State of Arizona Exceptional Event Documentation of High Wind Dust Event PM_{10} Exceedances on September 27-28, 2016 in the Maricopa County PM_{10} Nonattainment Area

Produced by:

Arizona Department of Environmental Quality
Maricopa County Air Quality Department
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DRAFT Report
April 2017

September 27-28, 2016 High Wind Dust Event

(Image source: http://www.azfamily.com/story/33265871/slideshow-massive-wall-of-dust-hits-valley?autostart=true)

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I. INTRODUCTION

This documentation is being submitted to the Environmental Protection Agency (EPA) to demonstrate that exceedances of the 24-hour PM_{10} standard at the Glendale and JLG Supersite monitors in the Maricopa County PM_{10} nonattainment area on September 27-28, 2016 should be excluded from use in determinations of exceedances or violations of the 24-hour PM_{10} National Ambient Air Quality Standards (NAAQS) as an exceptional event caused by a high wind dust event. This documentation serves to meet the requirements of Clean Air Act Section 319(b) (Air quality monitoring data influenced by exceptional events) and the EPA final rule, *Treatment of Data Influenced by Exceptional Events* (81 FR 68216), as codified in 40 CFR Sections 50.1 and 50.14. Additionally, state and local agencies are in the process of developing a mitigation plan for the Maricopa County PM_{10} nonattainment area to meet the requirements of 40 CFR Section 51.930. The mitigation plan will be submitted to EPA by September 30, 2018, as required by 40 CFR Section 51.930(b)(3).

Summary of the Exceptional Event

On September 27, 2016, a strong evening thunderstorm outflow materialized over the west-central desert of Pinal County, sending significant blowing dust northward into the Maricopa County PM_{10} nonattainment area. The National Weather Service issued a blowing dust advisory for the greater Phoenix area, warning of wind gusts up to 40 mph and localized visibilities falling below one mile. Sustained winds near the source area of the outflow were reported as high as 25 mph with gusts of 41 mph. As the outflow moved north into the nonattainment area, wind speeds decreased, but were still significant enough to carry the initial wall of windblown dust into the area. The outflow winds died down after reaching the core of the greater Phoenix area, leaving the dust trapped and suspended in the air overnight and into the morning hours of September 28, 2016, ultimately causing exceedances on September 27 and 28, 2016.

PM_{10} concentrations spiked rapidly in the greater Phoenix area with the arrival of the outflow-generated windblown dust, with five-minute average concentrations as high as 2,860 $\mu g/m^3$. PM_{10} concentrations remained elevated throughout the evening and into the morning of September 28, 2016, as trapped windblown dust slowly settled out of the air under calm conditions. Two monitors located in the central portion of the nonattainment area exceeded the 24-hour PM_{10} standard on September 27, 2016, and one monitor exceeded on September 28, 2016, as a result of the high wind dust event (Table 1–1). The source area of the windblown dust is identified as the desert of west-central Pinal County. While the outflow-generated winds were strong enough to transport windblown dust into the nonattainment area, wind speeds had started to subside as the outflow reached the nonattainment area, making it unlikely that any significant windblown dust from anthropogenic sources within the nonattainment area contributed to the exceedances.

Table 1-1. PM_{10} Monitors Affected by the High Wind Dust Event.

Monitor Name	County	Operating Agency	Monitor ID	Exceeding 24-Hour PM_{10} Concentration
Glendale	Maricopa	Maricopa County Air Quality Department	04-013-2001	180 $\mu g/m^3$ (9/27/2016) 161 $\mu g/m^3$ (9/28/2016)
JLG Supersite	Maricopa	Arizona Department of Environmental Quality	04-013-9997	223 µg/m3 (9/27/2016)

Statutory and Regulatory Requirements

Clean Air Act Section 319(b) defines an exceptional event as an event that:

(i) affects air quality;
(ii) is not reasonably controllable or preventable.;
(iii) is an event caused by human activity that is unlikely to recur at a particular location or a natural event; and
(iv) is determined by the Administrator through the process established in the regulations promulgated under paragraph (2) [Regulations] to be an exceptional event.

EPA regulation in 40 CFR Section 50.1(j) further defines an exceptional event as:

> "...an event(s) and its resulting emissions that affect air quality in such a way that there exists a clear causal relationship between the specific event(s) and the monitored exceedance(s) or violation(s), is not reasonably controllable or preventable, is an event(s) caused by human activity that is unlikely to recur at a particular location or a natural event(s), and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event. It does not include air pollution relating to source noncompliance. Stagnation of air masses and meteorological inversions do not directly cause pollutant emissions and are not exceptional events. Meteorological events involving high temperatures or lack of precipitation (*i.e.*, severe, extreme or exceptional drought) also do not directly cause pollutant emissions and are not considered exceptional events. However, conditions involving high temperatures or lack of precipitation may promote occurrences of particular types of exceptional events, such as wildfires or high wind events, which do directly cause emissions."

EPA regulation in 40 CFR Section 50.14(c)(3)(iv) states that a demonstration to justify the exclusion of monitor data as an exceptional event must include:

(A) A narrative conceptual model that describes the event(s) causing the exceedance or violation and a discussion of how emissions from the event(s) led to the exceedance or violation at the affected monitor(s);
(B) A demonstration that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation;
(C) Analyses comparing the claimed event-influenced concentration(s) to concentrations at the same monitoring site at other times to support the requirement at paragraph (c)(3)(iv)(B) [clear causal relationship] of this section. The Administrator shall not require a State to prove a specific percentile point in the distribution of data;
(D) A demonstration that the event was both not reasonably controllable and not reasonably preventable; and
(E) A demonstration that the event was a human activity that is unlikely to recur at a particular location or was a natural event.

Additionally, specific regulatory requirements related to demonstrations for high wind dust events are included in 40 CFR Section 50.14(b)(5). Details on how the statutory and regulatory requirements are addressed in this documentation are presented in the bulleted list below:

- Chapter II of this assessment includes a narrative conceptual model that describes the genesis of the high wind dust event and how PM_{10} emissions from the high wind dust event caused the PM_{10} exceedances on September 27-28, 2016 in the Maricopa County nonattainment area.

- Chapter III provides a detailed body of evidence that the event affected air quality through the clear causal relationship between the PM_{10} emissions from the high wind dust event and the exceedances at the monitors in the Maricopa County PM_{10} nonattainment area. Section III also includes an analysis comparing the event-influenced exceeding PM_{10} concentrations at the exceeding monitors to historical PM_{10} concentrations at the monitors.

- Chapter IV presents evidence that the high wind dust event was a natural event and that the high wind dust event was neither reasonably controllable nor preventable.

- Chapter V includes a summary conclusion of the evidence presented in Chapters II-IV.

Procedural Requirements

This procedural requirements for submitting a demonstration to EPA for an exceptional event are included in 40 CFR Section 50.14(c). The procedural requirements include the schedules and procedures for notifying the public when an event occurs; for providing EPA with the initial notification of a potential exceptional event; and for documenting the public comment process. Specific procedural requirements are presented below:

- 40 CFR Section 50.14(c)(1)(i) – Public notification that event was occurring:

  The Arizona Department of Environmental Quality (ADEQ) issued ensemble air quality forecasts for the Greater Phoenix area and dust control forecasts for Maricopa County on September 26-28, 2016 that discuss the possibility of blowing dust and elevated PM_{10} concentrations as a result of thunderstorm outflows from monsoon season weather patterns. The forecast products that were issued on September 26-28, 2016 are included in Appendix A.

- 40 CFR Section 50.14(c)(2)(i) – Initial notification of potential exceptional event by creating an initial event description and flagging the associated data that have been submitted to the AQS database:

  The Maricopa County Air Quality Department (MCAQD) has created an initial event description (high wind dust event) and flagged the associated air quality monitoring data for September 27-28, 2016 as an exceptional event in AQS. The following monitors have been flagged as exceeding the PM_{10} standard on September 27-28, 2016 as a result of a high wind dust event:

  September 27, 2016: Glendale (04-013-2001) and JLG Supersite (04-013-9997)
  September 28, 2016: Glendale (04-013-2001)

- 40 CFR Section 50.14(c)(2)(i)(A) – Regular communication with the EPA Regional office to identify data that have been potentially influenced by an exceptional event, to determine whether the identified data may affect a regulatory determination and to discuss whether the State should develop and submit an exceptional events demonstration:

  ADEQ began initial discussions with EPA about this event on May 18, 2017. ADEQ submitted formal initial notification of the September 27-28, 2016 high wind dust event to EPA Region IX on at that time.

- 40 CFR Section 50.14(c)(2)(i)(B) – For data that may affect an anticipated regulatory determination or where circumstances otherwise compel EPA to prioritize the resulting demonstration, EPA shall respond to the State's initial notification with a demonstration due date:

  EPA did not provide a due date for this demonstration.

- 40 CFR Section 50.14(c)(2)(i)(C) – EPA may waive the initial notification of potential exceptional event process on a case-by-case basis:

  EPA did not waive the initial notification of potential exceptional event process.

- 40 CFR Section 50.14(c)(3)(v) – With submission of the demonstration containing the elements in 40 CFR Section 50.14(c)(3)(iv), the State must document that a public comment process was followed, submit any public comments received, and address in the submission to EPA those comments disputing or contradicting factual evidence provided in the demonstration:

  ADEQ will post this assessment report on the ADEQ webpage and placed a hardcopy of the report in the ADEQ Records Management Center for public review. The 30-day public comment period is to TBD. A copy of the public notice certification, along with any comments received and responses to those comments, will be submitted to EPA, consistent with the requirements of 40 CFR Section 50.14(c)(3)(v).

Mitigation Requirements

Per the requirements of 40 CFR Section 51.930(b)(1)(B)(ii), EPA provided written notification in the Federal Register notice for the EPA final rule, *Treatment of Data Influenced by Exceptional Events* (81 FR 68216), that the Maricopa County PM_{10} nonattainment area is required to develop a mitigation plan for high wind dust events that satisfy the requirements of 40 CFR Section 51.930(b)(2). A high wind dust event mitigation plan for the Maricopa County PM_{10} nonattainment area is required to be submitted to EPA by September 30, 2018. State and local agencies are in the process of developing the mitigation plan. The documentation for the September 27-28, 2016 high wind dust event is being submitted to EPA before a mitigation plan for the Maricopa County PM_{10} nonattainment area is in place as allowed under 40 CFR Section 50.14(b)(9)(ii)(B).

II. CONCEPTUAL MODEL

Geographic Setting and Climate

Geographic Setting

The Maricopa County PM_{10} nonattainment area 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 area, the topography of the area is generally flat. The 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 area 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 PM_{10} nonattainment area contains a fairly dense network of PM_{10} 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 the nonattainment area, as well as the locations of PM_{10} monitors in the nonattainment area and throughout the state.

Figure 2–2 depicts the drainage systems or watersheds for the State of Arizona. Many of the rivers that form Arizona's drainage system are dry for most of the year and, consequently, are sources of silt and fine soils that become suspended and add to regional PM_{10} loadings during high wind events. Much of this alluvial matter and fine 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.

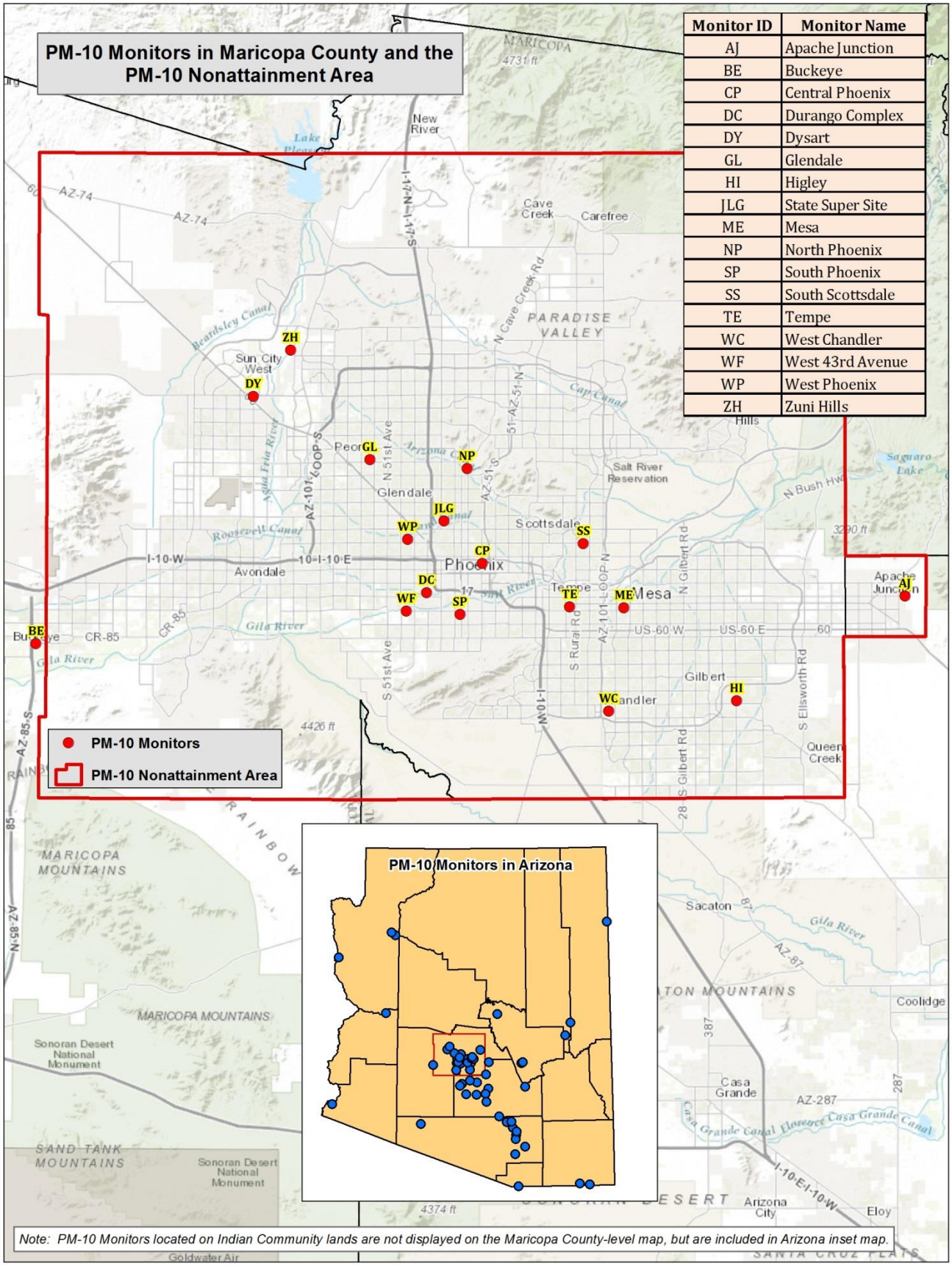

Figure 2-1. Maricopa County PM_{10} nonattainment area geographic setting and PM_{10} monitor locations.

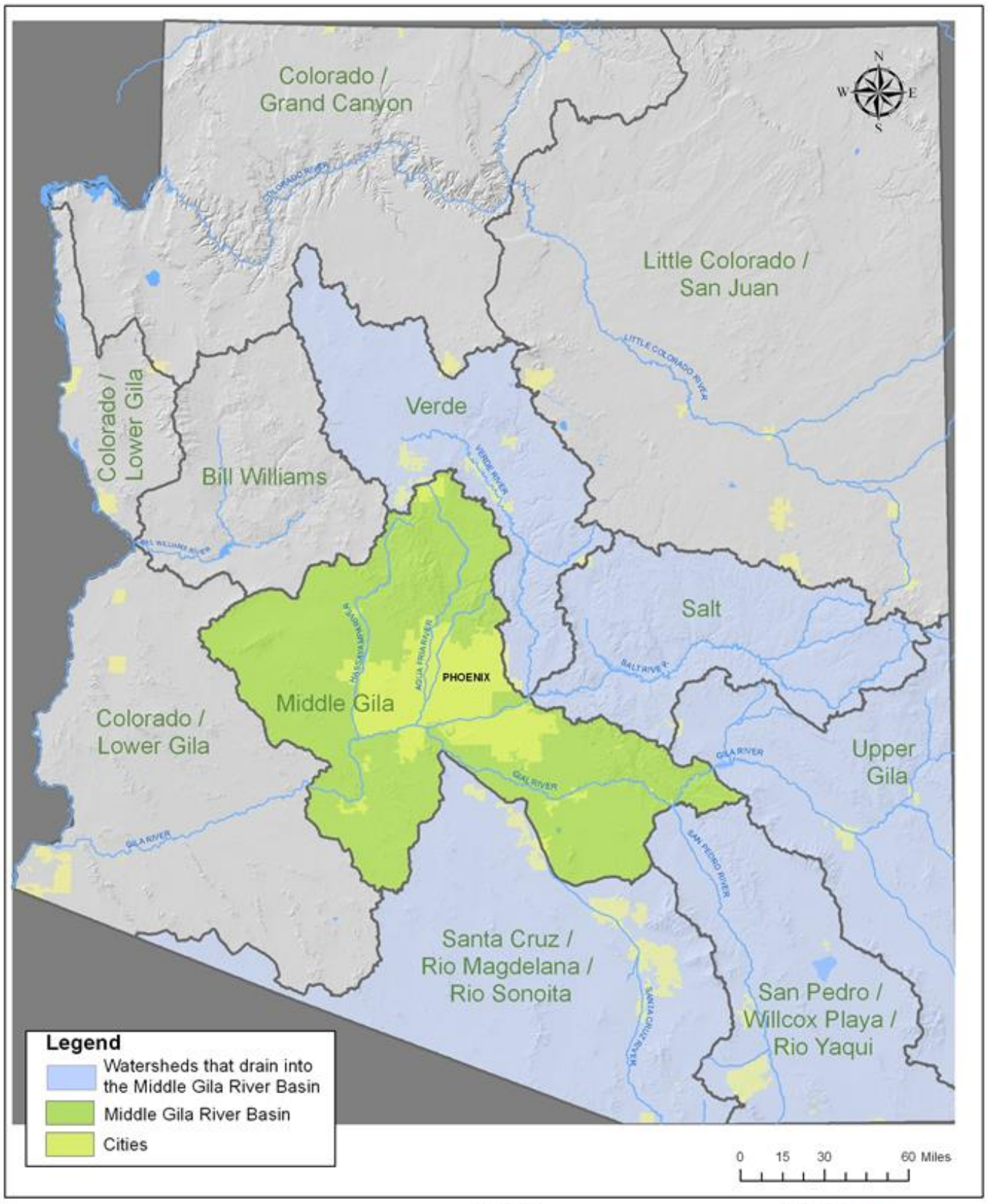

Figure 2-2. Drainage basins of the State of Arizona.

Climate

The Maricopa County PM_{10} nonattainment area has an arid climate, with very hot summers and temperate winters. The average summer high temperature is among the hottest of any populated area in the United States. The temperature reaches or exceeds 100ºF an average of 110 days during the year and highs top 110ºF an average of 18 days during the year. The area 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 the nonattainment area and the rest of Arizona. While these weather patterns describe the general climatology for the nonattainment area over a long period of time, the area and the entire state of Arizona is also prone to a high degree of variability in these weather patterns from year to year.

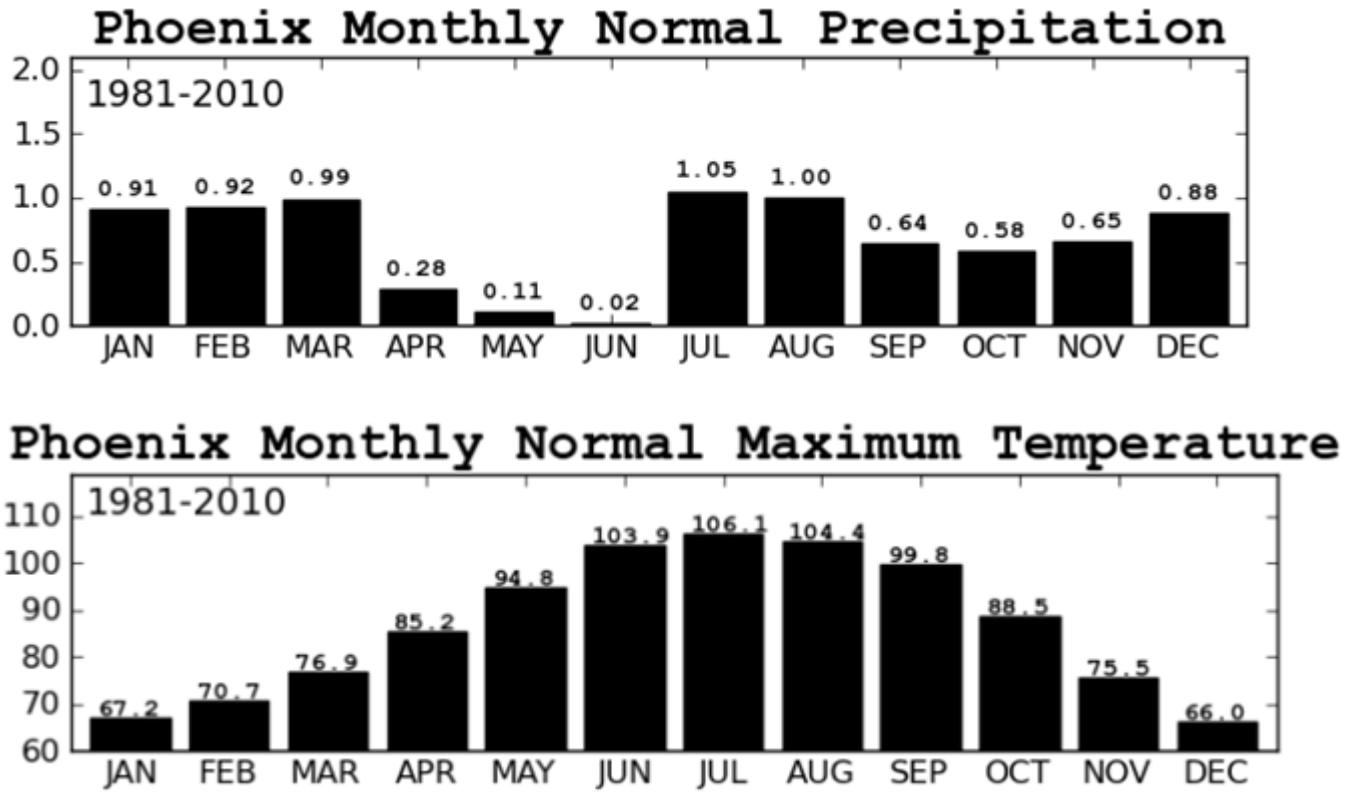

Figure 2-3 Phoenix monthly precipitation (top) and maximum temperature (bottom) climatology (source: National Weather Service).

Monsoon Season High Wind Dust 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).

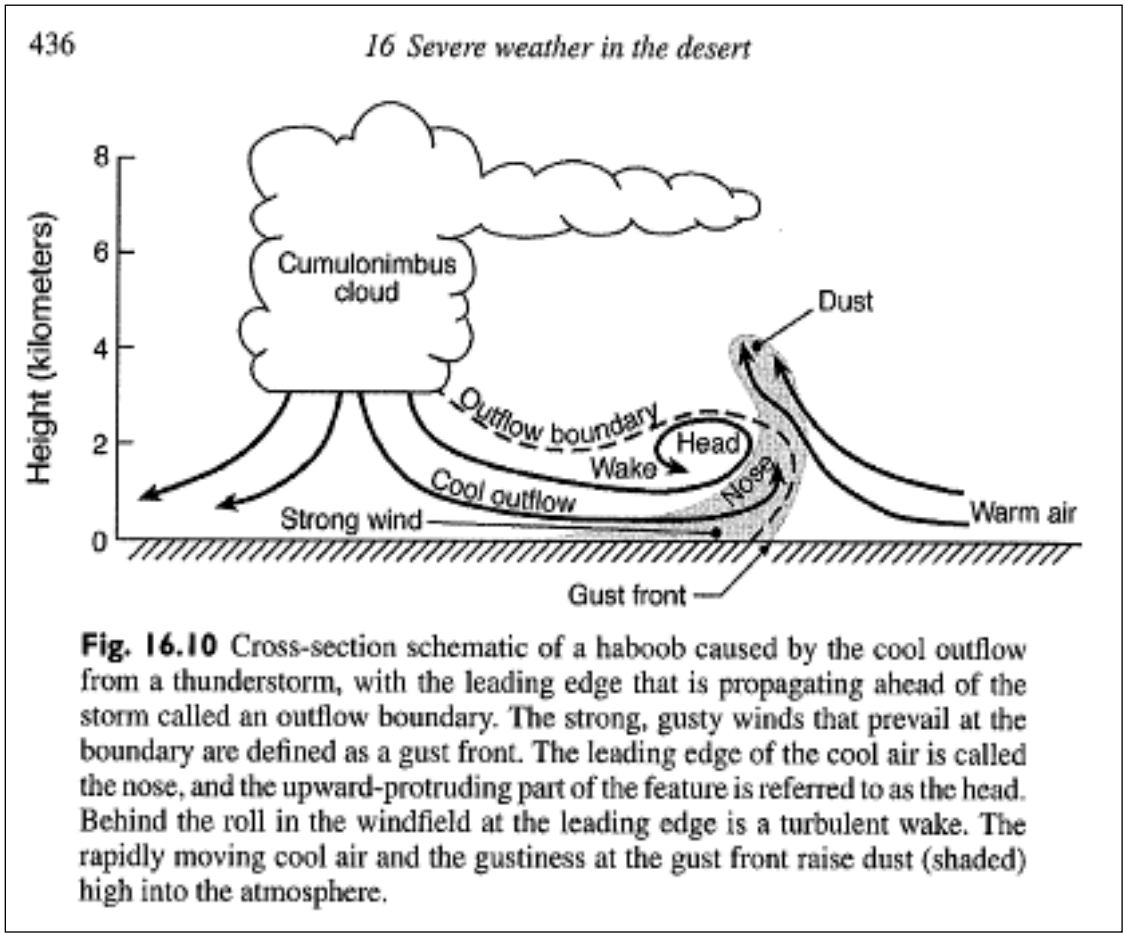

Fig. 16.10 Cross-section schematic of a haboob caused by the cool outflow from a thunderstorm, with the leading edge that is propagating ahead of the storm called an outflow boundary. The strong, gusty winds that prevail at the boundary are defined as a gust front. The leading edge of the cool air is called the nose, and the upward-protruding part of the feature 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 2-4. Cross-section of a thunderstorm creating an outflow boundary and haboob (Desert Meteorology. Thomas T. Warner. 2004.)

According to the National Weather Service (NWS), a strong evening thunderstorm outflow materialized on September 27, 2016 over the west-central desert of Pinal County, sending significant blowing dust northward into the Maricopa County PM_{10} nonattainment area. In response, The NWS issued a dust blowing dust advisory for the greater Phoenix area and northwest and north-central Pinal County at 6:08 PM. The advisories predicted wind gusts up to 40 mph and localized visibilities falling below one mile. Sustained winds of 25 mph and gusts of 41 mph were recorded near the source area (Casa Grande Airport) of the thunderstorm outflow (See Appendix B). The blowing dust moved quickly through western Pinal County and into the Maricopa County PM_{10} nonattainment area on the thunderstorm outflow, raising PM_{10} concentrations at monitors in the nonattainment area and in Pinal County. The outflow winds died down after reaching the core of the greater Phoenix area, leaving the windblown dust trapped and suspended in the air overnight and into the morning hours of September 28, 2016, ultimately causing exceedances on both September 27 and September 28, 2016.

PM_{10} concentrations in the nonattainment area from the outflow-generated windblown dust were densest at the South Phoenix monitor peaking at 7:00 PM with a five-minute concentration of 2,860 $\mu g/m^3$. Concentrations were high throughout the central portion of the nonattainment area where the outflow winds initially transported the windblown dust and then left the dust suspended for several hours afterwards under calm, late-evening and early-morning conditions. The windblown dust from the thunderstorm outflow caused the Glendale and JLG Supersite monitors to exceed on September 27, 2016, and the Glendale monitor to exceed on September 28, 2016. Several other monitors in the central portion of the nonattainment area nearly exceeded as well on September 27-28, 2016 (see Table 2–1).

Visibility readings in synch with the passage of the dust storm outflow were reported to be as low as 1.0 mile at the Sky Harbor International Airport in the nonattainment area by the NWS. Visibilities remained reduced throughout the evening and into the early morning as the suspended windblown dust settled in a haze over the central portion of the nonattainment area. The Deer Valley Airport reported visibilities in the range of 2.5 to 6.0 miles from 7:53 PM on September 27 to 12:53 AM on September 28, 2016, demonstrating the persistence in haze from the windblown dust after the outflow winds had ceased.

The source area of the windblown dust is identified as the desert of west-central Pinal County (see Figures 3–5 and 3–6). While the primary source area is identified as the natural desert areas of west-central Pinal County, sustained wind speeds in the source area of 25 mph, with gusts as high as 41 mph, are sufficient to overwhelm any controls on anthropogenic sources that may be present in the source area. Additionally, while the outflow-generated winds were strong enough to transport windblown dust into the Maricopa County PM_{10} nonattainment area, wind speeds had started to subside as the outflow reached the nonattainment area, making it unlikely that any significant windblown dust from anthropogenic sources within the Maricopa County PM_{10} nonattainment area contributed to the exceedances.

As seen in Figure 2–5, moderate drought conditions throughout Maricopa and Pinal counties likely exacerbated the amount of dust the thunderstorm outflow was able to entrain. No precipitation associated with the thunderstorm outflow was recorded at any PM_{10} nonattainment area NWS stations after the dust storm had passed through the nonattainment area.

