Clark County Department of Air Quality

Exceptional Event Documentation for the July 3, 2011, PM_{10} High-Wind Exceedance Event

April 11, 2014

ACKNOWLEDGMENTS

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ACRONYMS AND ABBREVIATIONS

Acronyms

AQR	Clark County Air Quality Regulation
AQS	Air Quality System
BACM	Best Available Control Measures
CAA	Federal Clean Air Act
CFR	Code of Federal Regulations
DAQ	Clark County Department of Air Quality
EPA	U.S. Environmental Protection Agency
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
NAAQS	National Ambient Air Quality Standard
NEAP	Natural Events Action Plan
NOAA	National Oceanic and Atmospheric Administration
PDT	Pacific Daylight Time
PST	Pacific Standard Time
VAR	variable winds/calm winds

Abbreviations

mb	millibar
mph	miles per hour
$PM_{2.5}$	Particulate Matter 2.5 microns or less in aerodynamic diameter
PM_{10}	Particulate Matter 10 microns or less in aerodynamic diameter

1.0 INTRODUCTION

1.1 CLARK COUNTY EXCEPTIONAL EVENT DOCUMENTATION OBJECTIVES

Clark County through its Department of Air Quality (DAQ) is requesting U.S. Environmental Protection Agency (EPA) to review this exceptional event documentation. The DAQ prepared this document for two purposes: first, Clark County wishes to obtain EPA concurrence that the 24-hour particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) concentration recorded on July 3, 2011, was an exceptional event due to high-winds from large thunderstorm cells out of the southwestern, northwestern and central Arizona desert hereinafter defined as "source area (Figure 1.). In Clark County, the Eldorado and Las Vegas valleys were affected by multiple large storm cells and large area monsoonal flows. This in turn caused resultant multiple outflow boundaries that conveyed a large dust cloud mass in the predominant north by northwest direction through the Blyth and Needles California Airport desert areas. This dust moved through Bullhead City, Arizona, along the Colorado River corridor toward the Eldorado Valley (Boulder City) and Las Vegas area and then out of the Las Vegas Valley to the north by northeast direction; second, Clark County wishes to eliminate consideration of the July 3, 2011, PM_{10} concentration in future assessments of historical fluctuations of PM_{10} concentrations.

1.2 DOCUMENT OVERVIEW

This document sets forth justification for exceptional event classification of dust from documented high winds from the source area that affected portions of Clark County, Nevada, on July 3, 2011. Subsections 1.3 and 1.4 of the report summarize the characteristics of the Las Vegas Valley with respect to predominant seasons and weather.

Subsection 2.1 summarizes the event. Subsection 2.2 outlines Clark County's Natural Event Action Plan (NEAP) for high winds with regard to notifying the public, posting of advisories/alerts, and the parameters for actions required by the DAQ to protect public health. Subsection 2.3 describes the Exceptional Event Rule documentation requirements for demonstration submittals.

Subsection 2.4 contains EPA's four-part test as outlined in 40 Code of Federal Regulations (CFR) §50.14(c) (3) (iii). Specifically, §2.4.1 provides demonstration that the event satisfies the criteria set forth in 40 CFR §50.1(j); §2.4.1.1 describes how the event affected air quality; §2.4.1.2 explains why the event was not reasonably controllable or preventable; §2.4.2 describes the clear causal connection between the exceedances and the exceptional event; §2.4.3 explains how the event is associated with a measured concentration in excess of normal historical fluctuations, including background; and §2.4.4 describes how there would have been no exceedance or violation but for the event.

Section 3.0 Event Data presents a discussion with references to data tables, graphs, and figures to make the case for the exceptional event finding. Subsection 3.1 covers the "Meteorology Assessment," an essential element of the conceptual model for the event demonstration. §3.1.1 summarizes weather associated with the event. §3.1.2 outlines the weather data resources used

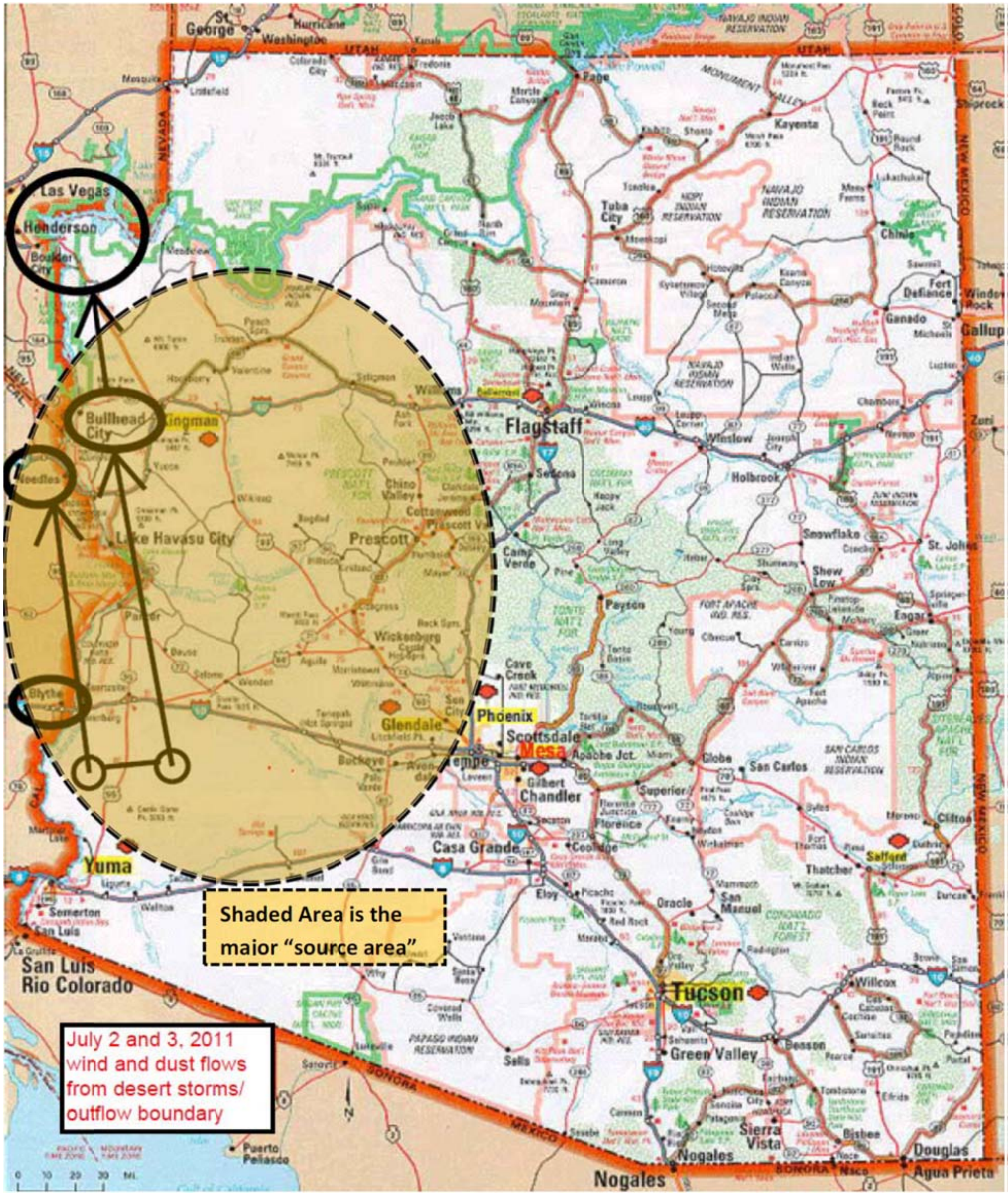


Figure 1. Predominant wind/dust direction source flow on July 2 & 3, 2011.

with the documentation package. §3.1.2.1 through §3.1.2.3 illustrate and highlight data sources, such as local climatological data, Clark County Air Quality Monitoring Stations data, and weather charts used in the document. §3.1.3 contains the monitoring network measurement background and a description of how the system works and how data is obtained. §3.1.4 provides an explanation using weather charts and maps prior to the event of July 3, 2011. §3.1.5 presents weather data during the event using weather charts, data tables, graphs, and maps. §3.1.6 presents weather data tables and conditions experienced after the event. §3.1.7 contains National Oceanic and Atmospheric Administration (NOAA) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling results and graphical illustrations of the event. Subsection 3.2 contains video media and news coverage of the high-wind dust transported event.

Section 4.0 Emission Sources and Activity covers all PM_{10} network monitoring sites discussed in the report, including documentation of adjacent sources and activities, maps, and aerial photography.

Section 5.0 Compliance and Enforcement Activity covers Clark County State Implementation Plan-required Best Available Control Measures (BACM). Discussions include activities the DAQ took with respect to transported dust prior to the forecast event, during the dust event, and after the event. Subsection 5.1 outlines implemented controls, event forecast, public notices, and an assessment of local source emissions on the measured concentrations. Subsection 5.2 Precipitation in Potential Fugitive Dust Source Region contains discussion of soil moisture contribution to fugitive dust in Clark County. Further, there is discussion of precipitation levels experienced in the County during 2010 and 2011 along with tables, maps, and figures to illustrate. Subsection 5.3 Establishing Wind Thresholds for Clark County outlines wind tunnel studies conducted in Clark County. These studies established thresholds of sustained winds of 25 miles per hour (mph) and/or gusts of 40 mph or more that overwhelm BACM, native desert, and disturbed stabilized vacant land. Appendix A contains the Summary of Refined PM_{10} Aeolian Emission Factors for Native Desert and Disturbed Vacant Land Areas. (The full report is included in CD format in the Appendix A.)

Section 6.0 Conclusion summarizes the document findings and requests EPA concurrence of flagging the July 3, 2011, exceedance as a high-wind dust exceptional event. The event was flagged in the EPA Air Quality System (AQS) on December 12, 2011, with RL code for “other.” At the time of flagging it was not known that the event was caused by multiple outflow boundaries from multiple storm cells; otherwise it would have been classified as “RJ” for high-wind influenced event.

1.3 EXCEPTIONAL EVENT CONCEPTUAL MODEL

On July 3, 2011, an exceedance of the 24-hour National Ambient Air Quality Standard (NAAQS) for PM_{10} occurred in the Eldorado Valley (Boulder City) and the Las Vegas Valley. The July 3, 2011, exceptional event is conceptually characterized as a high-wind-generated dust event. The monitored values for the affected Las Vegas Valley sites within the network were elevated, and two out of seven sites exceeded. The two exceeding sites were: Sunrise Acres (CAMS 0561) at 191 µg/m^3, and J. D. Smith (CAMS 2002) at 185 µg/m^3. The monitoring site outside the Las Vegas Valley in Boulder City (CAMS 0601) experienced the highest concentration (242 µg/m^3) in Clark County for the exceedance day. The remaining monitoring sites in the Las Vegas Valley that recorded high concentrations of PM_{10} but did not exceed were: Green Valley (CAMS 0298) at 143 µg/m^3, Joe Neal (CAMS 0075) at 130 µg/m^3, Paul Meyer (CAMS 0043) at 103 µg/m^3, and Palo Verde (CAMS 0073) at 89 µg/m^3. A small mountain ridge (Figure 2. Orange dotted oval) to the east of the Green Valley site influenced PM_{10} concentrations measured at these locations. The remaining network PM_{10} site that did not exceed was located thirty-five miles southwest of the Las Vegas Valley, in the Ivanpah Valley – Jean, Nevada (CAMS 1019) which was not in the predominant wind and dust flow corridor. The 24-hour PM_{10} concentration measured on that day at Jean was 79 µg/m^3.

The high-wind regionally transported dust was caused by thunderstorms in the source area, which came through the Colorado River corridor through Bullhead City, Arizona. From the Bullhead City area the windblown dust came up the Colorado River corridor through Boulder City and into the Las Vegas Valley. The storm caused what is referred to as an "outflow boundary," where the boundary separated thunderstorm-cooled air from the surrounding air. This outflow traveled several miles from its origin, picking up dust that reduced visibility in southwestern and northwestern Arizona and parts of southern Nevada in the Eldorado and Las Vegas Valleys. (Figure 3 - graphical illustration of outflow boundary.) The Ivanpah Valley (Jean, Nevada) monitoring site was not affected by the dust transported from Bullhead City in northwestern Arizona.

Anthropogenic sources near all monitoring sites did not play a role in elevated PM_{10} levels. Wind speeds during the majority of the event day were below Clark County's established thresholds for dust re-entrainment. Wind speeds for the day were an hourly average of 11.6 mph with wind gusts to 30 mph throughout the Valley. These relatively low wind speeds and the predominant wind direction from the southeast to the northeast served to spread the dust from the high-wind dust transport event throughout the Eldorado and Las Vegas Valleys during the first half of the day through early afternoon. At approximately 6:30 pm the wind speeds increased slightly and began "washing out" the high particulate matter concentrations to the northeast of the Valley. The concentrations began dropping at approximately 7:00 pm throughout the PM_{10} network. Not all PM_{10} sites exceeded--only the ones affected by the predominant wind direction and dust flows (Figure 1, Figure 2 and Figure 4.)

For any local sources, DAQ has stringent controls in place to reduce dust from anthropogenic sources, including BACM required by the PM_{10} State Implementation Plan and Clark County Air Quality Regulations (AQRs). This event, however, was a high-wind-generated dust storm, and an "outflow boundary" caused the transported dust to overwhelm both BACM and native desert conditions; this resulted in the PM_{10} exceedances in both Valleys (Eldorado and Las Vegas).

Prior to this event the forecast models did not predict any unusual weather patterns, increased winds, or reduced visibility. Based on this preliminary information, no dust advisory notices or alerts were issued for the weekend for this unpredicted high-wind transported dust event. As a result no enhanced DAQ Compliance inspections were conducted throughout the Valleys. No additional staff was scheduled for the weekend for enhanced inspections. This event occurred on a Sunday when no DAQ staff was on duty. Moreover, the next day was the July 4th holiday, and compliance staff did not conduct routine inspections. While visual inspections would normally

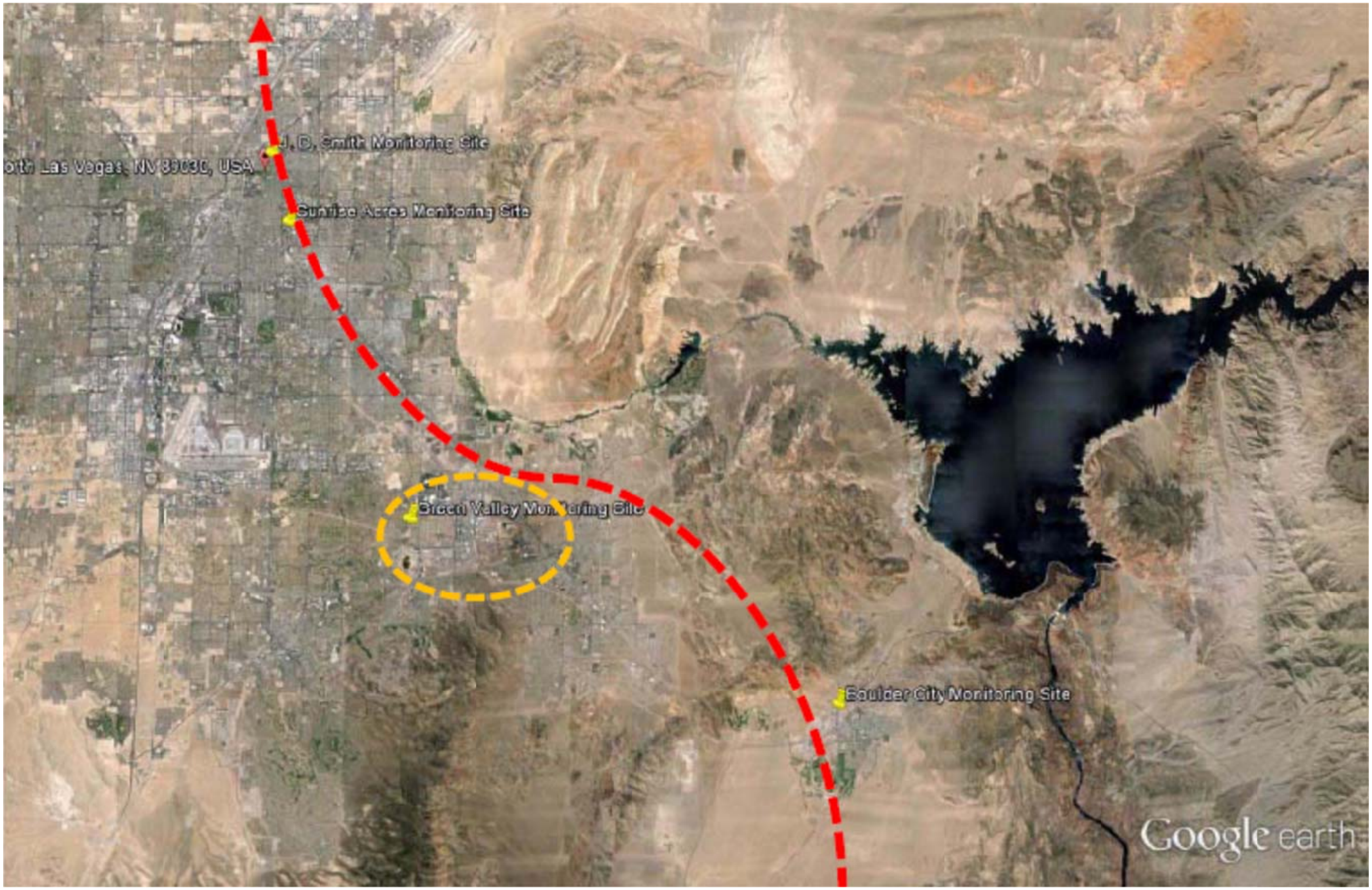
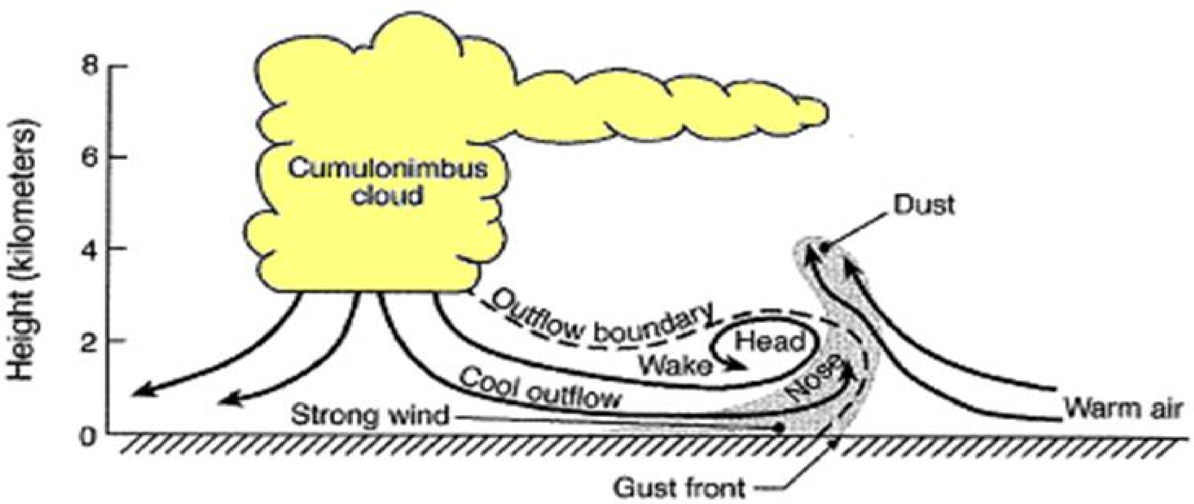


Figure 2. Predominant dust flow route into the Las Vegas Valley from Boulder City.

document the implementation of BACM on all relevant sources of emissions, the Clark County Dust Hotline's records were reviewed, and no reports of anthropogenic dust were made. Areas throughout the Las Vegas Valley were not emitting dust from BAQM stabilized areas or native desert areas. Dust transported from outside the Las Vegas Valley from desert storms south-southwest and southeast of the valley was the only affecting element for the exceedance day.

Severe weather in the desert



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 3. Cross section of a thunderstorm creating an outflow boundary (source: Desert Meteorology. Thomas T. Warner. 2004).

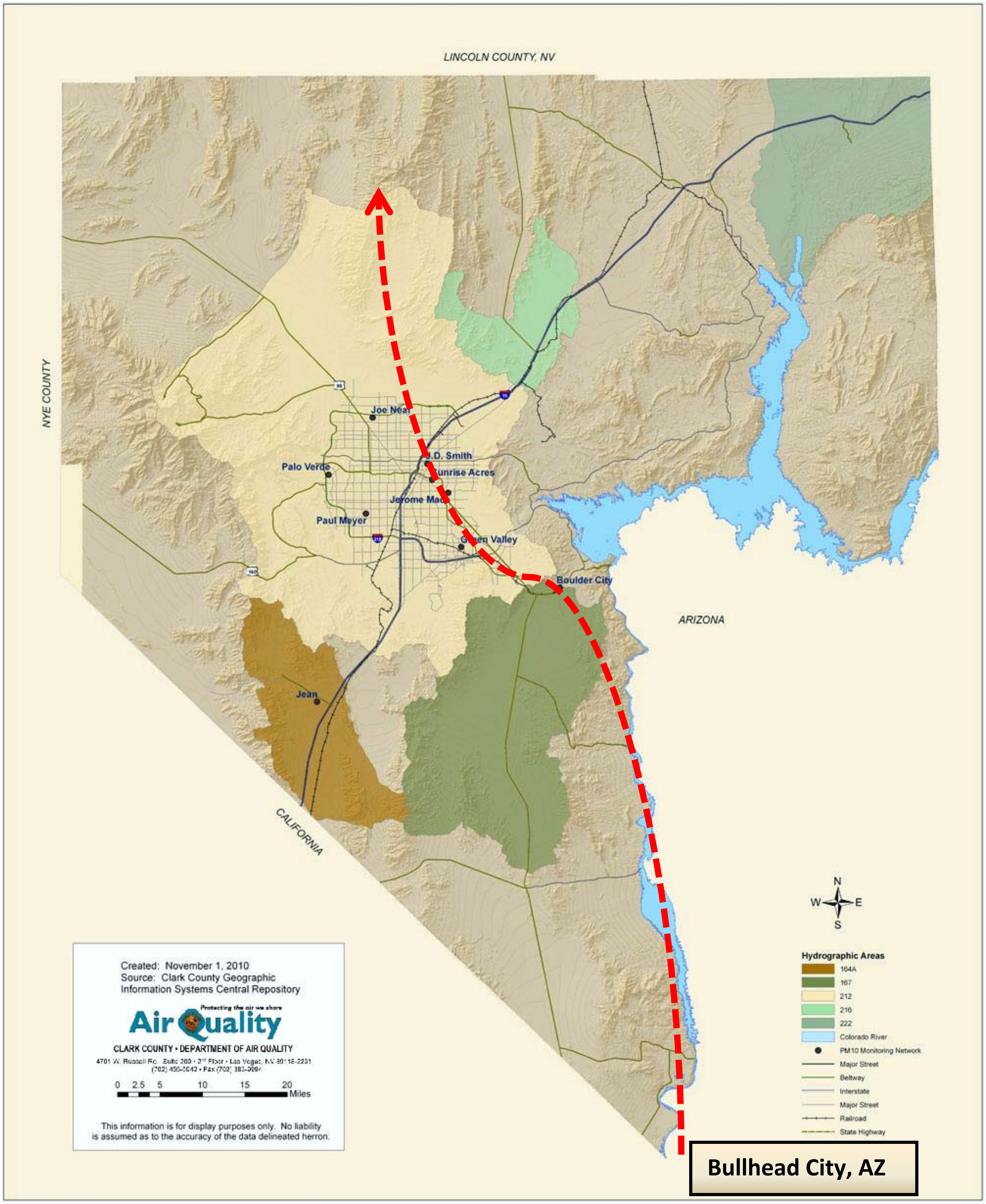


Figure 4. Predominant wind direction and dust flow on July 3, 2011.

1.4 CLARK COUNTY EXCEPTIONAL EVENT PROCESS

The Clark County Natural Events Action Plan and internal DAQ policy set forth the process for minimizing public health effects from high concentrations of particulate matter generated by high winds, sustained winds, and other mechanisms, such as outflow boundaries, desert storms, and other meteorological anomalies. The DAQ performs meteorological forecasting to predict when winds or other meteorological events are likely to generate elevated concentrations of particulate matter. This particular event was not evident until the early morning hours (between 1:00 am and 2:00 am Pacific Daylight Time). The event was apparent in the hours prior to sunrise through monitoring site instrument concentration readings.

Meteorological models and weather software can track desert storm conditions that can lead to dust transport, sometimes for several miles if prior knowledge is gained or if it is an event downwind of the monitoring domain. Normally, when wind speeds are predicted to reach established thresholds for high particulate concentrations, a wind advisory is broadcast to the public through multiple media channels. When high concentrations of dust occur as a result of desert storms, it is possible to forecast where and when increased dust levels will occur, but not necessarily how long they will remain in an area, especially if wind speeds are low. An air quality advisory was not broadcast during the early morning hours of the event day of July 3, 2011. There was a forecast advisory sent out for the Fourth of July 2011 for smoke due to local fireworks that would occur during the evening in the Las Vegas Valley. With this published advisory Clark County believes that some of the health-affected elements of the high-wind generated transported dust were addressed, and local residents and visitors were able to make health decisions with respect to the resultant air pollution. See Appendix B for a copy of this advisory that was published on July1, 2011, to cover the holiday smoke/dust on July 4 and 5, 2011.

The DAQ Compliance Division normally initiates an enhanced proactive enforcement program to ensure all applicable BACM are fully employed for high-wind events. Since this high-wind generated transported dust event occurred during the early hours of the event day, there was no pre-event compliance activity. Furthermore, prior to this event the forecast models did not predict any unusual weather patterns, increased winds, or reduced visibility. Based on this preliminary information no enhanced DAQ Compliance inspections were conducted throughout the valleys to ensure AQR compliance and that no additional dust was generated at sources. No additional staff was scheduled for the weekend enhanced inspections. This event occurred on a Sunday when no DAQ staff was on duty.

Following the event, the DAQ Planning and Monitoring Division conduct a preliminary assessment to determine what may have caused the exceedance and whether an initial data flag in the EPA Air Quality System (AQS) was appropriate. If a data flag for high-wind dust conditions as a result of a high-wind dust event is warranted, the Planning Division initiates a more in-depth assessment to determine if all conditions necessary to document an exceptional event are applicable to the exceedance. The Planning Division, in collaboration with the Monitoring and Compliance Divisions, documents whether or not timely advisories were issued; that there is a clear causal relationship between the high-wind transported dust and exceedance(s); that inspections/enforcement occurred; and that implementation of BACM was documented. If these requirements are met, the Planning Division develops detailed exceptional events documentation. If all conditions are not met, then each case is handled on a case by case basis. If the case is compelling and most elements are present, then a documentation package would be developed. This was the case for this July 3, 2011, event. Following completion of the documentation, a minimum of 30 days is provided for public comment, after which the DAQ may or may not make revisions to the documentation. The documentation is then submitted to EPA for review and consideration for a concurrence finding.

1.5 GEOGRAPHY, POPULATION, AND CLIMATE

The Las Vegas Valley is located in Clark County, at the southern tip of Nevada. It encompasses about 600 square miles, running northwest to southeast; a downward slope from west to east affects local climatology, driving variations in wind, precipitation, and storm water runoff. The surrounding mountains extend 2,000 to 10,000 feet above the valley floor. The Sheep Range bounds the valley on the north, and the McCullough Range bounds it on the south. The Spring Mountains, at the west edge of the valley, include Mount Charleston, the region's highest peak at 11,918 feet. The east rim of valley is formed by the River Mountains.

The Las Vegas Valley remains one of the fastest growing metropolitan areas in the nation, although growth slowed during the economic downturn of 2008 through 2010. From 2011 to the present the Las Vegas Valley has rebound and continues to grow at a continuous rate. The population expanded from about 805,000 in 1990 to 1,966,630 million in 2011.[1] The cities of Las Vegas, North Las Vegas, and Henderson comprise the Las Vegas metropolitan area, which is located in Hydrographic Area 212, a PM_{10} nonattainment area. Seven of the nine monitoring sites discussed in this exceptional event package are located in the Las Vegas Valley.

Official weather observations began in 1937 at what is now Nellis Air Force Base. In 1948, the U.S. Weather Bureau moved to McCarran Field (now McCarran International Airport), 7 miles south of downtown Las Vegas. The airport is approximately 5 miles southwest of, and 300 feet higher than, the lowest part of the Valley.

Beyond formal climatic data publications, there is very little material containing summaries of extreme weather events relevant to this exceptional event submittal. The valley climate is pleasant most of the year; however, during the summer (June through August) temperatures normally climb above 100 °F and the relative humidity can rise above 90.

Summers are characterized by hot days, warm nights, and mild winds, especially during these recent drier years. Strong wind episodes in the summer are usually connected with thunderstorms, and are thus more isolated and localized.[2] The relative humidity increases for several weeks each summer in association with a moist monsoonal flow from the south, typically during July and August. These moist winds support the development of spectacular desert thunderstorms that are frequently associated with significant flash flooding and/or strong downburst winds (outflow boundaries). Northwestern Arizona experiences the same, and these

[1]*Southern Nevada Regional Planning Coalition Consensus Population Estimates/Clark County Demographics 2011*.
[2]Gorelow, Andrew S. 2005. "Climate of Las Vegas, Nevada." National Oceanic and Atmospheric Administration Technical Memorandum NWS WR-271.

can influence air quality conditions when there are southeasterly winds and air flows from the southeast into southern Clark County through high-wind generated transport dust events.

Winters are mild and pleasant. Afternoon temperatures average near 60 degrees and skies are mostly clear. Pacific storms occasionally produce rainfall in the Las Vegas Valley, but in general, the Sierra Nevada Mountains of eastern California and the Spring Mountains immediately west of the Las Vegas Valley act as barriers to moisture.

The spring and fall seasons are generally considered ideal. Although sharp temperature changes can occur, outdoor activities are seldom hampered. Winter and spring wind events often generate widespread areas of blowing dust and sand. Problematic windstorms are common during late winter and spring, with winds predominantly coming from the southwest.

1.6 30-DAY PUBLIC COMMENT PERIOD

Clark County posts the July 3, 2011, high-wind generated transported dust event document and the supporting appendices on the DAQ Web site for a 30-day comment period effective upon completion of internal review. Appendix C contains the official web postings and results of the 30-day Public Comment period from the DAQ Web page, comments received and responses to those comments.

2.0 EXCEPTIONAL EVENT DOCUMENTATION

2.1 SUMMARY OF EVENT DAY

As noted in Section 1.3, sustained low velocity wind speeds throughout the Eldorado Valley into the Las Vegas Valley in the early morning of July 3, 2011, transported dust from the desert storm in the source area, causing PM_{10} exceedances at three sites in the Clark County Monitoring Network (Figures 5 and 6.) The monitoring site located in Boulder City recorded the first NAAQS exceedance on the event day, recording high PM_{10} masses at approximately 6:00 am and PM_{10} hourly concentrations through 6:00 pm. Anthropogenic sources near the monitoring site did not play a role in the elevated PM_{10} levels at the site. (Figures 113 through 152 – Clark County Air Quality Monitoring Network sites.)

2.2 CLARK COUNTY NATURAL EVENTS ACTION PLAN FOR HIGH-WIND EVENTS

The Clark County Board of County Commissioners adopted DAQ's *Natural Events Action Plan for High-Wind Events* (NEAP) for Clark County in April 2005. Clark County through its DAQ developed the NEAP with the assistance of stakeholders from many Clark County agencies, organizations, and private citizens. The only EPA guidance in effect when the NEAP was developed was the 1996 policy memorandum titled "Areas Affected by PM_{10} Natural Events," which describes the requirements for natural event data flagging and for developing a NEAP. The 1996 policy allowed air quality data to be flagged so as not to count toward an area's attainment status if it could be shown there was a clear causal relationship between the data and one of three categories of natural events: volcanic and seismic activity; unwanted wild land fires; and high-wind events. Clark County is developing a new process for Transported Dust Events, the "*High-Wind Transported Dust Action Plan (TDAP),*"which has not been published in time for this exceptional event submittal. Clark County will use the process from the existing NEAP until the plan for high-wind transported dust events is adopted by the BCC.

On March 22, 2007, EPA promulgated the final rule in the *Federal Register* addressing the review and handling of air quality monitoring data influenced by exceptional events. Events deemed "exceptional" are those for which the normal planning and regulatory process established by the Clean Air Act (CAA) is not appropriate.

Clark County NEAP procedures have been very effective since their adoption, and improvements due to changes in the EPA exceptional event rule requirements have created an even stronger program. Clark County through its DAQ now provides more information to EPA in event submittals, and has adopted many procedures to enhance early warning processes to better inform the regulated community and the public.

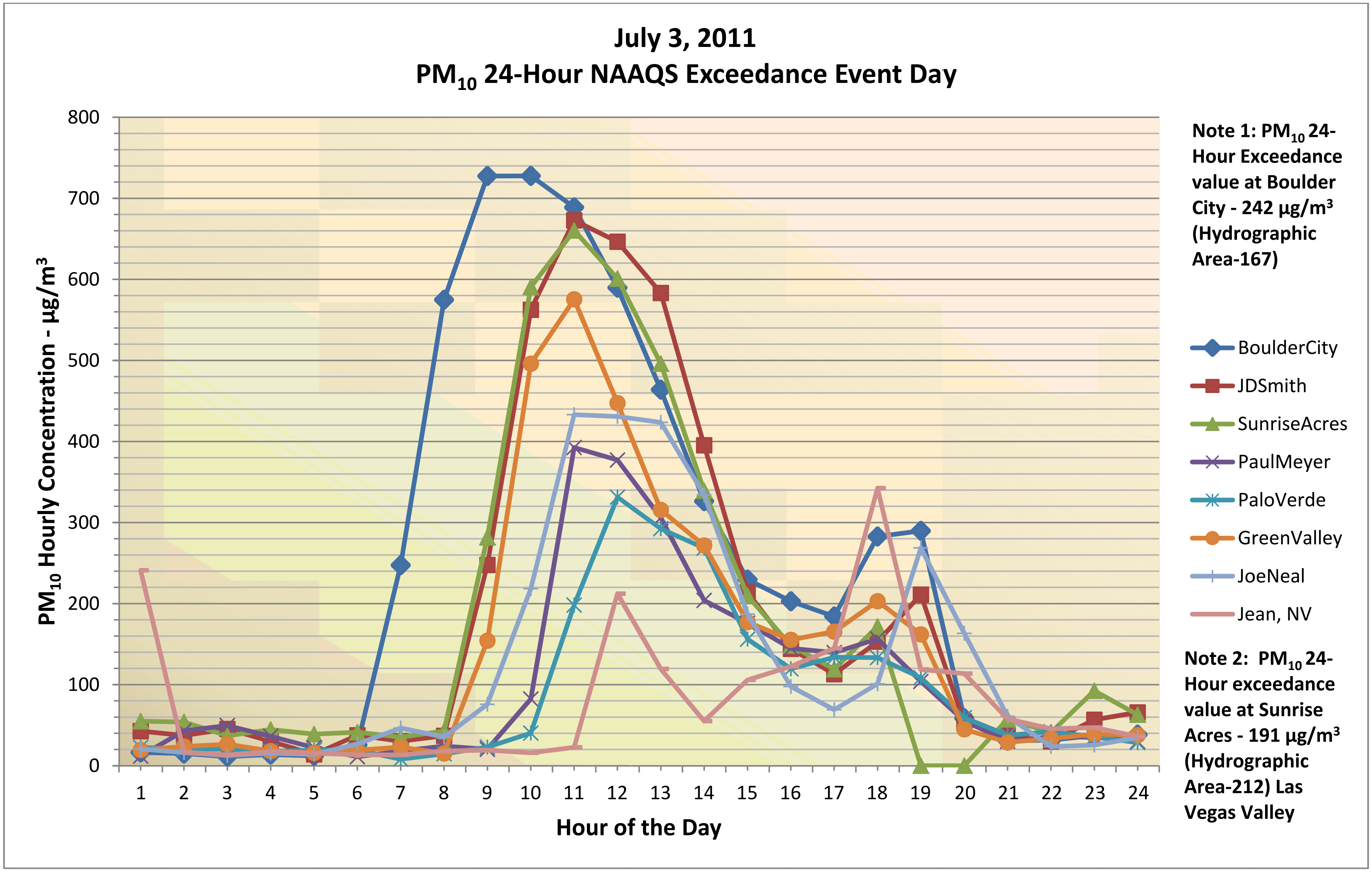


Figure 5. **PM_{10} 24-hour NAAQS exceedance event day.**

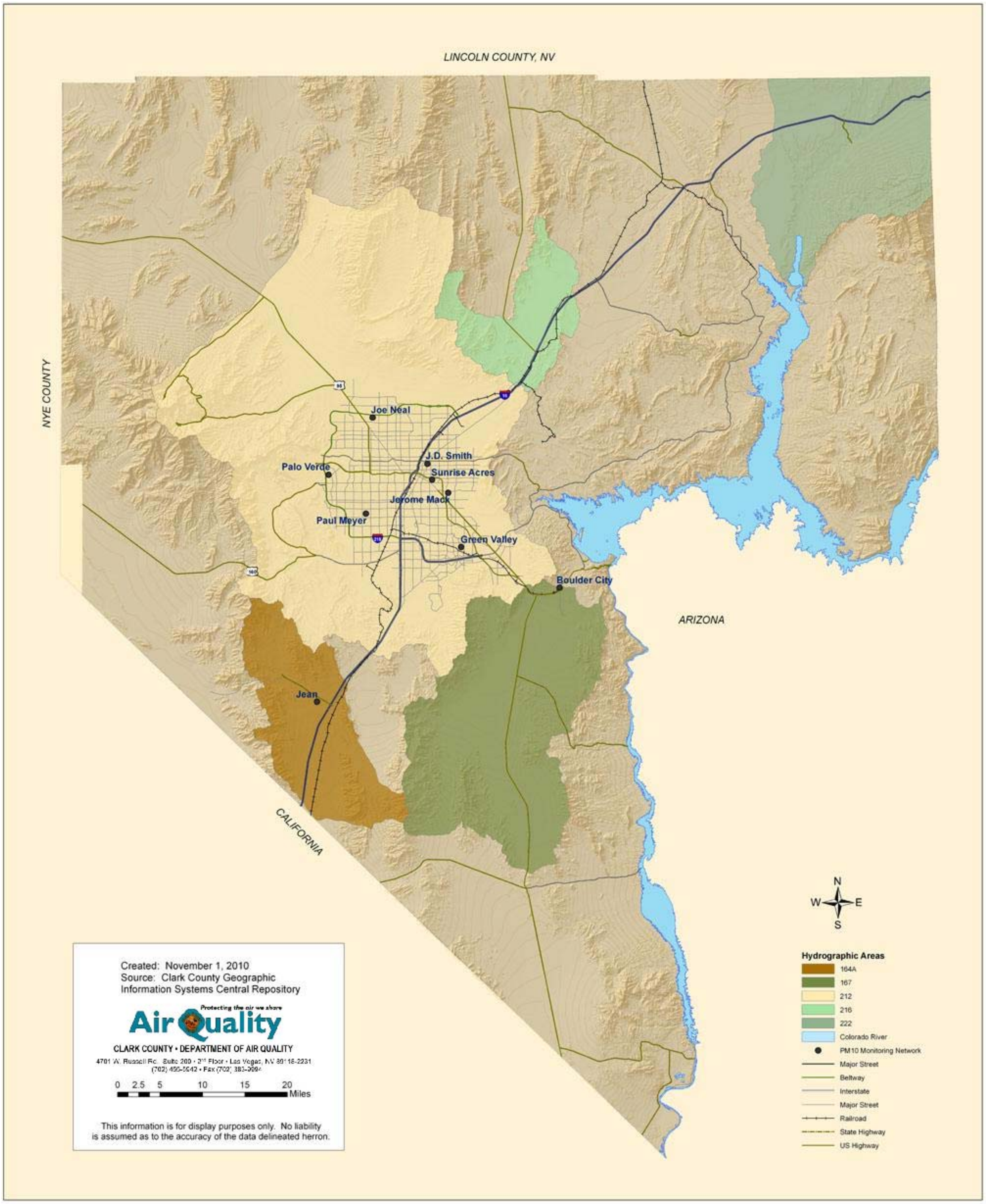


Figure 6. PM_{10} high-wind transport dust event monitoring sites, Clark County, Nevada.

Protection of public health is the foundation of the NEAP and the future TDAP. The primary components of the existing NEAP are:

- A high-wind event notification system that includes an early warning procedure.
- Education and outreach programs.
- Enhanced enforcement and compliance programs to reduce emissions.
- A system of required documentation submitted to EPA where an exceedance is caused by an exceptional event.

The NEAP protects public health by warning of impending wind events, notifying the public of wind events in progress, and educating the citizens of Clark County on the health hazards of particulate matter. The NEAP provides further instruction on how people can reduce airborne particulate emissions by avoiding certain individual or collective activities.

Improvements or enhancements to Clark County's natural events program are made as needed, such as the future publishing of the TDAP. Presently, one example of enhancement is the high-wind exceptional event exercise drill, which is conducted each year before the windy season to re-familiarize staff with procedures and to identify potential problem areas. This drill, along with other enhancements, provides an essential tool to evaluate processes, which helps the DAQ reduce the health and environmental effects of particulate matter.

2.3 EXCEPTIONAL EVENTS RULE DOCUMENTATION REQUIREMENTS

CAA, as amended Section 319(b)(3)(B)(i) requires a state air quality agency to demonstrate through "reliable, accurate data that is promptly produced" that an exceptional event occurred. CAA, as amended Section 319(b)(3)(B)(ii) requires that "a clear causal relationship be established" between a measured exceedance of a NAAQS and the exceptional event demonstrating "that the exceptional event caused a specific air pollution concentration at a particular location" (40 CFR 50 and 51 Treatment of Data Influenced by Exceptional Events; Final Rule FR Vol. 72, No. 55, p 13561).

In accordance with Section 319 of the CAA, as amended, EPA defines the term "exceptional event" in 40 CFR 50.1(j) to mean "an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event. It does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or air pollution relating to source noncompliance."

2.4 EXCEPTIONAL EVENT CRITERIA

The data and analysis in this document show that the exceedances of the 24-hour PM_{10} NAAQS at the Boulder City (CAMS-0601), Sunrise Acres (CAMS-0561), and J.D. Smith (CAMS-2002) monitoring sites on July 3. 2011 satisfy the following exceptional event criteria.

2.4.1 Satisfying criteria set forth in 40 CFR 50.1(j).

2.4.1.1 The event affected air quality.

Tables 1, 2, and 3 show high-winds following in time and magnitude from the Blythe Airport area to the Needles Airport area and up through the Laughlin, Nevada/Bullhead City, Arizona airport in a northeasterly direction to affect the Eldorado and Las Vegas Valleys. Tables 4 and 5, simultaneously show winds from the Sky Harbor Airport area to the Deer Valley Airport area from southeast of Phoenix and up through northwest Arizona to Laughlin, Nevada/Bullhead City, Arizona airport in a northwesterly direction to affect the Eldorado and Las Vegas Valleys. This storm cell out of the source area caused many outflow boundaries moving a dust cloud up the Colorado River corridor into Boulder City, Nevada. Figures 7 and 8 show this flow of air and dust pollution. This dust cloud blew into the Las Vegas Valley toward the J.D. Smith and Sunrise Acres monitoring sites. The predominantly northeastern travel into the Las Vegas Valley and relative low wind speeds enabled the dust to drift and distribute throughout the valley. This effect elevated PM_{10} concentration values at most of the monitoring sites and caused two sites to exceed the PM_{10} 24-Hour NAAQS, as a result of the exceeding sites location in the eastern and lower elevation portion of the Las Vegas Valley. There was another storm cell from the northwestern and central (Phoenix-Buckeye) Arizona desert that merged with the storm cell from southeastern California (Blythe)/southwestern Arizona in the Laughlin, Nevada/Bullhead City, Arizona area that pushed the dust cloud up the Colorado River corridor to the Eldorado valley causing the Boulder City monitoring site to exceed the PM_{10} 24-Hour NAAQS first prior to the dust entering the Las Vegas Valley from the south/southeast. Figures 9 and 10 show a graphic of HYSPLIT results for air/dust pollutant flows with respect to the converging desert storms and the travel flows to Clark County. Figures 11 through 18 are graphics from IDEA network -"Infusing satellite Data into Environmental air quality Applications." (The IDEA is a NASA-EPA-NOAA partnership to improve air quality assessment, management, and prediction by infusing (NASA) satellite measurements into (EPA, NOAA) analyses for public benefit.) See Appendix D for the full animated **MODIS AOD** graphic. These graphics show the detail of the storm building in northwestern and central Arizona at key times of 8:00 am and 11:00 am when Eldorado and Las Vegas Valley monitors start significantly climbing in concentrations levels and peak reading are experienced. Furthermore, these graphics show the travel up the Colorado River corridor through Laughlin/Bullhead City and to the Eldorado and Las Vegas Valleys. This storm then progressed through the Las Vegas Valley remaining predominantly to the eastern portion of the valley, hugging the mountain range directly east of the valley and exited to the northeast of the Las Vegas Valley. Note that the haze reported in the three tables push forward in time from Blythe to Needles and on to Bullhead City Airport in a wind and dust flow direction to Eldorado/Las Vegas. Wind speeds decrease over time as shown by Tables 1, 2 and 3 and Figures 19 and 20.

Tables 6 and 7 show that PM_{10} hourly concentrations at the Boulder City monitoring site were low on the days before and after the high-wind transported dust event. Table 8 and Figure 21 show that hourly PM_{10} concentrations increased rapidly with the arrival of the high-wind transported dust from the Laughlin, Nevada/Bullhead City, Arizona Airport area, most significantly between the hours of 6:00 am and 6:00 pm PST. Figure 21a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day at the Boulder City Airport (KVBU). Note that the low wind speeds coincide with the high hourly PM_{10} concentrations caused by drift and deposition. Source-generated dust was not a factor. By early afternoon, hourly sustained winds and hourly peak wind gusts increased and blew the bulk of the dust out of the Eldorado Valley and continually into the Las Vegas Valley. This trend continued to "wash out" the dusty mass of air pollution to the northeast of the Las Vegas Valley and affected only two other monitoring sites with exceedance-level concentrations within the predominant northeasterly air flow (Figure 4.) By 8:00 pm the Boulder City monitoring site began to exhibit normal background concentrations in the low 30s.

Tables 9 and 10show that PM_{10} hourly concentrations at the Sunrise Acres monitoring site were low on the days before and after the high-wind transported dust event. Table 11 and Figure 22 show that hourly PM_{10} concentrations increased rapidly, concurrently with the arrival of the transported dust from the Eldorado Valley into the Las Vegas Valley. Figure 22a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day. Note that the low wind speeds coincide with the high hourly PM_{10} concentrations caused by drift and deposition. There was no notable source-generated dust in the Sunrise Acres monitoring area. By early afternoon hourly sustained winds and hourly peak wind gusts increased and blew the transported dust out of the Sunrise Acres monitoring area continually toward the next monitoring site in the network (J. D. Smith). No significant local dust was coming from particulate matter sources in the area. Increasing winds continued to "wash out" and dilute the drifting dusty mass of air pollution to the northeast of the Las Vegas Valley. By 9:00 pm the Sunrise Acres monitoring site began to exhibit normal background concentrations in the 40s.

Tables 12 and 13 show that PM_{10} hourly concentrations at the J. D. Smith monitoring site were low on the days before and after the high-wind transported dust event. Table 14 and Figure 23 show that hourly PM_{10} concentrations increased rapidly, concurrently with the arrival of the transported dust from the Eldorado Valley into the Las Vegas Valley from the Sunrise Acres monitoring site direction, most significantly between the hours of 8:00 am and 6:00 pm. Figure 23a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day. Note that the low wind speeds coincide with the high hourly PM_{10} concentrations caused by drift and deposition. There was not any significant source-generated dust in the J. D. Smith monitoring area. By early afternoon hourly sustained winds and hourly peak wind gusts increased and blew the transported dust out of the J. D. Smith monitoring area. No local dust was coming from particulate matter sources in the area. Increasing winds continued to "wash out" and dilute the dusty mass of air pollution to the northeast of the Las Vegas Valley, dispersing the dust mass drift in multiple directions. By 8:00 pm the J. D. Smith monitoring site began to exhibit normal background concentrations in the 30s.

Tables 15 and 16 show that PM_{10} hourly concentrations at the Green Valley monitoring site were low on the days before and after the transported dust event. Table 17 and Figure 24 show that hourly PM_{10} concentrations increased slowly with the arrival of the high-wind transported dust from the Eldorado Valley into the Las Vegas Valley, most significantly between the hours of

8:00 am and 6:00 pm. Figure 24a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day. Note that the low wind speeds coincide with the high hourly PM_{10} concentrations experienced later in the morning hours from drift and deposition. An additional factor influencing this site was the small mountain ridge located approximately 2.5 miles east of this site. This ridge runs in an approximate north south direction, with the northern terminus slightly north of the Green Valley site as shown in Figure 2. This ridge was positioned to divert a portion of the PM_{10} laden airflow southeast to northeast from Boulder City to the northeast of this site, resulting in lower particulate measurements at this site than those recorded at Boulder City, Sunrise Acres, and J.D. Smith. There was no notable source-generated dust in the Green Valley monitoring site area. By mid-afternoon hourly sustained winds and hourly peak wind gusts increased and blew the high-wind transport dust out of the Green Valley monitoring site area. Increasing winds continued to “wash out” and dilute the dusty mass of air pollution to the northeast of the Las Vegas Valley. By 8:00 pm the Green Valley monitoring site began to exhibit normal background concentrations in the 20s. Green Valley experienced above-normal PM_{10} concentrations for eleven hours this day due to drift and deposition, but those readings did not result in a recorded exceedance of the PM_{10} 24-hour NAAQS.

Tables 18 and 19 show that PM_{10} hourly concentrations at the Joe Neal monitoring site were low on the days before and after the high-wind transported dust event. Table 20 and Figure 25 show that hourly PM_{10} concentrations increased rapidly, concurrently with the arrival of the transported dust from the Eldorado Valley into the Las Vegas Valley from the general drifting direction east to west, most significantly between the hours of 8:00 am and 7:00 pm. Figure 25a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day. Note that the low wind speeds coincide with the high hourly PM_{10} concentrations caused by deposition. There was no notable source-generated dust in the Joe Neal monitoring site area. By early afternoon hourly sustained winds and hourly peak wind gusts increased and blew the high-wind transported dust out of the Joe Neal monitoring site area toward the northeast and out of the Las Vegas Valley. By 9:00 pm the Joe Neal monitoring site began to exhibit normal background concentrations in the 20s.

Tables 21 and 22 show that PM_{10} hourly concentrations at the Paul Meyer monitoring site were low on the days before and after the transported dust event. Table 23 and Figure 26 show that hourly PM_{10} concentrations increased slowly with the arrival of the transported dust from the Eldorado Valley into the Las Vegas Valley from the general direction of northeastern dust and air flows, most significantly between the hours of 9:00 am and 6:00 pm. Paul Meyer remained between high-moderate and low moderate for the majority of the event day. Figure 26a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day. Note that the low wind speeds coincide with the high hourly PM_{10} concentrations experienced later in the morning hours and into the afternoon hours. There was no notable source-generated dust in the Paul Meyer monitoring site area. By late morning, hourly sustained winds and hourly peak wind gusts increased and blew the transported dust out of the Paul Meyer monitoring site area. Increasing winds continued to “wash out” and dilute the dusty mass of air pollution to the general northeast part of the Las Vegas Valley. By 8:00 pm the Paul Meyer monitoring site began to exhibit normal background concentrations in the low 30s. Paul Meyer experienced above-normal PM_{10} concentrations for ten hours that day, but those readings did not result in a recorded exceedance of the PM_{10} 24-hour NAAQS.

Tables 24 and 25 show that PM_{10} hourly concentrations at the Palo Verde monitoring site were low on the days before and after the transported dust event. Table 26 and Figure 27 show that hourly PM_{10} concentrations increased slowly with the arrival of the transported dust from the Eldorado Valley into the Las Vegas Valley, most significantly between 10:00 am and 6:00 pm. Figure 27a shows the speeds of hourly sustained winds and the hourly average of maximum wind gusts on the event day. Note that the low wind speeds coincide with the high hourly PM_{10} concentrations experienced later in the morning hours and into the afternoon. There was no notable source-generated dust in the in the Palo Verde monitoring site area. By mid-afternoon hourly sustained winds and hourly peak wind gusts increased and blew the transported dust out of the Palo Verde monitoring site area. Increasing winds continued to “wash out” and dilute the drifting dusty mass of air pollution to the northeast of the Las Vegas Valley. By 8:00 pm the Palo Verde monitoring site began to exhibit normal background concentrations in the low 30s. Palo Verde experienced above-normal PM_{10} concentrations for nine hours and a high spike at approximately 11:00 am on that day, but those readings did not result in a recorded exceedance of the PM_{10} 24-hour NAAQS.

Tables 27 and 28 shows that PM_{10} hourly concentrations at the Jean monitoring site were low on the days before and after the July 3, 2011, high-wind transported dust event that occurred in the Eldorado and Las Vegas Valleys. Table 29 and Figure 28 show that hourly PM_{10} concentrations were not affected by the event from any wind flows in or near the Ivanpah Valley (Jean monitoring site), roughly 35 miles southwest of the Las Vegas Valley. There were some air flows out of California from desert storm cells, but not significant enough to produce elevated readings at the Jean site, which recorded a 24-hour PM_{10} concentration of 79 $\mu g/m^3$.

Table 1. Blythe Airport, Blythe, California (23158) on July 2-3, 2011.

Date	Wind Speed (mph)	Wind Gusts (mph)	Wind Direction (degrees)	Winds From	Visibility (SM)	Weather Type
7/02/2011 00:52 AM	6	ND	350	NNW	10.00	ND
7/02/2011 1:52 AM	5	ND	350	NNW	10.00	ND
7/02/2011 2:52 AM	5	ND	360	N	10.00	ND
7/02/2011 3:52 AM	8	ND	350	NNW	10.00	ND
7/02/2011 4:52 AM	7	ND	330	NW	10.00	ND
7/02/2011 5:52 AM	3	ND	VAR	VAR	10.00	ND
7/02/2011 6:52 AM	ND	ND	ND	ND	10.00	ND
7/02/2011 7:52 AM	ND	ND	ND	ND	10.00	ND
7/02/2011 8:52 AM	3	ND	VAR	VAR	10.00	ND
7/02/2011 9:52 AM	5	ND	060	NE	10.00	ND
7/02/2011 10:52 AM	ND	ND	ND	ND	10.00	ND
7/02/2011 11:52 AM	5	ND	ND	ND	10.00	ND
7/02/2011 12:52 PM	6	ND	210	SSW	10.00	ND
7/02/2011 1:52 PM	8	ND	250	WSW	10.00	ND
7/02/2011 2:52 PM	8	ND	190	S	10.00	ND
7/02/2011 3:52 PM	7	ND	150	SE	10.00	ND
7/02/2011 4:52 PM	5	ND	160	SSE	10.00	ND
7/02/2011 5:52 PM	3	ND	VAR	VAR	10.00	ND
7/02/2011 6:52 PM	9	ND	250	WSW	10.00	ND
7/02/2011 7:52 PM	8	ND	250	WSW	10.00	ND
7/02/2011 8:52 PM	9	ND	260	WSW	10.00	ND
7/02/2011 9:52 PM	9	ND	260	WSW	10.00	ND
7/02/2011 10:52 PM	ND	ND	ND	ND	ND	ND
7/02/2011 11:52 PM	9	ND	170	SSE	10.00	ND
7/03/2011 00:45 AM	36	43	180	S	2.00	Haze
7/03/2011 00:48 AM	32	44	180	S	1.25	Haze
7/03/2011 00:50 AM	33	44	180	S	1.25	Haze
7/03/2011 00:52 AM	37	48	180	S	1.00	Haze
7/03/2011 1:19 AM	32	44	180	S	1.75	Haze
7/03/2011 1:24 AM	29	44	190	S	2.00	Haze
7/03/2011 1:43 AM	24	38	180	S	2.50	Haze
7/03/2011 1:52 AM	20	29	180	S	3.00	Haze
7/03/2011 2:01 AM	16	26	180	S	3.00	Haze
7/03/2011 2:52 AM	16	ND	190	S	4.00	Haze
7/03/2011 2:59 AM	14	ND	190	S	4.00	Haze
7/03/2011 3:21 AM	13	17	180	S	5.00	Haze
7/03/2011 3:52 AM	11	ND	190	S	6.00	Haze
7/03/2011 4:52 AM	9	ND	200	S	6.00	Haze
7/03/2011 5:52 AM	7	ND	190	S	9.00	ND
7/03/2011 6:52 AM	7	ND	120	ESE	10.00	ND
7/03/2011 7:52 AM	6	ND	180	S	10.00	ND

7/03/2011 8:52 AM	10	ND	200	S	10.00	ND
7/03/2011 9:52 AM	15	22	190	S	10.00	ND
7/03/2011 10:52 AM	16	23	180	S	10.00	ND
7/03/2011 11:52 AM	18	25	190	S	10.00	ND
7/03/2011 12:52 PM	11	20	180	S	10.00	ND
7/03/2011 1:52 PM	17	ND	180	S	10.00	ND
7/03/2011 2:52 PM	16	21	190	S	10.00	ND
7/03/2011 3:52 PM	16	24	190	S	10.00	ND
7/03/2011 4:52 PM	13	ND	190	S	10.00	ND
7/03/2011 5:52 PM	21	26	200	S	10.00	ND
7/03/2011 6:52 PM	14	ND	210	SSW	10.00	ND
7/03/2011 7:52 PM	10	ND	200	S	10.00	ND
7/03/2011 8:52 PM	7	ND	200	S	10.00	ND
7/03/2011 9:52 PM	3	ND	VAR	VAR	10.00	ND
7/03/2011 10:52 PM	8	ND	030	NNE	10.00	Rain
7/03/2011 11:52 PM	15	ND	060	NE	10.00	Rain

Note: There is no wind direction associated with wind speeds < 3.45 mph and will be referred as **VAR** for variable/calm, in that corresponding cell block.

Table 2. Needles Airport, Needles, California (23179) on July 3, 2011

Date	Wind Speed (mph)	Wind Gusts (mph)	Wind Direction (degrees)	Winds From	Visibility (SM)	Weather Type
7/03/2011 00:56 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 1:56 AM	6	ND	280	W	10.00	ND
7/03/2011 2:56 AM	24	40	220	SSW	6.00	Haze
7/03/2011 3:06 AM	23	30	200	S	3.00	Haze
7/03/2011 3:11 AM	22	30	200	S	2.50	Haze
7/03/2011 3:33 AM	23	36	220	SSW	3.00	Haze
7/03/2011 3:56 AM	15	26	190	S	4.00	Haze
7/03/2011 4:40 AM	ND	ND	ND	ND	2.50	Haze
7/03/2011 4:47 AM	5	ND	090	E	3.00	Haze
7/03/2011 4:56 AM	ND	ND	ND	ND	3.00	Haze
7/03/2011 5:12 AM	7	ND	220	SSW	2.50	Haze
7/03/2011 5:27 AM	ND	ND	ND	ND	2.50	Haze
7/03/2011 5:44 AM	3	ND	VAR	VAR	3.00	Haze
7/03/2011 5:56 AM	5	ND	160	SSE	3.00	Haze
7/03/2011 6:09 AM	5	ND	ND	ND	3.00	Haze
7/03/2011 6:25 AM	5	ND	200	S	2.50	Haze
7/03/2011 6:56 AM	8	ND	160	SSE	3.00	Haze
7/03/2011 7:56 AM	9	ND	150	SE	5.00	Haze
7/03/2011 8:56 AM	11	17	180	S	7.00	ND
7/03/2011 9:56 AM	15	22	230	SW	10.00	ND
7/03/2011 10:56 AM	16	21	210	SSW	10.00	ND
7/03/2011 11:56 AM	15	25	200	S	10.00	ND
7/03/2011 12:56 PM	11	22	200	S	10.00	ND
7/03/2011 1:56 PM	5	16	ND	ND	10.00	ND
7/03/2011 2:56 PM	17	24	220	SSW	10.00	ND
7/03/2011 3:56 PM	7	17	ND	ND	10.00	ND
7/03/2011 4:56 PM	16	22	200	S	10.00	ND
7/03/2011 5:56 PM	8	ND	200	S	10.00	ND
7/03/2011 6:56 PM	10	ND	200	S	10.00	ND
7/03/2011 7:56 PM	9	ND	220	SSW	10.00	ND
7/03/2011 8:56 PM	6	ND	080	ENE	10.00	ND
7/03/2011 9:54 PM	16	ND	130	ESE	10.00	ND
7/03/2011 21:56 PM	14	ND	120	ESE	10.00	Rain
7/03/2011 22:56 PM	5	ND	200	S	10.00	ND
7/03/2011 23:56 PM	34	45	190	S	10.00	ND

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as **VAR** for variable/calm in that corresponding cell block.

Table 3. Bullhead City/Laughlin, Nevada Airport (53135) on July 3, 2011

Date	Wind Speed (mph)	Wind Gusts (mph)	Wind Direction (degrees)	Winds From	Visibility (SM)	Weather Type
7/03/2011 00:15 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 00:35 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 00:55 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 1:15 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 1:35 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 1:55 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 2:15 AM	6	ND	170	SSE	10.00	ND
7/03/2011 2:35 AM	5	ND	190	S	10.00	ND
7/03/2011 2:55 AM	3	ND	VAR	VAR	10.00	ND
7/03/2011 3:15 AM	5	ND	140	SE	10.00	ND
7/03/2011 3:35 AM	5	ND	110	ESE	10.00	ND
7/03/2011 3:55 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 4:15 AM	7	ND	150	SE	10.00	ND
7/03/2011 4:35 AM	5	ND	220	SSW	10.00	ND
7/03/2011 4:55 AM	6	ND	240	SW	10.00	ND
7/03/2011 5:15 AM	20	31	150	SE	5.00	Haze
7/03/2011 5:35 AM	15	24	170	SSE	2.50	Haze
7/03/2011 5:55 AM	8	18	200	S	2.50	Haze
7/03/2011 6:15 AM	20	ND	210	SSW	2.50	Haze
7/03/2011 6:35 AM	15	ND	200	S	2.00	Haze
7/03/2011 6:55 AM	8	ND	210	SSW	2.00	Haze
7/03/2011 7:15 AM	9	ND	210	SSW	2.00	Haze
7/03/2011 7:35 AM	8	ND	230	SW	2.00	Haze
7/03/2011 7:55 AM	10	ND	220	SSW	2.00	Haze
7/03/2011 8:15 AM	10	ND	220	SSW	2.50	Haze
7/03/2011 8:35 AM	13	ND	210	SSW	3.00	Haze
7/03/2011 8:55 AM	13	ND	220	SSW	3.00	Haze
7/03/2011 9:15 AM	13	18	200	S	4.00	Haze
7/03/2011 9 :35 AM	14	24	190	S	5.00	Haze
7/03/2011 9:55 AM	16	25	190	S	5.00	Haze
7/03/2011 10:15 AM	16	23	220	S	4.00	Haze
7/03/2011 10:35 AM	11	21	220	SSW	5.00	Haze
7/03/2011 10:55 AM	15	20	220	SSW	5.00	Haze
7/03/2011 11:15 AM	17	23	200	S	6.00	Haze

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as **VAR** for variable/calm in that corresponding cell block.

Table 4. Sky Harbor, Phoenix, Arizona (23183) on July 3, 2011

Date	Wind Speed (mph)	Wind Gusts (mph)	Wind Direction (degrees)	Winds From	Visibility (SM)	Weather Type
7/03/2011 00:12 AM	17	30	160	SSE	2.00	BLDU
7/03/2011 00:38 AM	10	22	160	SSE	3.00	BLDU
7/03/2011 00:51 AM	13	20	170	SSE	5.00	BLDU
7/03/2011 1:51 AM	6	ND	140	SE	7.00	ND
7/03/2011 2:51 AM	6	ND	120	SE	10.00	ND
7/03/2011 3:51 AM	6	ND	150	SSE	10.00	ND
7/03/2011 4:51 AM	5	ND	110	ESE	10.00	ND
7/03/2011 5:51 AM	5	ND	070	ENE	10.00	ND
7/03/2011 6:51 AM	7	ND	350	N	10.00	ND
7/03/2011 7:51 AM	6	ND	320	NW	10.00	ND
7/03/2011 8:51 AM	7	ND	320	NW	10.00	ND
7/03/2011 9:51 AM	ND	ND	ND	ND	10.00	ND
7/03/2011 10:51 AM	7	ND	300	WNW	10.00	ND
7/03/2011 11:51 AM	3	ND	VAR	ND	10.00	ND
7/03/2011 12:51 PM	7	ND	ND	ND	10.00	ND
7/03/2011 1:51 PM	9	17	190	S	10.00	ND
7/03/2011 2:51 PM	11	18	200	S	10.00	ND
7/03/2011 3:51 PM	8	ND	270	W	10.00	ND
7/03/2011 4:51 PM	ND	ND	ND	ND	6.00	ND
7/03/2011 5:51 PM	26	36	250	WSW	9.00	HZ BLDU
7/03/2011 6:51 PM	25	34	260	WSW	10.00	ND
7/03/2011 7:51 PM	17	ND	270	W	10.00	ND
7/03/2011 8:08 PM	24	32	010	N	10.00	-TSRA
7/03/2011 8:26 PM	8	ND	350	NNW	10.00	ND
7/03/2011 8:51 PM	11	ND	350	NNW	10.00	ND
7/03/2011 9:51 PM	10	ND	290	WNW	10.00	ND
7/03/2011 10:51 PM	9	ND	250	WSW	10.00	ND
7/03/2011 11:51 PM	7	ND	280	W	10.00	ND

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as **VAR** for variable/calm in that corresponding cell block.

Table 5. Deer Valley Airport, Phoenix, Arizona (03184) on July 3, 2011

Date	Wind Speed (mph)	Wind Gusts (mph)	Wind Direction (degrees)	Winds From	Visibility (SM)	Weather Type
7/03/2011 00:53 AM	13	23	150	SE	3.00	BLDU
7/03/2011 00:53 AM	11	23	150	SE	3.00	BLDU
7/03/2011 1:01 AM	11	ND	140	SE	2.50	BLDU
7/03/2011 1:21 AM	13	ND	120	ESE	3.00	BLDU
7/03/2011 1:53 AM	11	ND	120	ESE	4.00	BLDU
7/03/2011 2:41 AM	6	ND	120	ESE	7.00	BLDUs
7/03/2011 2:51 AM	6	ND	140	SE	7.00	BLDUs
7/03/2011 2:53 AM	6	ND	140	SE	7.00	BLDUs
7/03/2011 3:37 AM	5	ND	130	ESE	8.00	BLDUs
7/03/2011 3:53 AM	6	ND	150	SE	8.00	BLDUs
7/03/2011 4:53 AM	ND	ND	ND	ND	8.00	BLDUs
7/03/2011 5:53 AM	ND	ND	ND	ND	7.00	BLDUs
7/03/2011 6:53 AM	3	ND	VAR	WNW	7.00	BLDUs
7/03/2011 7:00 AM	3	ND	VAR	WNW	7.00	BLDUs
7/03/2011 7:09 AM	ND	ND	ND	ND	7.00	BLDUs
7/03/2011 7:53 AM	ND	ND	ND	ND	7.00	BLDUs
7/03/2011 8:53 AM	9	ND	290	W	8.00	ND
7/03/2011 9:53 AM	ND	ND	ND	ND	9.00	ND
7/03/2011 10:53 AM	3	ND	VAR	ND	10.00	ND
7/03/2011 11:53 AM	6	ND	210	SSW	10.00	ND
7/03/2011 12:53 PM	13	16	210	SSW	10.00	ND
7/03/2011 1:53 PM	9	ND	260	WSW	10.00	ND
7/03/2011 2:53 PM	9	21	180	S	10.00	ND
7/03/2011 3:53 PM	14	18	270	W	10.00	ND
7/03/2011 4:53 PM	6	ND	230	SW	10.00	ND
7/03/2011 5:53 PM	10	ND	230	SW	10.00	ND
7/03/2011 6:50 PM	22	38	230	SW	4.00	HZ
7/03/2011 6:53 PM	29	37	240	SW	4.00	HZ
7/03/2011 7:09 PM	22	37	240	SW	7.00	ND
7/03/2011 7:51 PM	7	21	290	WNW	10.00	ND
7/03/2011 7:53 PM	8	ND	290	WNW	10.00	ND
7/03/2011 8:07 PM	23	37	060	ENE	7.00	ND
7/03/2011 8:19 PM	16	31	070	ENE	10.00	ND
7/03/2011 8:32 PM	9	ND	010	N	7.00	-RA
7/03/2011 8:51 PM	5	ND	360	N	6.00	VCTS -RA
7/03/2011 8:53 PM	3	ND	VAR	ND	7.00	VCTS -RA
7/03/2011 9:11 PM	11	22	290	WNW	9.00	ND
7/03/2011 9:53 PM	ND	ND	ND	ND	10.00	ND
7/03/2011 10:53 PM	7	ND	270	W	7.00	ND

7/03/2011 11:53 PM	3	ND	VAR	WNW	10.00	ND

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as **VAR** for variable/calm in that corresponding cell block.

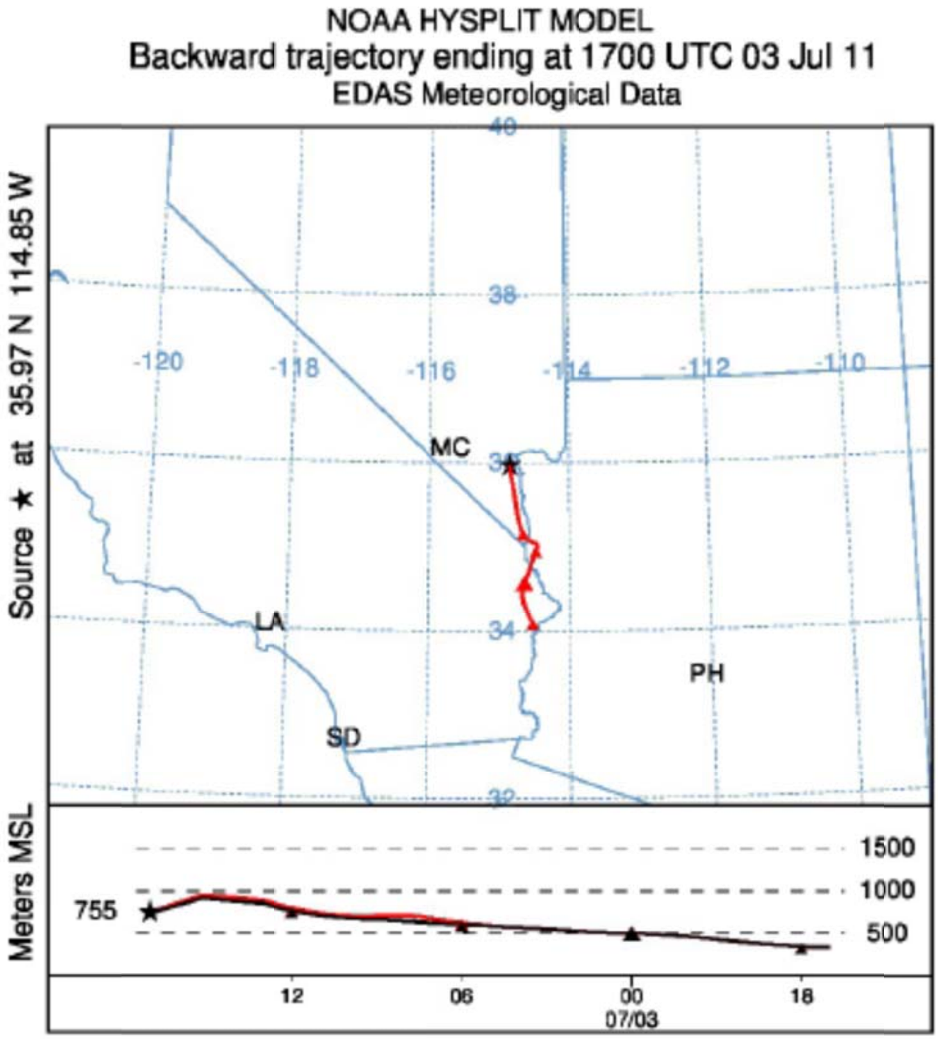


Figure 7. NOAA HYSPLIT backward trajectory 9:00 am, local time July 3, 2011

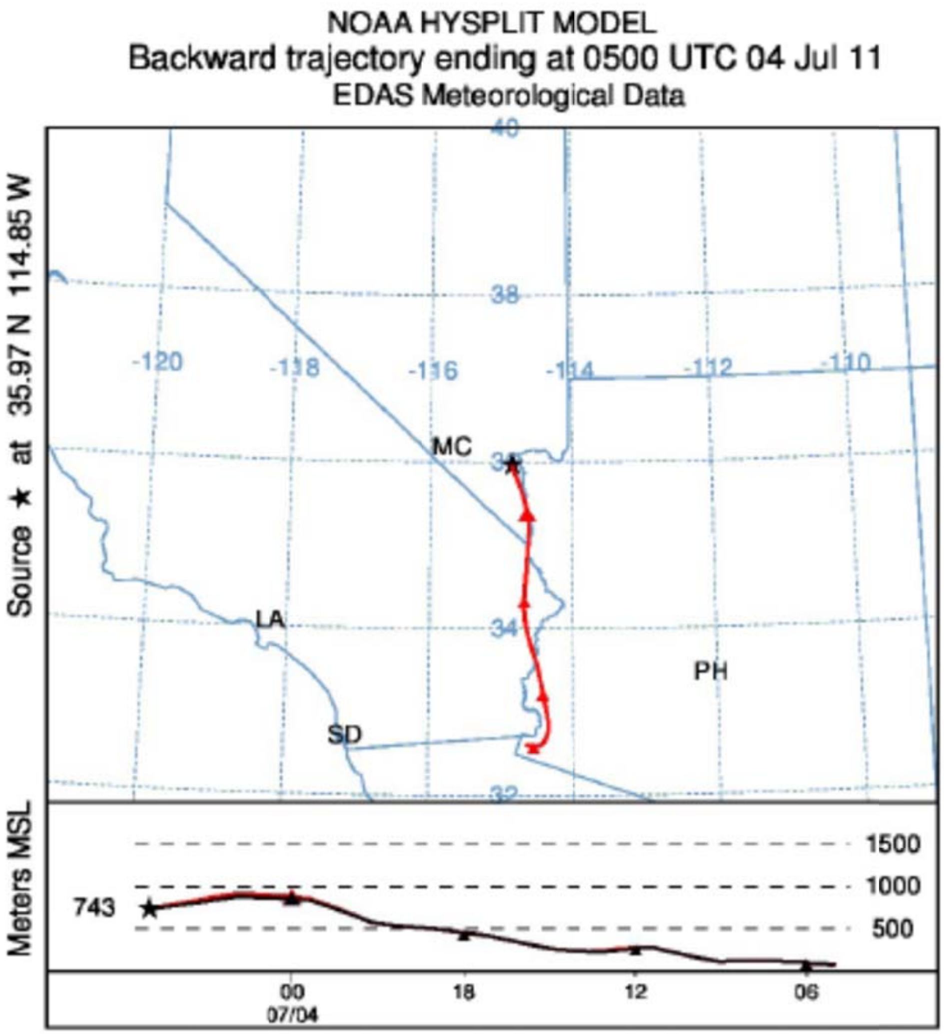


Figure 8. NOAA HYSPLIT backward trajectory 9:00 pm local time, July 3, 2011.

