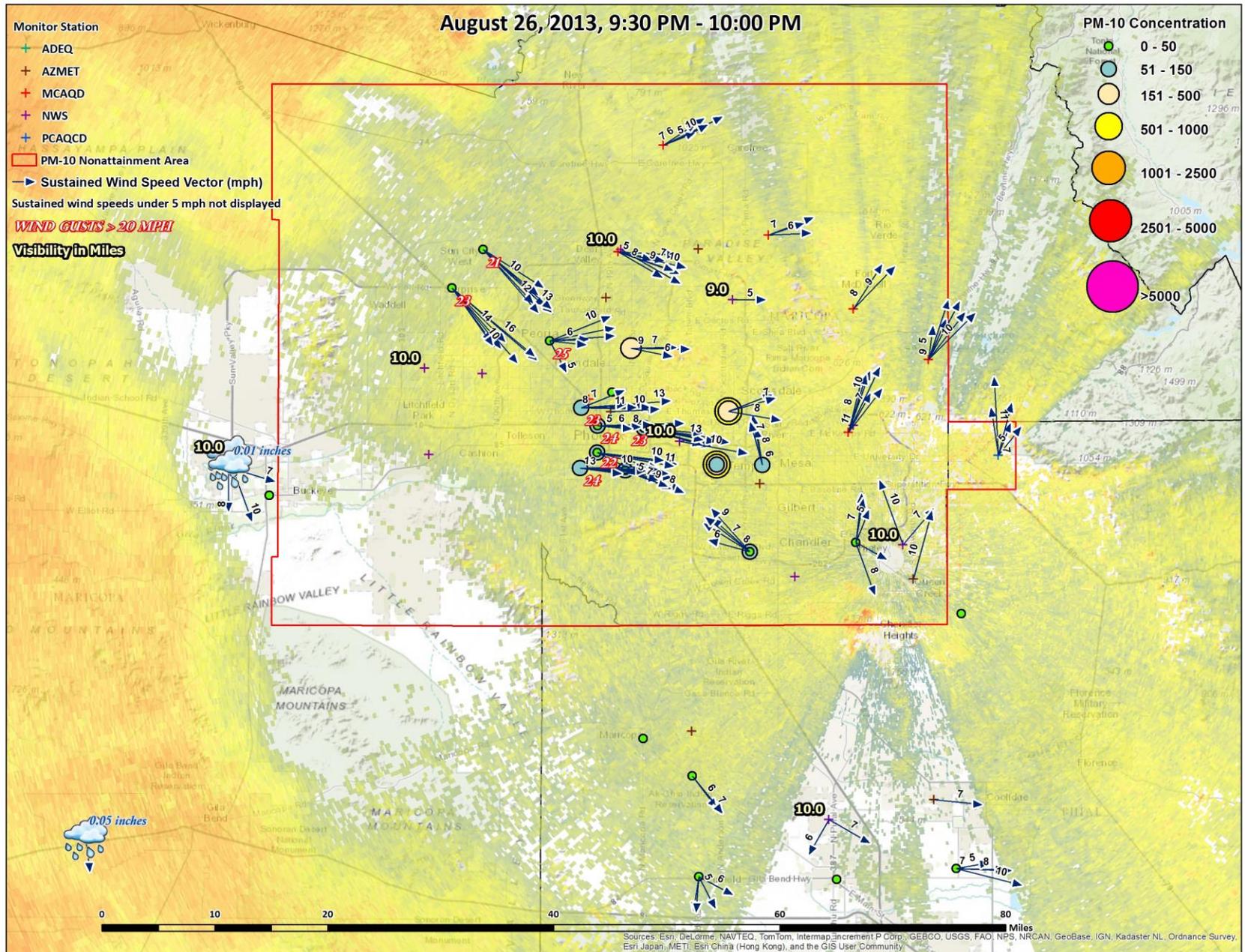


Figure 5-11. August 26, 2013, 9:30 PM – 10:00 PM.