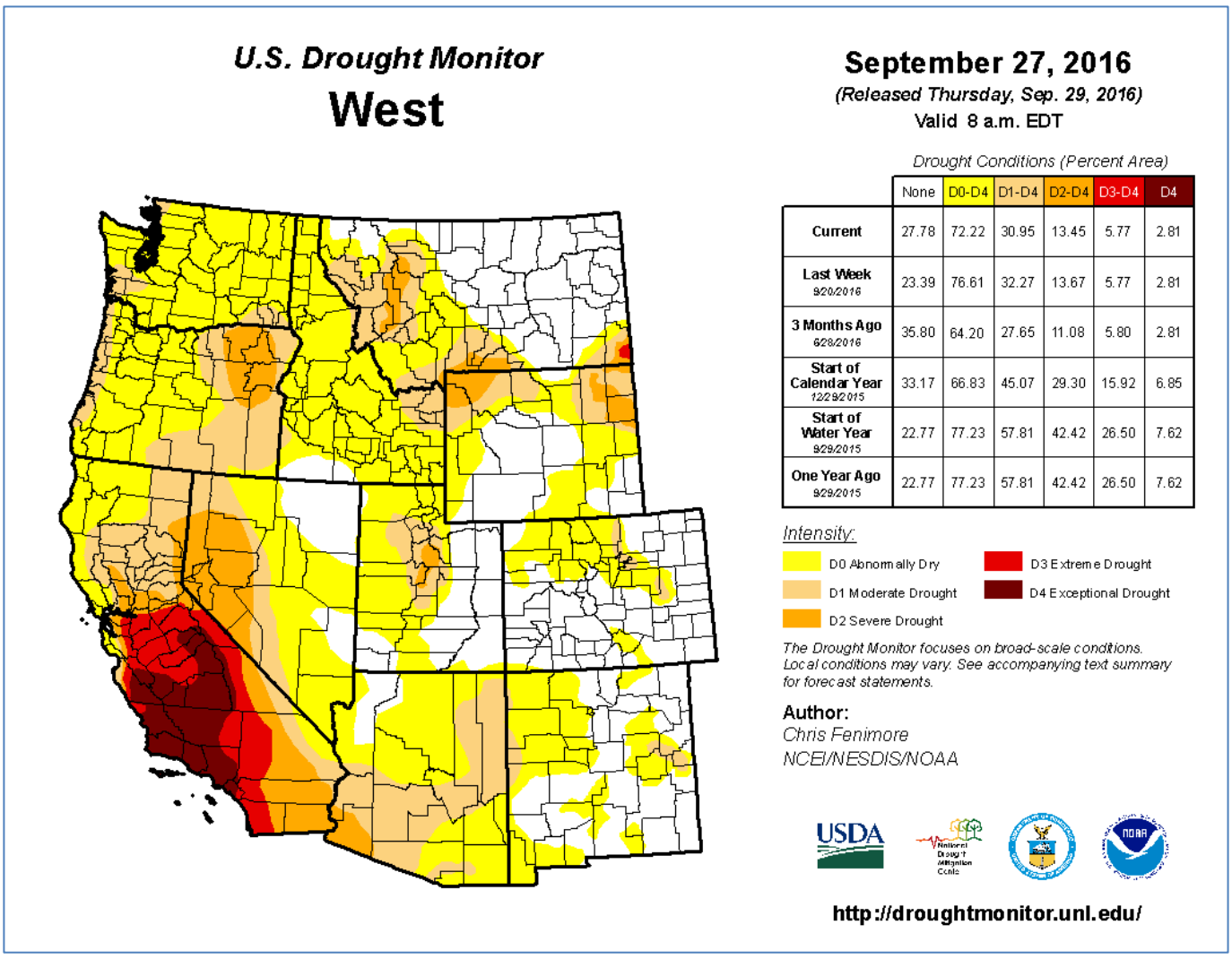

Figure 2-5. Western states drought monitor as of September 27, 2016.

As a summary of the PM_{10} concentrations during the event, Table 2–1 contains PM_{10} concentration data at Maricopa County and nonattainment area monitors from September 20 – October 5, 2016, indicating the high levels of PM_{10} seen on September 27-28, 2016 as compared to the prior and following week. Figure 2–6 displays those same 24-hour average PM_{10} concentrations while Figure 2–7 contains the diurnal pattern of PM_{10} at the Maricopa County and PM_{10} nonattainment area monitors on September 27-28, 2016. Lastly, Figures 2–8 and 2–9 displays hourly average PM_{10} concentrations, maximum hourly 5-minute wind speeds, and maximum hourly gusts as recorded at the exceeding Glendale and JLG Supersite monitors.

Table 2-1. 24-Hour Average PM_{10} Concentrations ($\mu g/m^3$) at Maricopa County and PM_{10} Nonattainment Area Monitors on September 20-October 5, 2016.

Monitor	Sept 20	Sept 21	Sept 22	Sept 23	Sept 24	Sept 25	Sept 26	Sept 27	Sept 28	Sept 29	Sept 30	Oct 1	Oct 2	Oct 3	Oct 4	Oct 5
Apache Junction	22	19	13	67	34	22	31	**64**	**11**	6	8	14	13	12	22	21
Buckeye	44	31	13	93	30	20	77	**36**	**104**	25	22	41	20	48	51	66
Central Phoenix	30	28	13	99	35	23	47	**102**	**69**	13	13	14	13	25	35	31
Durango Complex	25	24	10	77	27	15	39	**112**	**51**	14	15	10	8	23	34	37
Dysart	29	22	12	100	30	13	31	**77**	**77**	10	10	13	14	27	32	28
Glendale	16	12	5	78	22	10	27	**180**	**161**	6	9	12	8	23	24	20
JLG Supersite	27	NA	NA	NA	36	15	36	**223**	**110**	14	13	16	12	28	33	29
Mesa	17	14	8	74	24	9	40	**48**	**52**	8	7	9	8	18	22	20
North Phoenix	17	15	6	70	22	8	28	**141**	**76**	9	8	10	9	14	21	20
South Phoenix	20	17	9	80	30	18	29	**54**	**27**	14	11	13	9	21	26	26
South Scottsdale	25	22	12	92	30	13	46	**113**	**64**	12	13	15	14	21	29	29
Tempe	15	13	7	59	21	12	24	**67**	**34**	7	6	10	7	14	18	19
West 43rd Avenue	42	35	29	98	37	22	53	**118**	**63**	27	24	22	14	39	47	41
West Chandler	26	22	13	76	39	17	55	**44**	**23**	12	12	13	18	16	27	24
West Phoenix	20	20	8	79	28	14	31	**133**	**138**	11	13	15	11	24	30	27
Zuni Hills	19	19		87	30	18	31	**138**	**50**	9	10	13	15	20	32	25

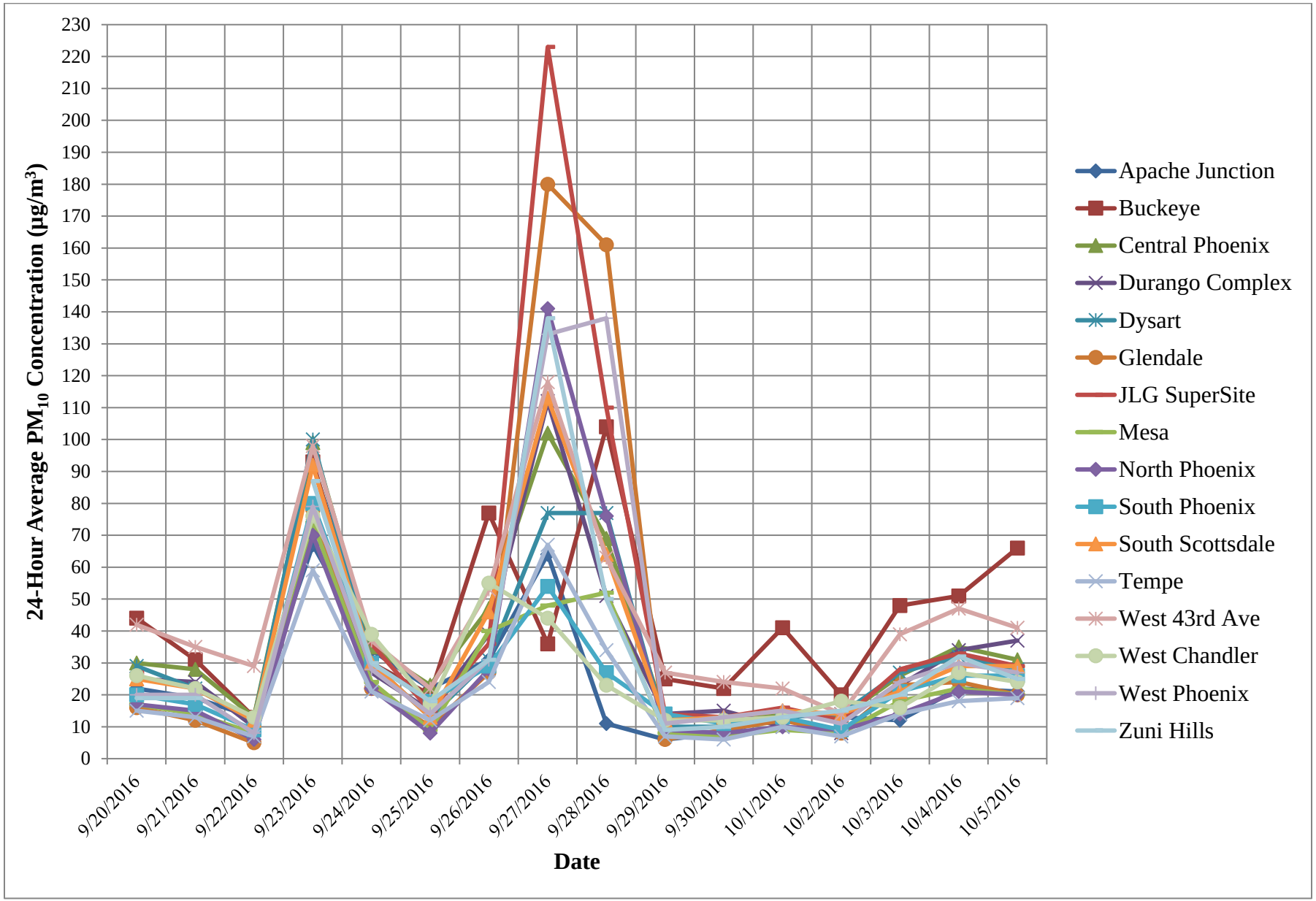

Figure 2-6. 24-hour average PM_{10} concentrations (µg/m^3) at Maricopa County and nonattainment area monitors on September 20-October 5, 2016.

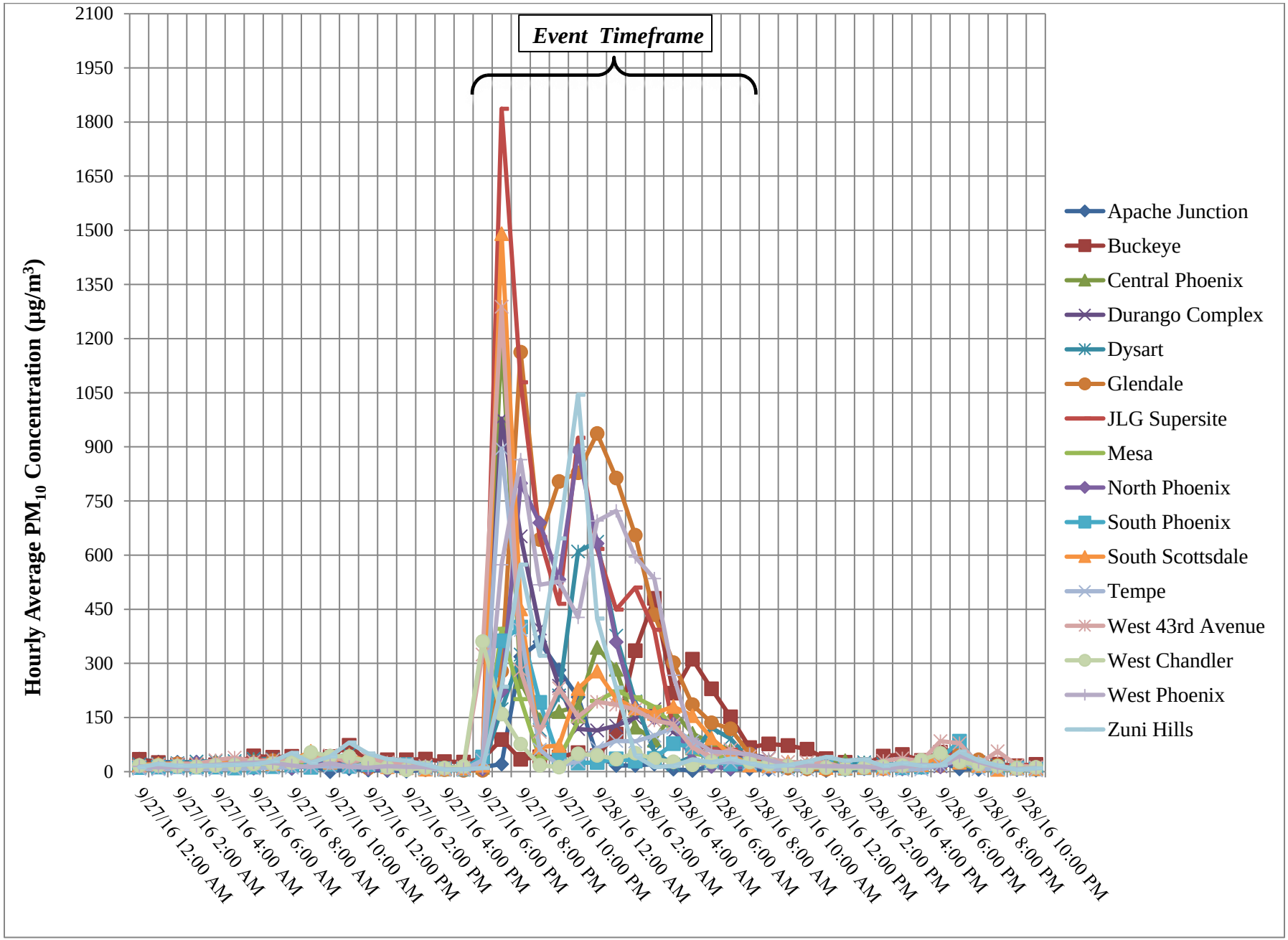

Figure 2-7. Diurnal profile of monitors on September 27-28, 2016.

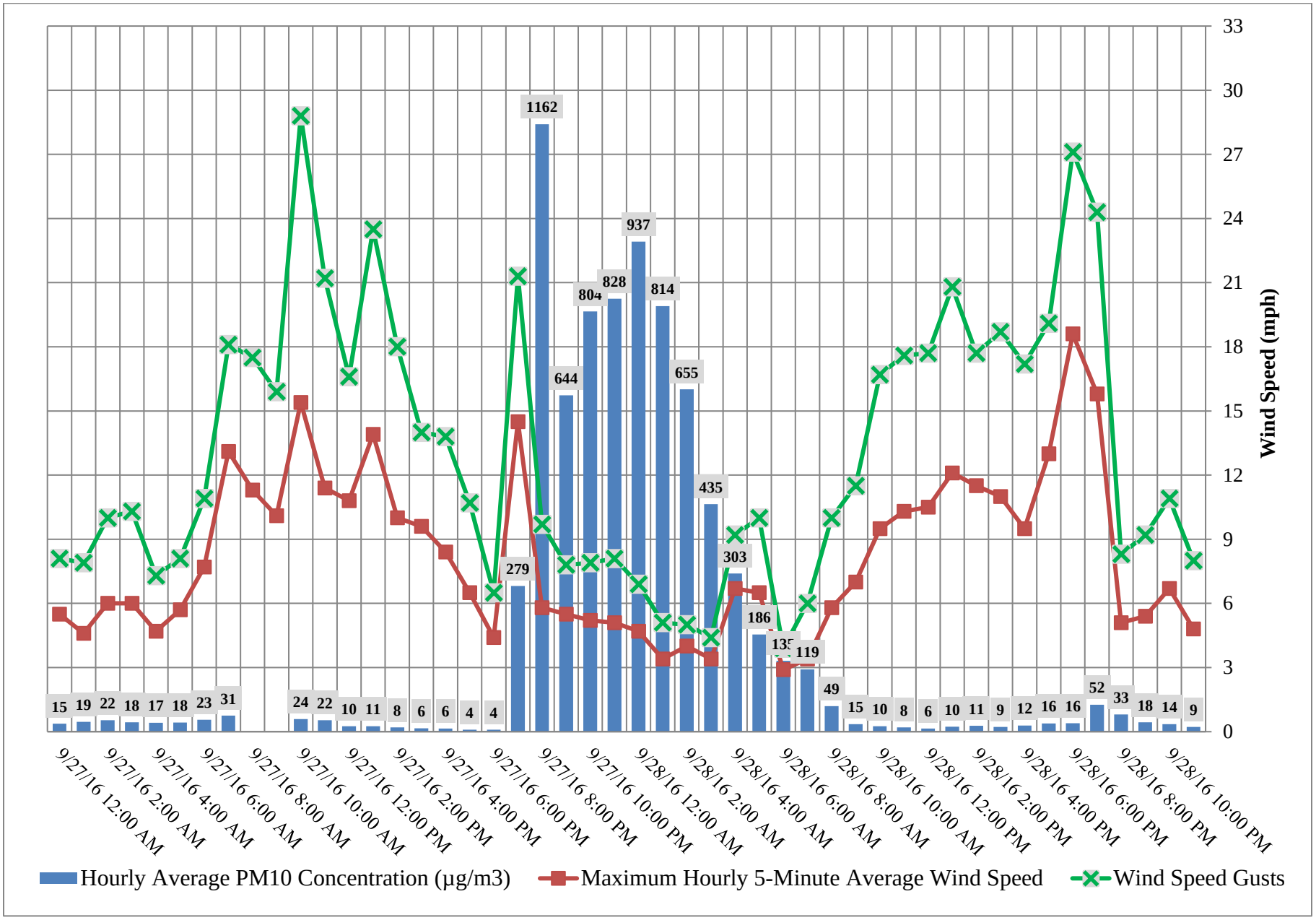

Figure 2-8. Hourly average PM_{10} concentrations, maximum hourly 5-minute average wind speeds, and maximum hourly gusts as recorded at the exceeding Glendale monitor.

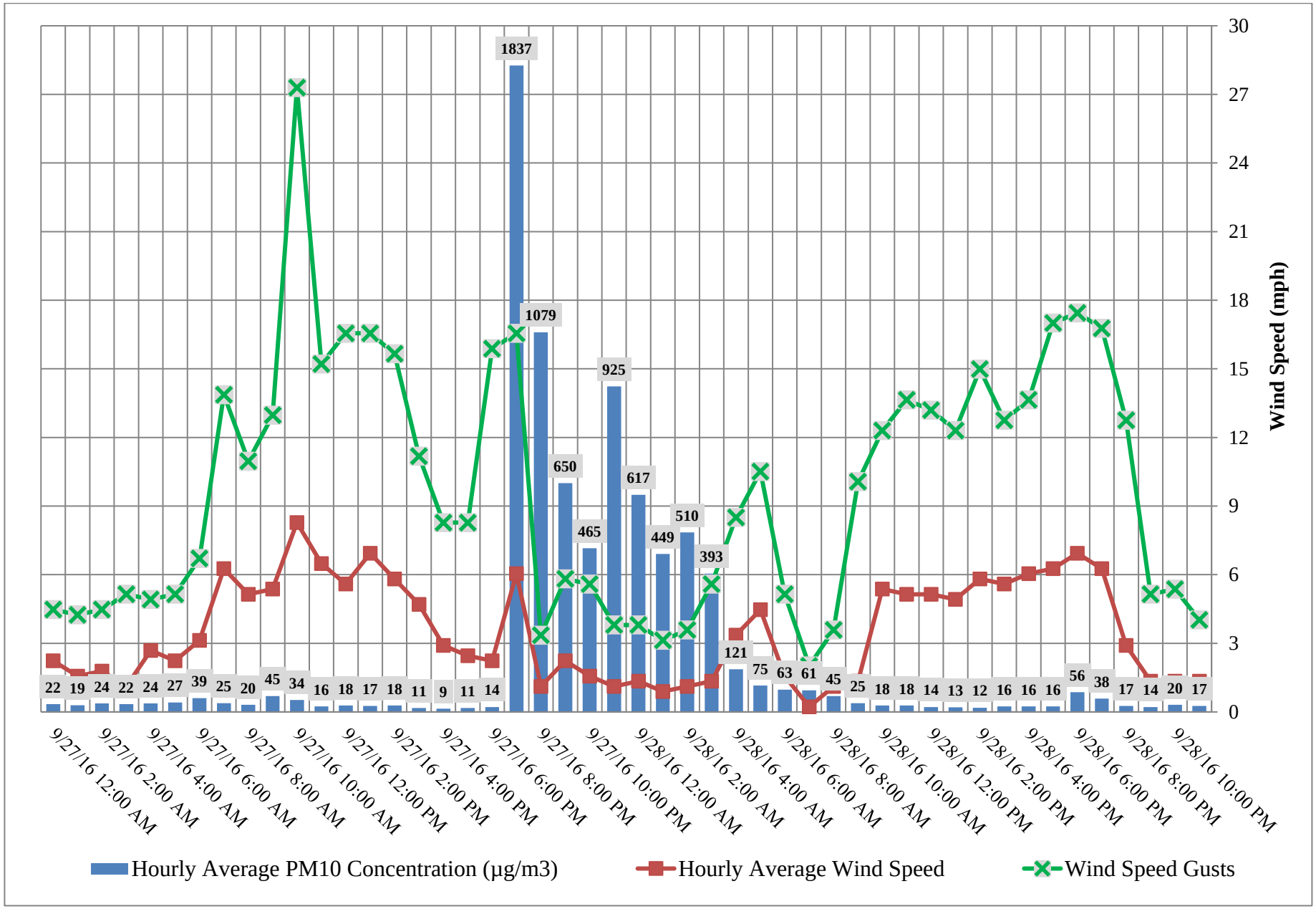

Figure 2-9. Hourly average PM_{10} concentrations, maximum hourly 5-minute average wind speeds, and maximum hourly gusts as recorded at the exceeding JLG Supersite monitor.

III. CLEAR CAUSAL RELATIONSHIP

Introduction

One of the core statutory elements that must be addressed to exclude a monitored exceedance or violation caused by an exceptional event is a demonstration that the exceptional event "affected air quality in such a way that there exists a clear causal relationship between the event and the monitored exceedance or violation." The requirement to include this demonstration is codified in 40 CFR Section 50.14(c)(3)(iv)(B). To support the clear causal relationship requirements in 40 CFR Section 50.14(c)(3)(iv)(B), analyses comparing the claimed event-influenced concentration to concentrations at the same monitoring site at other times are required as stated in 40 CFR Section 50.14(c)(3)(iv)(C).

Additionally, specific to high wind dust events, the preamble to the revised exceptional events rule states that "EPA expects air agencies to provide relevant wind data...showing how the observed sustained wind speed compares to the established high wind threshold and demonstrates a relationship between the sustained wind speeds and measured PM concentrations at a particular monitoring location". Demonstrations covering all of the required elements of a clear causal relationship are presented in the sections below.

Comparison of High Wind Dust Event Concentrations with Historical Concentrations

In Table 2 of the preamble to the revised exceptional events rule, EPA includes as guidance seven categories of "historical concentration evidence" that should be addressed in order to meet the requirement in 40 CFR Section 50.14(c)(3)(iv)(C) to provide analyses comparing the claimed event-influenced concentration to concentrations at the same monitoring site at other times. The seven categories listed by EPA and where they are addressed in this documentation are listed below:

1. Compare the concentrations on the claimed event day with past historical data (included in Figure 3–1 and 3–2).
2. Demonstrate spatial and/or temporal variability of the pollutant of interest in the area (included in Figures 3–5 through 3–37 and Figure 2-6).
3. Determine percentile ranking: 99th percentile for all exceedances at both monitors (based upon five years of data, September 27, 2011 – September 28, 2016).
4. Plot annual time series to show the range of "normal" values (included in Figures 3–1 and 3–2).
5. Identify all "high" values in all plots (included in Figures 3–1 and 3–2).
6. Identify historical trends (optional, included in Figures 3–1 and 3–2).
7. Identify diurnal or seasonal patterns (included in Figures 3–1 through 3–4).

The bulk of the seven categories listed above are addressed in Figures 3–1 and 3–2. Figures 3–1 and 3–2 include all 24-hour average PM_{10} concentrations at the exceeding Glendale and JLG Supersite monitors from January 1, 2011 through December 31, 2016. This period includes the most recent five calendar years of concentration data at the exceeding monitoring sites, as recommended by EPA in the preamble to the revised exceptional events rule. Within the time period presented, Figures 3–1 and 3–2 identify all days that have been flagged as high wind dust events (including the concurrence status of those days by EPA) and all exceedance days.

All exceedances in Figures 3–1 and 3–2 have been identified as high wind dust events. Figures 3–1 and 3–2 generally indicates that high wind dust events normally occur in spring and summer (when dry cold fronts and the summer monsoon season are most active), but may occur at any time. The high wind dust events are relatively rare occurring on 11 days out of 2,192, or 0.5% of the time at the Glendale monitor. High wind dust events at the JLG Supersite monitor occur on 9 days out of 2,192, or 0.4% of the time. The specific percentile ranking of the high wind dust event 24-hour average PM_{10} concentrations are in the 99th percentile on both exceedance days and at both exceeding monitors, based upon five years of data (September 27, 2011 – September 28, 2016).

While not specifically indicated in Figures 3–1 and 3–2, it is important to note that some of the other high, but not exceeding PM_{10} concentrations (75-150 $\mu g/m^3$) at the Glendale and JLG Supersite monitors, occurred on days when high wind dust events nearly caused an exceedance, or on days when high wind dust events caused exceedances at other monitors in the Maricopa County PM_{10} nonattainment area. Because of the vast size of the nonattainment area, it is rare that a high wind dust event will cause all monitors within the nonattainment area to exceed the PM_{10} standard. As seen in this high wind dust event, PM_{10} concentrations were elevated at all nonattainment area monitors within the path of the thunderstorm outflow, particularly at the central nonattainment area monitors (e.g., North Phoenix monitor at 141 $\mu g/m^3$ on September 27, 2016), but only the Glendale and JLG Supersite monitors exceeded on September 27-28, 2016.

Figures 3–1 and 3–2 also include a linear trend line of the 24-hour average PM_{10} concentration data at the Glendale and JLG Supersite monitors. The trend line for the Glendale monitor shows a small decline in PM_{10} concentrations based upon data from January 1, 2011 to December 31, 2016, while the trend line for the JLG Supersite monitor is relatively flat. While the trend lines represent an average of concentration data that can vary significantly from day to day, the trend line does indicate that overall PM_{10} concentrations at the Glendale and JLG Supersite monitors have been declining or steady through time, despite an increase in population, employment and vehicle traffic throughout the nonattainment area. This is not unexpected given that the Glendale and JLG Supersite monitors are located in developed urban areas, where PM_{10} concentrations are generally low and well-controlled and common sources of fugitive dust (e.g., natural desert areas, vacant lands) are sparse.

As can be seen in Figures 3–1 and 3–2, there is not a distinct seasonal pattern for PM_{10}, but rather concentrations can vary daily in all seasons. In general terms, wintertime inversion conditions can elevate PM_{10} on stagnant days in the winter months, and elevated winds particularly during the monsoon season produce the highest overall PM_{10} concentrations. However, these meteorological conditions are not constant enough to create a definite "season" when PM_{10} is elevated or suppressed.

Figures 3–3 and 3–4 display the average diurnal patterns of PM_{10} as observed over 5 years from January 1, 2011 through December 31, 2015 at the Glendale and JLG Supersite monitors. The figures include annual hourly average concentrations, average hourly concentrations in September (the month the event occurred), and the diurnal pattern observed on the event days (September 27-28, 2016). Hourly PM_{10} concentrations that were flagged in AQS as being the result of an exceptional event have been removed from the averages. As can be seen in the Figures 3–3 and 3–4, there is little difference between the annual hourly averages and the hourly averages in the month of September over the 5 year period. Diurnal emissions on the high wind dust event days (September 27-28, 2016) were very similar to the annual and September averages, except during the hours when windblown dust from the thunderstorm outflow arrived and remained suspended (6pm on September 27, 2016 to 8am on September 28, 2016), providing evidence that no unusual anthropogenic activity was occurring around the exceeding Glendale and JLG Supersite monitors on the high wind dust event days (i.e., no elevated hourly PM_{10} concentrations during non-event hours on the event days as compared to historical hourly averages).

In addition to the data presented in Figures 3–1 through 3–4, data in Figure 2–6 displays the 24-hour average PM_{10} concentrations at all nonattainment area monitors a week before and after the high wind dust event on September 27-28, 2016. The non-exceedance peak seen on September 23, 2016 is attributed to long range transport from the passage of a cold front. No other exceedances were recorded the week before or after the event on September 27-28, 2016.