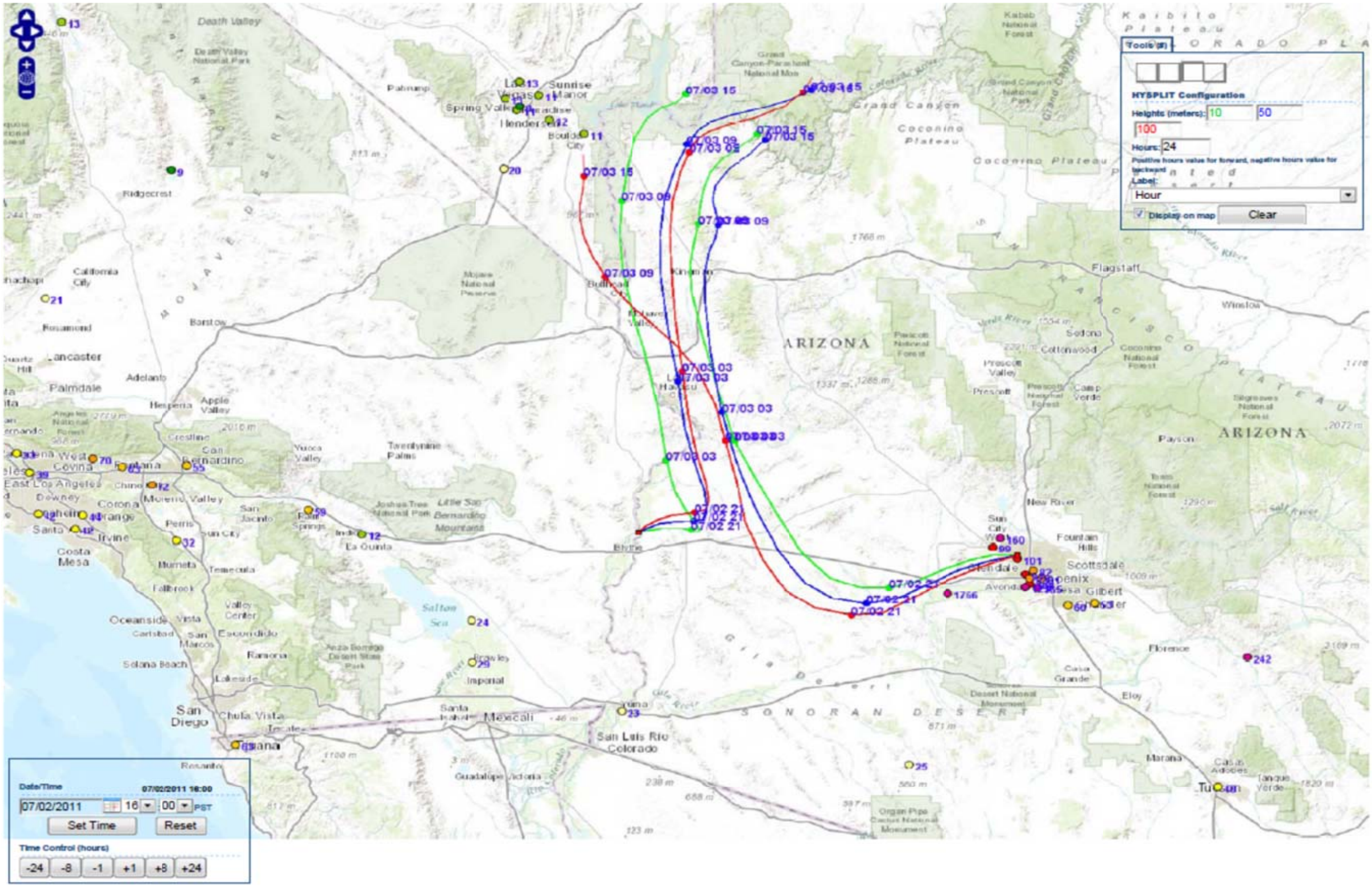


Figure 9. Forward trajectory +24 hours.

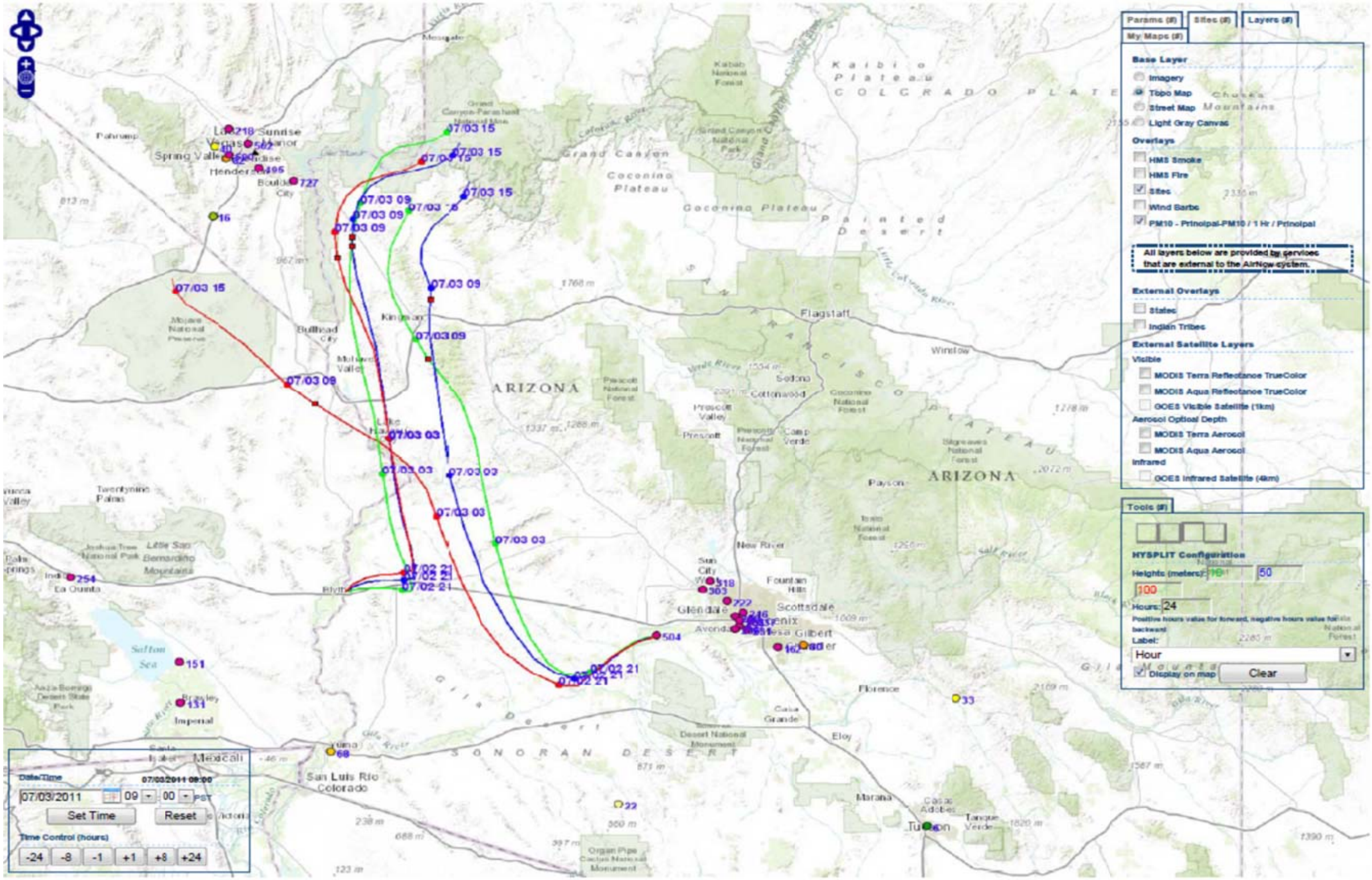


Figure 10. HYSPLIT trajectory July 3, 2011.

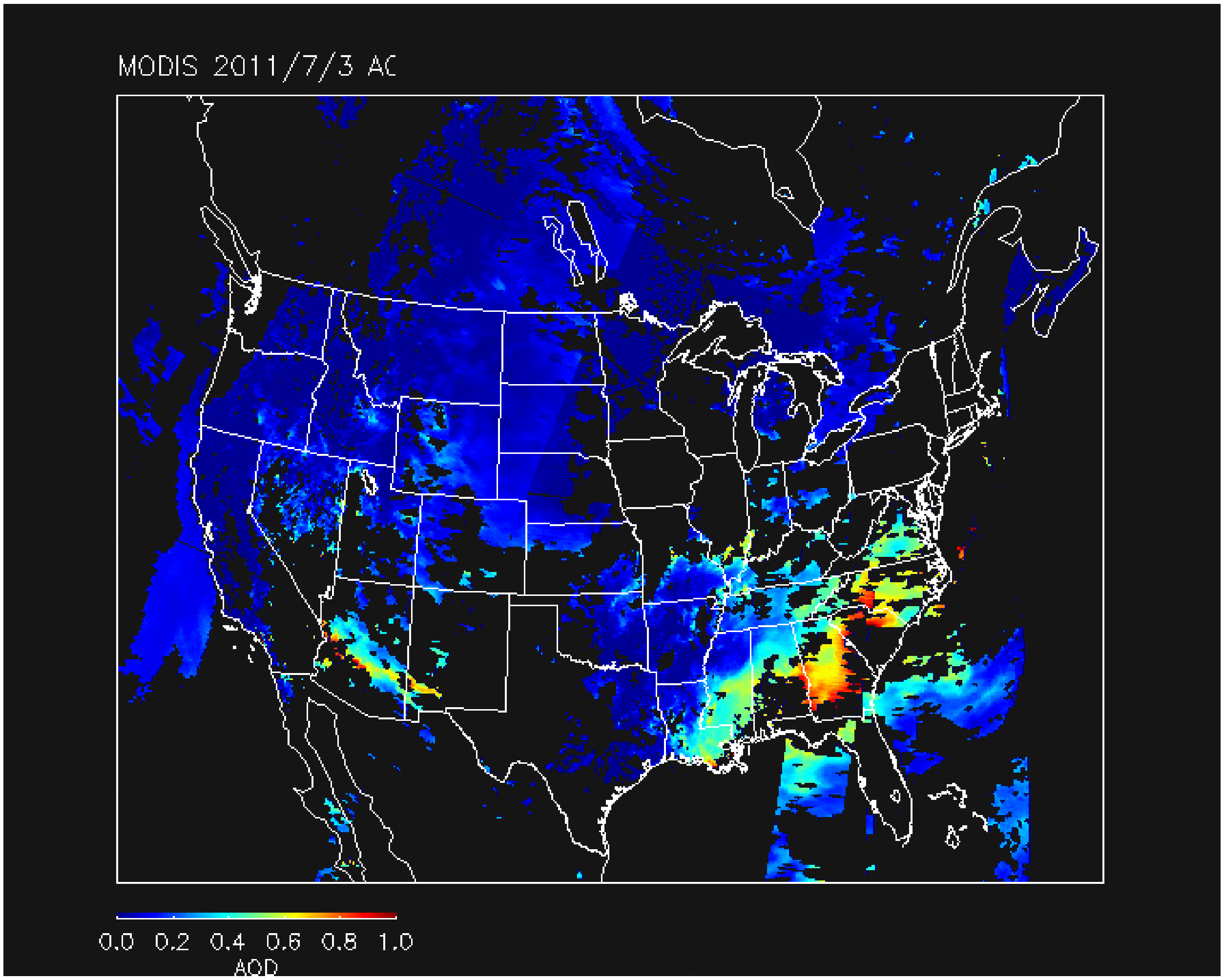


Figure 11. High MODIS (Moderate Resolution Imaging Spectroradiometer) aerosol optical depth-July 3, 2011 at 8:00 am (storm satellite image map).

Note desert storm building in central/southwest Arizona source area at approximately 8:00 am on July 3, 2011.

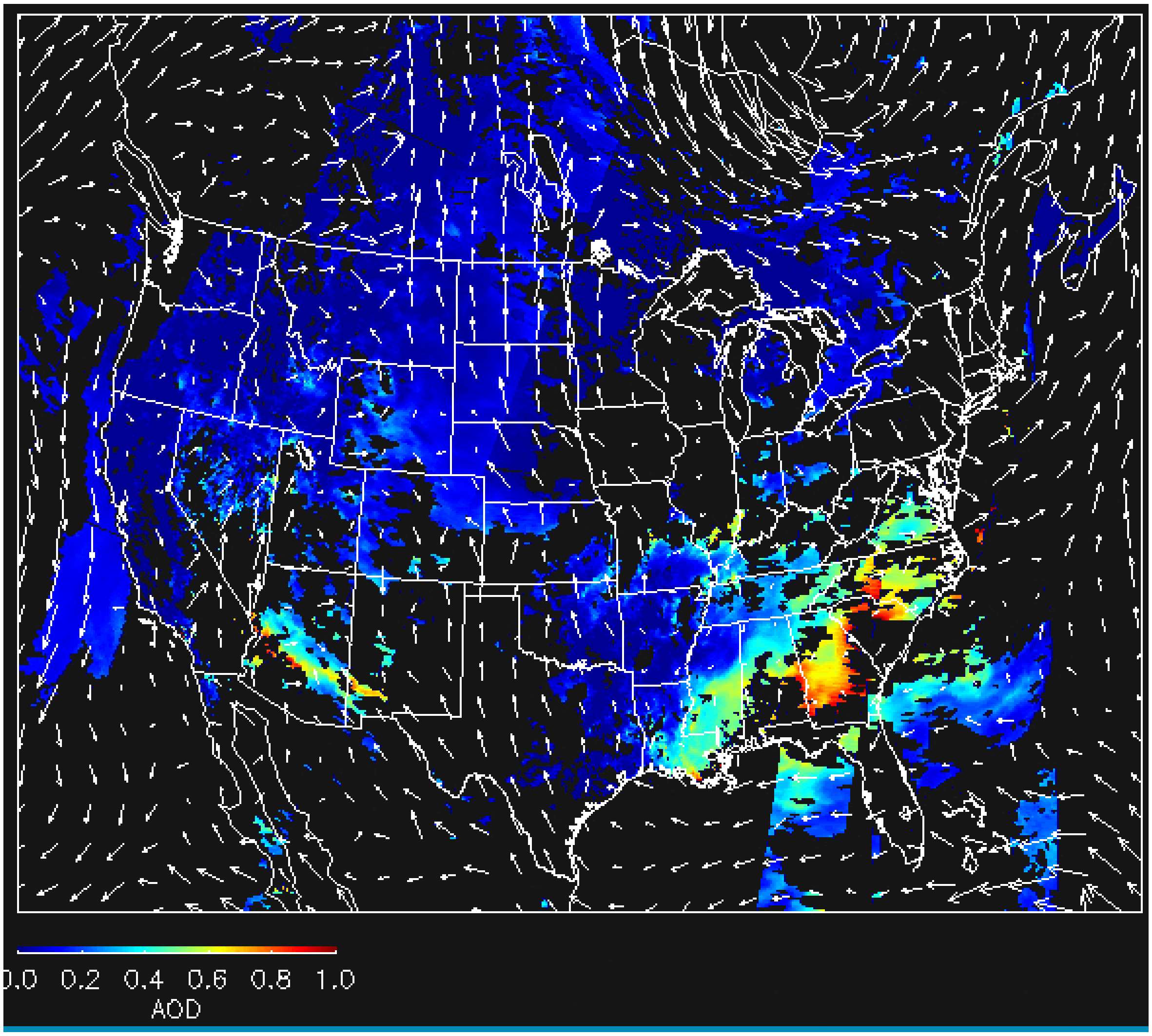


Figure 12. High MODIS aerosol optical depth-July 3, 2011 at 8:00 am (storm satellite image map with wind barbs displayed).

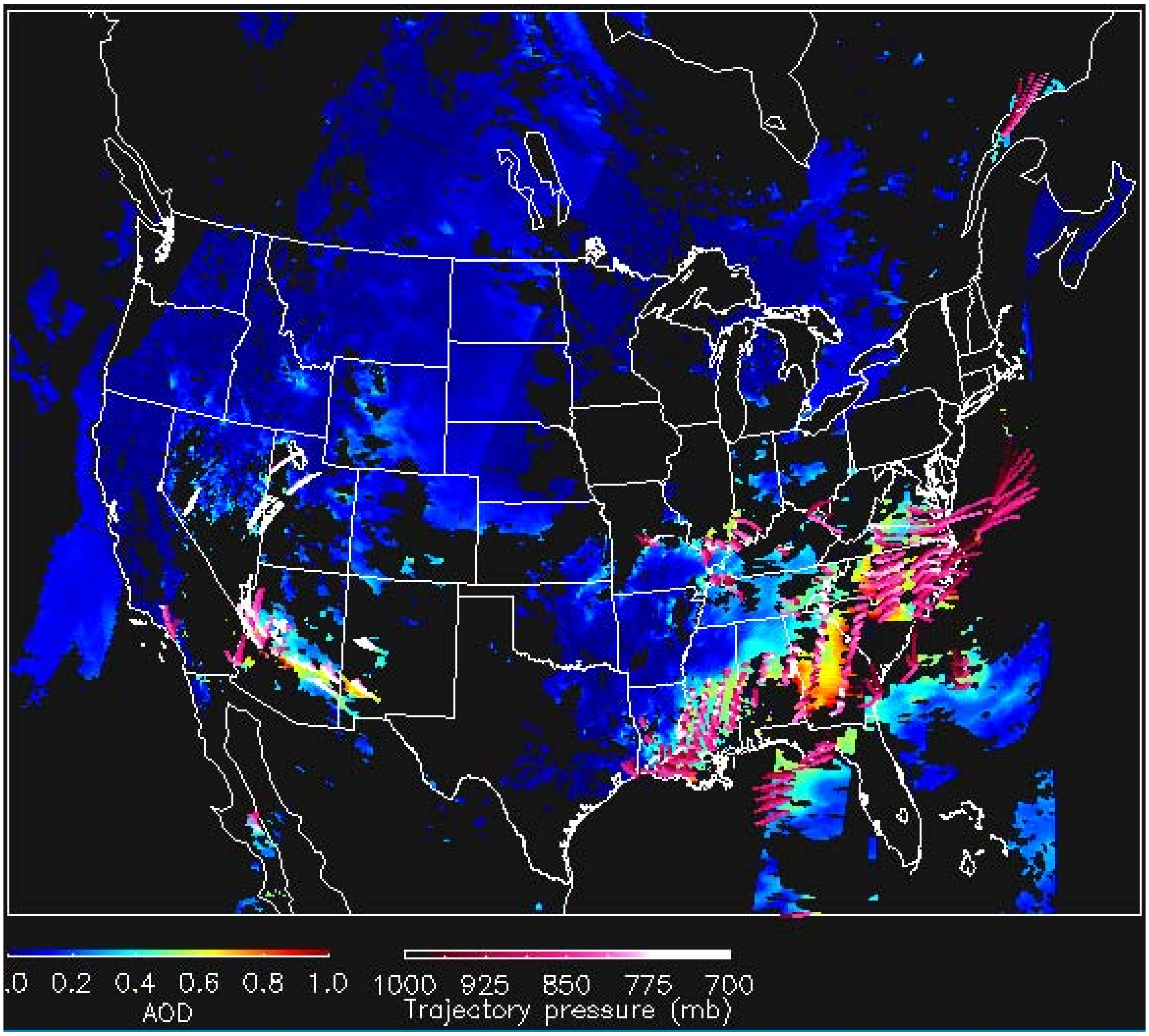


Figure 13. Trajectory forecast for high MODIS aerosol optical depth-July 3, 2011 at 8:00 am (storm satellite image map with trajectory forecast displayed).

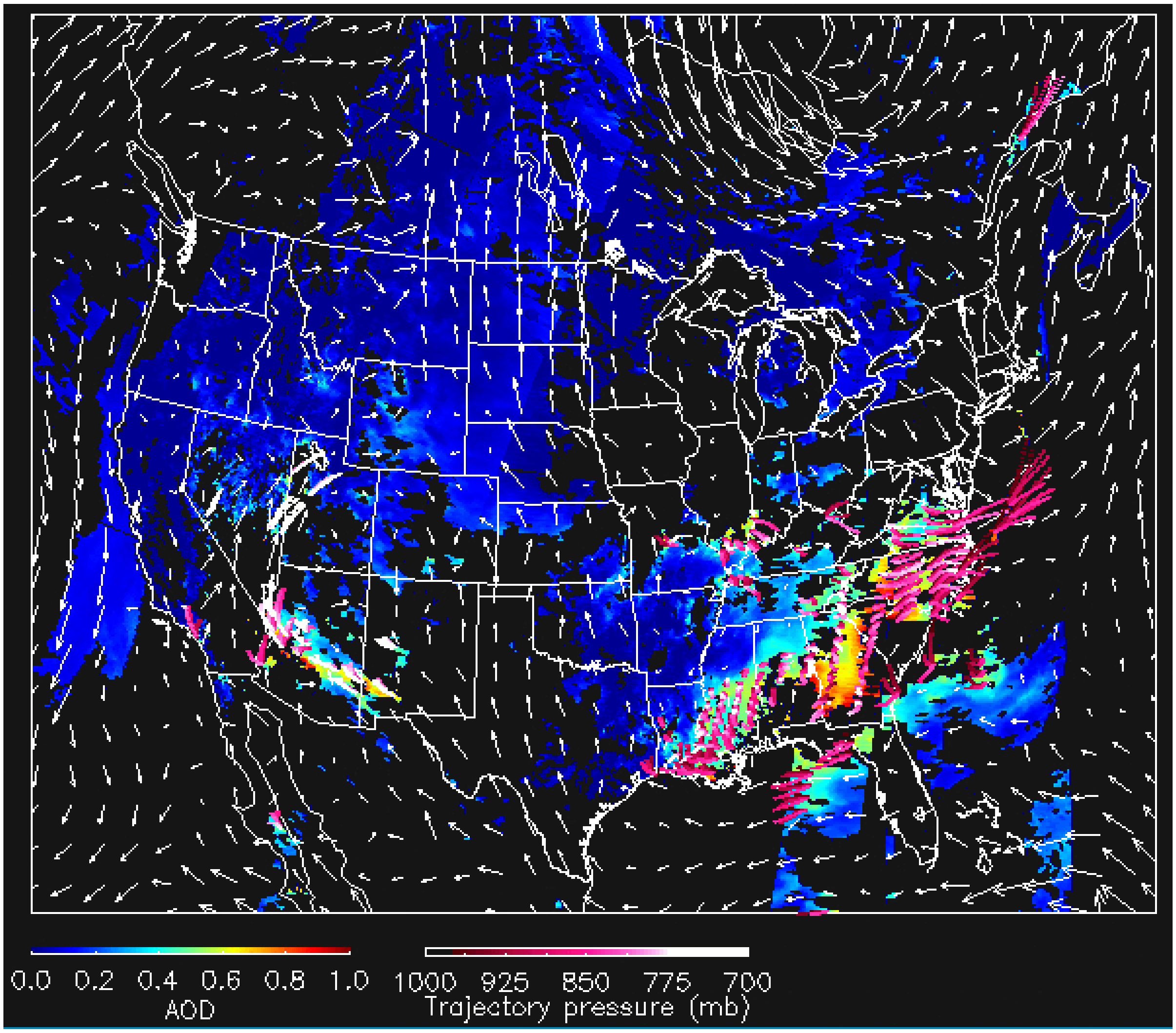


Figure 14. Trajectory forecast for high MODIS aerosol optical depth-July 3, 2011 at 8:00 am.

All elements displayed, wind direction barbs, forward air parcel trajectory and storm satellite map image.

Note that the storm and trajectory at 8:00 am on July 3, 2011, and winds brought the transported dust into southern Nevada and with a predominant travel direction of north by northeast. Principal direction brought the dust mass out of the Las Vegas Valley.

AOD: Aerosol optical depth. Darker red display means dirtier air (dust); the larger the number, the worse the air is.

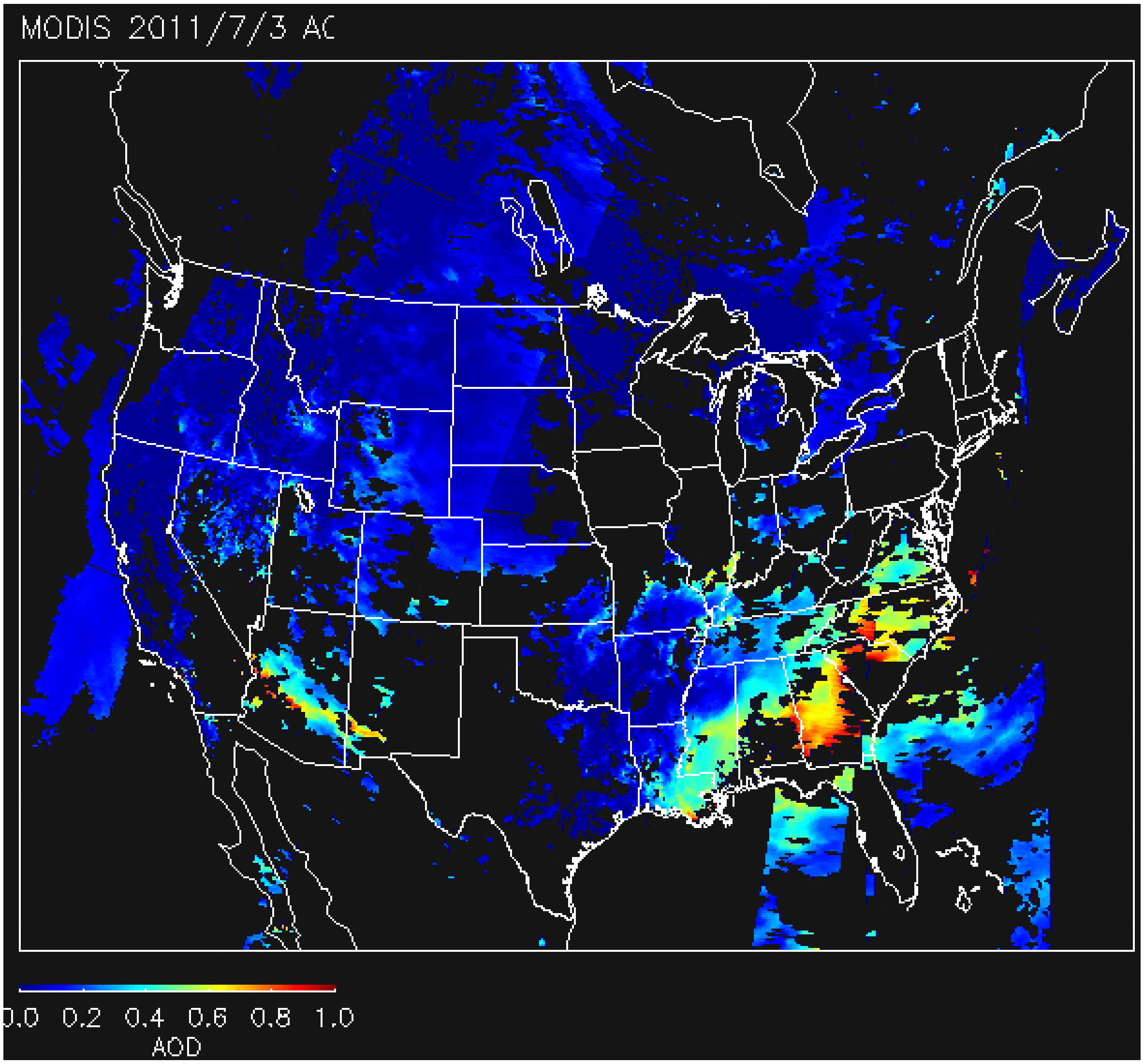


Figure 15. High MODIS aerosol optical depth-July 3, 2011 at 11:00 am (storm satellite image map).

Note the desert storm continually building in central/southwest Arizona source area at approximately 11:00 am on July 3, 2011.

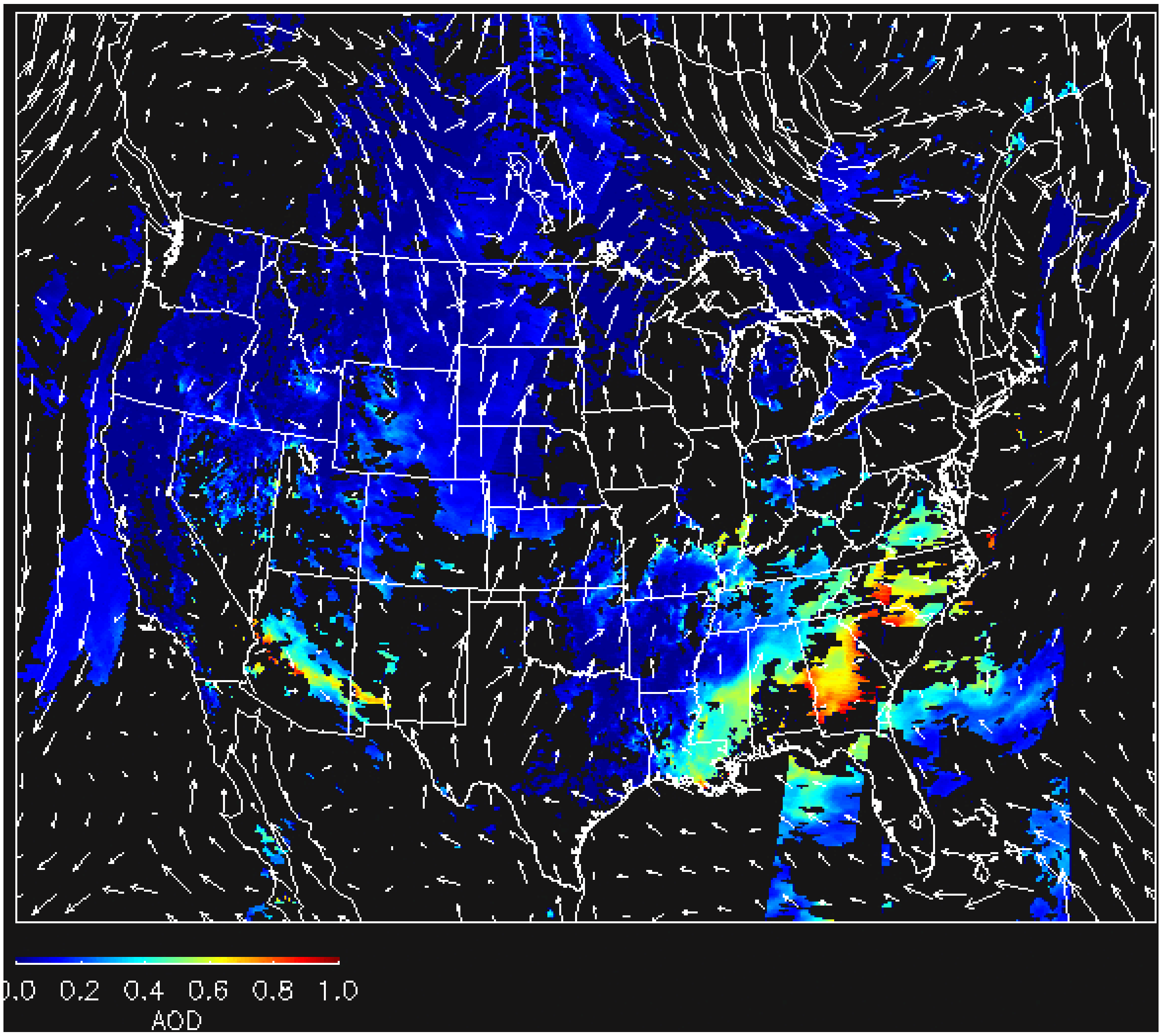


Figure 16. High MODIS aerosol optical depth-July 3, 2011 at 11:00 am (storm satellite image map with wind barbs displayed).

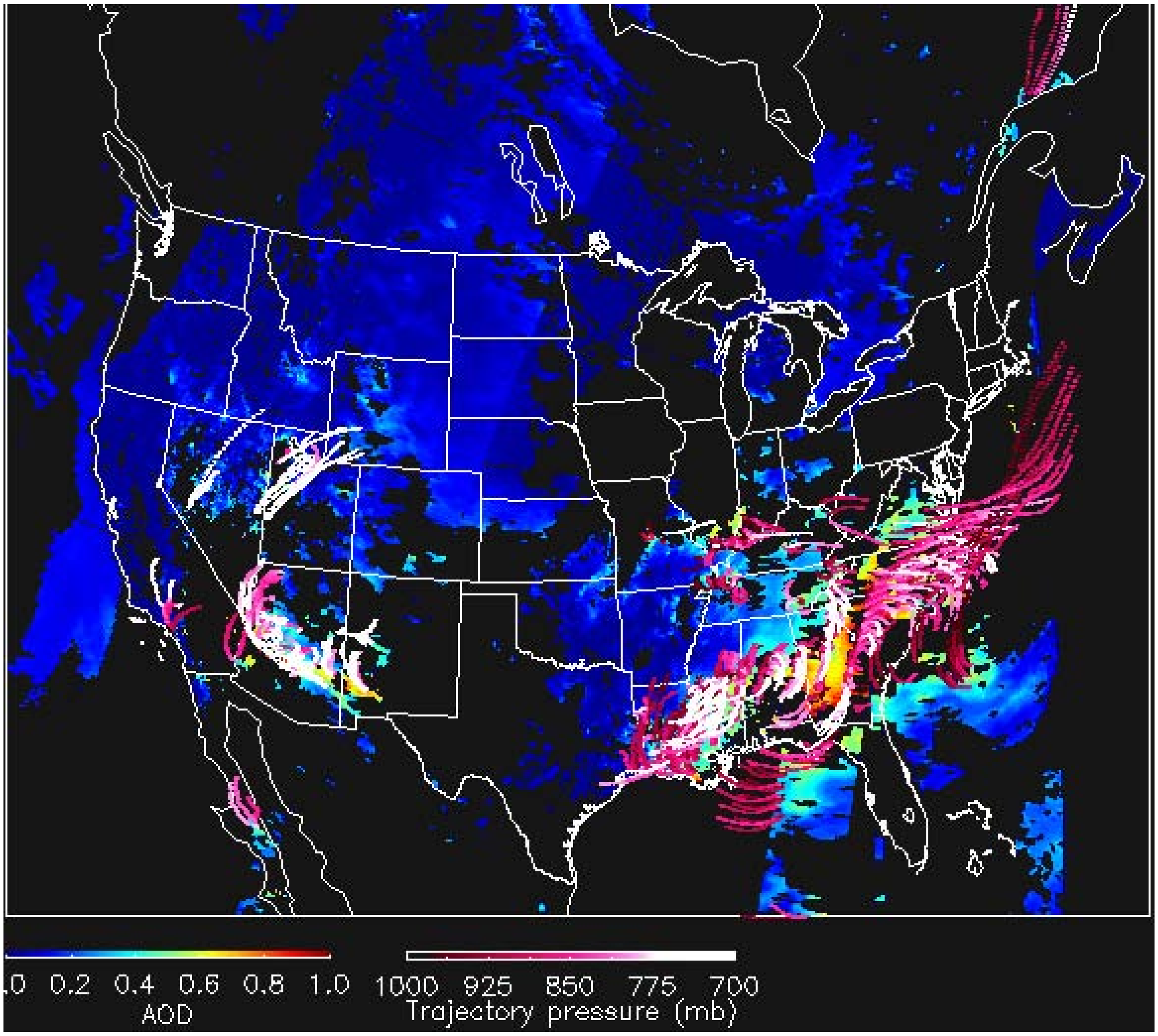


Figure 17. Trajectory forecast for high MODIS aerosol optical depth-July 3, 2011 at 11:00 am (storm satellite image map with trajectory forecast displayed).

Note the direction of air pollutant flows is to the north by northeast.

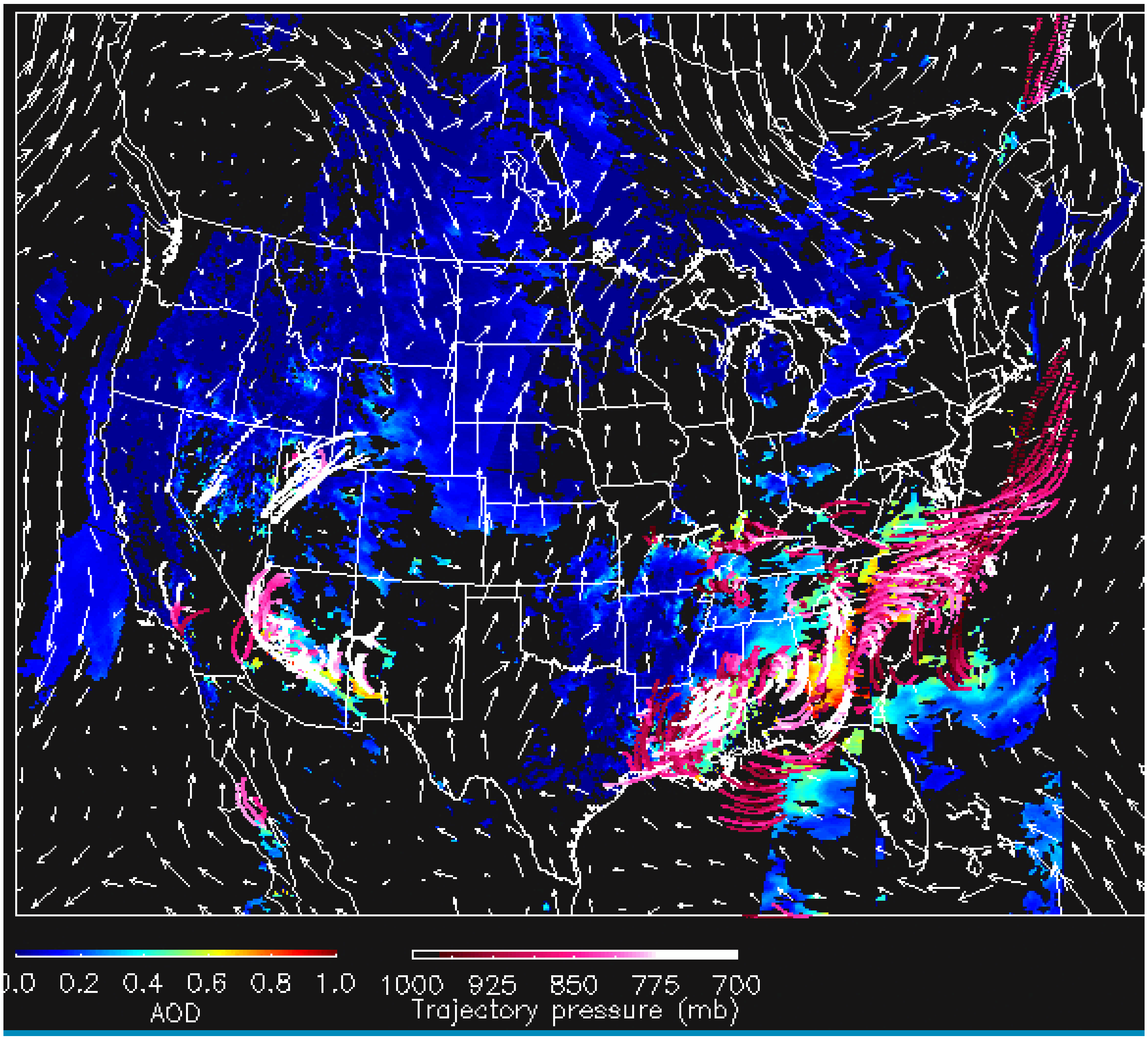


Figure 18. Trajectory forecast for high MODIS aerosol optical depth-July 3, 2011 at 11:00 am.

All elements displayed, wind direction barbs, forward air parcel trajectory and storm satellite map image.

Note that the storm and trajectory at 11:00 am on July 3, 2011, and winds brought the transported dust into southern Nevada and with a predominant travel direction of north by northeast out of the Las Vegas Valley.

Note: AOD-Aerosol optical depth; darker red display means dirtier air (dust); the larger the number, the worse the air is.

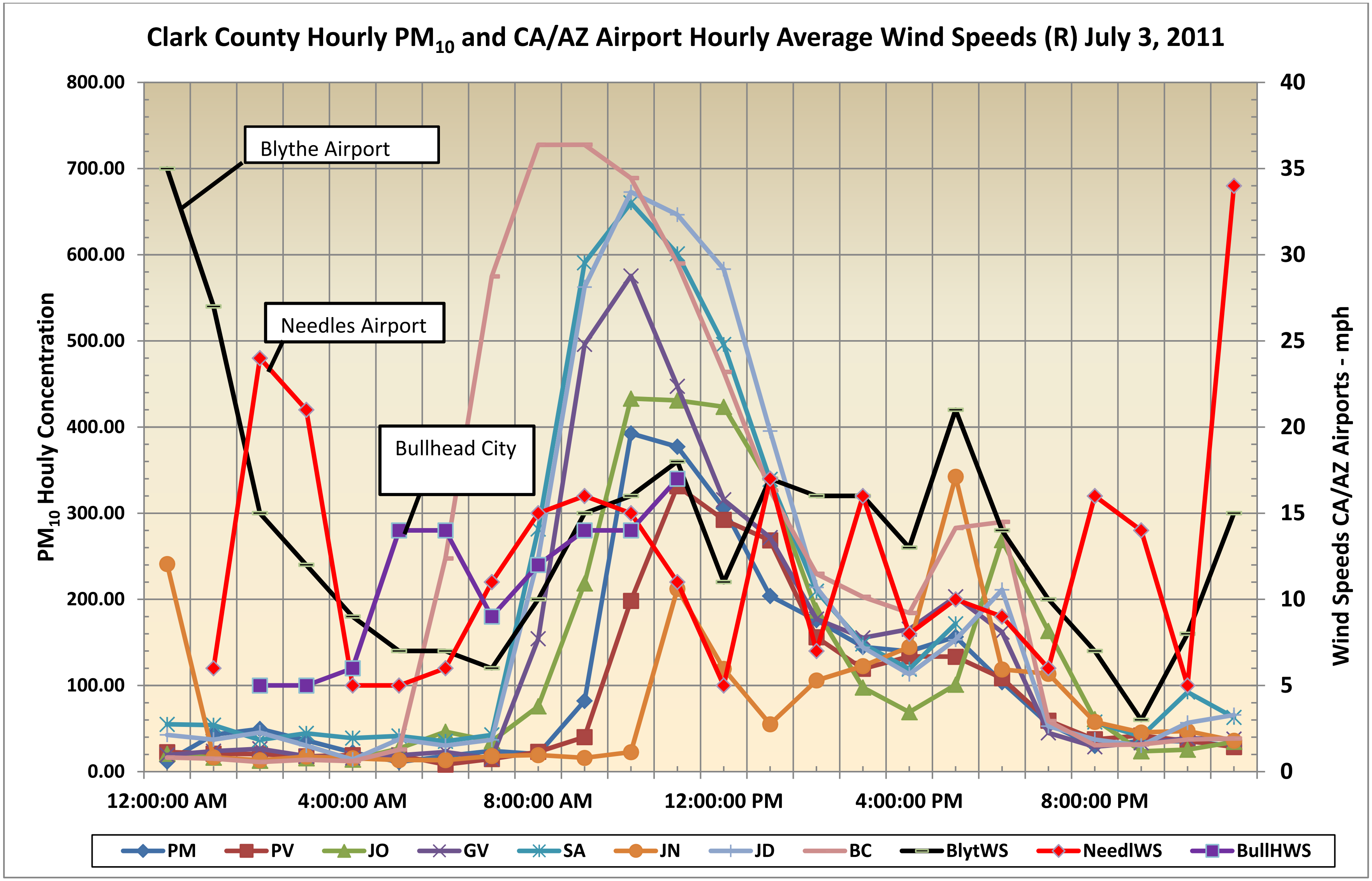


Figure 19. Clark County hourly PM_{10} and California/Arizona Airport average hourly sustained wind speeds on July 3, 2011.

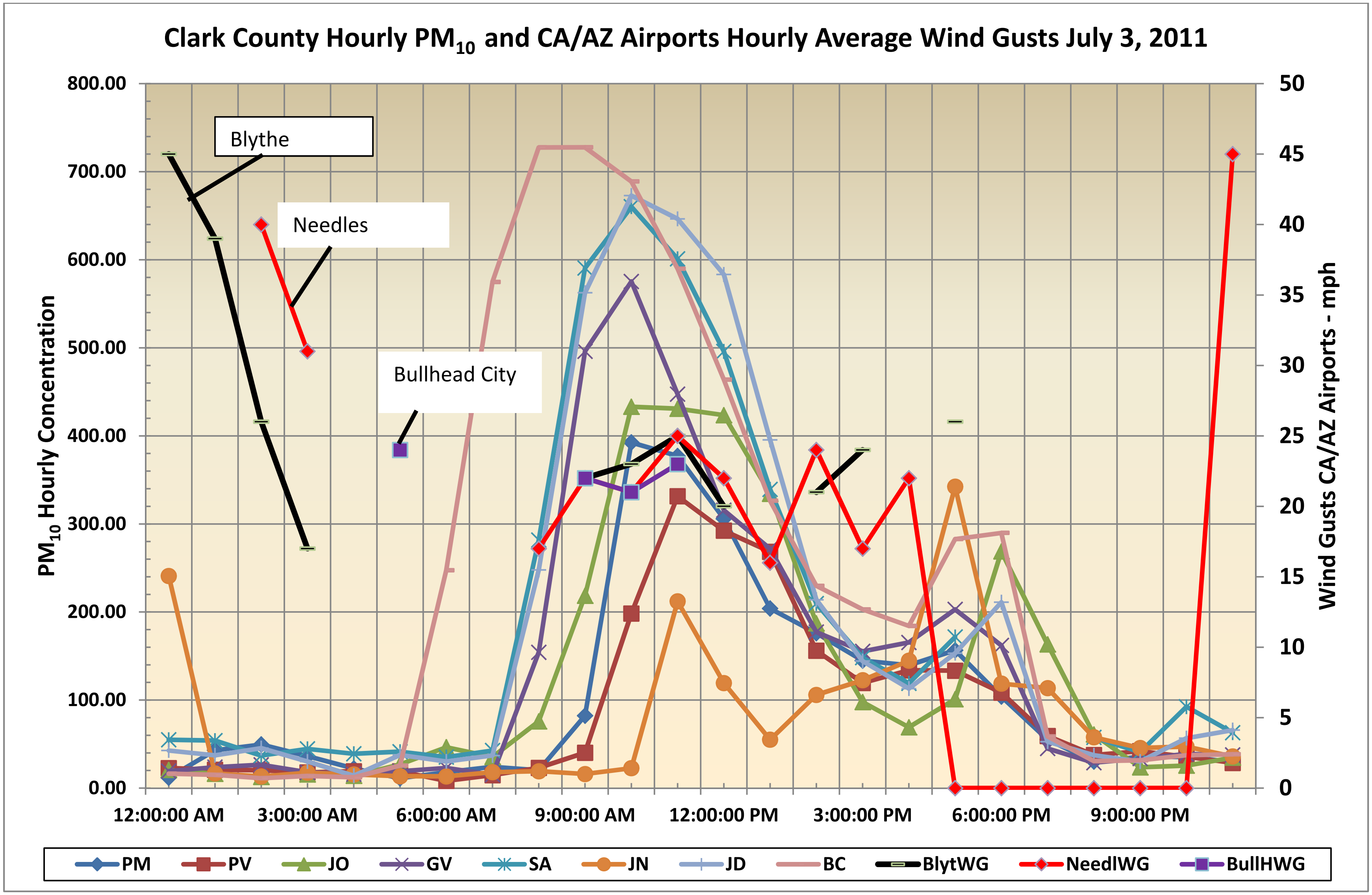


Figure 20. Clark County hourly PM_{10} and California/Arizona Airport average hourly wind gusts on July 3, 2011.

Table 6. Boulder City Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	ND	ND	ND	12.49	218.15
2011	7	2	0100	ND	ND	ND	11.73	227.17
2011	7	2	0200	ND	ND	ND	12.75	236.85
2011	7	2	0300	ND	ND	ND	12.02	248.02
2011	7	2	0400	ND	ND	ND	16.78	259.47
2011	7	2	0500	ND	ND	ND	14.86	270.26
2011	7	2	0600	ND	ND	ND	21.60	280.36
2011	7	2	0700	ND	ND	ND	25.11	292.24
2011	7	2	0800	ND	ND	ND	25.94	28.12
2011	7	2	0900	ND	ND	ND	20.92	25.34
2011	7	2	1000	ND	ND	ND	17.29	36.34
2011	7	2	1100	ND	ND	ND	13.44	47.98
2011	7	2	1200	ND	ND	ND	11.33	63.07
2011	7	2	1300	ND	ND	ND	10.60	77.47
2011	7	2	1400	ND	ND	ND	6.36	95.92
2011	7	2	1500	ND	ND	ND	7.58	119.07
2011	7	2	1600	ND	ND	ND	11.41	142.07
2011	7	2	1700	ND	ND	ND	10.00	161.55
2011	7	2	1800	ND	ND	ND	11.59	176.79
2011	7	2	1900	ND	ND	ND	15.21	188.03
2011	7	2	2000	ND	ND	ND	15.34	199.58
2011	7	2	2100	ND	ND	ND	11.35	208.42
2011	7	2	2200	ND	ND	ND	9.97	215.75
2011	7	2	2300	ND	ND	ND	7.73	220.96

Table 7. Boulder City Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM$_{10}$ Concentration (µg/m3)	PM$_{10}$ Mass Accumulation (µg)
11	7	4	0000	ND	ND	ND	73.10	813.14
2011	7	4	0100	ND	ND	ND	98.80	252.26
2011	7	4	0200	ND	ND	ND	69.84	499.23
2011	7	4	0300	ND	ND	ND	31.18	551.88
2011	7	4	0400	ND	ND	ND	23.30	580.03
2011	7	4	0500	ND	ND	ND	21.68	609.47
2011	7	4	0600	ND	ND	ND	24.99	644.24
2011	7	4	0700	ND	ND	ND	13.54	679.97
2011	7	4	0800	ND	ND	ND	15.47	64.65
2011	7	4	0900	ND	ND	ND	21.70	123.21
2011	7	4	1000	ND	ND	ND	19.55	186.29
2011	7	4	1100	ND	ND	ND	11.27	215.64
2011	7	4	1200	ND	ND	ND	6.17	237.24
2011	7	4	1300	ND	ND	ND	7.88	258.02
2011	7	4	1400	ND	ND	ND	6.80	281.19
2011	7	4	1500	ND	ND	ND	5.26	294.13
2011	7	4	1600	ND	ND	ND	7.12	308.48
2011	7	4	1700	ND	ND	ND	14.74	328.61
2011	7	4	1800	ND	ND	ND	11.44	346.93
2011	7	4	1900	ND	ND	ND	6.83	357.77
2011	7	4	2000	ND	ND	ND	11.31	362.48
2011	7	4	2100	ND	ND	ND	10.54	369.6
2011	7	4	2200	ND	ND	ND	20.14	376.05
2011	7	4	2300	ND	ND	ND	19.53	380.51

Table 8. Boulder City Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	ND	ND	ND	16.36	231.27
2011	7	3	0100	ND	ND	ND	14.98	239.15
2011	7	3	0200	ND	ND	ND	11.19	250.48
2011	7	3	0300	ND	ND	ND	13.70	263.87
2011	7	3	0400	ND	ND	ND	12.14	276.37
2011	7	3	0500	ND	ND	ND	25.61	287.67
2011	7	3	0600	ND	ND	ND	247.39	296.29
2011	7	3	0700	ND	ND	ND	574.81	304.06
2011	7	3	0800	ND	ND	ND	727.52	15.7
2011	7	3	0900	ND	ND	ND	727.63	13.11
2011	7	3	1000	ND	ND	ND	688.89	23.32
2011	7	3	1100	ND	ND	ND	589.80	35.38
2011	7	3	1200	ND	ND	ND	463.89	46.77
2011	7	3	1300	ND	ND	ND	326.29	72.99
2011	7	3	1400	ND	ND	ND	229.64	308.02
2011	7	3	1500	ND	ND	ND	202.85	828.66
2011	7	3	1600	ND	ND	ND	184.14	783.27
2011	7	3	1700	ND	ND	ND	282.82	639.93
2011	7	3	1800	ND	ND	ND	289.82	1213.33
2011	7	3	1900	ND	ND	ND	58.63	256.18
2011	7	3	2000	ND	ND	ND	30.66	668.08
2011	7	3	2100	ND	ND	ND	31.54	955.28
2011	7	3	2200	ND	ND	ND	37.35	1155.91
2011	7	3	2300	ND	ND	ND	38.39	1335.49

Table 8a. Boulder City Nevada Airport (KBVU) Meteorology Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Wind Gust (mph)
2011	7	3	00:15	3.5	350	ND
2011	7	3	00:35	3.5	20	ND
2011	7	3	00:55	5.8	30	ND
2011	7	3	01:15	4.6	30	ND
2011	7	3	01:35	6.9	40	ND
2011	7	3	01:55	6.9	50	ND
2011	7	3	02:15	6.9	50	ND
2011	7	3	02:35	5.8	60	ND
2011	7	3	02:55	6.9	60	ND
2011	7	3	03:15	5.8	60	ND
2011	7	3	03:35	3.5	70	ND
2011	7	3	03:55	4.6	20	ND
2011	7	3	04:15	ND	ND	ND
2011	7	3	04:35	4.6	20	ND
2011	7	3	04:55	3.5	40	ND
2011	7	3	05:15	4.6	80	ND
2011	7	3	05:35	6.9	80	ND
2011	7	3	05:55	4.6	50	ND
2011	7	3	06:15	3.5	90	ND
2011	7	3	06:35	5.8	150	ND
2011	7	3	06:55	10.4	140	ND
2011	7	3	07:15	15	130	ND
2011	7	3	07:35	12.7	140	ND
2011	7	3	07:55	13.8	130	ND
2011	7	3	08:15	12.7	150	ND
2011	7	3	08:35	15	140	ND
2011	7	3	08:55	12.7	150	18
2011	7	3	09:15	17.3	150	ND
2011	7	3	09:35	15	140	ND
2011	7	3	09:55	13.8	150	ND
2011	7	3	10:15	19.6	160	ND
2011	7	3	10:35	17.3	160	23
2011	7	3	10:55	15	160	ND
2011	7	3	11:15	15	170	ND
2011	7	3	11:35	13.8	160	ND
2011	7	3	11:55	8.1	180	ND
2011	7	3	12:15	9.2	170	16

2011	7	3	12:35	9.2	180	ND
2011	7	3	12:55	6.9	130	ND
2011	7	3	13:15	5.8	120	ND
2011	7	3	13:35	8.1	120	ND
2011	7	3	13:55	10.4	150	ND
2011	7	3	14:15	8.1	170	ND
2011	7	3	14:35	4.6	140	ND
2011	7	3	14:55	5.8	310	ND
2011	7	3	15:15	4.6	150	ND
2011	7	3	15:35	4.6	200	ND
2011	7	3	15:55	5.8	90	ND
2011	7	3	16:15	11.5	110	ND
2011	7	3	16:35	11.5	120	18
2011	7	3	16:55	13.8	140	ND
2011	7	3	17:15	11.5	100	ND
2011	7	3	17:35	15	110	18
2011	7	3	17:55	13.8	130	ND
2011	7	3	18:15	11.5	140	ND
2011	7	3	18:35	40.3	100	45
2011	7	3	18:55	27.6	100	40
2011	7	3	19:15	25.3	100	29
2011	7	3	19:35	8.1	280	ND
2011	7	3	19:55	18.4	320	28
2011	7	3	20:15	23	330	31
2011	7	3	20:35	9.2	350	38
2011	7	3	20:55	12.7	40	ND
2011	7	3	21:15	10.4	300	21
2011	7	3	21:35	12.7	360	ND
2011	7	3	21:55	17.3	30	ND
2011	7	3	22:15	10.4	70	ND
2011	7	3	22:35	6.9	270	ND
2011	7	3	22:55	5.8	250	ND
2011	7	3	23:15	3.5	300	ND
2011	7	3	23:35	4.6	310	ND
2011	7	3	23:55	ND	ND	ND

Source: National Weather Service -MesoWest-2011(atmos-mesowest@lists.utah.edu)

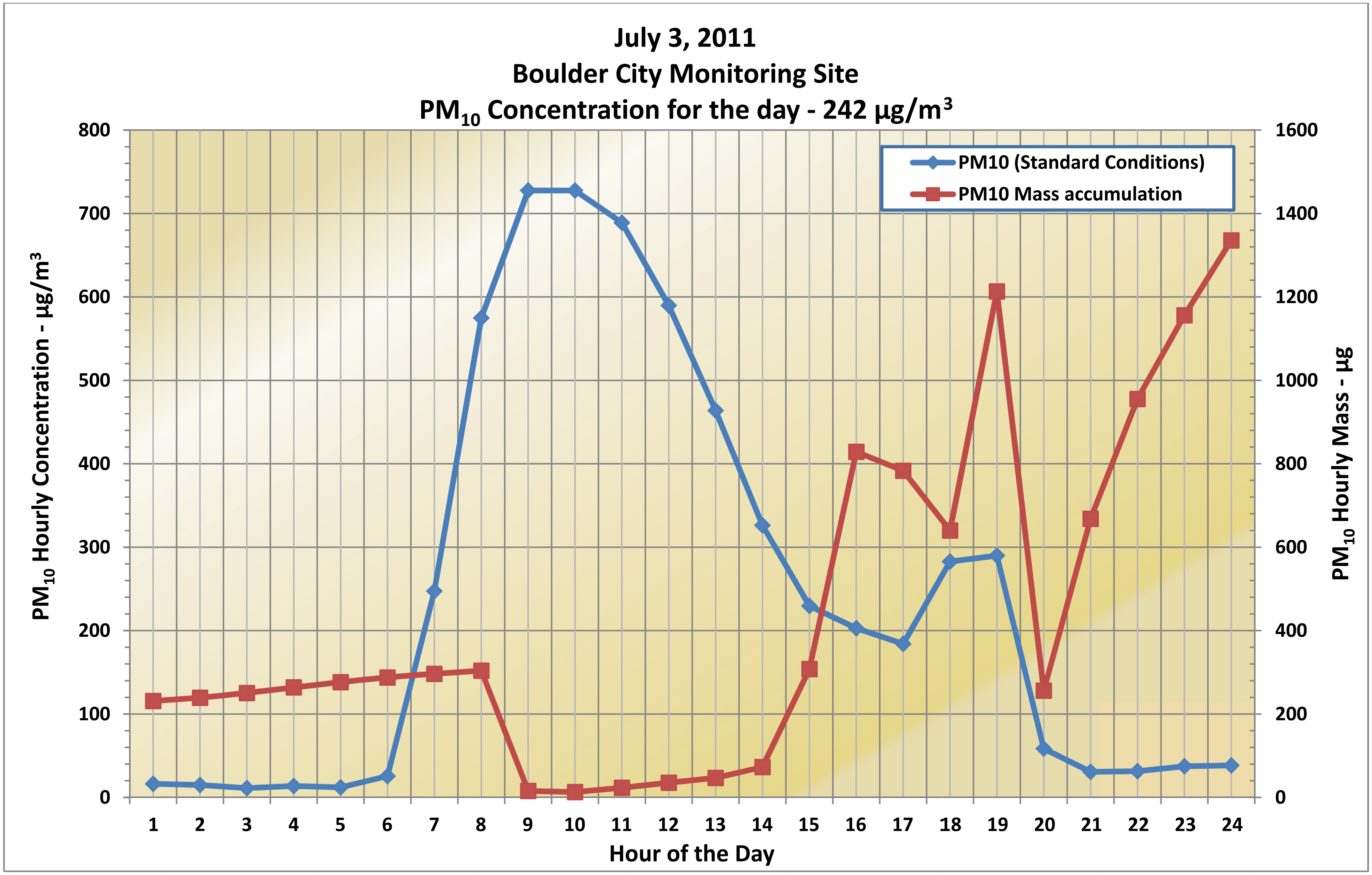


Figure 21. PM_{10} concentrations at Boulder City monitoring site, July 3, 2011.

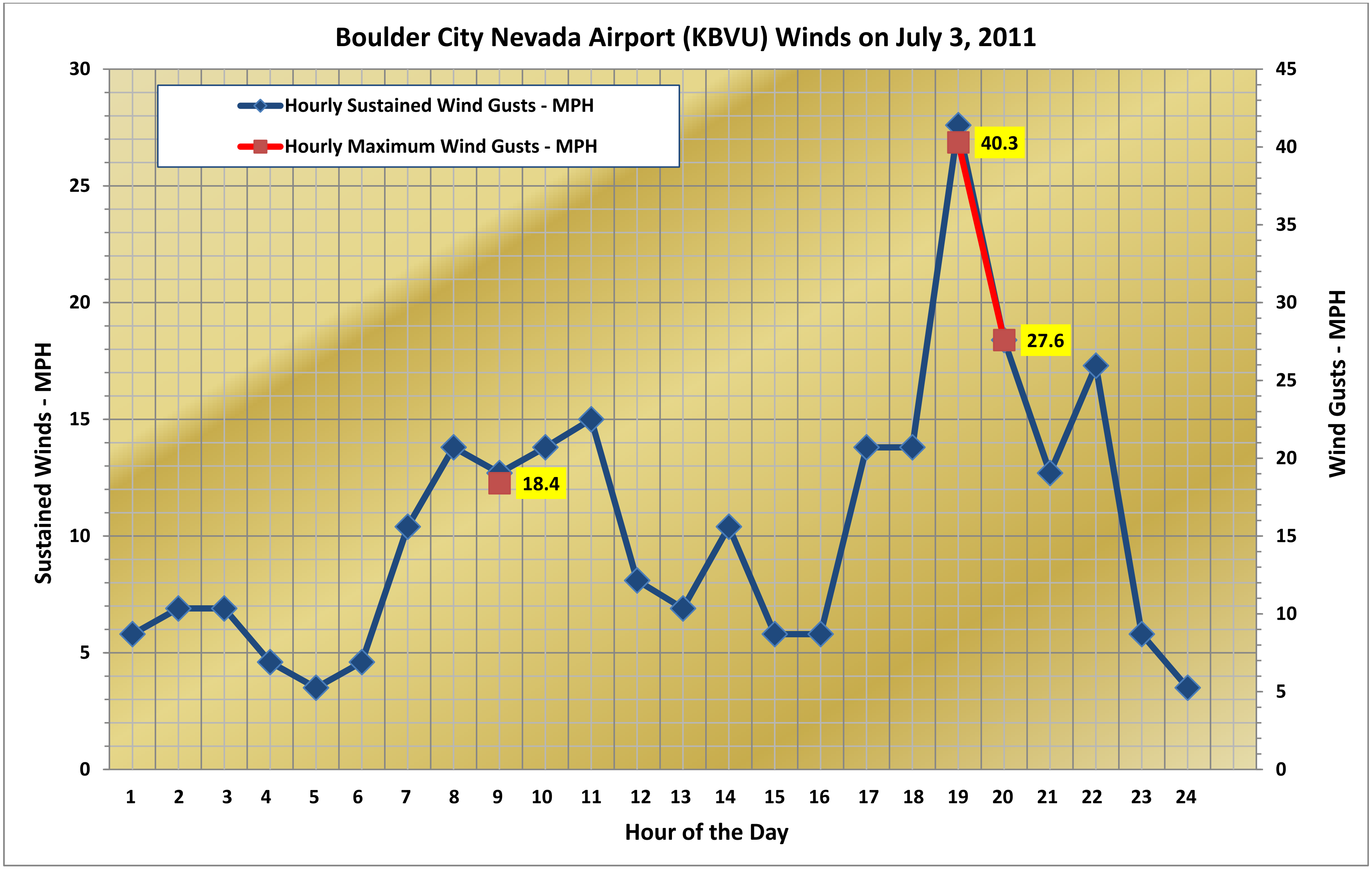


Figure 21a. Wind speeds at Boulder City Airport (KVBU) on July 3, 2011.

Table 9. Sunrise Acres Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	1	VAR	3	48.83	409.9
2011	7	2	0100	2	VAR	4	49.50	418.57
2011	7	2	0200	2	VAR	4	49.41	427.48
2011	7	2	0300	1	VAR	3	40.82	446.32
2011	7	2	0400	1	VAR	3	48.15	489.99
2011	7	2	0500	2	VAR	9	34.65	537.19
2011	7	2	0600	2	VAR	8	34.93	582.03
2011	7	2	0700	2	VAR	8	25.41	626.06
2011	7	2	0800	3	VAR	11	19.42	55.62
2011	7	2	0900	3	VAR	11	17.73	73.53
2011	7	2	1000	4	119	12	14.71	119.07
2011	7	2	1100	3	VAR	12	20.53	157.7
2011	7	2	1200	3	VAR	13	10.70	202.25
2011	7	2	1300	4	162	16	8.15	235.88
2011	7	2	1400	5	127	19	10.88	269.63
2011	7	2	1500	6	126	18	12.47	292.68
2011	7	2	1600	6	99	16	8.23	311
2011	7	2	1700	6	113	17	10.43	327.73
2011	7	2	1800	4	100	13	15.69	341.77
2011	7	2	1900	3	VAR	10	19.38	360.3
2011	7	2	2000	4	237	13	22.42	368.55
2011	7	2	2100	3	VAR	12	23.68	377.41
2011	7	2	2200	2	VAR	6	34.14	387.01
2011	7	2	2300	1	VAR	3	47.57	397.98

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 10. Sunrise Acres Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	3	VAR	9	57.95	380.33
2011	7	4	0100	3	VAR	9	52.40	535.06
2011	7	4	0200	3	VAR	12	74.52	129.16
2011	7	4	0300	3	VAR	11	67.73	0.09
2011	7	4	0400	2	VAR	5	51.79	0.1
2011	7	4	0500	2	VAR	7	43.18	0.54
2011	7	4	0600	2	VAR	8	40.00	51.7
2011	7	4	0700	7	124	18	40.83	112.41
2011	7	4	0800	7	121	18	25.92	30.88
2011	7	4	0900	5	155	15	17.52	75.48
2011	7	4	1000	10	145	24	13.00	146.7
2011	7	4	1100	9	114	25	17.36	209.59
2011	7	4	1200	4	145	12	12.28	259.52
2011	7	4	1300	6	140	13	10.37	299.79
2011	7	4	1400	5	115	13	8.33	337.71
2011	7	4	1500	5	110	14	5.34	375.19
2011	7	4	1600	3	VAR	11	8.29	400.41
2011	7	4	1700	3	VAR	10	10.09	416.2
2011	7	4	1800	3	VAR	11	14.37	429.83
2011	7	4	1900	3	VAR	6	21.49	444.22
2011	7	4	2000	3	VAR	5	181.39	457.06
2011	7	4	2100	3	VAR	9	213.55	467.76
2011	7	4	2200	1	VAR	3	274.67	474.55
2011	7	4	2300	1	VAR	3	355.99	480.22

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 11. Sunrise Acres Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	1	VAR	4	54.87	405.02
2011	7	3	0100	1	VAR	5	53.96	414.95
2011	7	3	0200	1	VAR	3	36.92	429.4
2011	7	3	0300	1	VAR	3	44.53	447.26
2011	7	3	0400	2	VAR	4	38.94	467.57
2011	7	3	0500	3	VAR	9	41.35	488.94
2011	7	3	0600	2	VAR	6	35.24	522.12
2011	7	3	0700	4	79	14	42.71	565.24
2011	7	3	0800	8	123	21	281.63	60.04
2011	7	3	0900	9	137	24	590.60	82.99
2011	7	3	1000	5	110	17	660.27	118.63
2011	7	3	1100	8	104	22	601.01	159.52
2011	7	3	1200	7	103	18	495.92	196.4
2011	7	3	1300	5	93	18	339.28	235.59
2011	7	3	1400	5	74	16	209.52	268.54
2011	7	3	1500	5	50	15	148.17	313.1
2011	7	3	1600	6	144	50	119.06	580.33
2011	7	3	1700	10	212	37	171.65	1123.97
2011	7	3	1800	15	141	47	ND	433.37
2011	7	3	1900	9	158	25	ND	713.93
2011	7	3	2000	5	255	18	57.59	1161.82
2011	7	3	2100	3	VAR	15	40.97	937.15
2011	7	3	2200	2	VAR	7	92.38	137.87
2011	7	3	2300	4	110	16	62.95	269.34

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

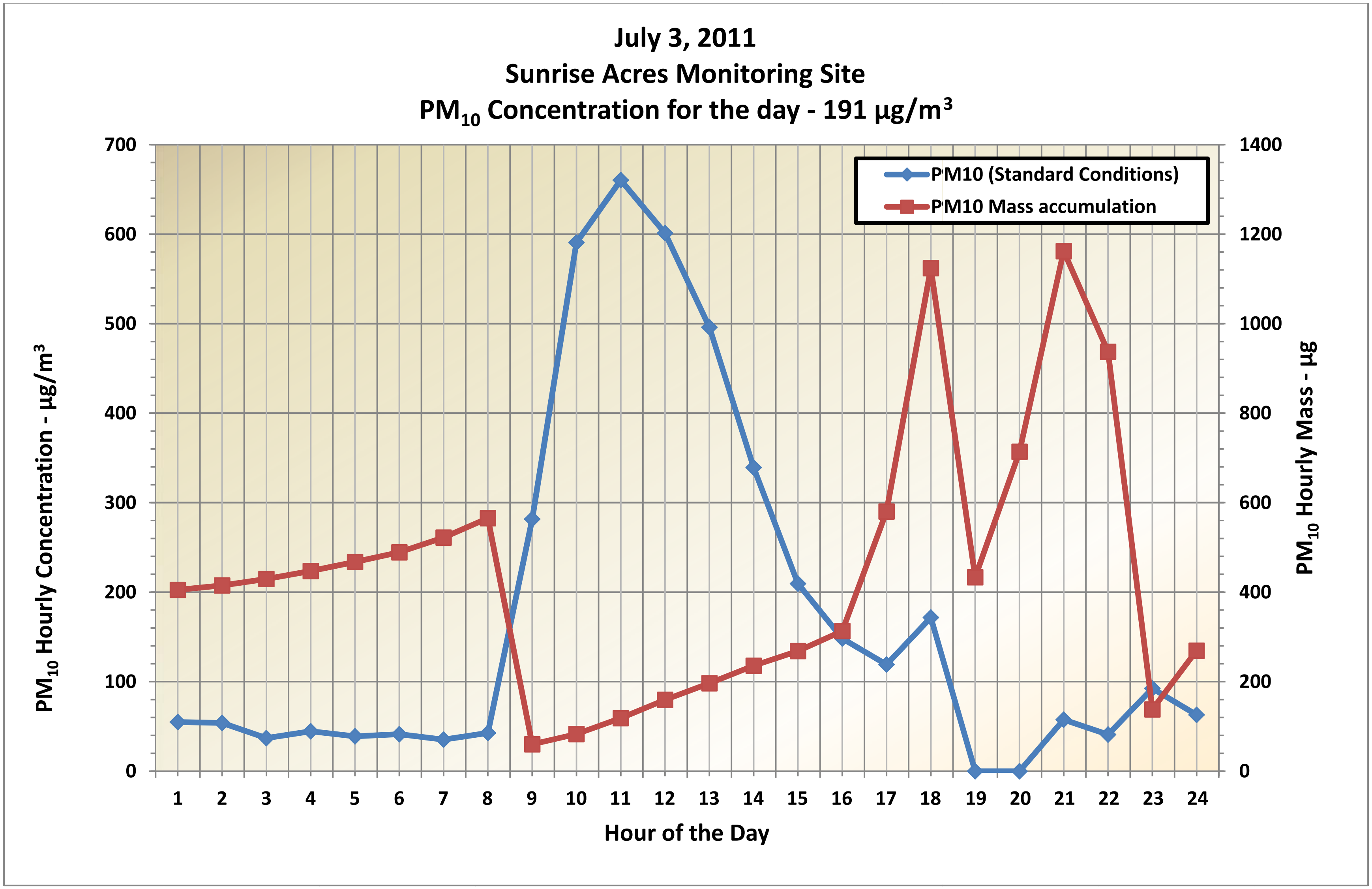


Figure 22. PM_{10} concentrations at Sunrise Acres monitoring site, July 3, 2011.