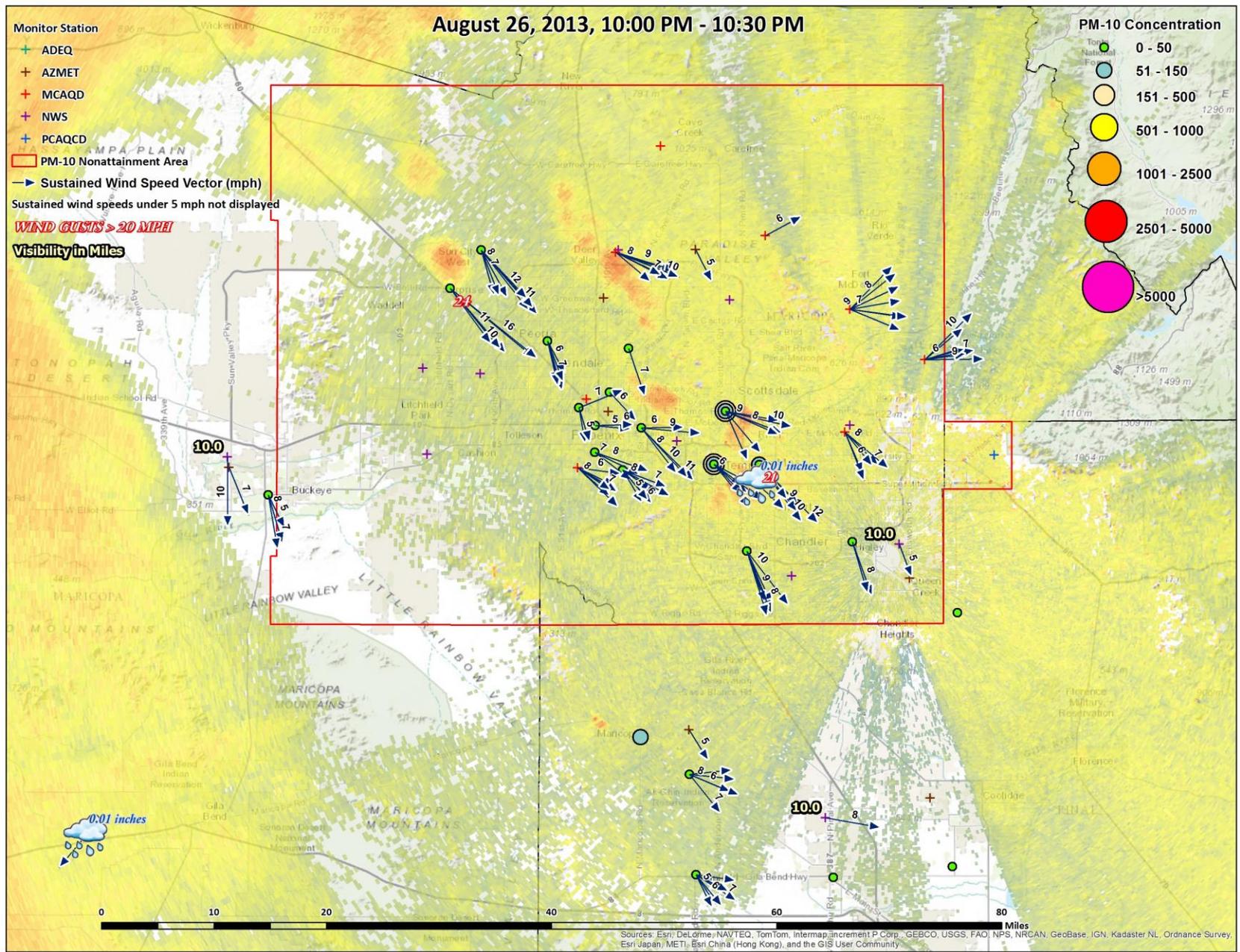


Figure 5-12. August 26, 2013, 10:00 PM – 10:30 PM.