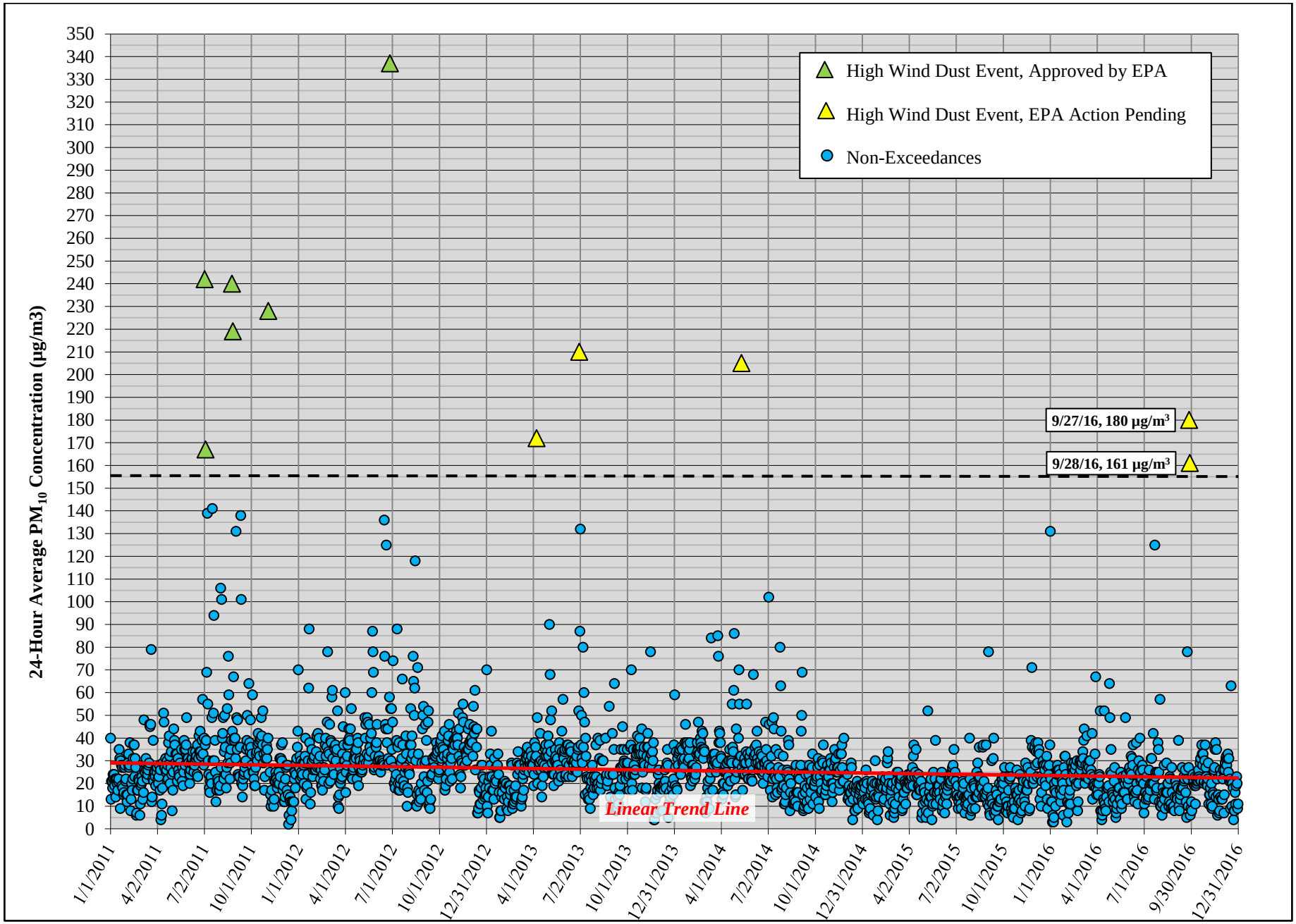

Figure 3-1. Plot of 24-hour average PM_{10} concentrations at the Glendale monitor, January 2011 – December 2016.

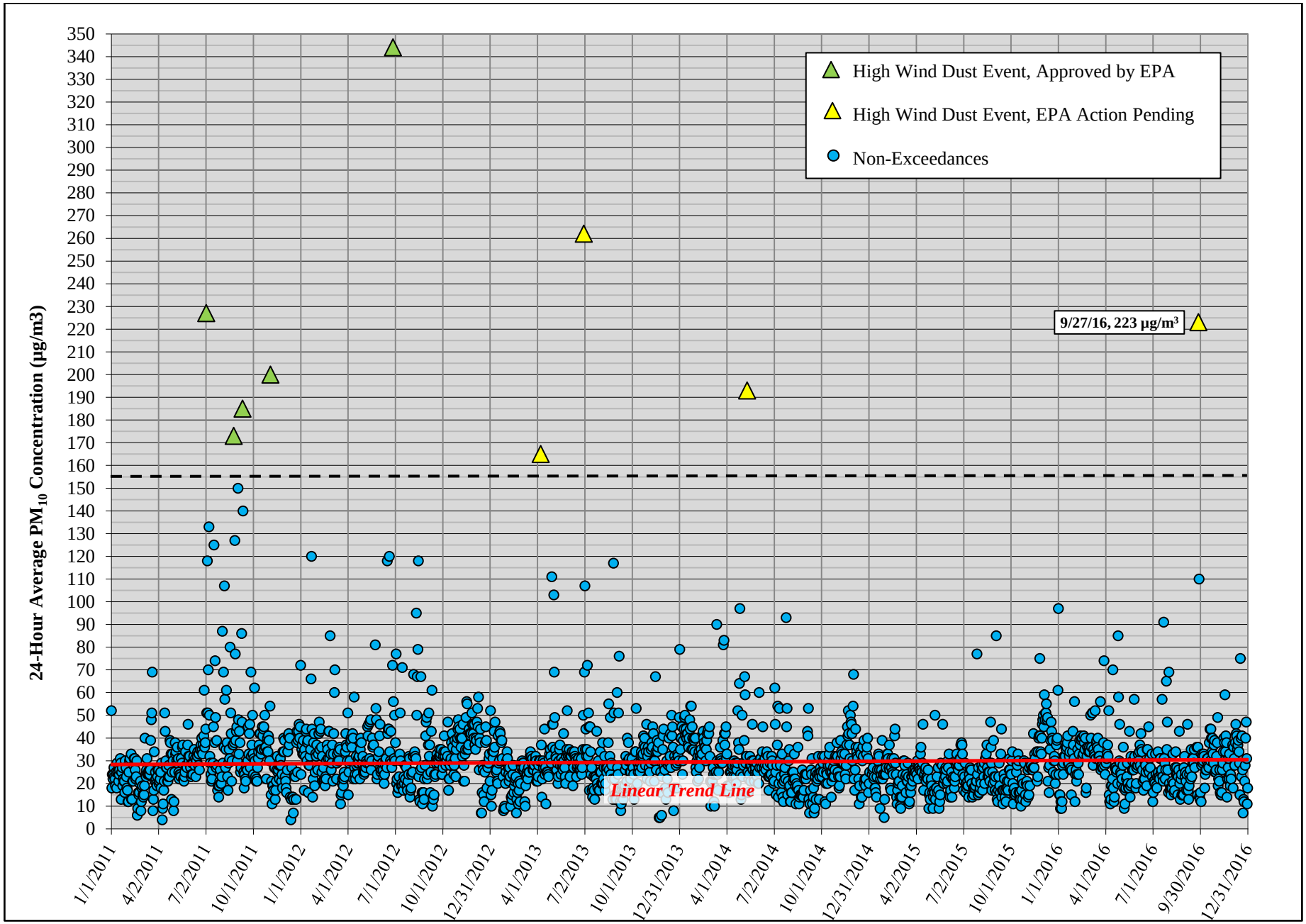

Figure 3-2. Plot of 24-hour average PM_{10} concentrations at the JLG Supersite monitor, January 2011 – December 2016.

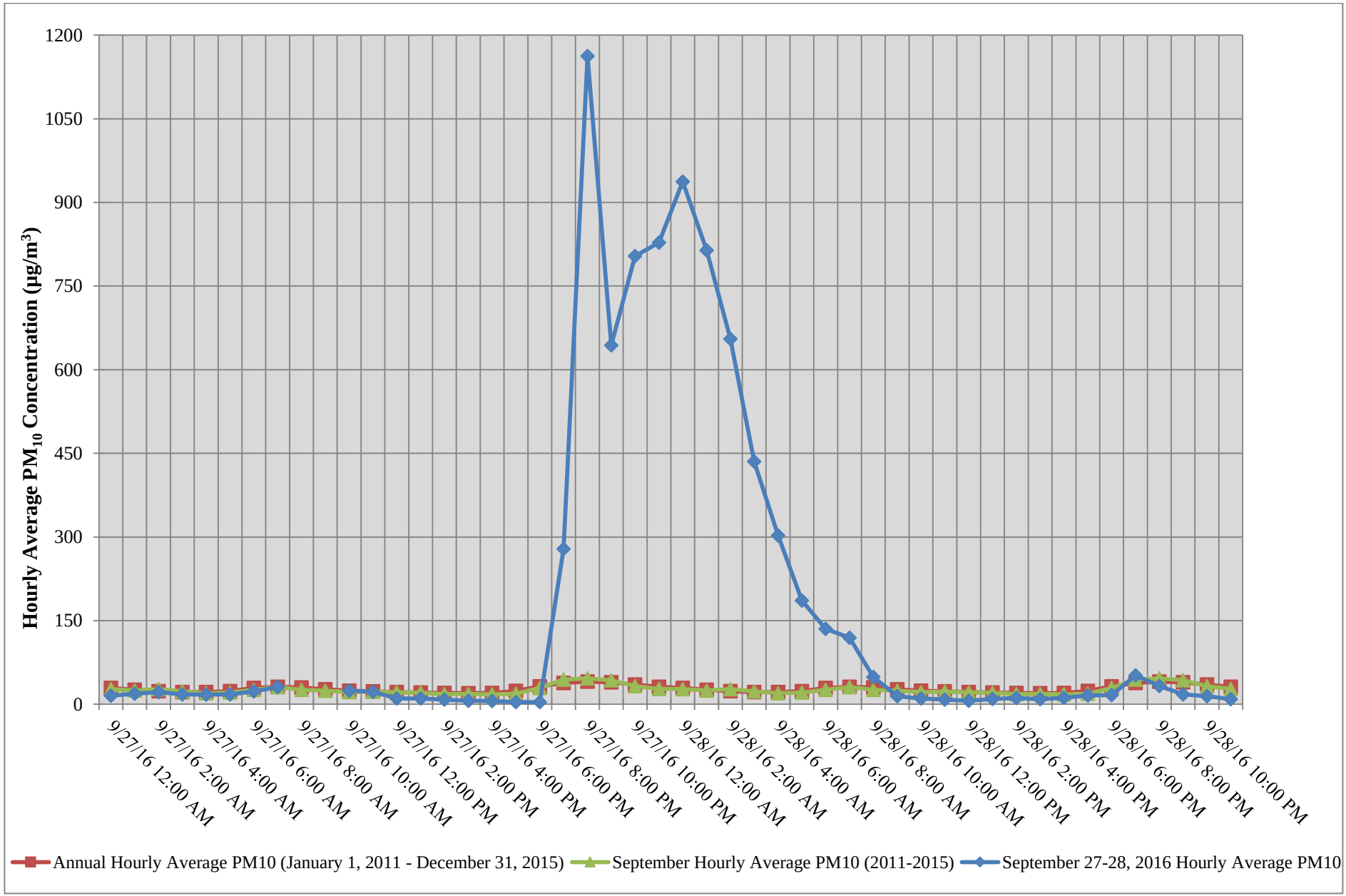

Figure 3-3. Plot of annual hourly average PM_{10} concentrations (1/1/2011 – 12/31/2015), hourly average PM_{10} concentrations in September (2011 – 2015), and diurnal PM_{10} concentrations at the Glendale monitor on the September 27-28, 2016 high wind dust event day.

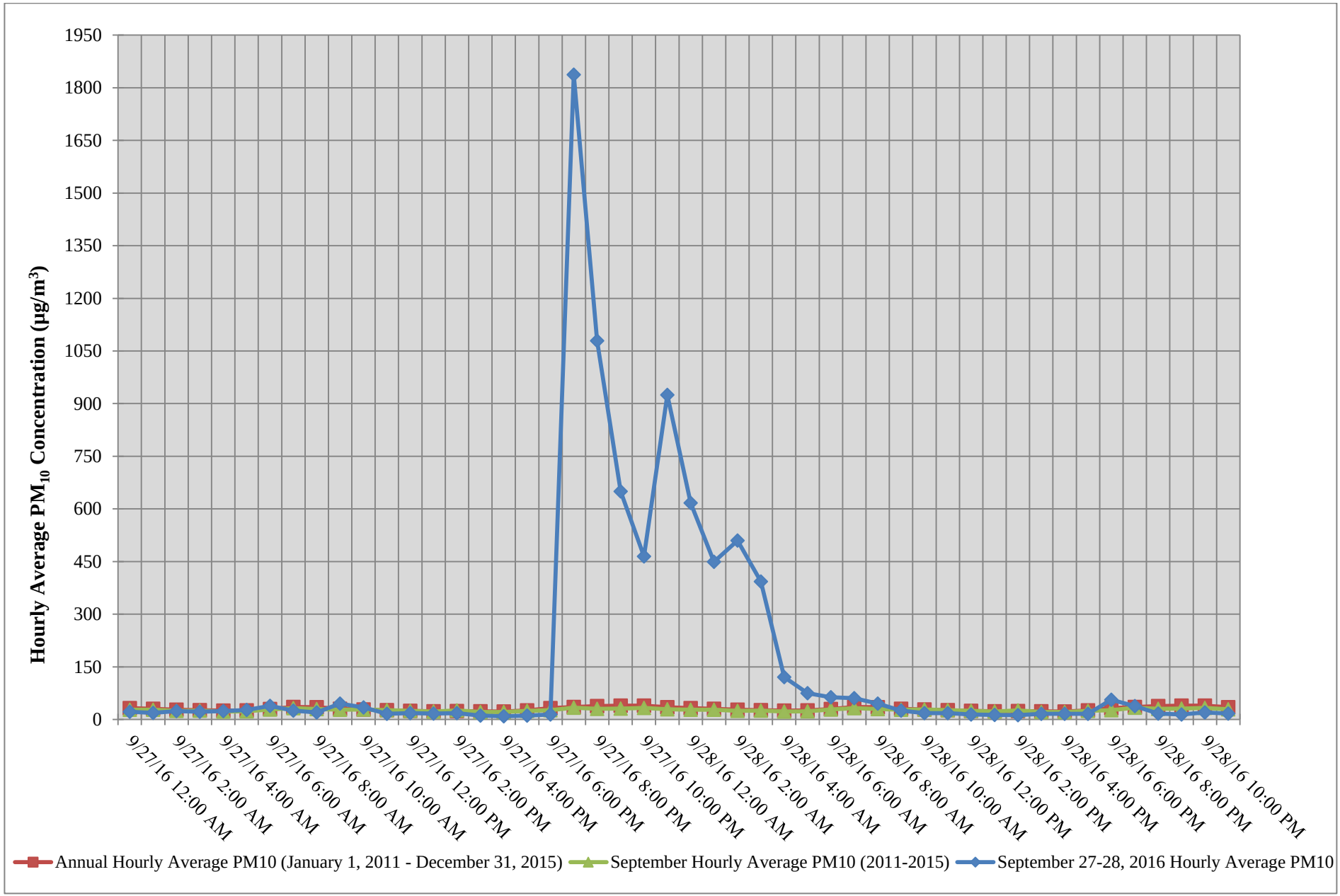

Figure 3-4. Plot of annual hourly average PM_{10} concentrations (1/1/2011 – 12/31/2015), hourly average PM_{10} concentrations in September (2011 – 2015), and diurnal PM_{10} concentrations at the JLG Supersite monitor on the September 27-28, 2016 high wind dust event day.

Chronological and Spatial Presentation of Wind, Visibility, and PM_{10} Concentration Data During the High Wind Dust Event in the Maricopa County PM_{10} Nonattainment Area

In addition to the analyses focused on comparison of the high wind dust event PM_{10} concentration to historical concentrations, Figure 3–5 through 3–37 display the chronological and spatial distribution of wind, visibility and PM_{10} concentration data throughout the nonattainment area in mapped form. The figures establish a clear causal relationship between elevated PM_{10} concentrations, elevated wind speeds and reduced visibility in the nonattainment area. The figures also establish the transport of PM_{10} across the nonattainment area with the thunderstorm outflow winds and the subsequent suspension of windblown dust after the outflow winds died down in the nonattainment area.

In 40 CFR Section 50.14(b)(5)(iii), EPA establishes a default high wind threshold of a sustained wind of 25 mph, as the wind speed necessary to entrain significant amounts of dust from undisturbed, natural areas, as well as disturbed, anthropogenic source areas that are subject to reasonable controls. Sustained winds, as represented in the figures, were recorded at 25 mph, with gusts of 41 mph, near the source area of the thunderstorm outflow, indicating that reasonable controls on anthropogenic sources of windblown dust were overwhelmed and that emissions of dust from natural desert areas would be expected. Although wind speeds decreased as the outflow entered the Maricopa County PM10 nonattainment area, visibility readings and photos make it clear that the winds were still strong enough to transport significant windblown dust into the nonattainment area, causing the exceedances at the Glendale and JLG Supersite monitors. Ironically, had the wind speeds been higher in the nonattainment area, the windblown dust created by the thunderstorm outflow likely would have been transported out of the nonattainment area, instead of becoming suspended overnight, and exceedances at the monitors likely would have been avoided. In summary, the figures make it clear that without the high wind dust event caused by the thunderstorm outflow and the subsequent trapping of suspended windblown dust, there would have been no exceedance at the Glendale and JLG Supersite monitors.

The data displayed in the following figures were gathered from five data sources. All available meteorological and air quality data were used in order to present the most complete story of the event. Table 3–1 displays the types of data used from each agency in creating the maps. Each map in the figures represents the chronological and spatial distribution of wind, visibility and PM_{10} concentration in a 30-minute period. The figures start with the 5:00-5:30 PM period on September 27, 2016 and end with the 9:00-9:30 AM period on September 28, 2016, covering the arrival, passing and suspension of the thunderstorm outflow-generated windblown dust across the Maricopa County PM_{10} nonattainment area.

Table 3-1. Data Sets Used in the Creation of Chronological and Spatial Maps.

Agency	Data Sets
Arizona Department of Environmental Quality (ADEQ)	Hourly PM_{10} 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 PM_{10} Concentrations, 5-Minute Wind Speed and Wind Direction, and Maximum Hourly Wind Gusts
Pinal County Air Quality Control District (PCAQCD)	5-Minute and Hourly PM_{10} 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 Radial Velocity Radar

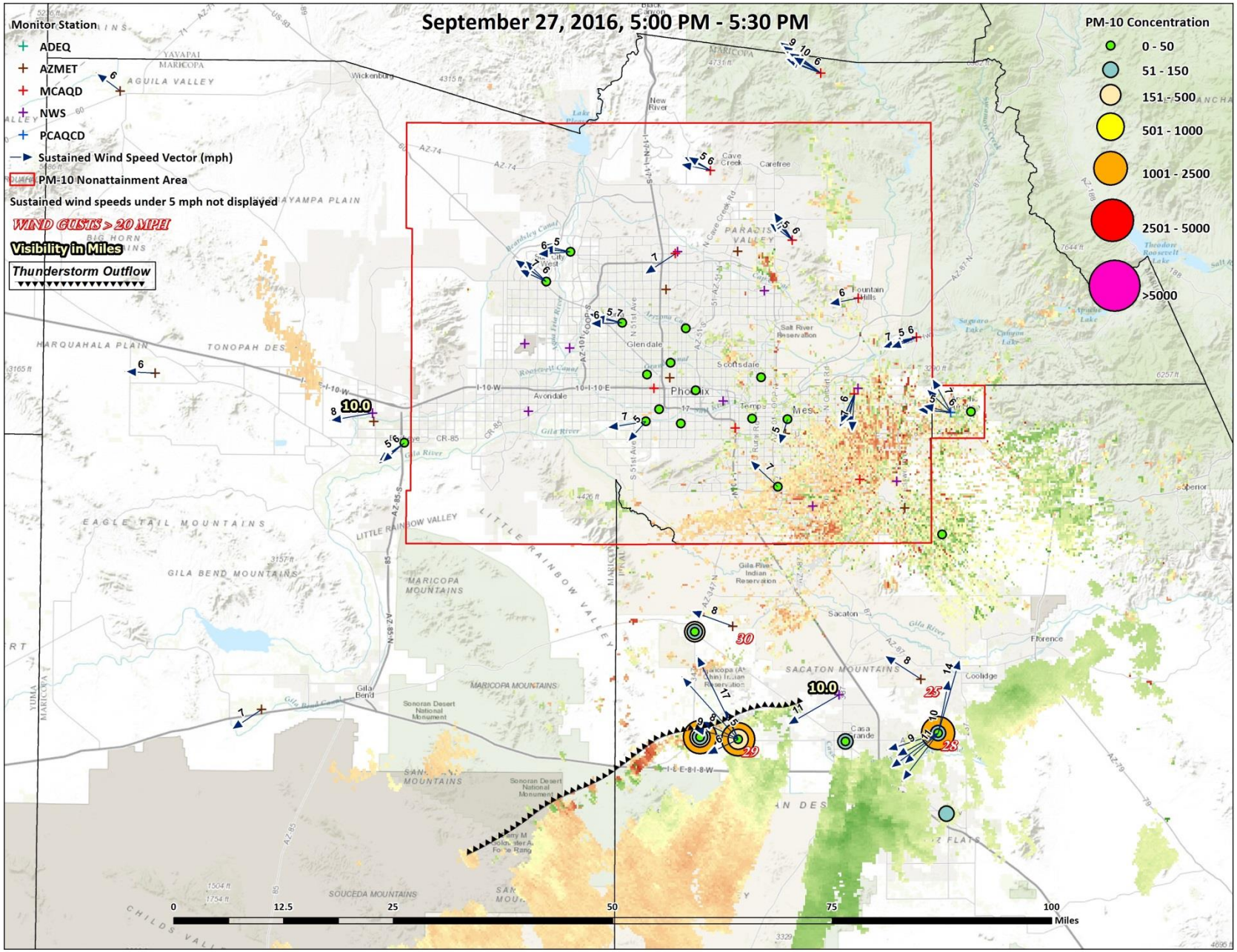

Figure 3-5. September 27, 2016, 5:00 PM – 5:30 PM.

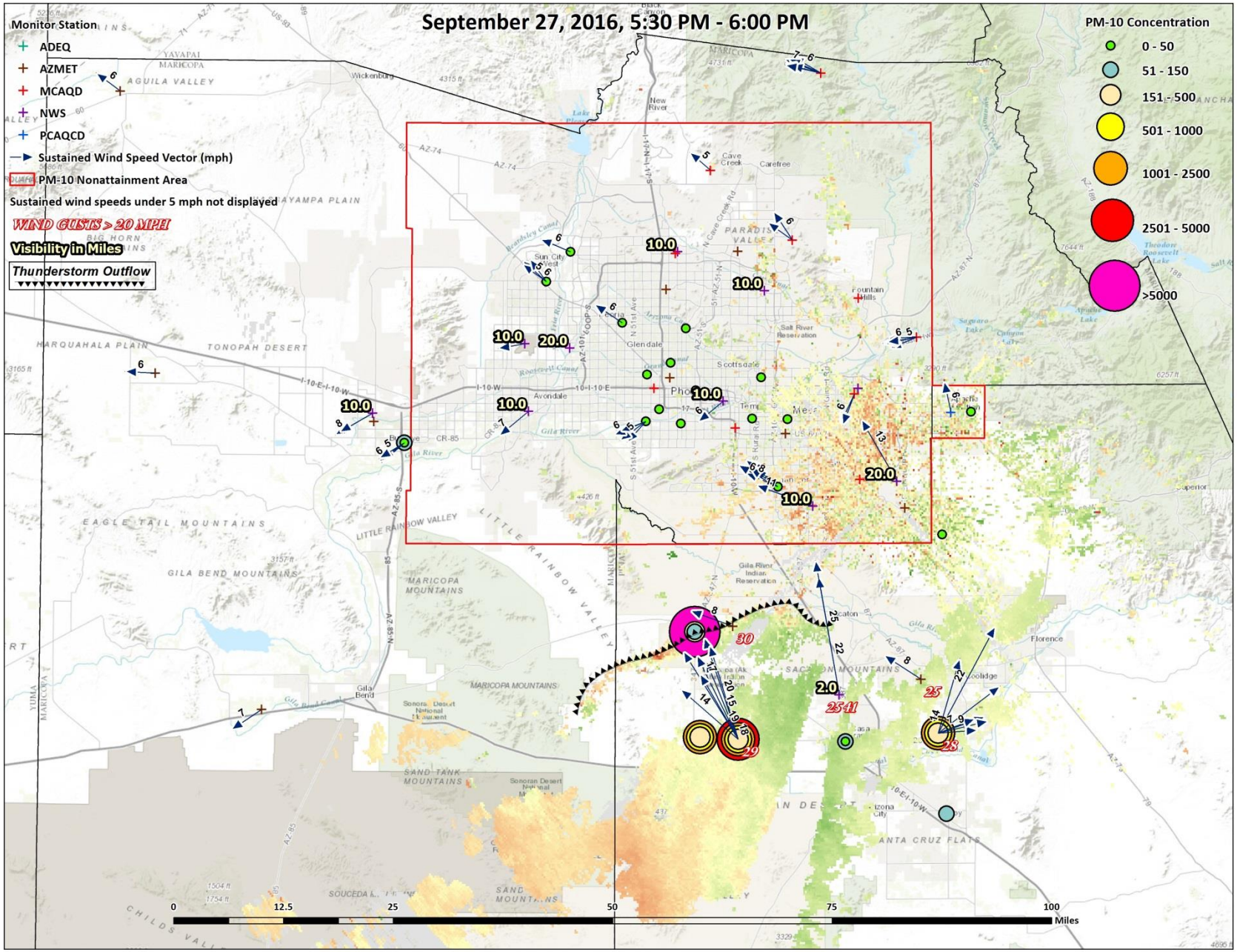

Figure 3-6. September 27, 2016, 5:30 PM – 6:00 PM.

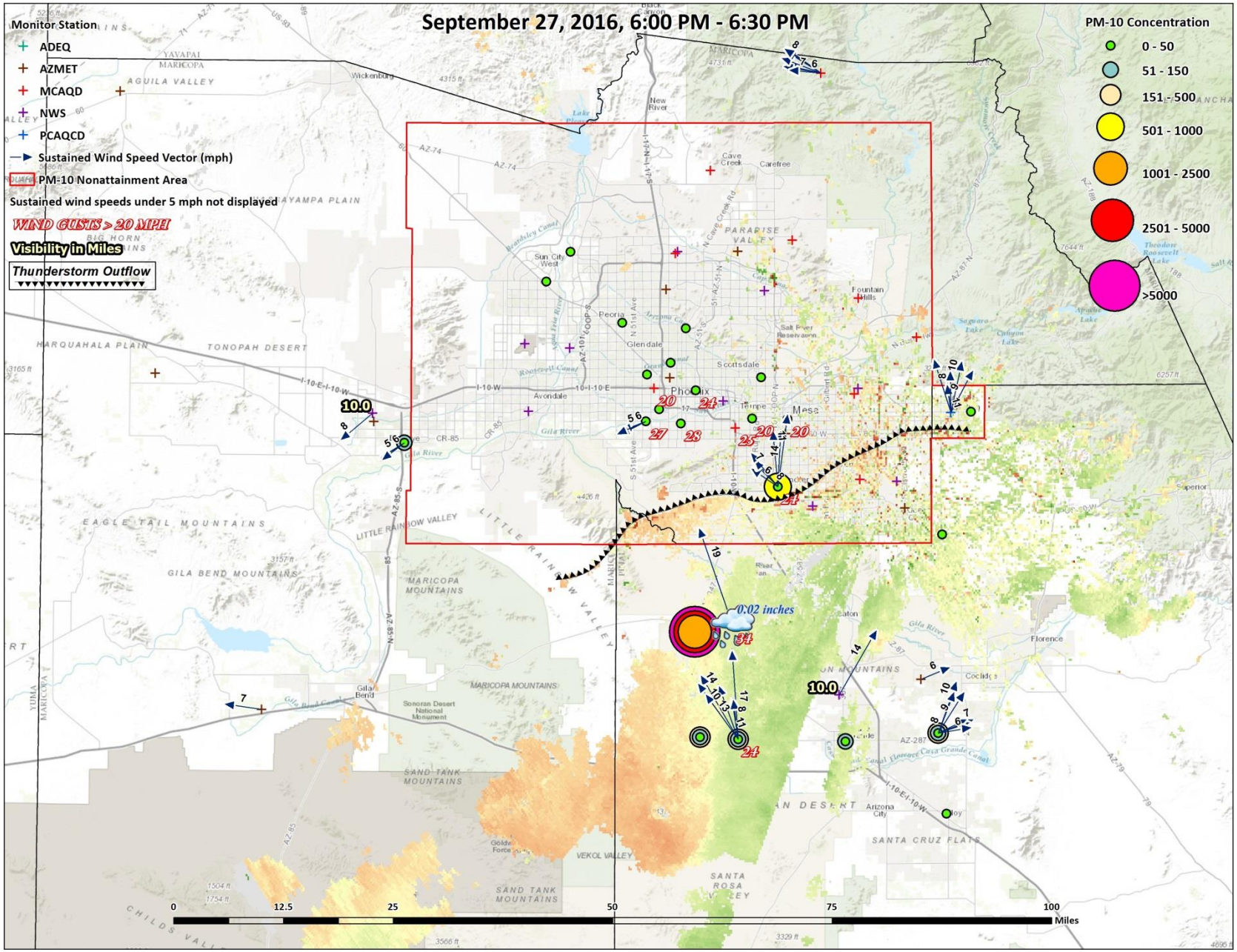

Figure 3-7. September 27, 2016, 6:00 PM – 6:30 PM.