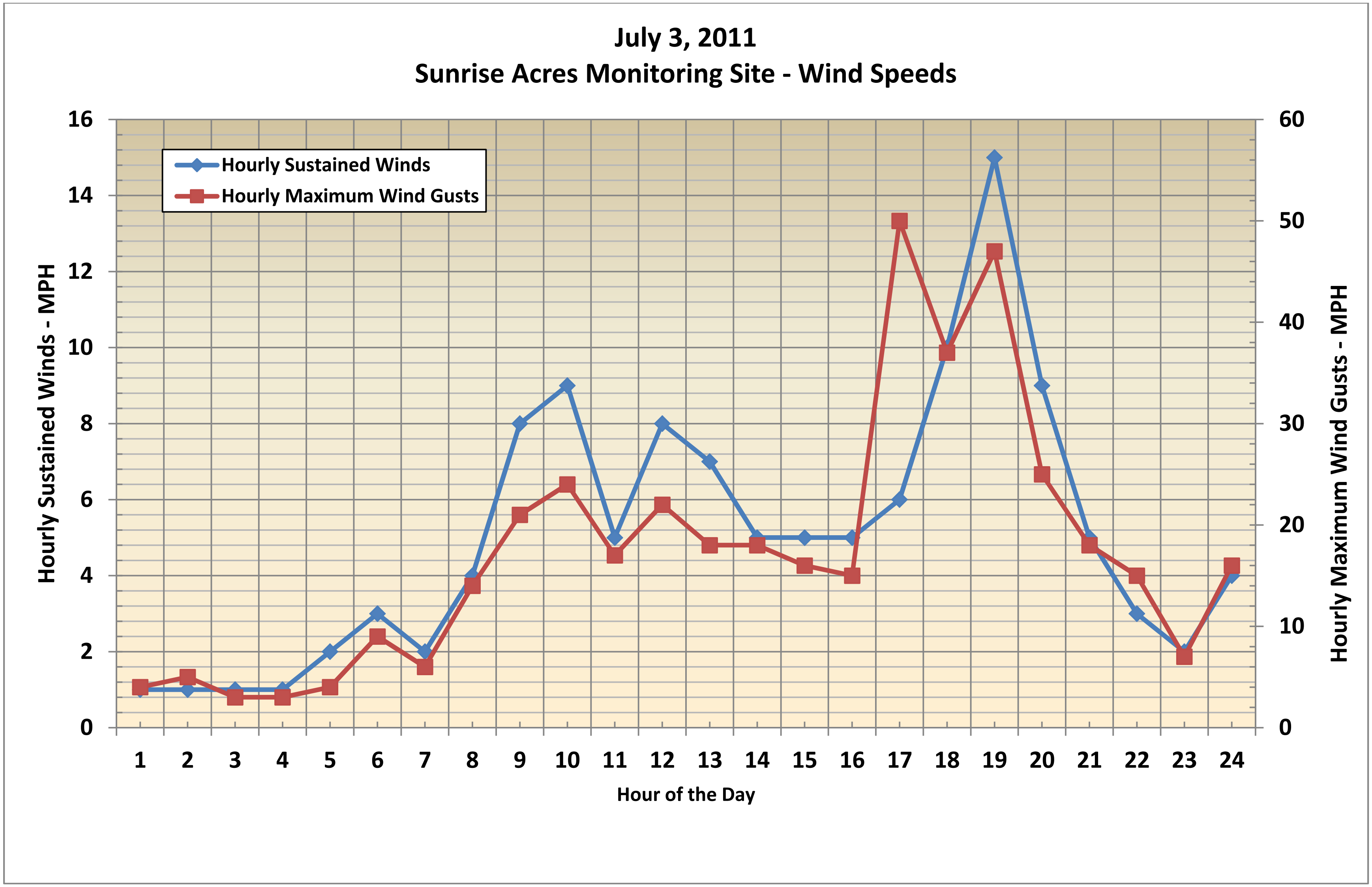


Figure 22a. **Wind speeds at Sunrise Acres monitoring site, July 3, 2011.**

Table 12. J. D. Smith Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	2	VAR	4	48.24	472.81
2011	7	2	0100	2	VAR	5	34.54	475.93
2011	7	2	0200	2	VAR	3	39.44	487.52
2011	7	2	0300	2	VAR	4	34.13	507.42
2011	7	2	0400	1	VAR	3	36.99	538.1
2011	7	2	0500	1	VAR	3	29.28	592.74
2011	7	2	0600	1	VAR	5	42.68	625.73
2011	7	2	0700	2	VAR	6	30.78	664.15
2011	7	2	0800	2	VAR	7	21.82	49.54
2011	7	2	0900	4	60	9	21.72	60.25
2011	7	2	1000	4	83	9	26.72	96.27
2011	7	2	1100	4	90	8	23.05	127.98
2011	7	2	1200	3	VAR	10	21.35	162.24
2011	7	2	1300	5	172	14	21.03	191.61
2011	7	2	1400	6	125	14	18.24	229.65
2011	7	2	1500	7	109	16	9.11	257.75
2011	7	2	1600	6	119	13	11.14	277.53
2011	7	2	1700	5	111	10	9.65	296.82
2011	7	2	1800	5	105	10	7.01	321.93
2011	7	2	1900	2	VAR	5	19.04	342.48
2011	7	2	2000	4	237	9	17.46	360.35
2011	7	2	2100	4	273	8	2.00	379.2
2011	7	2	2200	2	VAR	4	29.91	395.52
2011	7	2	2300	2	VAR	4	32.29	406.34

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 13. J. D. Smith Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	3	VAR	10	52.24	413.3
2011	7	4	0100	2	VAR	6	65.90	421.75
2011	7	4	0200	3	VAR	8	76.60	429.03
2011	7	4	0300	4	103	7	69.03	446.77
2011	7	4	0400	1	VAR	4	52.61	460.24
2011	7	4	0500	1	VAR	4	47.36	463.42
2011	7	4	0600	2	VAR	5	48.34	488.76
2011	7	4	0700	7	128	20	43.77	518.54
2011	7	4	0800	8	116	17	35.78	31.72
2011	7	4	0900	6	139	16	23.23	44.46
2011	7	4	1000	10	144	26	16.75	86.03
2011	7	4	1100	10	120	21	30.44	112.95
2011	7	4	1200	4	146	10	2.77	124.8
2011	7	4	1300	7	147	12	26.08	159.89
2011	7	4	1400	6	125	11	3.36	187.89
2011	7	4	1500	4	130	10	19.61	227.01
2011	7	4	1600	3	VAR	9	32.83	460.11
2011	7	4	1700	3	VAR	8	31.23	975.39
2011	7	4	1800	4	87	8	12.19	646.33
2011	7	4	1900	2	VAR	6	69.89	662.56
2011	7	4	2000	2	VAR	5	179.51	1182.2
2011	7	4	2100	2	VAR	4	336.34	541.15
2011	7	4	2200	2	VAR	4	278.55	215.53
2011	7	4	2300	1	VAR	4	181.67	341.55

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 14. J. D. Smith Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	2	VAR	4	**42.65**	443.64
2011	7	3	0100	2	VAR	7	**37.22**	579.67
2011	7	3	0200	3	VAR	7	**45.44**	763.83
2011	7	3	0300	2	VAR	5	**30.17**	821.23
2011	7	3	0400	2	VAR	6	**14.05**	856.88
2011	7	3	0500	3	VAR	6	**37.58**	884.78
2011	7	3	0600	2	VAR	5	**30.28**	937.59
2011	7	3	0700	3	VAR	9	**37.01**	996.23
2011	7	3	0800	7	119	17	247.72	72.65
2011	7	3	0900	8	132	17	562.54	99.37
2011	7	3	1000	6	116	13	672.84	173.38
2011	7	3	1100	8	111	16	646.49	237.71
2011	7	3	1200	7	116	18	583.27	284.57
2011	7	3	1300	5	131	12	395.39	330.01
2011	7	3	1400	4	138	13	213.89	376.1
2011	7	3	1500	3	VAR	9	144.32	416.86
2011	7	3	1600	6	170	24	113.03	448.56
2011	7	3	1700	9	234	32	153.17	471.27
2011	7	3	1800	15	143	53	211.13	485.28
2011	7	3	1900	7	155	21	52.81	512.36
2011	7	3	2000	5	264	10	37.31	508.14
2011	7	3	2100	4	238	10	30.15	529.22
2011	7	3	2200	3	VAR	7	56.69	528.81
2011	7	3	2300	5	108	14	65.84	547.6

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

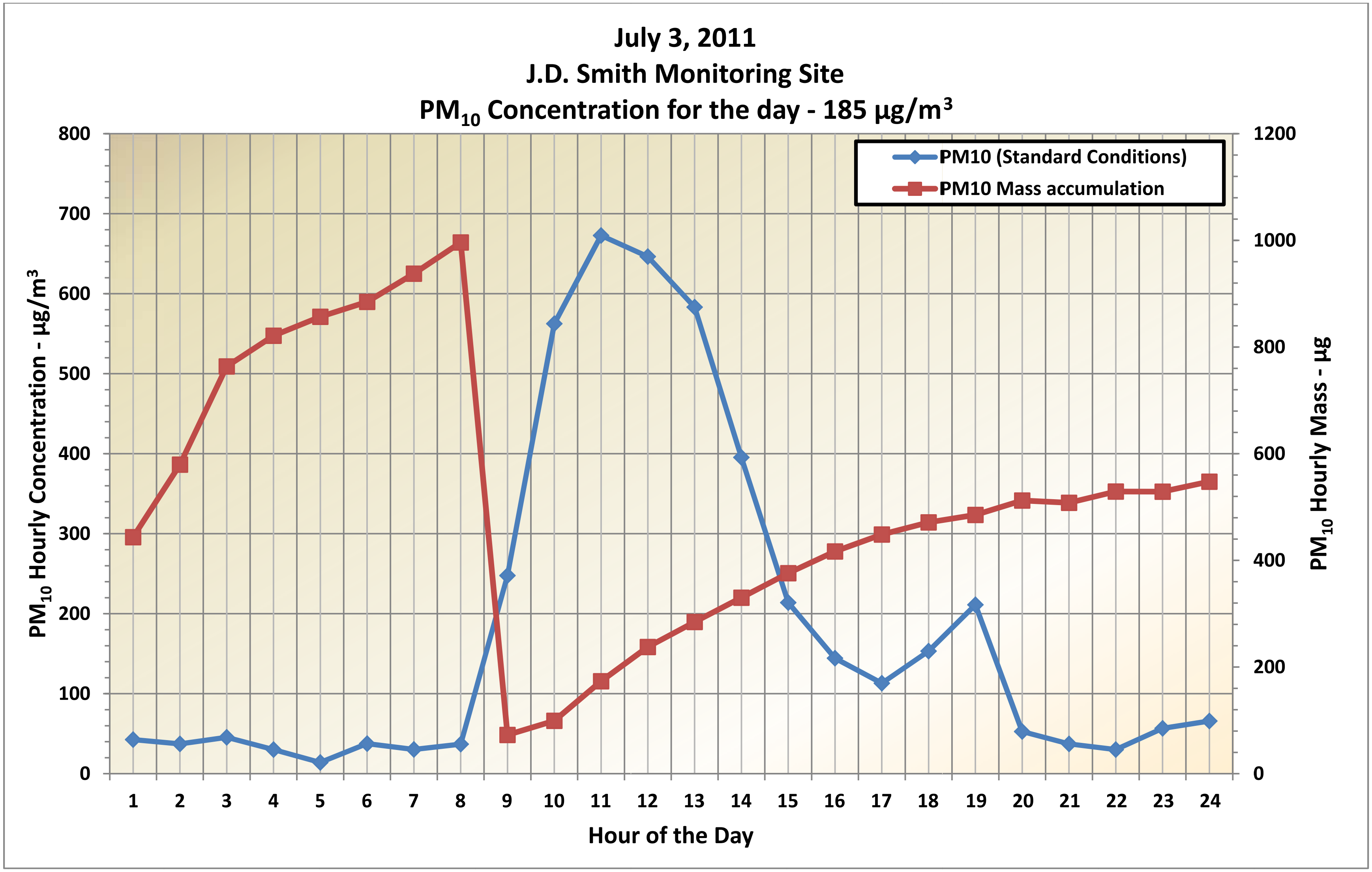


Figure 23. PM$_{10}$ concentrations at J.D. Smith monitoring site, July 3, 2011.

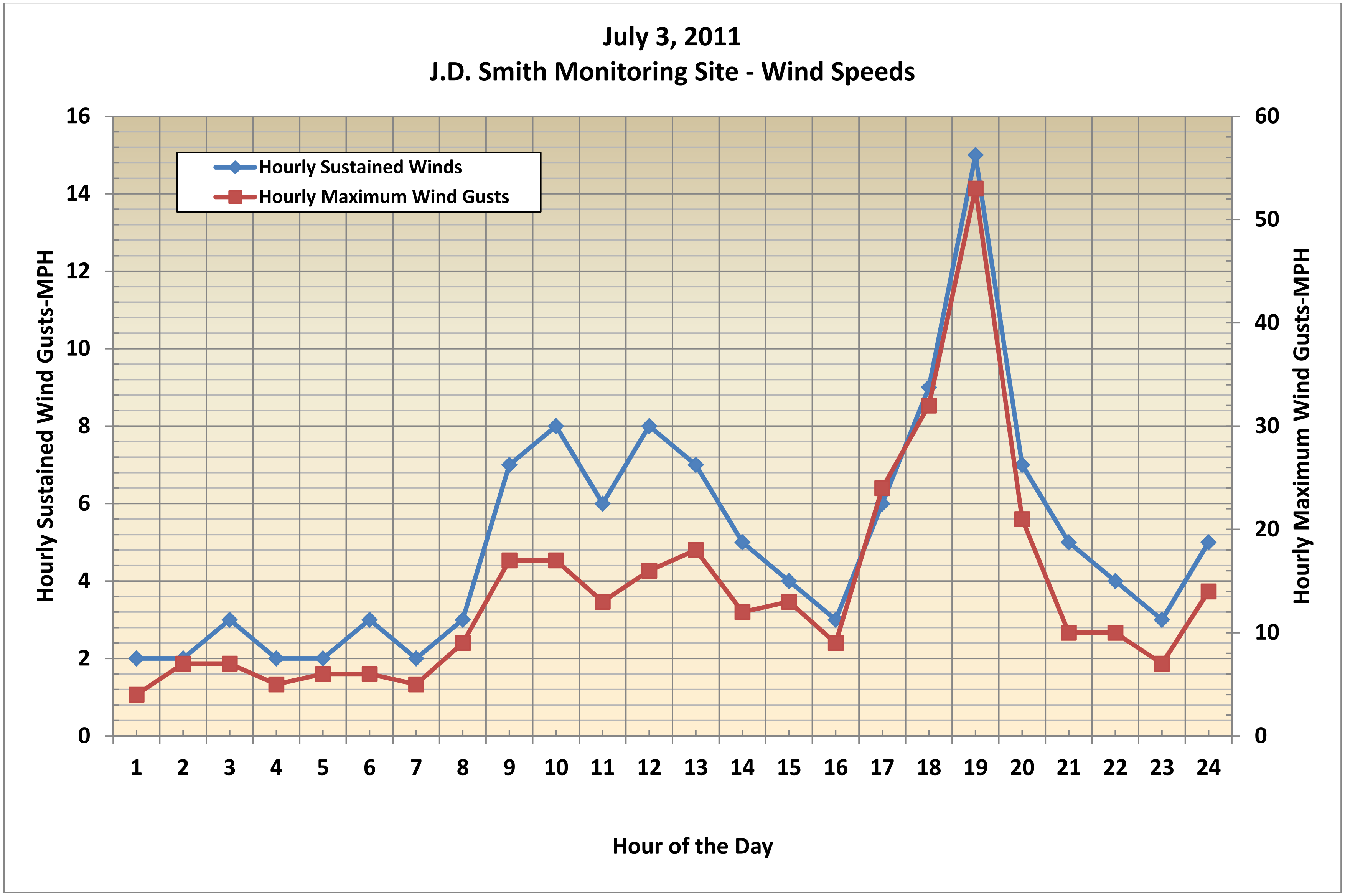


Figure 23a. Wind speeds at J.D. Smith monitoring site, July 3, 2011.

Table 15. Green Valley Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	4	237	9	13.18	289.38
2011	7	2	0100	2	VAR	6	24.08	302.73
2011	7	2	0200	3	VAR	8	19.78	318.94
2011	7	2	0300	4	255	10	9.80	382.36
2011	7	2	0400	2	VAR	5	34.30	508.64
2011	7	2	0500	3	VAR	7	173.29	567.08
2011	7	2	0600	1	VAR	4	28.02	594.21
2011	7	2	0700	1	VAR	9	17.84	617.93
2011	7	2	0800	2	VAR	8	17.75	17.38
2011	7	2	0900	3	VAR	9	13.51	25.35
2011	7	2	1000	3	VAR	9	13.36	43.73
2011	7	2	1100	4	21	15	10.87	53.27
2011	7	2	1200	4	327	15	12.47	97.17
2011	7	2	1300	4	12	16	12.18	246.67
2011	7	2	1400	4	5	14	10.09	275.42
2011	7	2	1500	4	93	16	9.77	292.07
2011	7	2	1600	5	61	15	12.38	308.52
2011	7	2	1700	5	42	16	8.08	321.05
2011	7	2	1800	4	26	10	11.46	331.87
2011	7	2	1900	4	245	10	17.17	342.43
2011	7	2	2000	4	233	9	18.39	354.45
2011	7	2	2100	5	247	9	21.63	364.66
2011	7	2	2200	6	249	12	25.09	373.85
2011	7	2	2300	5	242	10	24.43	382.85

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 16. Green Valley Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	3	VAR	8	36.27	1100.75
2011	7	4	0100	3	VAR	7	44.47	1283.42
2011	7	4	0200	3	VAR	11	44.55	1428.37
2011	7	4	0300	2	VAR	4	28.48	1285.46
2011	7	4	0400	2	VAR	4	28.47	17.69
2011	7	4	0500	2	VAR	4	33.53	47.97
2011	7	4	0600	2	VAR	8	33.08	85.88
2011	7	4	0700	7	150	22	38.82	120.78
2011	7	4	0800	9	173	21	23.99	22.44
2011	7	4	0900	9	175	24	9.83	63.19
2011	7	4	1000	16	150	33	12.23	102.83
2011	7	4	1100	10	145	30	16.10	129.82
2011	7	4	1200	5	93	12	4.86	156.38
2011	7	4	1300	5	60	11	4.12	188.68
2011	7	4	1400	7	95	18	14.43	219.93
2011	7	4	1500	7	70	19	8.26	255.4
2011	7	4	1600	6	24	16	7.81	278.36
2011	7	4	1700	4	34	9	7.43	287.58
2011	7	4	1800	4	73	9	14.97	299.38
2011	7	4	1900	3	VAR	9	28.62	312.87
2011	7	4	2000	3	VAR	5	221.68	318.27
2011	7	4	2100	2	VAR	5	143.44	321.28
2011	7	4	2200	2	VAR	5	123.25	333.79
2011	7	4	2300	3	VAR	6	145.34	341.37

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 17. Green Valley Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	2	VAR	6	19.37	393.41
2011	7	3	0100	3	VAR	6	23.80	400.66
2011	7	3	0200	3	VAR	6	26.48	411.95
2011	7	3	0300	2	VAR	7	18.04	425.26
2011	7	3	0400	2	VAR	6	15.88	443.92
2011	7	3	0500	3	VAR	8	19.13	463.28
2011	7	3	0600	2	VAR	6	22.87	485.96
2011	7	3	0700	2	VAR	8	15.18	507.97
2011	7	3	0800	10	116	22	154.24	16.23
2011	7	3	0900	11	147	23	495.99	25.93
2011	7	3	1000	8	158	23	575.36	49.91
2011	7	3	1100	5	121	17	447.35	66.91
2011	7	3	1200	5	168	19	315.58	81.8
2011	7	3	1300	4	143	14	271.73	100.28
2011	7	3	1400	4	249	11	177.21	120.74
2011	7	3	1500	5	19	15	155.33	135.63
2011	7	3	1600	5	74	26	165.43	287.18
2011	7	3	1700	13	235	46	202.95	741.2
2011	7	3	1800	16	120	49	162.02	1262.01
2011	7	3	1900	12	123	35	44.96	231.16
2011	7	3	2000	7	137	19	28.88	411.1
2011	7	3	2100	4	231	10	33.51	652.77
2011	7	3	2200	5	216	13	38.78	810.93
2011	7	3	2300	4	193	12	37.75	950.89

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

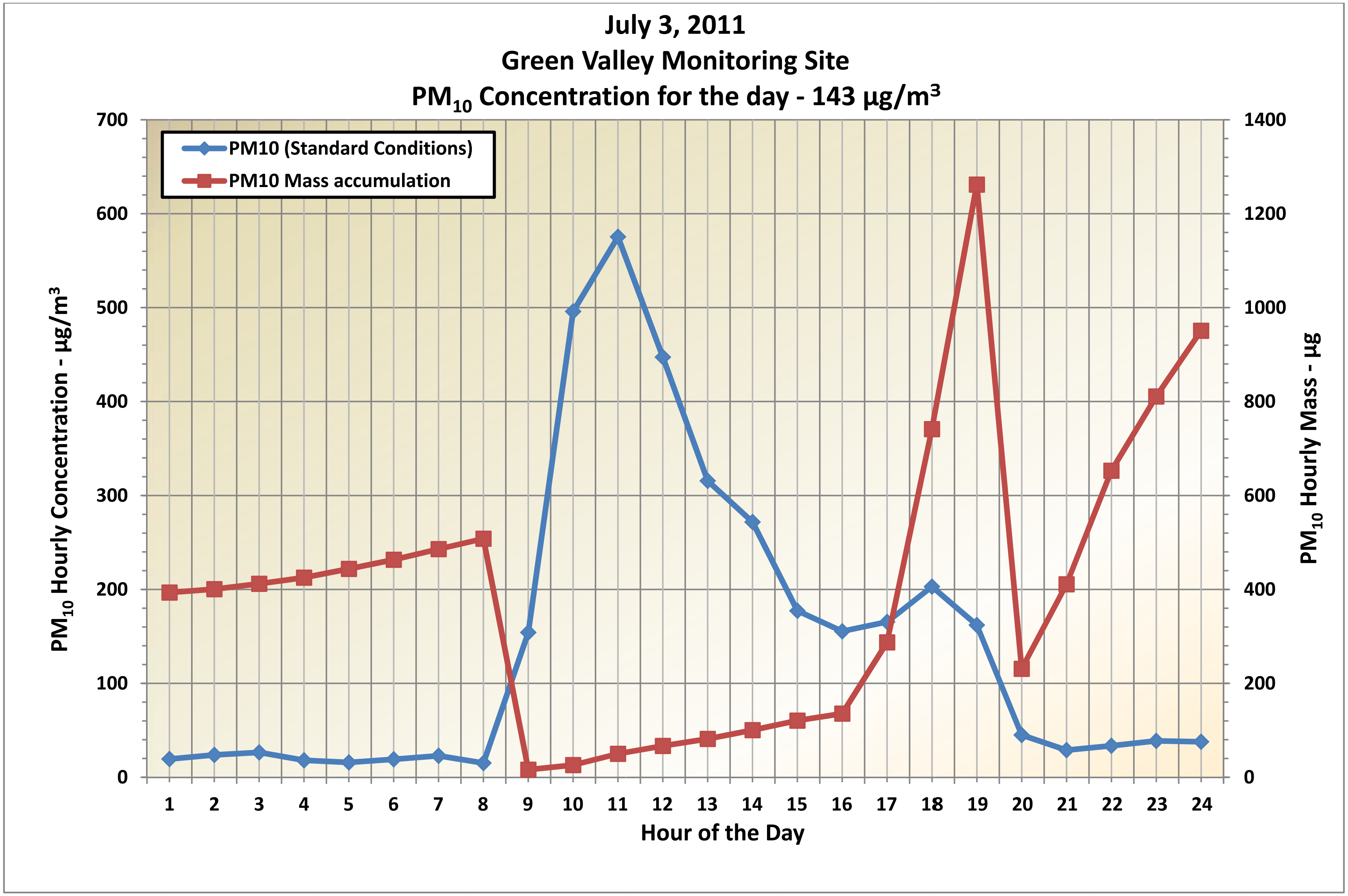


Figure 24. PM_{10} concentrations at Green Valley monitoring site, July 3, 2011.

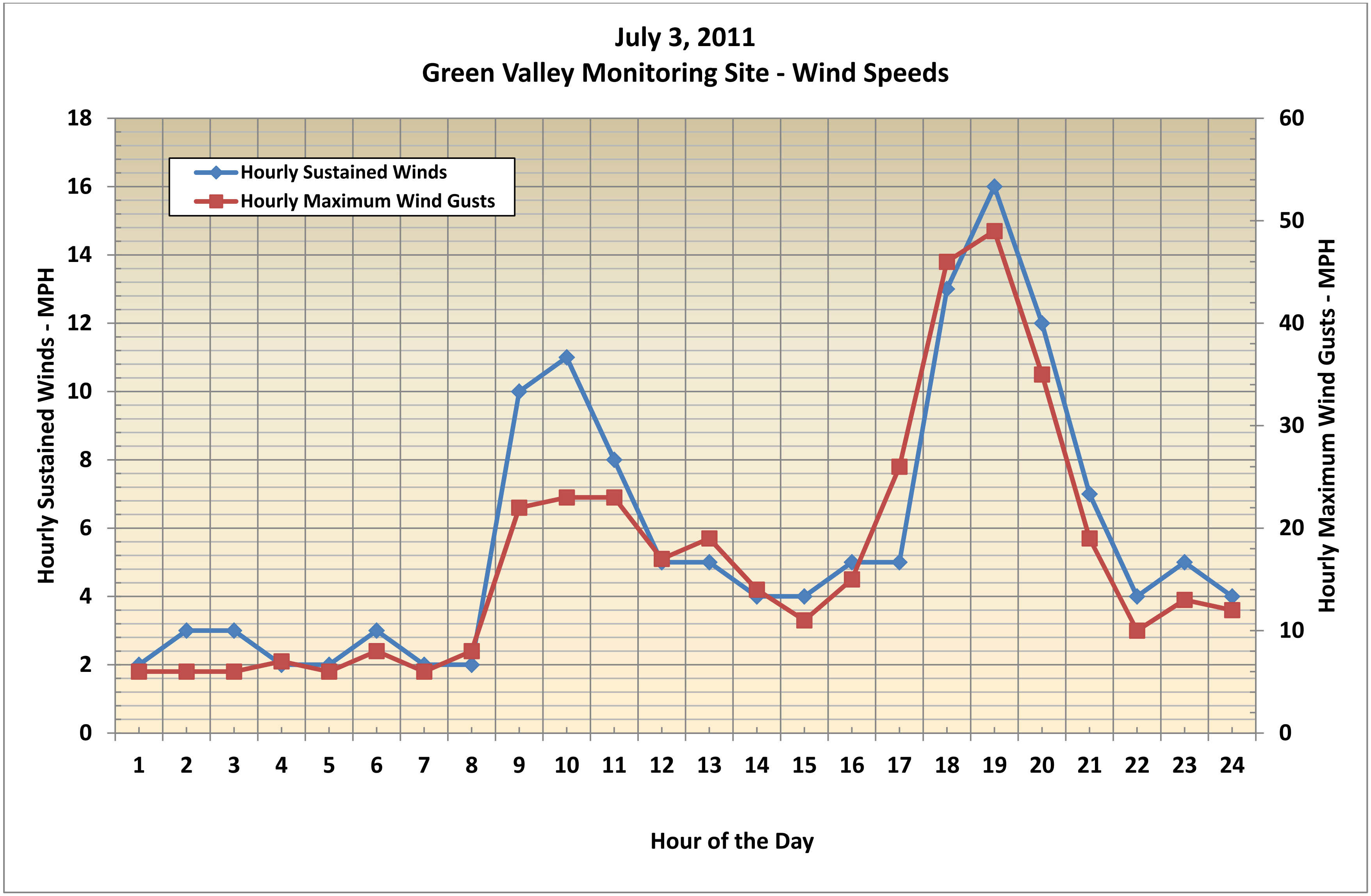


Figure 24a. Wind speeds at Green Valley monitoring site, July 3, 2011.

Table 18. Joe Neal Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	6	305	11	13.09	249.21
2011	7	2	0100	4	304	10	11.11	257.35
2011	7	2	0200	4	311	9	11.32	268.88
2011	7	2	0300	4	294	10	8.04	282.37
2011	7	2	0400	7	313	13	11.14	311.47
2011	7	2	0500	3	VAR	11	12.51	337.72
2011	7	2	0600	4	325	11	21.92	358.75
2011	7	2	0700	4	277	10	17.21	372.7
2011	7	2	0800	4	234	10	18.99	16.13
2011	7	2	0900	5	187	13	19.23	21.33
2011	7	2	1000	5	138	16	18.06	31.55
2011	7	2	1100	5	159	16	11.66	38.81
2011	7	2	1200	8	147	21	16.40	49.62
2011	7	2	1300	8	156	27	13.05	61.15
2011	7	2	1400	7	150	21	18.70	80.43
2011	7	2	1500	8	130	23	13.78	96.15
2011	7	2	1600	6	132	17	13.53	113.43
2011	7	2	1700	7	109	16	21.78	130.11
2011	7	2	1800	5	126	13	23.25	146.66
2011	7	2	1900	4	270	12	27.38	157.39
2011	7	2	2000	5	294	11	39.13	170.56
2011	7	2	2100	3	VAR	8	24.36	182.35
2011	7	2	2200	4	328	12	22.51	199.52
2011	7	2	2300	3	VAR	9	19.49	210.31

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 19. Joe Neal Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	8	99	24	28.62	690.22
2011	7	4	0100	5	106	14	27.83	778.92
2011	7	4	0200	8	86	18	38.59	1020.19
2011	7	4	0300	8	83	18	53.58	1173.32
2011	7	4	0400	4	106	16	46.63	1227.03
2011	7	4	0500	6	93	16	44.44	1249.71
2011	7	4	0600	4	95	12	27.79	1272.99
2011	7	4	0700	7	99	21	29.80	1302.54
2011	7	4	0800	9	119	17	40.99	36.79
2011	7	4	0900	7	111	18	18.02	47.21
2011	7	4	1000	10	121	21	20.45	82.73
2011	7	4	1100	13	129	26	15.24	132.03
2011	7	4	1200	6	118	17	9.42	175.33
2011	7	4	1300	8	133	17	9.22	215.98
2011	7	4	1400	7	136	18	5.49	241.83
2011	7	4	1500	7	116	21	9.03	269.28
2011	7	4	1600	7	92	17	9.85	306.59
2011	7	4	1700	6	112	14	7.58	323.47
2011	7	4	1800	6	107	15	12.83	341.14
2011	7	4	1900	3	VAR	6	17.63	355.87
2011	7	4	2000	2	VAR	4	134.55	364.11
2011	7	4	2100	2	VAR	4	231.90	371.37
2011	7	4	2200	3	VAR	6	212.52	376.75
2011	7	4	2300	5	321	12	149.02	385.53

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 20. Joe Neal Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	2	VAR	7	20.68	222.86
2011	7	3	0100	5	318	10	16.30	242.63
2011	7	3	0200	3	VAR	6	12.65	262.58
2011	7	3	0300	3	VAR	6	15.53	288.29
2011	7	3	0400	3	VAR	6	13.93	321.97
2011	7	3	0500	3	VAR	8	26.85	343.98
2011	7	3	0600	3	VAR	11	46.40	364.68
2011	7	3	0700	8	97	21	35.33	381.68
2011	7	3	0800	8	117	17	75.82	19.75
2011	7	3	0900	8	140	17	218.50	30.32
2011	7	3	1000	6	109	17	433.04	41.96
2011	7	3	1100	8	107	23	430.84	54.48
2011	7	3	1200	7	115	24	423.51	68.22
2011	7	3	1300	8	120	20	334.21	95.17
2011	7	3	1400	7	96	16	187.12	136.99
2011	7	3	1500	5	165	14	97.71	167.83
2011	7	3	1600	6	131	17	69.08	240.02
2011	7	3	1700	13	117	38	100.93	445.13
2011	7	3	1800	16	102	60	268.74	835.63
2011	7	3	1900	5	277	16	163.25	1224.77
2011	7	3	2000	6	227	15	60.97	446.74
2011	7	3	2100	4	213	12	23.58	377.98
2011	7	3	2200	3	VAR	9	25.51	543.52
2011	7	3	2300	4	82	20	34.62	628.96

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

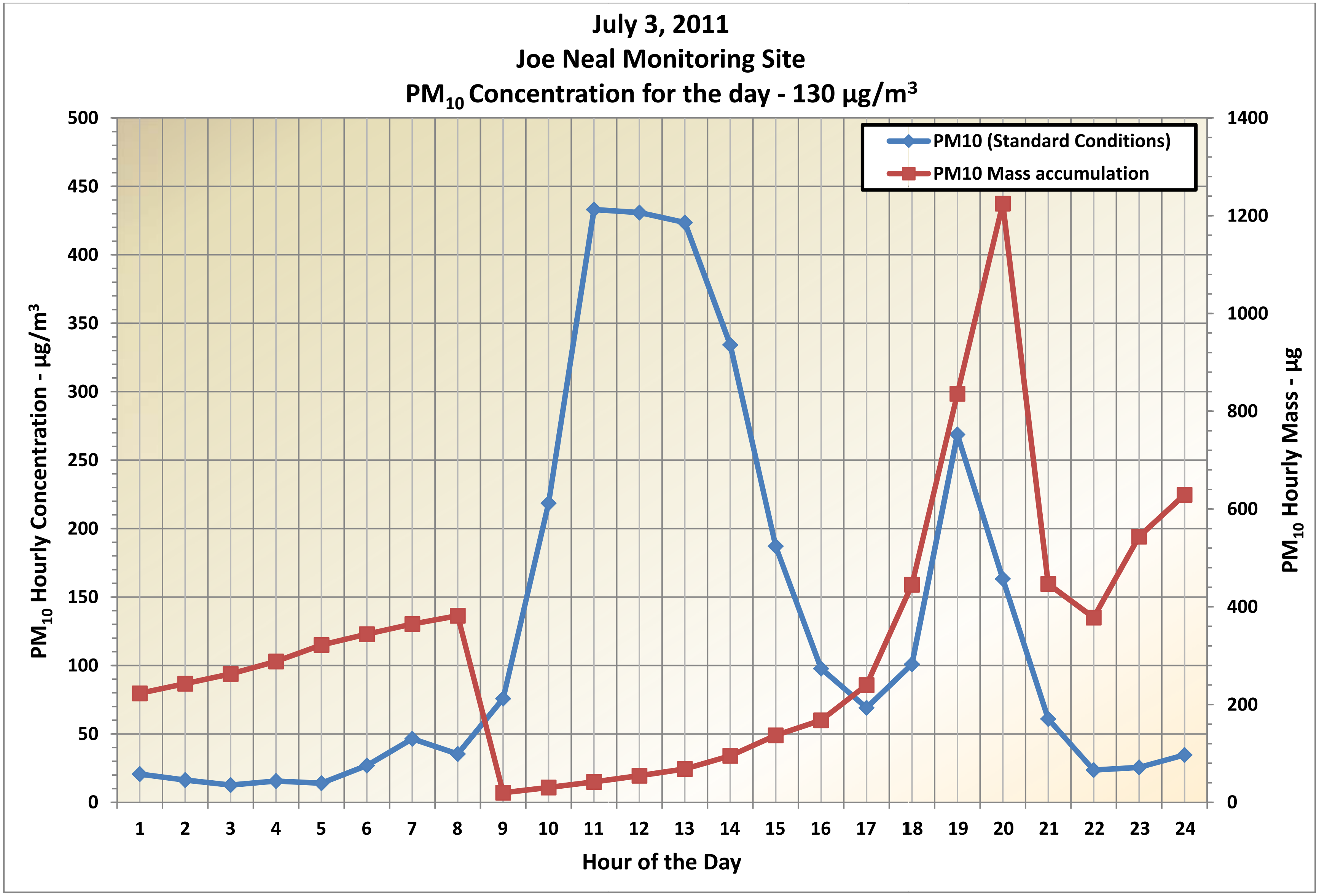


Figure 25. PM_{10} concentrations at Joe Neal monitoring site, July 3, 2011.

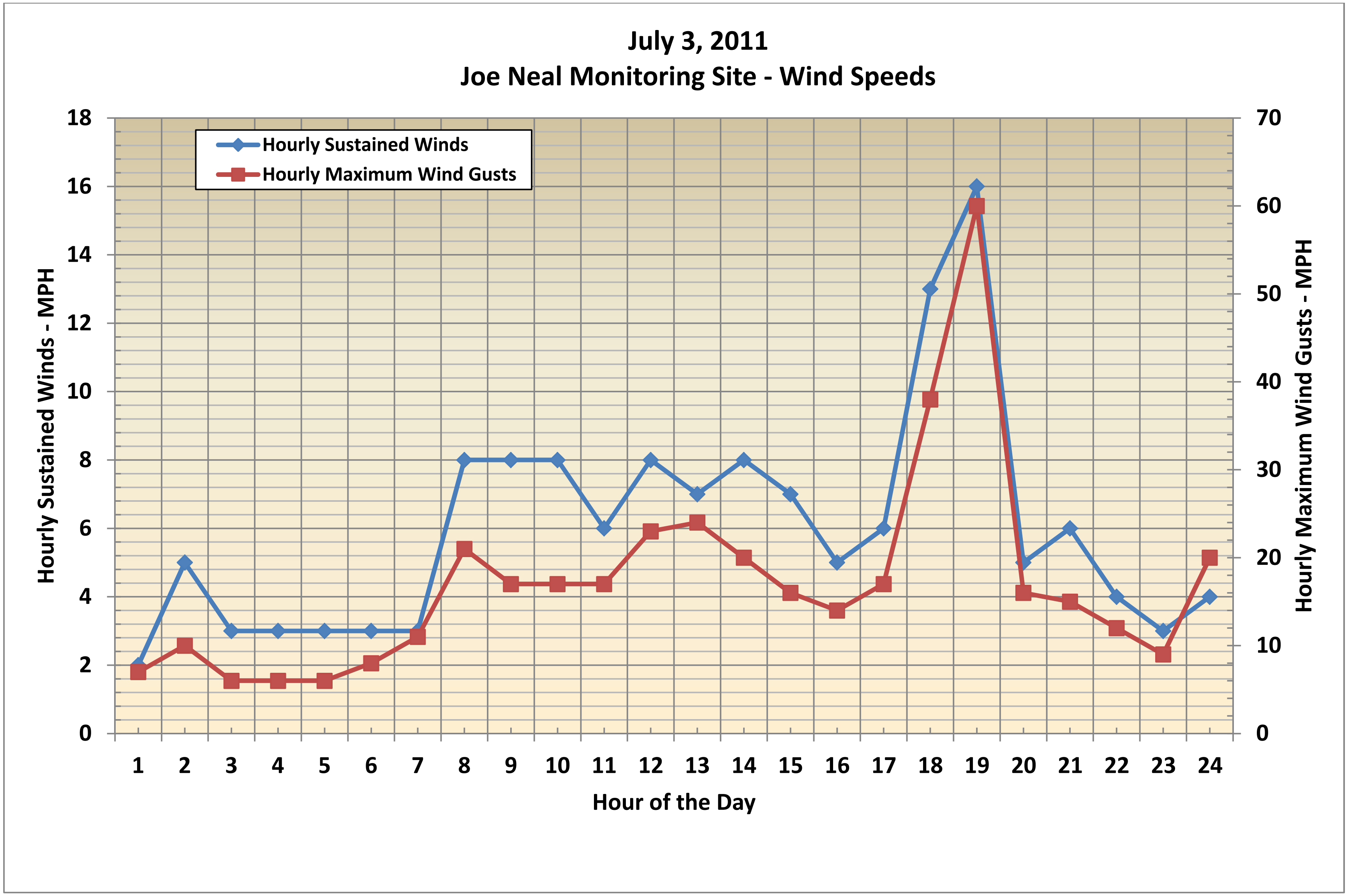


Figure 25a. Wind speeds at Joe Neal monitoring site, July 3, 2011.

Table 21. Paul Meyer Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	4	249	8	21.68	362.66
2011	7	2	0100	5	259	10	33.83	370.2
2011	7	2	0200	4	254	7	36.70	384.12
2011	7	2	0300	4	280	6	38.08	402.83
2011	7	2	0400	2	VAR	6	18.32	427.79
2011	7	2	0500	2	VAR	7	12.62	453.81
2011	7	2	0600	2	VAR	9	18.23	479.08
2011	7	2	0700	2	VAR	8	20.90	502.58
2011	7	2	0800	3	VAR	9	19.78	31.85
2011	7	2	0900	3	VAR	12	14.58	43.83
2011	7	2	1000	4	42	14	9.98	77.72
2011	7	2	1100	4	76	16	15.22	111.94
2011	7	2	1200	4	102	16	8.81	128.78
2011	7	2	1300	5	108	18	10.75	141.24
2011	7	2	1400	8	109	25	13.63	158.42
2011	7	2	1500	10	92	26	10.94	177.29
2011	7	2	1600	9	93	24	11.14	193.68
2011	7	2	1700	6	106	17	11.58	206.97
2011	7	2	1800	3	VAR	13	12.34	216.35
2011	7	2	1900	3	VAR	10	19.01	229.02
2011	7	2	2000	3	VAR	5	16.64	237.11
2011	7	2	2100	3	VAR	6	27.54	246.9
2011	7	2	2200	3	VAR	6	30.58	258.15
2011	7	2	2300	3	VAR	6	25.57	267.75

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 22. Paul Meyer Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	2	VAR	8	34.15	330.52
2011	7	4	0100	3	VAR	14	43.71	468.13
2011	7	4	0200	2	VAR	5	59.19	560.01
2011	7	4	0300	2	VAR	6	47.21	609.56
2011	7	4	0400	3	VAR	9	49.59	639.13
2011	7	4	0500	2	VAR	7	48.83	671.17
2011	7	4	0600	3	VAR	6	44.83	701.73
2011	7	4	0700	5	90	18	47.17	730.09
2011	7	4	0800	7	137	19	48.30	41.88
2011	7	4	0900	7	160	22	22.68	55.65
2011	7	4	1000	12	160	29	15.26	109.65
2011	7	4	1100	9	150	23	6.99	153.17
2011	7	4	1200	4	116	15	5.63	199.22
2011	7	4	1300	5	136	12	10.01	243.8
2011	7	4	1400	5	118	15	9.03	285.3
2011	7	4	1500	4	87	14	8.74	328.17
2011	7	4	1600	2	VAR	12	9.80	371.45
2011	7	4	1700	4	76	14	14.30	393.49
2011	7	4	1800	3	VAR	12	11.59	405.89
2011	7	4	1900	2	VAR	10	20.72	412.7
2011	7	4	2000	1	VAR	4	150.27	417.78
2011	7	4	2100	1	VAR	6	280.10	427.31
2011	7	4	2200	2	VAR	4	350.05	435.32
2011	7	4	2300	3	VAR	11	152.93	444.24

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 23. Paul Meyer Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	3	VAR	6	11.82	276.68
2011	7	3	0100	3	VAR	6	42.98	287.76
2011	7	3	0200	4	260	13	49.58	298.77
2011	7	3	0300	3	VAR	7	36.33	314.49
2011	7	3	0400	3	VAR	6	22.31	330.72
2011	7	3	0500	3	VAR	8	11.15	354.52
2011	7	3	0600	3	VAR	8	18.18	381.38
2011	7	3	0700	4	36	10	24.13	404.41
2011	7	3	0800	4	1	9	20.37	21.74
2011	7	3	0900	4	42	13	82.23	41.66
2011	7	3	1000	3	VAR	11	392.56	85.37
2011	7	3	1100	4	76	16	377.17	118.82
2011	7	3	1200	7	72	24	305.92	137.97
2011	7	3	1300	5	118	13	203.95	149.33
2011	7	3	1400	5	106	16	175.95	166.25
2011	7	3	1500	5	122	15	144.78	187.47
2011	7	3	1600	9	93	23	139.59	205.95
2011	7	3	1700	11	114	36	156.48	296.58
2011	7	3	1800	12	113	37	103.90	642.28
2011	7	3	1900	10	124	40	55.16	978.68
2011	7	3	2000	4	214	23	30.07	1249.16
2011	7	3	2100	3	VAR	12	35.70	1381.96
2011	7	3	2200	4	238	14	35.16	77.25
2011	7	3	2300	3	VAR	11	29.88	206.29

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

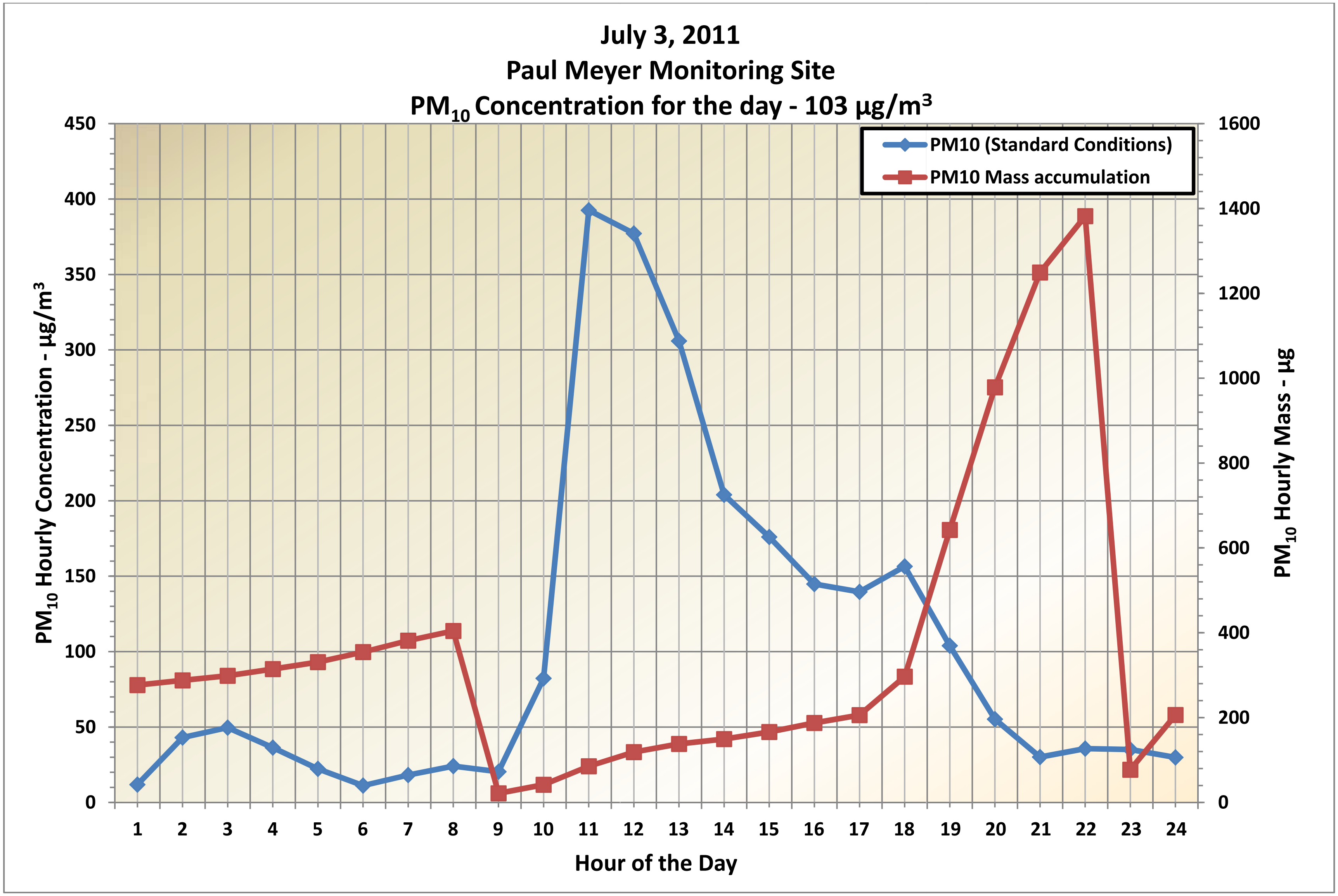


Figure 26. PM_{10} concentrations at Paul Meyer monitoring site, July 3, 2011.

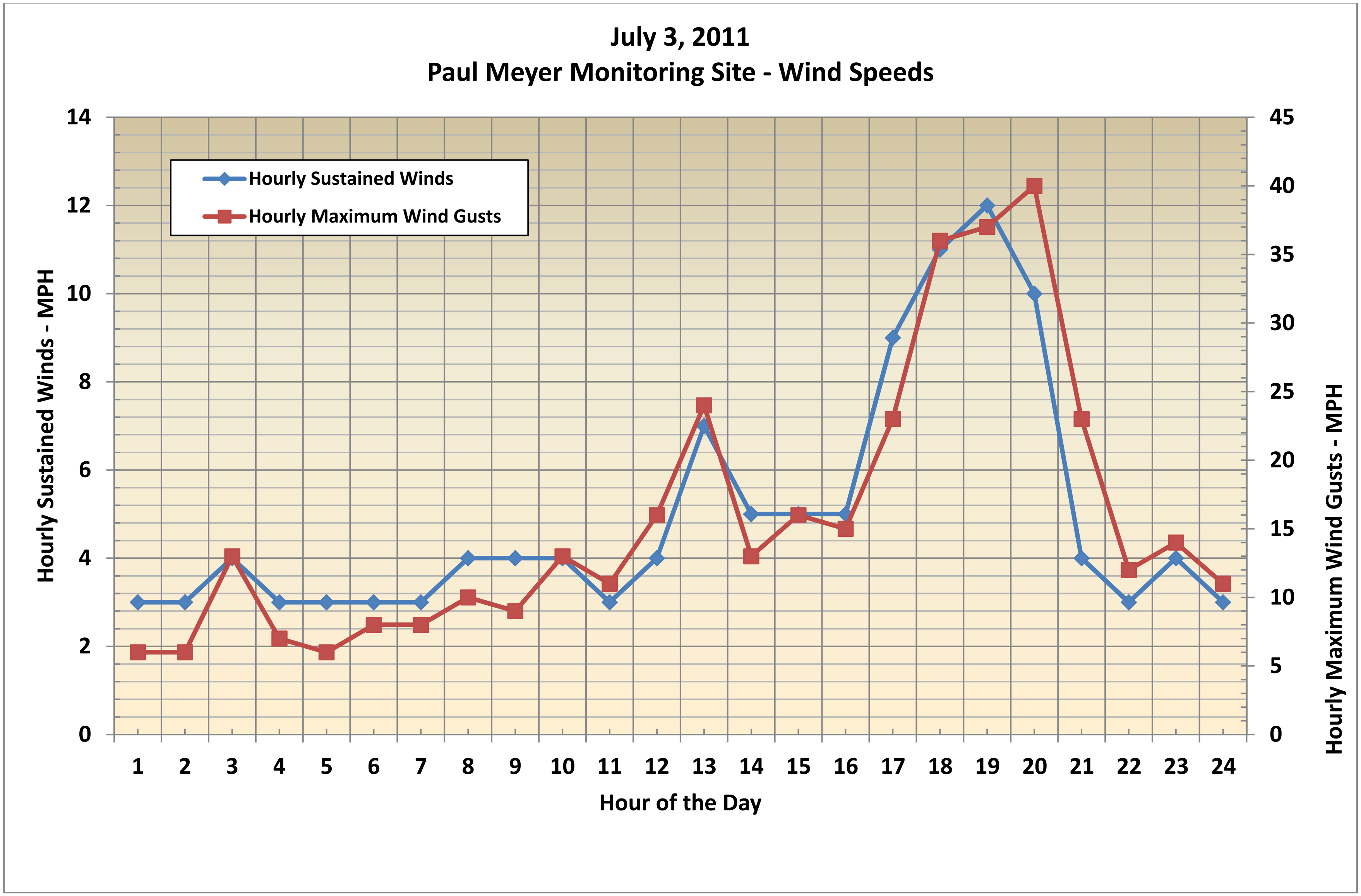


Figure 26a. Wind speeds at Paul Meyer monitoring site, July 3, 2011.

Table 24. Palo Verde Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	5	255	9	7.78	249.18
2011	7	2	0100	4	257	8	12.04	263.09
2011	7	2	0200	5	247	11	11.50	281.28
2011	7	2	0300	6	249	14	17.13	301.56
2011	7	2	0400	4	247	8	11.07	318.65
2011	7	2	0500	5	249	12	14.66	330.18
2011	7	2	0600	3	VAR	11	9.44	342.41
2011	7	2	0700	3	VAR	10	32.73	353.7
2011	7	2	0800	3	VAR	8	14.58	16.63
2011	7	2	0900	3	VAR	11	12.72	20.39
2011	7	2	1000	4	93	11	38.08	31.55
2011	7	2	1100	4	109	16	11.55	48.13
2011	7	2	1200	5	134	16	12.49	58.99
2011	7	2	1300	7	137	19	11.08	72.56
2011	7	2	1400	7	139	17	9.70	82.7
2011	7	2	1500	5	107	14	9.87	112.18
2011	7	2	1600	6	107	20	13.42	125.43
2011	7	2	1700	5	99	17	8.99	139.42
2011	7	2	1800	4	142	11	15.64	171.19
2011	7	2	1900	4	262	12	19.85	181.54
2011	7	2	2000	6	268	17	29.08	194
2011	7	2	2100	6	249	12	7.98	204.23
2011	7	2	2200	6	244	14	10.05	213.4
2011	7	2	2300	5	253	14	10.25	222.71

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 25. Palo Verde Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	2	VAR	7	33.43	652.07
2011	7	4	0100	2	VAR	6	29.81	136.27
2011	7	4	0200	3	VAR	7	44.00	230.11
2011	7	4	0300	3	VAR	7	39.06	283.75
2011	7	4	0400	4	4	7	55.67	319.18
2011	7	4	0500	2	VAR	5	50.85	357.33
2011	7	4	0600	1	VAR	7	49.13	390.3
2011	7	4	0700	4	85	13	47.18	415.68
2011	7	4	0800	4	99	12	54.19	16.73
2011	7	4	0900	4	143	20	33.18	36.86
2011	7	4	1000	10	155	25	20.36	76.48
2011	7	4	1100	10	148	23	7.58	114.43
2011	7	4	1200	5	143	15	8.98	164.57
2011	7	4	1300	6	152	16	7.37	210.4
2011	7	4	1400	7	149	17	6.29	255.02
2011	7	4	1500	5	160	15	7.41	299.09
2011	7	4	1600	3	VAR	12	11.41	347.3
2011	7	4	1700	4	134	9	7.61	378.92
2011	7	4	1800	4	114	8	16.31	397.38
2011	7	4	1900	2	VAR	5	23.15	405.42
2011	7	4	2000	2	VAR	4	54.71	413.48
2011	7	4	2100	3	VAR	5	165.73	420.45
2011	7	4	2200	4	304	6	78.75	426.66
2011	7	4	2300	4	290	7	47.13	434.42

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 26. Palo Verde Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	3	VAR	6	22.70	234.21
2011	7	3	0100	4	280	7	20.83	244.09
2011	7	3	0200	4	280	9	20.25	257.92
2011	7	3	0300	5	282	7	17.79	276.22
2011	7	3	0400	4	262	7	19.13	301.25
2011	7	3	0500	4	262	8	19.08	309.45
2011	7	3	0600	3	VAR	7	8.19	318.09
2011	7	3	0700	4	40	9	14.75	330.14
2011	7	3	0800	3	VAR	11	23.02	18.05
2011	7	3	0900	3	VAR	7	40.18	31.7
2011	7	3	1000	4	65	16	198.25	50.53
2011	7	3	1100	6	85	18	331.42	66.26
2011	7	3	1200	5	82	16	292.41	84.62
2011	7	3	1300	4	118	16	268.43	102.4
2011	7	3	1400	4	126	14	156.11	110.52
2011	7	3	1500	4	124	17	119.47	125.39
2011	7	3	1600	4	104	18	133.77	145.92
2011	7	3	1700	8	128	29	133.36	185.38
2011	7	3	1800	9	159	32	108.47	363.54
2011	7	3	1900	6	220	20	59.24	650.15
2011	7	3	2000	5	227	15	37.63	908.38
2011	7	3	2100	7	239	17	41.98	1137.95
2011	7	3	2200	7	236	14	35.68	1271.82
2011	7	3	2300	7	226	15	28.57	1377.56

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

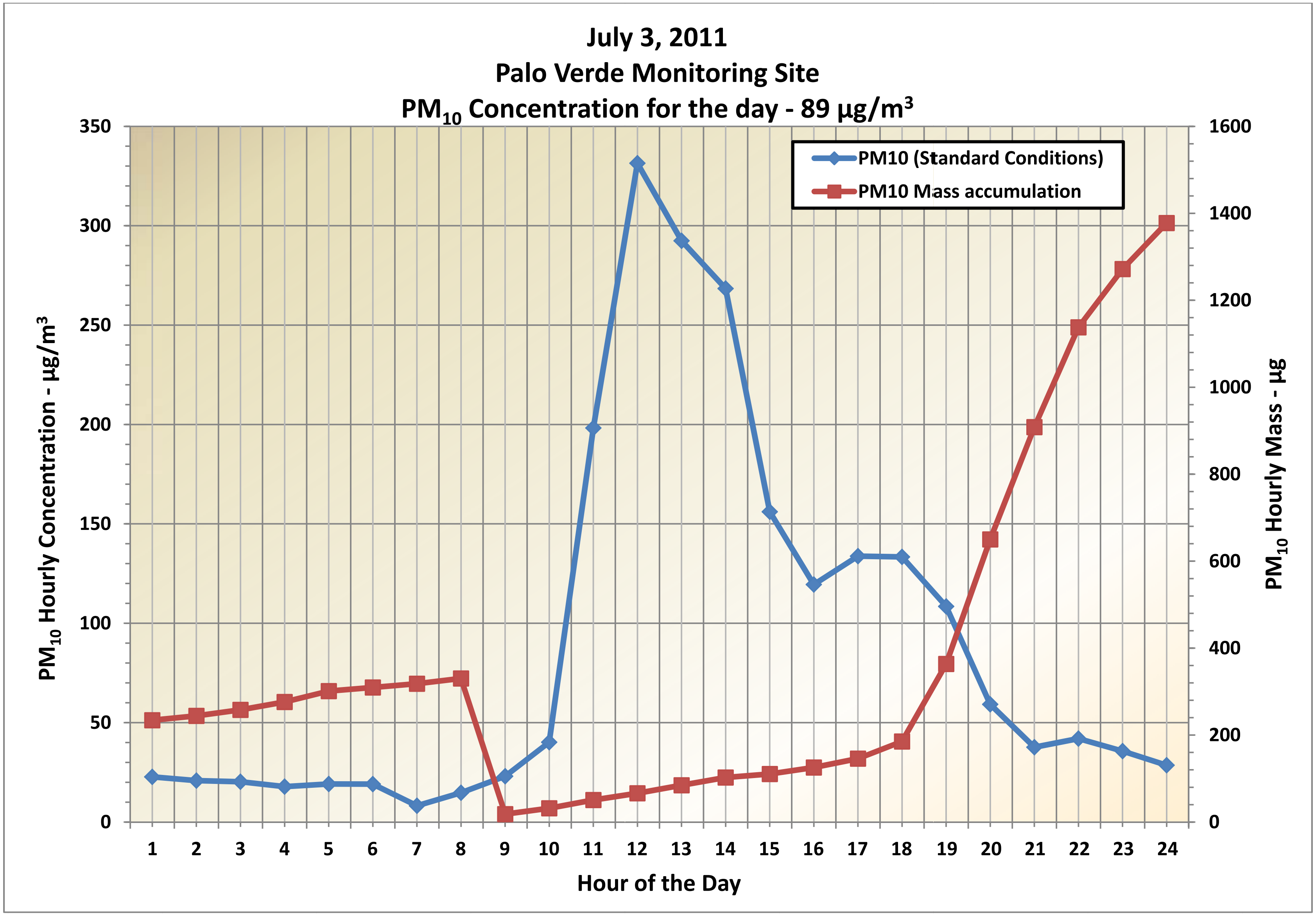


Figure 27. PM_{10} concentrations at Palo Verde monitoring site, July 3, 2011.

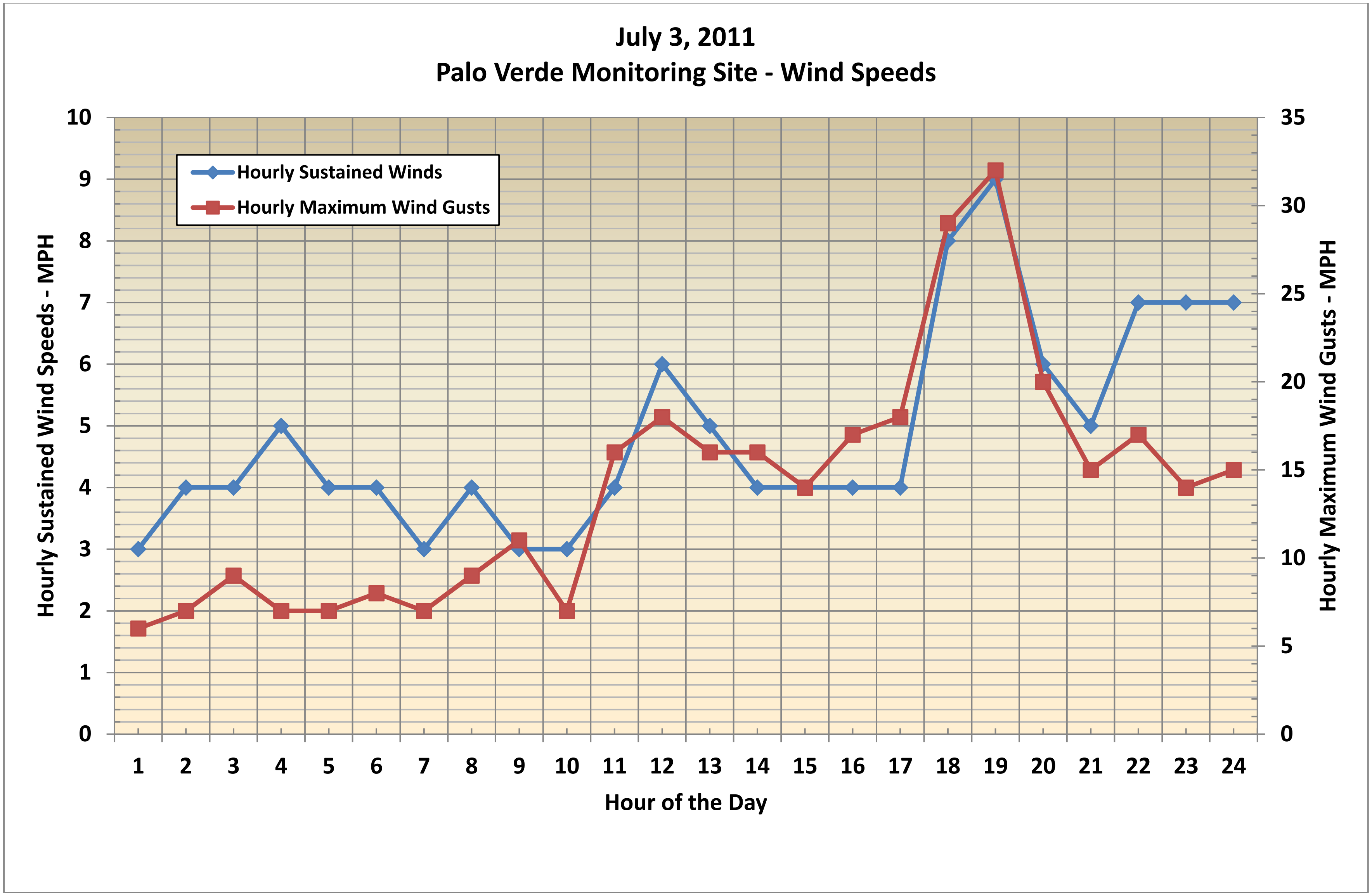


Figure 27a. Wind speeds at Palo Verde monitoring site, July 3, 2011.

Table 27. Jean Monitoring Data for July 2, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	2	0000	11	ND	15	36.34	321.73
2011	7	2	0100	9	ND	13	40.58	330.3
2011	7	2	0200	9	ND	14	114.23	340.88
2011	7	2	0300	10	ND	15	106.15	359.27
2011	7	2	0400	8	ND	13	207.86	366.86
2011	7	2	0500	4	ND	8	264.63	358.71
2011	7	2	0600	2	VAR	4	140.33	380.32
2011	7	2	0700	2	VAR	5	58.08	430.94
2011	7	2	0800	3	VAR	10	37.57	19.84
2011	7	2	0900	5	ND	15	14.95	4.93
2011	7	2	1000	5	ND	16	24.78	100.95
2011	7	2	1100	5	ND	13	7.25	216.57
2011	7	2	1200	5	ND	15	36.17	392.02
2011	7	2	1300	6	ND	18	8.78	620.41
2011	7	2	1400	12	ND	27	9.57	757.05
2011	7	2	1500	13	ND	25	17.45	810.58
2011	7	2	1600	11	ND	21	20.93	840.26
2011	7	2	1700	11	ND	20	4.23	853.08
2011	7	2	1800	9	ND	17	18.43	875.02
2011	7	2	1900	7	ND	11	31.28	883.97
2011	7	2	2000	6	ND	12	7.58	912.14
2011	7	2	2100	5	ND	10	1.80	917.04
2011	7	2	2200	7	ND	10	41.78	924.94
2011	7	2	2300	10	ND	13	143.47	939.96

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 28. Jean Monitoring Data for July 4, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	4	0000	3	VAR	9	56.10	822.63
2011	7	4	0100	3	VAR	9	58.95	1101.92
2011	7	4	0200	7	ND	12	67.22	1211.88
2011	7	4	0300	7	ND	11	63.45	1310.38
2011	7	4	0400	6	ND	9	74.30	1361.32
2011	7	4	0500	4	ND	7	75.56	1402.43
2011	7	4	0600	5	ND	9	64.17	1443.89
2011	7	4	0700	8	ND	20	42.33	804.29
2011	7	4	0800	14	ND	24	17.32	26.91
2011	7	4	0900	13	ND	23	24.64	75.45
2011	7	4	1000	14	ND	27	10.87	136.16
2011	7	4	1100	9	ND	20	8.53	194.65
2011	7	4	1200	7	ND	13	6.73	261.58
2011	7	4	1300	7	ND	14	7.68	330.09
2011	7	4	1400	5	ND	12	4.78	386.57
2011	7	4	1500	4	ND	13	6.67	424.33
2011	7	4	1600	4	ND	12	0.10	440.93
2011	7	4	1700	3	VAR	10	5.63	461.75
2011	7	4	1800	6	ND	12	2.32	471.42
2011	7	4	1900	6	ND	10	34.20	479.48
2011	7	4	2000	5	ND	9	11.45	484.74
2011	7	4	2100	7	ND	10	18.48	490.09
2011	7	4	2200	7	ND	12	14.60	493.83
2011	7	4	2300	6	ND	10	22.52	492.11

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

Table 29. Jean Monitoring Data for July 3, 2011

Year	Month	Day	Time	Wind Speed (mph)	Wind Direction (degrees)	Maximum. Gust (mph)	PM_{10} Concentration (µg/m3)	PM_{10} Mass Accumulation (µg)
2011	7	3	0000	9	ND	13	240.97	954.95
2011	7	3	0100	9	ND	14	16.75	958.95
2011	7	3	0200	9	ND	14	13.29	973.58
2011	7	3	0300	7	ND	13	17.50	1003.14
2011	7	3	0400	4	ND	7	15.48	1002.43
2011	7	3	0500	7	ND	10	13.43	996.05
2011	7	3	0600	3	VAR	9	13.31	1031.32
2011	7	3	0700	2	VAR	5	18.08	1170.71
2011	7	3	0800	2	VAR	8	19.17	61.17
2011	7	3	0900	3	VAR	8	16.00	14.97
2011	7	3	1000	7	ND	17	22.67	27.98
2011	7	3	1100	6	ND	13	212.14	43.74
2011	7	3	1200	5	ND	14	119.30	57.43
2011	7	3	1300	6	ND	17	55.01	68.24
2011	7	3	1400	7	ND	18	105.87	81.53
2011	7	3	1500	7	ND	24	122.53	98.13
2011	7	3	1600	6	ND	20	144.70	113.63
2011	7	3	1700	12	ND	26	342.39	127.63
2011	7	3	1800	13	ND	31	118.68	154.47
2011	7	3	1900	14	ND	26	113.59	334.77
2011	7	3	2000	7	ND	15	57.74	436.97
2011	7	3	2100	4	ND	6	45.53	487.05
2011	7	3	2200	6	ND	10	47.09	577.83
2011	7	3	2300	5	ND	10	35.98	683.38

Note: There is no wind direction associated with wind speeds <3.45 mph and will be referred as VAR for variable/calm in that corresponding cell block.

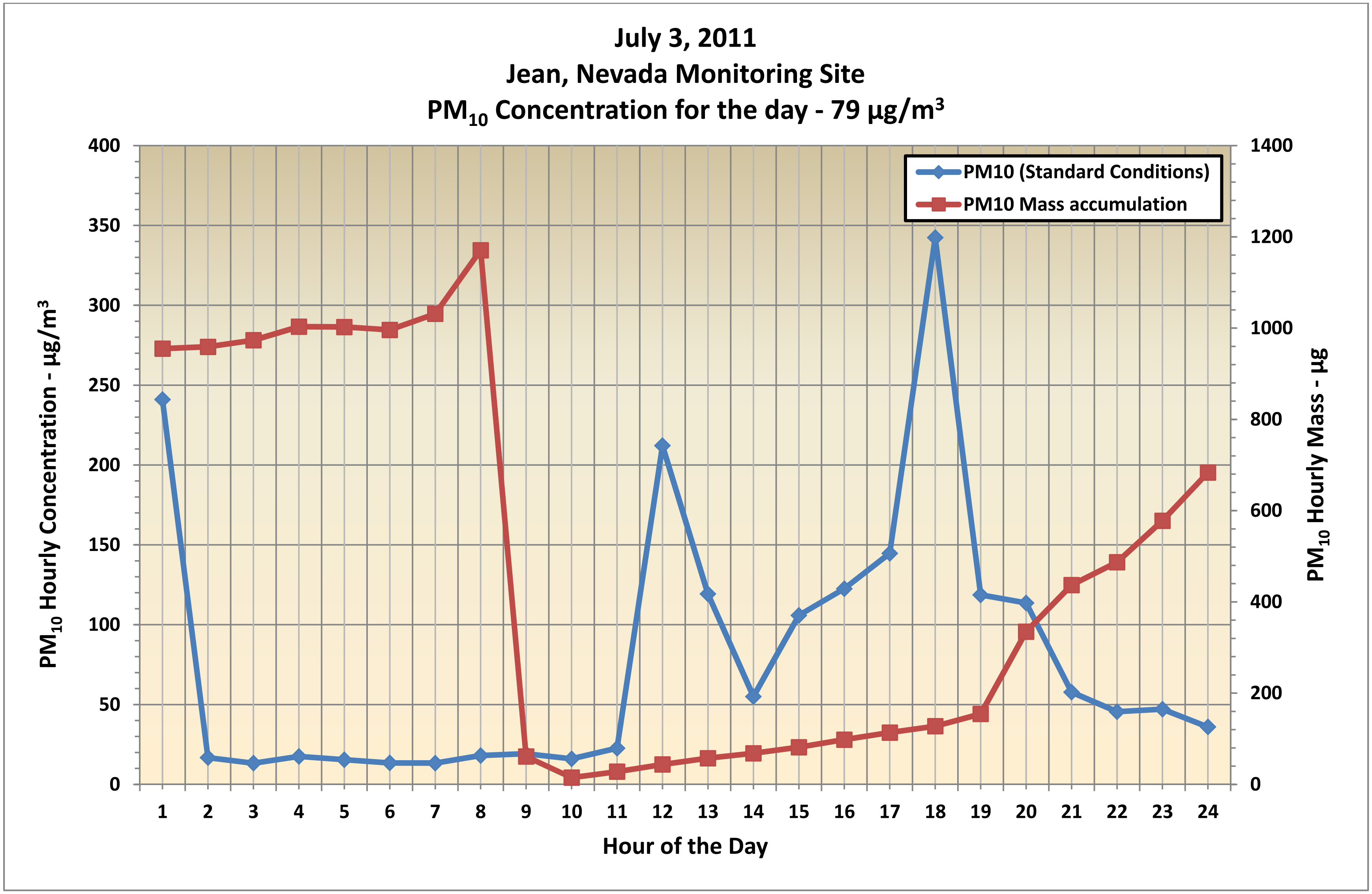


Figure 28. PM_{10} concentrations at Jean, Nevada monitoring site, July 3, 2011.