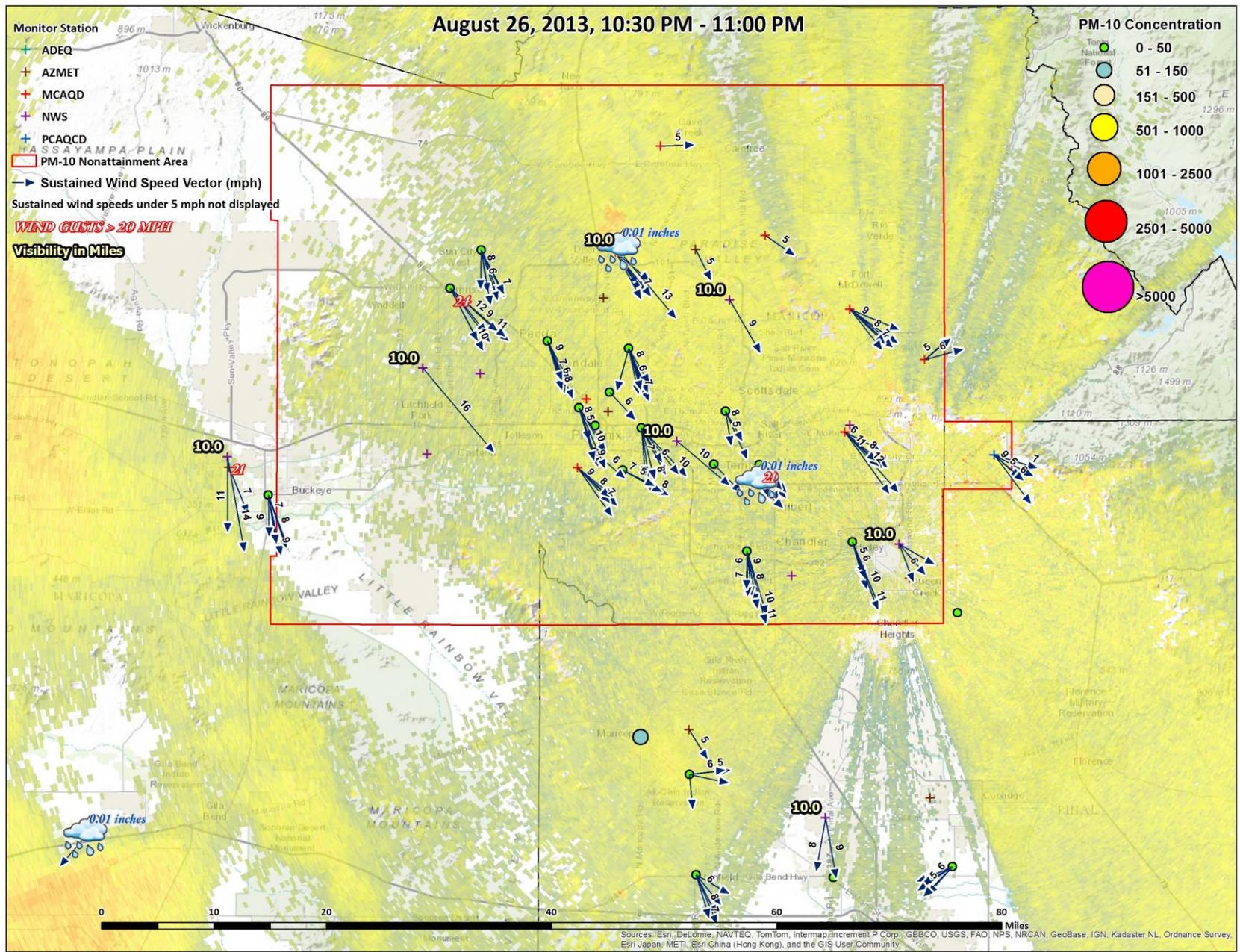


Figure 5-13. August 26, 2013, 10:30 PM – 11:00 PM.