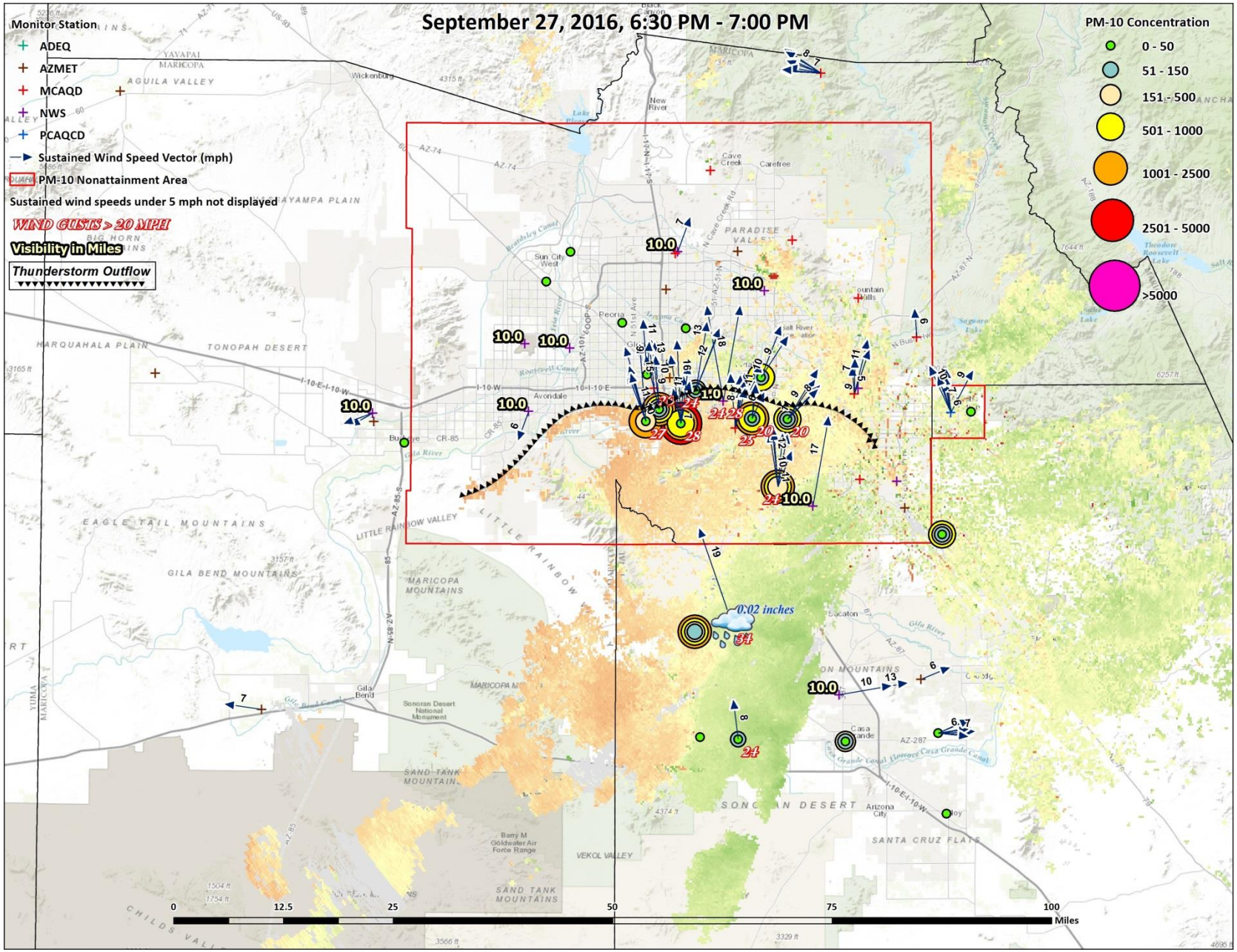

Figure 3-8. September 27, 2016, 6:30 PM – 7:00 PM.

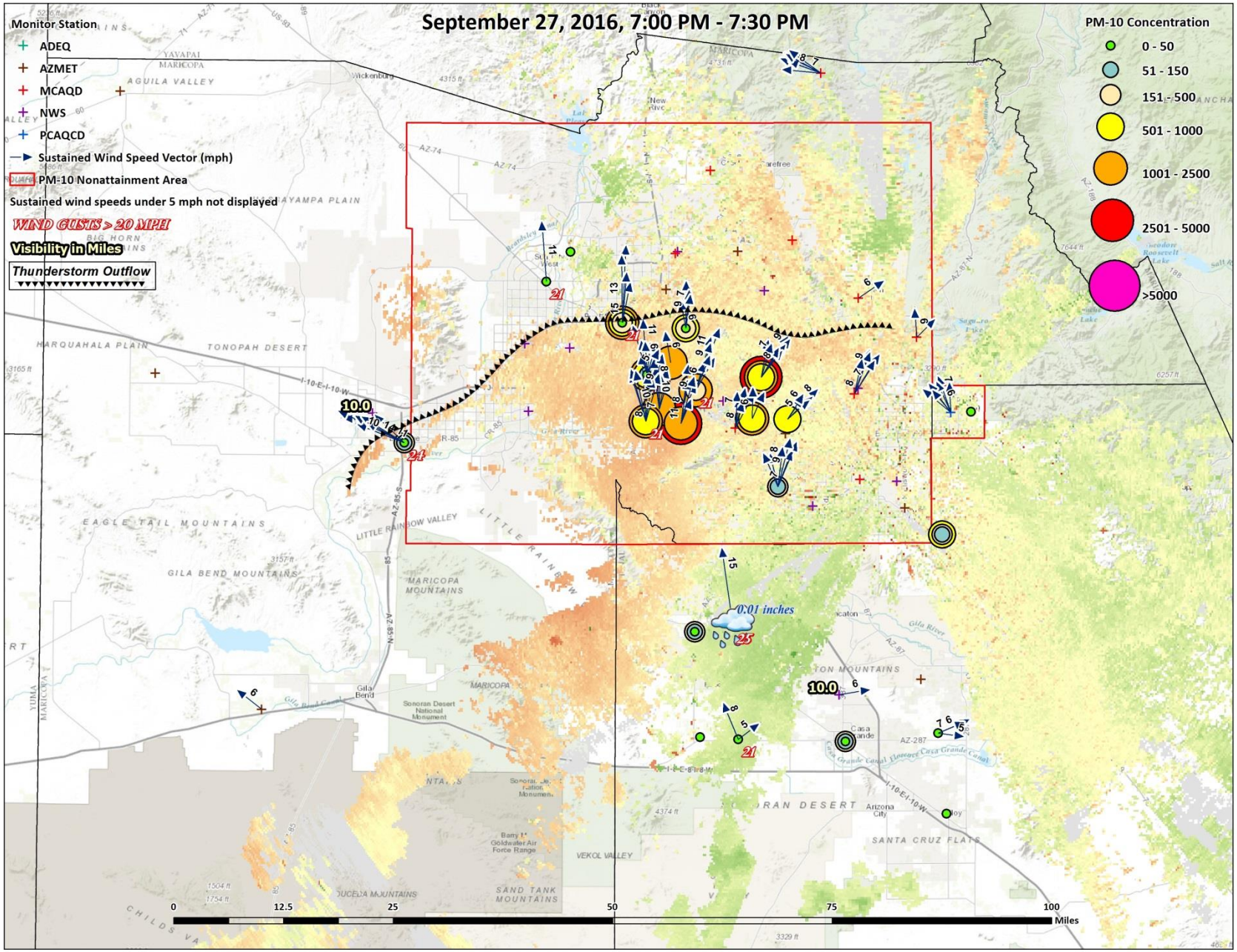

Figure 3-9. September 27, 2016, 7:00 PM – 7:30 PM.

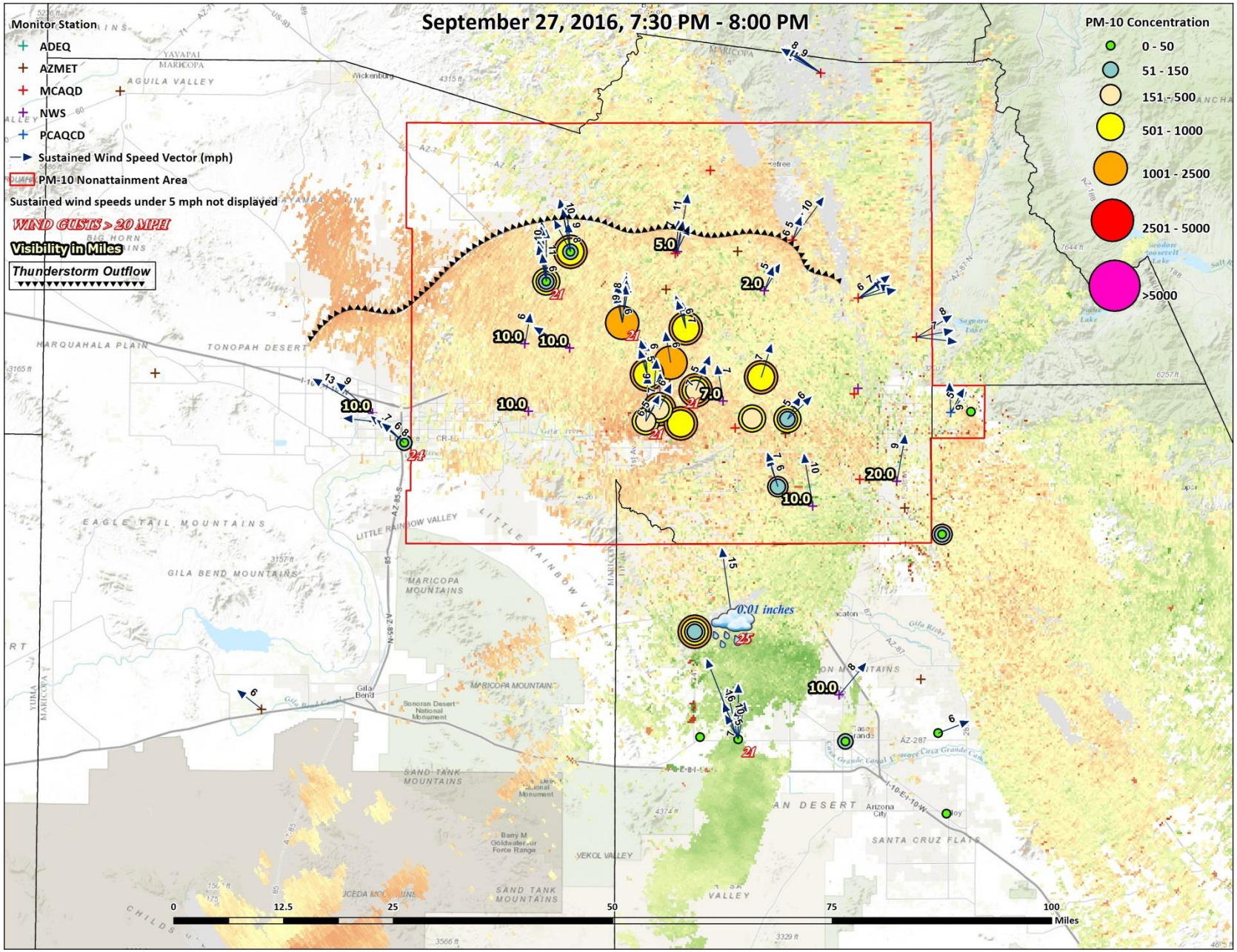

Figure 3-10. September 27, 2016, 7:30 PM – 8:00 PM.

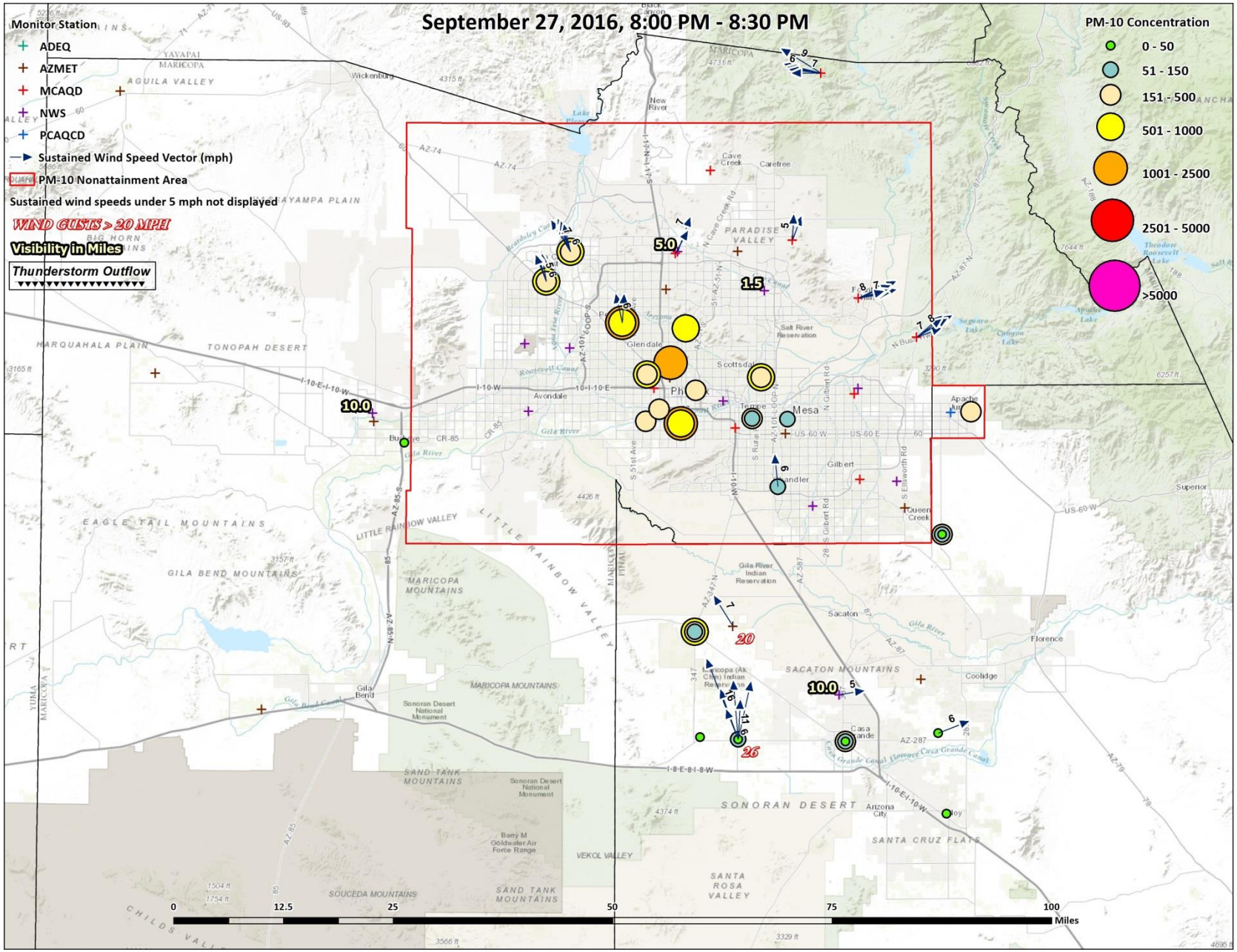

Figure 3-11. September 27, 2016, 8:00 PM – 8:30 PM.

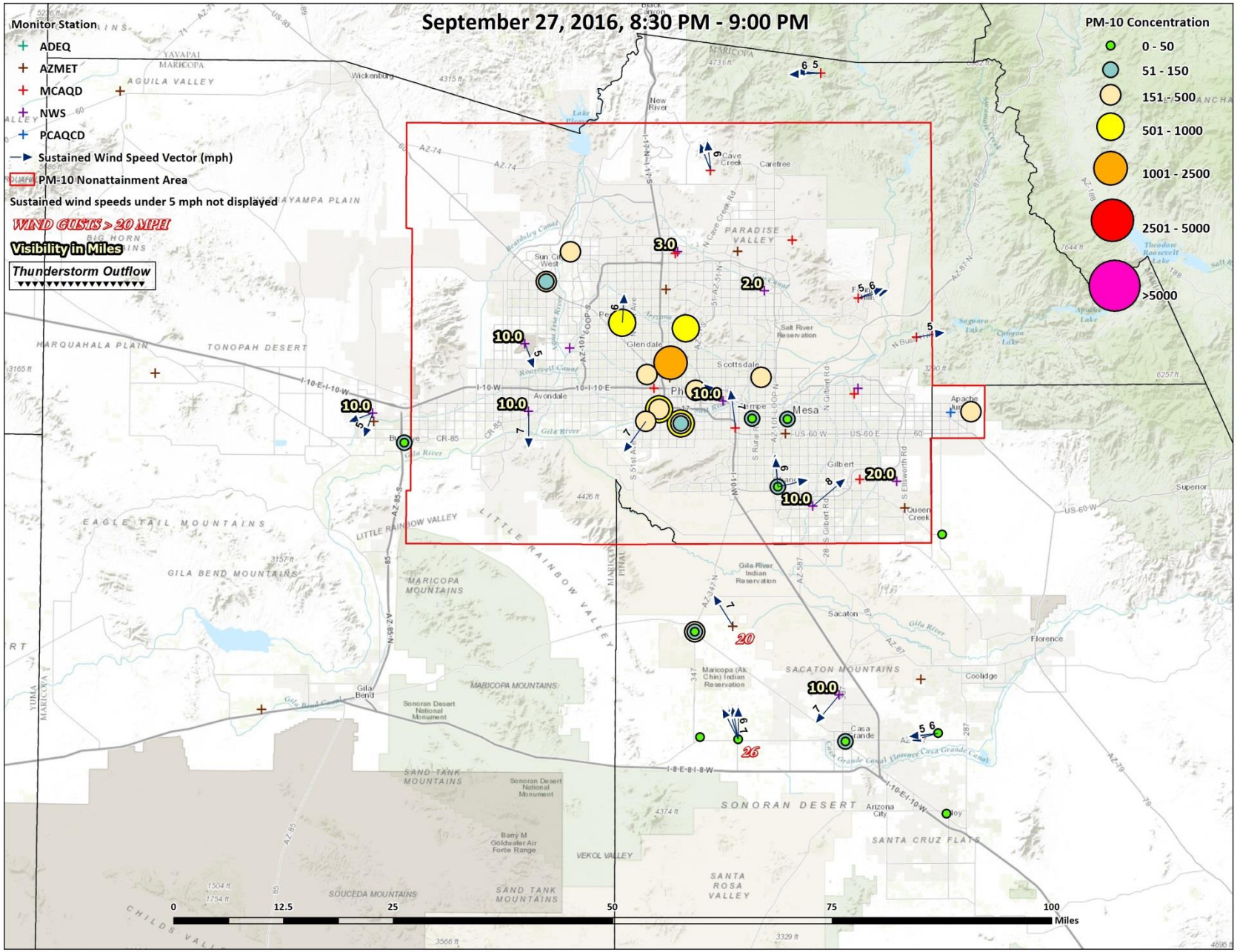

Figure 3-12. September 27, 2016, 8:30 PM – 9:00 PM.

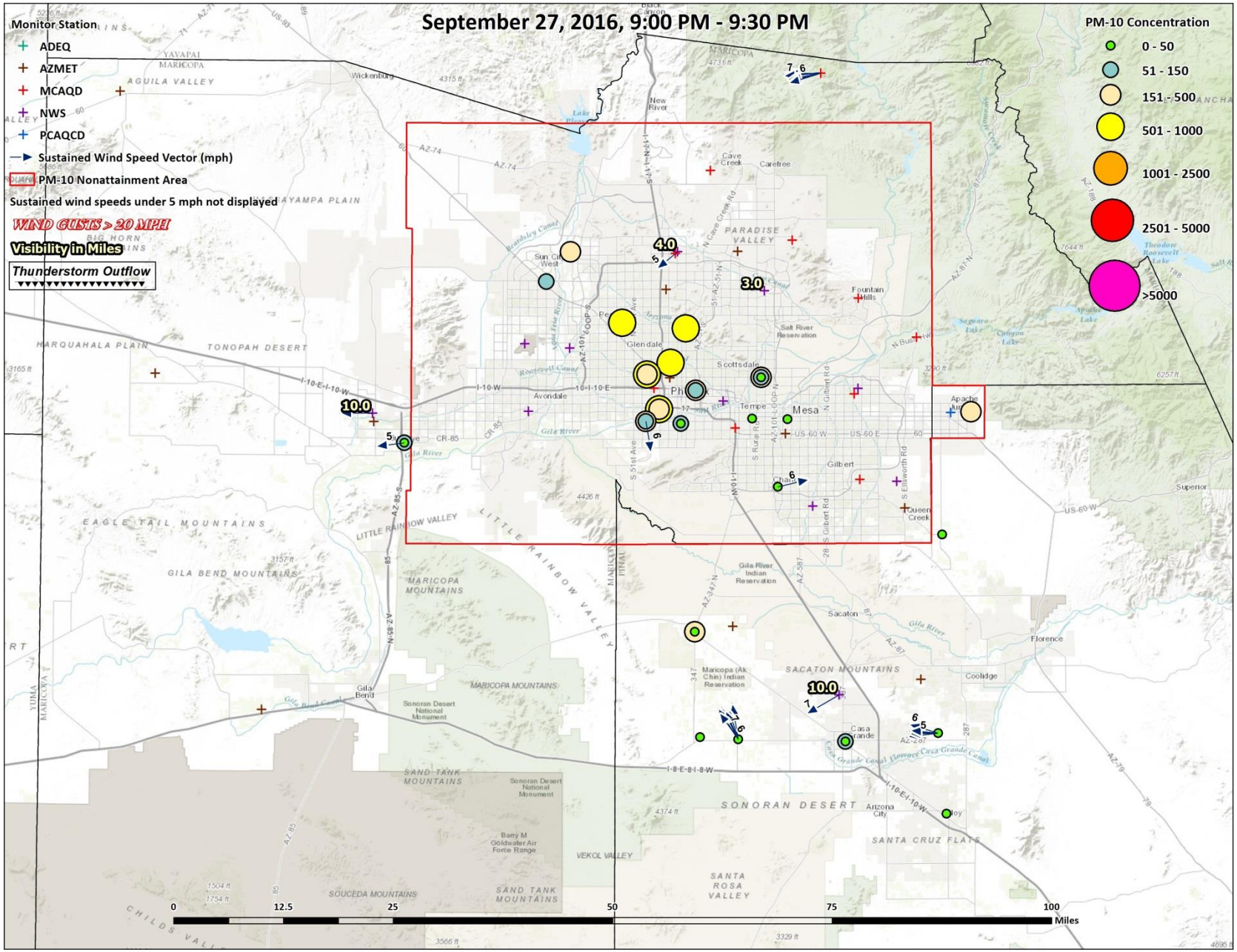

Figure 3-13. September 27, 2016, 9:00 PM – 9:30 PM.

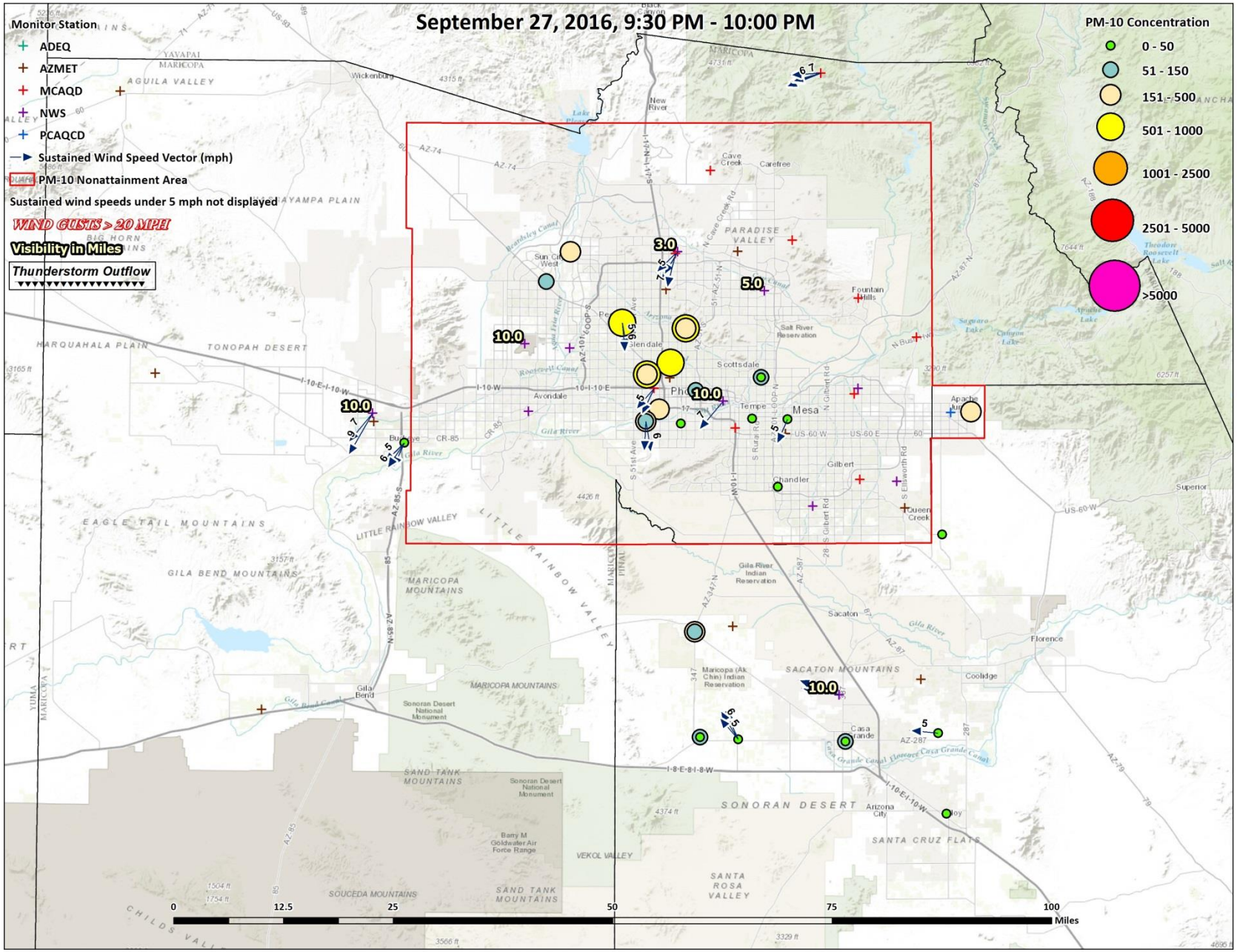

Figure 3-14. September 27, 2016, 9:30 PM – 10:00 PM.

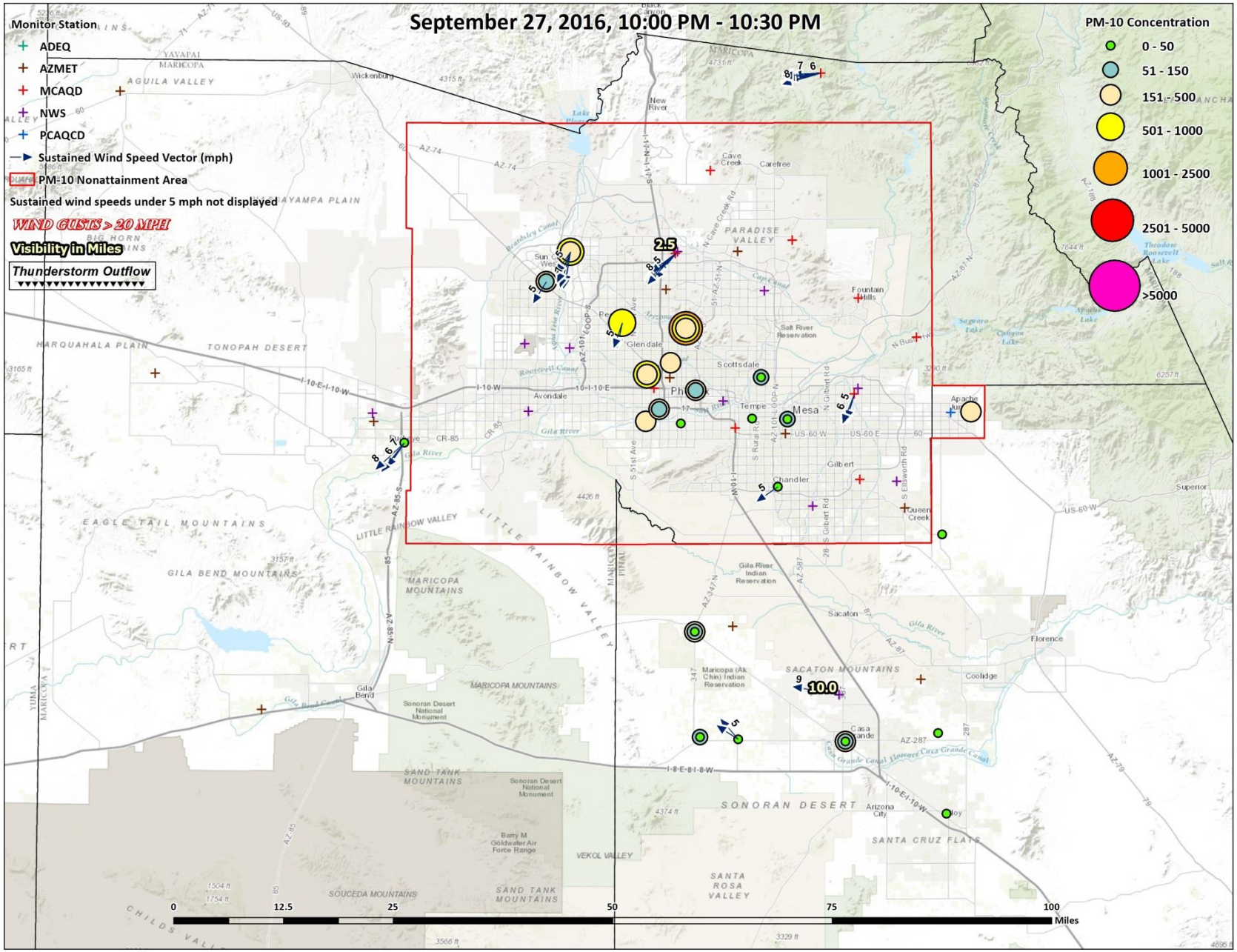

Figure 3-15. September 27, 2016, 10:00 PM – 10:30 PM.