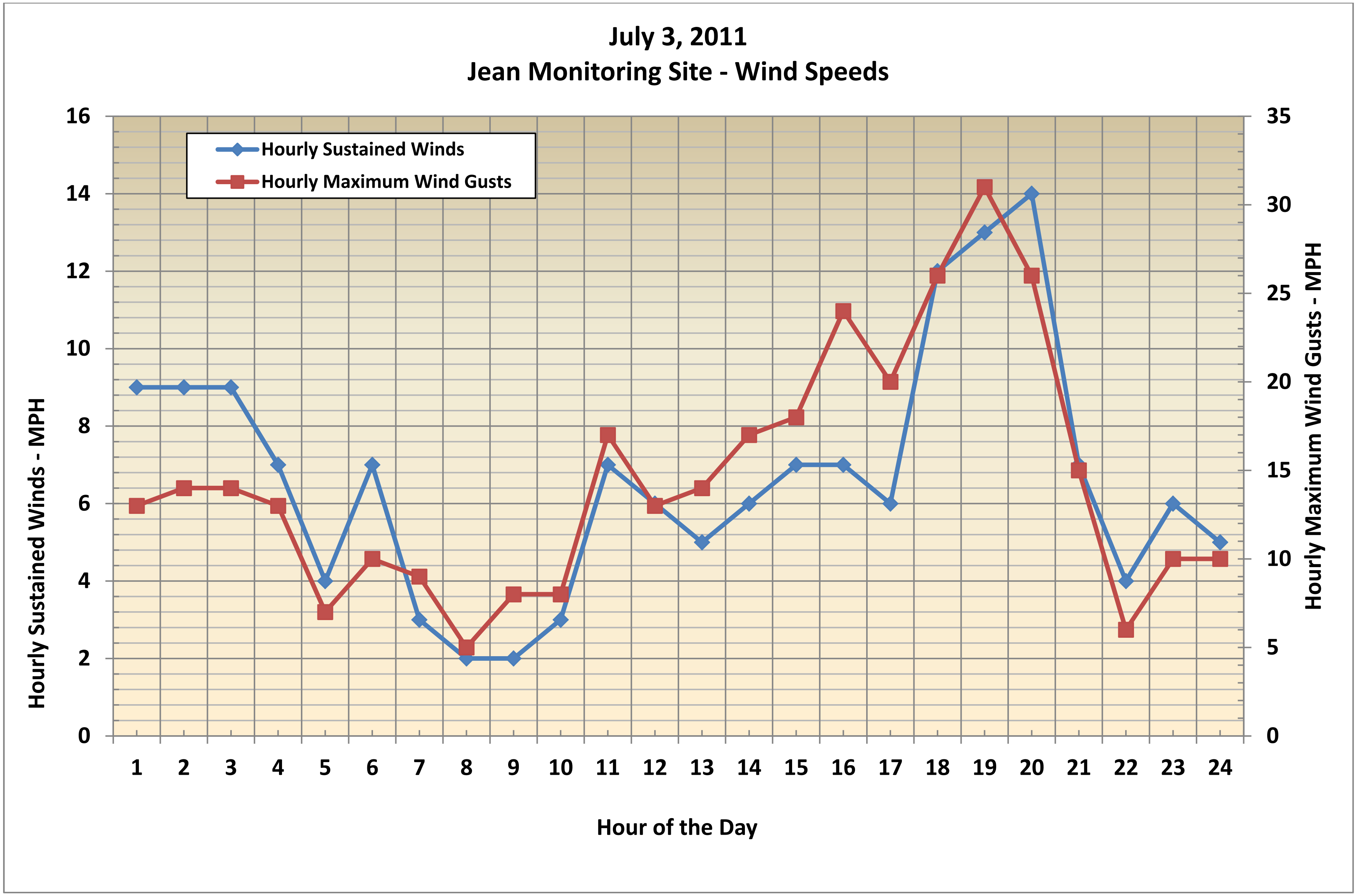


Figure 28a. Wind speeds at Jean, Nevada monitoring site, July 3, 2011.

2.4.1.2 The event was not reasonably controllable or preventable.

As described in the Rule Effectiveness/Enforcement-Compliance section (Section 5.0) of this document, there were no unusual emission activities on the event day. No local sources within a mile and a half radius of any of the monitoring sites in the PM_{10} network were contributing measureable dust to the mix of air pollution experienced on July 3, 2011, from the high-wind transported dust event.

2.4.2 Clear causal connection between the exceedances and the event.

The causal connection is demonstrated by the dramatic increase in hourly PM_{10} concentrations that coincided with the high-wind transported dust from the multiple storm cells in the source area and the outflow boundary that occurred in source area that blew through Bullhead City, Arizona, up the Colorado River corridor into the Eldorado and Las Vegas Valleys. The Blythe and Needles, California airports reported the winds and gusts that pushed northeast into Bullhead City, Arizona. See tables 1, 2 , 3, 4 and 5 for details of wind direction and wind speeds that pushed the storm cell conditions toward Bullhead City and from the northeast cells in Arizona that converged in that area.

2.4.3 Measured concentration in excess of normal historical fluctuations

The 24-hour average PM_{10} concentration of 242 $\mu g/m^3$ at the Boulder City monitoring site in Eldorado Valley on July 3, 2011, is the highest 24-hour average PM_{10} concentration recorded in the Clark County PM_{10} Monitoring Network between 2006 and 2011. The reading indicates an excess of normal historical fluctuation, including background (Figure 29).

The 24-hour average PM_{10} concentration of 191 $\mu g/m^3$ at the Sunrise Acres monitoring site on July 3, 2011, is the second highest 24-hour average PM_{10} concentration recorded in the Clark County PM_{10} Monitoring Network between 2006 and 2011. Furthermore, this concentration is the highest concentration recorded at this monitoring site in over six years. The reading indicates an excess of normal historical fluctuation, including background (Figure 30).

The 24-hour average PM_{10} concentration of 185 $\mu g/m^3$ at the J. D. Smith monitoring site on July 3, 2011, is the third highest 24-hour average PM_{10} concentration recorded in the Clark County PM_{10} Monitoring Network between 2006 and 2011. Furthermore, this concentration is the highest concentration recorded at this monitoring site in over six years. The reading indicates an excess of normal historical fluctuation, including background (Figure 31).

The 24-hour average PM_{10} concentration of 143 $\mu g/m^3$ at the Green Valley monitoring site on July 3, 2011, is the fifth highest 24-hour average PM_{10} concentration recorded in the Clark County PM_{10} Monitoring Network between 2006 and 2011. Furthermore, this concentration is the highest concentration recorded at this monitoring site in over three years. This site did not exceed the 24-hour PM_{10} NAAQS on the event day but exhibited a similar trend with the exceedance sites discussed in this document. Since this was the fifth highest 24-hour average PM_{10} concentration recorded in a six-year period, the reading indicates an excess of normal historical fluctuation, including background (Figure 32).

The 24-hour average PM_{10} concentration of 130 µg/m^3 at the Joe Neal monitoring site on July 3, 2011, is the seventh highest 24-hour average PM_{10} concentration recorded in the Clark County PM_{10} Monitoring Network between 2006 and 2011. Joel Neal's concentration makes it the highest concentration recorded at this monitoring site in over six years. The reading indicates an excess of normal historical fluctuation, including background (Figure 33).

The 24-hour average PM_{10} concentration of 103 µg/m^3 at the Paul Meyer monitoring site on July 3, 2011, is the highest 24-hour average PM_{10} concentration recorded at this site between 2006 and 2011. This site did not exceed the 24-hour PM_{10} NAAQS on the event day but exhibited a similar trend with the exceedance sites discussed in this document. Since this was the highest 24-hour average PM_{10} concentration recorded in a six-year period at this site, the reading indicates an excess of normal historical fluctuation, including background (Figure 34).

The 24-hour average PM_{10} concentration of 89 µg/m^3 at the Palo Verde monitoring site on July 3, 2011, is the highest 24-hour average PM_{10} concentration recorded at this site between 2006 and 2011. Furthermore, this concentration is the highest concentration recorded at this monitoring site in over six years. This site did not exceed the 24-hour PM_{10} NAAQS on the event day but exhibited a similar trend with the exceedance sites discussed in this document. Since this was the highest 24-hour average PM_{10} concentration recorded in a six-year period at this site, the reading indicates an excess of normal historical fluctuation, including background (Figure 35).

The 24-hour average PM_{10} concentration of 79 µg/m^3 at the Jean monitoring site on July 3, 2011, was the lowest concentration value sampled on the exceedance event day. If fact it was the lowest 24-hour value sampled at any of the network PM_{10} sites. This site did not exceed the 24-hour PM_{10} NAAQS on the event day and did not exhibit similar trends with the exceedance sites or non-exceedance Las Vegas Valley sites discussed in this document (Figure 36).

2.4.4 There would have been no exceedance but for the event.

There are several indications that the PM_{10} NAAQS would not have been exceeded on July 3, 2011, but for the presence of the high-wind transported dust from the multiple desert storms in the source area. DAQ's exceptional event data shows that PM_{10} concentrations in Clark County were low until the arrival of the dust. Wind speeds were low and constant, and the dust flowed into the Eldorado and Las Vegas Valleys. The predominant direction upon entry into the Las Vegas Valley was northeasterly. Only two sites in the valley exceeded because of their location in southeastern valley. When wind speeds increased in the early afternoon the dust was pushed out of both valleys, and concentrations at all affected PM_{10} sites decreased rapidly. From the data this document provides, the DAQ concludes that the PM_{10} NAAQS would not have been exceeded on this event day if the additional dust from the high-wind dust transport event had not been present.

The meteorological analysis, established science-based transported particulate entrainment, and implementation of BACM on relevant sources of particulate emissions detailed in the following sections of this document demonstrate that during this high-wind transported dust event, PM_{10} emissions were not reasonably controllable, and the exceedance was not reasonably preventable.

The July 3, 2011, exceedance would not have occurred ***but for*** the high-wind regionally transported dust event.

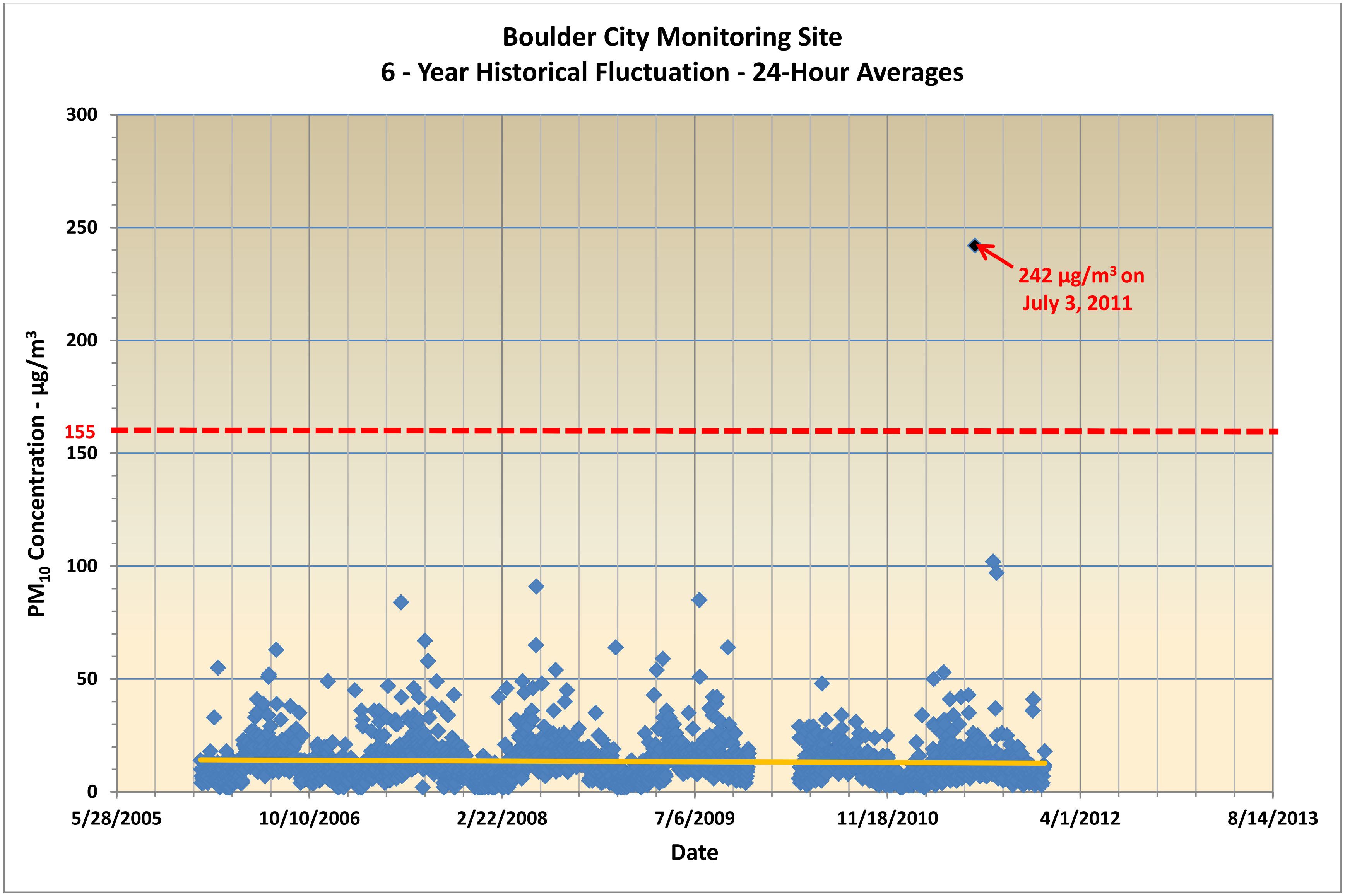


Figure 29. Boulder City monitoring site, 6 - year historical trends in 24-hour PM_{10} concentrations with trend line.

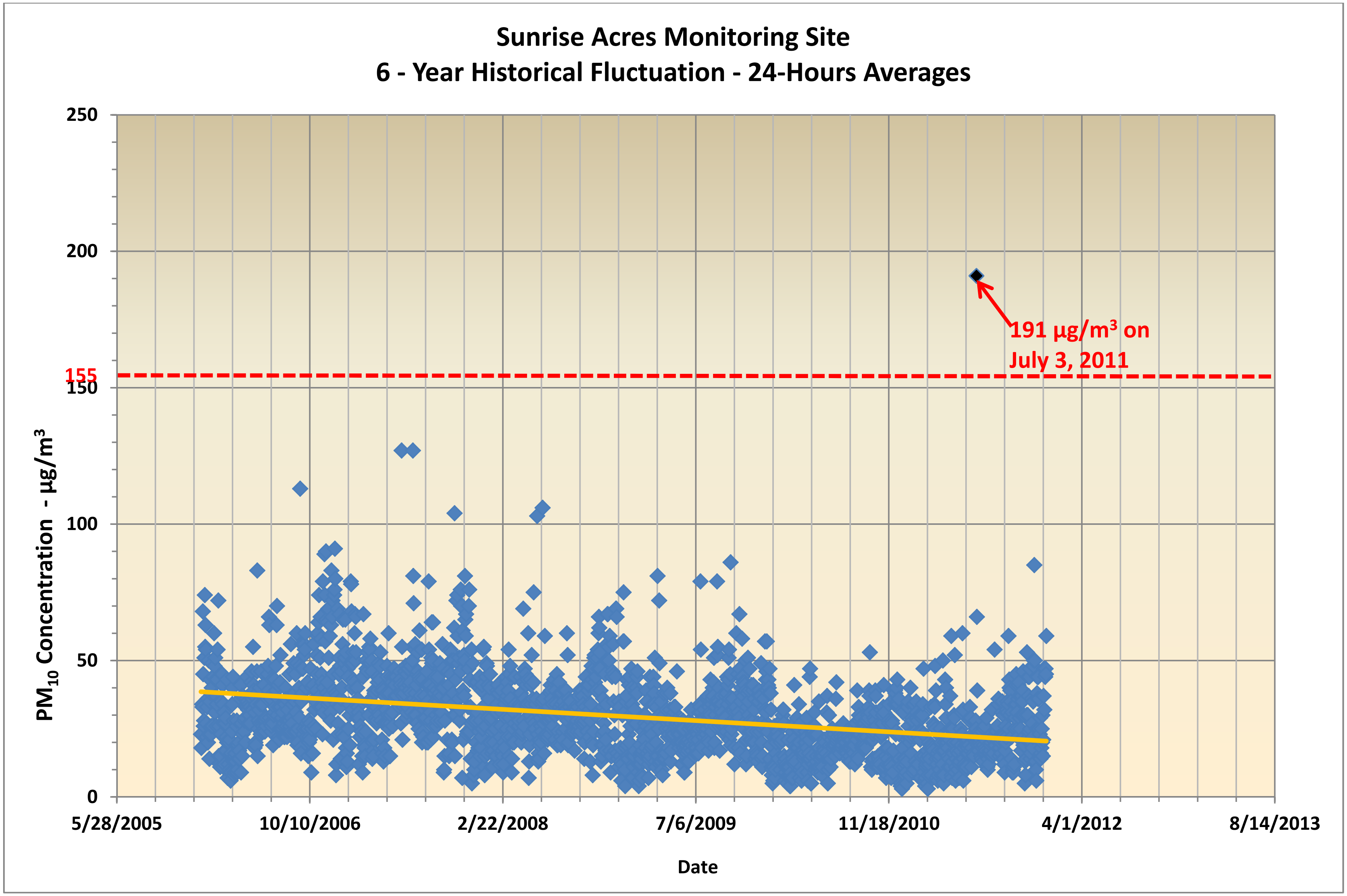


Figure 30. **Sunrise Acres monitoring site, 6 - year historical trends in 24-hour PM10 concentrations with trend line.**

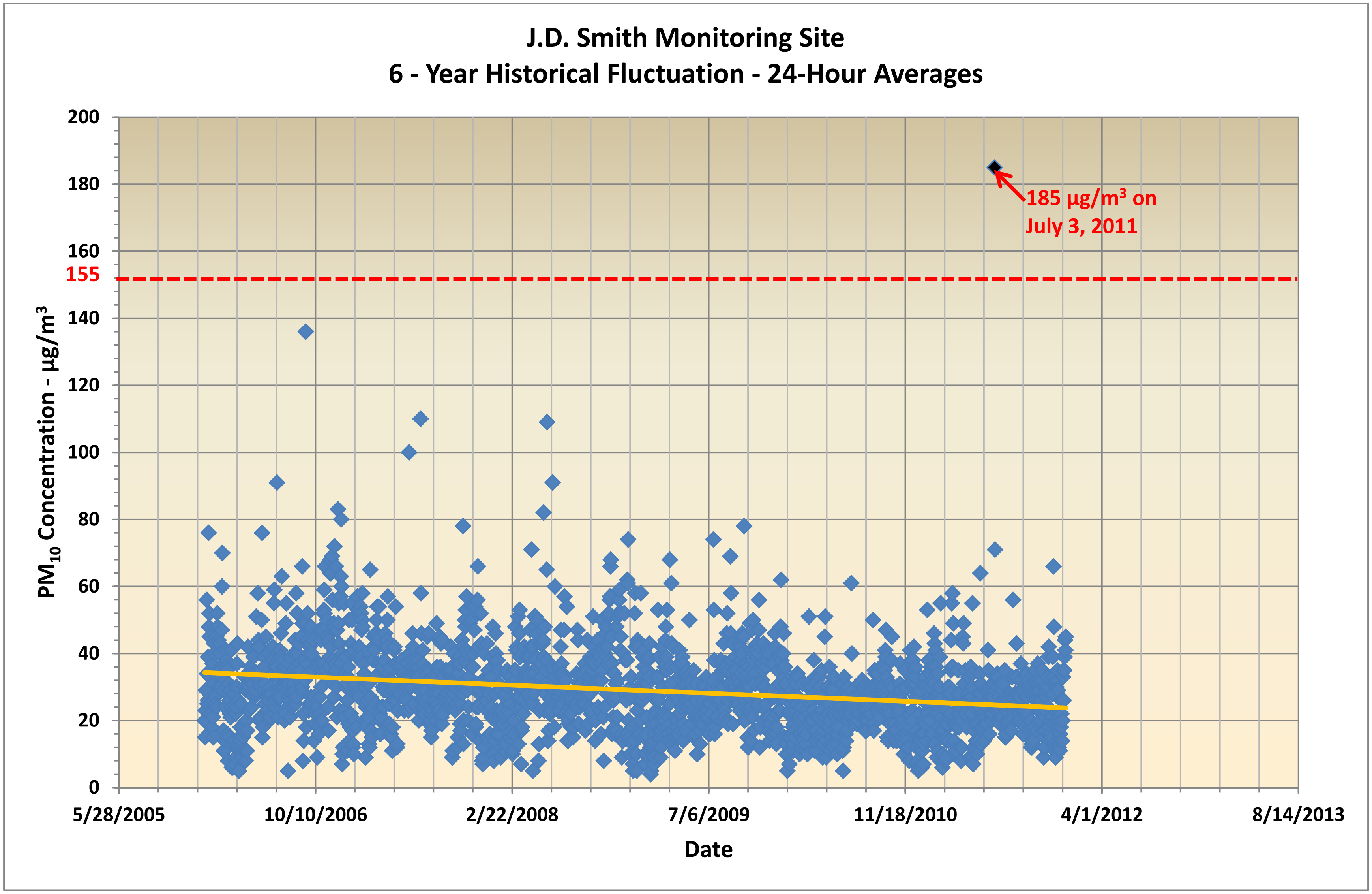


Figure 31. J.D. Smith monitoring site, 6 - year historical trends in 24-hour PM_{10} concentrations with trend line.

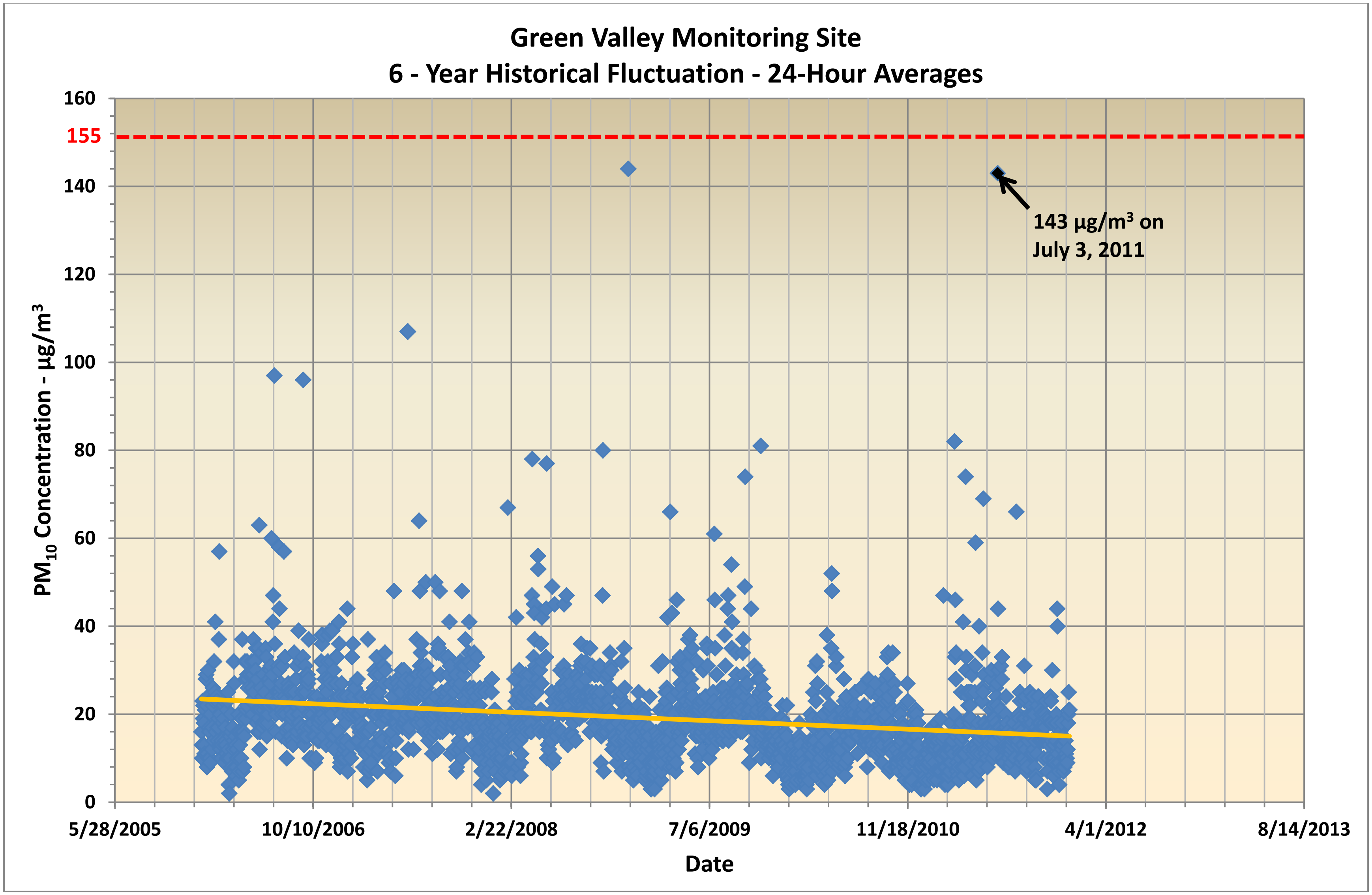


Figure 32. Green Valley monitoring site, 6 – year historical trends in 24-hour PM_{10} concentrations with trend line.

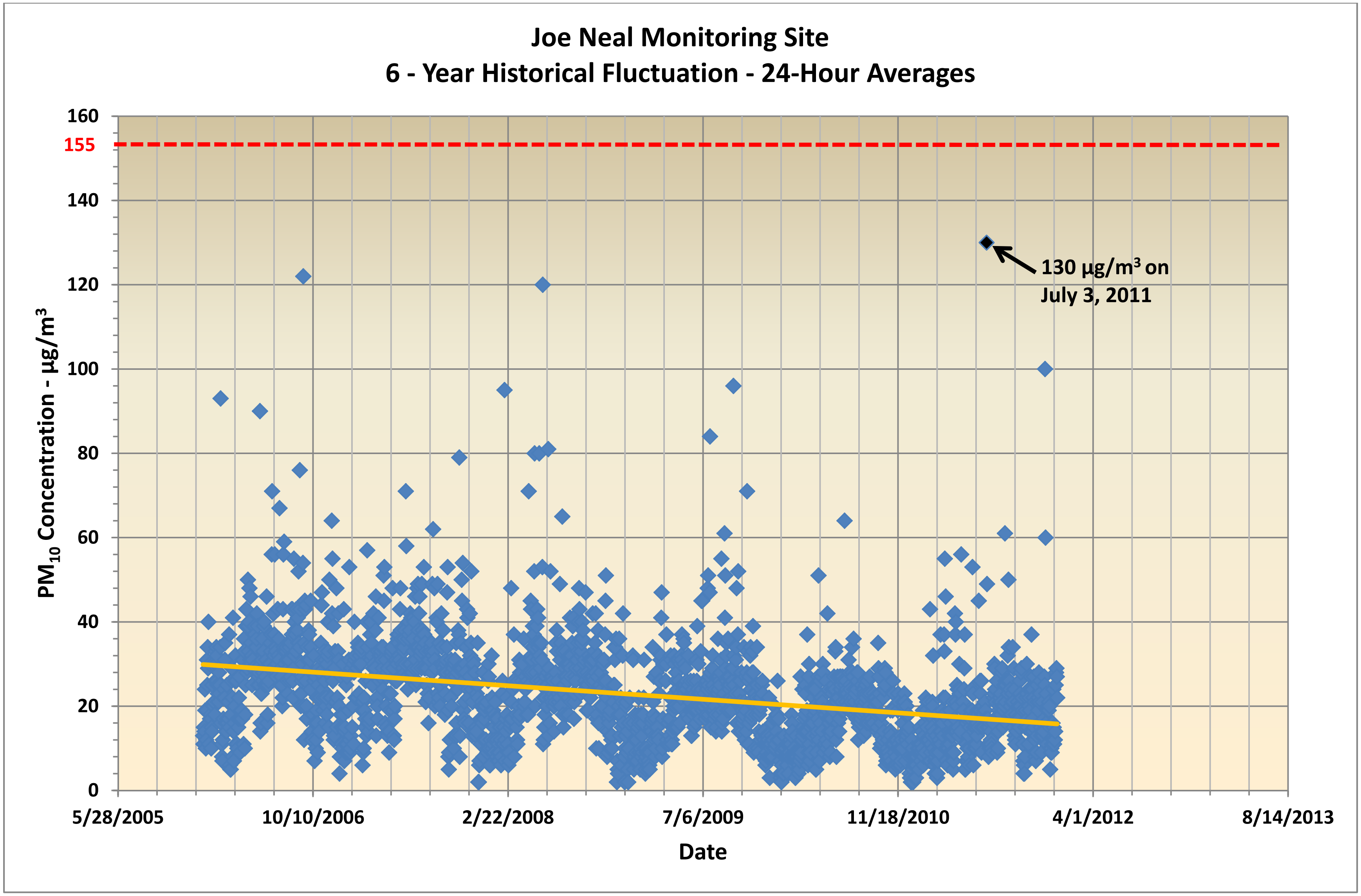


Figure 33. Joe Neal monitoring site, 6 - year historical trends in 24-hour PM_{10} concentrations with trend line.

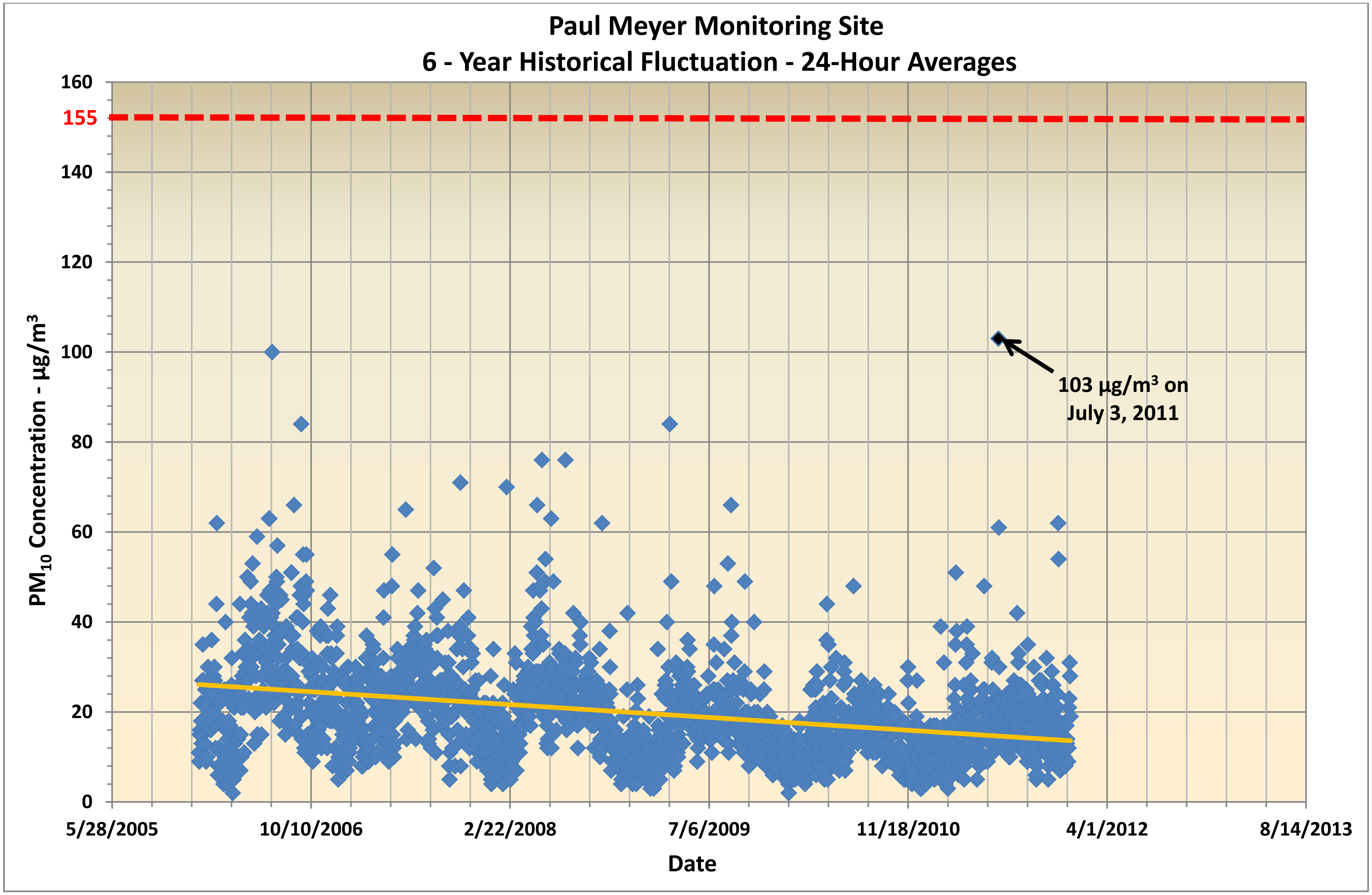


Figure 34. Paul Meyer monitoring site, 6 - year historical trends in 24-hour PM_{10} concentrations with trend line.

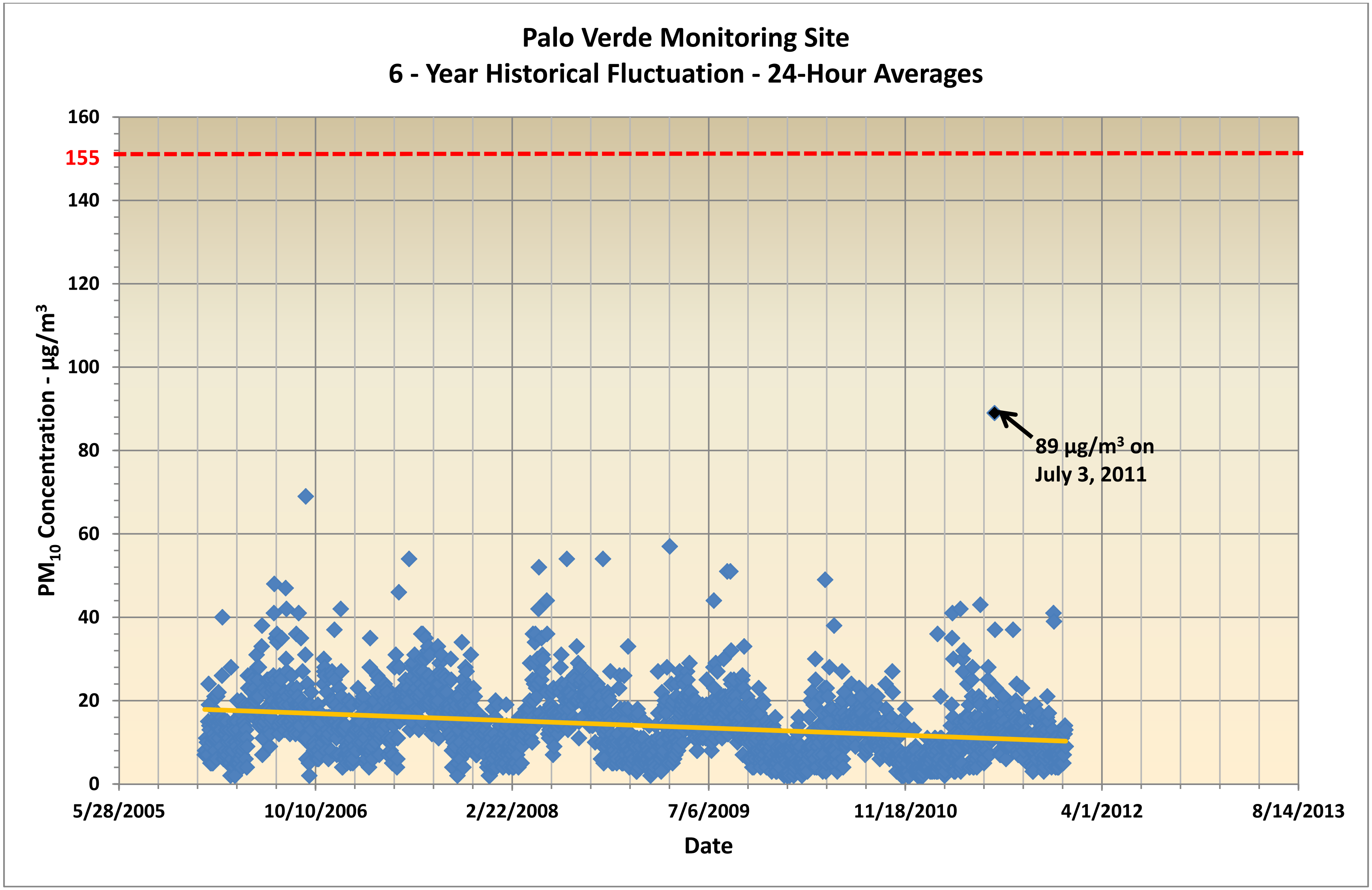


Figure 35. Palo Verde monitoring site, 6 - year historical trends in 24-hour PM_{10} concentrations with trend line.

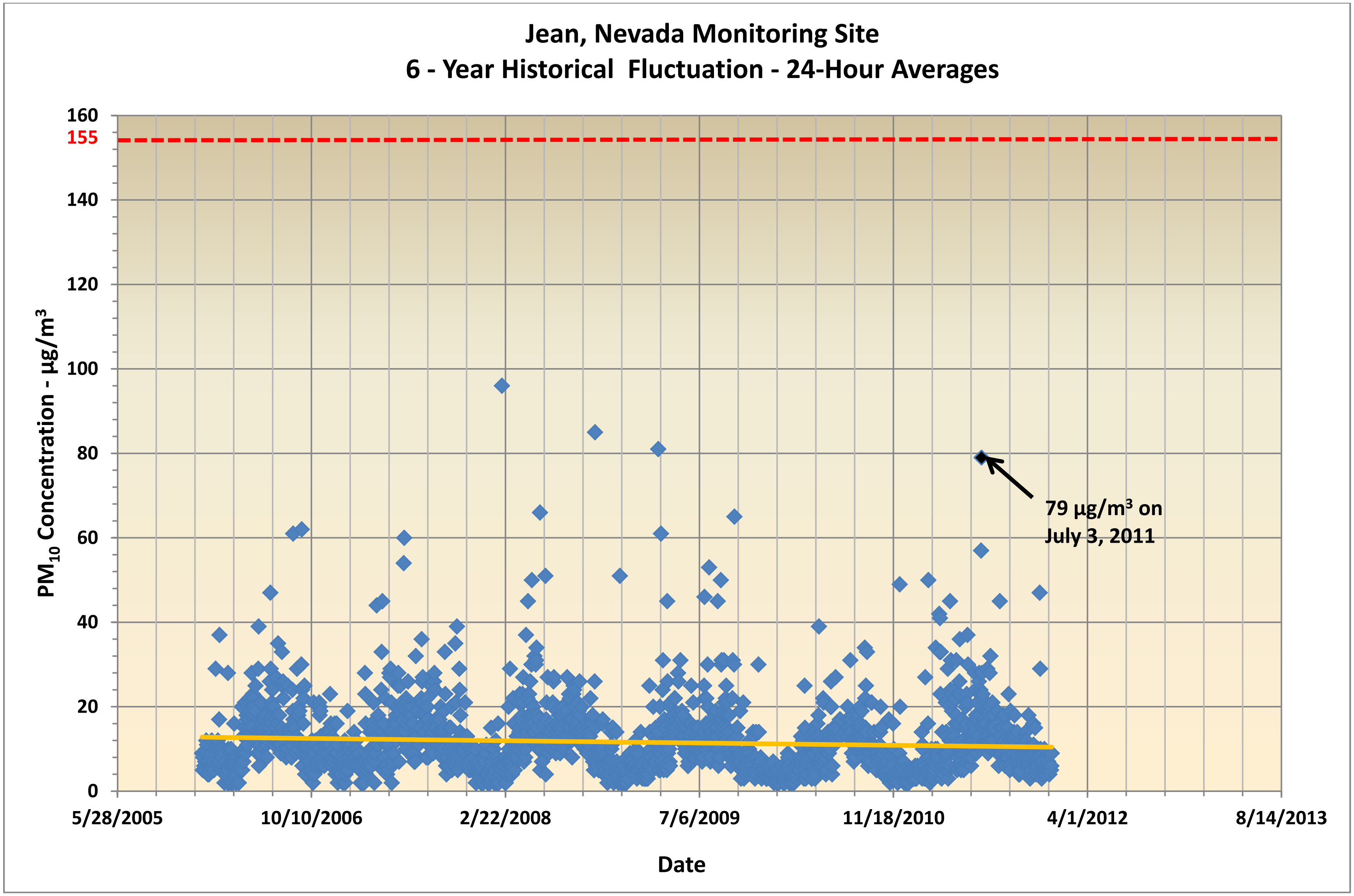


Figure 36. Jean, Nevada monitoring site, 6 - year historical trends in 24-hour PM_{10} concentrations with trend line.

Figure 37 illustrates the highest recorded concentrations for PM_{10} monitored in Clark County between 2006 and 2011 for active air quality monitors. Table 30 contains the calculated 95th and 99th percentiles for PM_{10}, which are the values that exceed all but the highest 5 percent and 1 percent of the values, respectively. Like the number of exceedances (Figure 37), maximum concentrations vary from year to year, depending on meteorological conditions. Maximum concentrations are not the best indicators of long-term trends; the 95th percentile is less influenced by extreme events and probably provides a better indication of the underlying trend in the data.

Figures 38 and 39 show a 52 percent change in 95th percentile data in Las Vegas over the last six years for all exceedance events/exceedance days; Figures 40 and 41 show a 75 percent change in the 99th percentile data for the same period for exceedance events/days. Figure 42 shows what the combined 95th and 99th percentiles with the corresponding concentration levels were for the applicable exceedance event for all hydrographic areas involved. Figure 43 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Boulder City site. Figure 44 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Sunrise Acres site. Figure 45 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the JD Smith site. Figure 46 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Green Valley site. Figure 47 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Joe Neal site. Figure 48 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Paul Meyer site. Figure 49 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Palo Verde site. Figure 50 shows both the 95th and 99th percentiles for 2011, and where the exceedance fell that year for the Jean, Nevada site.

Figure 51 shows sustained wind speeds and maximum wind gusts in 2011, and contrasts the transported dust event on July 3, 2011, with other wind speed values (sustained winds of 11.6 mph and maximum wind gusts of 31 mph) measured during the year. The measured wind values on July 3, 2011, are close to the mean value levels for the Las Vegas Valley. (The mean sustained wind and maximum wind gust values for the year are 9.1 mph and 25.4 mph, respectively.) Wind speed values played little or no causal link to the increase of fugitive dust in the area of influence around any of the monitoring sites. In fact, hourly wind speed increases in the early to late afternoon assisted the clearing of dust out of the Eldorado and Las Vegas Valleys. As a result of the high-wind transported dust event, the exceedance concentration values for PM_{10} for July 3, 2011, have occurred less than 16 percent (once since 2006) of the time over the last six years, and fall outside normal seasonal variations.

Figures 51 through 56 show the sustained and maximum wind gusts for 2011 back to 2006 for comparison with 2011 winds. Both sustained winds and maximum wind gusts for the represented years are average for the Las Vegas Valley at greater than or equal to 8 mph sustained winds and greater than or equal to 25 mph gusts.

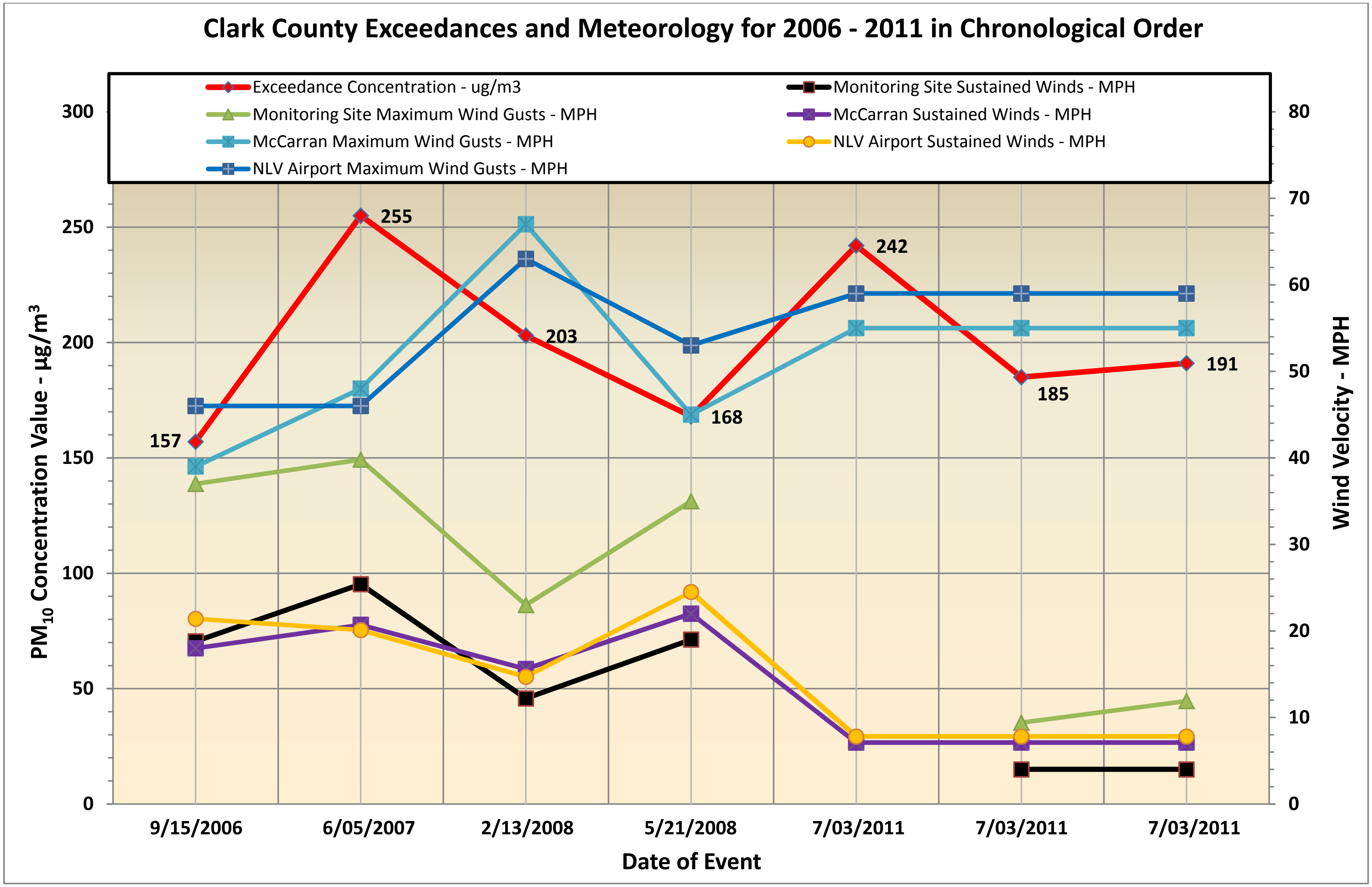


Figure 37. Clark County exceedance days in chronological order, 2006-2011.

Table 30. PM_{10} Concentration Percentages of NAAQS and 95th and 99th Percentiles Data 2006-2011

Exceedance Value - Micrograms per cubic meter ($\mu g/m^3$)	$\mu g/m^3$ % of 155 NAAQS	Month & Year	$\mu g/m^3$ 95th Percentile	$\mu g/m^3$ 99th Percentile
255	165	06/2007	75	111
242	156	07/2011	30	53
203	131	05/2008	67	124
191	123	07/2011	47	60
185	119	07/2011	44	64
168	108	02/2008	67	124
157	101	09/2006	77	79

Table 31 shows the nonattainment area's exceedance history between 2006 and 2011 for all hydrographic areas involved. There was only one case on September 15, 2006, that would have been submitted under EPA's 1996 natural event policy, if it would have been as a result of non-anthropogenic activity (i.e., the Mary Nichols memorandum). The table indicates pending action by EPA, if applicable. Exceedances caused by anthropogenic activity were not submitted for EPA review. There are two cases (February 13 and May 21, 2008) submitted under the new exceptional event rule; EPA has not taken action on those two cases prior to this exceptional event documentation package submittal.

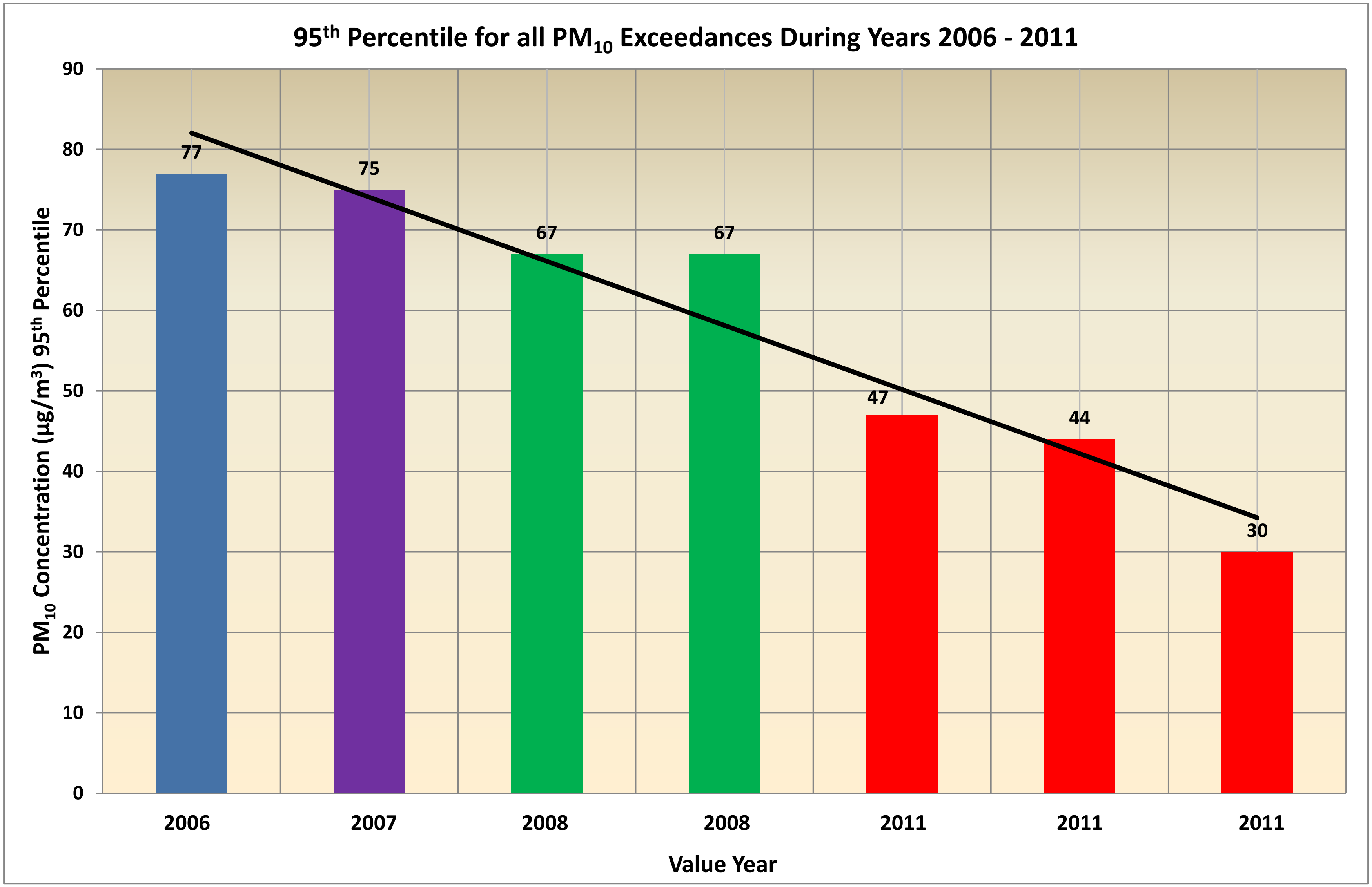


Figure 38. 95th percentile for all PM_{10} exceedances during years 2006 through 2011 with trend line.

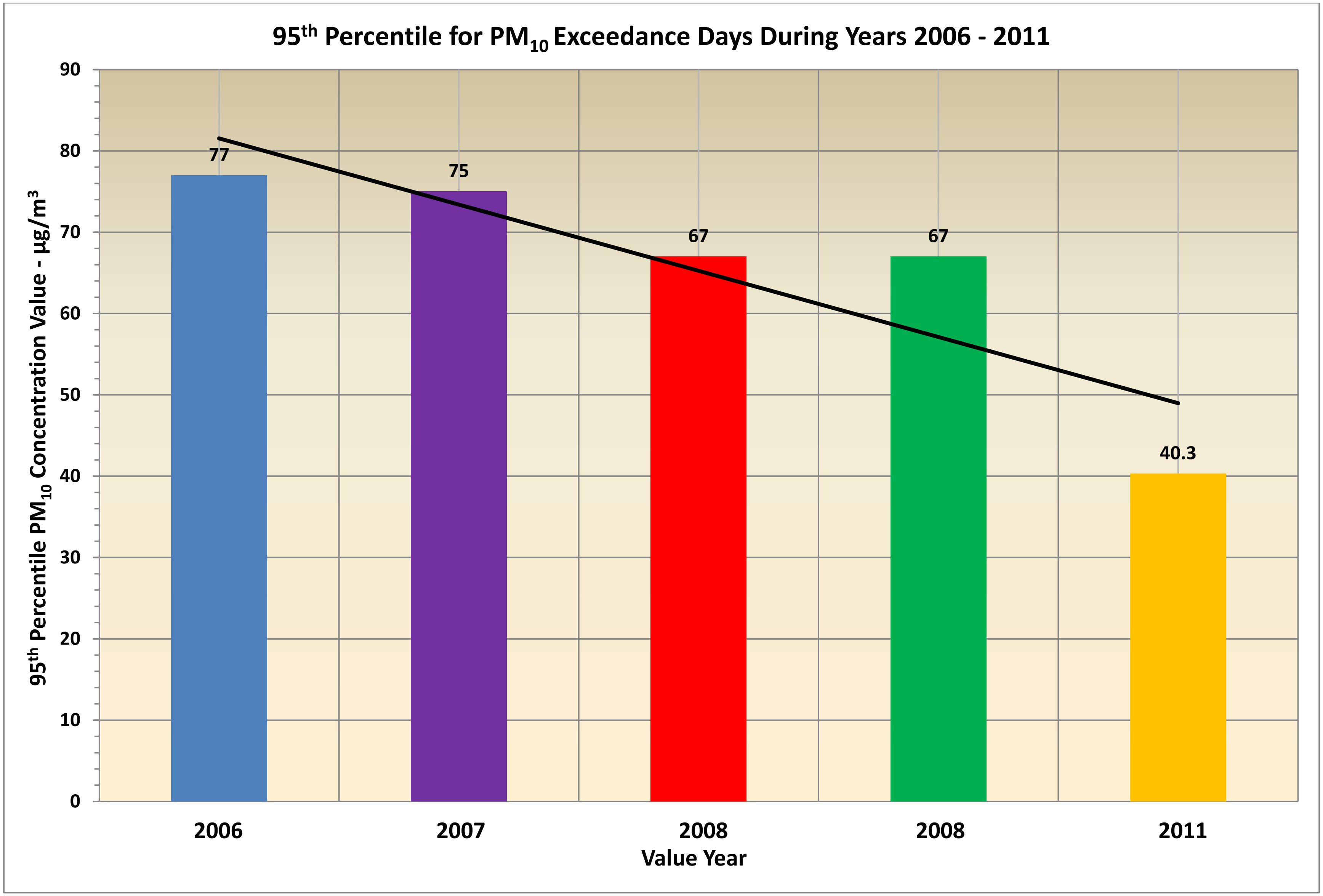


Figure 39. 95th percentile for PM_{10} exceedance days during years 2006 through 2011 with trend line.

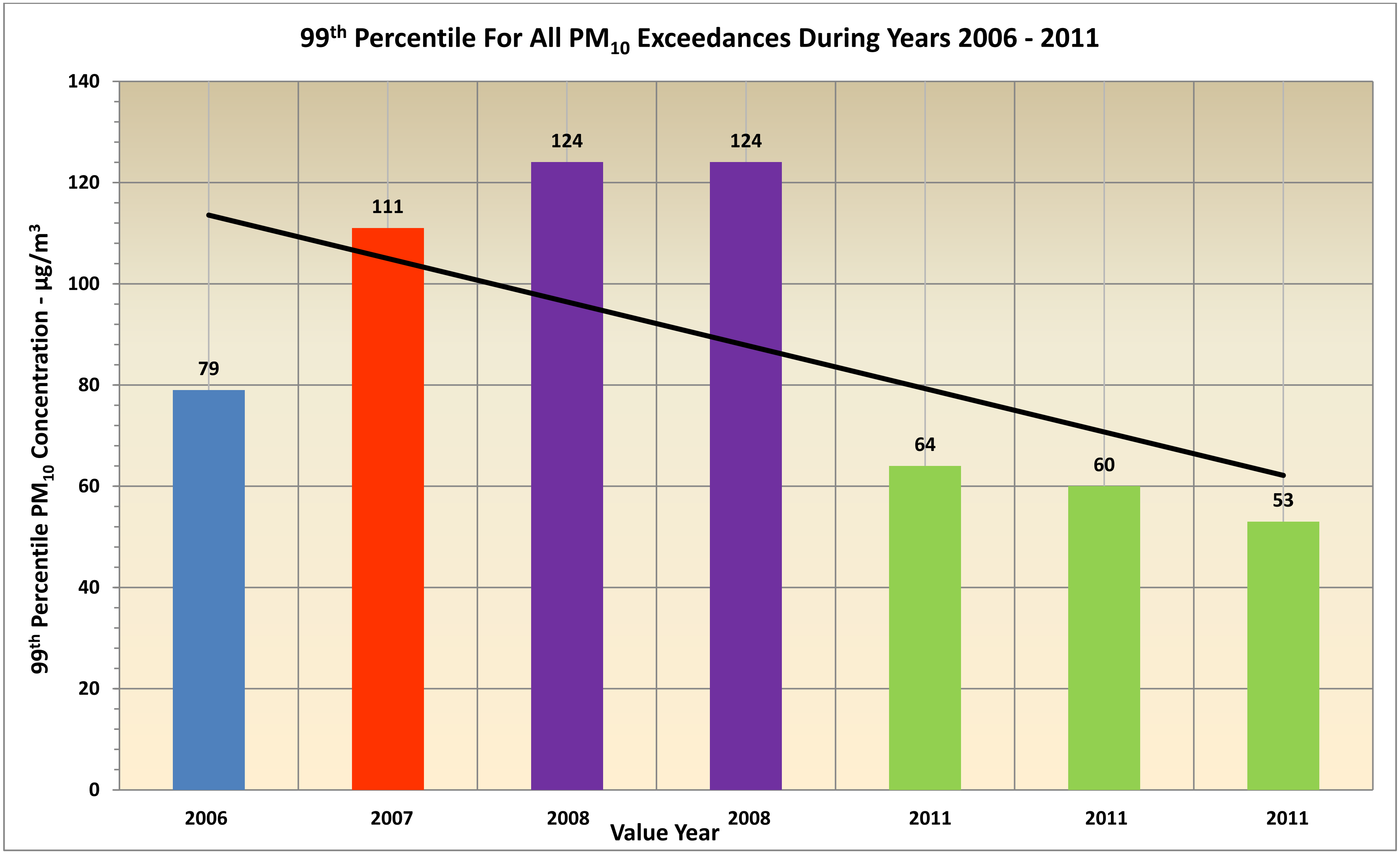


Figure 40. **99th percentile for all PM_{10} exceedances during years 2006 through 2011 with trend line.**

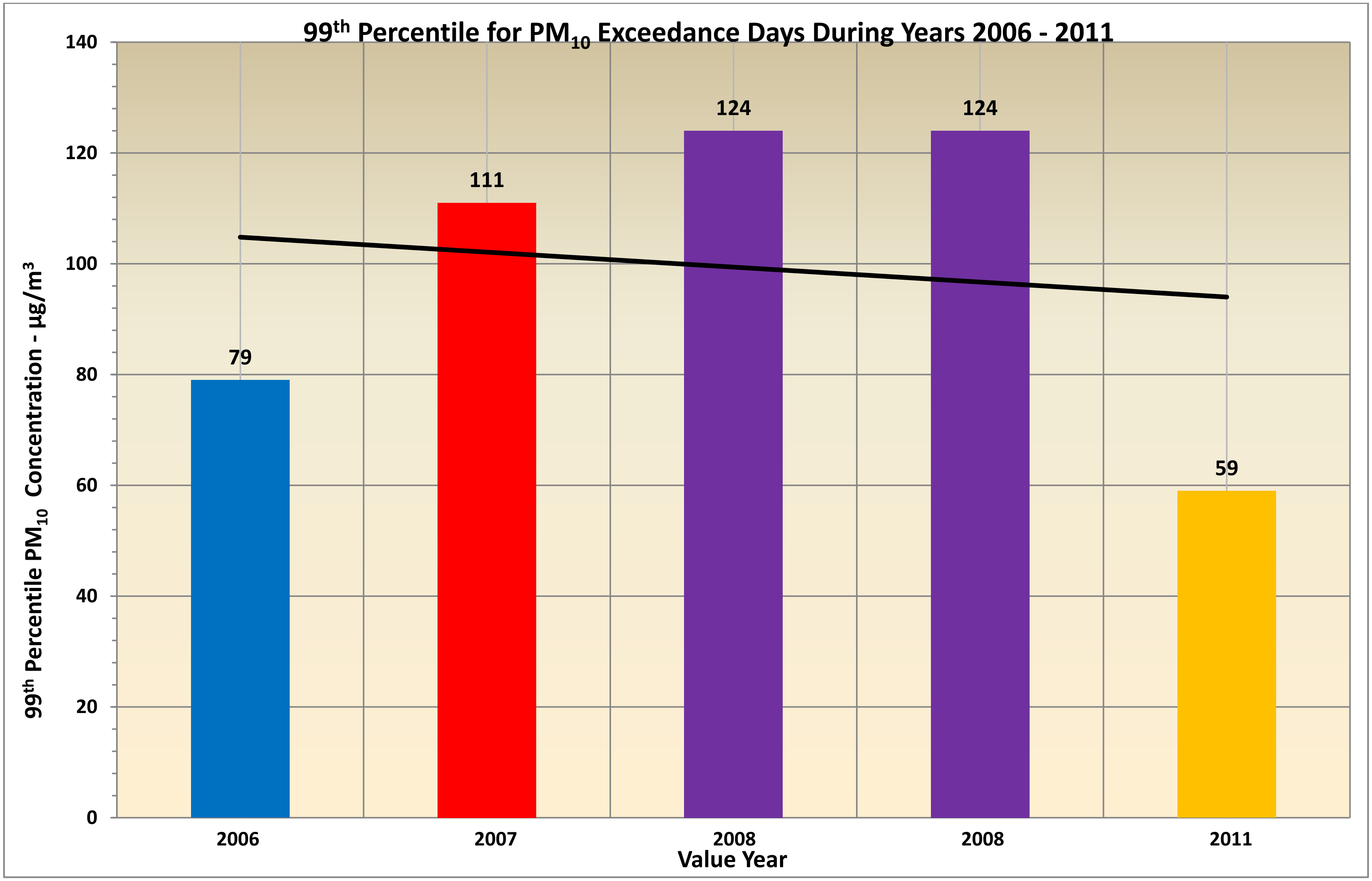


Figure 41. 99th percentile for PM_{10} exceedance days during years 2006 through 2011 with trend line.

Table 31. Clark County Exceedance History for Years 2006 – 2011 for all Applicable Hydrographic Areas

Date	μg/m³	Site ID	Name	Active Site	NAA	EPA Concur	Type Event	MSSW	MSMWG	MCSWS	MCMWG	NLVSWS	NLVMWG
20060915	157	32-003-0020	E. Craig Rd.	No	Yes-212	Anthropogenic	High Wind	18.8	37.0	18	39	21.4	46
20070605	255	32-003-0022	Apex	No	No	Anthropogenic	High Wind	25.4	39.8	20.7	48	20.1	46
20080213	203	32-003-0020	E. Craig Rd.	No	Yes-212	EPA Review	High Wind	12.2	23	15.6	67	14.7	63
20080521	168	32-003-0020	E. Craig Rd.	No	Yes-212	EPA Review	High Wind	19.0	35.0	22	45	24.5	53
20110703	242	32-003-0601	Boulder City	Yes	No	Pending EPA Review	High-Wind Transported Dust	N/A	N/A	7.1	55	7.8	59
20110703	185	32-003-2002	J.D. Smith	Yes	Yes-212	Pending EPA Review	High-Wind Transported Dust	5.0	14	7.1	55	7.8	59
20110703	191	32-003-0561	Sunrise Acres	Yes	Yes-212	Pending EPA Review	High-Wind Transported Dust	5.0	17	7.1	55	7.8	59

MSWS-Monitoring Site Sustained Winds-MPH

MSMWG-Monitoring Site Maximum Wind Gusts-MPH

MCSWS-McCarran International Airport Sustained Wind Speed-MPH
MCMWG- McCarran International Airport Maximum Wind Gusts-MPH

NLVSWS-North Las Vegas Airport Sustained Wind Speed-MPH

NLVMWG-North Las Vegas Airport Maximum Wind Gusts-MPH

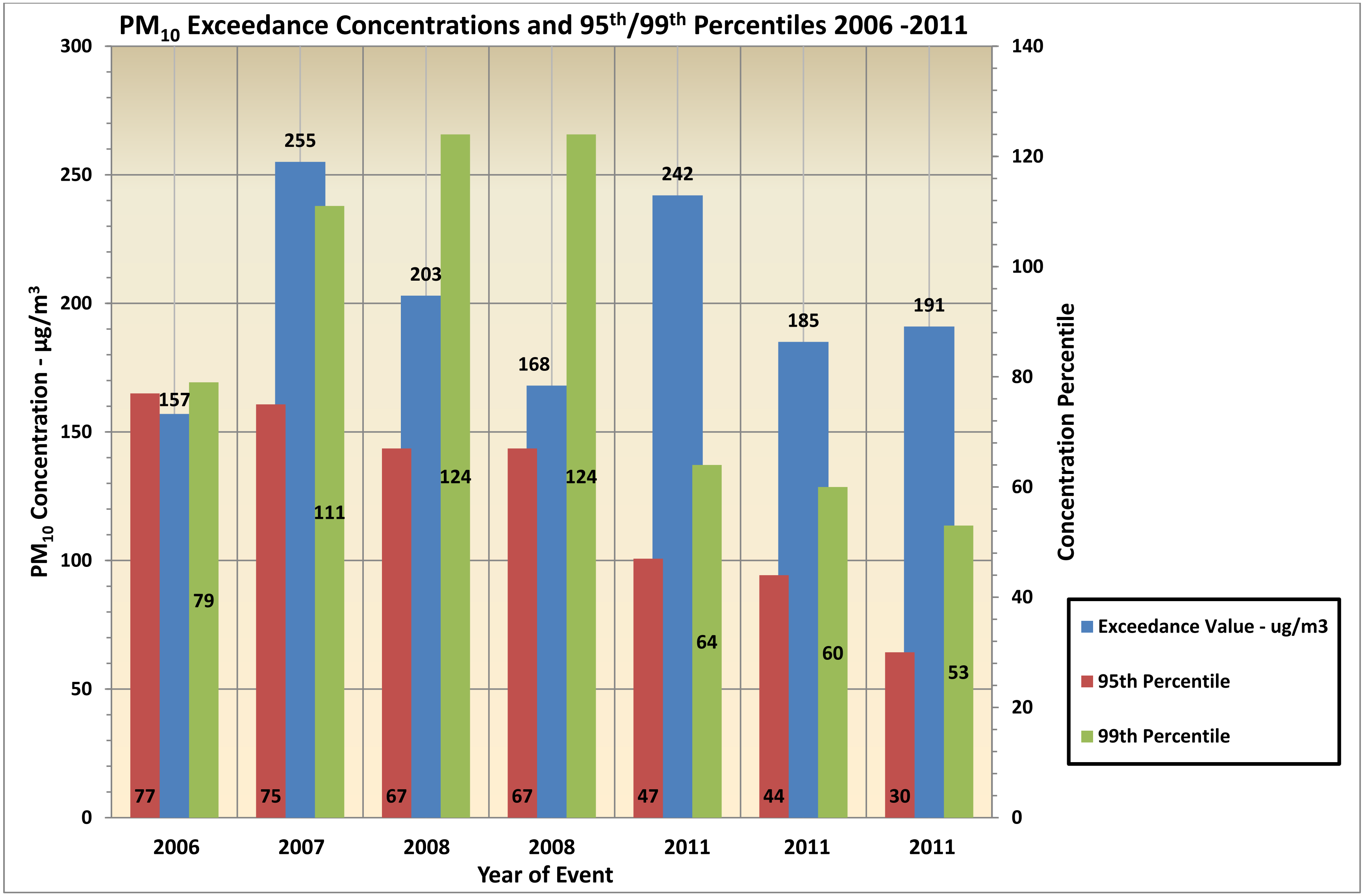


Figure 42. PM_{10} exceedance concentrations and 95th/99th percentiles 2006 – 2011.

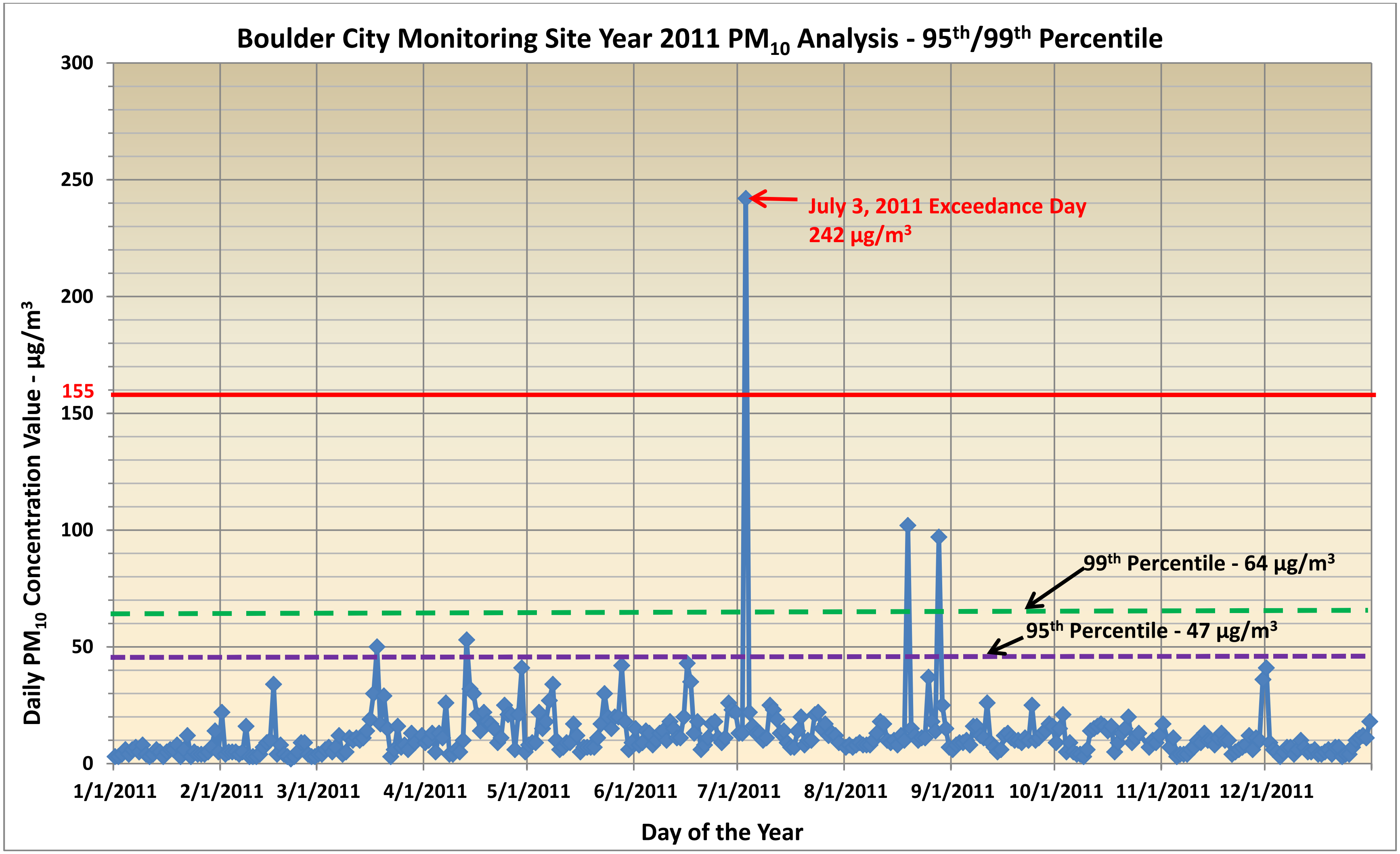


Figure 43. Boulder City PM_{10} analysis – 95th/99th percentile year 2011.