Visibility Photos

Time series videos of visibility photos taken by the South Mountain (link #1) and Camelback Mountain (link #2) cameras in the area of the exceeding monitors clearly shows the approach of the thunderstorm outflow and decreased visibility due to the overwhelming dust storm associated with the thunderstorm outflow. Locations for visibility cameras positioned in the Phoenix area are shown in link #3.

- 1.) http://www.phoenixvis.net/tlapse_camera.aspx?site=SOMT1
- 2.) http://www.phoenixvis.net/tlapse_camera.aspx?site=CAME1
- 3.) <http://www.phoenixvis.net/>

Conclusion

The information presented within this section has adequately demonstrated a clear causal relationship between the emissions generated by uncontrollable natural events and the exceedances measured at the Maricopa County monitors. The maps provided in this section contain an illustration of the event as it unfolded. The series of maps for the event show a spatial and temporal representation of the thunderstorm outflow winds and associated windblown dust as they move throughout Maricopa and Pinal counties. These maps show a clear causal connection between the windblown dust generated and transported by the thunderstorm outflow winds and the exceedance at the Maricopa County monitors. Visibility photos help show the approach of the thunderstorm outflow and the reduced visibilities associated with the dust storm generated by the outflow. It is clear from these data that thunderstorm outflow winds generated and transported uncontrollable windblown PM10 emissions to the Maricopa County monitors, demonstrating a clear causal connection between the event and the exceedances.

VI. “BUT FOR” ANALYSIS

Section 50.14(c)(3)(iv)(D) in 40 CFR part 50 requires that an exceptional event demonstration must satisfy 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 the exceedances on August 26, 2013, were not reasonably controllable or preventable and that there is a clear causal relationship between the windblown dust generated and transported by thunderstorm outflow winds and the exceedances at the Maricopa County monitors. The weight of evidence in these sections demonstrates that but for the existence of windblown dust emissions generated and transported by thunderstorm outflow winds, there would have been no exceedance of the 24-Hour PM10 standard.

As detailed in Section IV, all reasonable control measures were in place and actively enforced before, during, and after the exceedances on August 26, 2013. Inspection and compliance data of local fugitive dust sources during this time period revealed that PM10 from anthropogenic activities was well controlled and constant. Real-time surveillance of PM10 monitoring stations during the event established a clear link between rapidly rising PM10 concentrations and the arrival of the thunderstorm outflow winds. As an example, Figure 6–1 shows that PM10 concentrations in the hours before the event at the exceeding West Phoenix monitor were at normal levels, indicating no significant anthropogenic activities. PM10 concentrations in the hours after the event show a quick return to low levels once transported dust from the thunderstorm outflow passed the monitoring station. Figures 6–2 through 6–4 display the same data for the other three exceeding monitors (sustained wind speed data from the nearby Sky Harbor International Airport is included on all the figures as this data better captures the strength of winds from the passing thunderstorm outflow as opposed to the hourly average wind speed values recorded at each monitoring station).

As shown in Section V, detailed, time series maps establish a clear causal relationship between the arrival of windblown dust generated by thunderstorm outflow winds and elevated PM10 concentrations at the monitors. The body of evidence presented in this submittal confirms that the exceedances on August 26, 2013, were a natural event and that there would have been no exceedance but for the presence of the uncontrollable windblown dust from the thunderstorm outflow winds.