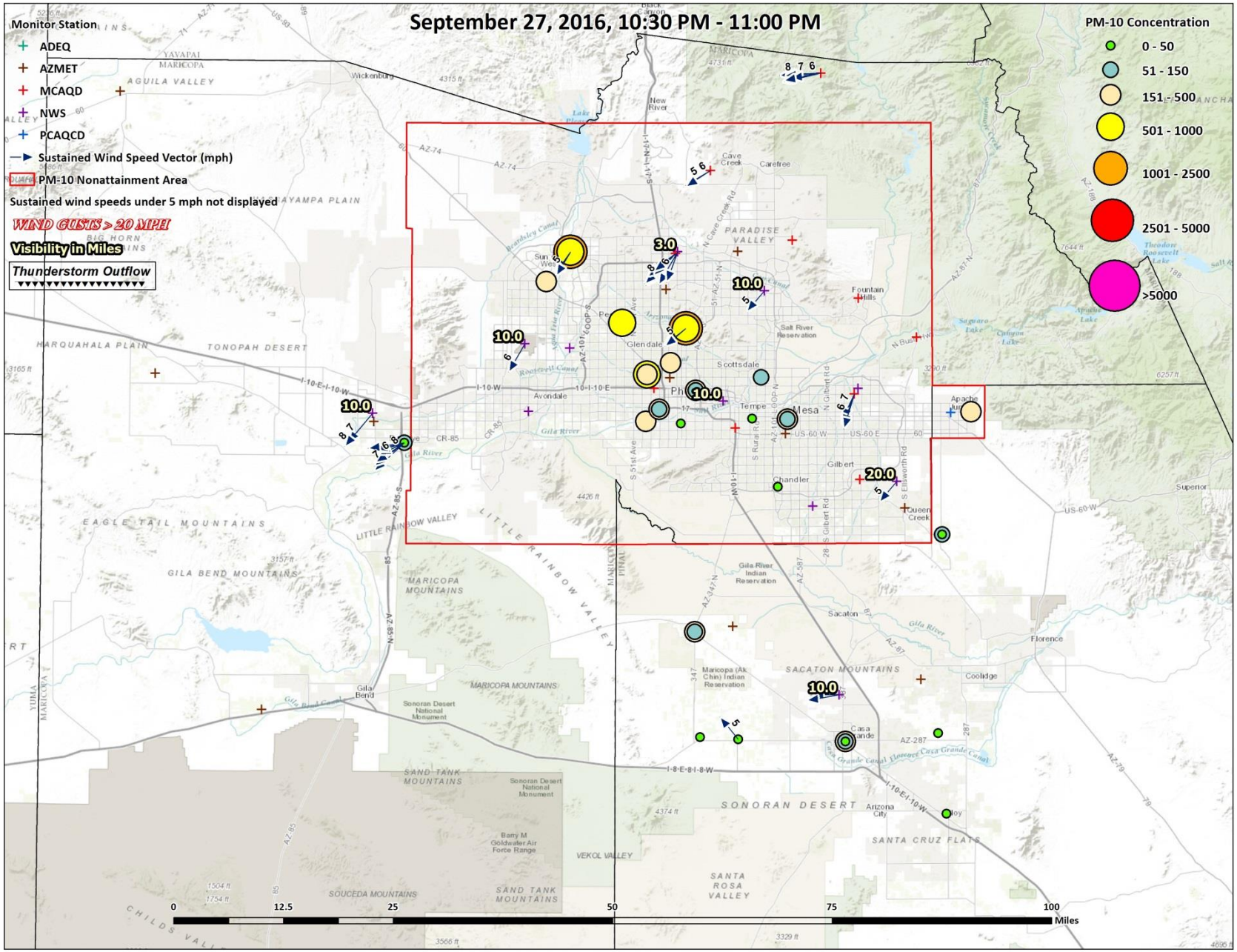

Figure 3-16. September 27, 2016, 10:30 PM – 11:00 PM.

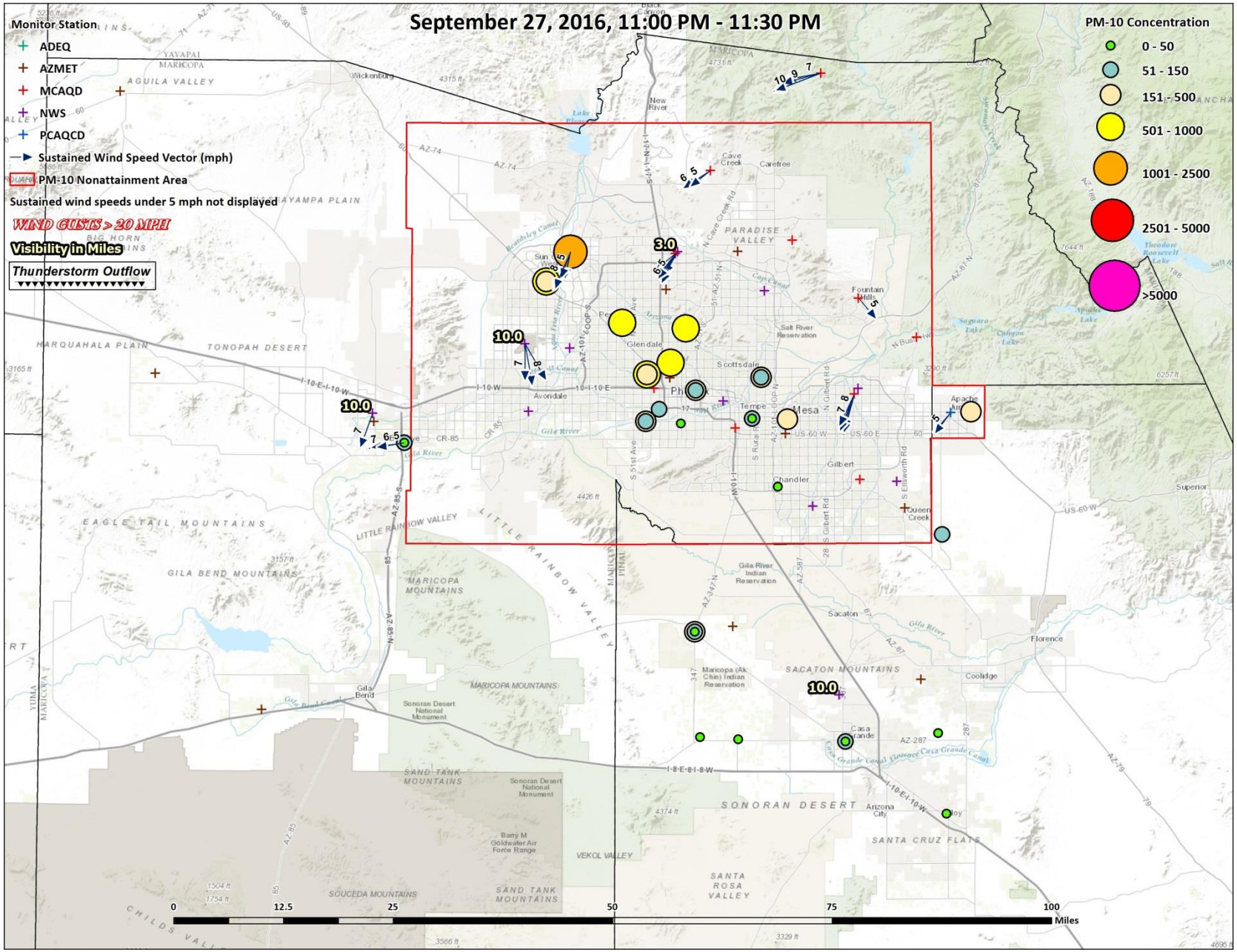

Figure 3-17. September 27, 2016, 11:00 PM – 11:30 PM.

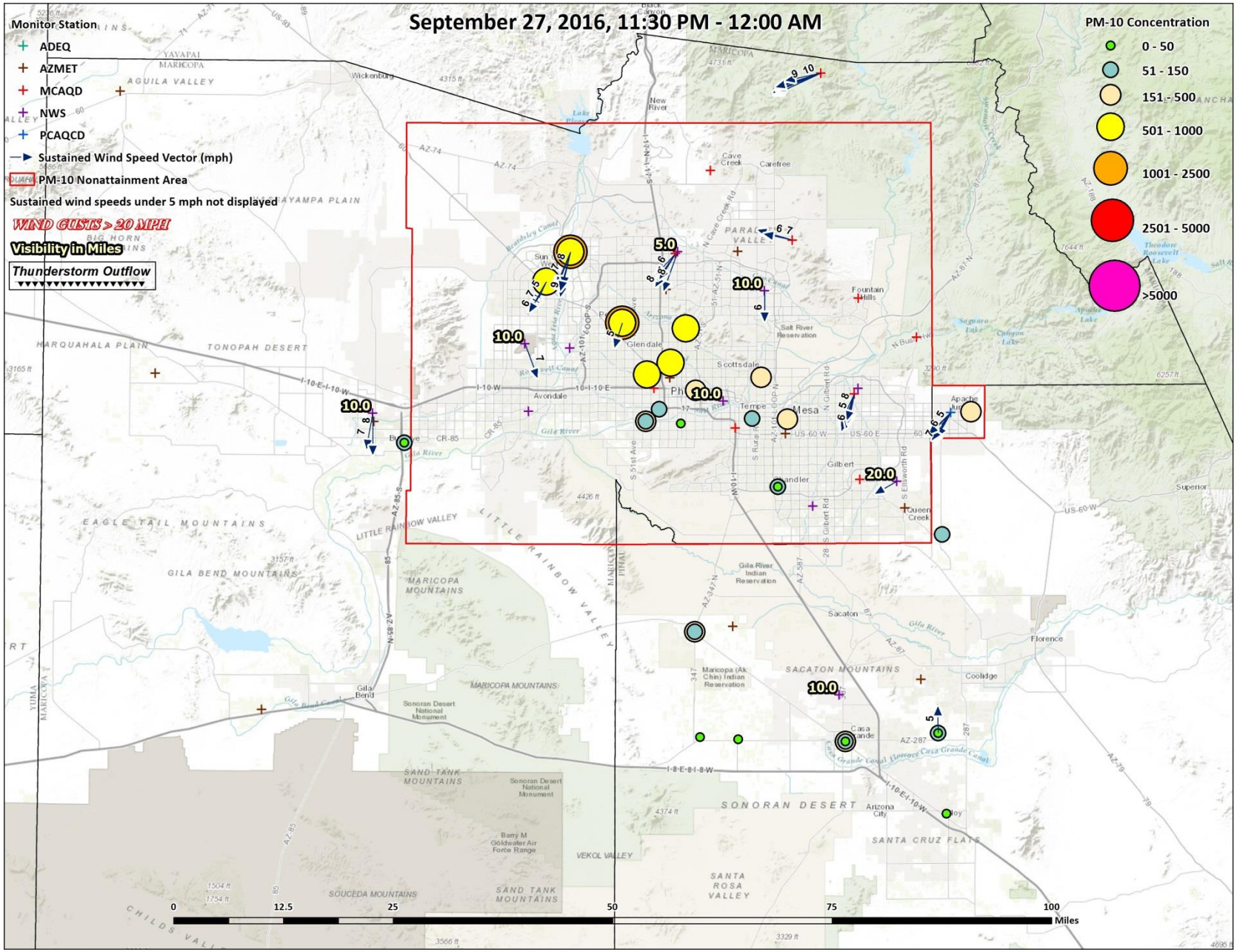

Figure 3-18. September 27, 2016, 11:30 PM – 12:00 AM.

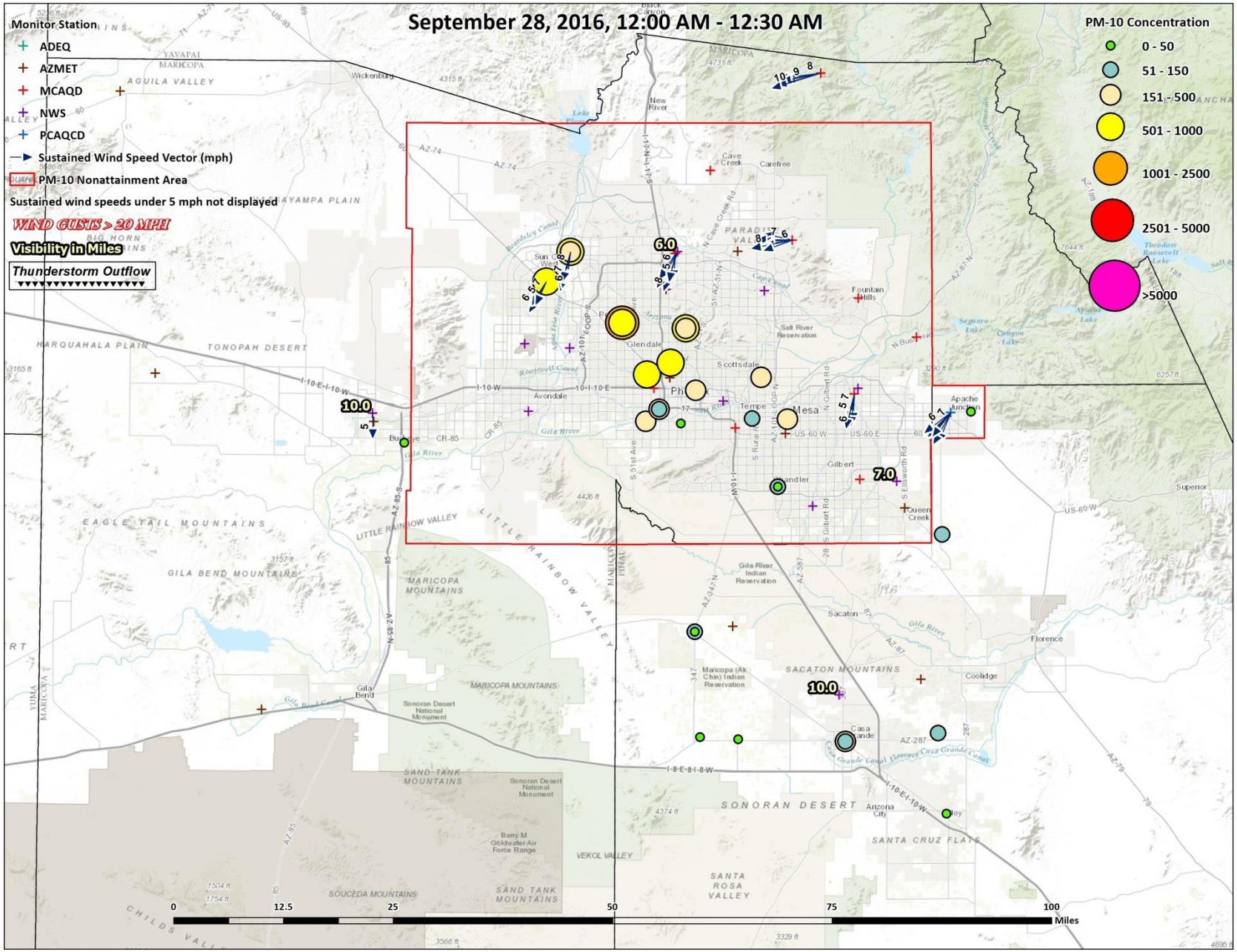

Figure 3-19. September 28, 2016, 12:00 AM – 12:30 AM.

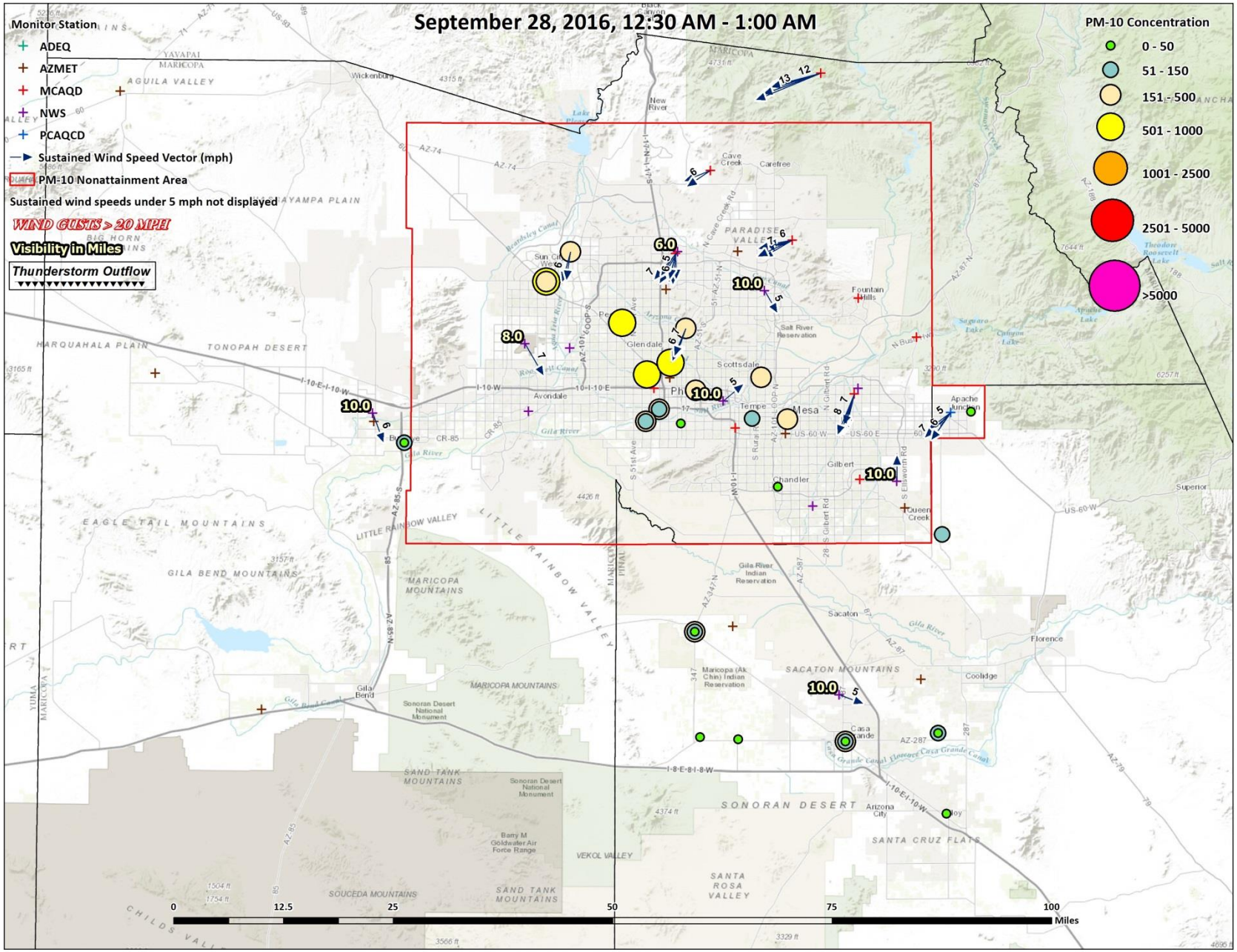

Figure 3-20. September 28, 2016, 12:30 AM – 1:00 AM.

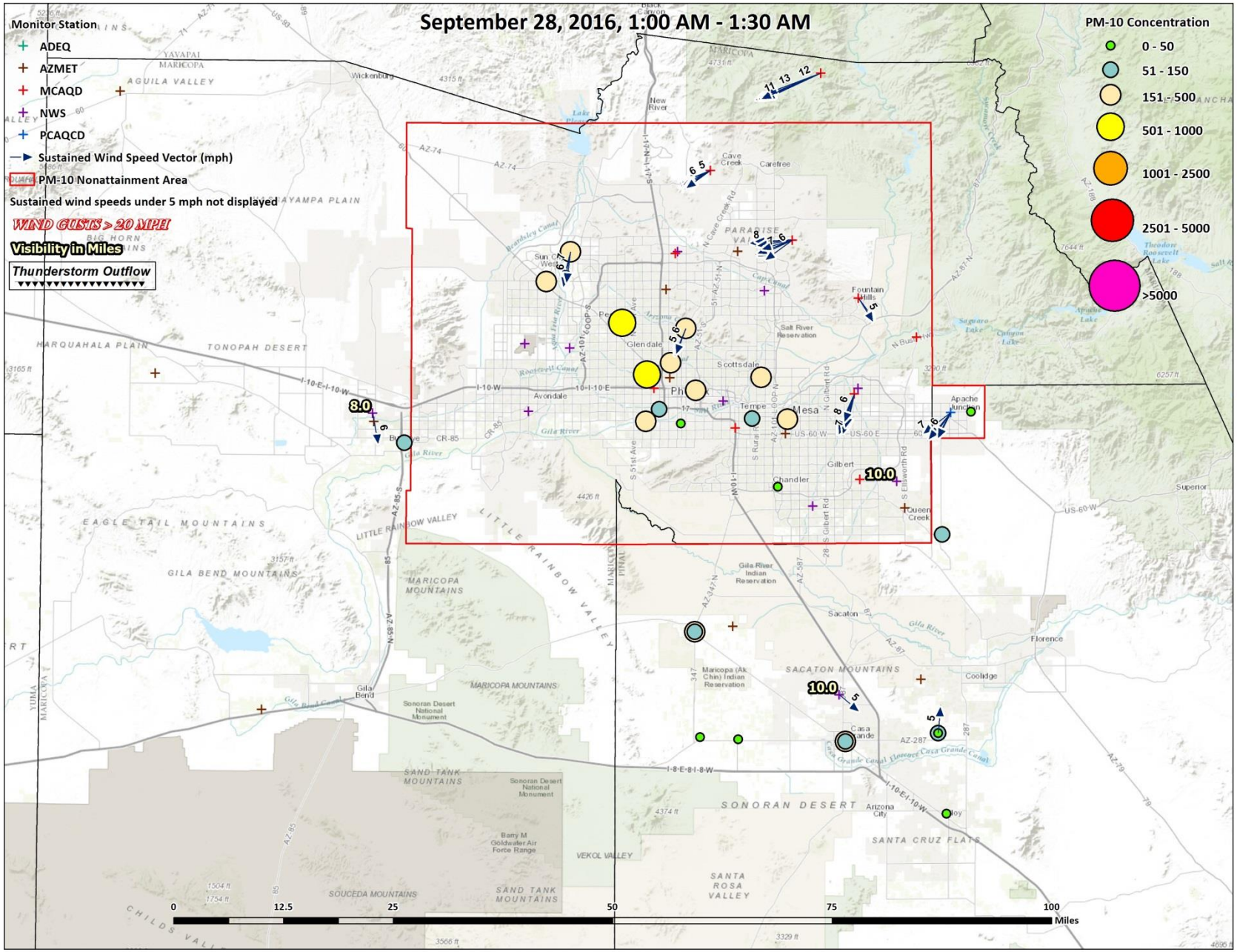

Figure 3-21. September 28, 2016, 1:00 AM – 1:30 AM.

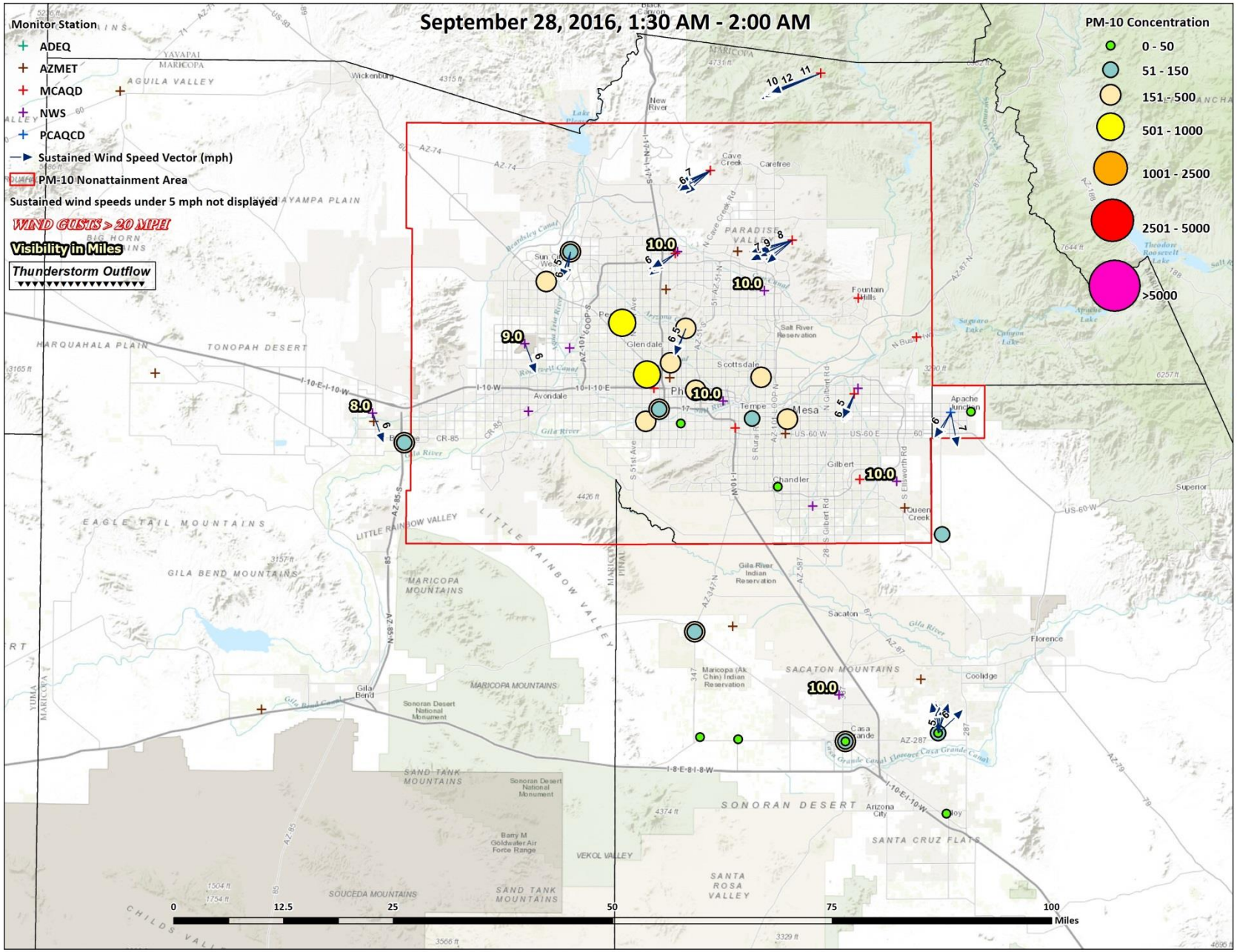

Figure 3-22. September 28, 2016, 1:30 AM – 2:00 AM.

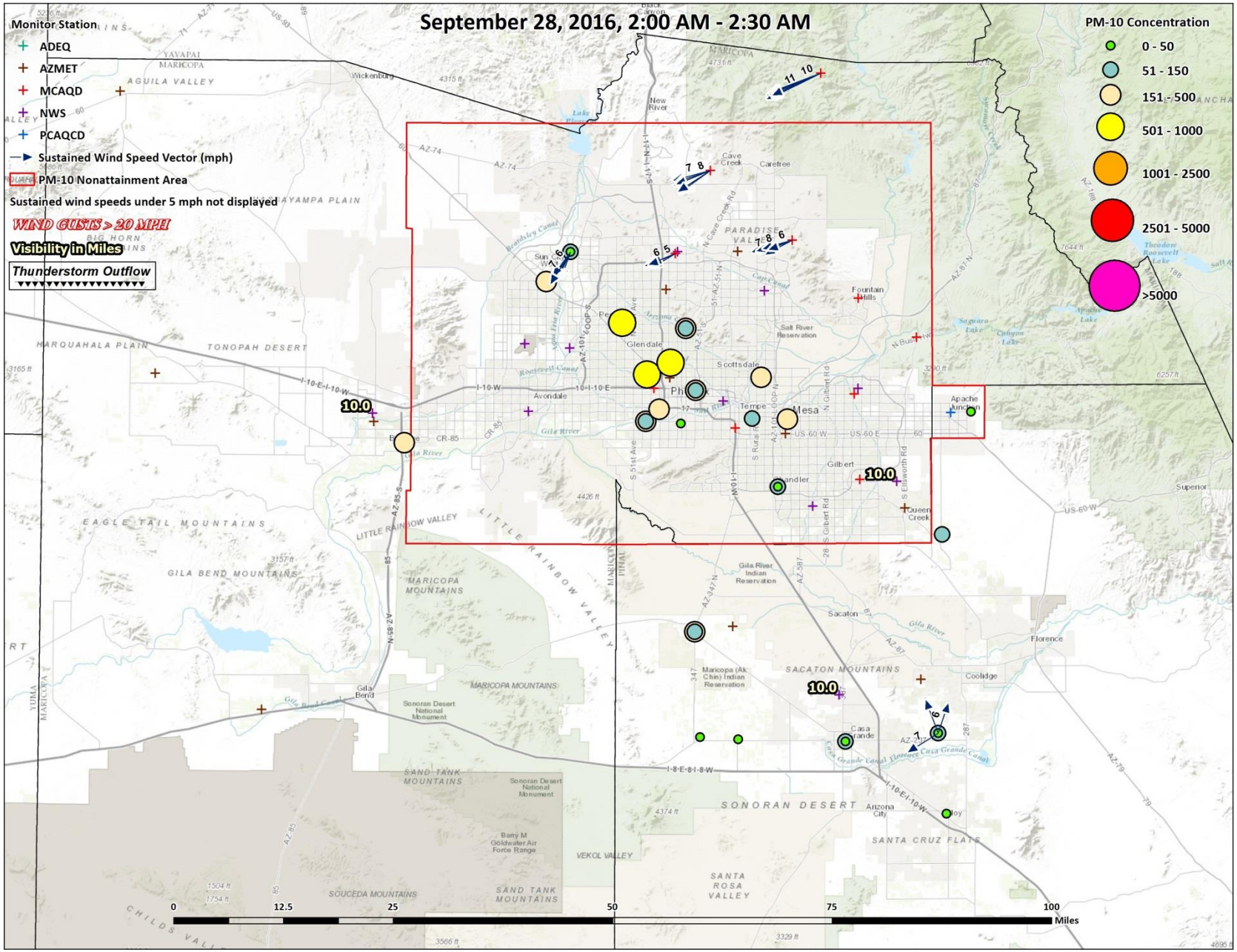

Figure 3-23. September 28, 2016, 2:00 AM – 2:30 AM.