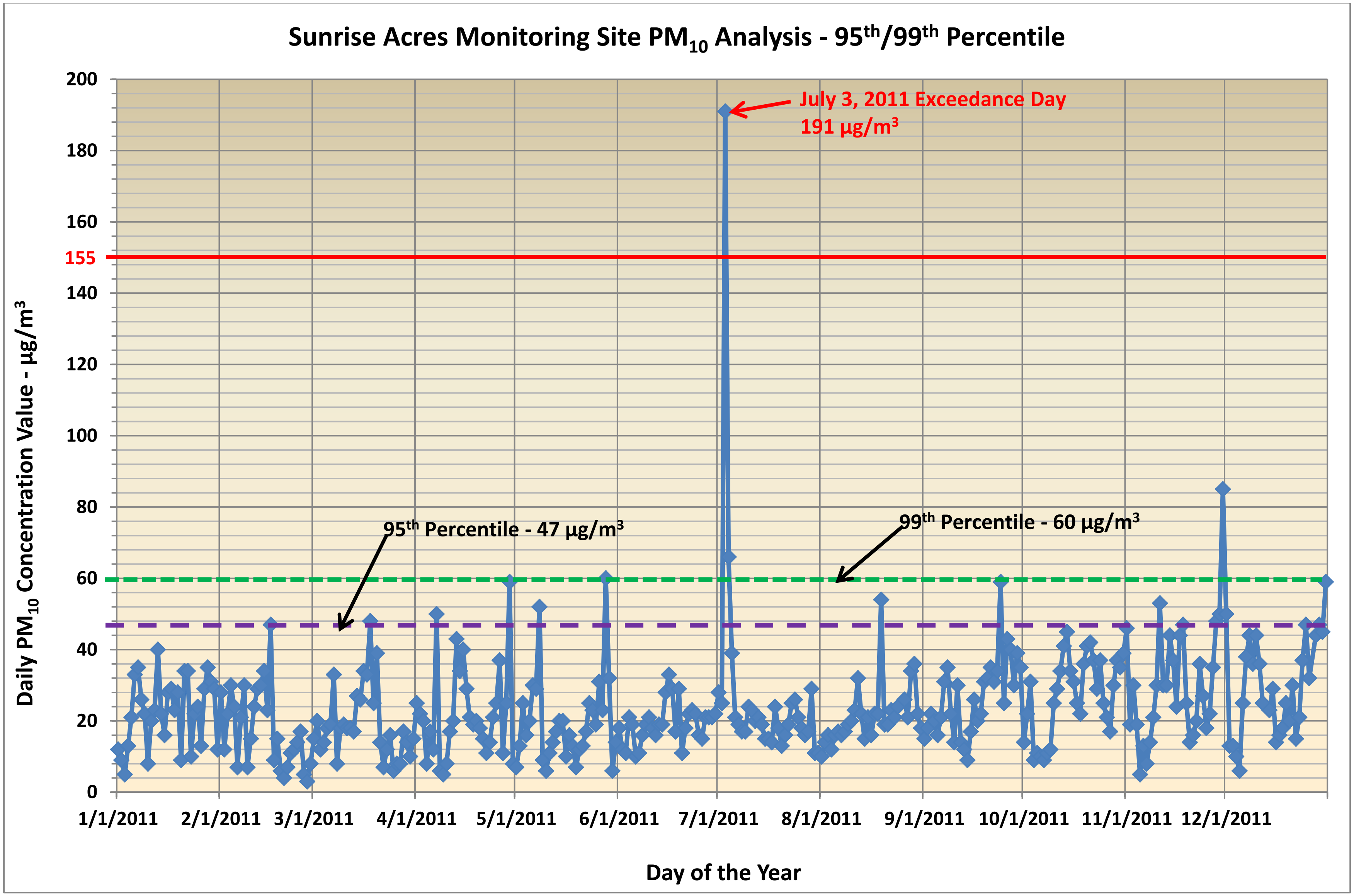


Figure 44. Sunrise Acres PM_{10} analysis – 95th/99th percentile year 2011.

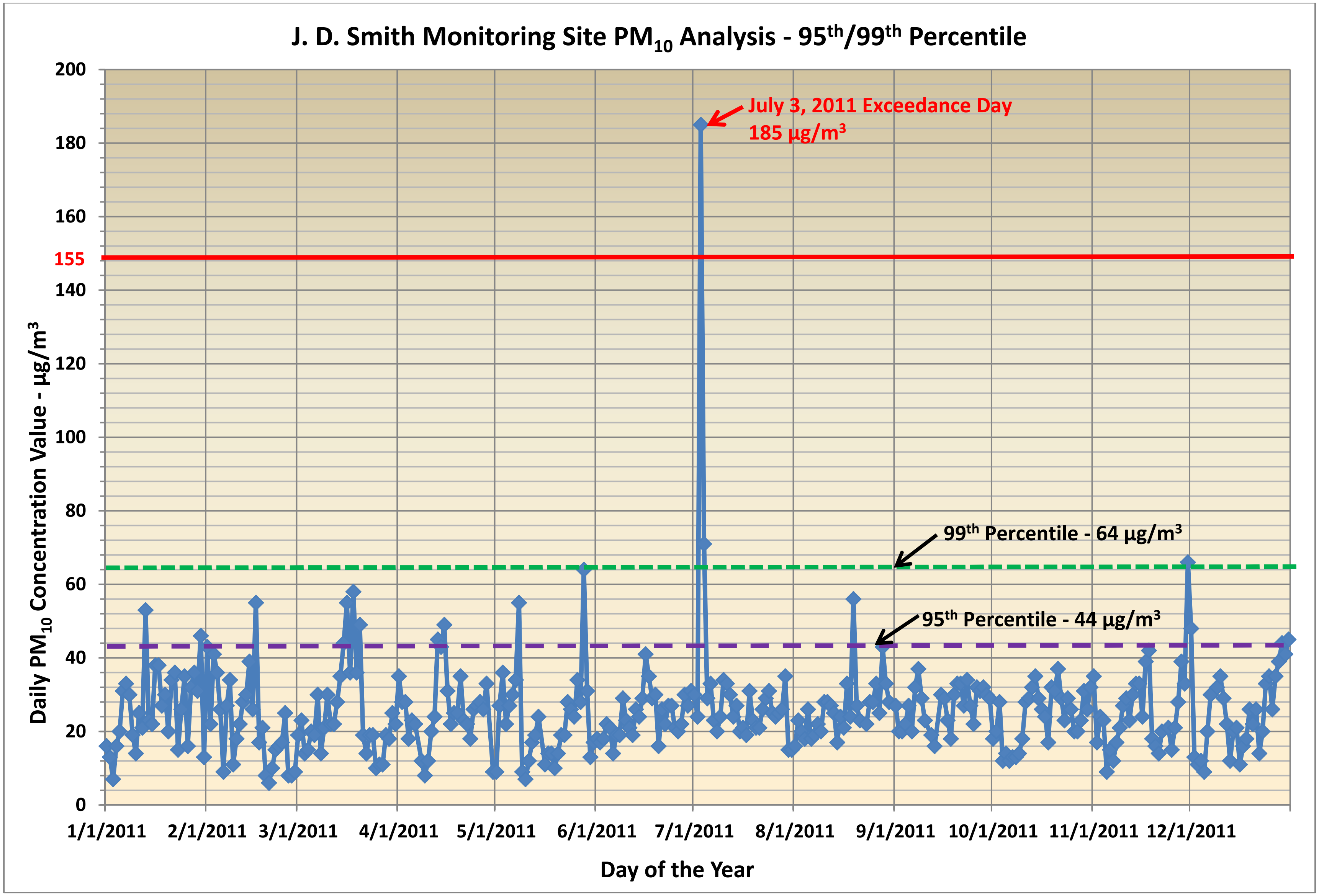


Figure 45. JD Smith PM_{10} analysis – 95th/99th percentile year 2011.

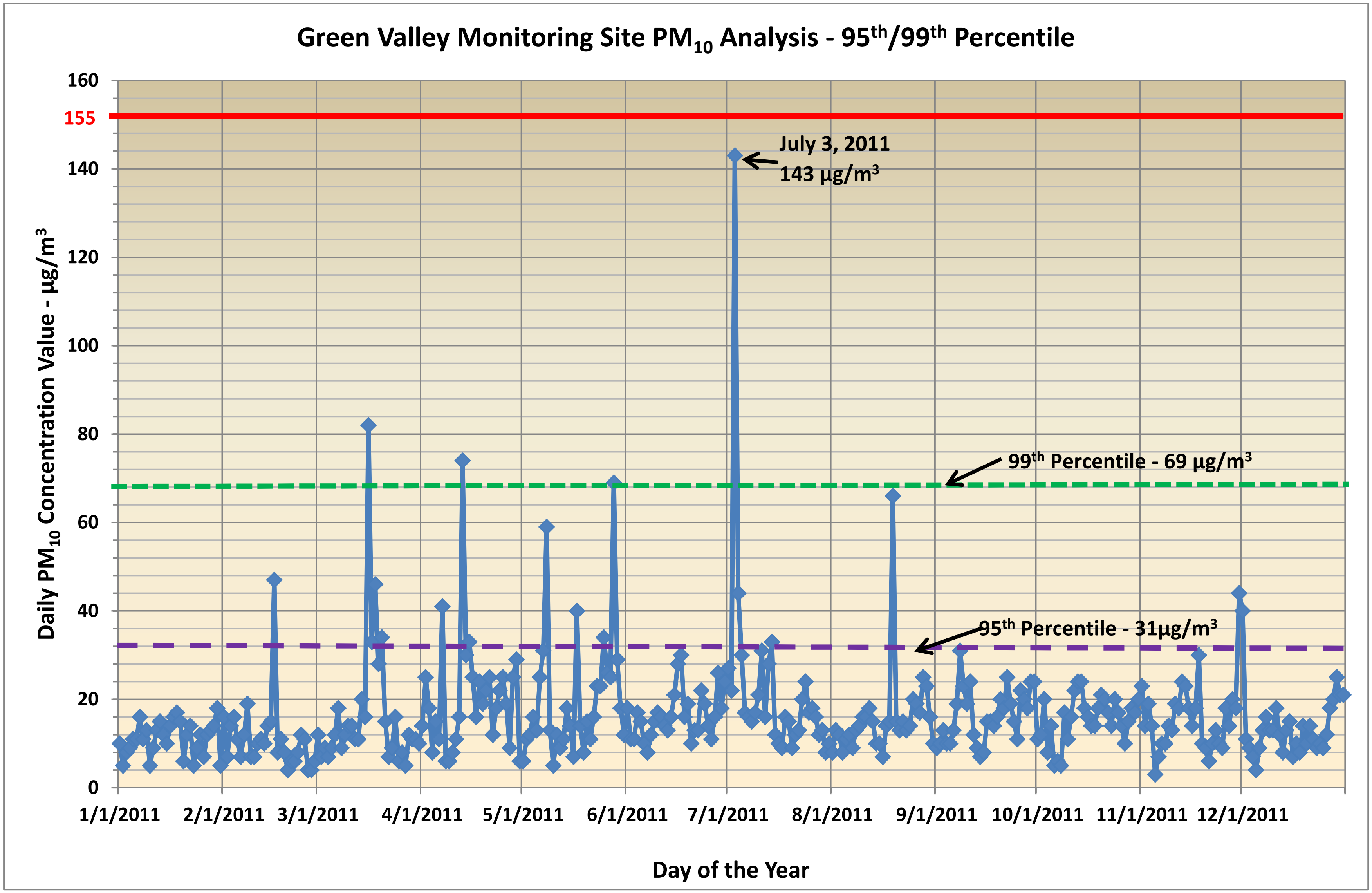


Figure 46. Green Valley PM_{10} analysis – 95th/99th percentile year 2011.

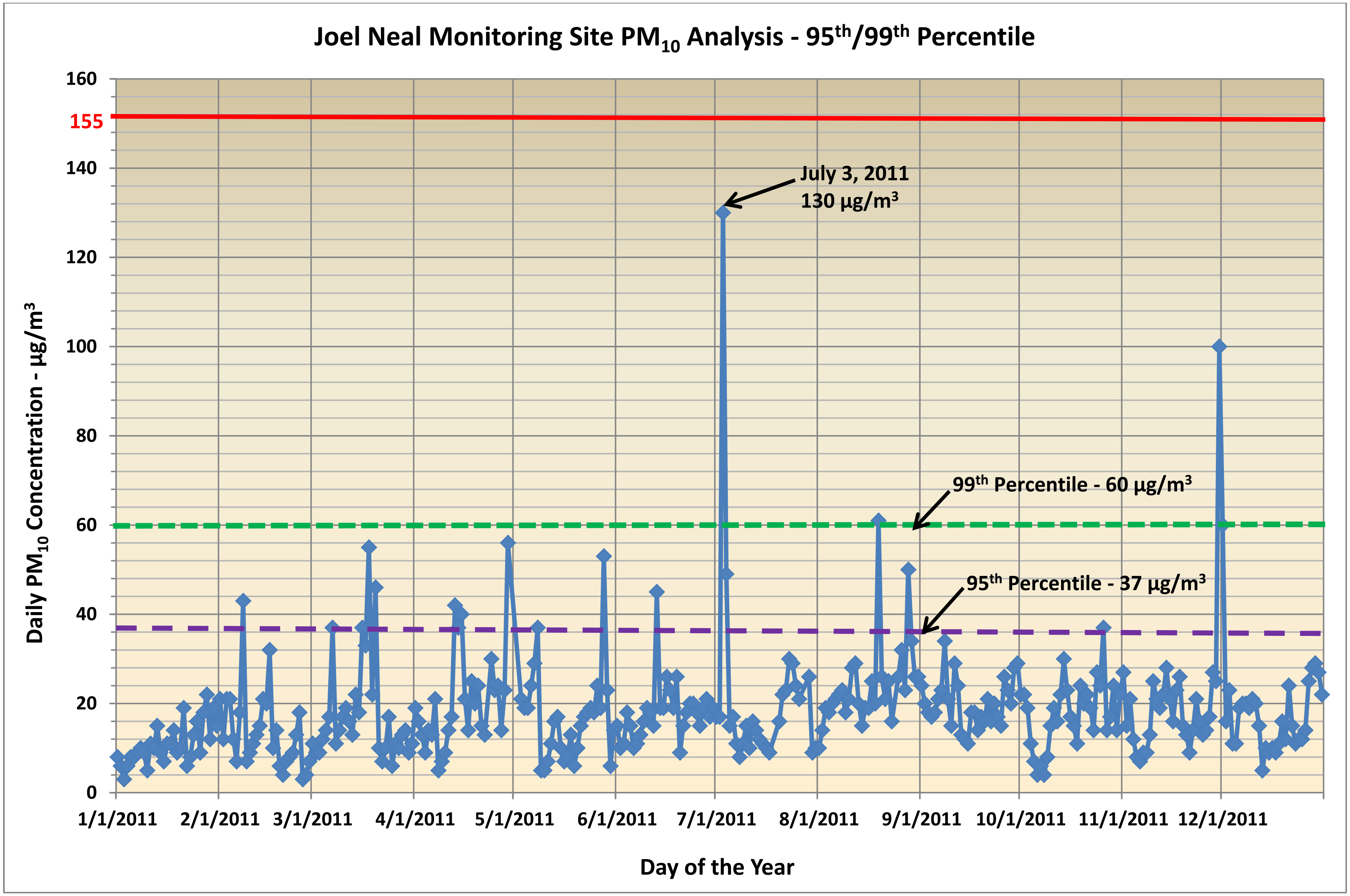


Figure 47. Joe Neal PM_{10} analysis – 95th/99th percentile year 2011.

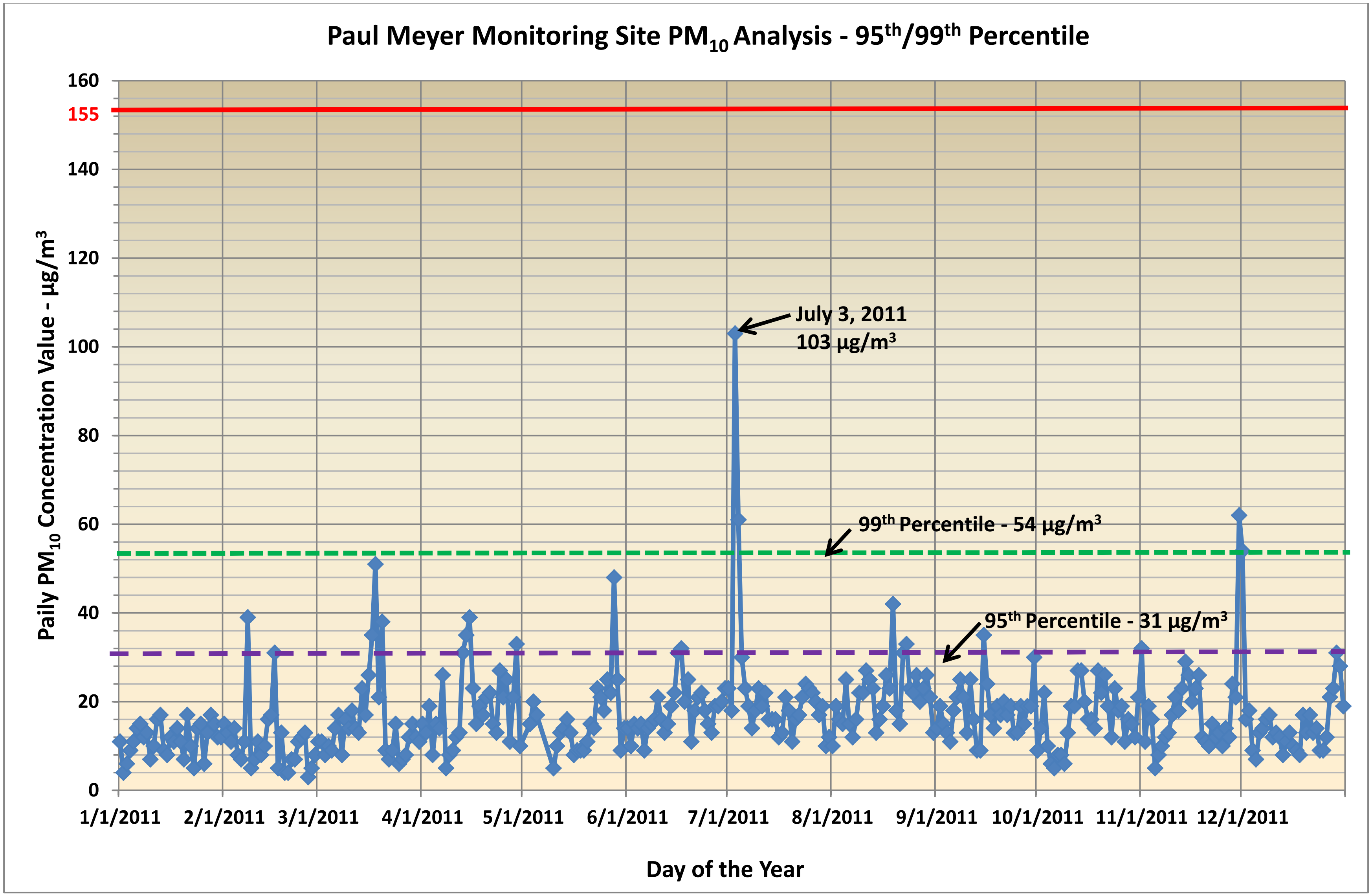


Figure 48. Paul Meyer PM_{10} analysis – 95th/99th percentile year 2011.

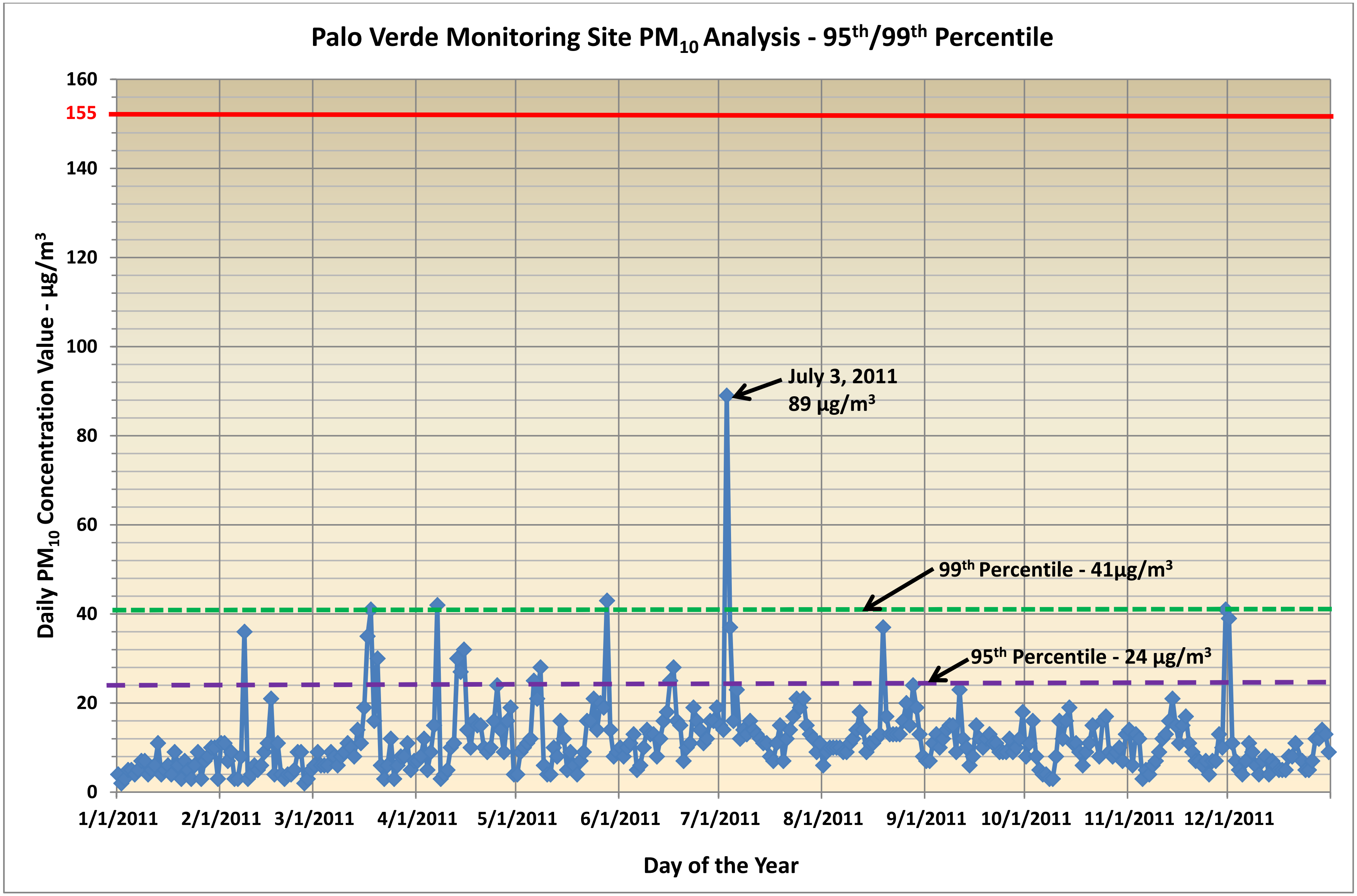


Figure 49. Palo Verde PM_{10} analysis – 95th/99th percentile year 2011.

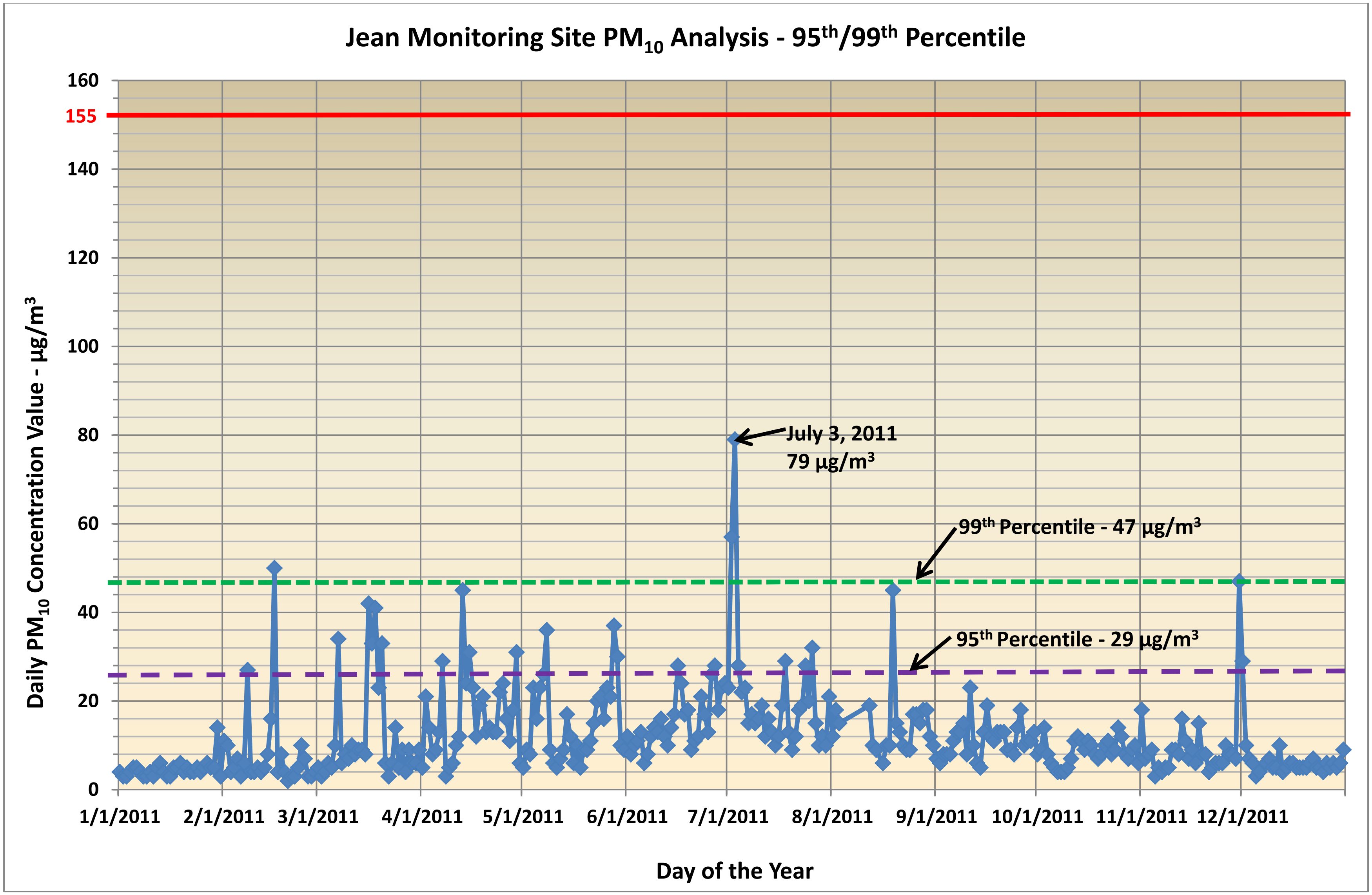


Figure 50. Jean PM_{10} analysis – 95th/99th percentile year 2011.

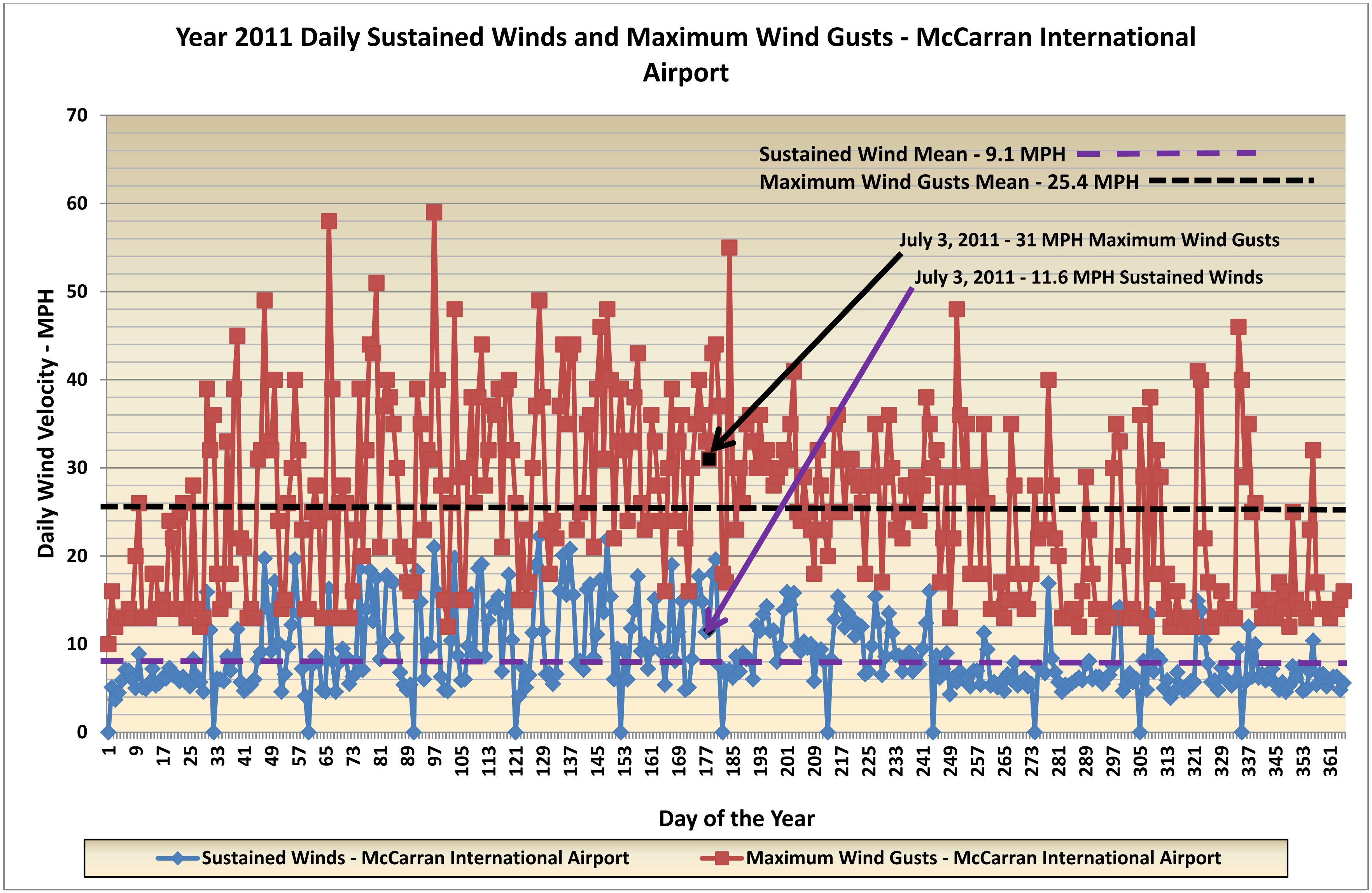


Figure 51. McCarran International Airport sustained winds and maximum wind gusts in 2011.

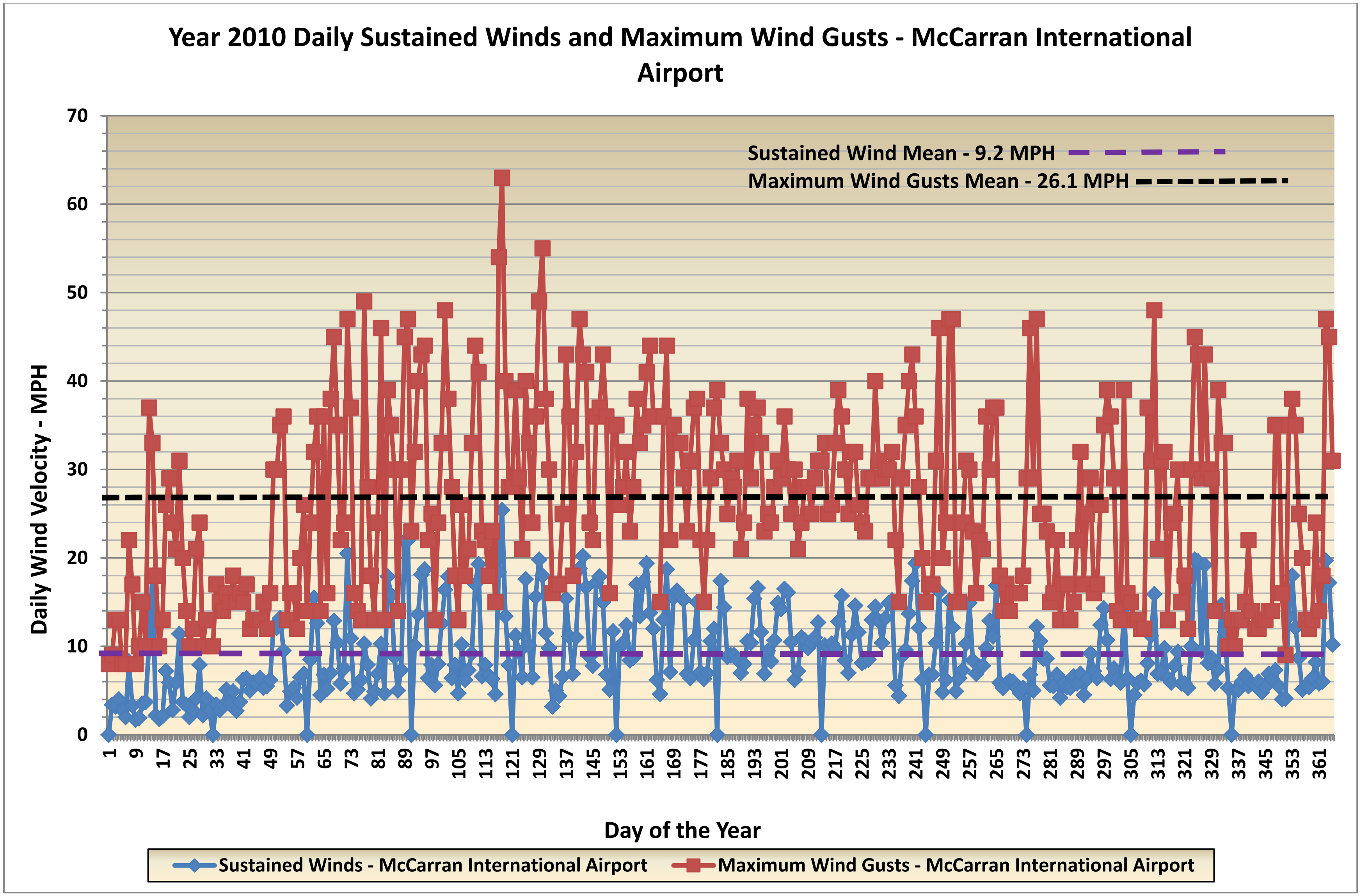


Figure 52. McCarran International Airport sustained winds and maximum wind gusts in 2010.

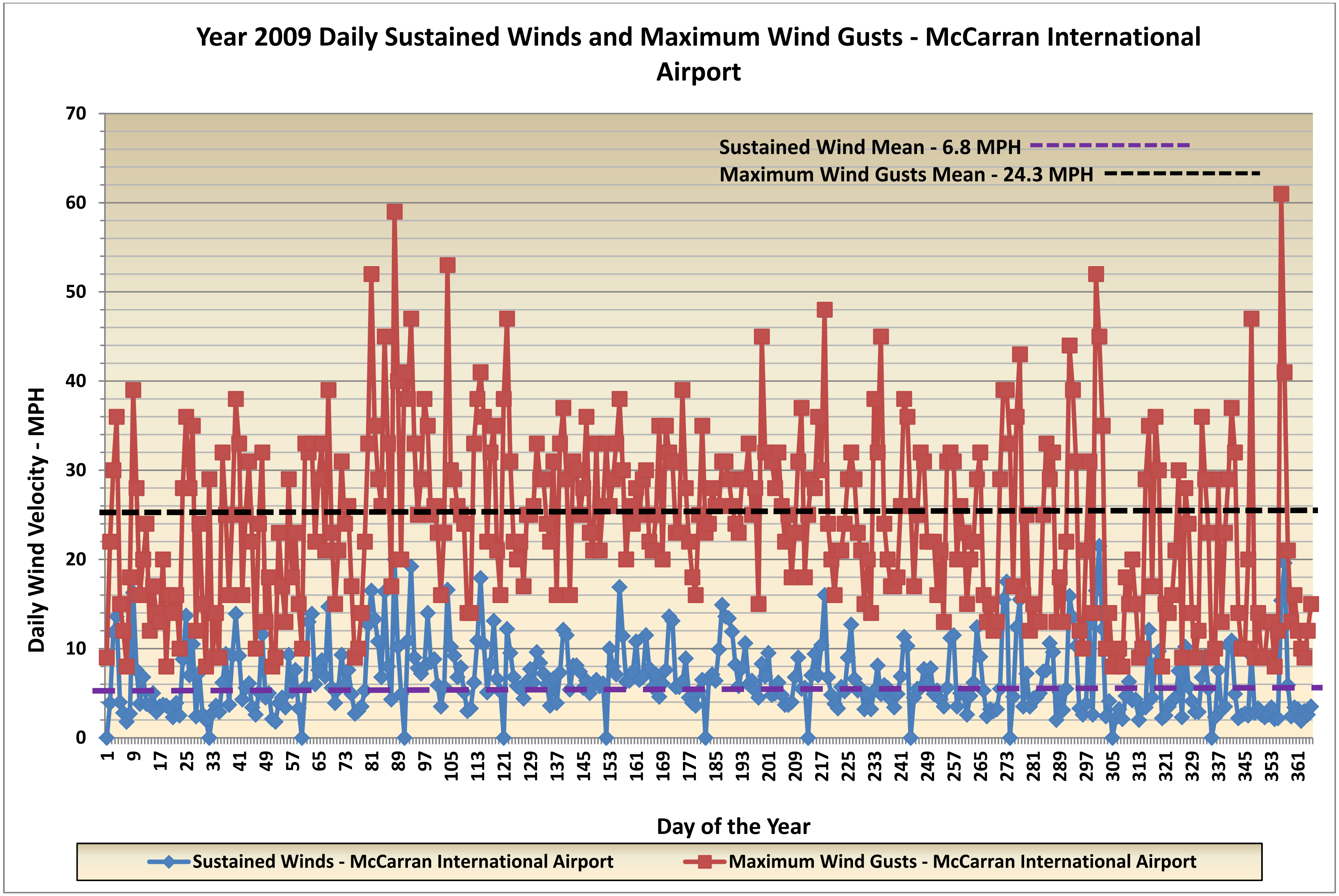


Figure 53. McCarran International Airport sustained winds and maximum wind gusts in 2009.

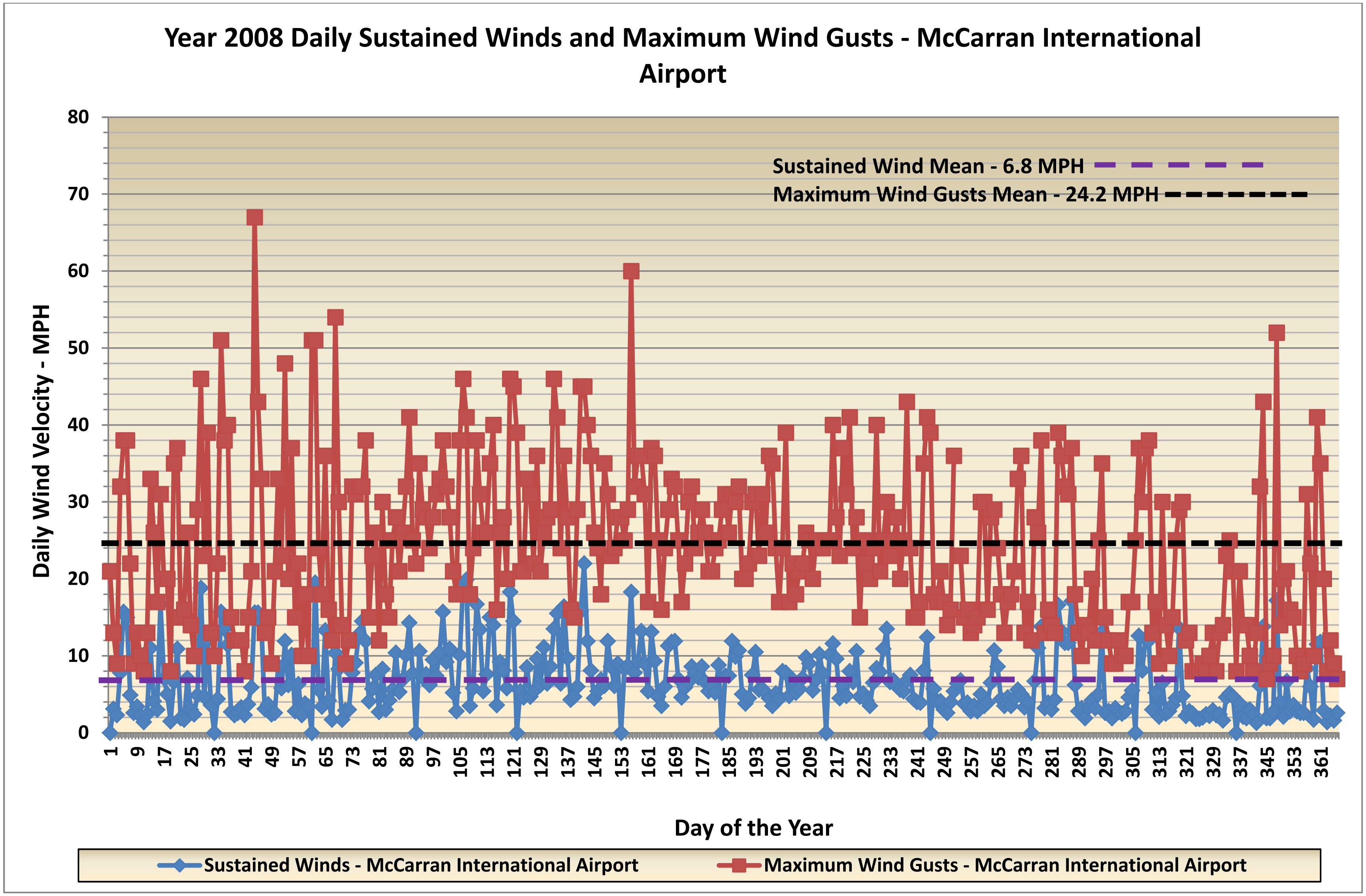


Figure 54. McCarran International Airport sustained winds and maximum wind gusts in 2008.

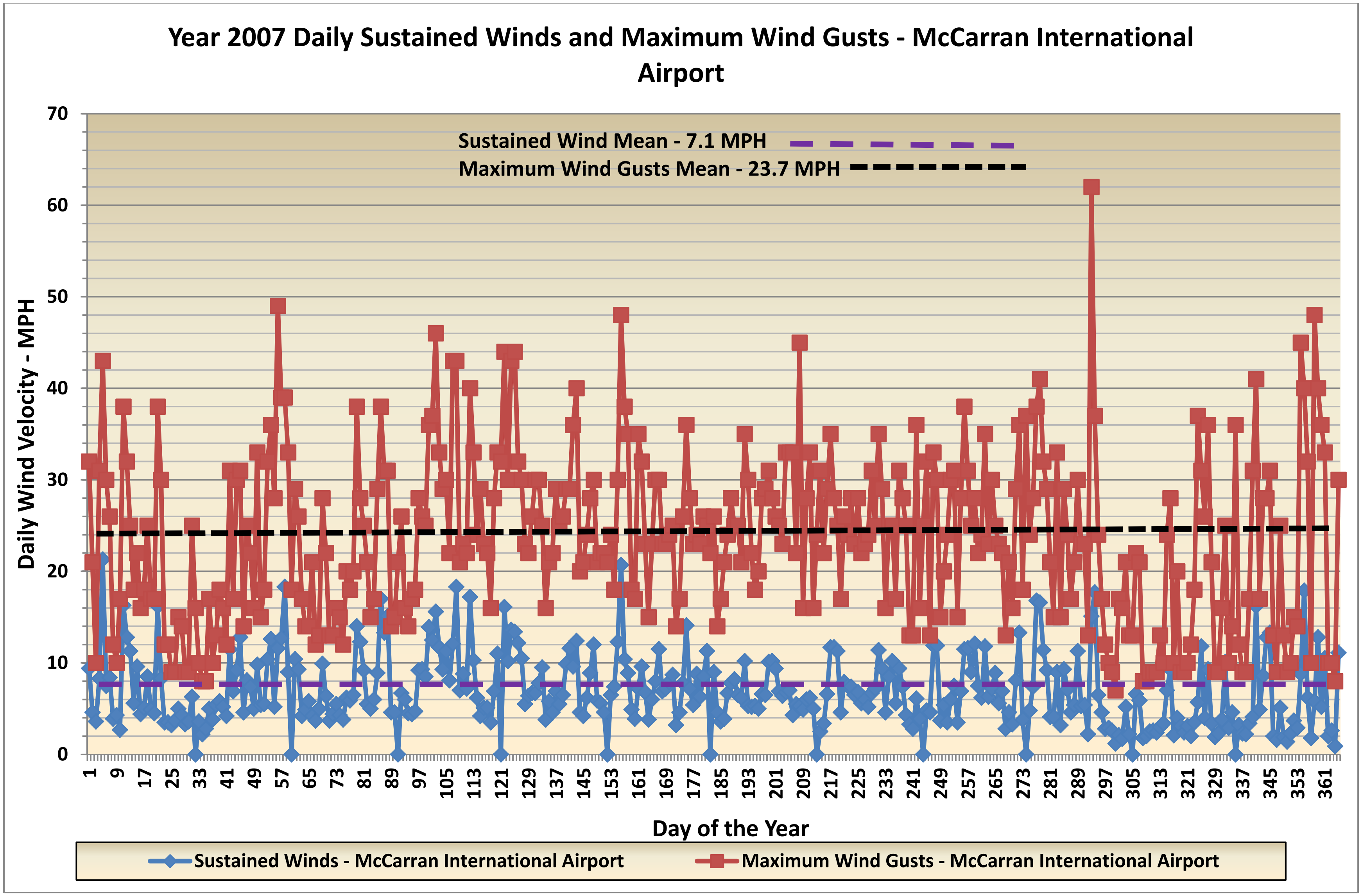


Figure 55. McCarran International Airport sustained winds and maximum wind gusts in 2007.

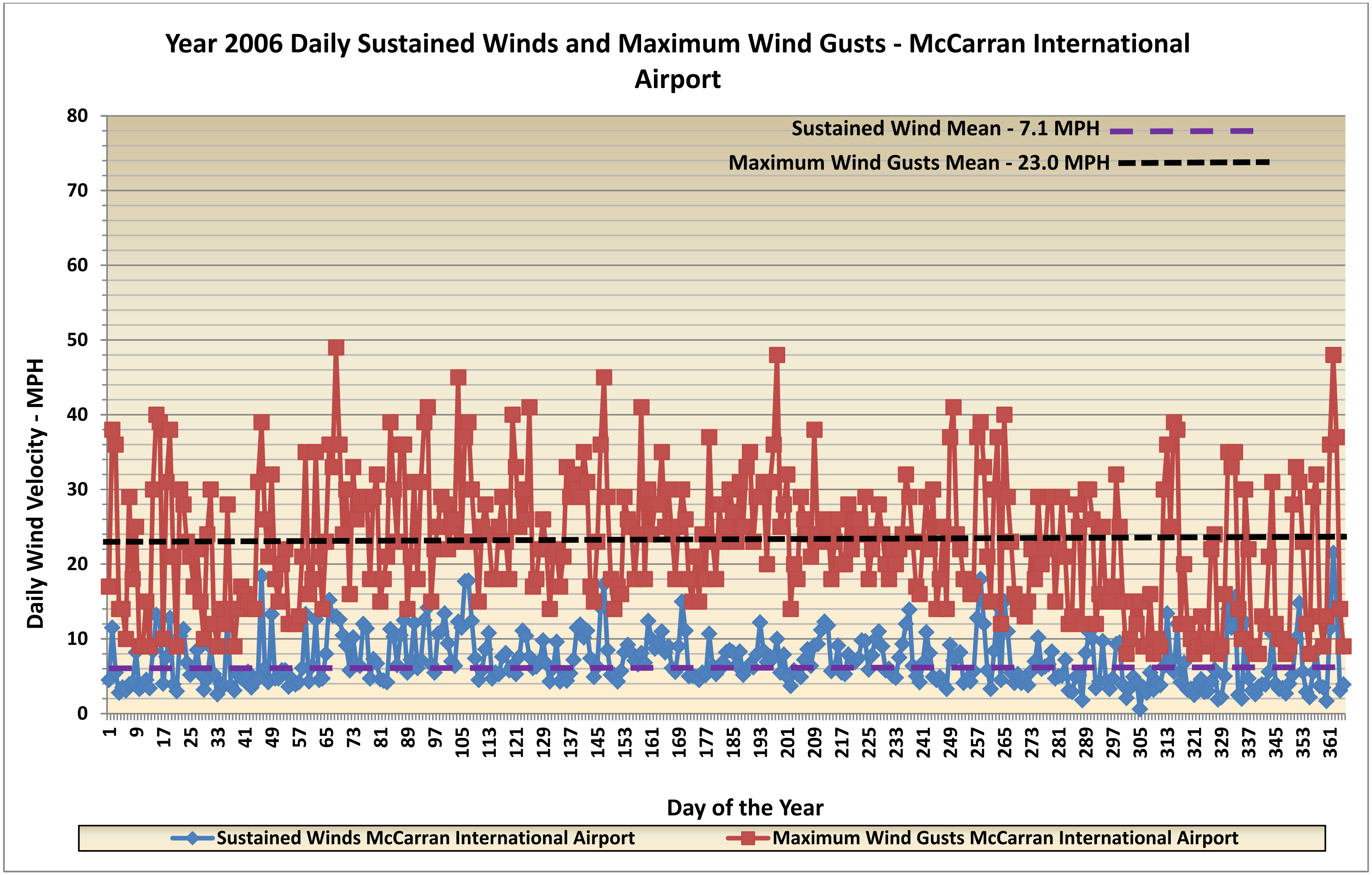


Figure 56. McCarran International Airport sustained winds and maximum wind gusts in 2006.

Table 32 shows the measured mean average values for sustained winds and maximum gusts between 2006 and 2011 at McCarran International Airport. Although the valley often experiences some elevated winds in July, the sustained winds and wind gusts experienced on July 3, 2011, are average and did not contribute to the exceedances.

Table 32. Annual Mean Wind Velocities for Sustained Winds and Maximum Wind Gusts at McCarran International Airport, 2006 through 2011

MCWS[1] (mph)	MCMWG[2] (mph)	Year[3]
7.1	23.0	2006
7.1	23.7	2007
6.8	24.2	2008
6.8	24.3	2009
9.1	26.1	2010
9.1	25.4	2011
7.66	***24.45***	***Six Year Average for Airport***

[1]MCWS = Daily Average Sustained Winds (McCarran International Airport).
[2]MCMWG = Maximum Daily Average Wind Gusts (McCarran International Airport).
[3]Annual local climatological data for 2006-2011 from National Oceanic and Atmospheric Administration's National Climatic Data Center

3.0 EVENT DATA

Tables 6-29 list readings for the days before, during, and after the exceptional event for all PM_{10} sites. These data clearly show that the event occurred on July 3, 2011, between 0600 and 1900 PST. The wind direction was predominantly from the southeast from the source area to the southwest desert area's storm cells from Phoenix, Arizona. This dust continued both northwest and northeast up the Colorado River corridor to Boulder City and continued into the Las Vegas Valley to the northeast. Once in the Vegas Valley a drift of winds to the northwest occurred once the bulk of the dust pollution had reached the Las Vegas Valley. Monitoring sites measured peak gusts of 30 mph and sustained two-minute winds of 11.6 mph for better than half of the day.

Other supporting documentation includes meteorological data and analysis (e.g., wind speed and wind direction); HYSPLIT model and trajectory runs with full meteorological analysis; hourly PM_{10} sampled mass compared to wind data to support a source/receptor relationship; precipitation data; and photographs and maps of the area showing emission sources.

If the dust sources contributing to a transported dust event are anthropogenic, the state must document the application of applicable reasonable control measures to those sources. Section 5.0, Rule Effectiveness, describes the application of BACM to these sources.

As set forth in the proceeding analysis, this section demonstrates that the high-wind transported dust event on July 3, 2011, affected the monitoring sites that recorded a PM_{10} exceedance that day. Emissions generated by this event caused an exceedance of the 24-hour PM_{10} NAAQS, which would not have occurred ***but for*** the high-wind transported dust event.

The DAQ sent the air quality data affected by the high-wind transported dust event to EPA on December 12, 2011, for inclusion in the AQS database, as required by 40 CFR 50 and 51.

3.1 METEOROLOGY ASSESSMENT FOR THE DUST EVENT

3.1.1 Weather Summary

Information about the meteorological conditions associated with the July 3, 2011, exceedance of the 24-hour PM_{10} ambient air quality standard at the DAQ Boulder City, Sunrise Acres, and JD Smith monitoring stations (FEM sites, CAMS 0601, 0561, and 2002, respectively) is presented in this section. The portion of the Exceptional Event rule (Title 40 CFR Part 50.14) that is most relevant to this case is on "PM_{10} exceedance that affects ambient particulate matter concentrations through the raising of dust or through the re-entrainment of material that has been deposited" (72FR55, p13565, IV.E.5.c). During this event there were numerous storm cells and outflow boundaries out of the source area toward Bullhead City, Arizona and Laughlin, Nevada. The effects of this storm continued up the Colorado River corridor northeast to the Eldorado Valley (Boulder City, Nevada) and into the Las Vegas Valley on July 3, 2011. The details of the event from Bullhead City, Arizona, are discussed next.

In summary, the excessive ambient PM_{10} concentrations were due to several factors. A strong outflow boundary moved through the Bullhead City, Arizona area at 04:15 PST on July 3, 2011, which raised a large amount of dust and dropped visibility down to 2 miles (as reported by the national weather service observations and forecast discussion). The large mass of suspended dust moved north, and into parts of southern Clark County. Monsoonal flow continued to cause the transport of suspended dust into Boulder City, and into the central and eastern portions of the Las Vegas Valley throughout the remainder of the day. The orientation of the weak ridge kept most of the suspended dust from reaching the Jean, Nevada, monitoring site and the western portions of the Las Vegas Valley. With the exception of Jean and the western portions of the Las Vegas Valley, all sites in Clark County that measure PM_{10}, experienced elevated levels but only 3 sites exceeded the 24-hour NAAQS. The low wind speeds during the hours of maximum PM_{10} concentration deposits show this as a drifting and settling of dust into the area and not a local high-wind event but the result of high-wind conditions outside of Clark County that facilitated the dust to be transported to the Eldorado and Las Vegas Valleys. The orientation of the weak ridge is what kept the suspended dust from reaching Jean and the western portions of the Las Vegas Valley. Thus, there is a clear causal relationship between the PM_{10} exceedance and the high-wind transported dust from the source area which traveled northeast up the Colorado River corridor.

3.1.2 Weather Data Resources

3.1.2.1 Local Climatological Data

Hourly surface weather observations are documented in the local climatological data reports from McCarran International and North Las Vegas Airports. These quality-controlled data were obtained from the National Climatic Data Center. The hourly data are observations made over the period of a few minutes in the end of an hour; gusts are noted when the value exceeds 10 knots greater than the average during the observation.

Hourly values of wind speed average, wind speed gust, and resultant wind direction from the DAQ monitoring stations are included in the analysis. The hourly sampling period at the DAQ stations is an important distinction from the local climatological data that consist of observations made over the period of a few minutes.

Surface and upper-air pressure charts produced with the National Oceanic and Atmospheric Administration (NOAA) models were used in the analysis.

3.1.2.2 Clark County Monitoring Stations

DAQ's exceptional event analysis includes hourly values for wind speed average, wind speed gust, and wind direction from two of its monitoring stations in the Las Vegas Valley and one site in the Eldorado Valley.

3.1.2.3 Weather Charts

The DAQ used NOAA surface and upper air pressure charts in its analysis.

Surface Charts

- Areas of high and low pressure are shown with H or L.
- Lines of equal pressure (isobars, reduced to sea level) are shown with pressure value labels in millibar (mb). Closely spaced isobars typically indicate areas of stronger winds.
- Cold fronts are shown in blue with triangular wedges, and warm fronts are shown in red with semi-circular shapes. Both shapes point toward the direction of motion. A red and blue line with a mixture of cold and warm front symbols is a stationary front, showing a boundary between two air masses without appreciable motion.
- Purple lines with circles and wedges are examples of an occluded front, which is a mixture of cold and warm fronts overlapping in the vertical direction. An orange dashed line indicates a "trough," which is an area of low pressure.

Upper Air Charts

Upper-air synoptic scale charts show the pressure systems aloft, which strongly influence the near-surface conditions. The 250-millibar charts altitude is near the level of the core of the jet stream, so the tracks of the jet streams can be seen very clearly on this chart. The jet stream indicates the direction of flow of the wind, which is generally from west to east throughout most of the subtropics, mid- and high-latitudes. It is the steering mechanism for low-pressure systems. Momentum of jet stream carves the trough ridge pattern. If the jet stream winds are greater on the left side of a trough, the trough will become more amplified and move further south. If the jet stream winds are greater on the right side of a trough, the trough will become less amplified with time and move further north. This pressure level occurs approximately 12,000 meters (about 40,000 feet) above mean sea level.

The solid lines on the charts are heights of the 250 mb pressure surface in decameters (tens of meters). Thus, a height of 12,100 meters would appear as 1210. As with the surface chart, closely spaced lines indicate stronger winds.

In meteorological applications, a common representation of the synoptic scale weather conditions is the 500-millibar pressure pattern chart. This pressure level occurs approximately 5,600 meters (about 18,000 feet) above mean sea level; it is approximately one-half the average sea-level pressure. Features of the charts include the following graphical illustrations: the solid lines on the charts are heights of the 500 mb pressure surface in decameters; thus, a height of 5,600 meters would appear as 560; as with the surface chart, closely spaced lines indicate stronger winds.

A final common representation of the synoptic scale weather conditions in meteorological applications is the 850 mb pressure pattern chart. This pressure level occurs approximately 1,500 meters (about 5,000 feet) above mean sea level. Features of the charts include the following graphical illustrations: the solid lines on the charts are heights of the 850 mb pressure surface in decameters; thus, a height of 1,500 meters would appear as 150; as with the surface chart, closely spaced lines indicate stronger winds.

Features of the 250-mb, 500-mb, and 850-mb charts include the following graphical illustrations:

- Areas of low and high pressure are noted. A circular pattern of height lines around a low-pressure area is called a "closed Low"; this indicates a strong system. A "trough" of low pressure typically appears as a V-shaped pattern of height lines. A "ridge" of high pressure typically appears an inverted V-shaped pattern.

- These charts usually include the wind data at the upper-air station as arrow-shaped line figures as shown. The shaft of the arrow shows the direction from which the wind blows, with the reference point being on the upper-air station location. The "feathers" on the back of the arrow shaft indicate speed; a solid line is ten knots, and a triangle is 50 knots. (One knot is about 1.15 miles per hour). A colored scale for wind speeds is located on the bottom of these charts.

The trajectory plots presented were created using the NOAA HYSPLIT model run in the EPA AIRNow-Tech system. Features of the plots are discussed in Section 3.4.2.

3.2 MONITORING NETWORK MEASUREMENT BACKGROUND

Figure 57 is a map of the Las Vegas Valley showing the air quality monitoring stations referenced in the analysis. Figure 58 is a map of the overall Clark County PM_{10} monitoring network. Figure 59 is a map of the Boulder City (Eldorado Valley) monitoring site referenced in the analysis. Figure 60 is a map of the Jean (Ivanpah Valley) monitoring site referenced in the analysis. Figures 61, 62, 63, 64, 65, and 66 are maps of the Green Valley, JD Smith, Joe Neal, Palo Verde, Paul Meyer, and Sunrise Acres (Las Vegas Valley) monitoring sites referenced in the analysis with wind/pollution rose if available. All sites included in the analysis were selected to show representative conditions across Clark County.

The DAQ PM_{10} samplers are operated to comply with the EPA designation mode. This designated method for PM_{10} is an automated method (analyzer) that utilizes a measurement principle based on sample collection by filtration and analysis by beta-ray attenuation. As a designated reference or equivalent method, this method is acceptable for use by states and other air monitoring agencies under the requirements of 40 CFR Part 58, Ambient Air Quality Surveillance.

Air samples are collected on filter media and simultaneously exposed to beta radiation to determine the mass of material on the filter. The airflow rate is one cubic meter per hour. The samplers have two analog voltage output channels that are sampled by the data system once every minute. The concentration channel signal is proportional to the running 60-minute average value that is scaled from zero to 1,500 micrograms per cubic meter ($\mu g/m^3$). The mass accumulation channel signal passes through a digital filter with a two-minute time constant, and is scaled to an accumulated mass from zero to 1,500 micrograms.

Five-minute averages of the concentration and accumulated mass channels are calculated and recorded by the data system. Hourly values are subsequently calculated as the averages of the five-minute data. Since the concentration channel itself is a 60-minute running average, the hourly concentrations are calculated from a two-hour period. Since the volume of air sampled in one hour is one cubic meter, the hourly incremental mass accumulation (difference from one hour to the next) is equivalent to an ambient condition concentration in $\mu g/m^3$. The maximum signal value for the concentration channel is 1,500 $\mu g/m^3$, and is 1,500 micrograms for the mass channel. When the sampler registers the 1,500 micrograms mass value, it briefly interrupts sampling to advance the filter material and reset the mass signal to a zero base level. This cycle is evident in the five-minute data, and can readily be factored into hourly or daily concentration values based on the mass accumulation channel. Under typical operations, the directly measured concentration and concentrations calculated from incremental mass accumulation values are virtually identical over a few hours. When rapidly increasing amounts of PM_{10} material occur, the reset process can produce erroneous values without corrections for short time periods. The official reported 24-hour value for July 3, 2011, calculated for standard conditions, was 191.8 $\mu g/m^3$ at Sunrise Acres in the Las Vegas Valley (Hydrographic Area 212), and 242.8 $\mu g/m^3$ at Boulder City in the Eldorado Valley (Hydrographic Area 167).

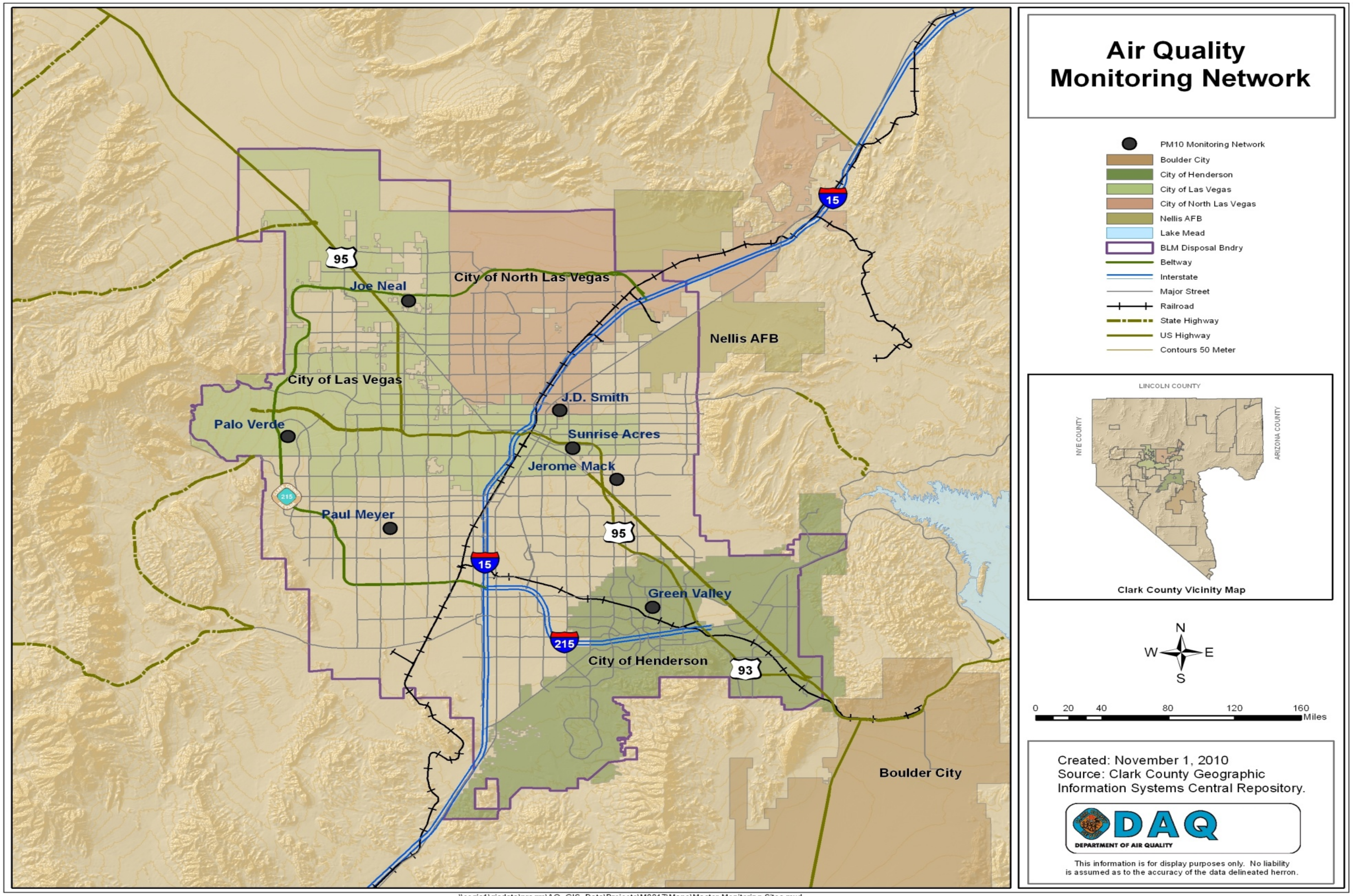


Figure 57. **Air Quality PM_{10} monitoring sites (FEM) - Las Vegas Valley.**

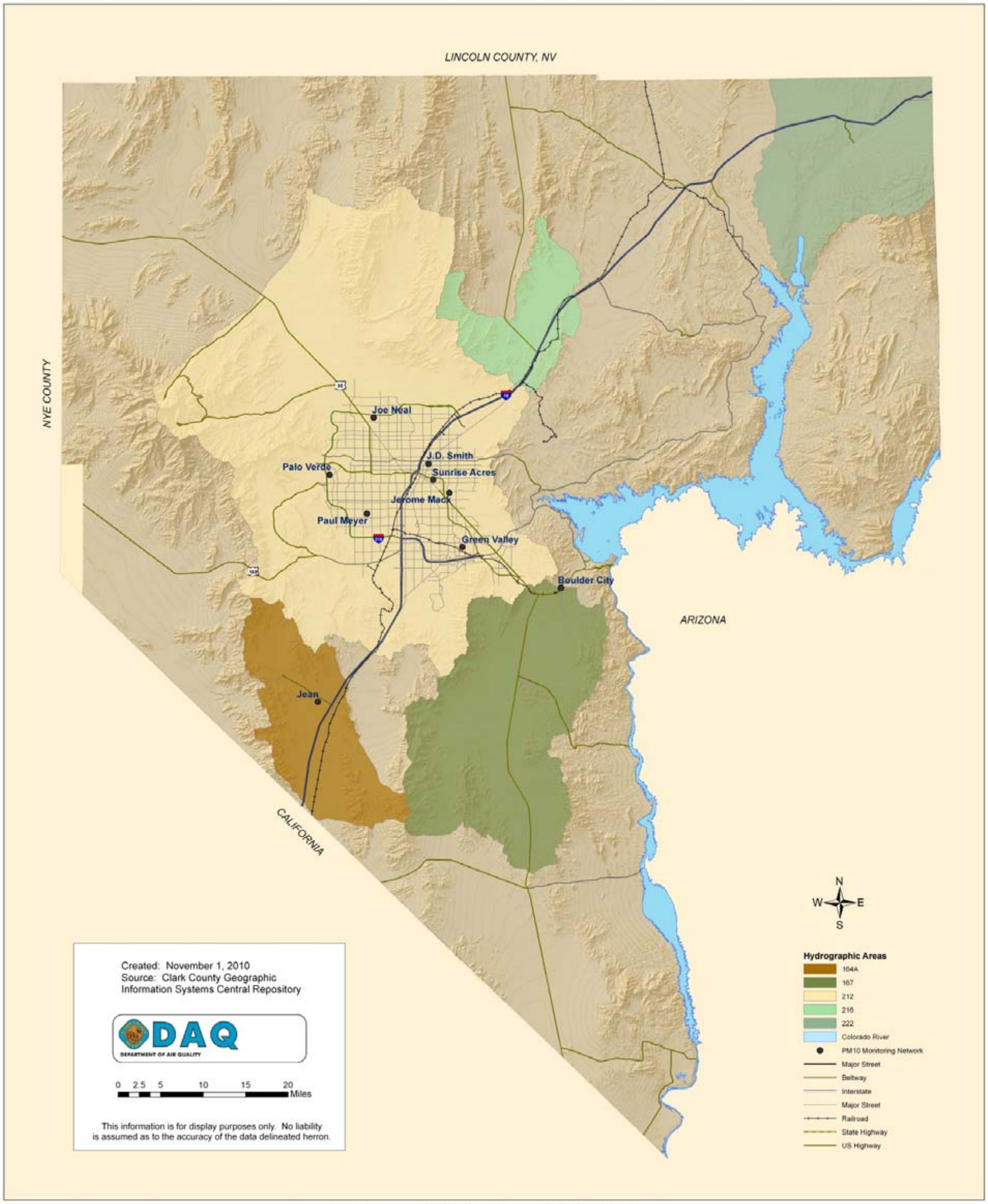


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Figure 58. Air Quality PM_{10} monitoring sites (FEM) for all of Clark County.

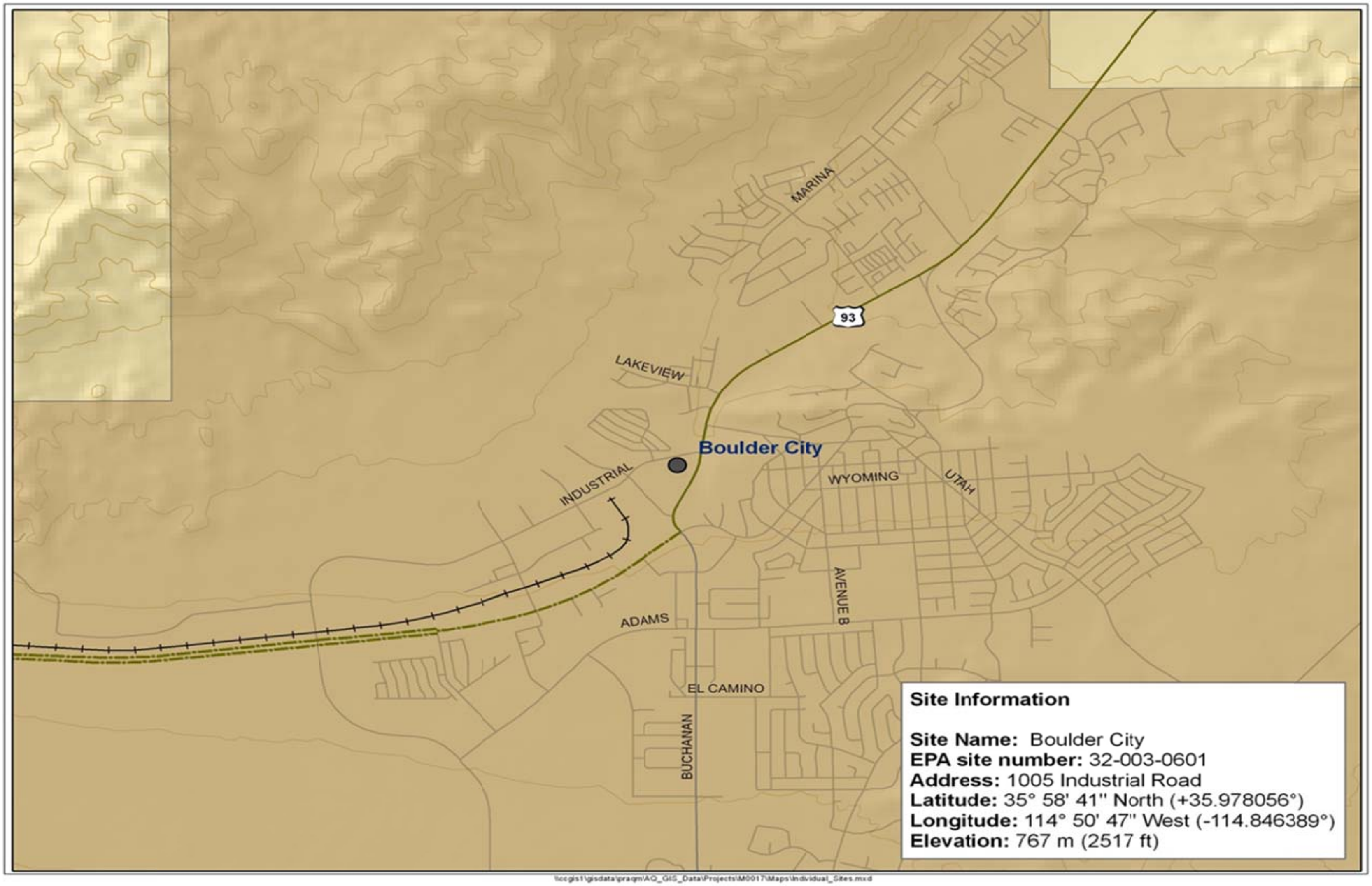


Figure 59. Air Quality PM_{10} monitoring site –Boulder City.