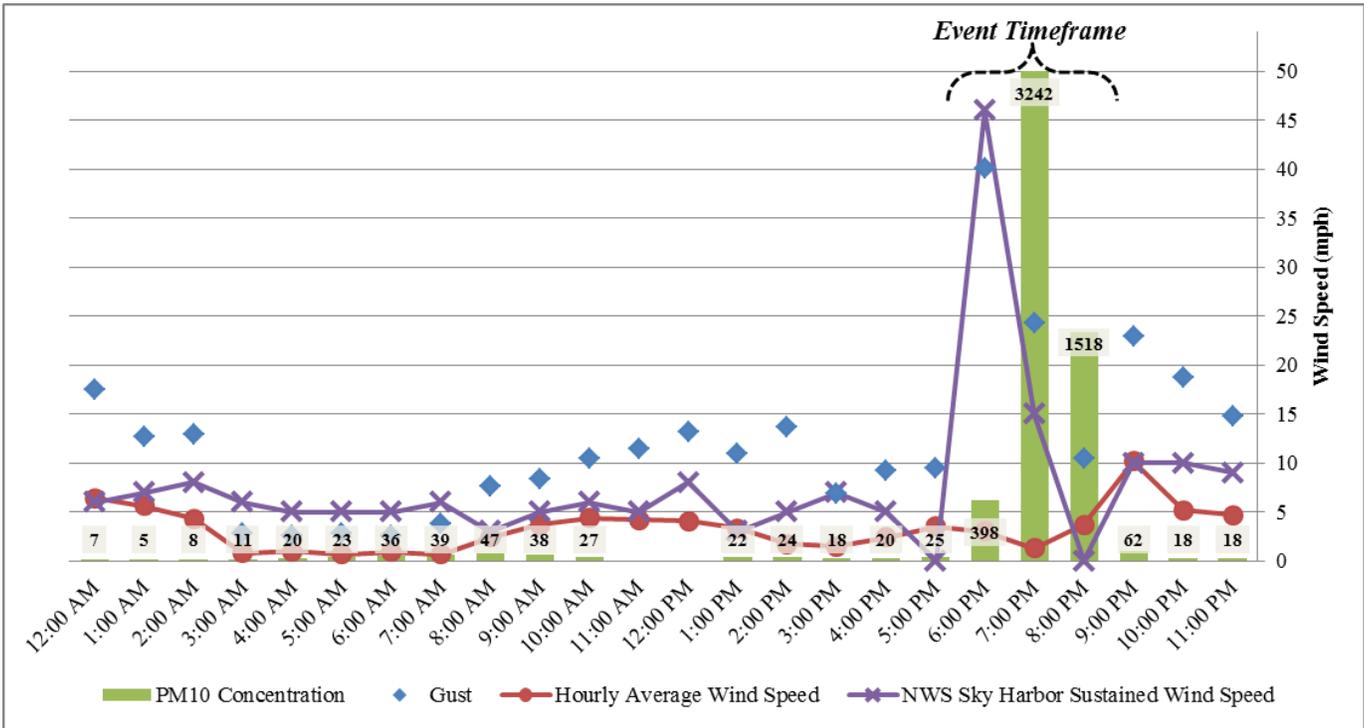


Figure 6-1. Hourly PM10 concentration, wind gust, and average wind speed as recorded at the exceeding West Phoenix monitor.