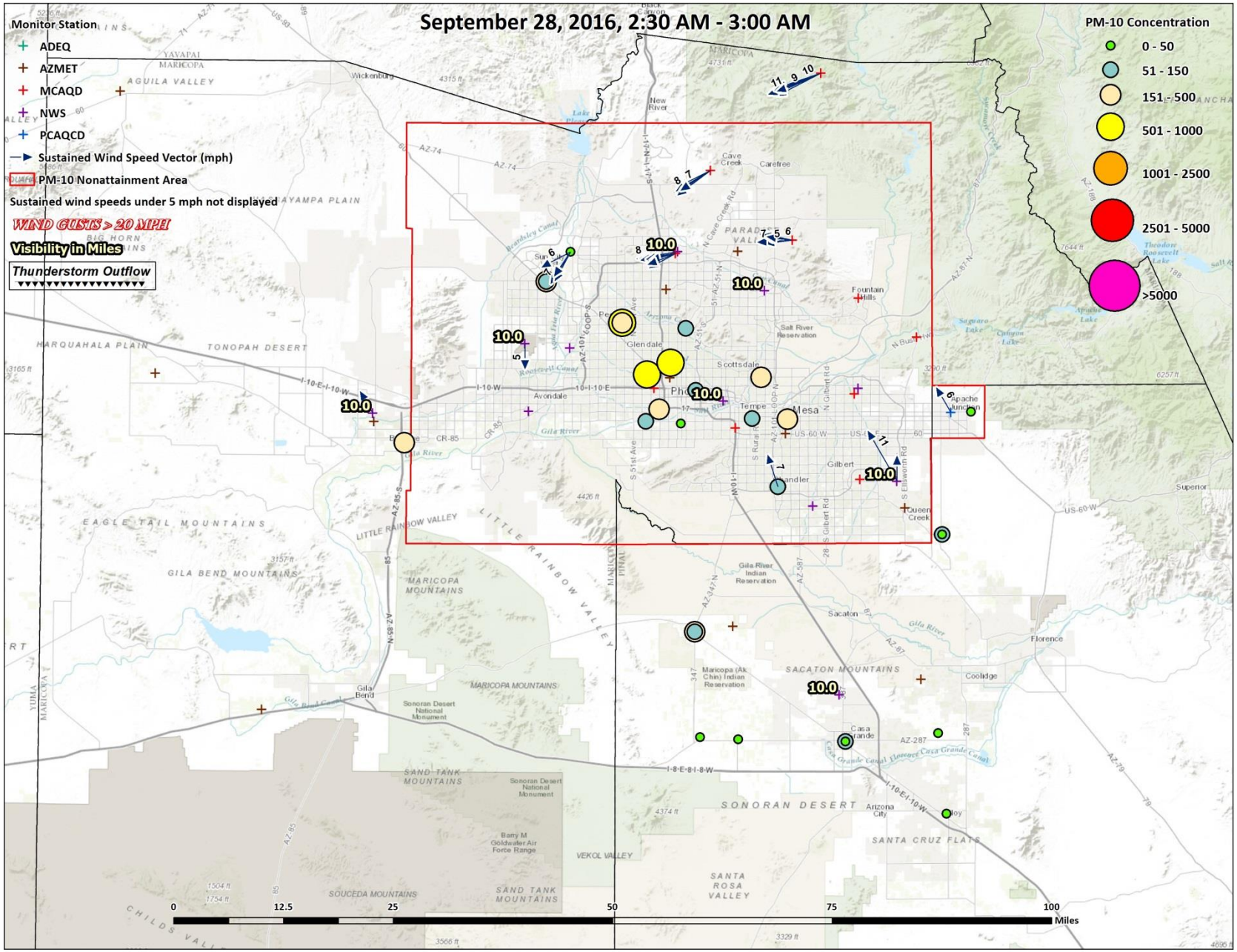

Figure 3-24. September 28, 2016, 2:30 AM – 3:00 AM.

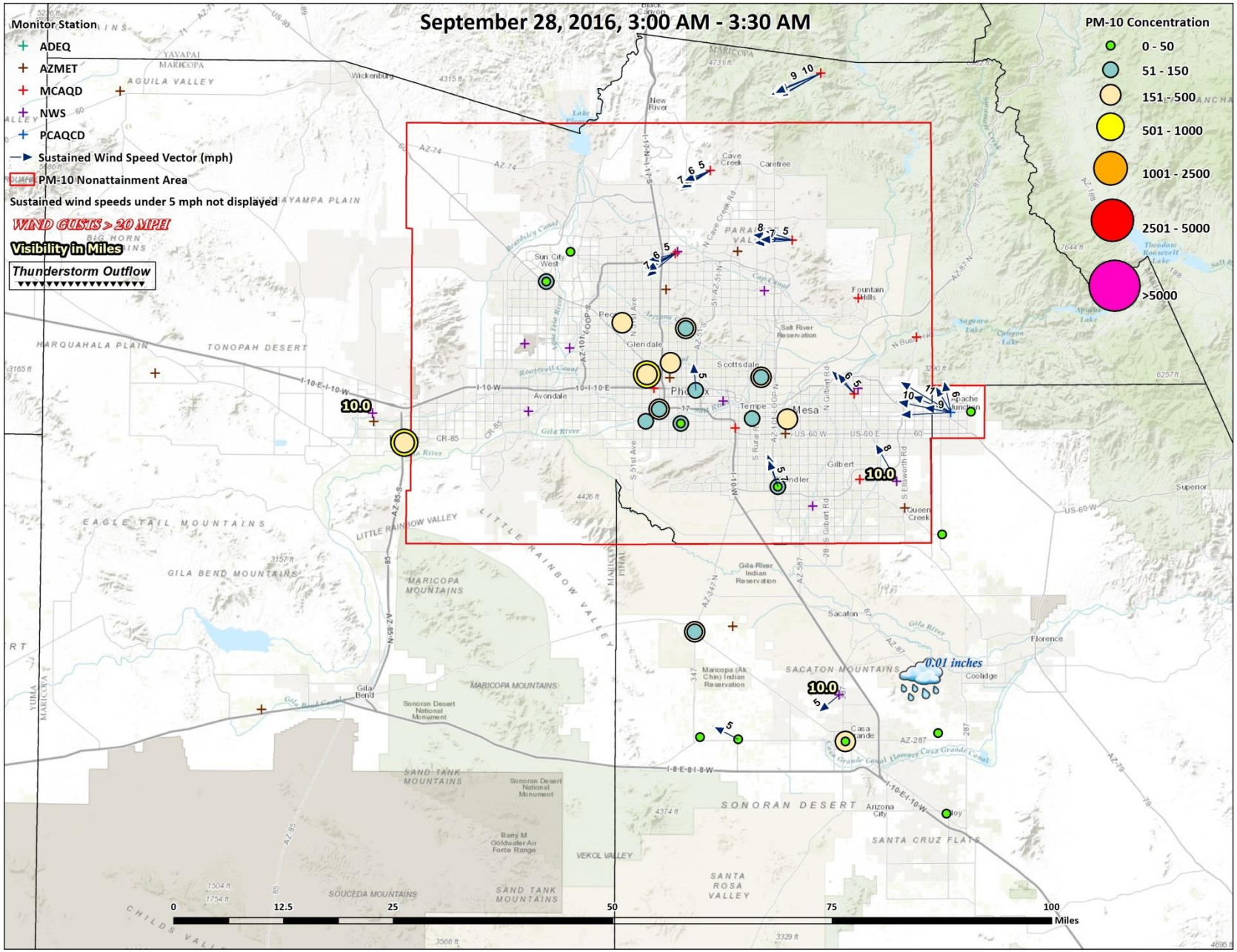

Figure 3-25. September 28, 2016, 3:00 AM – 3:30 AM.

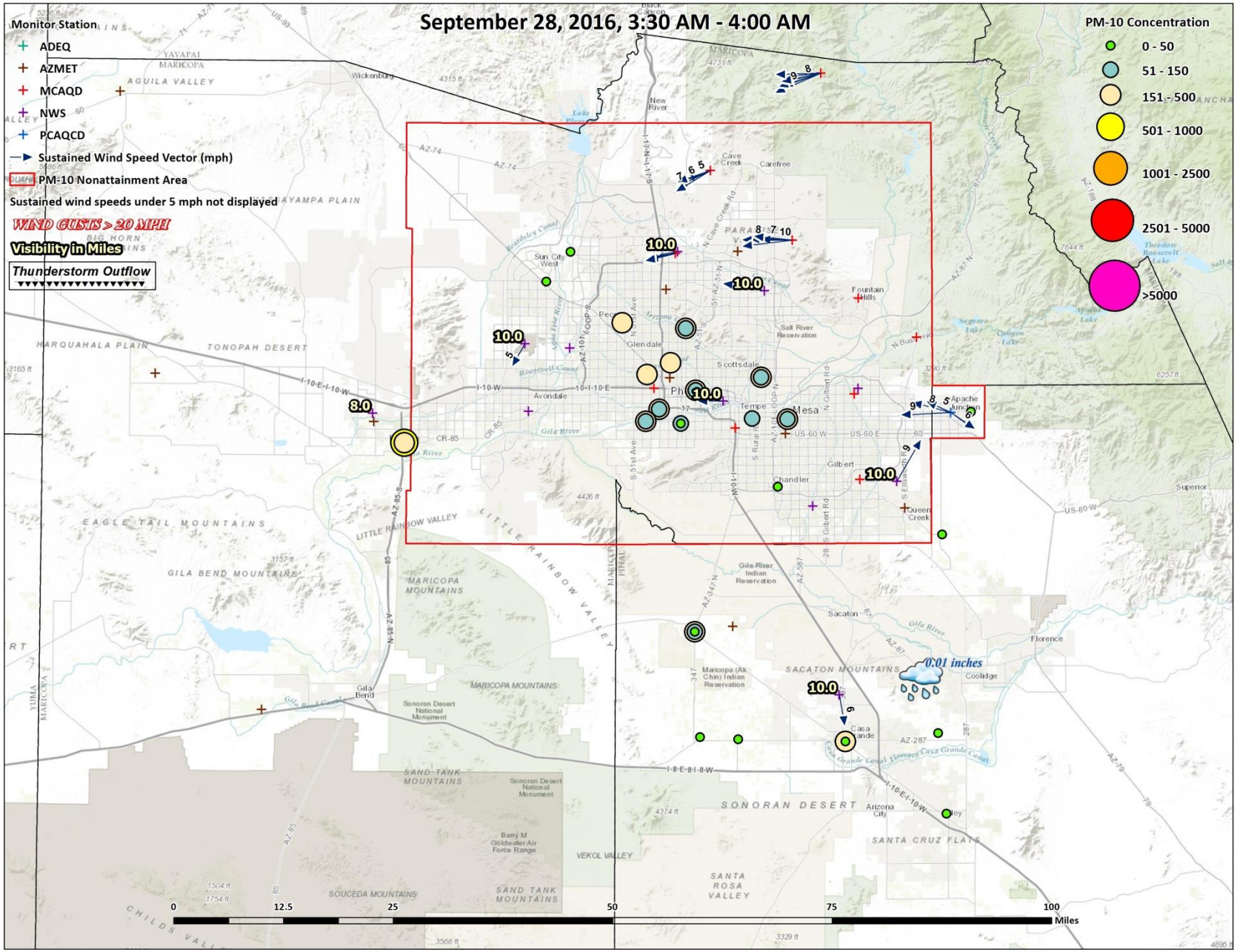

Figure 3-26. September 28, 2016, 3:30 AM – 4:00 AM.

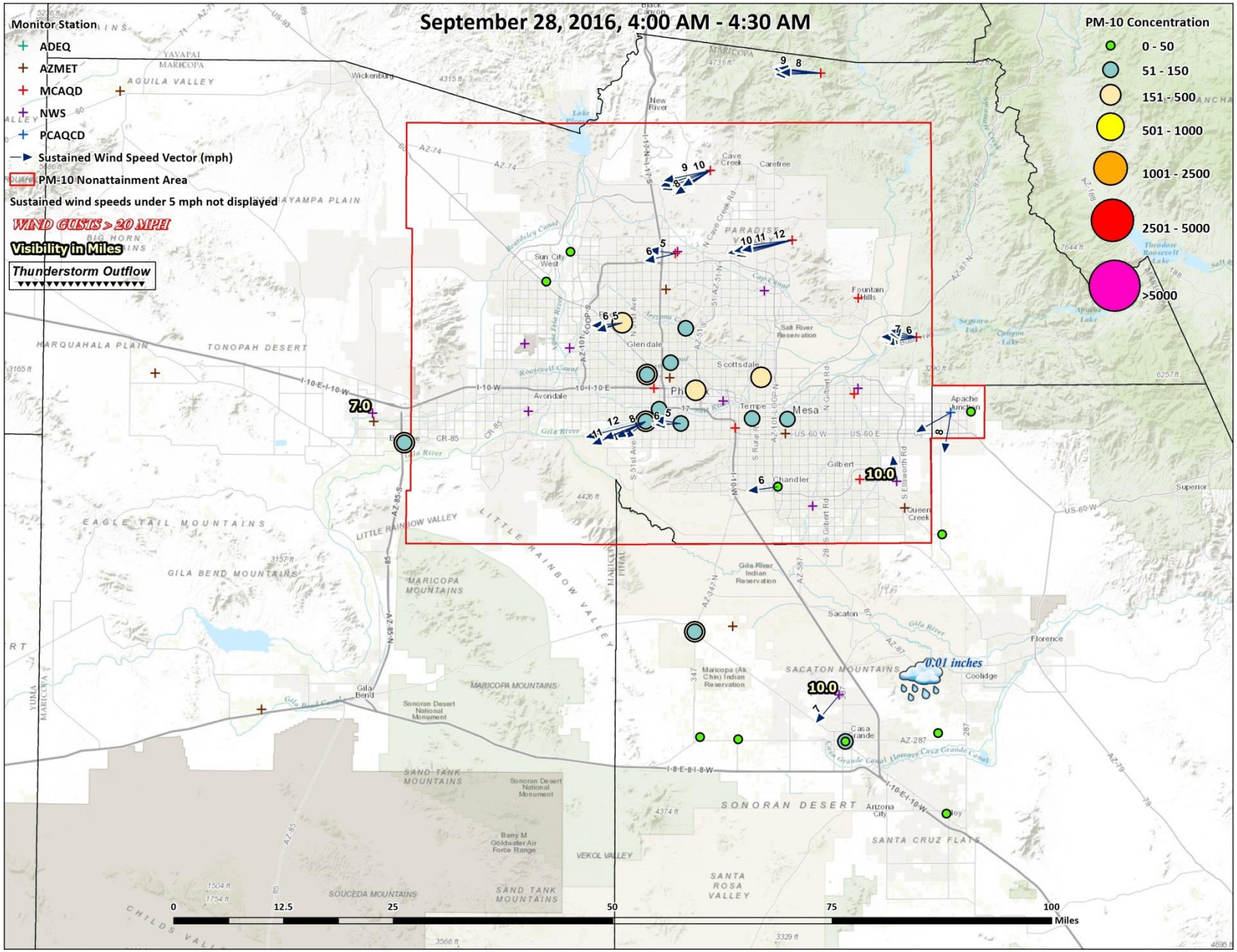

Figure 3-27. September 28, 2016, 4:00 AM – 4:30 AM.

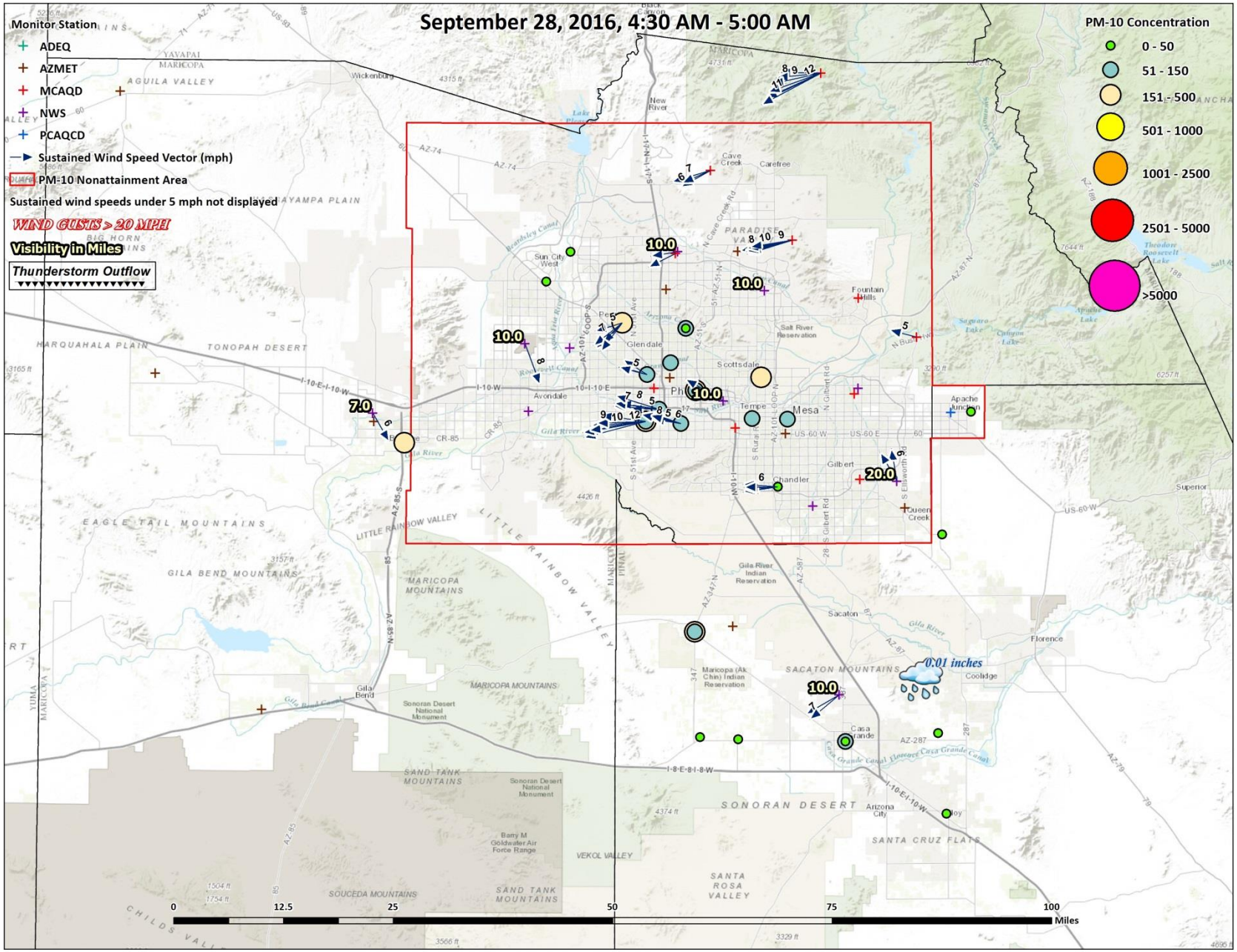

Figure 3-28. September 28, 2016, 4:30 AM – 5:00 AM.

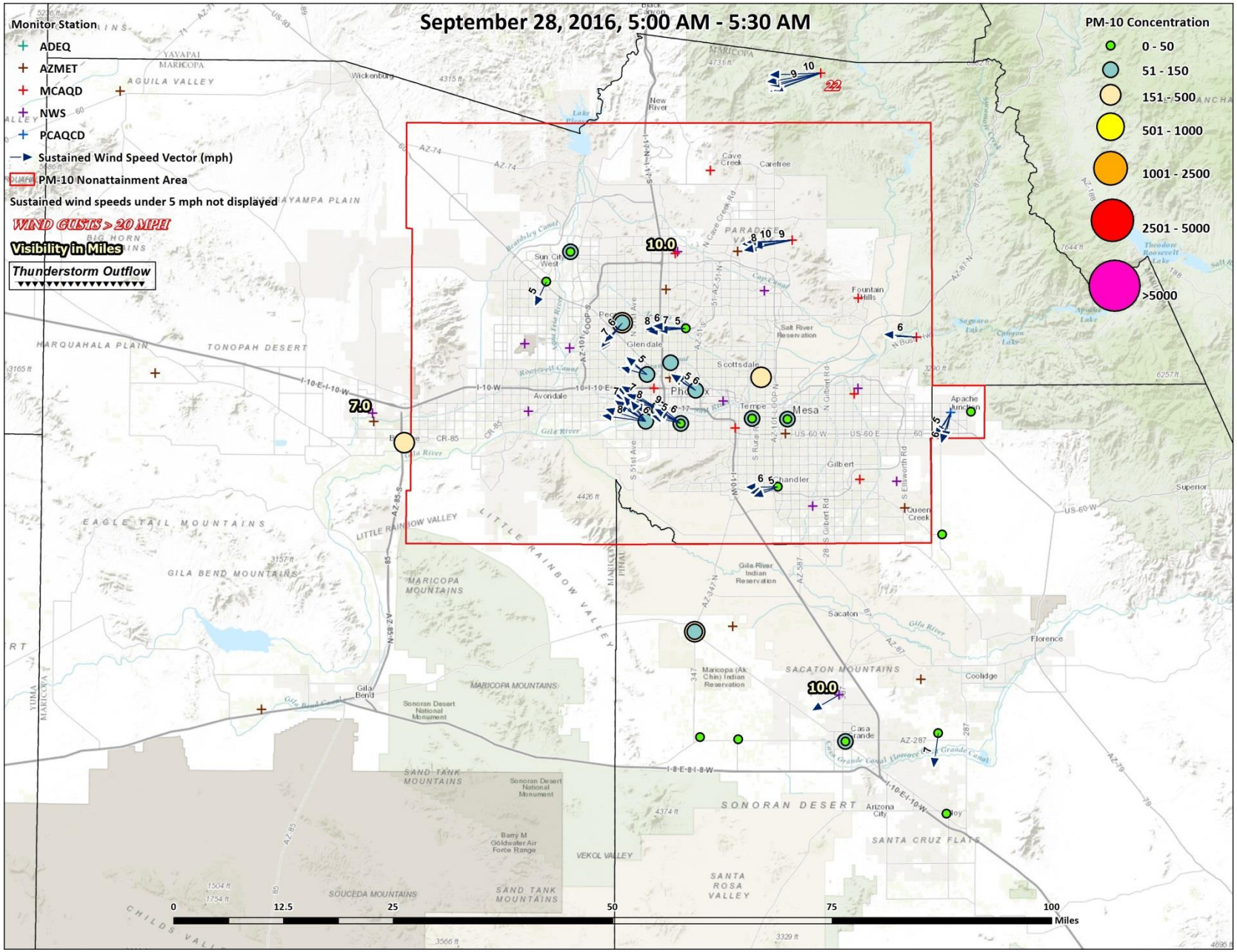

Figure 3-29. September 28, 2016, 5:00 AM – 5:30 AM.

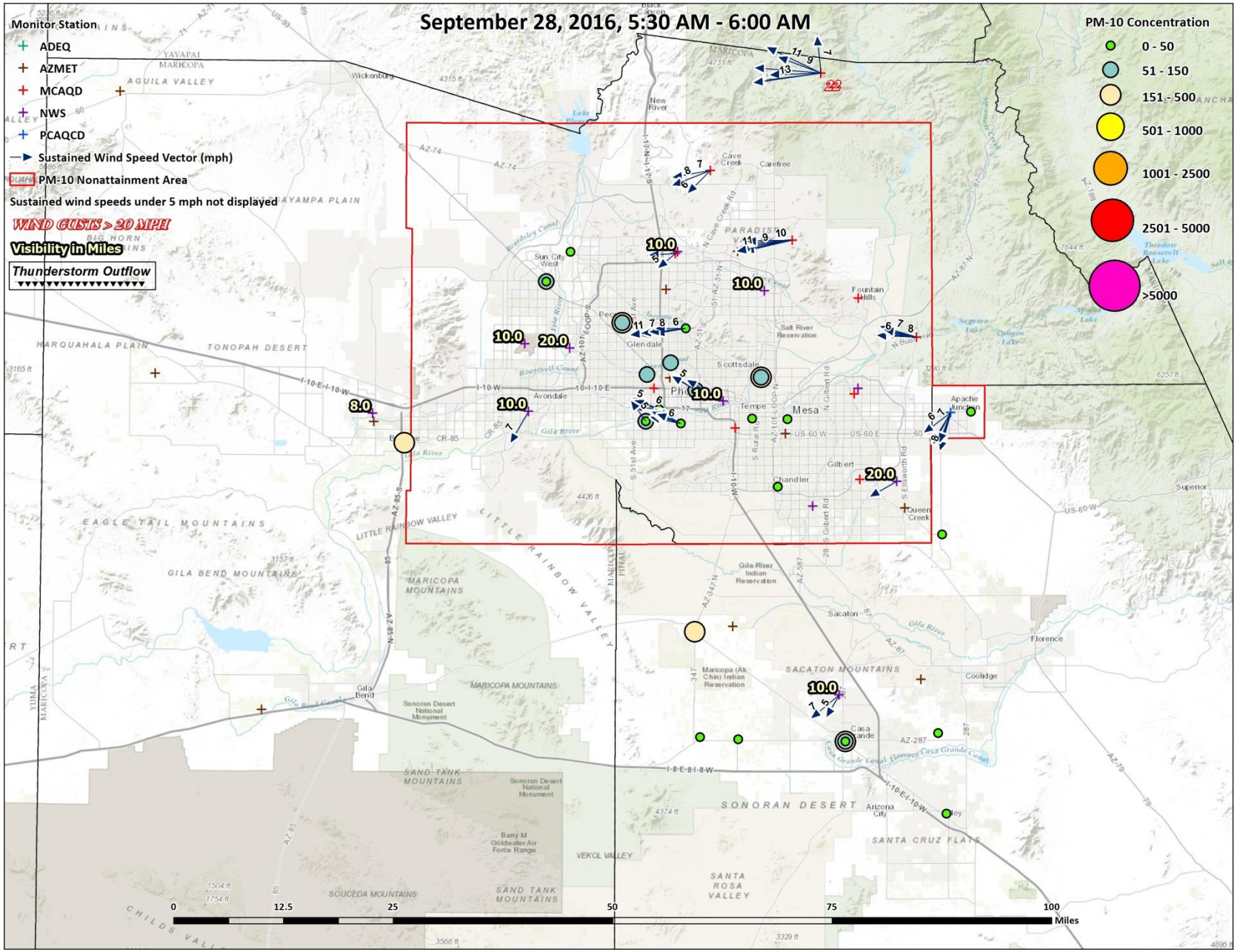

Figure 3-30. September 28, 2016, 5:30 AM – 6:00 AM.

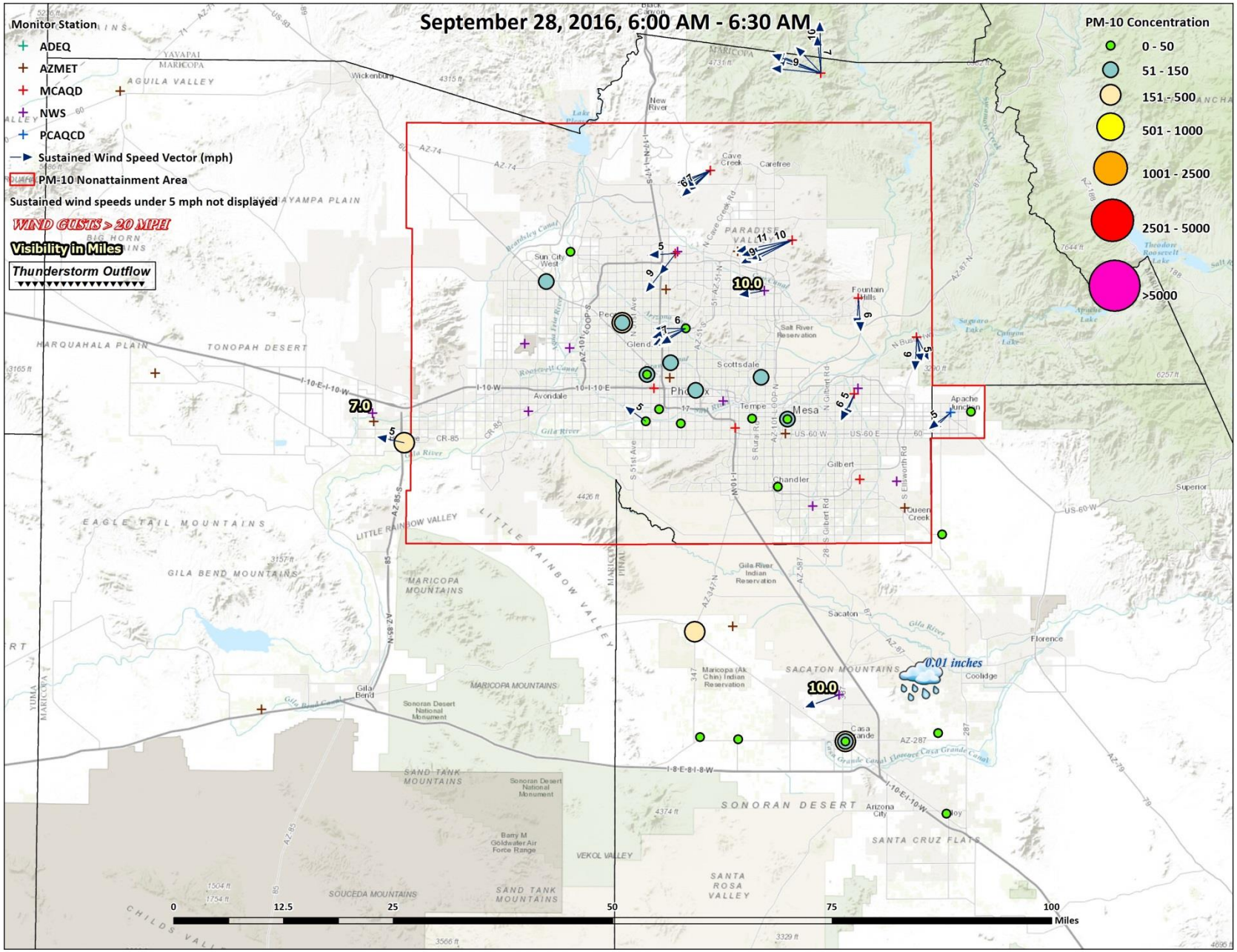

Figure 3-31. September 28, 2016, 6:00 AM – 6:30 AM.