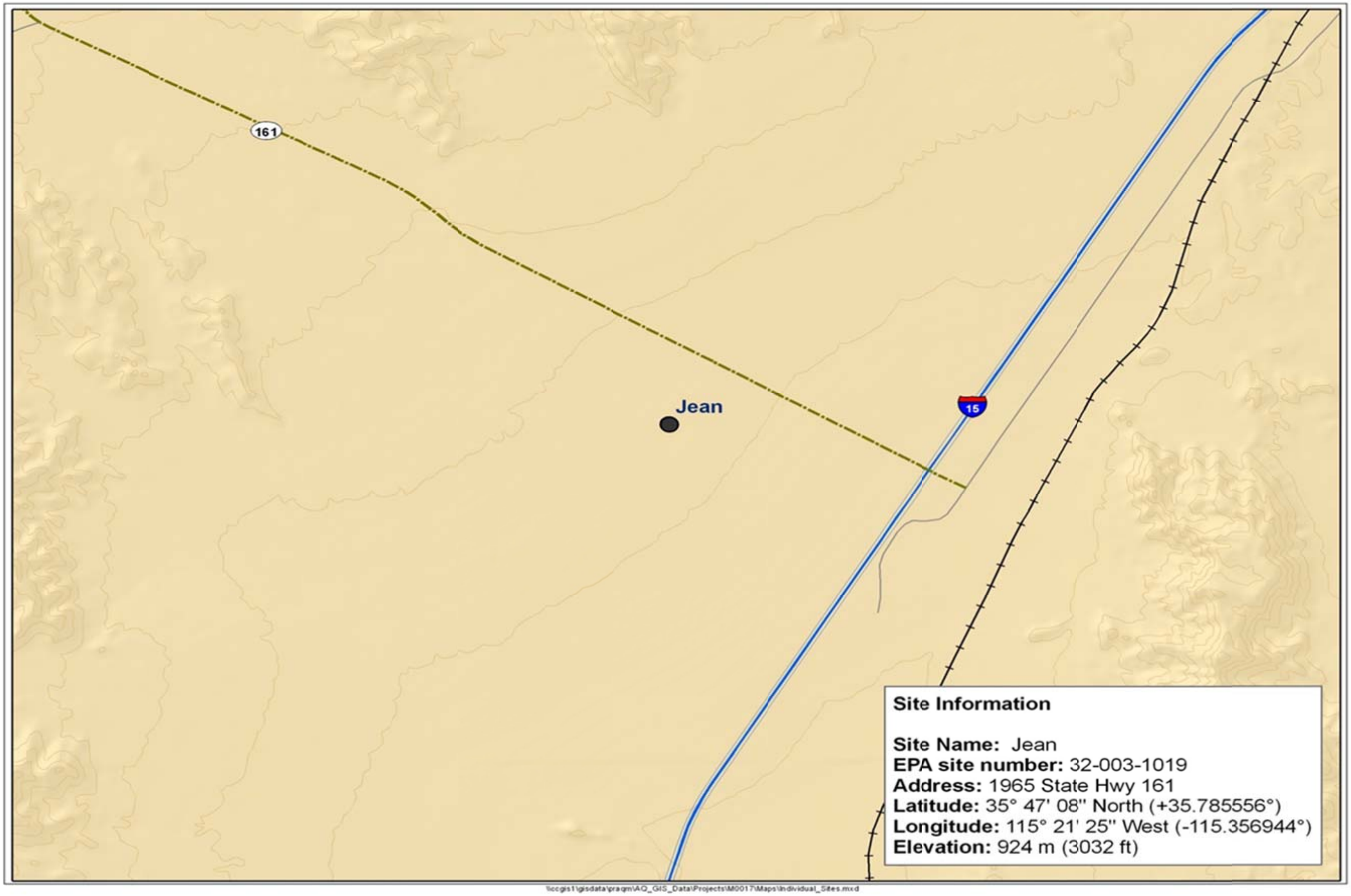


Figure 60. Air Quality PM_{10} monitoring site – Jean.

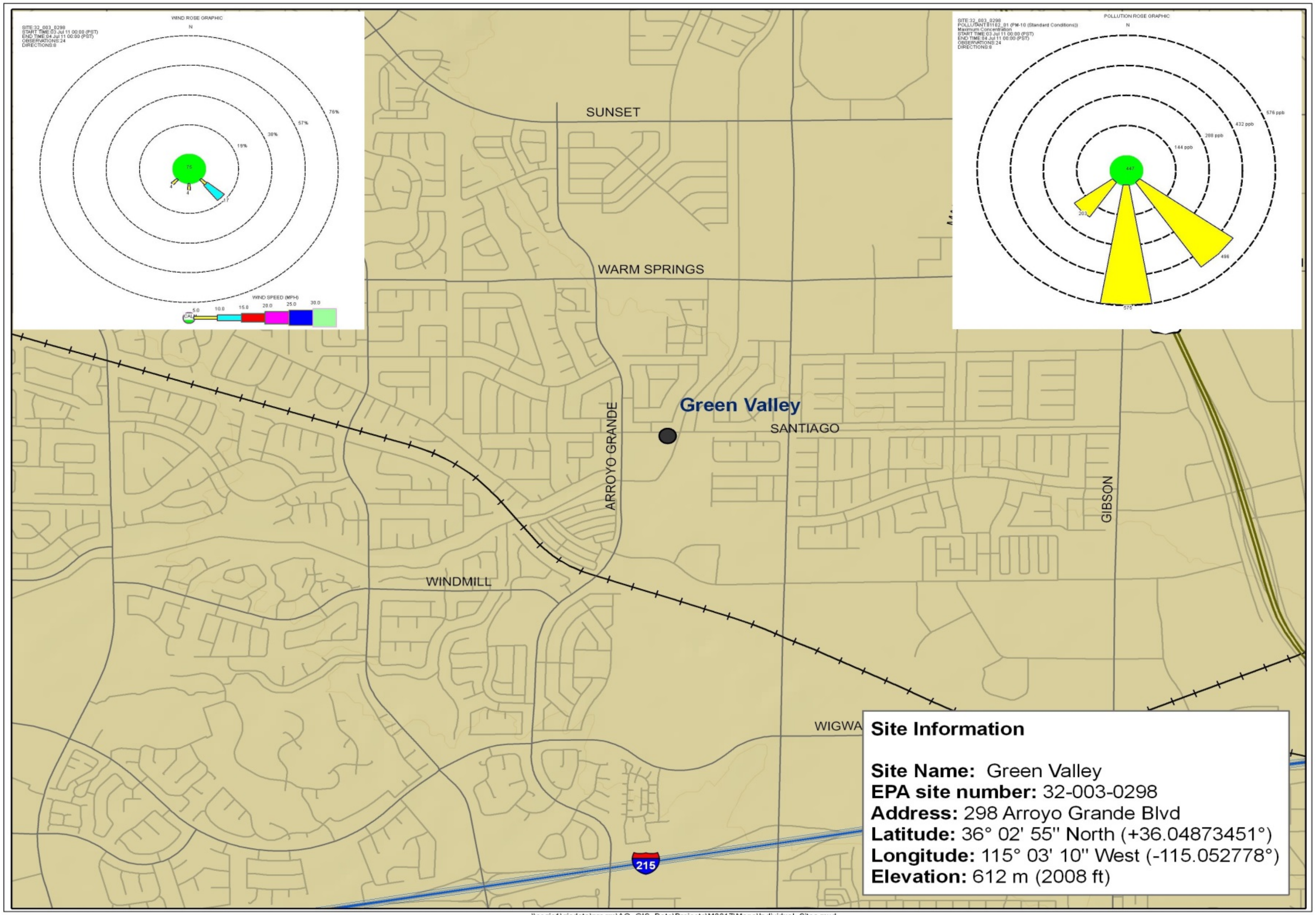


Figure 61. Air Quality PM_{10} monitoring site – Green Valley wind/pollution rose.

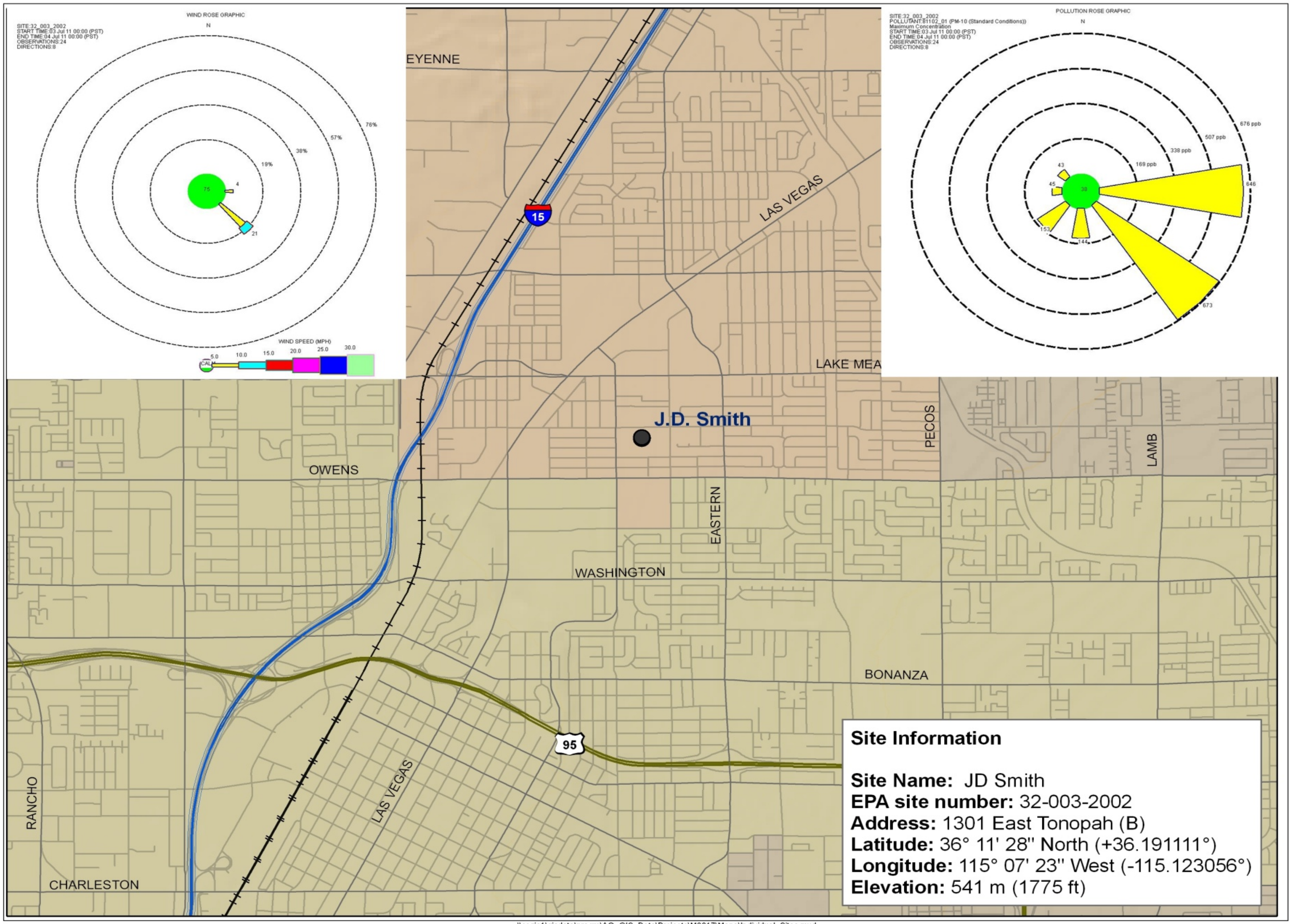


Figure 62. Air Quality PM_{10} monitoring site – JD Smith wind/pollution rose.

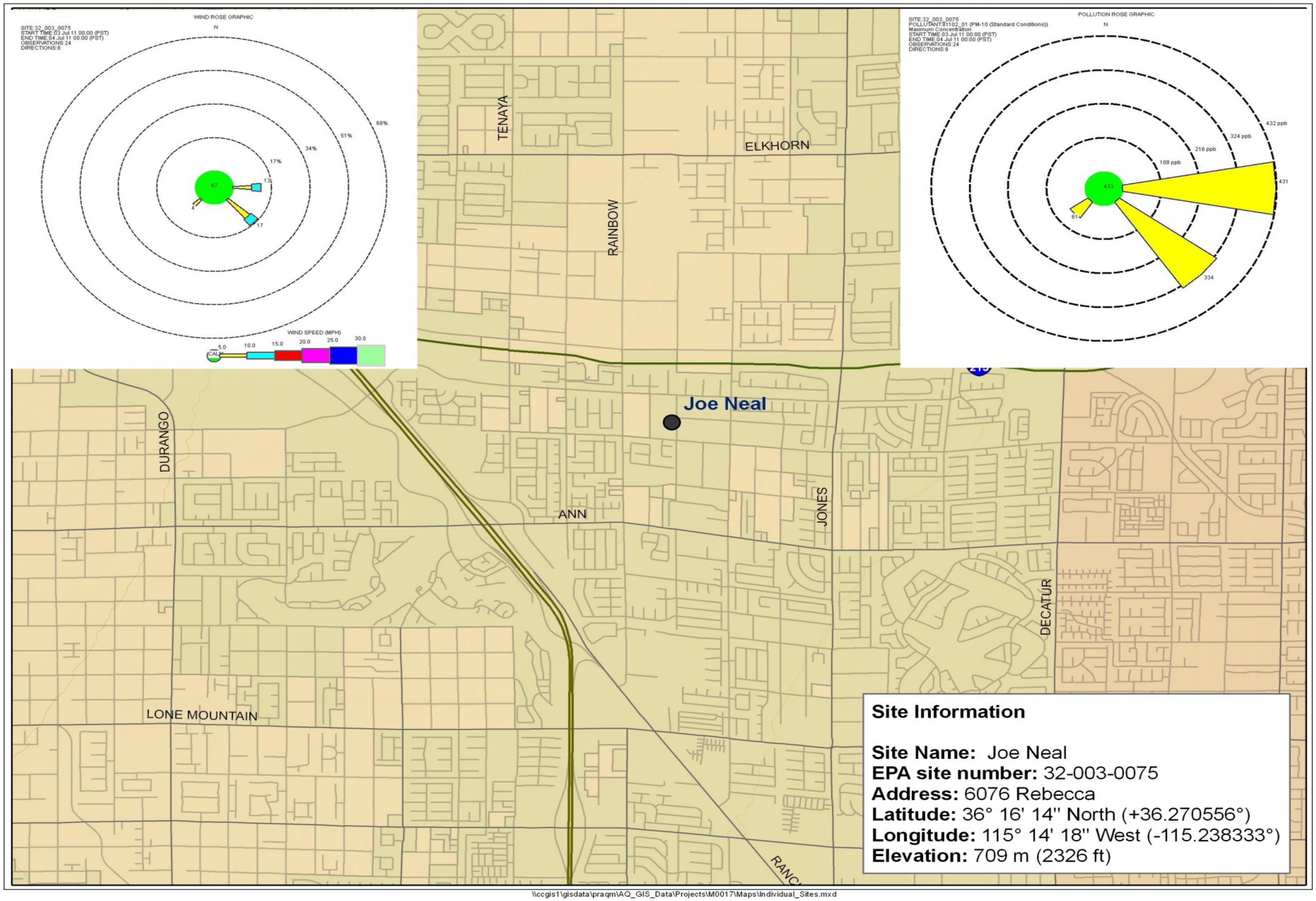


Figure 63. Air Quality PM_{10} monitoring site – Joe Neal with wind/pollution rose.

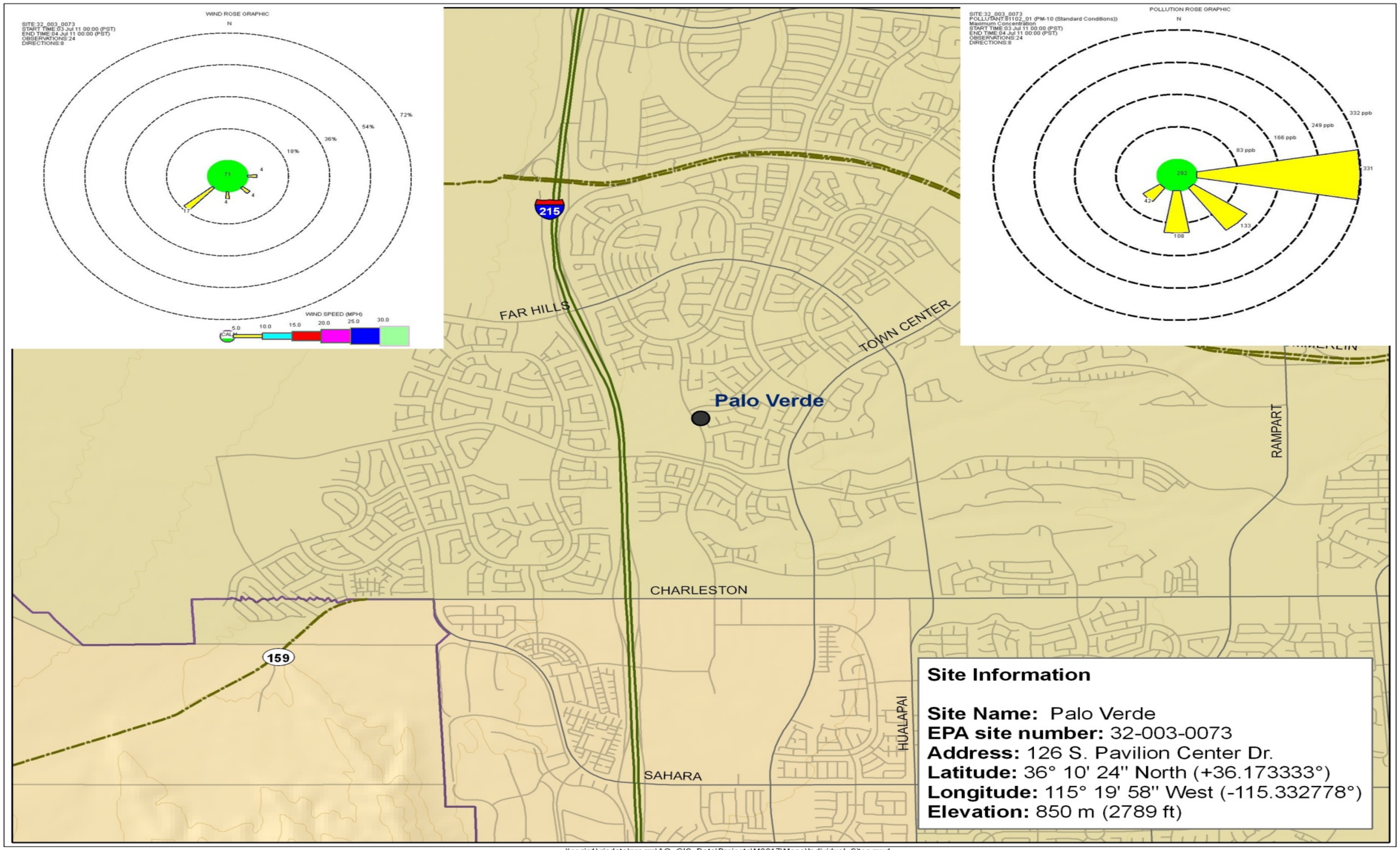


Figure 64. Air Quality PM_{10} monitoring site – Palo Verde with wind/pollution rose.

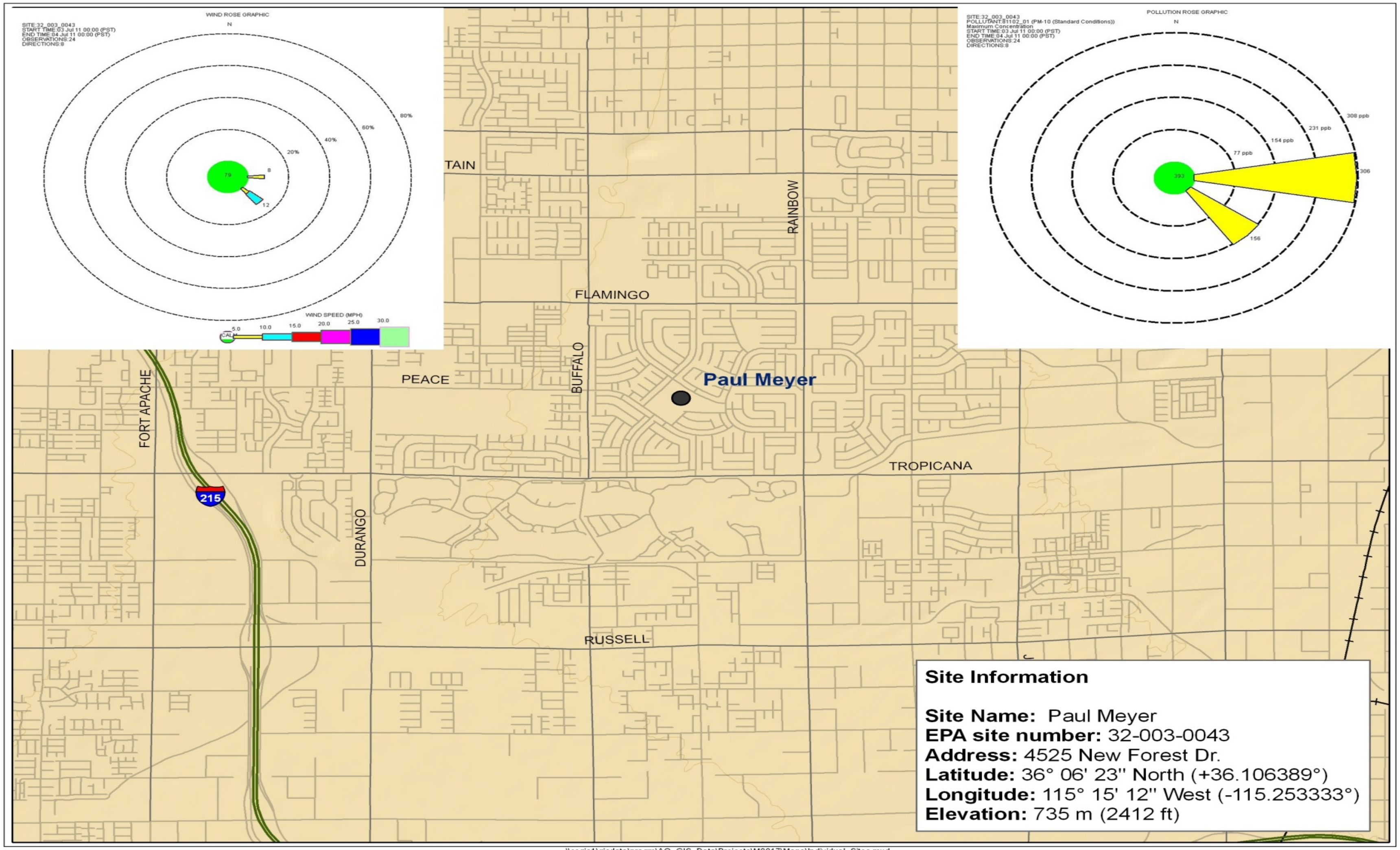


Figure 65. Air Quality PM_{10} monitoring site – Paul Meyer with wind/pollution rose.

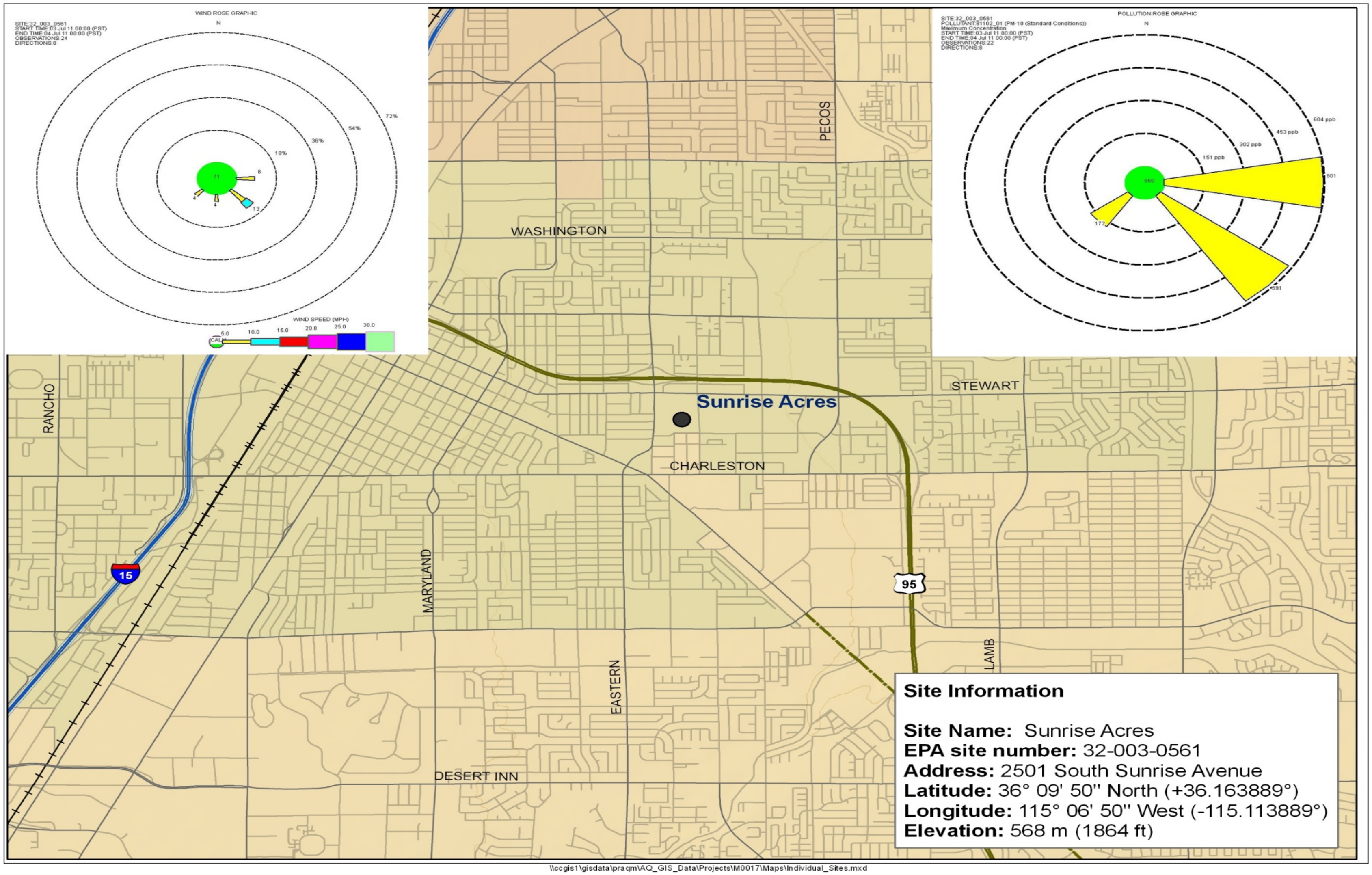


Figure 66. Air Quality PM_{10} monitoring site –Sunrise Acres with wind/pollution rose.

3.2.1 Weather before Event

Weather in Clark County for the period preceding the exceptional event on July 3, 2011 was dominated by weak ridging aloft and monsoonal flow at the surface. As depicted on the SFC charts an outflow boundary, which was associated with the monsoonal flow, began to form on July 2, 2011, at 18Z, south of Bullhead City. Table 33 is the monthly summary Local Climatological Data for the North Las Vegas Airport, and Table 34 is the monthly summary Local Climatological Data for the McCarran International Airport.

Surface Charts (Figures 67- 69)

These charts show a thermal low-pressure system over southern Nevada with a trough and an inverted trough extending south and north. Monsoonal flow can also be seen moving in on the inferred overlay.

Upper Air Charts (Figures 70-75)

850-Millibar Charts

The 850-millabar charts show monsoonal flow and an inverted trough over the west.

500-Millibar Charts

The 500-millibar charts show weak ridging and monsoonal flow over southern Nevada.

250-Millibar Charts

The 250-millibar charts show ridging building in.

Table 33. Quality Controlled Monthly Summary Local Climatological Data for the North Las Vegas Airport July 2011

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)
NOAA, National Climatic Data Center
Month: 07/2011

Station Location: NORTH LAS VEGAS AIRPORT (53123)
LAS VEGAS, NV
Lat. 36.211 Lon. -115.195
Elevation(Ground): 2203 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	max 5-second Dir	max 2-minute Speed	max 2-minute Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	103	76	90	M	30	59	0	25	-	-		M	M	M	0.00	27.50	29.76	2.1	31	3.3	14	150	10	130	01
02	110*	76	93	M	27	60	0	28	-	-		M	M	M	0.00	27.45	29.71	1.5	18	4.5	18	140	14	150	02
03	108	81	95	M	42	64	0	30	-	-	RA HZ	M	M	M	T	27.50	29.76	3.6	14	7.8	59	150	45	140	03
04	93	82	88	M	57	68	0	23	-	-		M	M	M	0.00	27.60	29.87	4.8	13	6.0	24	170	20	140	04
05	98	83	91	M	55	68	0	26	-	-		M	M	M	T	27.59	29.86	1.9	28	5.4	23	280	21	270	05
06	98	77	88	M	60	70	0	23	-	-		M	M	M	0.00	27.63	29.89	2.8	11	5.8	20	080	16	090	06
07	98	83	91	M	59	70	0	26	-	-	RA	M	M	M	0.00	27.56	29.83	5.9	34	9.1	38	310	28	330	07
08	100	82	91	M	56	68	0	26	-	-	RA	M	M	M	0.02	27.50	29.76	1.1	22	6.8	40	310	32	310	08
09	102	79	91	M	56	68	0	26	-	-	RA	M	M	M	0.09	27.47	29.74	3.7	16	6.7	38	220	28	160	09
10	98	76	87	M	59	69	0	22	-	-	TSRA	M	M	M	0.08	27.48	29.75	5.9	13	7.3	64	140	53	150	10
11	100	77	89	M	45	64	0	24	-	-		M	M	M	0.00	27.52	29.78	5.5	18	9.0	39	190	24	160	11
12	100	74	87	M	33	59	0	22	-	-		M	M	M	0.00	27.50	29.77	4.8	21	6.5	33	230	23	240	12
13	98	73	86	M	32	58	0	21	-	-		M	M	M	0.00	27.47	29.74	6.2	22	8.0	10s	220	9s	220	13
14	97	73	85	M	36	59	0	20	-	-		M	M	M	0.00	27.46	29.73	9.3	19	9.8	28	230	20	190	14
15	98	71	85	M	33	58	0	20	-	-		M	M	M	0.00	27.45	29.72	6.2	18	7.6	35	220	25	170	15
16	98	71	85	M	30	57	0	20	-	-		M	M	M	0.00	27.47	29.73	4.0	17	6.1	25	160	18	230	16
17	104	70*	87	M	24	57	0	22	-	-		M	M	M	0.00	27.50	29.77	2.4	16	6.7	22	200	18	200	17
18	106	75	91	M	35	61	0	26	-	-		M	M	M	0.00	27.55	29.81	5.6	15	8.3	31	150	25	150	18
19	107	81	94	M	40	64	0	29	-	-		M	M	M	0.00	27.53	29.79	6.4	22	8.7	32	210	22	170	19
20	106	77	92	M	16	58	0	27	-	-		M	M	M	0.00	27.52	29.77	5.6	23	8.6	36	220	22	200	20
21	103	74	89	M	23	58	0	24	-	-		M	M	M	0.00	27.46	29.72	7.3	21	8.6	30	210	24	210	21
22	104	71	88	M	26	58	0	23	-	-		M	M	M	0.00	27.45	29.71	5.6	21	8.8	30	210	23	200	22
23	104	75	90	M	42	63	0	25	-	-		M	M	M	0.00	27.57	29.83	2.8	16	7.3	30	100	21	100	23
24	102	80	91	M	50	66	0	26	-	-		M	M	M	0.00	27.65	29.92	4.7	13	6.4	23	140	20	140	24
25	106	83	95	M	52	68	0	30	-	-		M	M	M	0.00	27.54	29.80	4.8	20	7.5	25	220	17	200	25
26	98	86	92	M	54	68	0	27	-	-	RA	M	M	M	0.01	27.48	29.74	7.3	11	9.4	24	070	18	070	26
27	104	81	93	M	49	66	0	28	-	-		M	M	M	0.00	27.50	29.76	6.3	16	8.3	32	160	24	160	27
28	104	80	92	M	49	66	0	27	-	-		M	M	M	0.00	27.55	29.82	2.0	15	4.9	18	200	14	160	28
29	106	84	95*	M	51	67	0	30	-	-	TS	M	M	M	Ts	27.56	29.82	2.2	30	8.1	41	320	31	330	29
30	102	86	94	M	54	68	0	29	-	-		M	M	M	T	27.58	29.85	5.8	33	8.0	35	320	28	330	30
31	92	75	84*	M	65	70	0	19	-	-	RA	M	M	M	0.08	27.67	29.95	4.4	34	7.3	24	120	18	120	31
	M	M	M		43.2	63.8	0.0	25.0	<-----Monthly Averages | Totals----->				M	M	M	M	M	2.6	18	7.3	<Monthly Average				
	M	M	M	<-----------Departure From Normal----------->											M										

Table 34. Quality Controlled Monthly Summary Local Climatological Data for the McCarran International Airport July 2011

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)
NOAA, National Climatic Data Center
Month: 07/2011

Station Location: MCCARRAN INTERNATIONAL AIRPORT (23169)
LAS VEGAS, NV
Lat. 36.071 Lon. -115.163
Elevation(Ground): 2180 ft. above sea level

Date	Temperature (Fahrenheit) Max.	Min.	Avg.	Dep From Normal	Avg. Dew pt.	Avg Wet Bulb	Degree Days Base 65 Degrees Heating	Cooling	Sun Sunrise LST	Sunset LST	Significant Weather	Snow/Ice on Ground(In) 1200 UTC Depth	1800 UTC Water Equiv	Precipitation (In) 2400 LST Snow Fall	2400 LST Water Equiv	Pressure(inches of Hg) Avg. Station	Avg. Sea Level	Wind: Speed=mph Dir=tens of degrees Resultant Speed	Res Dir	Avg. Speed	max 5-second Speed	Dir	max 2-minute Speed	Dir	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
01	104	76	90	0	M	M	0	25	0427	1901		0	M	0.0	0.00	27.49	M	M	M	5.0	18	230	15	230	01
02	111*	79	95	5	M	M	0	30	0428	1901		0	M	0.0	0.00	27.45	M	M	M	6.6	17	090	14	180	02
03	108	77	93	3	41	64	0	28	0428	1901	TSRA RA HZ	0	M	0.0	0.74	27.50	29.68	3.4	17	7.1	55	180	40	180	03
04	94	80	87	-4	59	69	0	22	0429	1901		0	M	0.0	T	27.59	29.79	5.0	18	6.2	30	180	24	180	04
05	97	81	89	-2	M	M	0	24	0429	1901	RA	0	M	0.0	T	27.59	M	M	M	8.6	23	230	20	230	05
06	101	79	90	-1	61	70	0	25	0430	1901		0	M	0.0	0.00	27.62	29.80	5.3	16	6.9	30	180	23	180	06
07	100	82	91	0	60	70	0	26	0430	1901	TS	0	M	0.0	0.00	27.56	29.75	5.3	21	9.0	26	320	21	180	07
08	101	82	92	1	57	69	0	27	0431	1900	TS RA	0	M	0.0	0.02	27.50	29.69	4.6	21	8.3	35	180	26	230	08
09	103	79	91	0	56	68	0	26	0431	1900	TSRA	0	M	0.0	T	27.47	29.67	5.3	18	8.2	36	360	28	360	09
10	99	83	91	0	M	M	0	26	0432	1860	VCTS	0	M	0.0	0.01	27.47	M	M	M	6.0	33	180	25	170	10
11	102	79	91	0	41	63	0	26	0433	1860		0	M	0.0	0.00	27.51	29.70	11.5	19	12.1	30	190	23	190	11
12	101	79	90	-1	29	58	0	25	0433	1859		0	M	0.0	0.00	27.50	29.69	10.7	20	11.5	36	140	25	200	12
13	99	78	89	-3	30	58	0	24	0434	1859		0	M	0.0	0.00	27.47	29.65	12.8	20	13.4	31	180	23	190	13
14	98	74	86	-6	M	M	0	21	0435	1858		0	M	0.0	0.00	27.46	M	M	M	14.3	32	250	23	230	14
15	98	75	87	-5	30	58	0	22	0435	1858		0	M	0.0	0.00	27.45	29.64	10.8	20	11.5	30	190	23	200	15
16	100	76	88	-4	M	M	0	23	0436	1858		0	M	0.0	0.00	27.47	M	M	M	11.6	28	210	21	210	16
17	105	74*	90	-2	19	57	0	25	0436	1857		0	M	0.0	0.00	27.50	29.69	7.1	19	8.0	29	190	22	200	17
18	106	80	93	1	34	61	0	28	0437	1857		0	M	0.0	0.00	27.55	29.73	8.9	18	9.7	30	170	22	160	18
19	107	87	97	5	M	M	0	32	0438	1856		0	M	0.0	0.00	27.53	M	M	M	13.9	32	220	25	220	19
20	107	86	97	5	11	58	0	32	0439	1855		0	M	0.0	0.00	27.52	29.70	15.2	20	15.9	31	220	24	220	20
21	104	82	93	2	23	59	0	28	0439	1855		0	M	0.0	0.00	27.46	29.64	14.4	20	14.5	35	220	24	220	21
22	104	81	93	2	27	59	0	28	0440	1854		0	M	0.0	0.00	27.45	29.63	15.5	20	15.8	41	250	26	230	22
23	105	81	93	2	40	63	0	28	0441	1854		0	M	0.0	0.00	27.57	29.75	8.7	20	9.8	25	210	20	210	23
24	104	85	95	4	50	67	0	30	0442	1853		0	M	0.0	0.00	27.65	29.83	8.8	19	9.2	24	190	20	190	24
25	106	87	97	6	50	68	0	32	0442	1852		0	M	0.0	0.00	27.54	29.73	9.0	20	10.3	29	180	21	200	25
26	100	84	92	1	52	67	0	27	0443	1851	RA	0	M	0.0	T	27.48	29.66	5.9	14	9.6	25	190	20	190	26
27	104	82	93	2	M	M	0	28	0444	1851		0	M	0.0	0.00	27.50	M	M	M	10.0	23	230	17	200	27
28	105	85	95	4	49	67	0	30	0445	1850		0	M	0.0	0.00	27.55	29.73	4.2	17	5.8	18	090	15	190	28
29	108	88	98*	7	50	68	0	33	0445	1849		0	M	0.0	T	27.56	29.74	4.8	20	8.8	32	320	24	310	29
30	103	88	96	5	M	M	0	31	0446	1848		0	M	0.0	0.00	27.58	M	M	M	9.4	28	330	21	310	30
31	93	75	84*	-7	M	M	0	19	0447	1847	TS RA	0	M	0.0	0.06	27.67	M	M	M	8.0	23	190	20	200	31
	102.5	80.8	91.7		M	M	0.0	26.8	<-----Monthly Averages | Totals----->				M	0.0	0.83	27.52	29.71	M	M	9.8	<Monthly Average				

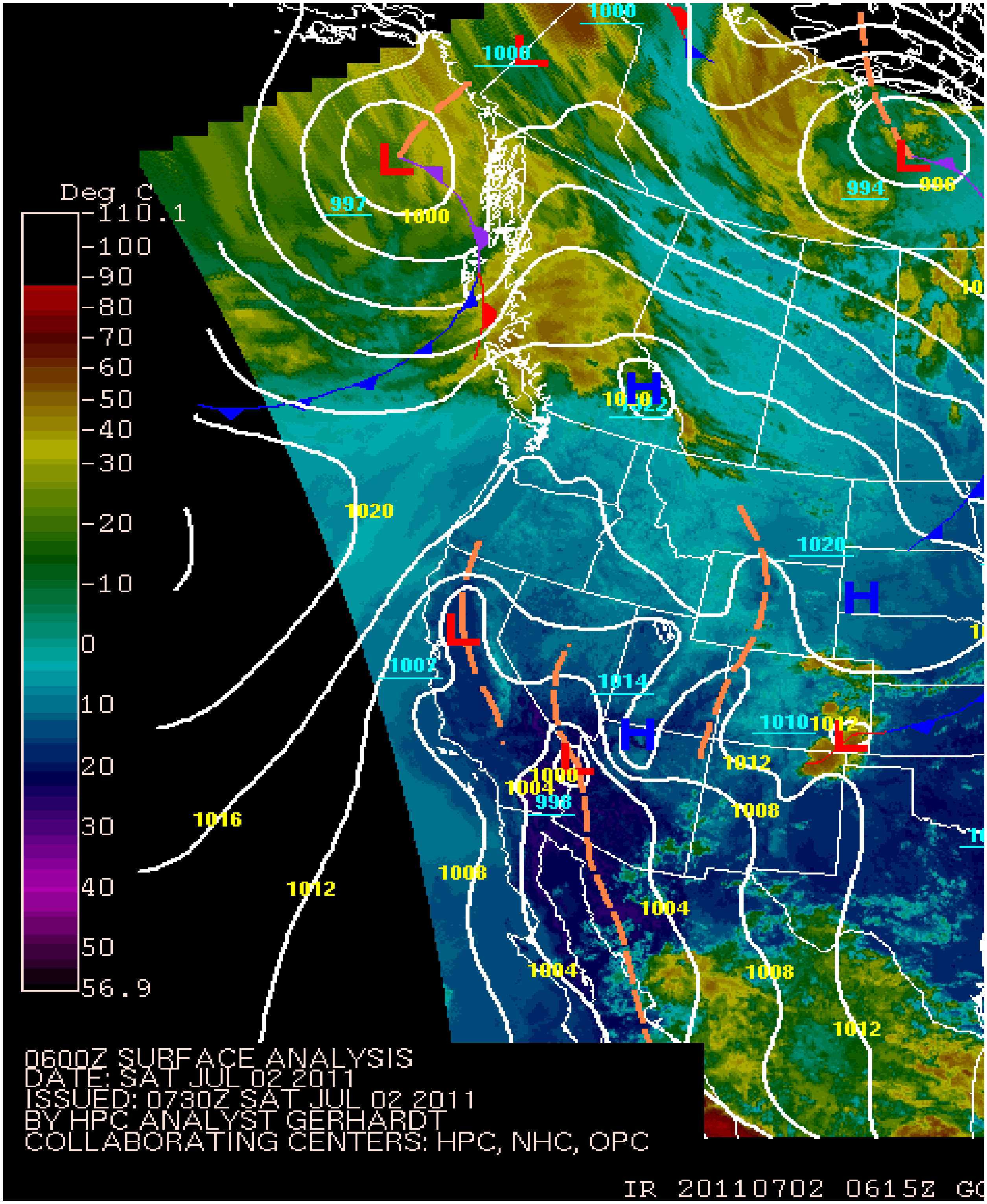


Figure 67. Surface prior to event weather chart with infer-red overlay July 2, 2011 06Z.

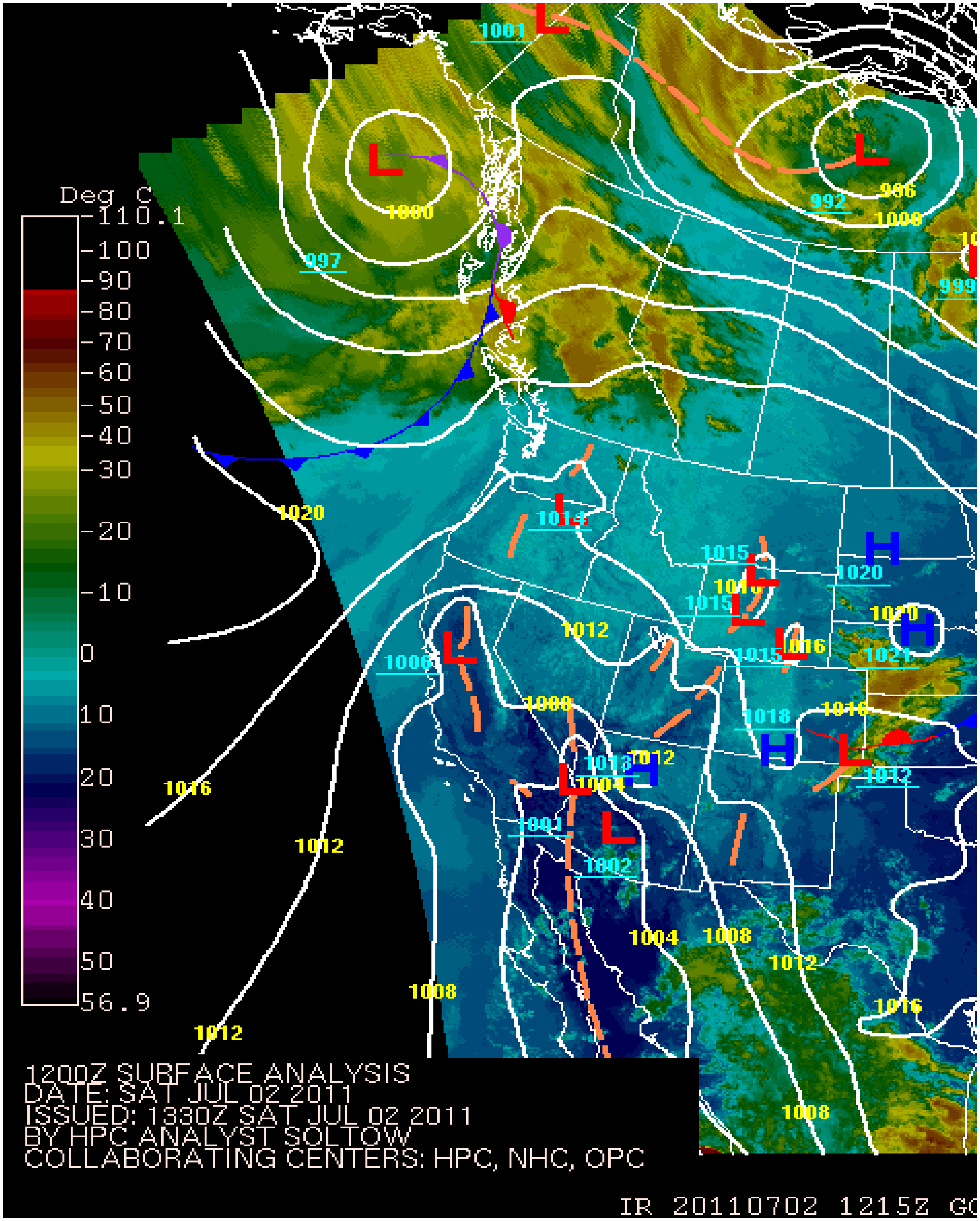


Figure 68. **Surface prior to event weather chart with infer-red overlay July 2, 2011 12Z.**

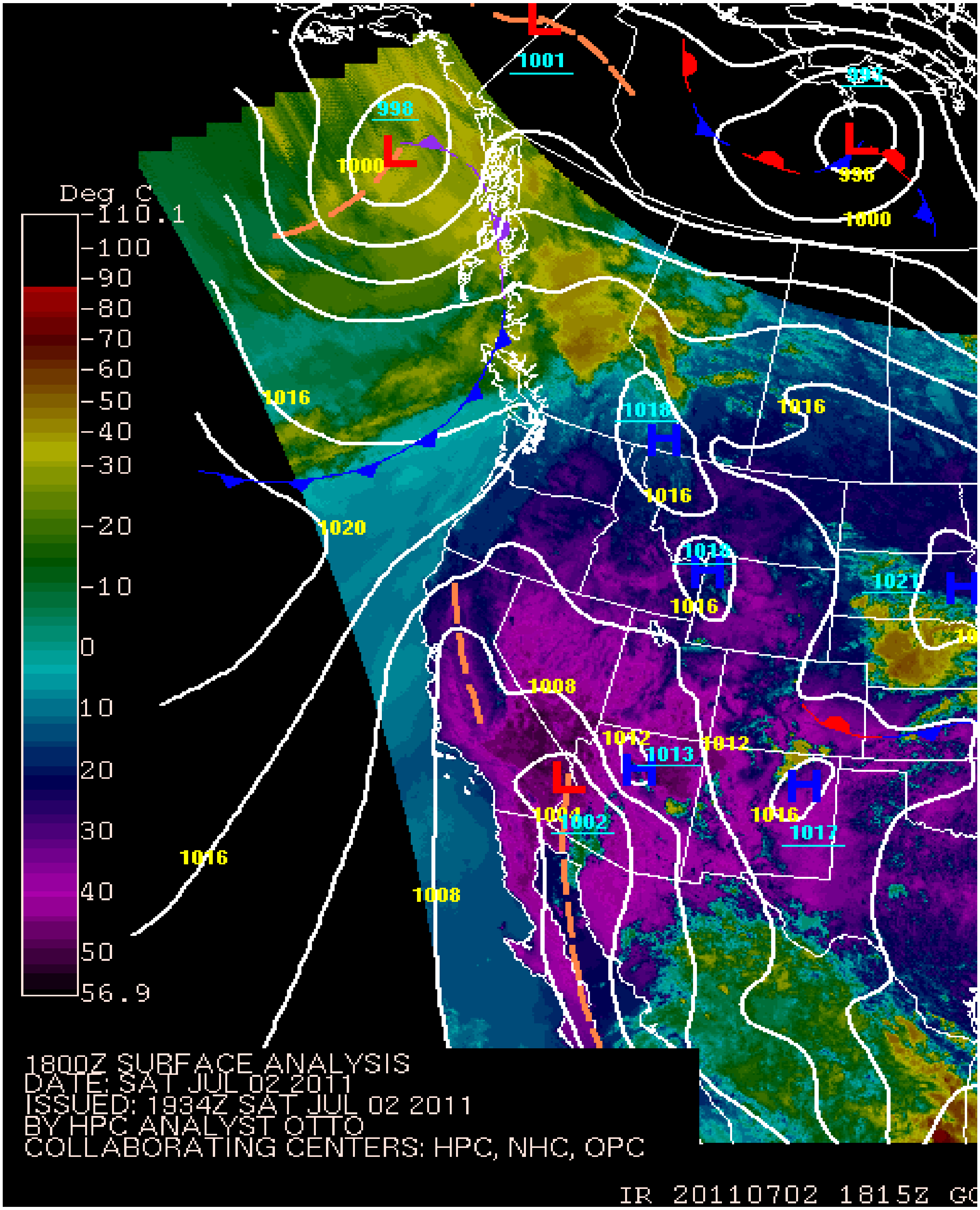


Figure 69. Surface prior to event weather chart with infer-red overlay July 2, 2011 18Z.

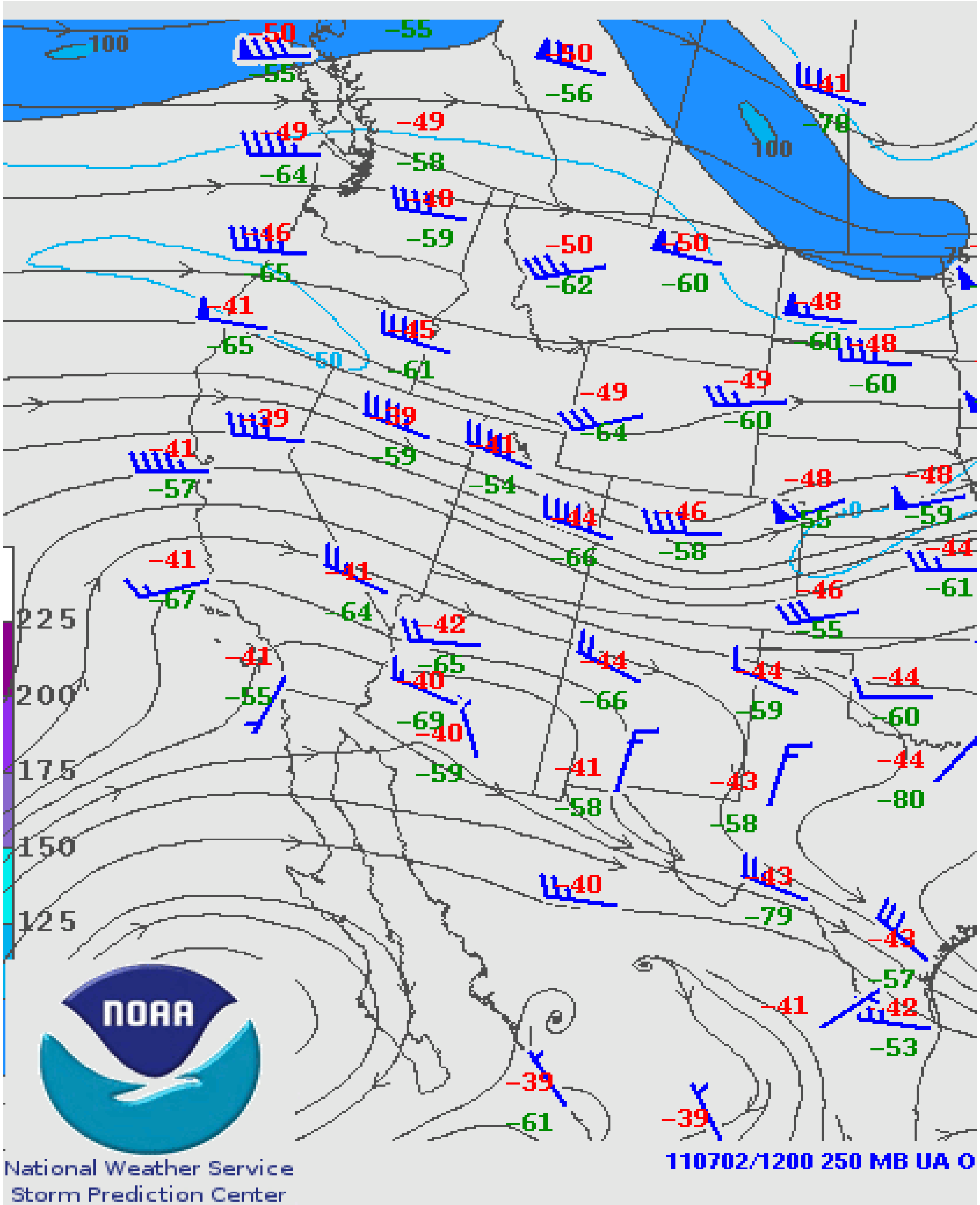


Figure 70. 250 mb prior to event weather chart July 2, 2011 12Z.

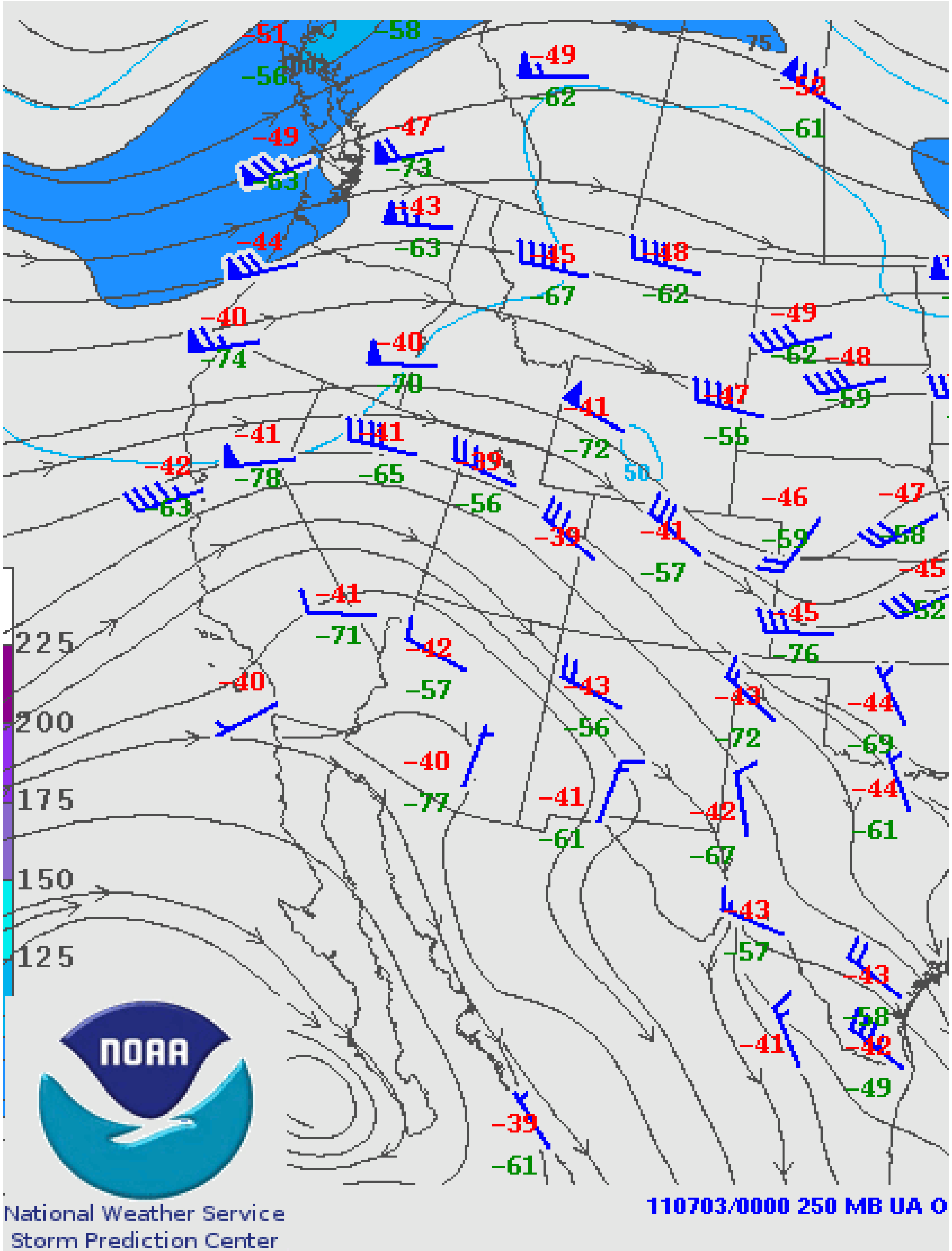


Figure 71. 250 mb prior to event weather chart July 3, 2011 00Z.

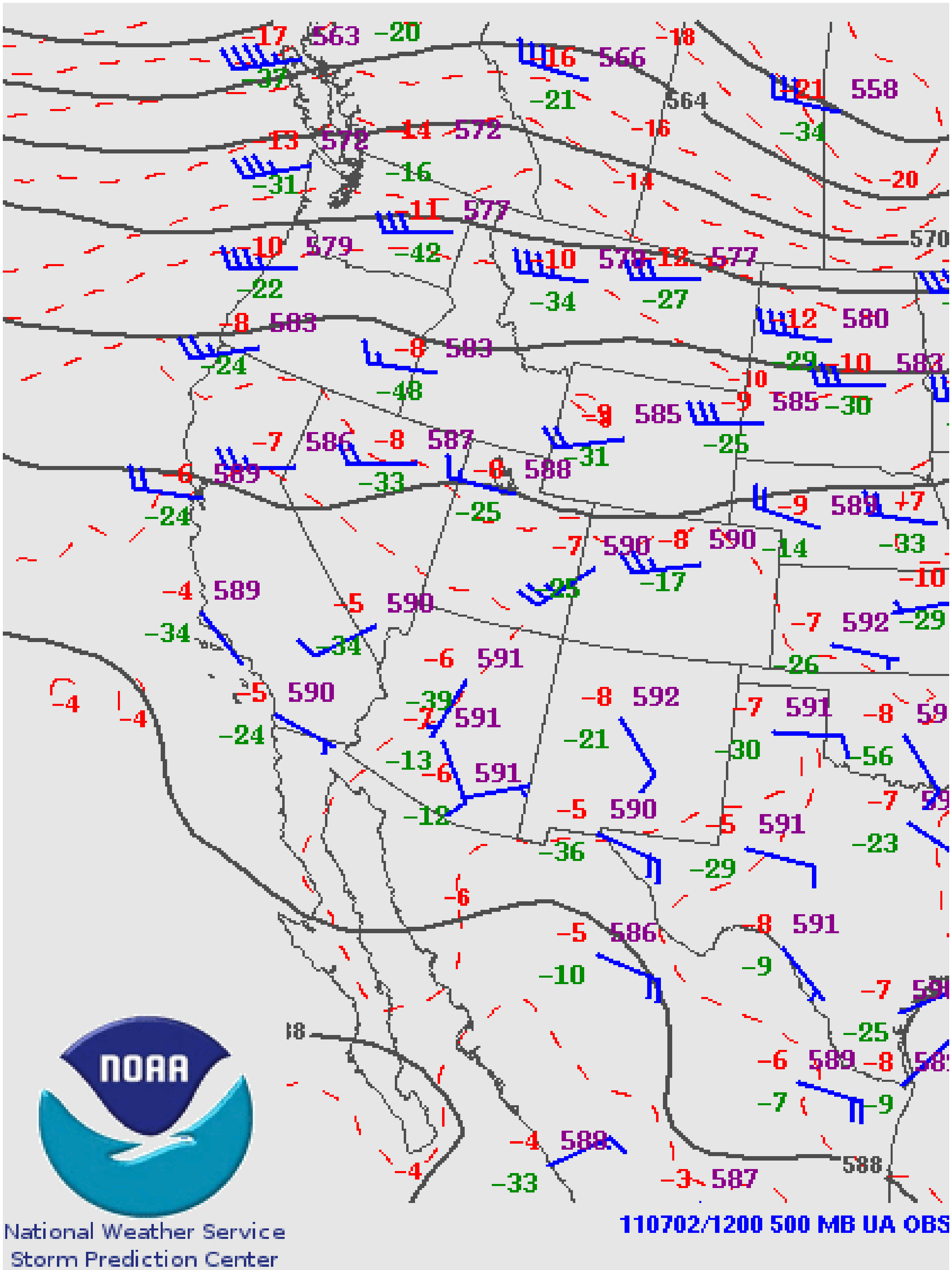


Figure 72. 500 mb prior to event weather chart July 2, 2011 12Z.

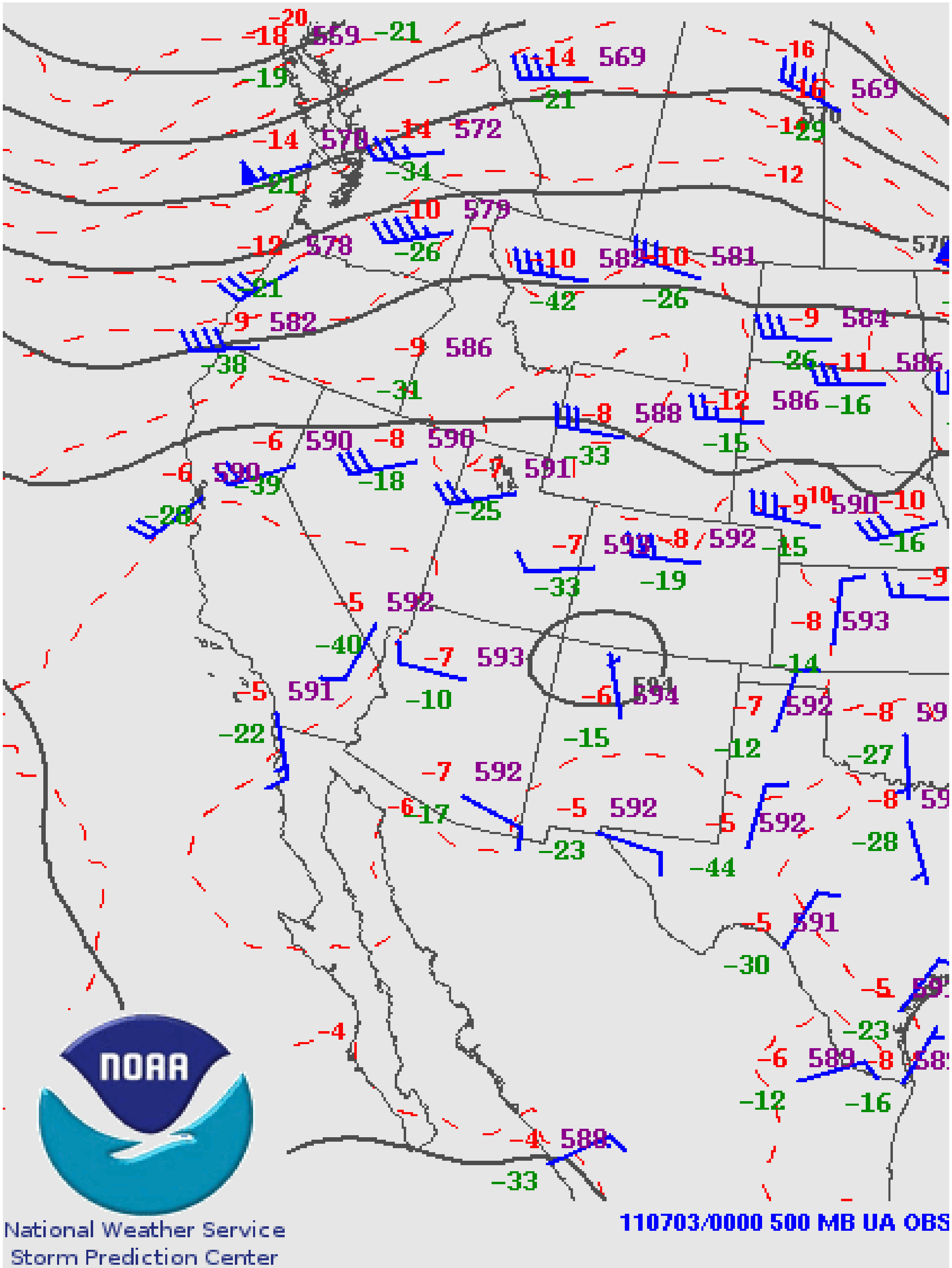


Figure 73. 500 mb prior to event weather chart July 3, 2011 00Z.

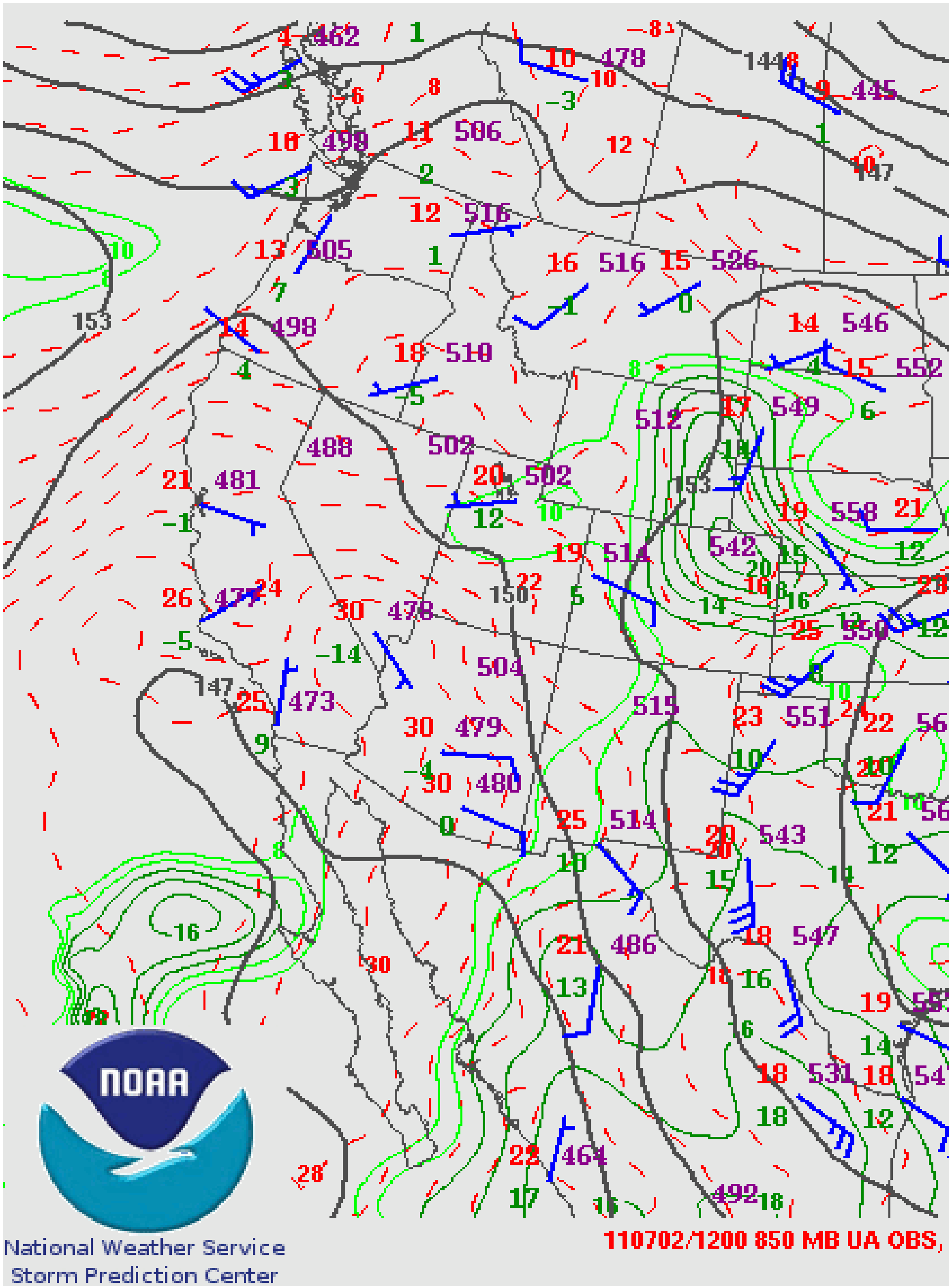


Figure 74. 850 mb prior to event weather chart July 2, 2011 12Z.

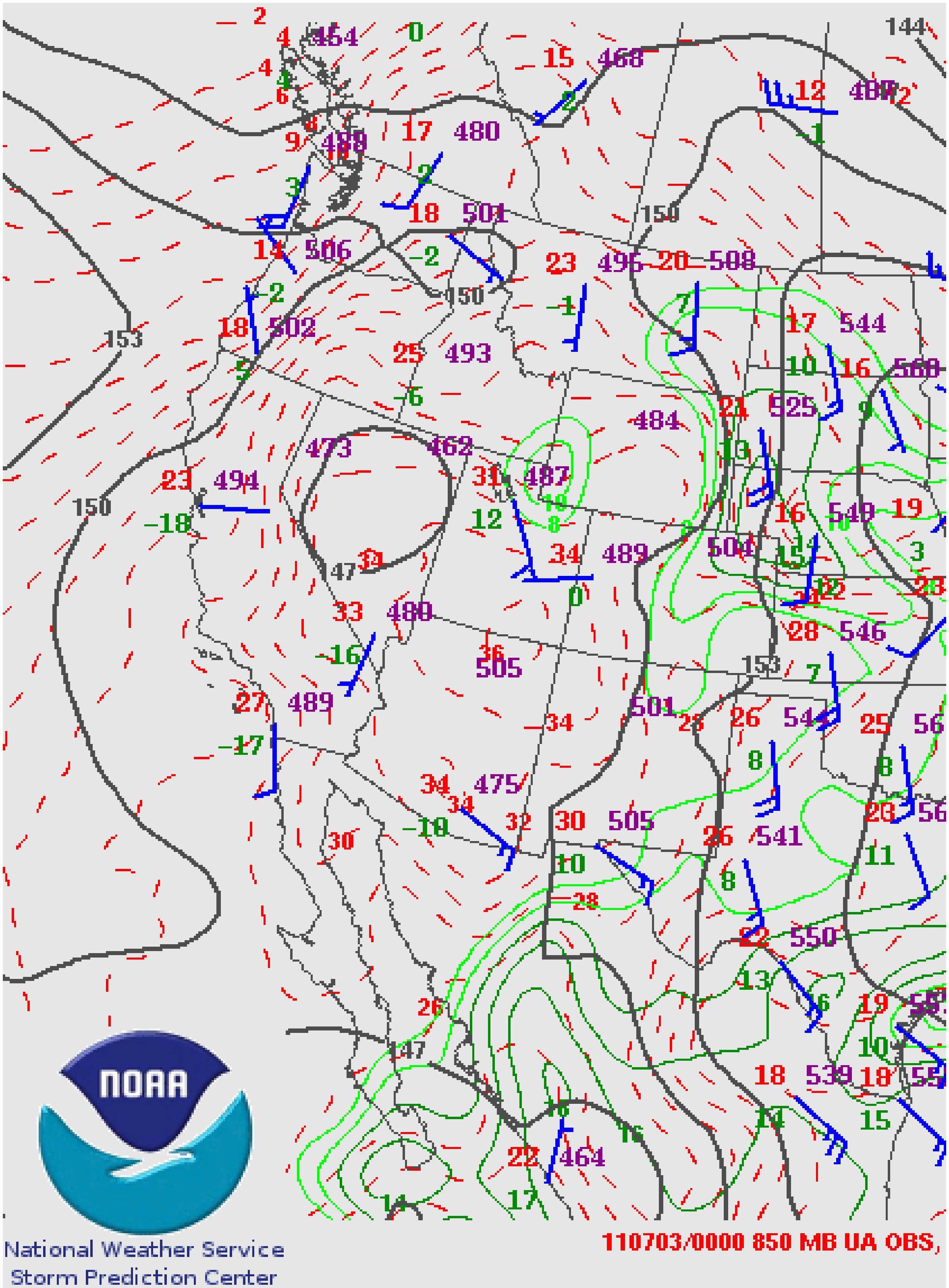


Figure 75. 850 mb prior to event weather chart July 3, 2011 00Z.