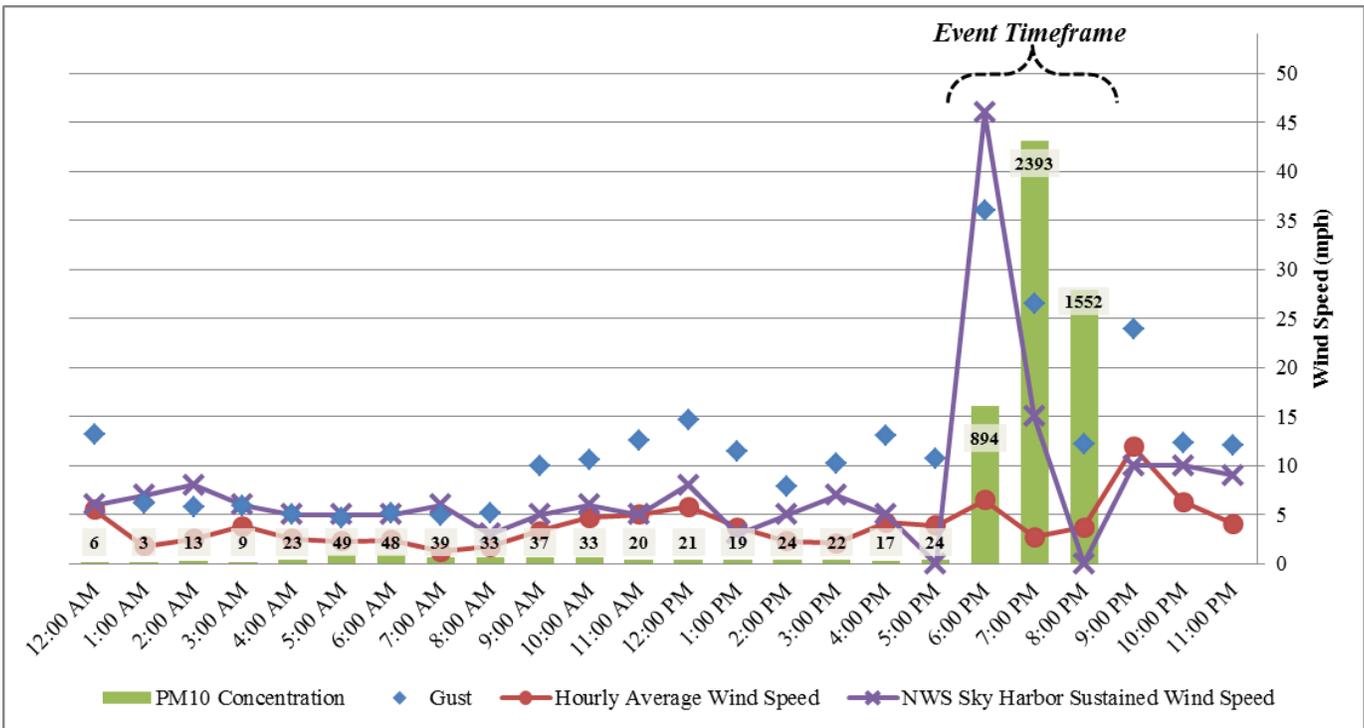


Figure 6-2. Hourly PM10 concentration, wind gust, and average wind speed as recorded at the exceeding West 43rd Avenue monitor.