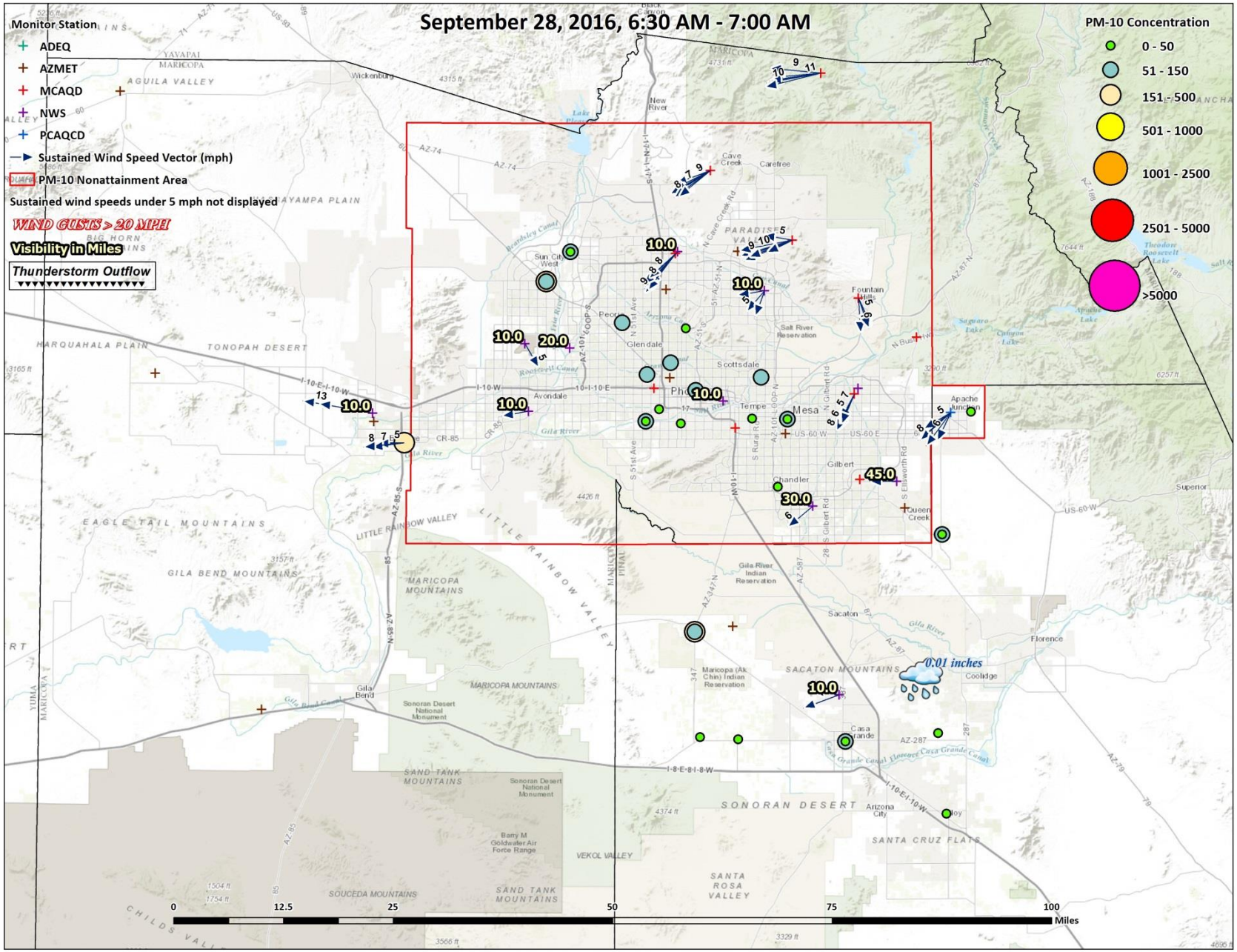

Figure 3-32. September 28, 2016, 6:30 AM – 7:00 AM.

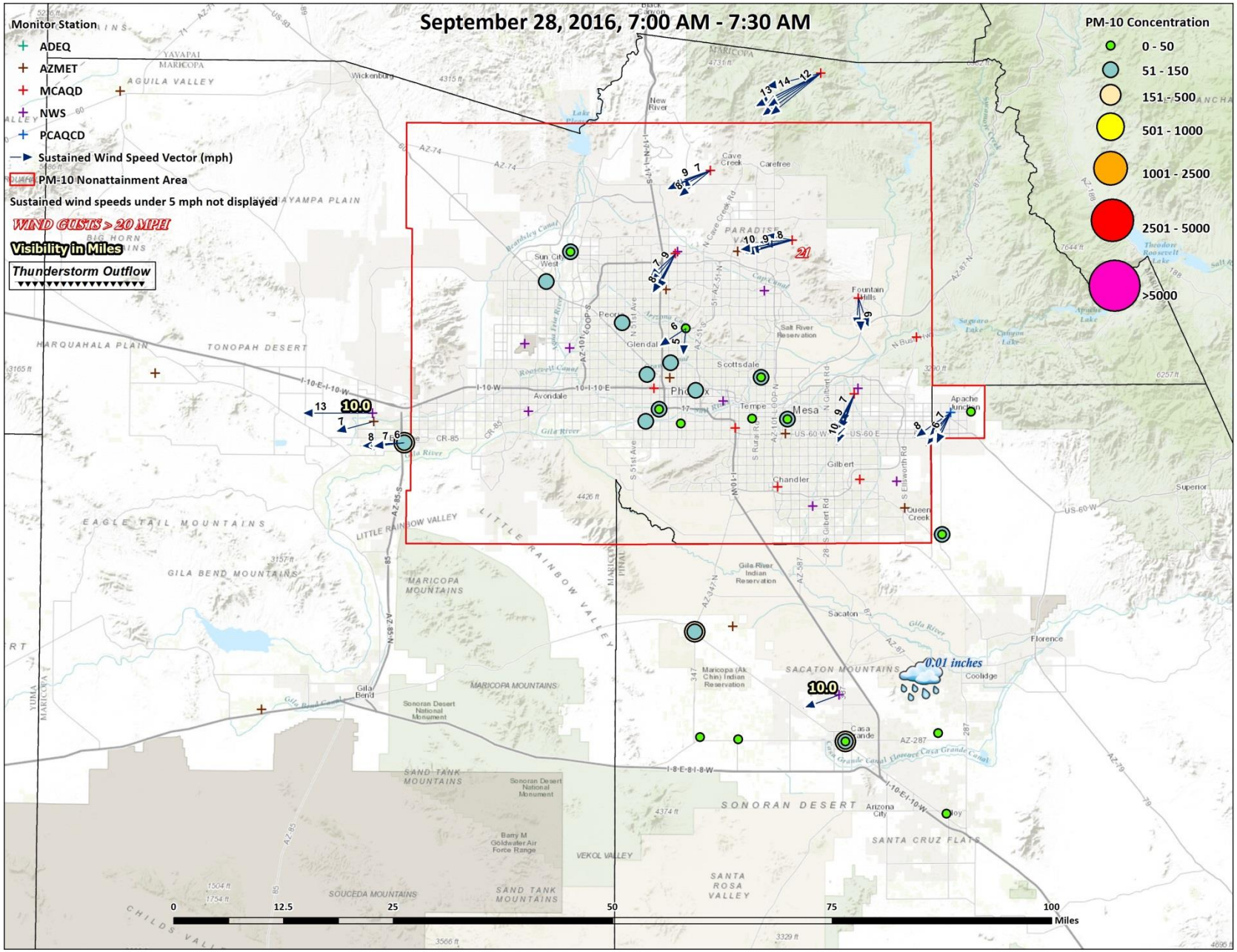

Figure 3-33. September 28, 2016, 7:00 AM – 7:30 AM.

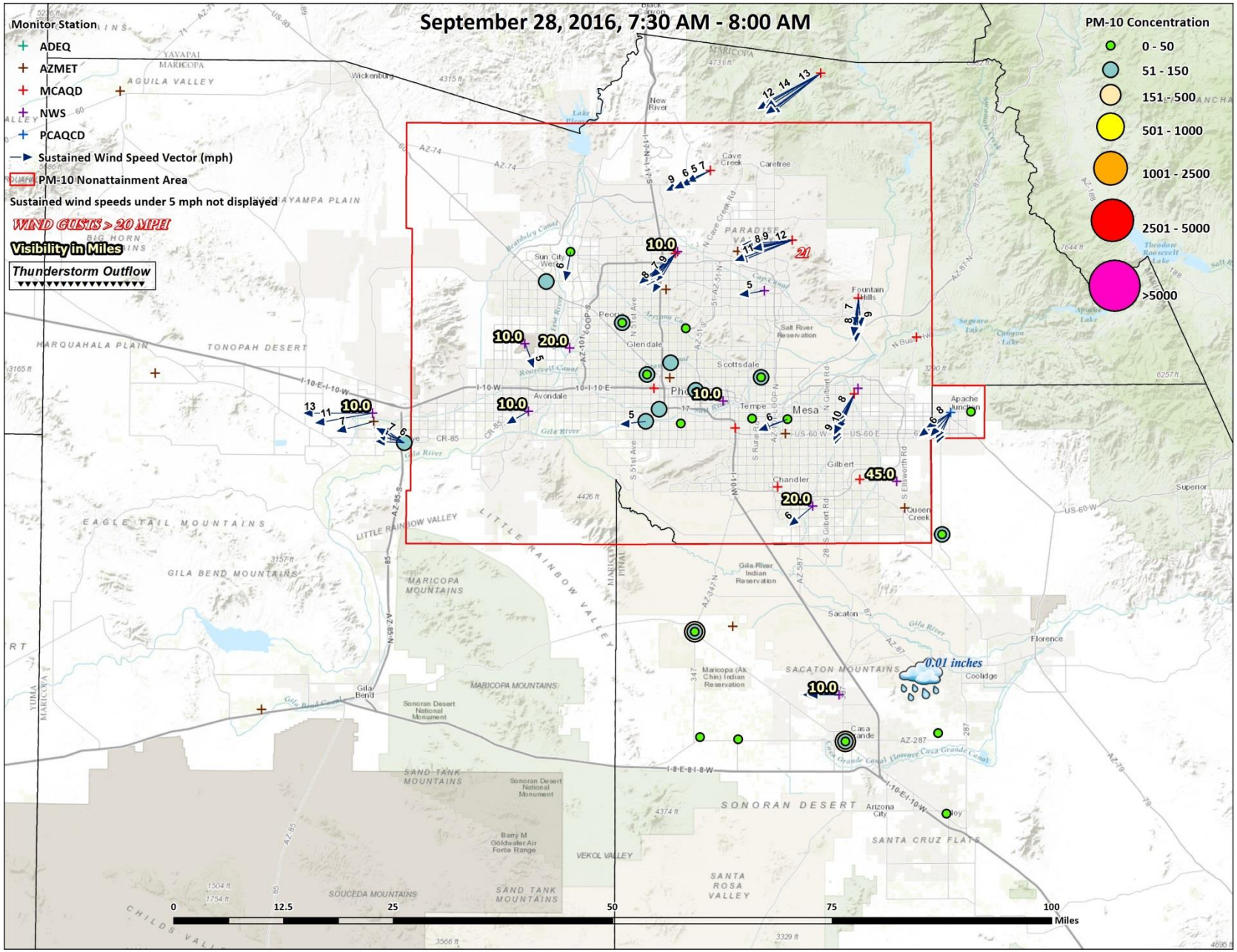

Figure 3-34. September 28, 2016, 7:30 AM – 8:00 AM.

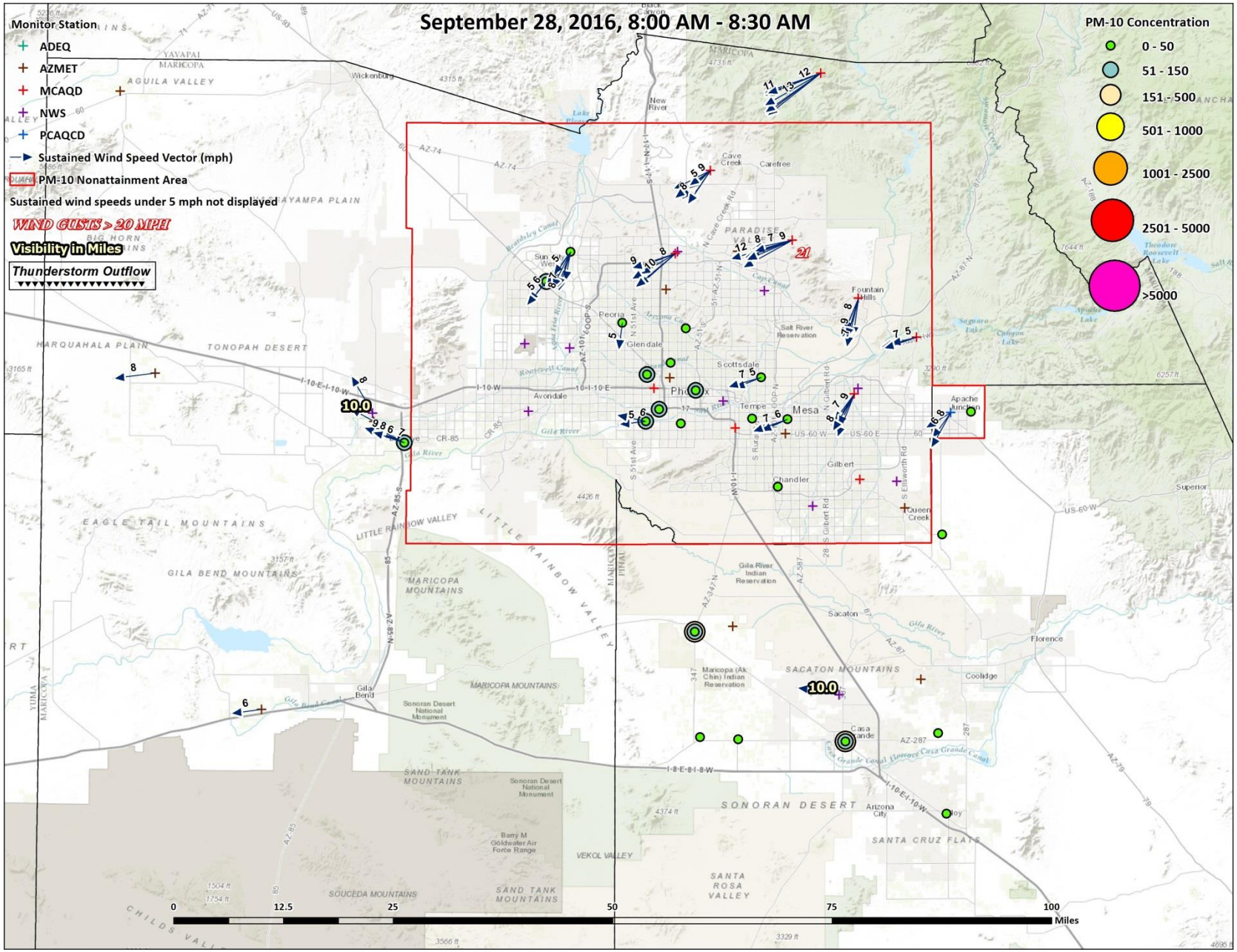

Figure 3-35. September 28, 2016, 8:00 AM – 8:30 AM.

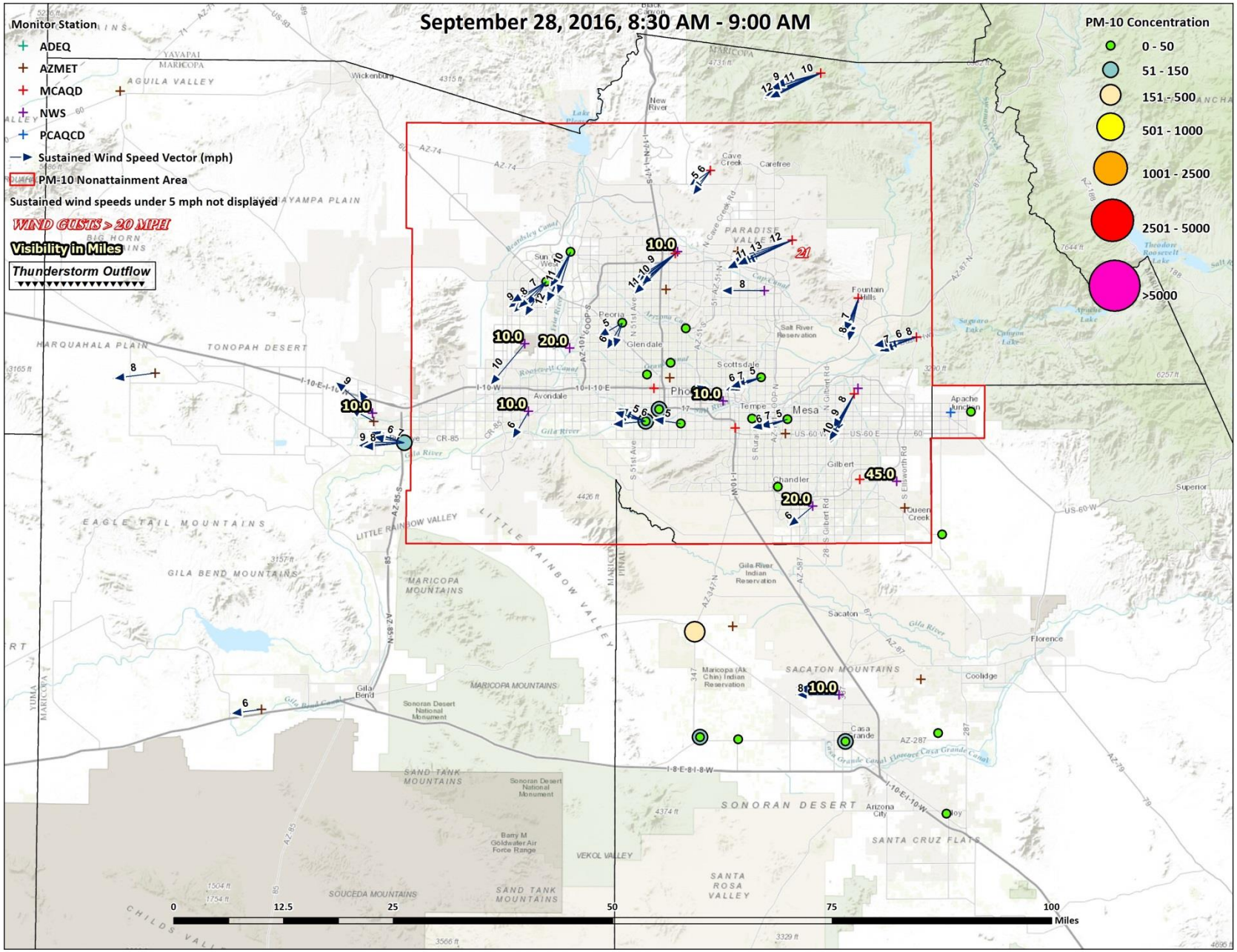

Figure 3-36. September 28, 2016, 8:30 AM – 9:00 AM.

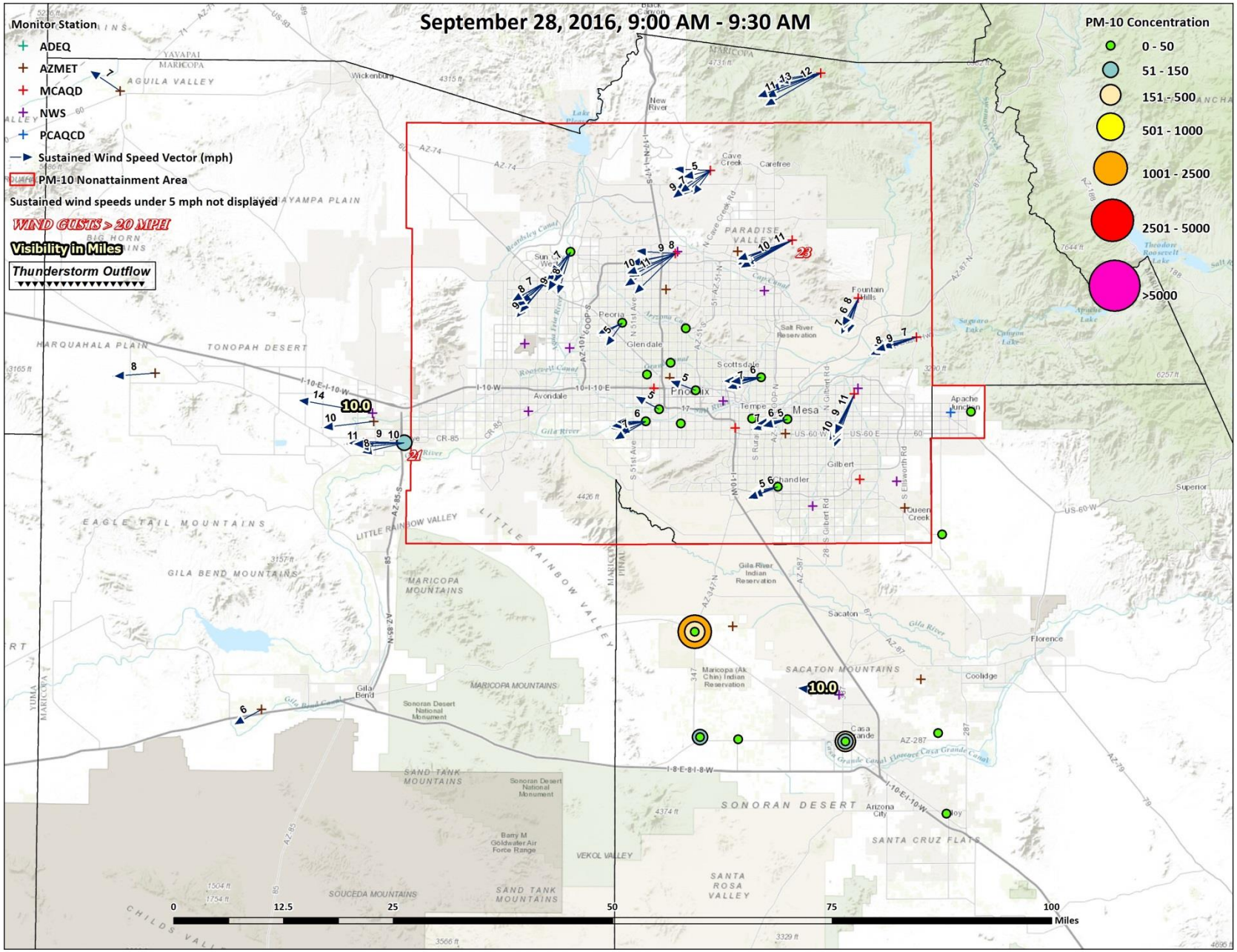

Figure 3-37. September 28, 2016, 9:30 AM – 9:30 AM.

Visibility Photos

ADEQ visibility photos (South Mountain) taken within the Maricopa County PM_{10} nonattainment area show the degradation of visibility as windblown dust from the outflow arrives and stays suspended in the nonattainment area. These photos provide additional evidence of the clear causal relationship between transported windblown dust from the high wind dust event and the exceedance at the Glendale and JLG Supersite monitors. Figure 3–38 displays visibility conditions on September 27, 2016 as the windblown dust makes it way into the central portion of the nonattainment area near the exceeding monitors. Figure 3–39 displays visibility photos that show the suspension of dust in the evening of September 27, 2016 through the early morning of September 28, 2016.

September 27, 2016

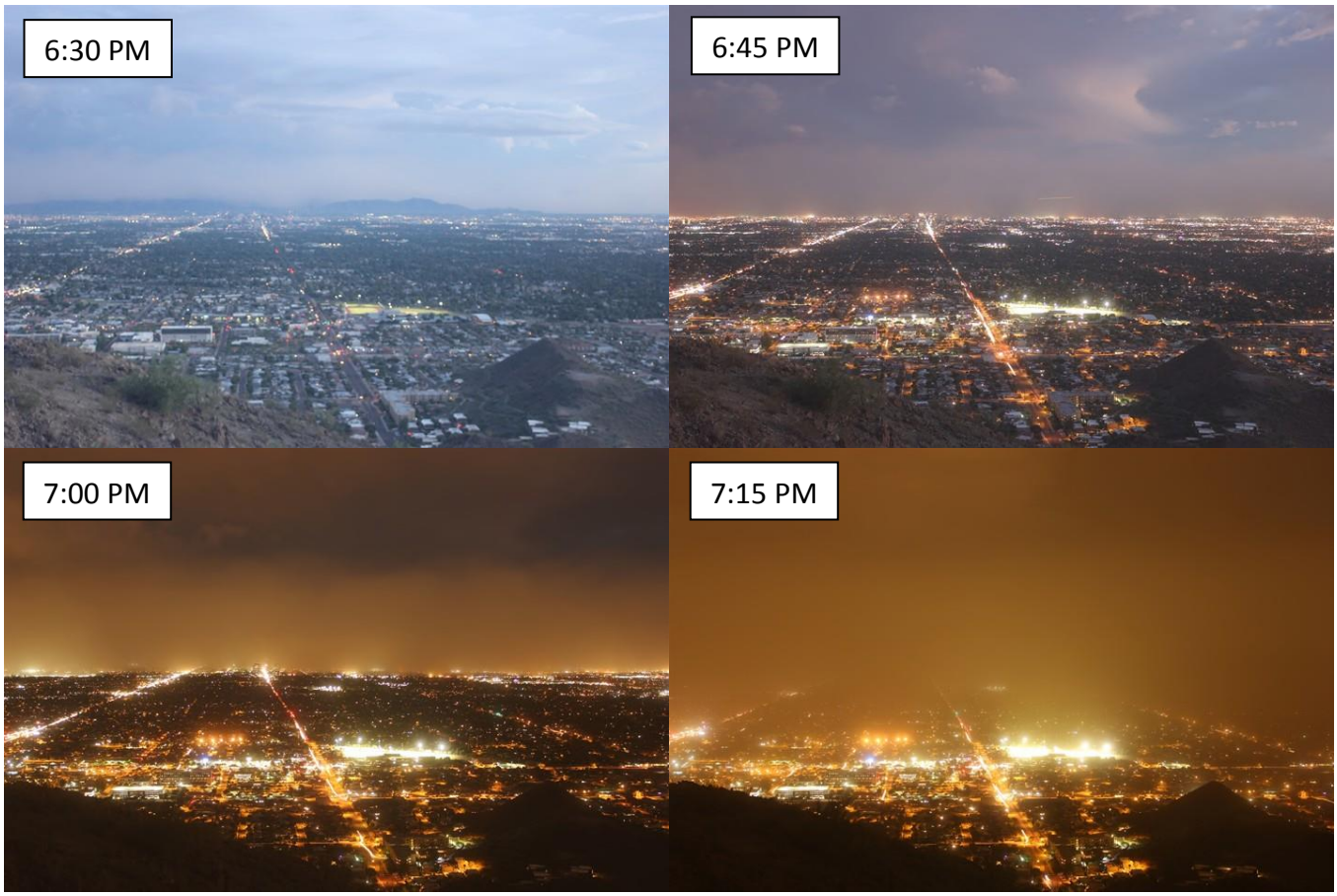

Figure 3-38. Visibility photos on September 27, 2016 as windblown dust enters the nonattainment area.