In Clark County, dry conditions and low wind speeds are conducive to building up a reservoir of loose dust on the surface; this dust can readily become airborne when wind speeds exceed 15–20 mph. Wind speeds for the majority of the day were lower than the Clark County wind threshold but strong enough to spread the dust from the high-wind dust transport event during early afternoon through the evening. These Clark County threshold speeds were measured during field studies in the Las Vegas area **(**Appendix A**).**

3.2.2 Weather during the Event

A large cloud of suspended dust in Bullhead City, Arizona, moved north and into parts of Clark County. The dust cloud arrived in Boulder City first and progressed into the Las Vegas Valley. Monsoonal flow continued to transport suspended dust into Clark County throughout the remainder of the day as can be seen on the charts, figures, and tables listed below. Figures 76 through 81 show the Surface Weather Charts with Infer-Red Overlays for July 2, 2011, at 11:00 pm (PST) through July 3, 2011, at 5:00 am (PST) in 6-hour increments, respectively. Figures 82 thru 90 show the 850-millibar pressure charts, 500-millibar pressure charts, and 250-millibar pressure charts for July 2, 2011, at 4:00 pm (PST) through July 3, 2011, at 4:00 pm (PST) in 12-hour increments, respectively. Tables 35 through 37 show the hourly winds from the North Las Vegas Airport, McCarran International Airport, and the Air Quality Monitoring stations. Tables 38 and 39 show the PM_{10} concentration and wind data from the Sunrise Acres monitoring site, the JD Smith monitoring site, and the McCarran International Airport.

Surface Charts (Figures 91-95) These charts show a thermal low over Clark County with an inverted trough extending northerly. An outflow boundary can be seen just south of Bullhead City at 06Z. By 18Z the outflow boundary covers most of Clark County and by 00Z on July 4, 2011, has progressed to only the northern to northeastern portion of Clark County.

Upper Air Charts (Figures 96-105)

850-Millibar Charts

The 850-millibar charts show monsoonal flow moving northwesterly and over Clark County.

500-Millibar Charts

The 500-millibar charts show a flat ridge colliding with monsoonal flow.

250-Millibar Charts

The 250-millibar charts show a ridge weakening and transitioning to the east.

Wind Data

Wind from the Local Climatological Data source for North Las Vegas Airport and McCarran International Airport for July 3, 2011, are shown in Tables 35 and 36.

Monitoring Site Wind Data

Table 37 lists the hourly wind speeds, direction, and gusts for the monitoring sites within the Las Vegas Valley.

Wind Graphs (Figures 106-111)

These figures show plots of the hourly average wind speed and maximum gust speed recorded at select DAQ monitoring stations compared with the McCarran International Airport wind data for July 3, 2011.

Monitoring Site PM Data

Tables 38 and 39 list the hourly average PM_{10} concentration data from JD Smith and Sunrise Acres monitoring sites for July 3, 2011, and wind data from McCarran International Airport.

National Weather Service Forecast Discussion (Illustration 1)

Note the following exert. *WIDESPREAD SUSPENDED DUST HAS SPREAD INTO SOUTHERN NEVADA...EASTERN CALIFORNIA...AND ARIZONA. IN SOME LOCALES **VISIBILITY** THIS MORNING COULD BE AS LOW AS A MILE.*

Table 40 lists the National Weather Service Weather Observations for Bullhead City

Note the wind speeds, direction, and gust as well as the reduced visibility beginning at 05:15 PST. This is the result from the outflow boundary shown on the surface charts. Location and speed of the HYSPLIT trajectory confirms this area as the source of the dust that drifted into Boulder City and the Las Vegas Valley.

HYSPLIT Trajectory modeling (Figure 112-115)

National Oceanic and Atmospheric Administration (NOAA) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) models that show Bullhead City, Arizona, as the source region for the dust that drifted into Boulder City and the Las Vegas Valley, as can be seen in the Bullhead City National Weather Service observations.

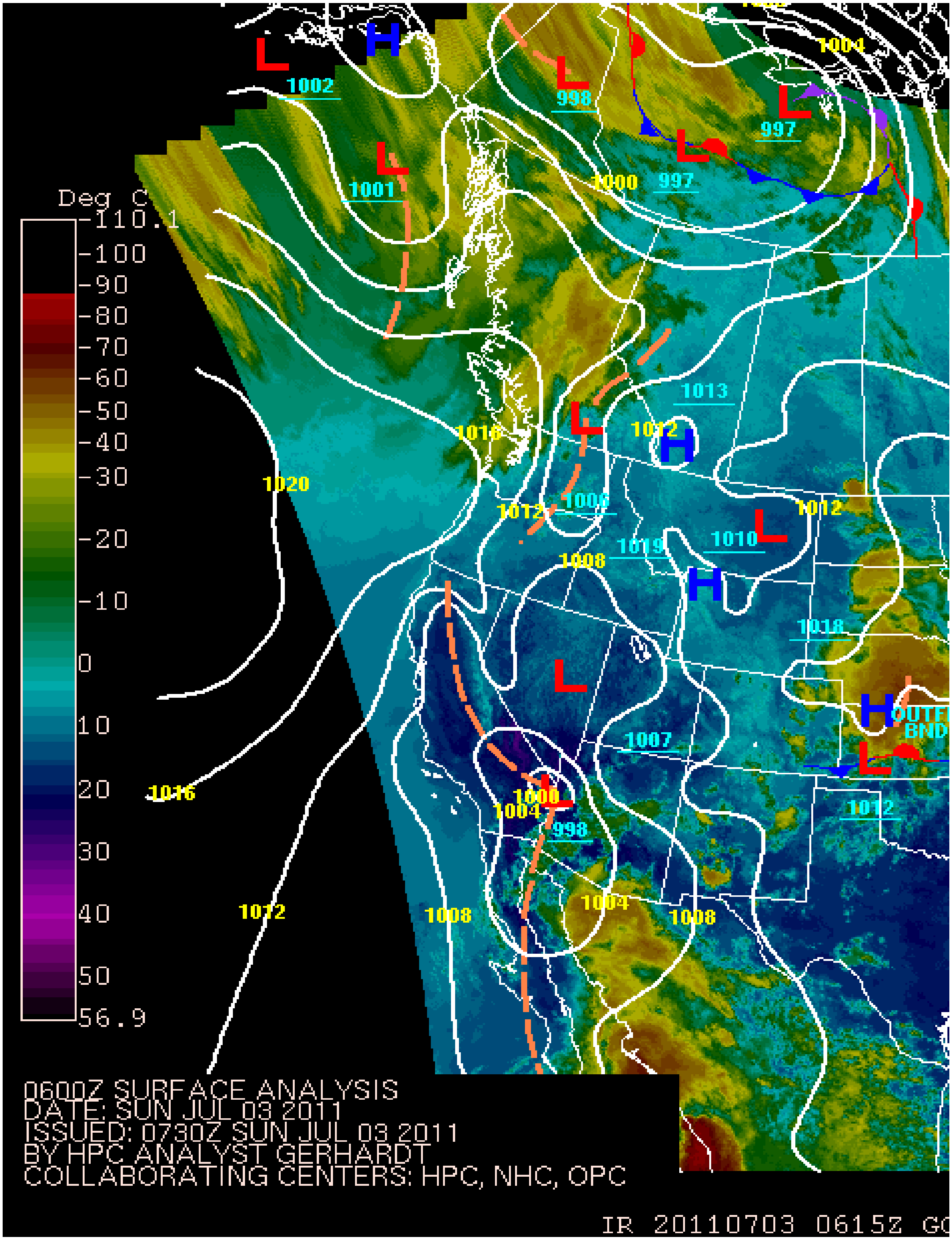


Figure 76. Surface during the event - weather chart with IR overlay July 3, 2011 06Z.

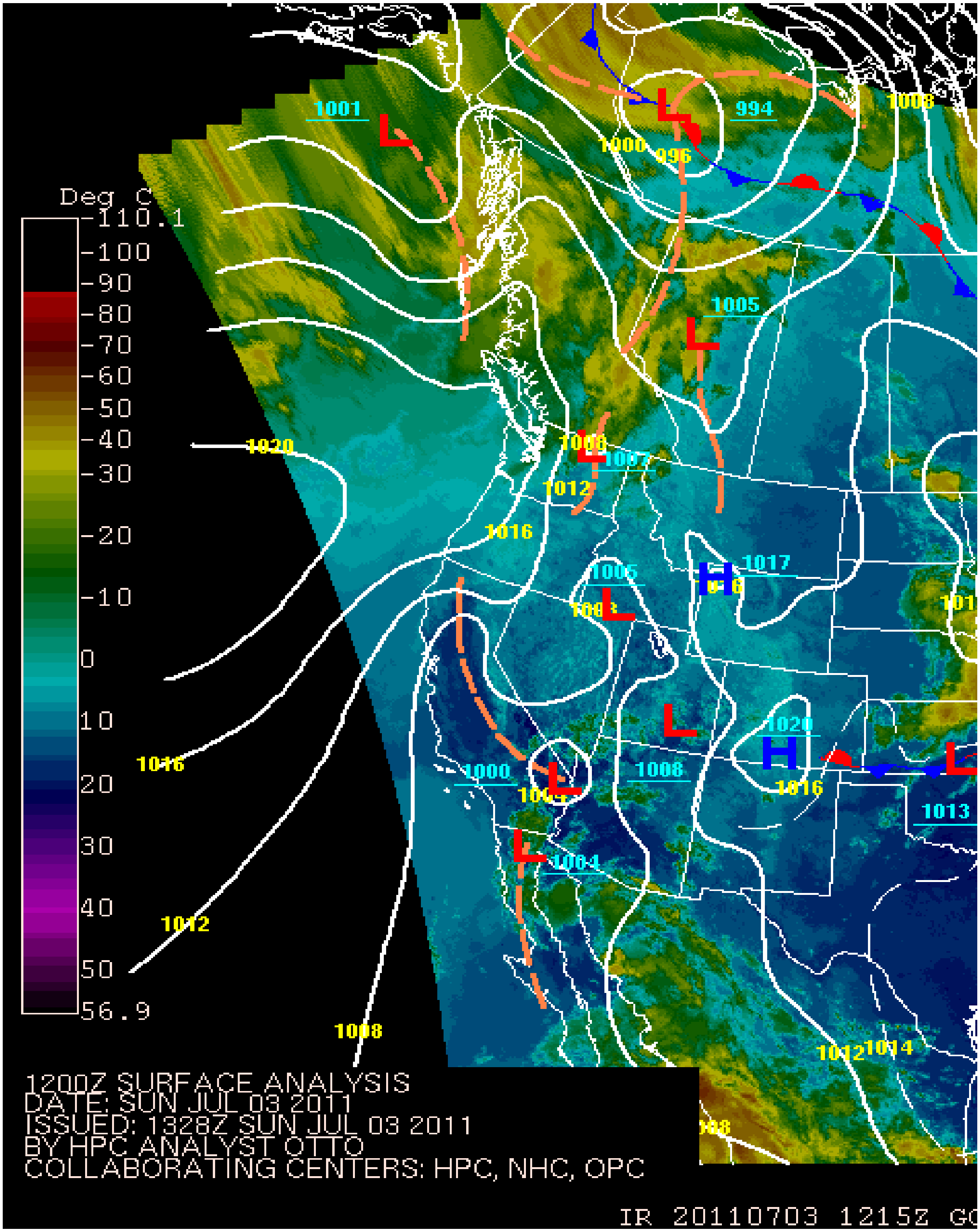


Figure 77. Surface during the event - weather chart with IR overlay July 3, 2011 12Z.

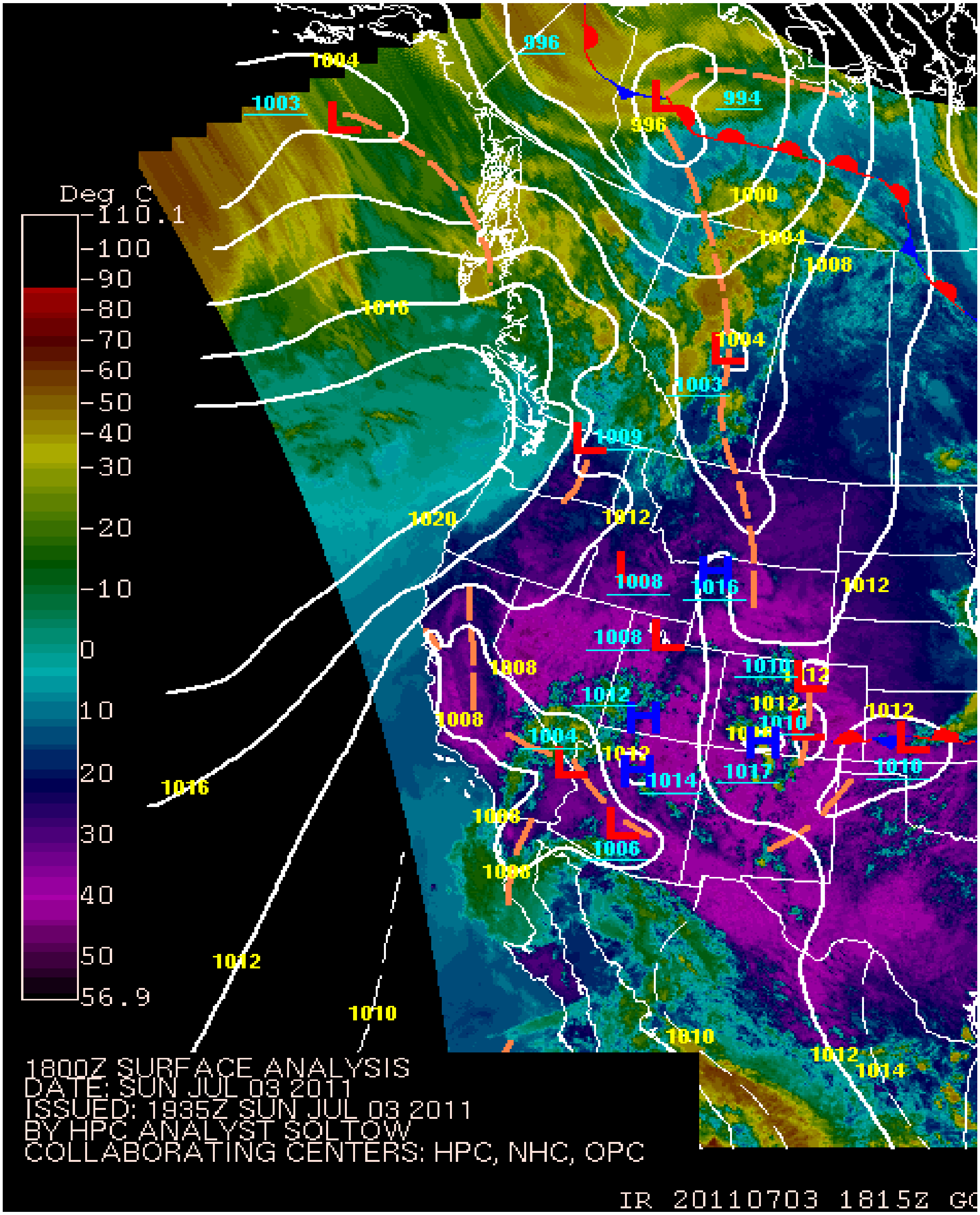


Figure 78. Surface during the event - weather chart with IR overlay July 3, 2011 18Z.

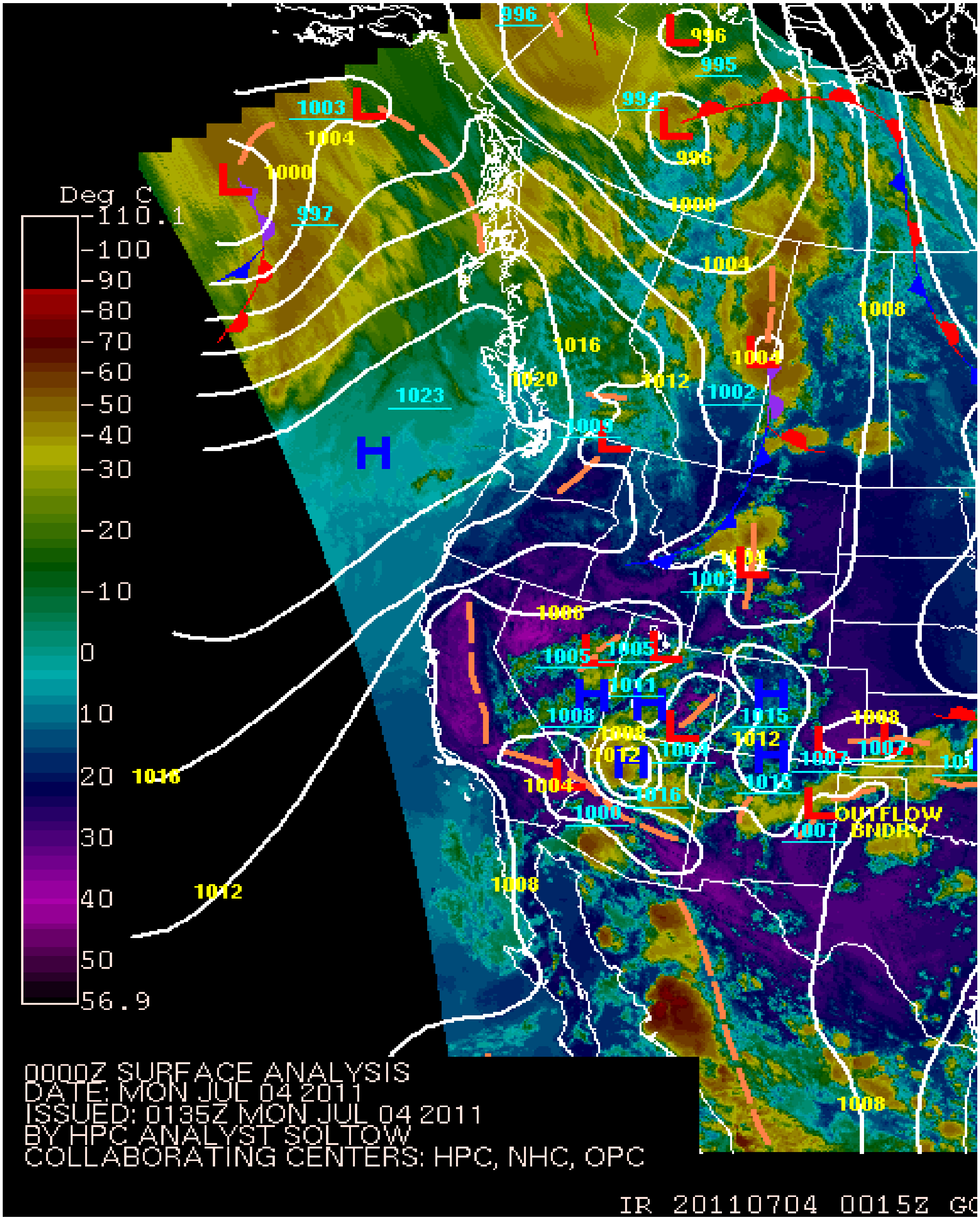


Figure 79. Surface during the event - weather chart with IR overlay July 4, 2011 00Z.

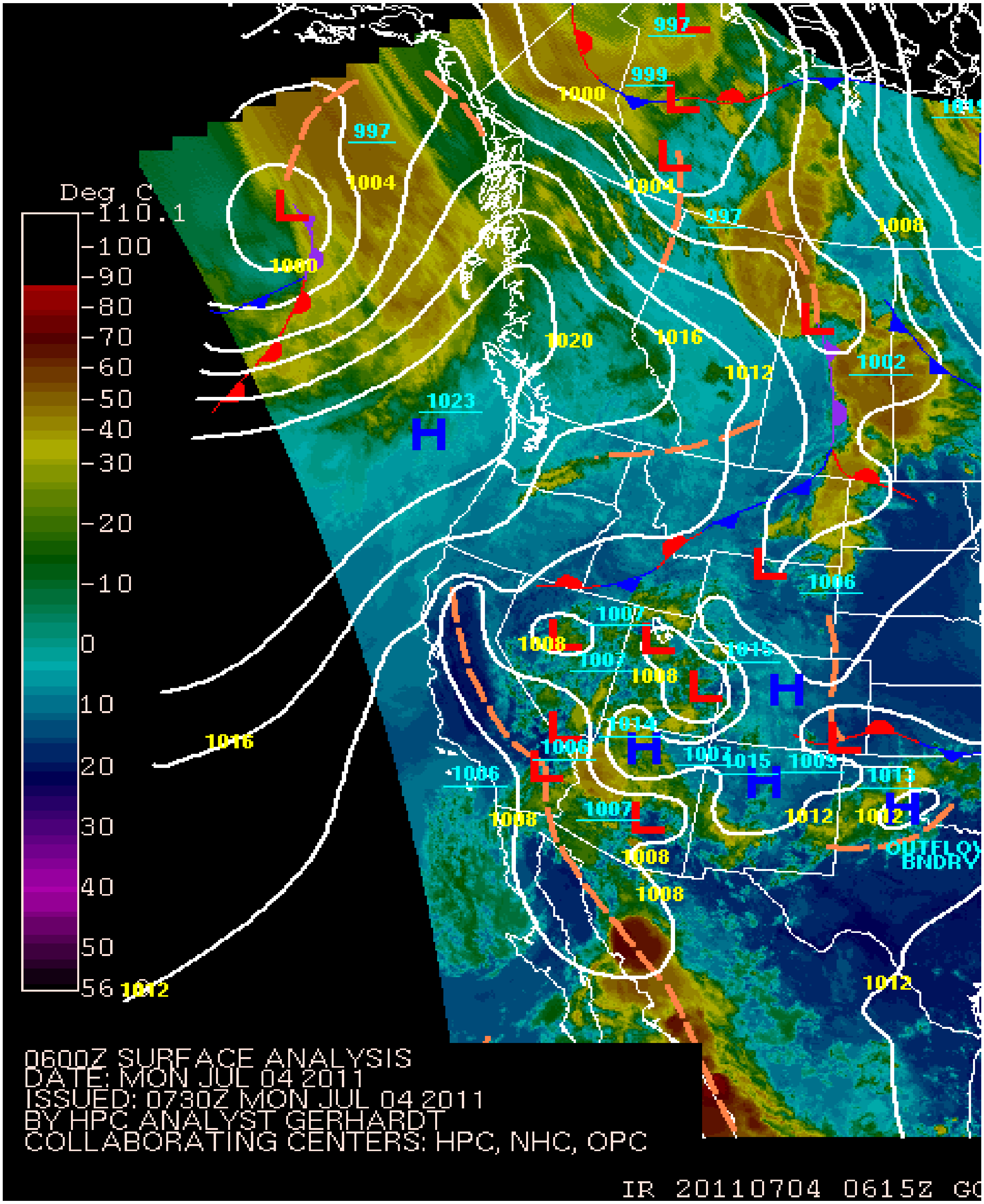


Figure 80. Surface during the event - weather chart with IR overlay July 4, 2011 06Z.

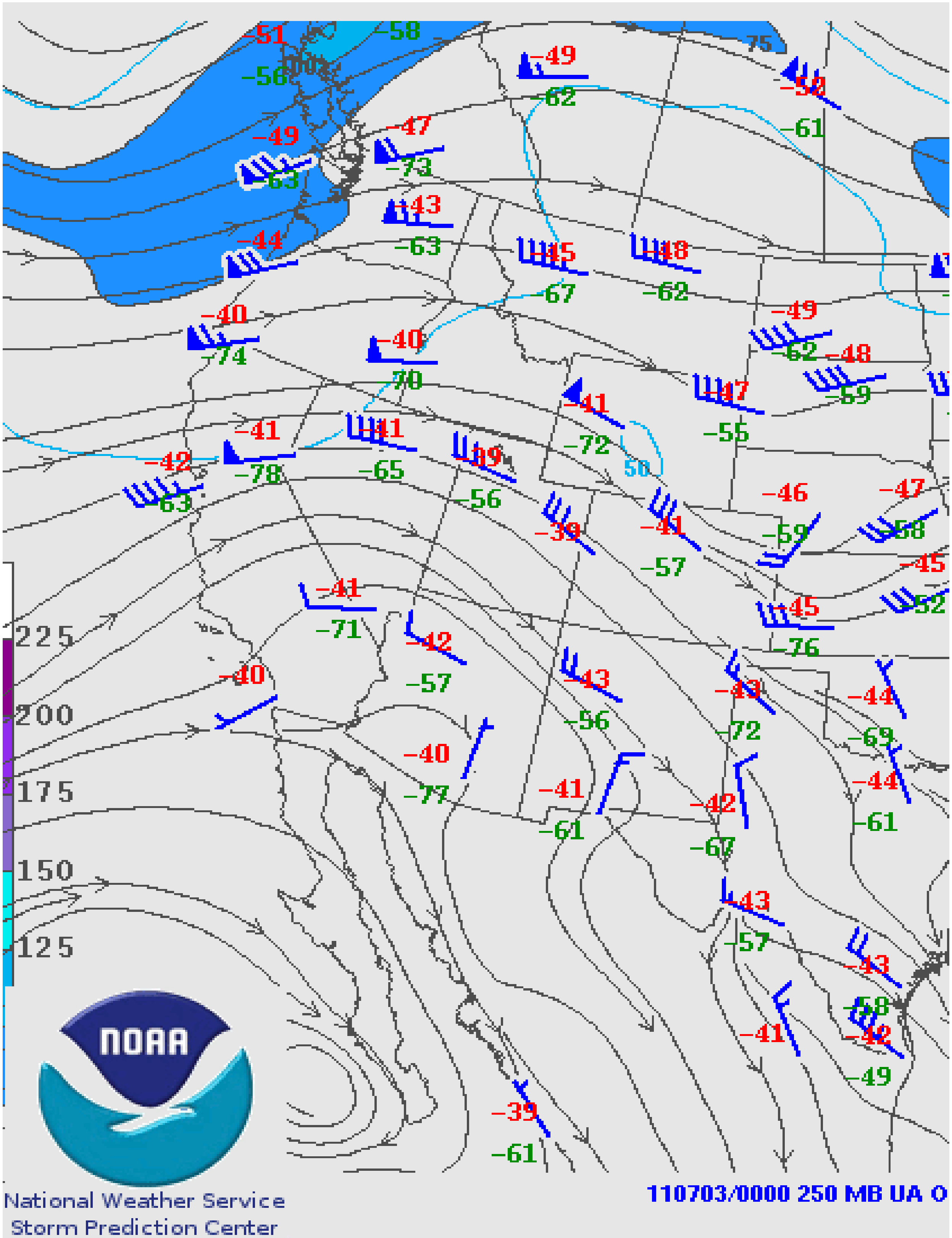


Figure 81. 250 mb during the event - weather chart July 3, 2011 00Z.

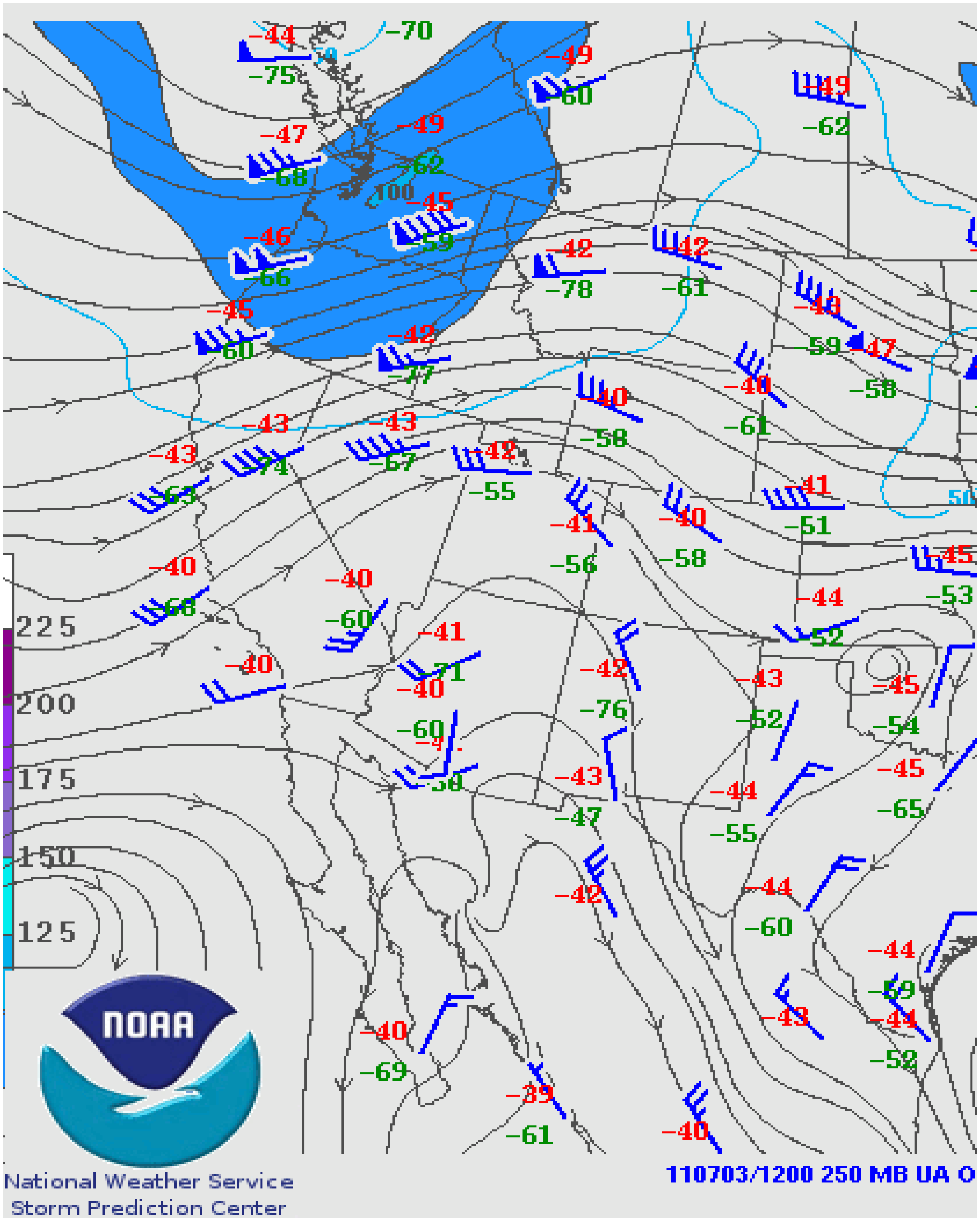


Figure 82. 250 mb during the event - weather chart July 3, 2011 12Z.

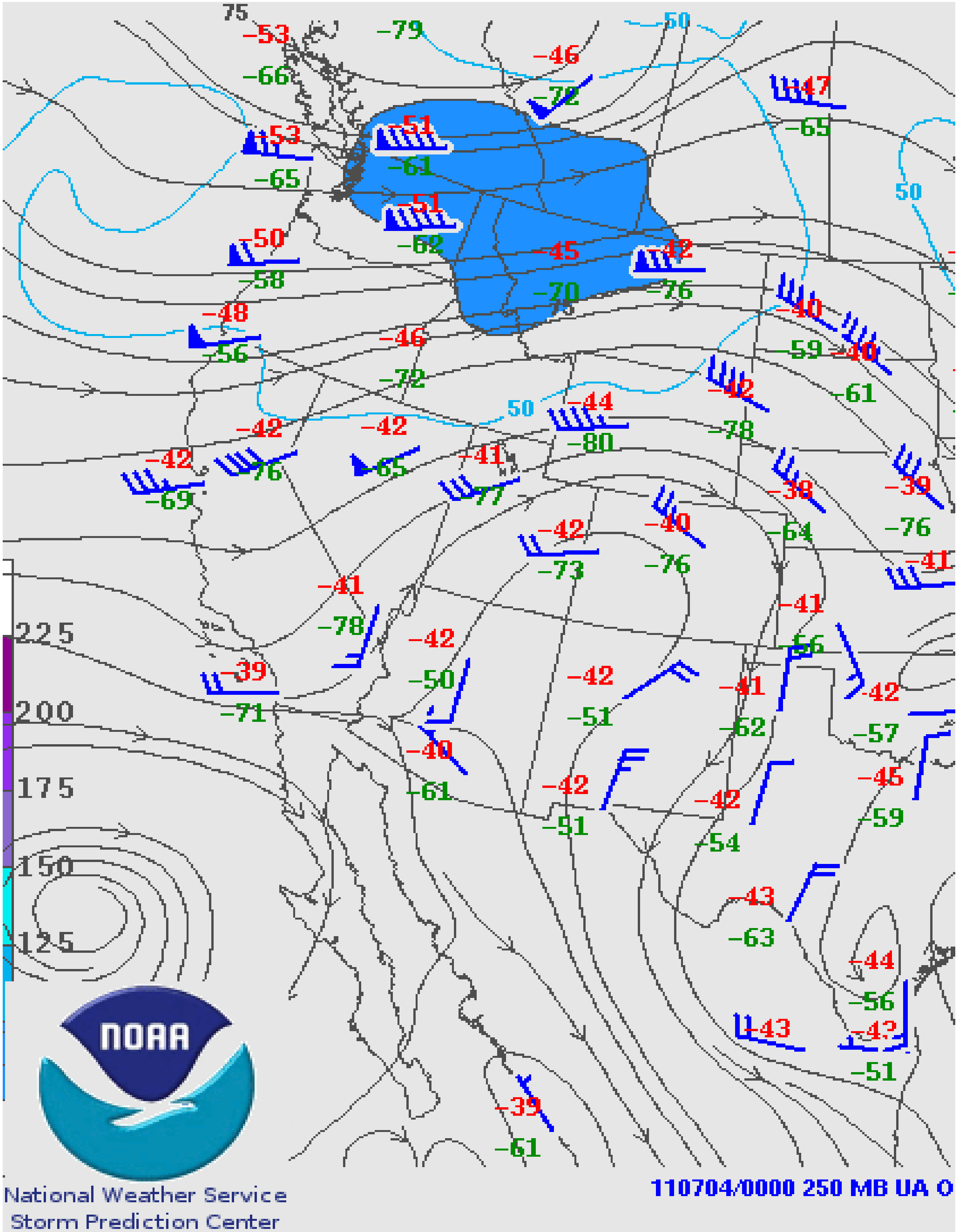


Figure 83. 250 mb during the event - weather chart July 4, 2011 00Z.

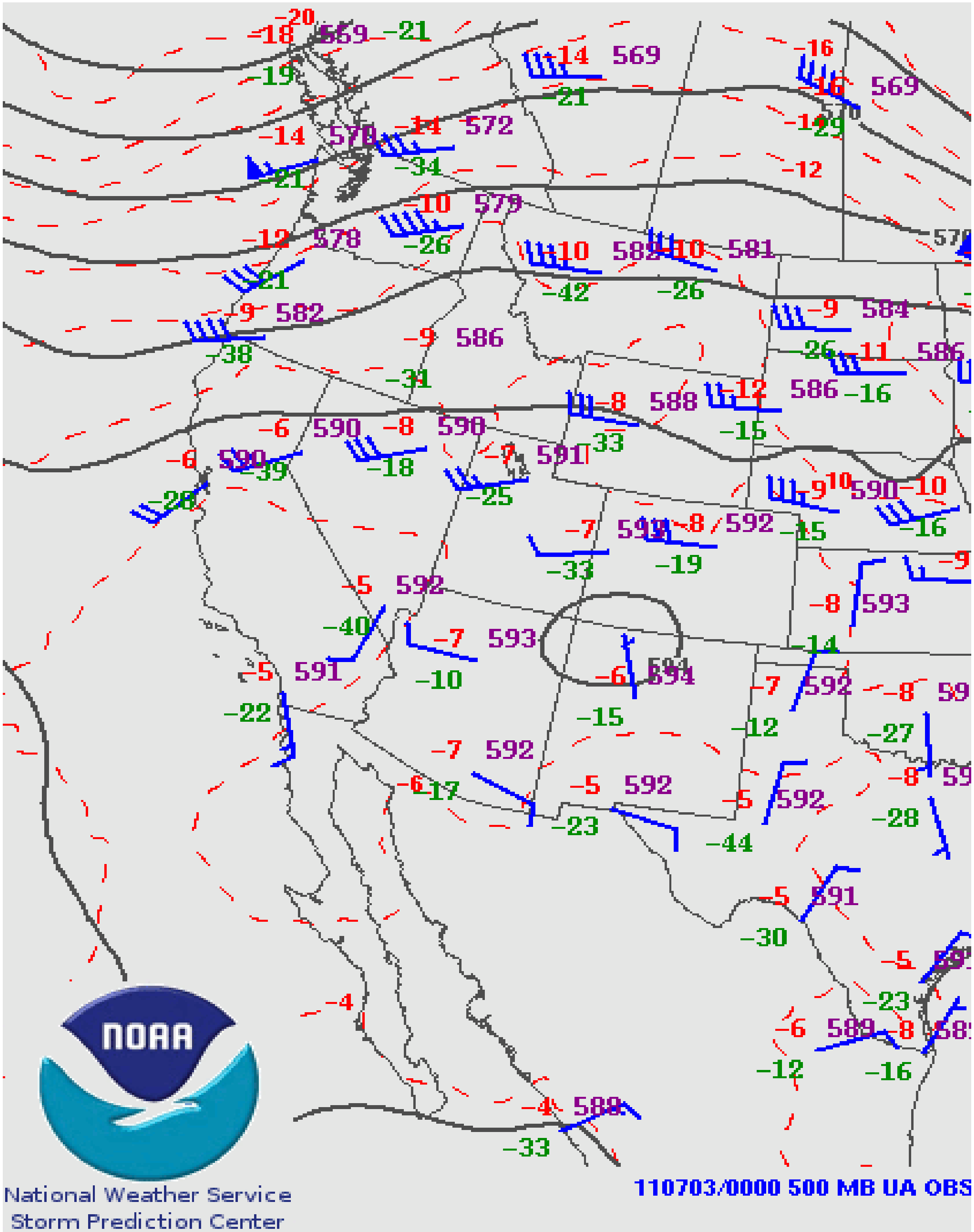


Figure 84. 500 mb during the event - weather chart July 3, 2011 00Z.

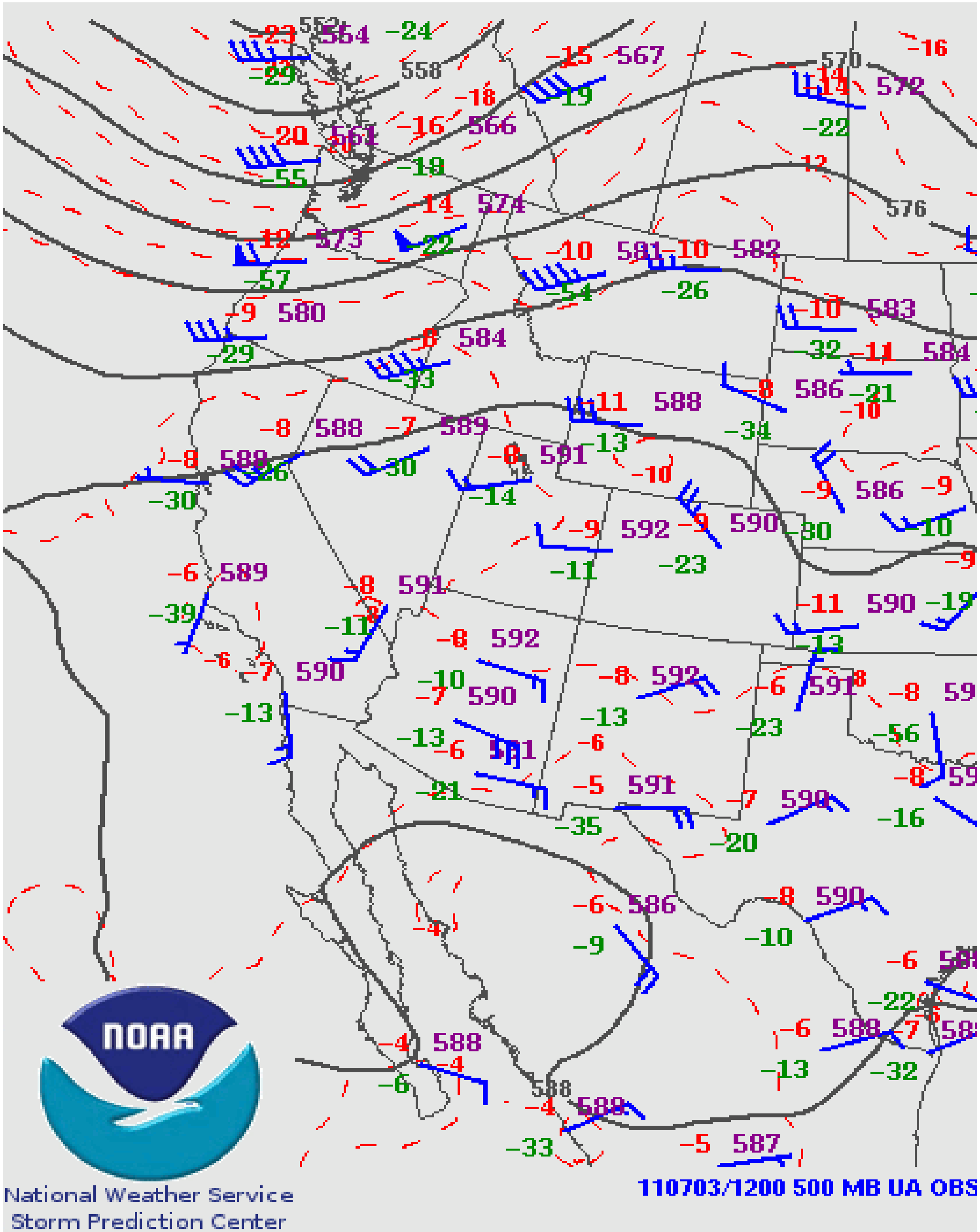


Figure 85. 500 mb during the event - weather chart July 3, 2011 12Z.

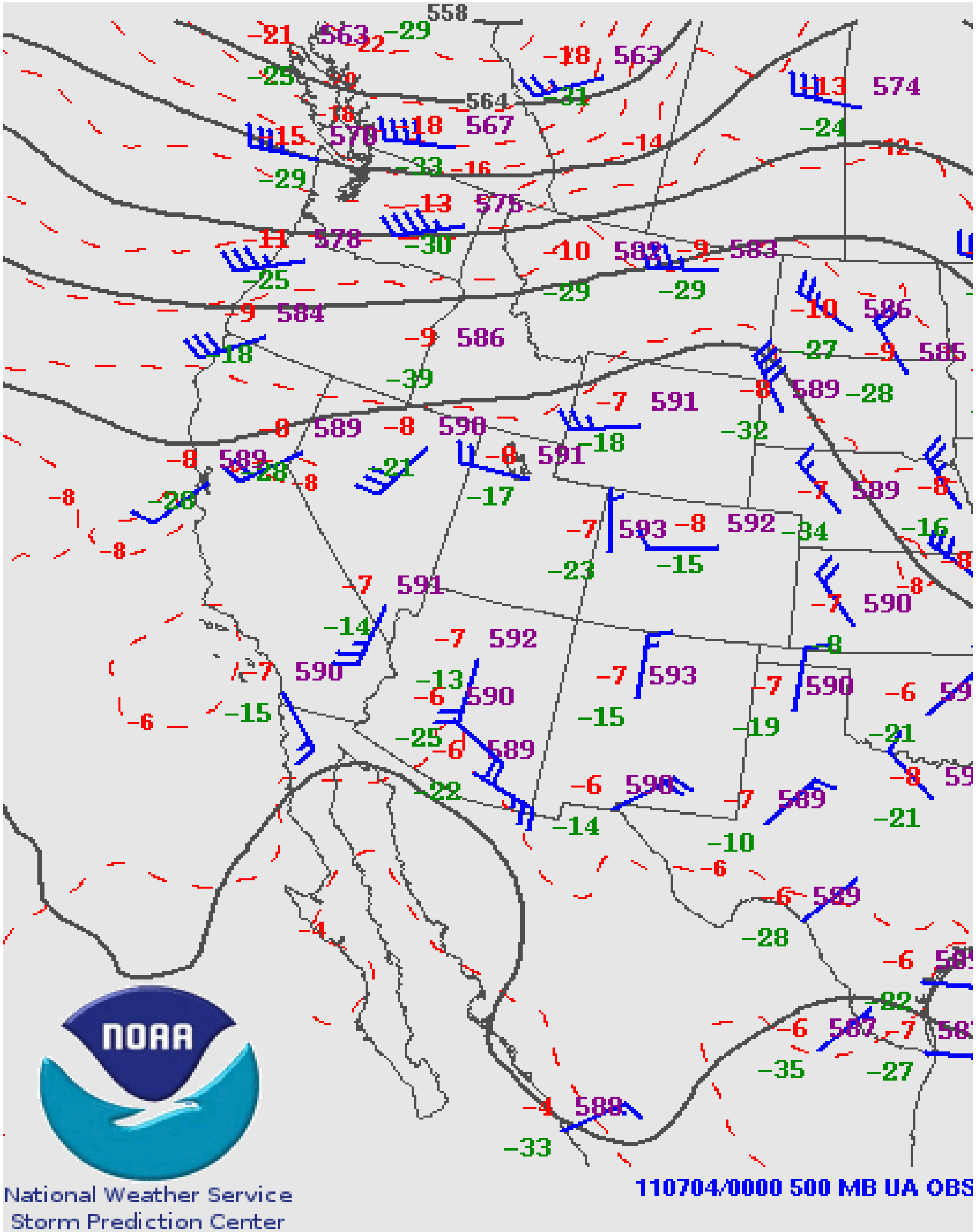


Figure 86. 500 mb during the event - weather chart July 4, 2011 00Z.

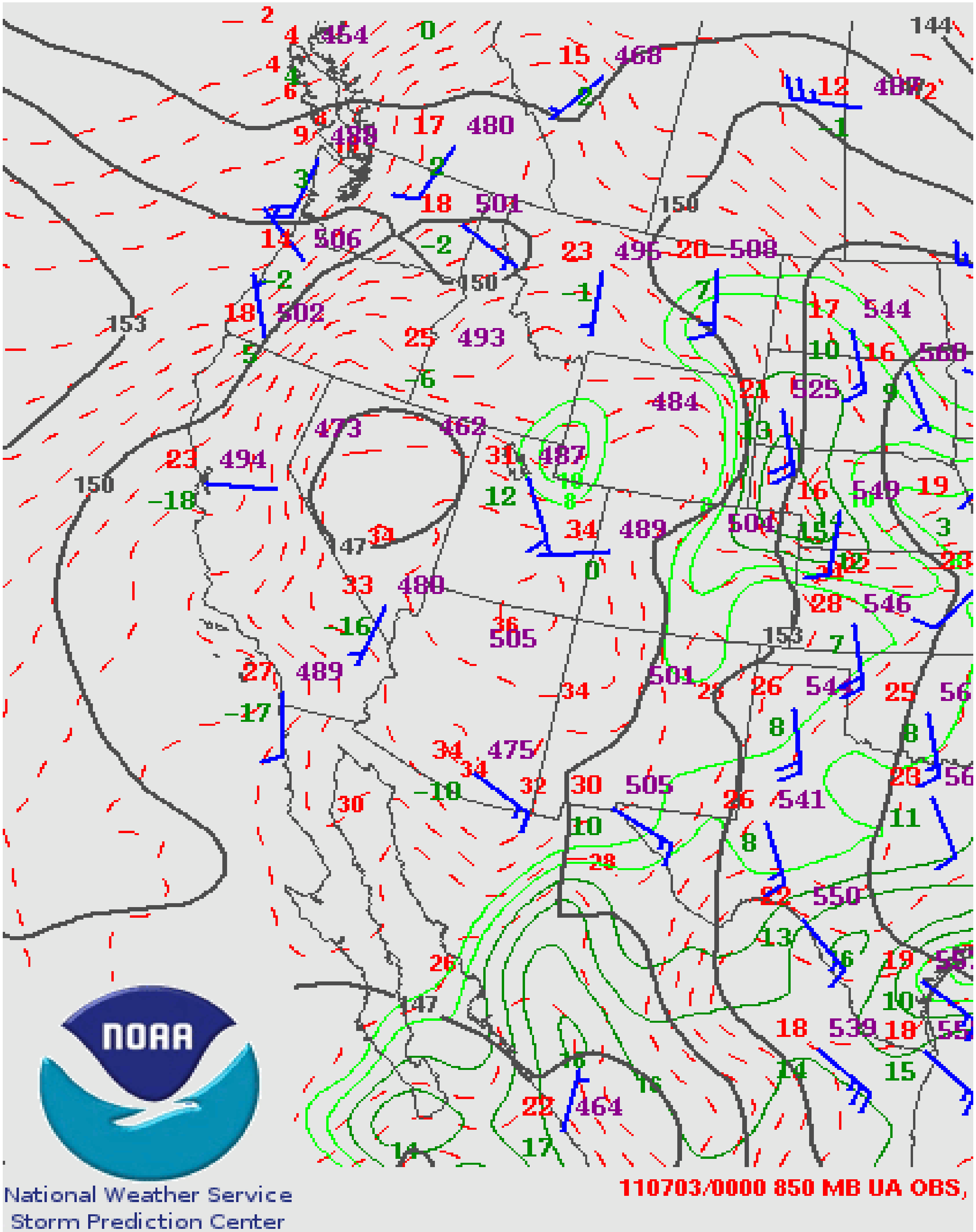


Figure 87. 850 mb during the event - weather chart July 3, 2011 00Z.

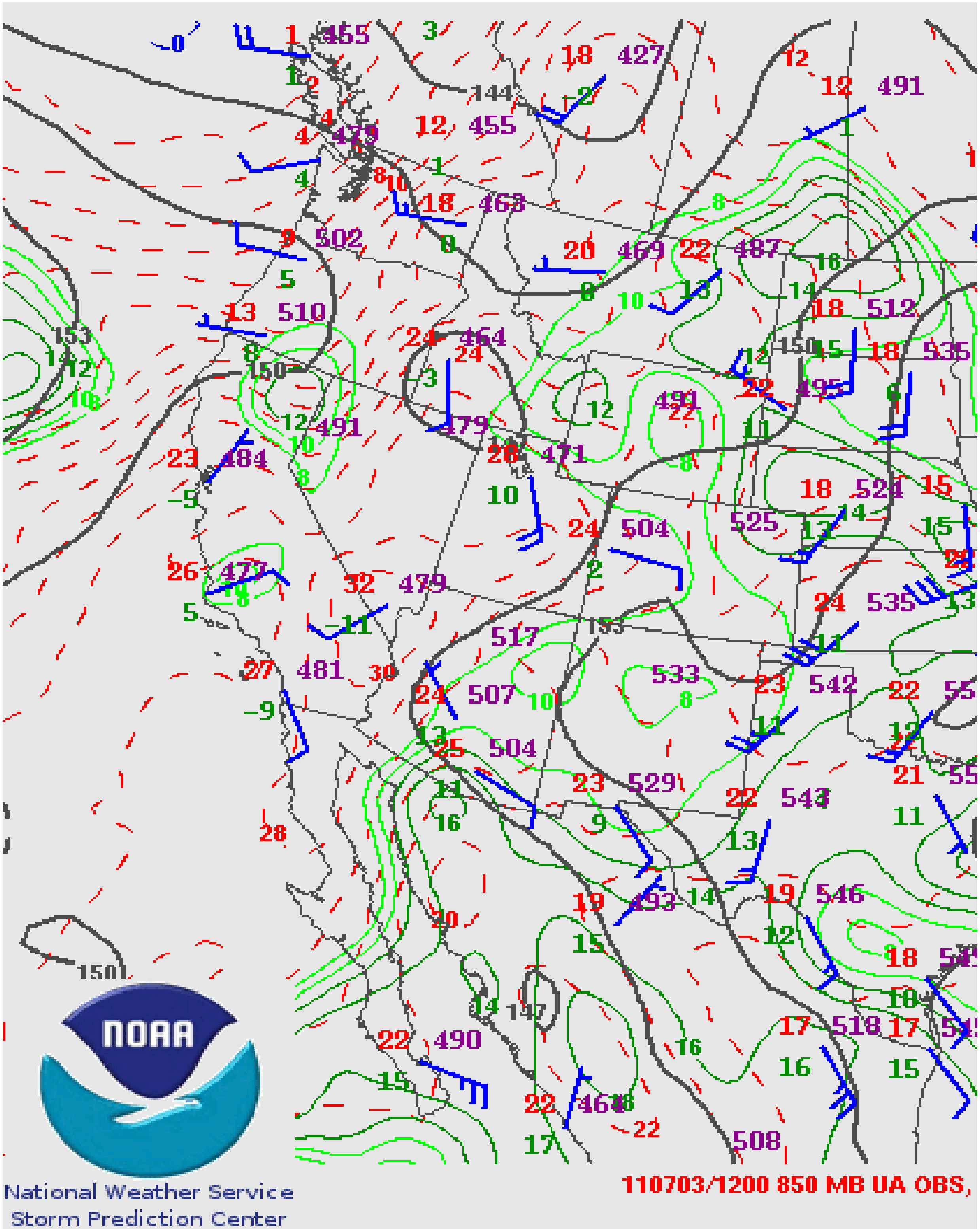


Figure 88. 850 mb during the event - weather chart July 3, 2011 12Z.

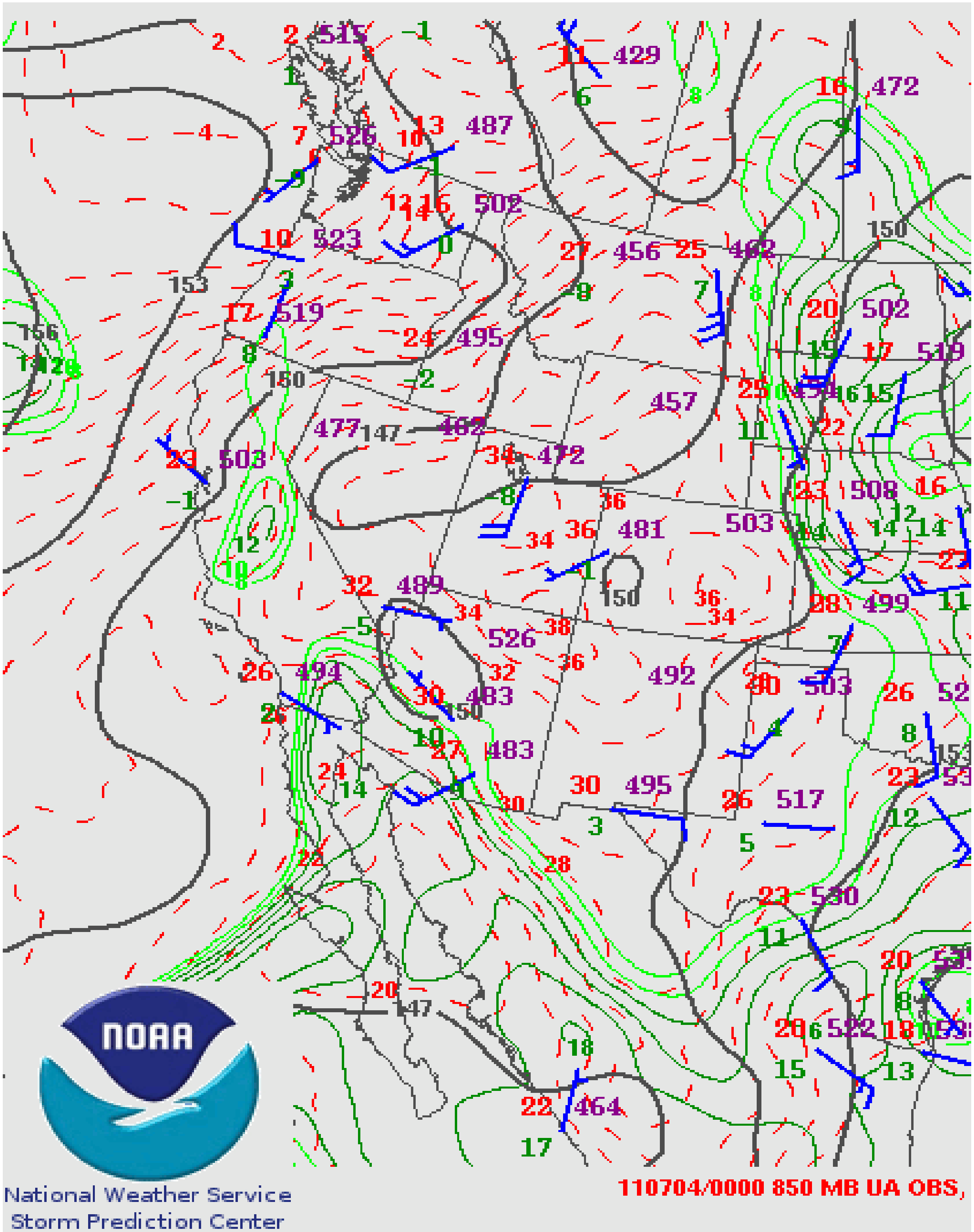


Figure 89. 850 mb during the event - weather chart July 4, 2011 00Z.

Table 35. Quality Controlled Hourly Observations Climatological Data for the North Las Vegas Airport July 3, 2011

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)
HOURLY OBSERVATIONS TABLE
NORTH LAS VEGAS AIRPORT (53123)
LAS VEGAS, NV
(07/2011)

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

Elevation: 2203 ft. above sea level
Latitude: 36.211
Longitude: -115.195
Data Version: VER2

Date	Time (LST)	Station Type	Sky Conditions	Visibility (SM)	Weather Type	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Humd %	Wind Speed (MPH)	Wind Dir	Wind Gusts (MPH)	Station Pressure (in. hg)	Press Tend	Net 3-hr Chg (mb)	Sea Level Pressure (in. hg)	Report Type	Precip. Total (in)	Alti-meter (in. hg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
03	0053	12	CLR	10.00		86	30.0	57	14.0	31	-0.6	14	3	340		27.43			29.68	AA		29.73
03	0153	12	CLR	10.00		87	30.6	58	14.7	34	1.1	15	7	290		27.44			29.68	AA		29.74
03	0253	12	CLR	10.00		84	28.9	57	14.0	34	1.1	17	7	310		27.44			29.68	AA		29.74
03	0353	12	CLR	10.00		83	28.3	56	13.3	31	-0.6	15	6	340		27.45			29.70	AA		29.75
03	0453	12	CLR	10.00		83	28.3	56	13.5	32	0.0	16	0	000		27.47			29.72	AA		29.77
03	0553	12	CLR	10.00		84	28.9	57	13.9	33	0.6	16	5	310		27.50			29.75	AA		29.80
03	0653	12	CLR	10.00		90	32.2	60	15.3	34	1.1	14	5	040		27.52			29.77	AA		29.82
03	0753	12	CLR	10.00		93	33.9	60	15.6	32	0.0	11	9	130		27.54			29.79	AA		29.84
03	0853	12	CLR	6.00	HZ	96	35.6	63	16.9	37	2.8	13	11	130		27.55			29.80	AA		29.85
03	0953	12	CLR	4.00	HZ	93	33.9	65	18.1	46	7.8	20	9	150		27.56			29.82	AA		29.87
03	1053	12	CLR	5.00	HZ	98	36.7	65	18.4	43	6.1	15	7	110		27.55			29.81	AA		29.86
03	1153	12	CLR	4.00	HZ	102	38.9	68	19.9	47	8.3	16	14	140	17	27.54			29.79	AA		29.84
03	1253	12	CLR	6.00	HZ	104	40.0	67	19.4	43	6.1	13	7	170		27.52			29.77	AA		29.82
03	1353	12	CLR	10.00		106	41.1	67	19.4	41	5.0	11	3	VR		27.49			29.74	AA		29.79
03	1453	12	CLR	10.00		106	41.1	66	18.7	37	2.8	9	5	VR		27.46			29.71	AA		29.76
03	1553	12	CLR	10.00		106	41.1	66	18.7	37	2.8	9	0	000		27.45			29.70	AA		29.75
03	1653	12	CLR	10.00		105	40.6	65	18.5	37	2.8	10	14	150		27.44			29.69	AA		29.74
03	1723	12	CLR	10.00		102	39.0	66	19.1	43	6.0	13	20	070	28	27.45			M	SP		29.75
03	1748	12	SCT039 SCT060	6.00	-RA SQ	99	37.0	67	19.1	46	8.0	16	3	VR	48	27.47			M	SP		29.77
03	1753	12	SCT050	8.00	-RA	99	37.2	67	19.4	47	8.3	17	3	VR	18	27.47			29.73	AA	T	29.77
03	1820	12	CLR	4.00	HZ	93	34.0	68	20.0	54	12.0	27	44s	140	59	27.49			M	SP		29.79
03	1822	12	CLR	1.75	HZ	91	33.0	68	19.9	55	13.0	30	41	140	59	27.50			M	SP		29.80
03	1824	12	CLR	1.50	TS HZ	88	31.0	68	20.0	57	14.0	35	39	150	59	27.50			M	SP		29.80
03	1831	12	CLR	3.00	-TSRA	84	29.0	69	20.5	61	16.0	46	32	140	52	27.51			M	SP		29.81
03	1832	12	CLR	4.00	-RA	84	29.0	69	20.5	61	16.0	46	32	150	52	27.51			M	SP		29.81
03	1853	12	FEW070	10.00		86	30.0	68	19.9	58	14.4	39	31	150	36	27.52			29.80	AA	T	29.83
03	1953	12	CLR	10.00		86	30.0	67	19.7	57	13.9	37	10	070		27.57			29.83	AA		29.88
03	2053	12	CLR	10.00		87	30.6	67	19.5	56	13.3	35	7	300		27.58			29.84	AA		29.89
03	2153	12	CLR	10.00		88	31.1	67	19.4	55	12.8	33	8	230		27.56			29.83	AA		29.87
03	2253	12	CLR	10.00		89	31.7	66	19.1	53	11.7	29	0	000		27.56			29.82	AA		29.87
03	2353	12	CLR	10.00		83	28.3	69	20.3	61	16.1	48	16	130	22	27.56			29.83	AA		29.87

Table 36. Quality Controlled Hourly Observations Climatological Data for the McCarran International Airport July 3, 2011

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)
HOURLY OBSERVATIONS TABLE
MCCARRAN INTERNATIONAL AIRPORT (23169)
LAS VEGAS, NV
(07/2011)

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

Elevation: 2180 ft. above sea level
Latitude: 36.071
Longitude: -115.163
Data Version: VER3

Date	Time (LST)	Station Type	Sky Conditions	Visibility (SM)	Weather Type	Dry Bulb Temp (F)	Dry Bulb Temp (C)	Wet Bulb Temp (F)	Wet Bulb Temp (C)	Dew Point Temp (F)	Dew Point Temp (C)	Rel Humd %	Wind Speed (MPH)	Wind Dir	Wind Gusts (MPH)	Station Pressure (in. hg)	Press Tend	Net 3-hr Chg (mb)	Sea Level Pressure (in. hg)	Report Type	Precip. Total (in)	Alti-meter (in. hg)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
03	0056	11	CLR	10.00		91	32.8	57	14.0	24	-4.4	9	0	000		27.43			29.60	AA		29.70
03	0156	11	FEW120	10.00		90	32.2	57	14.1	26	-3.3	10	7	200		27.43			29.60	AA		29.70
03	0256	11	FEW120	10.00		89	31.7	57	13.7	25	-3.9	10	7	210		27.44			29.60	AA		29.71
03	0356	11	FEW120 SCT150	10.00		86	30.0	56	13.1	25	-3.9	11	10	200		27.45			29.61	SY-MT		29.72
03	0456	11	FEW120 SCT180	10.00		87	30.6	56	13.4	26	-3.3	11	7	230		27.47			29.63	AA		29.74
03	0556	11	FEW120 SCT180	10.00		89	31.7	58	14.1	28	-2.2	11	8	200		27.50			29.66	AA		29.77
03	0656	11	FEW120 SCT180	10.00		94	34.4	59	14.9	26	-3.3	9	3	060		27.52			29.68	AA		29.79
03	0756	11	FEW120 SCT180	10.00		95	35.0	61	15.8	31	-0.6	10	0	000		27.52			29.70	AA		29.80
03	0856	11	FEW100 BKN150	9.00		96	35.6	62	16.6	35	1.7	12	5	VR		27.53			29.71	AA		29.81
03	0956	11	FEW080 BKN150	6.00	HZ	96	35.6	63	17.3	39	3.9	14	8	170		27.55			29.73	SY-MT		29.83
03	1056	11	FEW080 BKN150	6.00	HZ	99	37.2	64	17.8	39	3.9	12	3	VR		27.54			29.72	AA		29.82
03	1156	11	FEW080 BKN150	7.00		104	40.0	65	18.4	37	2.8	10	3	VR		27.53			29.71	AA		29.81
03	1256	11	FEW080 BKN150	10.00		106	41.1	65	18.1	33	0.6	8	3	230		27.52			29.68	AA		29.79
03	1356	11	FEW080 BKN150	10.00		106	41.1	65	18.3	34	1.1	8	8	180		27.49			29.65	AA		29.76
03	1456	11	FEW080 SCT150	10.00		108	42.2	66	18.9	36	2.2	8	7	150		27.46			29.62	AA		29.73
03	1556	11	SCT120 SCT180	10.00		106	41.1	67	19.2	40	4.4	10	3	VR		27.45			29.62	AA		29.72
03	1656	11	SCT080 BKN140	10.00		103	39.4	67	19.6	45	7.2	14	7	VR		27.44			29.61	AA		29.71
03	1719	11	SCT080CB BKN140	2.00	TSRA	90	32.0	70	20.9	59	15.0	35	40	180	55	27.45			M	SP		29.72
03	1722	11	SCT080CB BKN140	1.25	TSRA	88	31.0	69	20.5	59	15.0	38	20	160	55	27.47			M	SP		29.74
03	1733	11	BKN035CB OVC100	2.00	+TSRA	84	29.0	69	20.5	61	16.0	46	20	150	33	27.51			M	SP		29.78
03	1743	11	BKN035CB OVC100	1.25	+TSRA	81	27.0	69	20.6	63	17.0	54	30	170	39	27.53			M	SP		29.81
03	1754	11	BKN035CB OVC100	2.00	+TSRA	88	31.0	67	19.4	55	13.0	33	8	080	26	27.52			M	SP		29.79
03	1756	11	BKN035CB OVC100	2.50	+TSRA	86	30.0	68	19.9	58	14.4	39	15	060	20	27.51			29.70	AA	0.66	29.78
03	1803	11	BKN025CB OVC080	4.00	TSRA	91	33.0	68	19.9	55	13.0	30	13	090	33	27.51			M	SP		29.78
03	1836	11	SCT025CB BKN080 BKN120	10.00	-TSRA	81	27.0	69	20.6	63	17.0	54	22	110	30	27.56			M	SP		29.84
03	1856	11	SCT025CB BKN080 BKN120	10.00	-TSRA	80	26.7	69	20.7	64	17.8	58	20	110	25	27.57			29.76	AA	0.08	29.85
03	1910	11	SCT025 BKN100	10.00	-RA	81	27.0	71	21.6	66	19.0	60	14	100	26	27.57			M	SP		29.85
03	1956	11	SCT032 BKN080 BKN250	10.00	-RA	84	28.9	69	20.5	61	16.1	46	10	160		27.54			29.73	AA	T	29.82
03	2056	11	SCT032 BKN100 BKN250	10.00		84	28.9	70	21.1	63	17.2	49	3	VR		27.57			29.76	AA		29.85
03	2156	11	FEW032 SCT100 BKN200	10.00		85	29.4	69	20.6	61	16.1	45	8	240		27.56			29.75	AA		29.84
03	2256	11	FEW030 SCT110 BKN200	10.00		85	29.4	68	19.8	58	14.4	40	13	200		27.56			29.74	AA		29.84
03	2356	11	FEW110 SCT200	10.00		84	28.9	68	20.2	60	15.6	44	10	180		27.56			29.74	AA		29.84

Table 37. Hourly Observations Monitoring Site Data for July 3, 2011

Time	Green Valley			JD Smith			Joe Neal			Palo Verde			Paul Meyer			Sunrise Acres		
	WS[1]	WD[2]	WG[3]	WS[1]	WD[2]	WG[3]	WS[1]	WD[2]	WG[3]	WS[1]	WD[2]	WG[3]	WS[1]	WD[2]	WG[3]	WS[1]	WD[2]	WG[3]
0:00	2	VAR	6	2	VAR	4	2	VAR	7	3	VAR	6	3	VAR	6	1	VAR	4
1:00	3	VAR	6	2	VAR	7	5	318	10	4	280	7	3	VAR	6	1	VAR	5
2:00	3	VAR	6	3	VAR	7	3	VAR	6	4	280	9	4	260	13	1	VAR	3
3:00	2	VAR	7	2	VAR	5	3	VAR	6	5	282	7	3	VAR	7	1	VAR	3
4:00	2	VAR	6	2	VAR	6	3	VAR	6	4	262	7	3	VAR	6	2	VAR	4
5:00	3	VAR	8	3	VAR	6	3	VAR	8	4	262	8	3	VAR	8	3	VAR	9
6:00	2	VAR	6	2	VAR	5	3	VAR	11	3	VAR	7	3	VAR	8	2	VAR	6
7:00	2	VAR	8	3	VAR	9	8	97	21	4	40	9	4	36	10	4	79	14
8:00	10	116	22	7	119	17	8	117	17	3	VAR	11	4	1	9	8	123	21
9:00	11	147	23	8	132	17	8	140	17	3	VAR	7	4	42	13	9	137	24
10:00	8	158	23	6	116	13	6	109	17	4	65	16	3	VAR	11	5	110	17
11:00	5	121	17	8	111	16	8	107	23	6	85	18	4	76	16	8	104	22
12:00	5	168	19	7	116	18	7	115	24	5	82	16	7	72	24	7	103	18
13:00	4	143	14	5	131	12	8	120	20	4	118	16	5	118	13	5	93	18
14:00	4	249	11	4	138	13	7	96	16	4	126	14	5	106	16	5	74	16
15:00	5	19	15	3	VAR	9	5	165	14	4	124	17	5	122	15	5	50	15
16:00	5	74	26	6	170	24	6	131	17	4	104	18	9	93	23	6	144	50
17:00	13	235	46	9	234	32	13	117	38	8	128	29	11	114	36	10	212	37
18:00	16	120	49	15	143	53	16	102	60	9	159	32	12	113	37	15	141	47
19:00	12	123	35	7	155	21	5	277	16	6	220	20	10	124	40	9	158	25
20:00	7	137	19	5	264	10	6	227	15	5	227	15	4	214	23	5	255	18
21:00	4	231	10	4	238	10	4	213	12	7	239	17	3	VAR	12	3	VAR	15
22:00	5	216	13	3	VAR	7	3	VAR	9	7	236	14	4	238	14	2	VAR	7
23:00	4	193	12	5	108	14	4	82	20	7	226	15	3	VAR	11	4	110	16

VAR=Variable/calm conditions-no specific wind direction
[1] WS=Wind Speed in MPH
[2] WD=Wind Direction in Degrees
[3] WG=Wind Gusts in MPH

Figures 89-94 are plots of the hourly average wind speed and maximum gust speed recorded at select DAQ monitoring stations for July 3, 2011. The stations were chosen to represent conditions throughout the Las Vegas Valley PM_{10} sites. One important observation in these data is the speed of the winds. DAQ wind data, the wind speed observed at the routine hourly time at the McCarran International Airport is shown on each chart to facilitate comparisons between stations. Note that the DAQ data are averages and maximum values recorded throughout the hour, while the McCarran International Airport data are from a short observation period occurring a few minutes ahead of the time listed. The similarity between the monitoring sites and the McCarran International Airport indicates the regional-scale influence of the weather system affecting the area.