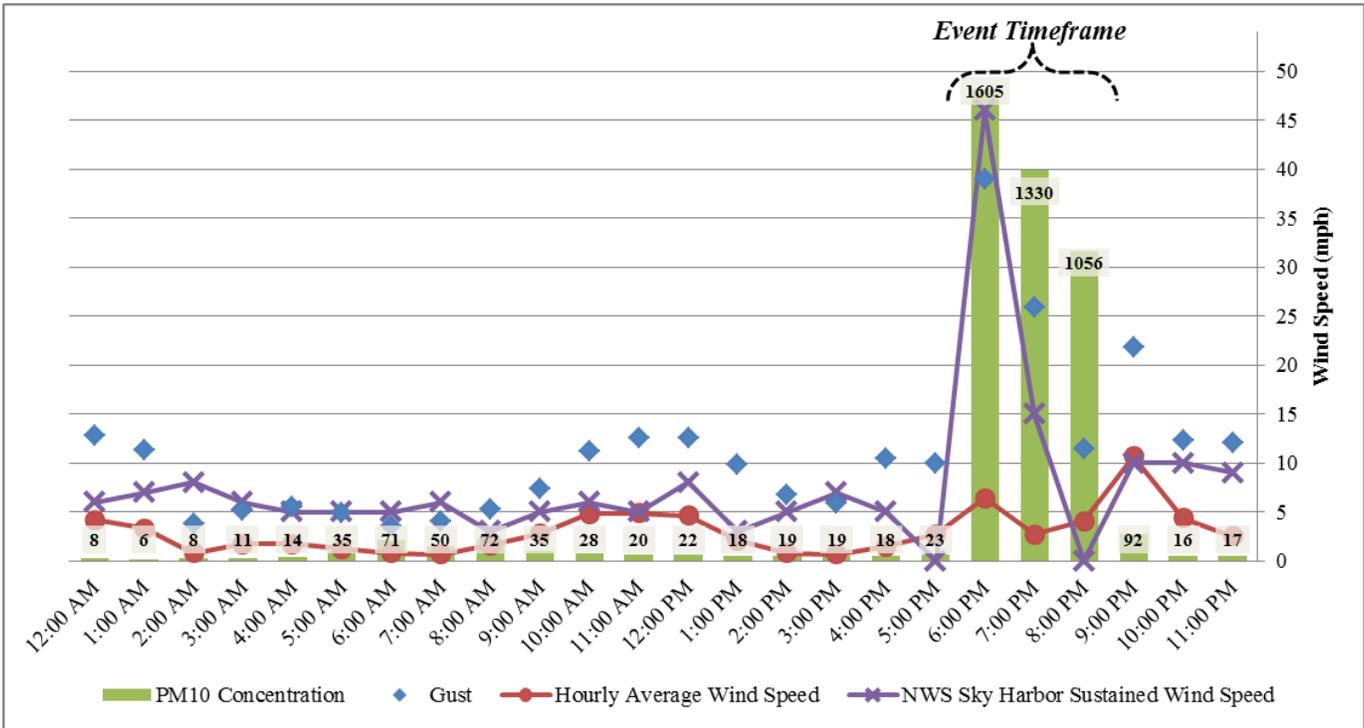


Figure 6-3. Hourly PM10 concentration, wind gust, and average wind speed as recorded at the exceeding Durango Complex monitor.