September 27-28, 2016

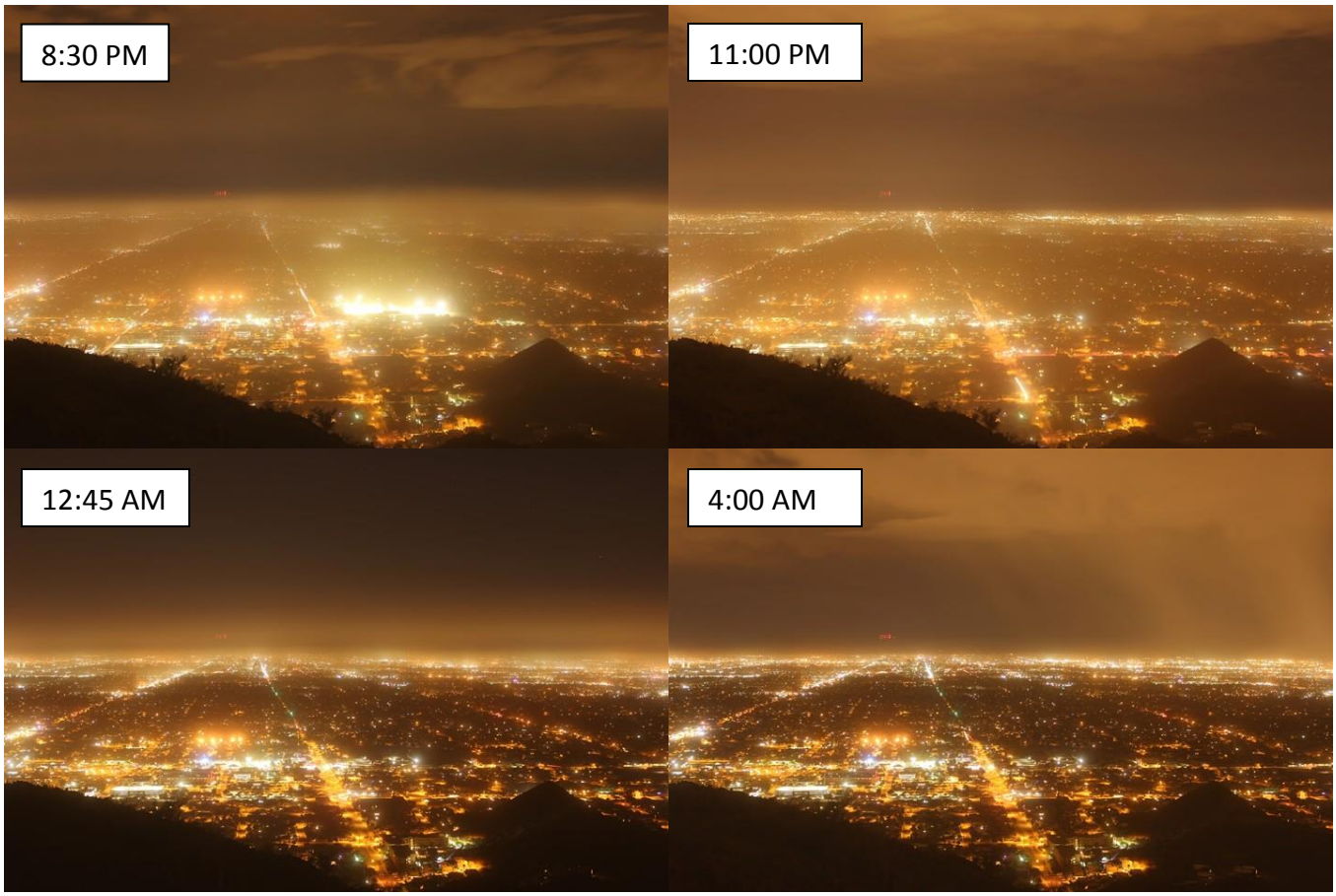

Figure 3-39. Visibility photos of suspended windblown dust on September 27-28, 2016 within the nonattainment area.

Conclusion

In summary, on September 27, 2016 a high wind dust event passed through the Maricopa County PM_{10} nonattainment area which generated and transported windblown dust in the form of PM_{10} resulting in elevated concentrations of PM_{10} across the nonattainment area and an exceedance of the PM_{10} standard at the Glendale and JLG Supersite monitors. The windblown dust remained suspended in the air through the evening of September 27, 2016 and into the morning of September 28, 2016, causing an exceedance at the Glendale monitor on September 28, 2016. The monitored PM_{10} concentrations on September 27-28, 2016 at the exceeding Glendale and JLG Supersite monitors were compared to historical concentrations at the site in several analyses. The analyses confirm a clear causal relationship between the exceedance and the high wind dust event as compared to historical high wind dust event days and non-exceedance days.

In addition to the comparison to historical concentrations, figures displaying the chronological and spatial distribution of wind, visibility and PM_{10} concentration data confirm that (1) sustained winds at 25 mph were high enough to entrain significant windblown dust from natural desert areas and disturbed, anthropogenic source areas subject to reasonable controls in the source area of the outflow; (2) PM_{10} concentrations peaked transported windblown dust arrived in the PM_{10} nonattainment area and when the windblown dust remained suspended in the nonattainment area throughout the evening of September 27 and the morning of September 28, 2016; and (3) visibility conditions (as confirmed through visibility

photos and NWS readings) at nonattainment area monitors where the thunderstorm outflow-generated windblown dust passed over or by were degraded as a result of the transported and suspended windblown dust from the high wind dust event. These analyses taken as a whole provide strong weight of evidence that the high wind dust event affected air quality in such a way that there exists a clear causal relationship between the high wind dust event on September 27-28, 2016 and the PM_{10} exceedances at the Glendale and JLG Supersite monitors on September 27-28, 2016, thus satisfying the clear causal relationship criterion.

IV. NATURAL EVENT AND NOT REASONABLY CONTROLLABLE OR PREVENTABLE CRITERIA

Natural Event

40 CFR Section 50.14(c)(3)(iv)(E) requires a demonstration that the exceptional event was either a human activity that is unlikely to recur at a particular location or was a natural event. The revised exceptional events rule defines a natural event at 40 CFR Section 50.1(k) as "an event and its resulting emissions, which may recur at the same location, in which human activity plays little or no direct causal role. For purposes of the definition of a natural event, anthropogenic sources that are reasonably controlled shall be considered to not play a direct role in causing emissions." Additionally, specific to high wind dust events, 40 CFR Section 50.14(b)(5)(ii) states that "[t]he Administrator will consider high wind dust events to be natural events in cases where windblown dust is entirely from natural undisturbed lands in the area or where all anthropogenic sources are reasonably controlled as determined in accordance with paragraph b(8) of this section."

The clear causal relationship demonstration in the prior chapter found that high wind dust events can recur at the exceeding Glendale and JLG Supersite monitors. Figures 3–1 and 3–2 indicate that 11 and 9 prior high wind dust events have occurred in the past five years at the monitor at the Glendale and JLG Supersite monitors, respectively. The clear causal relationship demonstration also found that the PM_{10} emissions which caused the exceedances at the Glendale and JLG Supersite monitors were associated with windblown dust generated and transported by sustained wind speeds that met the default high wind threshold of 25 mph established in 40 CFR Section 50.14(b)(5)(iii). EPA states in the preamble to the revised exceptional events rule that, "[f]or high wind dust events, if sustained wind speeds are above the high wind threshold and the anthropogenic emissions sources are reasonably controlled, it is more likely that human activity plays little or no direct role in causing emissions." The following section of this chapter demonstrates that reasonable controls were in place on all windblown dust anthropogenic sources in the Maricopa County PM_{10} nonattainment area during the high wind dust event. For these reasons, the high wind dust event on September 27-28, 2016, qualifies as a natural event.

Not Reasonably Controllable or Preventable

40 CFR Section 50.14(c)(3)(iv)(D) requires a demonstration that the exceptional event was both not reasonably controllable and not reasonably preventable. 40 CFR Section 50.14(b)(8) provides the demonstrations needed to establish that the exceptional event was not reasonably controllable or preventable for all exceptional events. Additionally, specific requirements regarding the not reasonably controllable or preventable criterion related to high wind dust events are provided in 40 CFR Section 50.14(b)(5).

40 CFR Sections 50.14(b)(8)(i) through (iii) states that "[t]he not reasonably controllable or preventable criterion has two prongs that the State must demonstrate: prevention and control. (ii) The Administrator shall determine an event is not reasonably preventable if the State shows that reasonable measures to prevent the event were applied at the time of the event. (iii) The Administrator shall determine that an event is not reasonably controllable if the State shows that reasonable measures to control the impact of the event on air quality were applied at the time of the event."

Regarding whether the event was not reasonably preventable, the revised exceptional events rule has specific regulations for high wind dust events that exempt a State from needing to provide a case-specific justification that the event was not reasonably preventable (40 CFR Section 50.14(b)(5)(iv)). In keeping with the specific high wind dust event regulation, and because the high winds that entrain the windblown dust are by nature unpreventable, a case-specific justification that the high wind dust event on September 27-28, 2016 was not preventable is not needed or presented in this documentation.

Regarding whether the event was not reasonably controllable, 40 CFR Section 50.14(b)(8)(iv) states that EPA "shall assess the reasonableness of available controls for anthropogenic sources based on information available as of the date of the event". Additionally, 40 CFR Section 50.14(b)(8)(v) provides deference to controls in a state implementation plan that have been approved by EPA within five years of the event date, "the Administrator shall consider enforceable control measures implemented in accordance with a state implementation plan...approved by the EPA within 5 years of the date of the event, that address the event-related pollutant and all sources necessary to fulfill the requirements of the Clean Air Act for the state implementation plan...to be reasonable controls with respect to all anthropogenic sources that have or may have contributed to the monitored exceedance or violation."

The *MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area* contains a wide variety of control measures and projects that have been implemented to reduce and control PM_{10} emissions, including PM_{10} emissions generated under high wind conditions, which were in place and implemented at the time of the event. Requirements to reduce and control PM_{10} emissions in the plan apply to a broad range of sources including: unpaved roads and shoulders, leaf blowers, unpaved parking lots, vacant lots, sweeping streets with certified sweepers, off-road vehicle use, open and recreational burning, residential wood burning, covered vehicle loads, dust generating operations, nonmetallic mineral processing, and other unpermitted sources. EPA published final approval of the MAG 2012 Five Percent Plan on June 10, 2014 (79 FR 33107).

On September 12, 2016 the U.S. Court of Appeals for the Ninth Circuit issued an opinion in the lawsuit filed by the Arizona Center for Law in the Public Interest (Bahr v. U.S. EPA) to challenge the Environmental Protection Agency approval of the MAG 2012 Five Percent Plan. The Court upheld EPA's determination that the control measures in the plan did not need to be updated and also upheld EPA's exclusion of PM_{10} exceedances in 2011 and 2012 as exceptional events caused by high wind dust events. The Court remanded the contingency measures in the plan to EPA for further consideration. Because EPA has approved the MAG 2012 Five Percent Plan within five years of the high wind dust event, and the approved plan addresses the event-related pollutant and all sources necessary to fulfill the requirements of the Clean Air Act, and because the State is not currently under obligation to revise the state implementation plan, the controls in the MAG 2012 Five Percent Plan are considered reasonable controls with respect to all anthropogenic sources that have or may have contributed to the monitored exceedance.

Specific to high wind dust events, 40 CFR Section 50.14(b)(5)(v) states that "[w]ith respect to the not reasonably controllable criterion of paragraph (c)(3)(iv)(D) of this section, dust controls on an anthropogenic source shall be considered reasonable in any case in which the controls render the anthropogenic source as resistant to high winds as natural undisturbed lands in the area affected by the high wind dust event. The Administrator may determine lesser controls reasonable on a case-by-case basis."

When evaluating this regulation, EPA considers whether wind speeds were above the high wind threshold (25 mph default) during the event as an important indicator for whether or not the implemented controls

were reasonable. In the preamble to the revised exceptional events rule, EPA states that, "[t]he EPA will continue to consider an area's high wind threshold when reviewing demonstrations for events in a nonattainment or maintenance area where the EPA has approved a SIP, TIP or FIP within 5 years of the date of the event. For a demonstration in such a case, the not reasonably controllable criterion hinges only on implementation of the control measures in the SIP, TIP or FIP, not on the content of those measures. For events with sustained wind speeds above the high wind threshold that occur simultaneously with high monitored PM concentrations, it is very plausible that SIP, TIP, or FIP controls were being implemented and the high PM concentrations resulted from emissions generated by sources in the area despite implementation of those controls...Therefore, the comparison of sustained wind speeds during an event to the high wind threshold will help the EPA Regional offices determine what evidence must be included in a demonstration. Specifically, it will inform the evidence required for the not reasonably controllable or preventable criteria, the possibility of noncompliance, or emissions from non-event sources."

The clear causal relationship demonstration in Chapter III of this documentation clearly establishes that high PM_{10} concentrations at the exceeding monitors and throughout the nonattainment area were the result of transported windblown dust that was generated by a thunderstorm outflow with recorded sustained wind speeds of 25 mph and gusts of 41 mph. This provides evidence that (1) the controls in place within the Maricopa County PM_{10} nonattainment area and at the exceeding monitors during the high wind dust event on September 27-28, 2016 meet the requirements of 40 CFR Section 50.14(b)(5)(v) by rendering anthropogenic sources as resistant to high winds as natural undisturbed lands, and that (2) source noncompliance is less likely given the severity of the wind speeds.

Lastly, 40 CFR Section 50.14(b)(8)(viii) requires that the State must include the following components in a demonstration that addresses the not reasonably controllable or preventable criterion for prescribed fire events and certain high wind dust events: "(A) Identification of the natural and anthropogenic sources of emissions causing and contributing to the monitored exceedance or violation, including the contribution from local sources. (B) Identification of the relevant state implementation plan, tribal implementation plan, or federal implementation plan or other enforceable control measures in place for sources identified in paragraph...(A) of this section and the implementation status of these controls. (C) Evidence of effective implementation and enforcement of the measures identified in paragraph...(B) of this section." The following sections satisfy the requirements of 40 CFR Section 50.14(b)(8)(viii).

Identification of Natural and Anthropogenic Sources of Emissions

As discussed in the narrative conceptual model and the clear causal relationship demonstration, due to the origin region of the thunderstorm outflow, the sources of the windblown dust during the event on September 27-28, 2016 are the natural desert areas of west-central Pinal County. The windblown dust from this source area was then transported to and suspended in the Maricopa County PM_{10} nonattainment area on diminishing thunderstorm outflow winds. If any anthropogenic source in the source area contributed to the event, those sources were overwhelmed by sustained winds of 25 mph and gusts of 41 mph as reported by the NWS. From the source area, windblown dust was then transported to the Maricopa County PM_{10} nonattainment area as confirmed by numerous visibility readings and photos. While the outflow-generated winds were strong enough to transport windblown dust into the nonattainment area, wind speeds had started to subside as the outflow reached the nonattainment area, making it unlikely that any significant windblown dust from anthropogenic sources within the nonattainment area contributed to the exceedances.

The most likely natural sources given the prevailing wind patterns of the high wind event include the desert areas of west-central Pinal County. While there is no evidence of anthropogenic sources

contributing to the event, if anthropogenic sources were to contribute to the exceedances at the Glendale and JLG Supersite monitors they would likely include those sources located immediately upwind (south) of the monitor. The immediate area (within four miles) around the Glendale and JLG Supersite monitors is developed and urbanized residential and commercial land uses. Anthropogenic PM_{10} emission sources in this area may likely include, but are not limited to, paved road dust, landscaping activities, and industrial activities. Figure 4–1 displays a recent aerial photo (2015) of the area upwind (approximately five to ten miles) of the Glendale and JLG Supersite monitors.

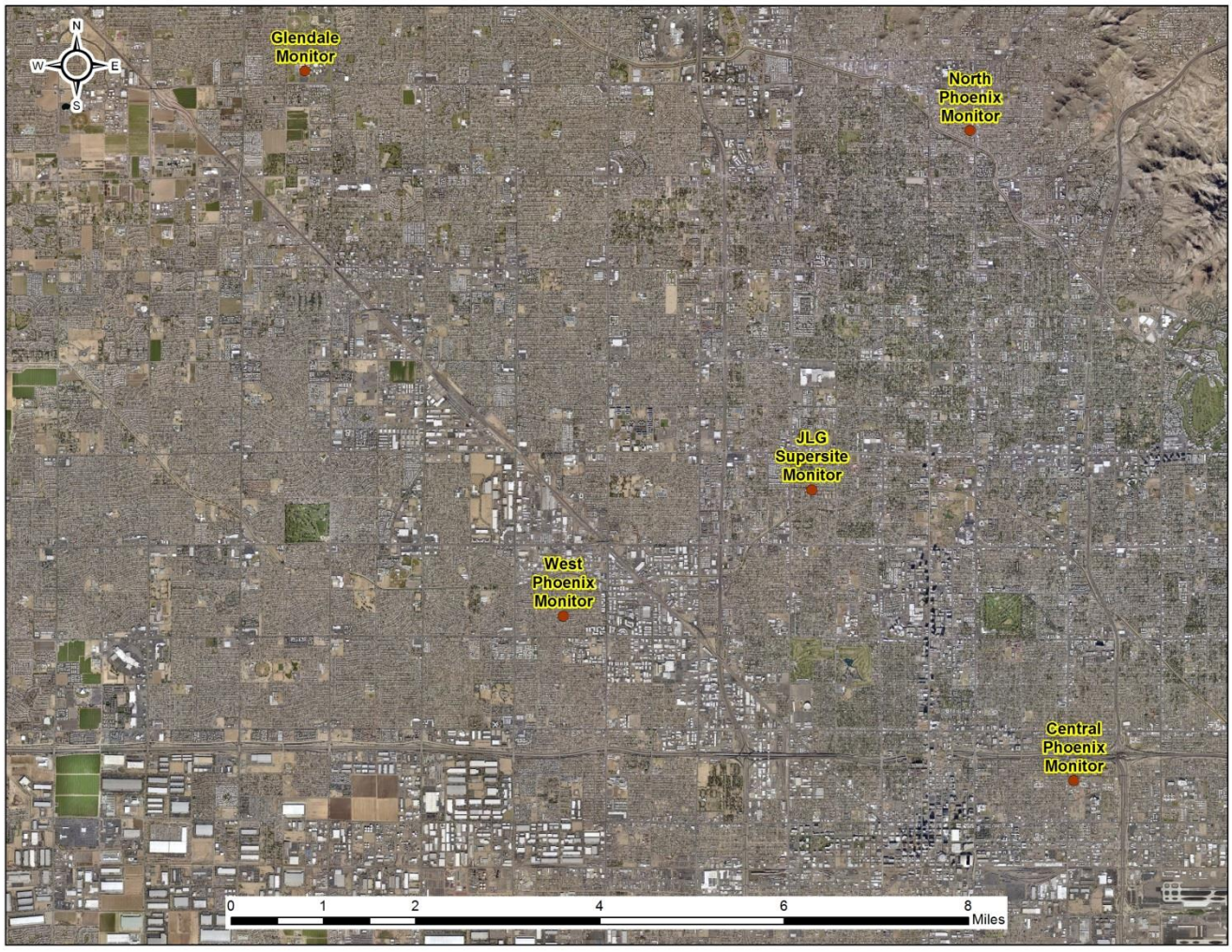

Figure 4-1. Aerial photo of the immediate area upwind of the exceeding Glendale and JLG Supersite monitors.

Identification of Relevant Control Measures

As discussed above, the *MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area* is the latest state implementation plan approved by EPA. This plan contains a wide variety of control measures and projects that have been, and are being, implemented to reduce and control PM_{10} emissions, including PM_{10} emissions generated under high wind conditions, which were in place and implemented at the time of the event. Requirements to reduce and control PM_{10} emissions in the plan apply to a broad range of sources including: unpaved roads and shoulders, leaf blowers, unpaved parking lots, vacant lots, sweeping streets with certified sweepers, off-road vehicle use, open and recreational burning, residential wood burning, covered vehicle loads, dust generating operations, nonmetallic mineral processing, and other unpermitted sources. Table 4–1 lists the control measures included in the MAG 2012 Five Percent Plan.

Table 4-1. Control Measures included in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area.

Arizona Revised Statutes (A.R.S.)	Description
A.R.S. § 9-500.04. Only A.3., A.5., A.6., A.7., A.8., A.9. and H.	Air quality control; definitions [city and town requirements in Area A regarding targeting unpaved roads and shoulders; leaf blower restrictions; restrictions related to parking, maneuvering, ingress and egress areas and vacant lots; requirement for certified street sweepers]
A.R.S. § 9-500.27.	Off-road vehicle ordinance; applicability; violation; classification
A.R.S. § 11-871. Only A., B. and D.4.	Emissions control; no burn; exemptions; penalty [no burn restriction for any HPA day, increased civil penalty]
A.R.S. § 11-877.	Air quality control measures [county leaf blower restrictions]
A.R.S. § 28-1098. Only A. and C.1.	Vehicle loads; restrictions; civil penalties [for safety or air pollution prevention purpose]
A.R.S. § 49-424. Only 11.	Duties of department [develop and disseminate air quality dust forecasts for the Maricopa County PM-10 nonattainment area]
A.R.S. § 49-457.01.	Leaf blower use restrictions and training; leaf blower equipment sellers; informational material; outreach; applicability
A.R.S. § 49-457.03.	Off-road vehicles; pollution advisory days; applicability; penalties
A.R.S. § 49-457.04.	Off-highway vehicle and all-terrain vehicle dealers; informational material; outreach; applicability
A.R.S. § 49-457.05. Only A., B., C., D. and I.	Dust action general permit; best management practices; applicability; definitions
A.R.S. § 49-474.01. Only A.4., A.5., A.6., A.7., A.8., A.11., B. and H.	Additional board duties in vehicle emissions control areas; definitions [county requirements for stabilization of targeted unpaved roads, alleys and shoulders; restrictions related to parking, maneuvering, ingress and egress areas and vacant lots; requirement for certified street sweepers]
A.R.S. § 49-474.05.	Dust control; training; site coordinators
A.R.S. § 49-474.06.	Dust control; subcontractor registration; fee
A.R.S. § 49-501. Only A.2., B.1., C., F. and G.	Unlawful open burning; exceptions; civil penalty; definitions [ban on outdoor fires from May 1 to September 30; deletion of recreational purpose exemption; no burn day restrictions; penalty provision]
A.R.S. § 49-541. Only 1.	Definitions [Area A]
Maricopa County Air Quality Department Rules	**Description**
310	Fugitive Dust from Dust-Generating Operations Adopted 1/27/10 and submitted to EPA 4/12/10 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]
310.01	Fugitive Dust From Non-Traditional Sources of Fugitive Dust Adopted 1/27/10 and submitted to EPA 4/12/10 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]
314	Open Outdoor Fires and Indoor Fireplaces at Commercial and Institutional Establishments Adopted 3/12/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 74 FR 57612; 11/9/09]

Table 4–1 (Continued)

Maricopa County Air Quality Department Rules	Description
316	Nonmetallic Mineral Processing Adopted 3/12/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 74 FR 58553; 11/13/09]
Appendix C	Fugitive Dust Test Methods Adopted 3/26/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]
Maricopa County Ordinance	**Description**
P-26	Residential Woodburning Restriction Adopted 3/26/08 and submitted to EPA 7/10/08; [Notice of Final Rulemaking 74 FR 57612; 11/9/09]
Appendices to the Plan	**Description**
Appendix C, Exhibit 1	Arizona Revised Statutes Listed in Table 4-1
Appendix C, Exhibit 2	Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area
Appendix C, Exhibit 3	Arizona Department of Environmental Quality Dust Action General Permit
Appendix C, Exhibit 4	Arizona Department of Environmental Quality Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure

In addition to the statutes, rules and regulations listed in Table 4–1, other PM_{10} reducing control measures (e.g., paving of unpaved roads, Agricultural Best Management Practices Program, Pinal County Fugitive Dust rules, etc.) have been committed to, and implemented by, local jurisdictions throughout the Maricopa County PM_{10} nonattainment area, and incorporated into the Arizona SIP through prior PM_{10} plans, such as the *Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area*, and in separate EPA actions.

Implementation and Enforcement of Control Measures

The Maricopa County Air Quality Department (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 ten 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 five-day Maricopa County Dust Control Forecast issued by ADEQ 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 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).

The Maricopa County Dust Control Forecast issued on September 26, 2016, indicated a Low risk for unhealthy PM_{10} levels, but included the possibility of blowing dust associated with gusty winds from thunderstorm outflows. The actual thunderstorm outflow from the deserts of west-central Pinal County created and transported windblown dust into the nonattainment area, leading to the exceedances at the Glendale and JLG Supersite monitors on September 27-28, 2016.

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 15 MCAQD air monitoring sites are equipped to allow the automatic reporting of monitored readings at 5-minute intervals. The real-time data reporting system includes a mechanism to alert MCAQD inspectors when PM_{10} 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 PM_{10} concentrations.

An evaluation of all inspection reports, air quality complaints, compliance reports, and other documentation indicate no evidence of unusual anthropogenic-based PM_{10} emissions. During the time period of September 24 through October 1, 2016, MCAQD inspectors conducted a total of 272 inspections of permitted facilities, of which 165 were at fugitive dust sources.

During this 7-day period, a total of five Notice of Violations were issued county-wide for PM_{10} and non-PM_{10}-related violations. No violations were issued to fugitive dust sources within a 4-mile radius of the exceeding Glendale or ADEQ's JLG Supersite monitor.

Also during this 7-day period, a total of 63 vacant lots were inspected, but only one 60-day letter was issued for non-compliant vacant lots and/or unpaved parking lots. This vacant lot was not located within 4-miles of the exceeding Glendale or ADEQ's JLG Supersite's monitors.

MCAQD was prepared for any complaints received due to the high wind event. During the 8-day period from September 24 through October 1, 2016, MCAQD received 30 complaints, of which 16 were windblown dust or PM_{10} related. Two of these complaints were located within 4 miles of the exceeding JLG Supersite monitor. These complaints consisted of:

- A construction site at 32nd Avenue and Myrtle was creating dust with their heavy machinery. The complaint occurred on 9/27/16.
- A home demolition at 3rd Street and Glendale Avenue was creating dust. The complaint occurred on 9/28/16.

Inspections were completed for each of these complaints and no violations were noted, though some of the complaints were held for further observation. Additionally, during the period of September 24, 2016 through October 1, 2016, no unusual agricultural activity in the upwind vicinity of the exceeding Glendale and JLG Supersite monitors was noted by the Arizona Department of Environmental Quality.

Conclusion

In summary, the information presented in this chapter addresses whether the high wind dust event on September 27-28, 2016 was not reasonably preventable or controllable. EPA's approval of the *MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area* on June 10, 2014 allows the control measures in that plan to be established as reasonable controls. Sustained wind speeds were at the high wind threshold during the event, making it less likely that uncontrolled anthropogenic sources were the main source of the windblown dust emissions. The natural and anthropogenic sources of windblown dust during the event were identified, along with the enforceable control measures in place and implemented during the event. Extensive documentation of enforcement of the implemented control measures was provided by the Maricopa County Air Quality Department and the Arizona Department of Environmental Quality, revealing no evidence of unusual anthropogenic-based PM_{10} emissions. For these reasons, the information presented in this chapter clearly demonstrates that the high wind dust event on September 27-28, 2016 was neither reasonably preventable nor controllable.

V. SUMMARY CONCLUSION

The documentation presented in the preceding chapters provides ample weight of evidence that the exceedances of the PM_{10} standard on September 27-28, 2016 at the Glendale and JLG Supersite monitors in the Maricopa County nonattainment area was caused by a high wind dust event, qualifying the exceedance for exclusion under the revised exceptional events rule. A bulleted summary of the demonstrations included in this documentation that meet the requirements of 40 CFR Sections 50.14(c)(3)(iv)(A) through (E) is provided below:

- The narrative conceptual model discussed the meteorological conditions (thunderstorm outflow) that led to the creation of the high wind dust event on September 27-28, 2016. The narrative highlighted that a thunderstorm outflow with sustained winds of 25 mph and gusts of 41 mph originated in the deserts of west-central Pinal County. The windblown dust from the outflow then transported into the Maricopa County PM_{10} nonattainment area with the passing of the thunderstorm outflow and remained suspended into the evening of September 27 and the morning of September 28, 2016. Tables and figures showing PM_{10} concentrations during the event were included with the narrative, indicating the PM_{10} concentrations on September 27-28, 2016 were elevated in conjunction with the arrival and suspension of windblown dust as compared to concentrations before and after the event.

- The monitored PM_{10} concentrations on September 27-28, 2016 at the exceeding Glendale and JLG Supersite monitors were compared to historical concentrations at the sites in several analyses. The analyses confirm a clear causal relationship between the exceedances and the high wind dust event as compared to historical high wind dust event days and non-exceedance days.

  In addition to the comparison to historical concentrations, figures displaying the chronological and spatial distribution of wind, visibility and PM_{10} concentration data confirm that (1) sustained winds at 25 mph were high enough to entrain significant windblown dust from natural desert areas and disturbed, anthropogenic source areas subject to reasonable controls in the source area of the outflow; (2) PM_{10} concentrations peaked transported windblown dust arrived in the PM_{10} nonattainment area and when the windblown dust remained suspended in the nonattainment area throughout the evening of September 27 and the morning of September 28, 2016; and (3) visibility conditions (as confirmed through visibility photos and NWS readings) at nonattainment area monitors where the thunderstorm outflow-generated windblown dust passed over or by were degraded as a result of the transported and suspended windblown dust from the high wind dust event. These analyses taken as a whole provide strong weight of evidence that the high wind dust event affected air quality in such a way that there exists a clear causal relationship between the high wind dust event on September 27-28, 2016 and the PM_{10} exceedances at the Glendale and JLG Supersite monitors on September 27-28, 2016, thus satisfying the clear causal relationship criterion.

- The comparison to historical concentrations and the clear causal relationship demonstration found that high wind dust events can frequently recur at the exceeding Glendale and JLG Supersite monitors and that the PM_{10} emissions which caused the exceedance at the monitors were associated with windblown dust generated and transported by sustained wind speeds at the default high wind threshold of 25 mph. EPA states that, "[f]or high wind dust events, if sustained wind speeds are above the high wind threshold and the anthropogenic emissions sources are reasonably

controlled, it is more likely that human activity plays little or no direct role in causing emissions." Since reasonable controls were in place on all significant anthropogenic sources of windblown dust in the Maricopa County PM_{10} nonattainment area during the event and sustained winds were at 25 mph in the source region of the outflow, the high wind dust event on September 27-28, 2016, qualifies as a natural event.

- EPA's approval of the *MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area* on June 10, 2014 allows the control measures in that plan to be established as reasonable controls. Sustained wind speeds were at the high wind threshold in the source region of the high wind dust event, making it unlikely that uncontrolled anthropogenic sources were the main source of the windblown dust emissions. The natural and anthropogenic sources of windblown dust during the event were identified, along with the enforceable control measures in place and implemented during the event. Extensive documentation of enforcement of the implemented control measures was provided by the Maricopa County Air Quality Department and the Arizona Department of Environmental Quality, revealing no evidence of unusual anthropogenic-based PM_{10} emissions. For these reasons, the high wind dust event on September 27-28, 2016 was neither reasonably preventable nor controllable.