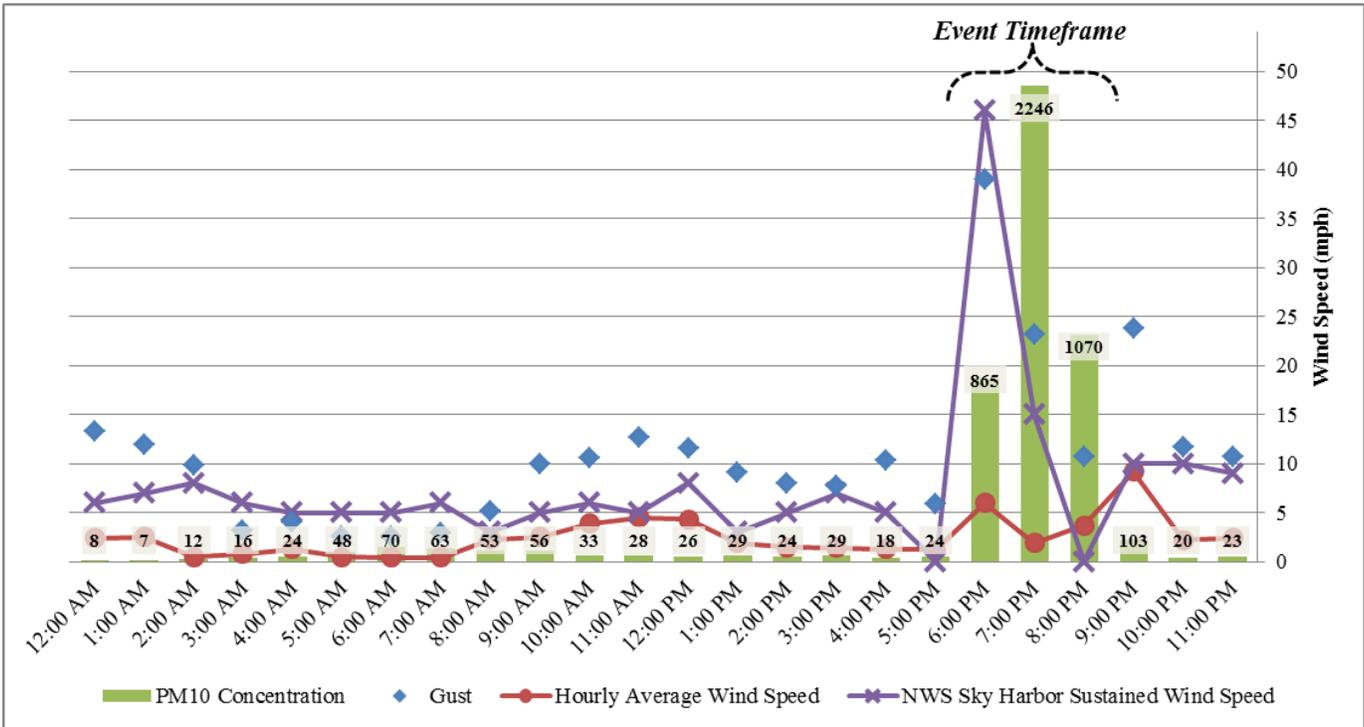


Figure 6-4. Hourly PM10 concentration, wind gust, and average wind speed as recorded at the exceeding Greenwood monitor.

VII. CONCLUSIONS

The exceedances that occurred on August 26, 2013, satisfy the criteria of 40 CFR 50.1(j) and meet the definition of an exceptional event. These criteria are:

- The event affects air quality.
- The event is not reasonably controllable or preventable.
- The event is unlikely to reoccur at a particular location or [is] a natural event.

A. Affects Air Quality

As stated in the preamble to the Exceptional Events Rule, 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 measured concentrations in excess of normal historical fluctuations. Given the information presented in Sections II, III, IV and V, it is reasonable to conclude that the event in question affected air quality.

B. Not Reasonably Controllable or Preventable

Section 50.1(j) of Title 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 and the PM10 nonattainment area, high wind conditions overwhelmed all reasonably available controls. Despite the deployment of comprehensive control measures and sophisticated response programs, high wind conditions associated with thunderstorms and thunderstorm outflows generated and brought high concentrations of PM10 emissions into the PM10 nonattainment area. The event discussed in this document that caused the exceedances in this request (see Sections II and V) was caused by thunderstorm driven outflow winds that generated and transported dust into Maricopa County from areas inside and outside of the PM10 nonattainment area. The fact that this was a natural event involving strong thunderstorm outflow winds that transported and generated PM10 emissions into Maricopa County, provides strong evidence that the event and exceedances of August 26, 2013, recorded at the Maricopa County monitors were not reasonably controllable or preventable.

C. Natural Event

As discussed above, the event shown to cause these exceedances were emissions of PM10 generated by high winds caused by thunderstorm activity and related outflow boundaries on August 26, 2013. The event therefore qualifies as a natural event.

In summary, the exceedances of the federal 24-hour PM10 standard on August 26, 2013, would not have occurred but for the monsoonal thunderstorm driven high winds and windblown dust generated and transported from areas inside and outside the nonattainment area, based on the following weight of evidence:

- Historical Fluctuation data in Section III showing five years of 24-hour average data for the Maricopa County monitors demonstrates that the values on August 26, 2013, were atypical and in excess of normal historical fluctuations.
- Section IV discusses rules that are in place in the nonattainment area as well as inspections that were conducted in the area to verify compliance with those rules in order to show that the event was not reasonably controllable or preventable.
- The exceedances of the PM10 standard recorded on August 26, 2013, are tied to thunderstorm activity and thunderstorm generated outflow winds, as can be seen in radar imagery analyses in Section V.
- Figures in Section V show that the timing of thunderstorm generated outflow boundary passage and increases in wind speeds at monitoring locations and National Weather Service stations during the event are consistent with the timing of elevated PM10 concentrations recorded at the monitoring locations in the nonattainment area.
- Wind directions, thunderstorm generated outflow boundary propagation, and concentration patterns showing elevated levels of PM10 in Pinal County prior to levels increasing in Maricopa County, all depicted in Section V, help to show that dust originating in Pinal County was transported to the nonattainment area.
- Visibility camera imagery displayed in Section V indicates the widespread nature of the windblown dust transported by thunderstorm outflow winds and provides evidence that high PM10 concentrations are linked to natural sources as opposed to specific anthropogenic sources of dust.