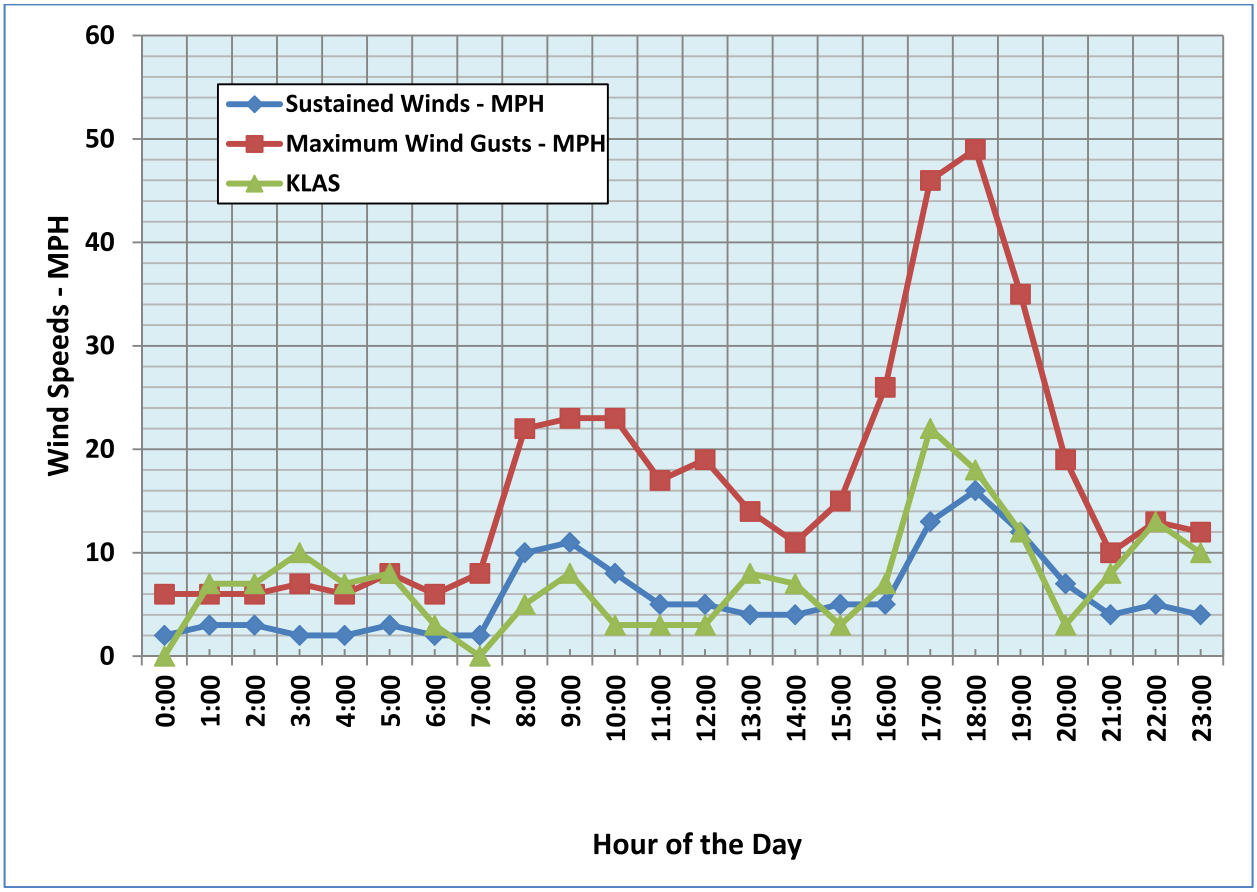


Figure 90. Green Valley – McCarran International Airport - Wind Speeds.

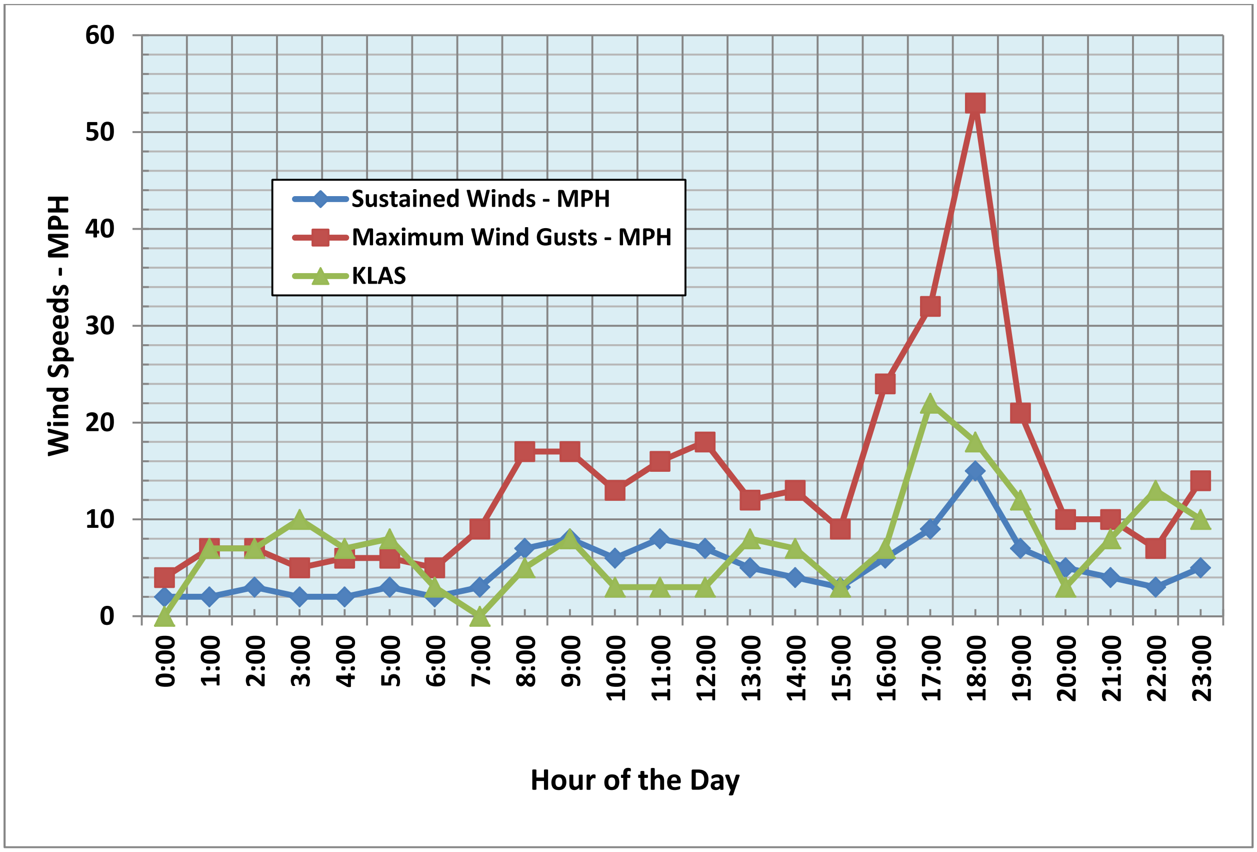


Figure 91. J. D. Smith – McCarran International Airport - Wind Speeds.

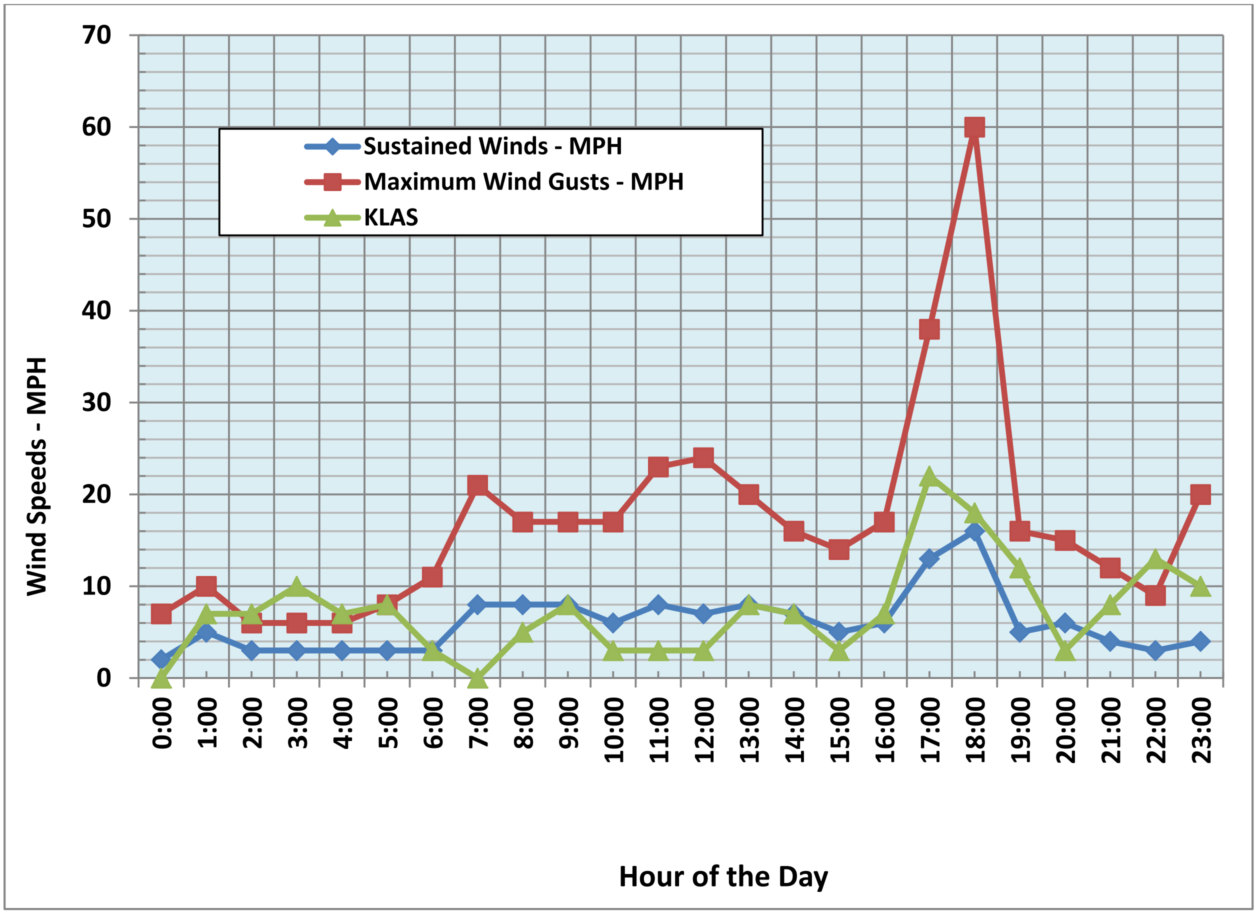


Figure 92. Joe Neal – McCarran International Airport - Wind Speeds.

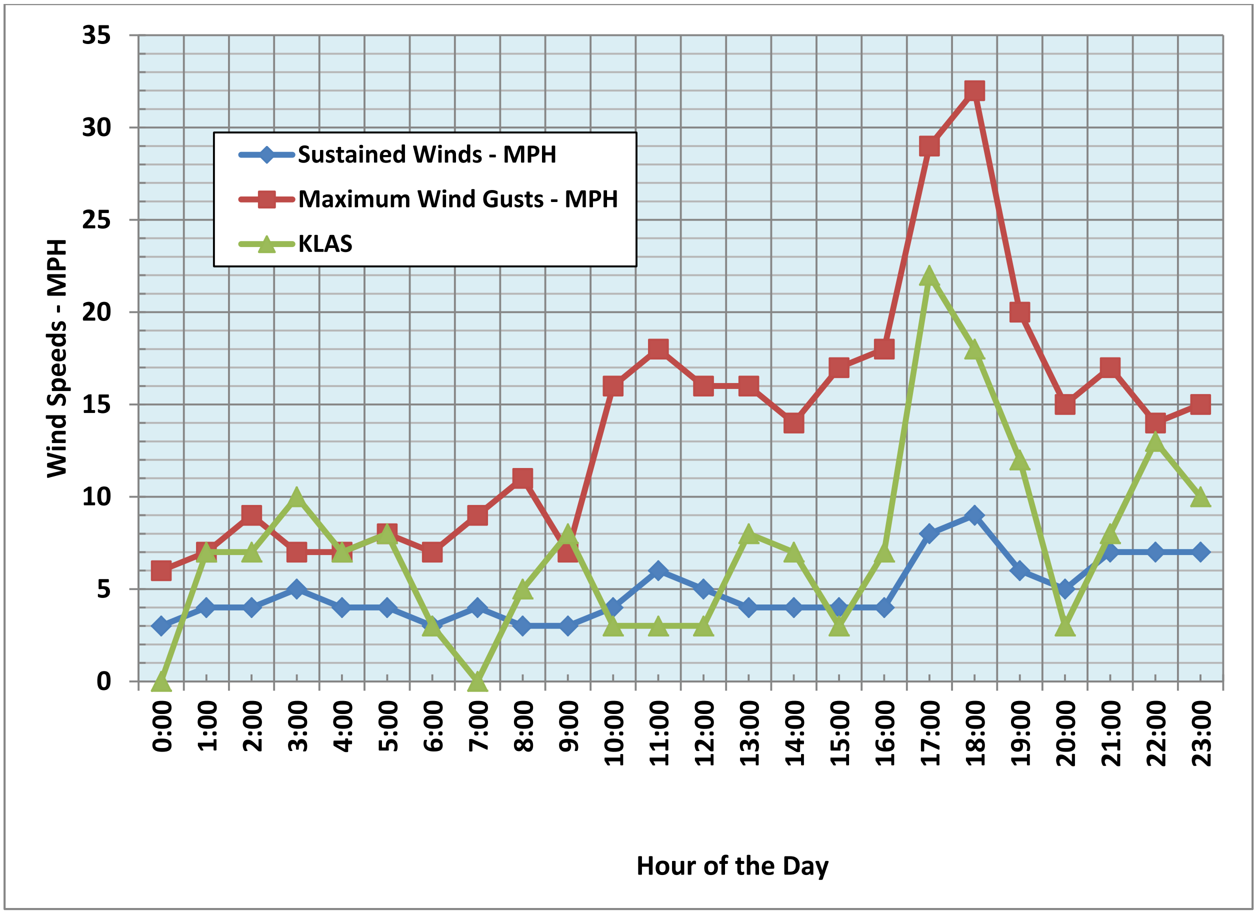


Figure 93. Palo Verde – McCarran International Airport - Wind Speeds.

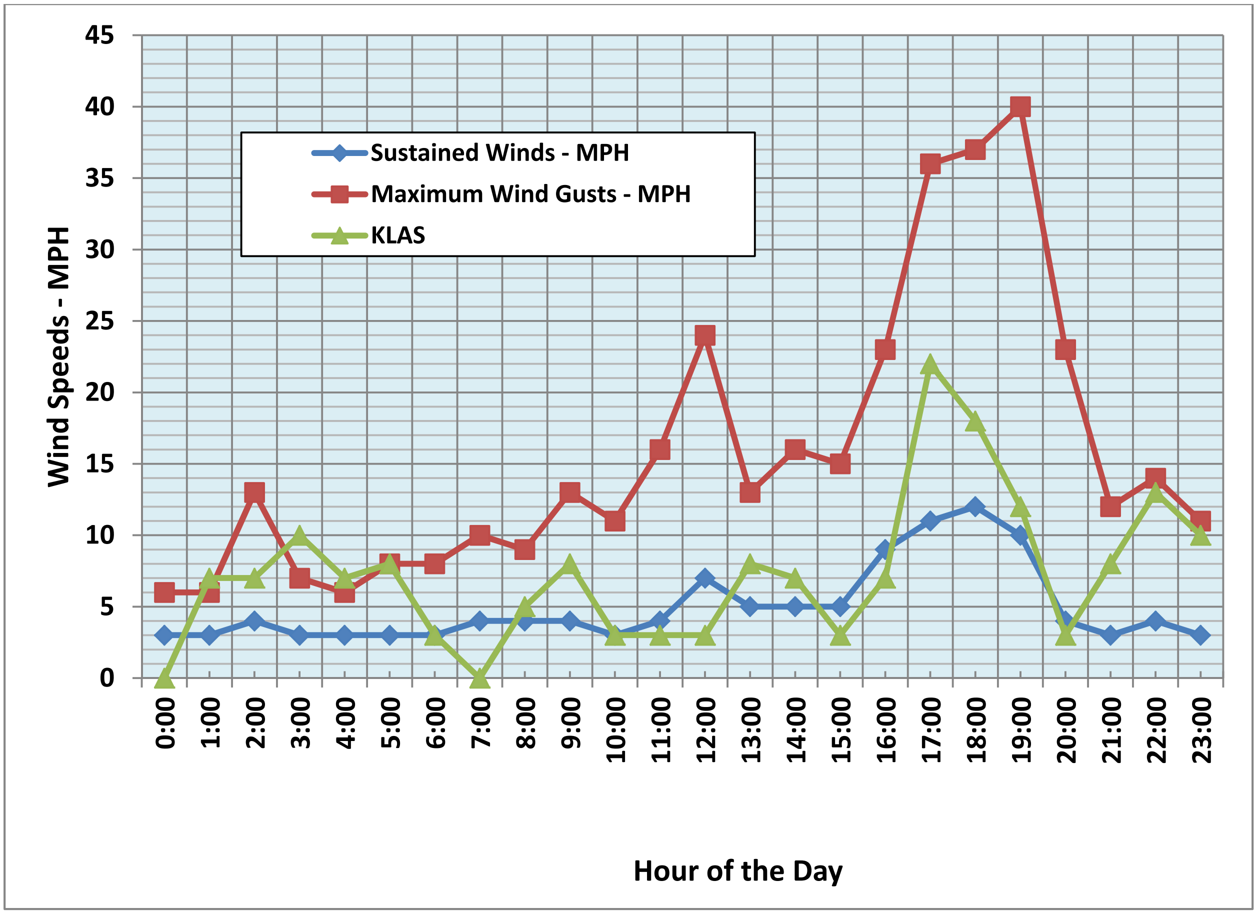


Figure 94. Paul Meyer – McCarran International Airport - Wind Speeds.

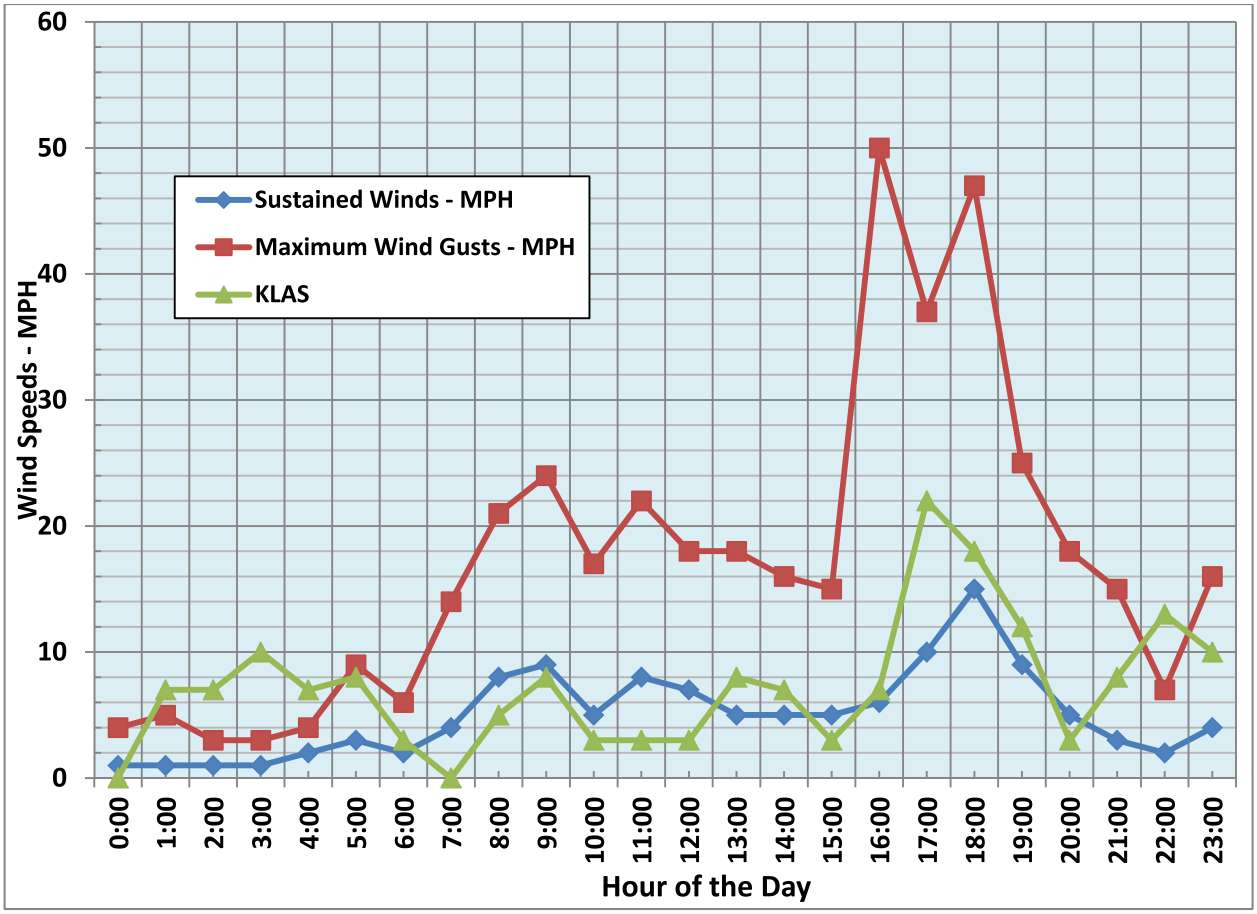


Figure 95. Sunrise Acres – McCarran International Airport - Wind Speeds.

Wind data from the McCarran International Airport and PM_{10} concentration data from J. D. Smith and Sunrise Acres monitoring sites for July 3, 2011, are shown in Tables 38 and 39. The DAQ wind data from Sunrise Acres are averages, except for the maximum wind gust, for the one-hour period beginning at the time shown. The McCarran Airport data are observations made during a few minutes prior to the time shown.

Table 38 PM_{10} Concentration and Wind Data from the J. D. Smith DAQ Station and McCarran International Airport Wind Data on July 3, 2011

J. D. Smith (DAQ Station 2002) (hourly averages, except for extreme speed gust)					McCarran International Airport (observations during a few minutes prior to time shown)			
Time	PM_{10} ($\mu g/m^3$)	Wind Speed (mph)	Wind Direction (degrees)	Wind Gust (mph)	Time	Wind Speed (mph)	Wind Direction (degrees)	Wind Gust (mph)
0:00	42.65	2	VAR	4	0:56	ND	ND	ND
1:00	37.22	2	VAR	7	1:56	7	200	ND
2:00	45.44	3	VAR	7	2:56	7	210	ND
3:00	30.17	2	VAR	5	3:56	10	200	ND
4:00	14.05	2	VAR	6	4:56	7	230	ND
5:00	37.58	3	VAR	6	5:56	8	200	ND
6:00	30.27	2	VAR	5	6:56	3	VAR	ND
7:00	37.01	3	VAR	9	7:56	ND	ND	ND
8:00	247.72	7	119	17	8:56	5	VR	ND
9:00	562.54	8	132	17	9:56	8	170	ND
10:00	672.84	6	116	13	10:56	3	VAR	ND
11:00	646.49	8	111	16	11:56	3	VAR	ND
12:00	583.27	7	116	18	12:56	3	VAR	ND
13:00	395.39	5	131	12	13:56	8	180	ND
14:00	213.89	4	138	13	14:56	7	150	ND
15:00	144.32	3	VAR	9	15:56	3	VAR	ND
16:00	113.03	6	170	24	16:56	7	VR	ND
17:00	153.17	9	234	32	**17:56**	22*	133*	38*
18:00	211.13	15	143	53	**18:56**	18*	103*	29*
19:00	52.81	7	155	21	**19:56**	12*	130*	26*
20:00	37.31	5	264	10	20:56	3	VAR	ND
21:00	30.15	4	238	10	21:56	8	240	ND
22:00	56.69	3	VAR	7	22:56	13	200	ND
23:00	65.84	5	108	7	23:56	10	180	ND

* = Multiple readings for that hour at McCarran that were averaged to compare with J.D. Smith monitoring site hourly averages.

Table 39. PM_{10} Concentration and Wind Data from the Sunrise Acres DAQ Station and McCarran International Airport Wind Data on July 3, 2011

Sunrise Acres (DAQ Station 0561) (hourly averages, except for extreme speed gust)					McCarran International Airport (observations during a few minutes prior to time shown)			
Time	**PM_{10} (μg/m^3)**	**Wind Speed (mph)**	**Wind Direction (degrees)**	**Wind Gust (mph)**	**Time**	**Wind Speed (mph)**	**Wind Direction (degrees)**	**Wind Gust (mph)**
0:00	54.87	1	VAR	4	0:56	ND	ND	ND
1:00	53.96	1	VAR	5	1:56	7	200	ND
2:00	36.92	1	VAR	3	2:56	7	210	ND
3:00	44.52	1	VAR	3	3:56	10	200	ND
4:00	38.94	2	VAR	4	4:56	7	230	ND
5:00	41.35	3	VAR	9	5:56	8	200	ND
6:00	35.24	2	VAR	6	6:56	3	VAR	ND
7:00	42.71	4	79	14	7:56	ND	ND	ND
8:00	281.63	8	123	21	8:56	5	VR	ND
9:00	590.6	9	137	24	9:56	8	170	ND
10:00	660.27	5	110	17	10:56	3	VAR	ND
11:00	601.01	8	104	22	11:56	3	VAR	ND
12:00	495.92	7	103	18	12:56	3	VAR	ND
13:00	339.28	5	93	18	13:56	8	180	ND
14:00	209.52	5	74	16	14:56	7	150	ND
15:00	148.17	5	50	15	15:56	3	VAR	ND
16:00	119.06	6	144	50	16:56	7	VR	ND
17:00	171.65	10	212	37	**17:56**	22*	133*	38*
18:00	ND	15	141	47	**18:56**	18*	103*	29*
19:00	ND	9	158	25	**19:56**	12*	130*	26*
20:00	57.59	5	255	18	20:56	3	VAR	ND
21:00	40.97	3	VAR	15	21:56	8	240	ND
22:00	92.38	2	VAR	7	22:56	13	200	ND
23:00	62.95	4	110	16	23:56	10	180	ND

* = Multiple readings for that hour at McCarran that were averaged to compare with J.D. Smith monitoring site hourly averages.

Illustration 2 - National Weather Service Forecast Discussion.

FXUS65 KVEF 031739
AFDVEF
AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE LAS VEGAS NV
1039 AM SUN JUL 3 2011
.SYNOPSIS...SUBTROPICAL **MOISTURE** MOVING IN FROM THE SOUTHEAST WILL BRING CHANCES FOR THUNDERSTORMS TO MUCH OF THE MOJAVE DESERT AND SOUTHERN GREAT **BASIN** THROUGH THE UPCOMING WEEK. **ISOLATED** DRY **LIGHTNING** AND GUSTY WINDS WILL BE THE MAIN CONCERNS TODAY IN SOUTHEAST NEVADA...WITH **ISOLATED FLASH** FLOODING BECOMING MORE **LIKELY** IN EASTERN CALIFORNIA AND SOUTHERN MOHAVE COUNTY. TEMPERATURES WILL BE NEAR TO SLIGHTLY ABOVE **NORMAL**...BUT THE **HUMIDITY** WILL MAKE IT FEEL QUITE UNCOMFORTABLE.
&&
.UPDATE...**MOISTURE SURGE** HAS ARRIVED AND BROUGHT CLOUDINESS WITH IT AS EXPECTED...BUT ALSO A LARGE CLOUD OF DUST. WEBCAMS SHOW REDUCED **VISIBILITY** IN MANY AREAS ALONG AND SOUTHEAST OF I-15. TWEAKED MANY GRIDS THIS AFTERNOON TO INCREASE SKY COVER CENTRAL AND SOUTHERN ZONES...REDUCE HIGH TEMPERATURES IN AREAS WITH CLOUDS AND HIGHER DEWPOINTS...EXCHANGE DRY THUNDERSTORMS FOR WET IN A STRIP OF THE CENTRAL **CWFA** WHERE DEWPOINTS ARE ON THE RISE...AND INCLUDE **BLOWING** DUST /WHICH IS NOT REALLY TECHNICALLY CORRECT BUT IT IS THE CLOSEST OPTION WITH THE AVAILABLE TOOLS/ FOR CLARK...MOHAVE...AND SAN BERNARDINO COUNTIES.

FOR THE REST OF SOUTHERN NEVADA...NORTHWEST ARIZONA...AND SOUTHEAST CALIFORNIA...WIDESPREAD SUSPENDED DUST HAS SPREAD INTO SOUTHERN NEVADA...EASTERN CALIFORNIA...AND ARIZONA. IN SOME LOCALES **VISIBILITY** THIS MORNING COULD BE AS LOW AS A MILE. CONDITIONS WILL IMPROVE THIS AFTERNOON. ALONG WITH THE DUST...**MONSOON MOISTURE** HAS MOVED INTO THE REGION. EXTENSIVE CEILINGS AROUND 10-15K FEET WILL SPREAD OVER MOST AREAS BY LATE THIS MORNING AND PERSIST UNTIL LATE EVENING. THUNDERSTORMS ARE POSSIBLE TODAY AND THIS EVENING WITH THE BEST PROBABILITIES BEING IN AREAS SOUTH AND EAST OF INTERSTATE 15. THOSE THAT FORM WEST OF THIS LINE WILL MOST **LIKELY** BE HIGH BASED AND PRODUCE STRONG **OUTFLOW** WINDS WHILE THOSE TO THE EAST WILL **LIKELY** PRODUCE HEAVIER **RAINFALL**.

Table 40. National Weather Service Weather Observations for Bullhead City Arizona

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

QUALITY CONTROLLED LOCAL HOURLY OBSERVATIONS TABLE
LAUGHLIN/BULLHEAD INTERNATIONAL AIRPORT
BULLHEAD CITY, AZ (07/2011)

Date	Time (LST)	Sky Conditions	Visibility (SM)	Weather Type	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Humd %	Wind Speed (MPH)	Wind Dir	Wind Gusts (MPH)	Station Pressure (in. hg)	Press Tend	Net 3-hr Chg (mb)	Sea Level Pressure (in. hg)	Report Type	Precip. Total (in)	Alti-meter (in. hg)
					(F)	(C)	(F)	(C)	(F)	(C)											
1	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
03	0015	CLR	10.00			35.0	60	15.5	27	-3.0	9	0	000		28.87			M	AA		29.61
03	0035	CLR	10.00			37.0	62	16.3	27	-3.0	8	0	000		28.87			M	AA		29.61
03	0055	CLR	10.00			35.0	60	15.5	27	-3.0	9	0	000		28.87			M	AA		29.61
03	0115	CLR	10.00			35.0	60	15.5	27	-3.0	9	0	000		28.87			M	AA		29.61
03	0135	CLR	10.00			34.0	59	15.1	27	-3.0	9	0	000		28.86			M	AA		29.60
03	0155	CLR	10.00			33.0	59	14.8	28	-2.0	10	0	000		28.87			M	AA		29.61
03	0215	CLR	10.00			34.0	59	15.1	27	-3.0	9	6	170		28.88			M	AA		29.62
03	0235	CLR	10.00			34.0	60	15.3	28	-2.0	10	5	190		28.88			M	AA		29.62
03	0255	CLR	10.00			33.0	59	14.8	28	-2.0	10	3	130		28.88			M	AA		29.62
03	0315	CLR	10.00			33.0	59	15.1	30	-1.0	11	5	140		28.88			M	AA		29.62
03	0335	CLR	10.00			33.0	59	14.9	28	-2.0	10	5	110		28.89			M	AA		29.63
03	0355	CLR	10.00			33.0	59	15.1	30	-1.0	11	0	000		28.90			M	AA		29.64
03	0415	CLR	10.00			33.0	59	14.9	28	-2.0	10	7	150		28.92			M	AA		29.66
03	0435	CLR	10.00			32.0	60	15.2	32	0.0	13	5	220		28.94			M	AA		29.68
03	0455	CLR	10.00			31.0	59	15.1	34	1.0	15	6	240		28.95			M	AA		29.69
03	0515	FEW002	5.00			35.0	63	17.0	37	3.0	13	20	150	31	28.96			M	AA		29.70
03	0535	BKN002	2.50			35.0	64	17.7	41	5.0	15	15	170	24	28.97			M	AA		29.71
03	0555	BKN002	2.50			34.0	65	18.2	45	7.0	19	8	200	18	28.98			M	AA		29.72
03	0615	OVC002	2.50			32.0	64	17.8	46	8.0	22	9	210		28.99			M	AA		29.73
03	0635	BKN002	2.00			32.0	64	17.8	46	8.0	22	8	200		28.99			M	AA		29.73
03	0655	BKN002	2.00			32.0	65	18.3	48	9.0	24	10	210		29.00			M	AA		29.74
03	0715	SCT002	2.00			31.0	67	19.4	54	12.0	31	10	210		29.02			M	AA		29.76
03	0735	CLR	2.00			32.0	68	19.7	54	12.0	29	6	230		29.02			M	AA		29.76
03	0755	CLR	2.00			32.0	69	20.5	57	14.0	33	9	220		29.03			M	AA		29.77
03	0815	CLR	2.50			32.0	70	21.0	59	15.0	35	9	220		29.04			M	AA		29.78
03	0835	CLR	3.00			33.0	72	22.4	63	17.0	39	13	210		29.04			M	AA		29.78
03	0855	CLR	3.00			34.0	73	22.7	63	17.0	37	13	220		29.04			M	AA		29.78
03	0915	CLR	4.00			35.0	73	23.0	63	17.0	35	13	200	18	29.04			M	AA		29.78
03	0935	CLR	5.00			36.0	73	22.7	61	16.0	30	14	190	24	29.04			M	AA		29.78
03	0955	CLR	5.00			36.0	73	22.7	61	16.0	30	16	190	25	29.04			M	AA		29.78
03	1015	CLR	4.00			36.0	72	22.2	59	15.0	28	16	220	23	29.04			M	AA		29.78
03	1035	CLR	5.00			36.0	72	22.2	59	15.0	28	11	220	21	29.04			M	AA		29.78
03	1055	CLR	5.00			37.0	72	21.9	57	14.0	25	15	220	20	29.03			M	AA		29.77
03	1115	CLR	6.00			37.0	72	21.9	57	14.0	25	17	200	23	29.03			M	AA		29.77
03	1135	M	M			M	M	M	M	M	M	M	M		M			M	AA		M
03	1155	M	M			M	M	M	M	M	M	M	M		M			M	AA		M

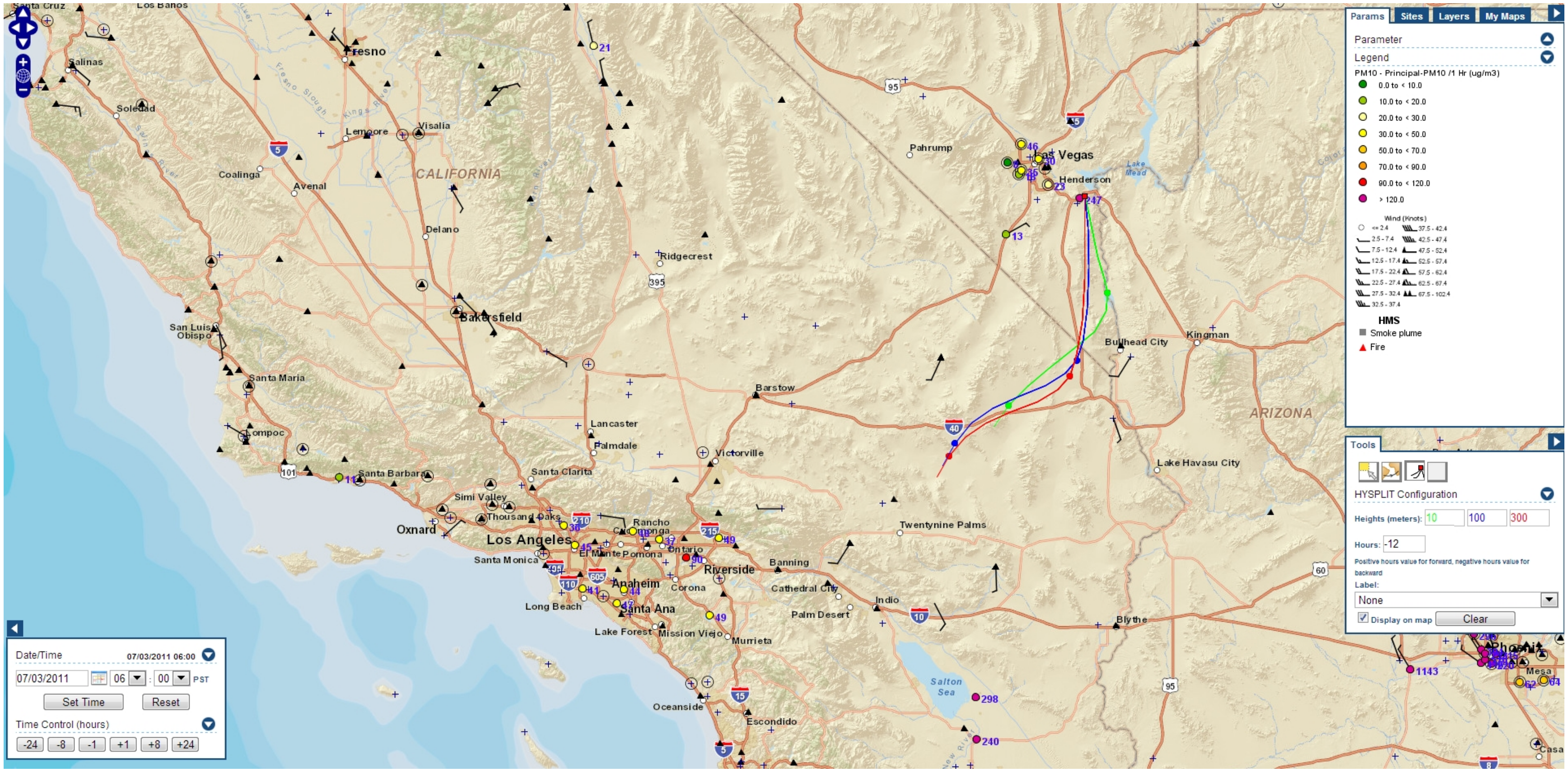


Figure 96. 12-hour backward trajectory HYSPLIT for Boulder City and J. D. Smith DAQ stations July 3, 2011 06:00 PST.

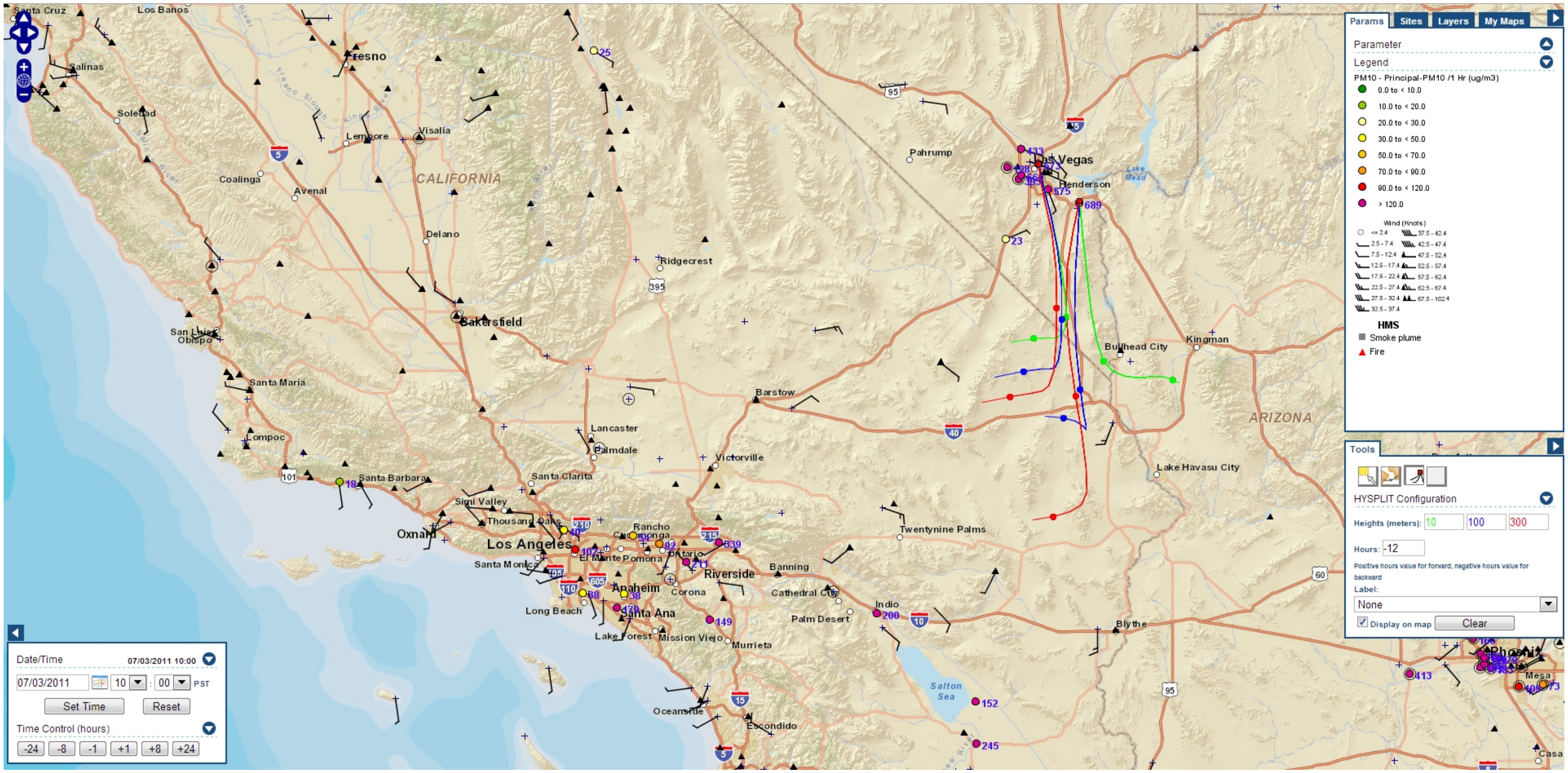


Figure 97. 12-hour backward trajectory HYSPLIT for Boulder City and J. D. Smith DAQ stations July 3, 2011 10:00 PST.

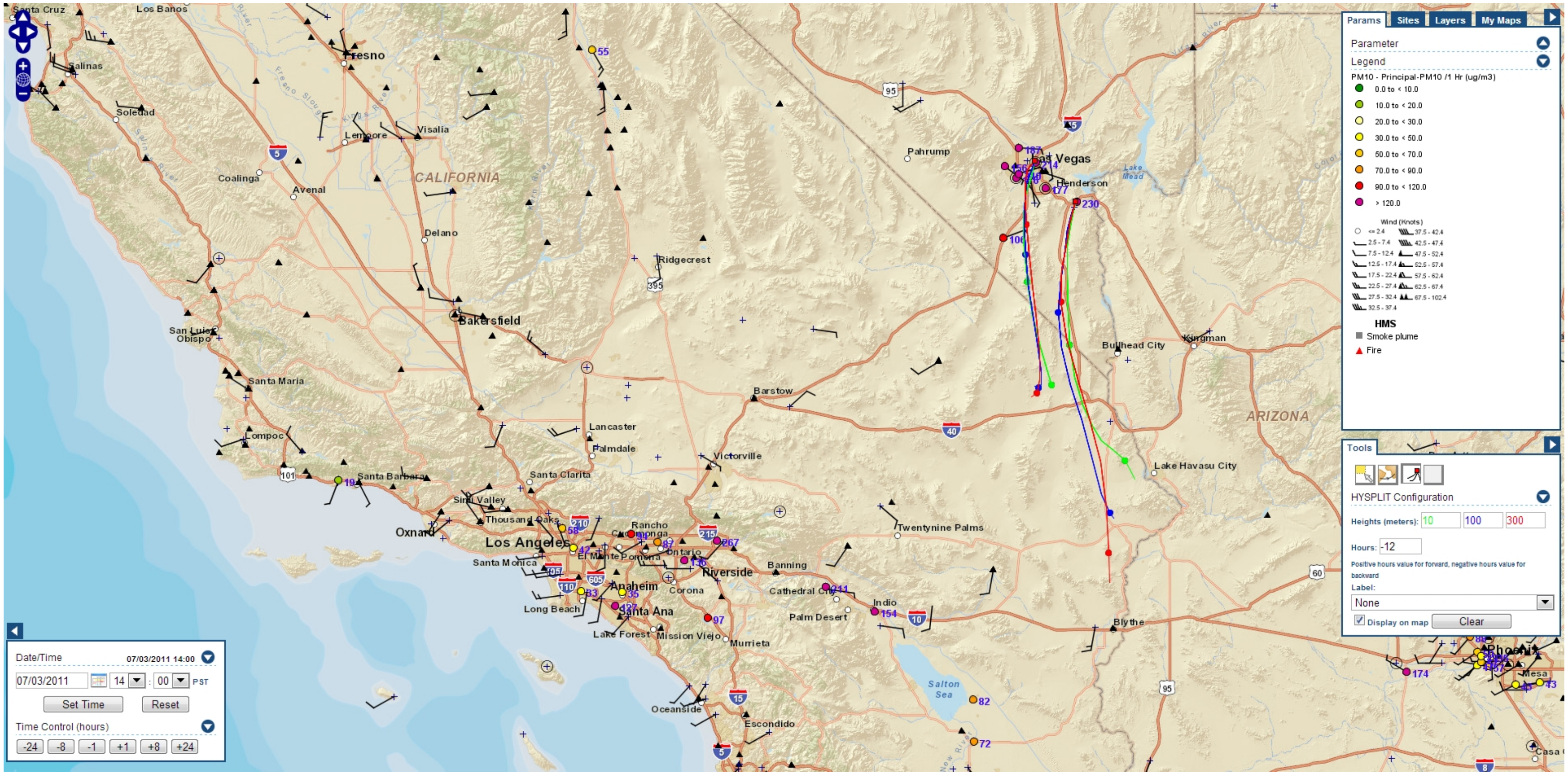


Figure 98. **12-hour backward trajectory HYSPLIT for Boulder City and J. D. Smith DAQ stations July 3, 2011 14:00 PST.**

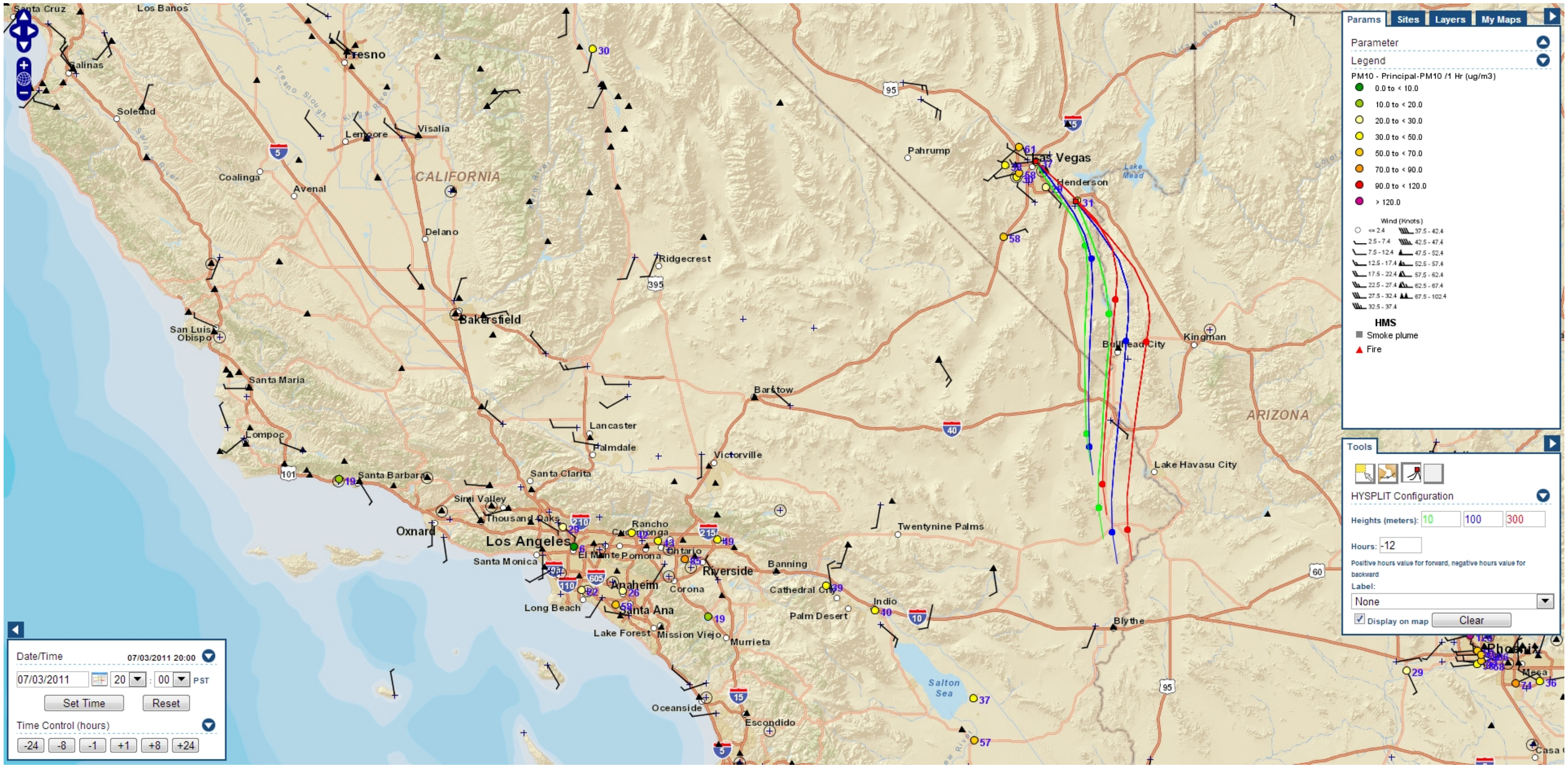


Figure 99. 12-hour backward trajectory HYSPLIT for Boulder City and J. D. Smith DAQ stations July 3, 2011 20:00 PST.

Weather after the event

Surface Charts (Figures 100-102)

These charts show monsoonal flow dominating most of the southwest. Widening of gradients and increased monsoonal moisture helped to knock down the existing suspended dust that was over parts of Clark County.

Upper Air Charts (Figures 103-108)

850-Millibar Charts

The 850-millibar charts show monsoonal flow dominating most of the southwest.

500-Millibar Charts

The 500-millibar charts show the ridge that was over Clark County breaking down and giving way to monsoonal flow.

250-Millibar Charts

The 250-millibar charts show a ridge just east of Clark County.

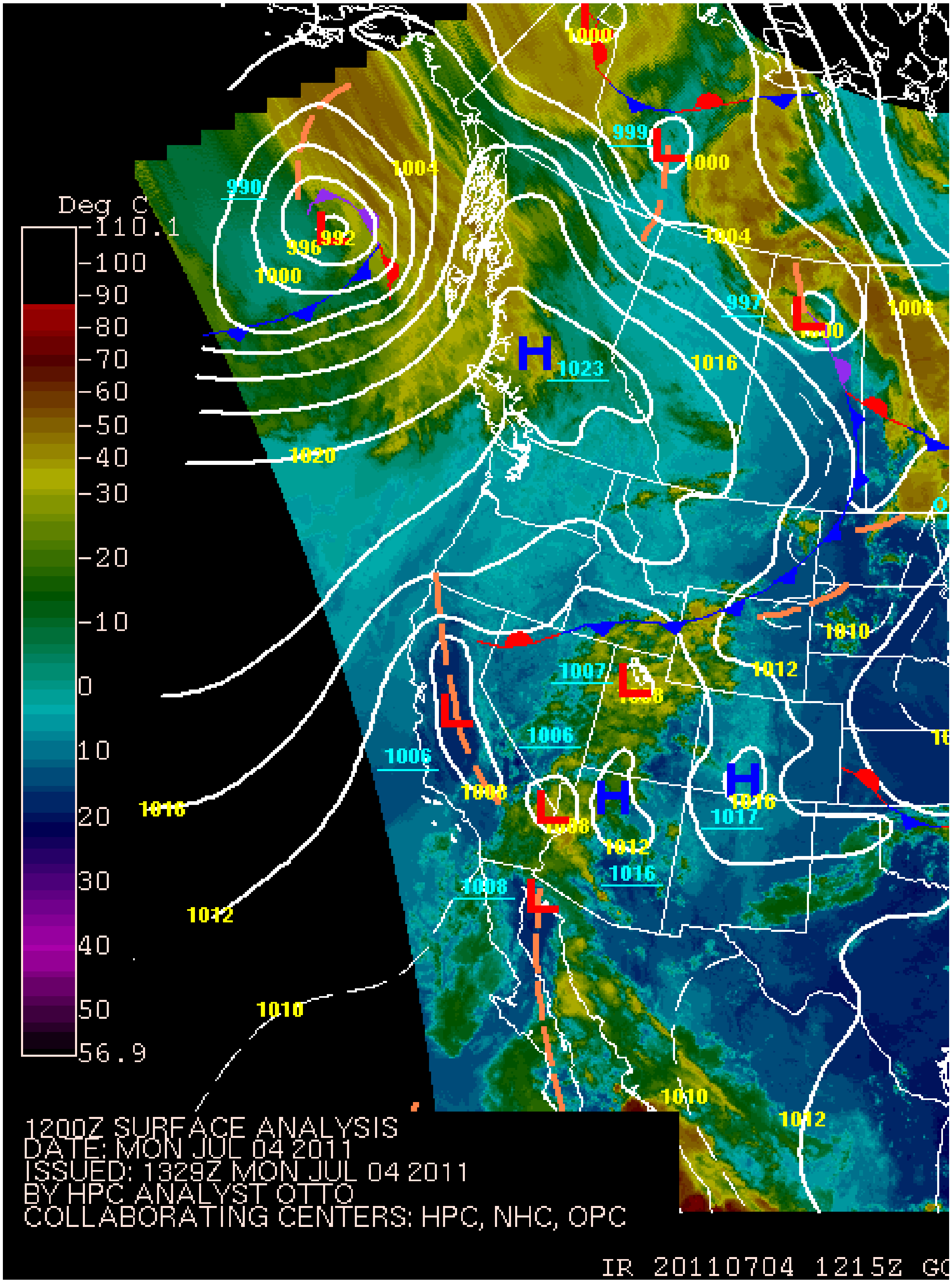


Figure 100. Surface weather chart after the event July 4, 2011 12Z.

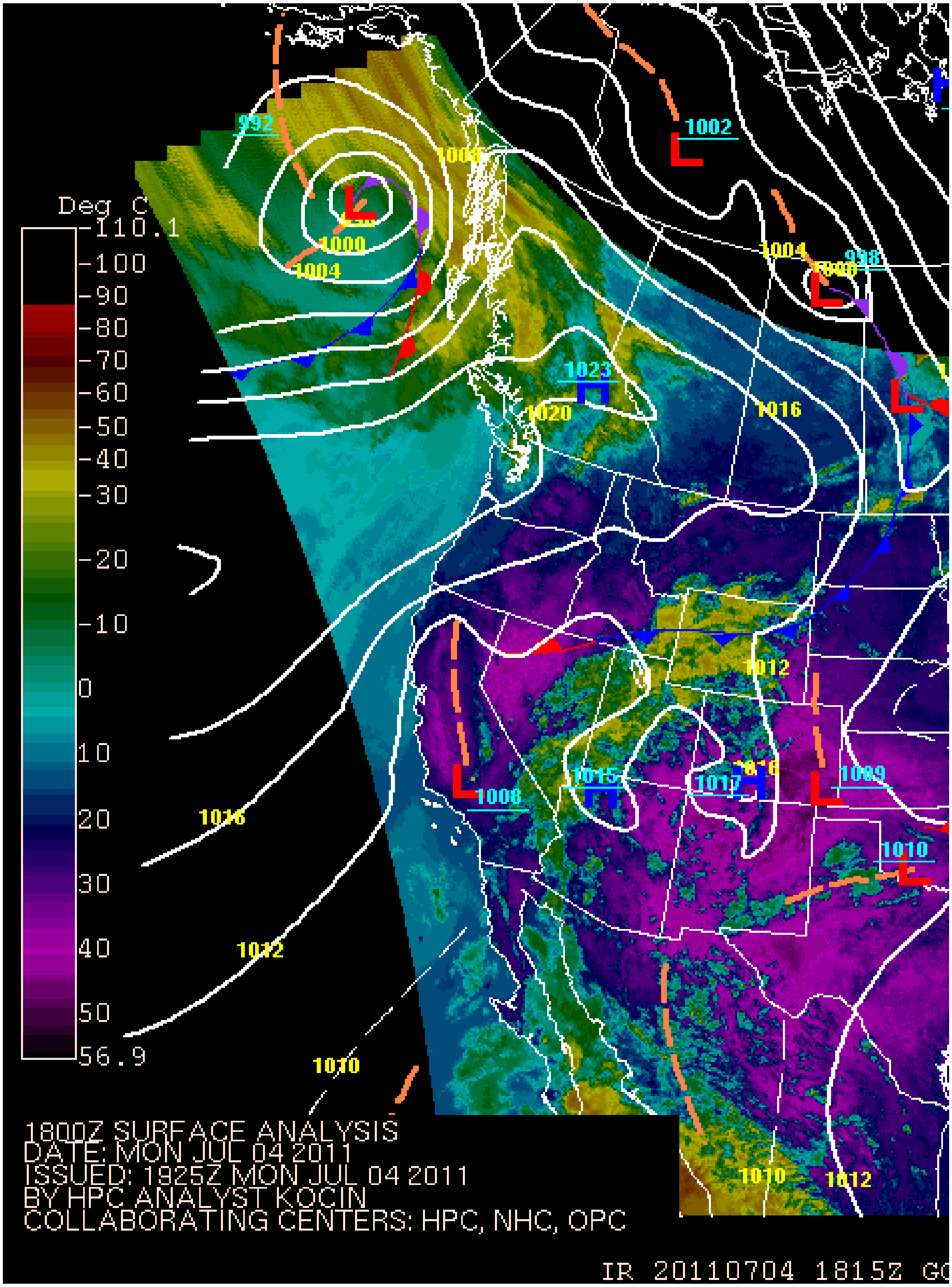


Figure 101. Surface weather chart after the event July 4, 2011 18Z.

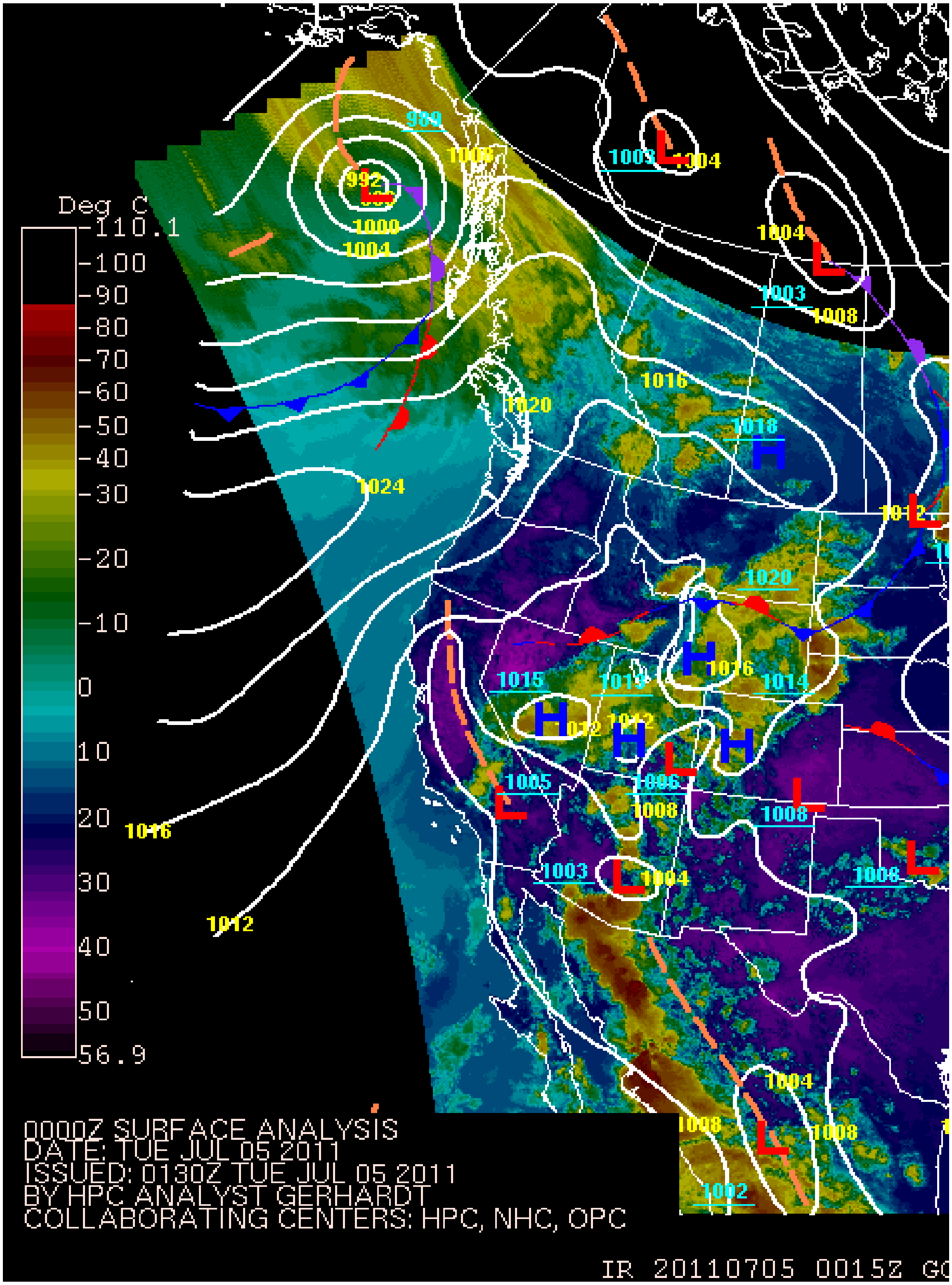


Figure 102. Surface weather chart after the event July 5, 2011 00Z.

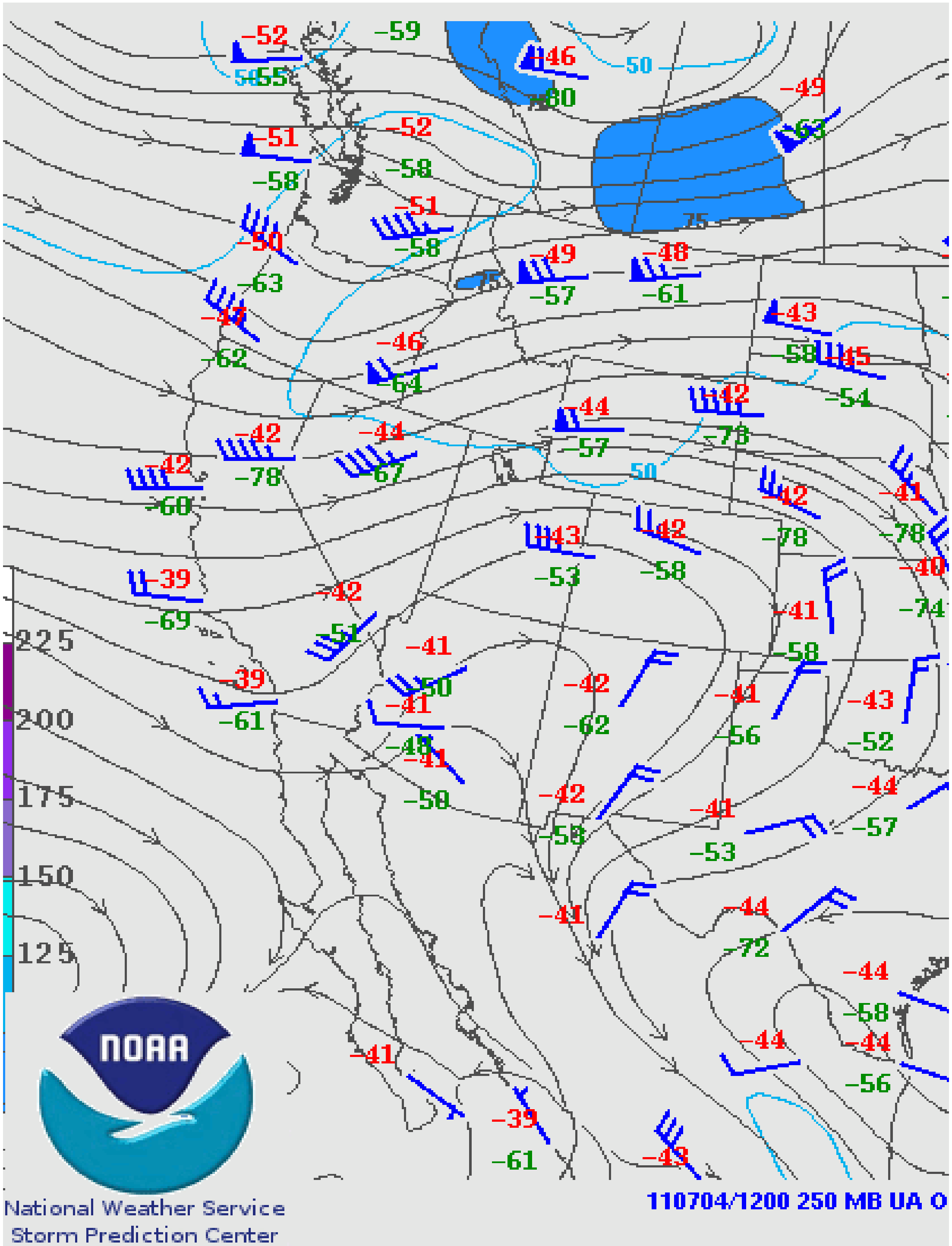


Figure 103. 250 MB after the event weather chart July 4, 2011 12Z.

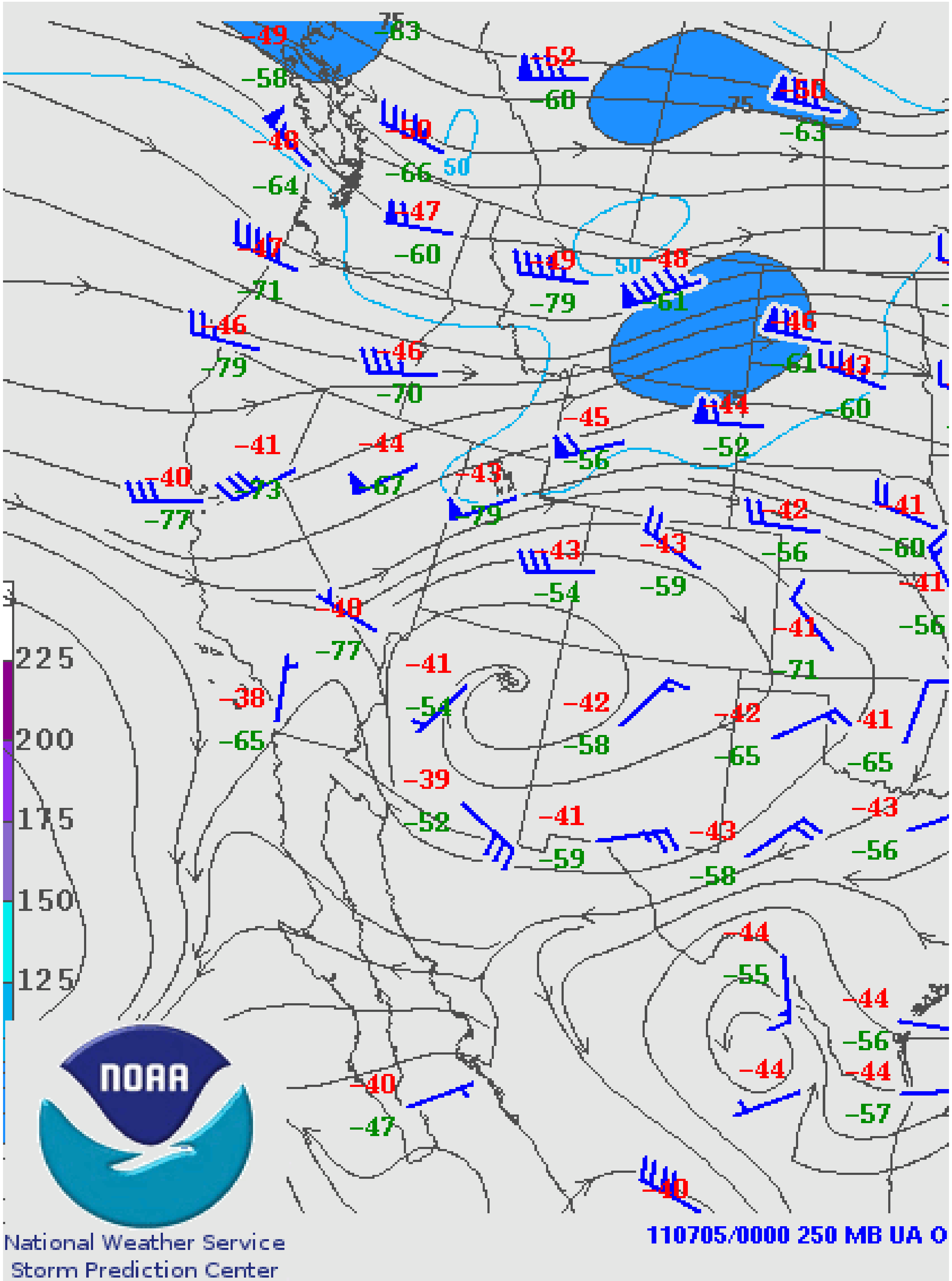


Figure 104. 250 MB after the event weather chart July 5, 2011 00Z.

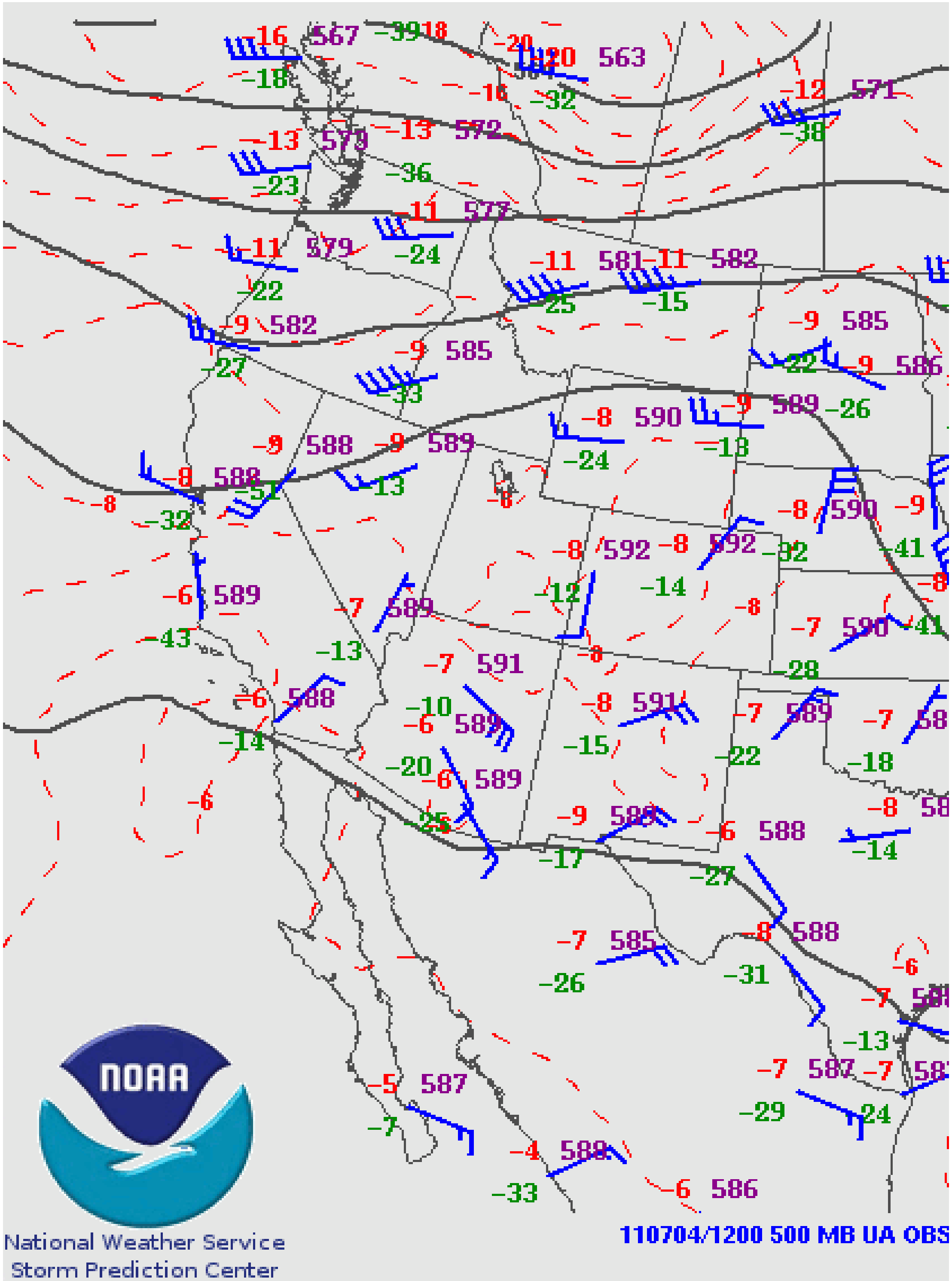


Figure 105. 500 MB after the event weather chart July 4, 2011 12Z.

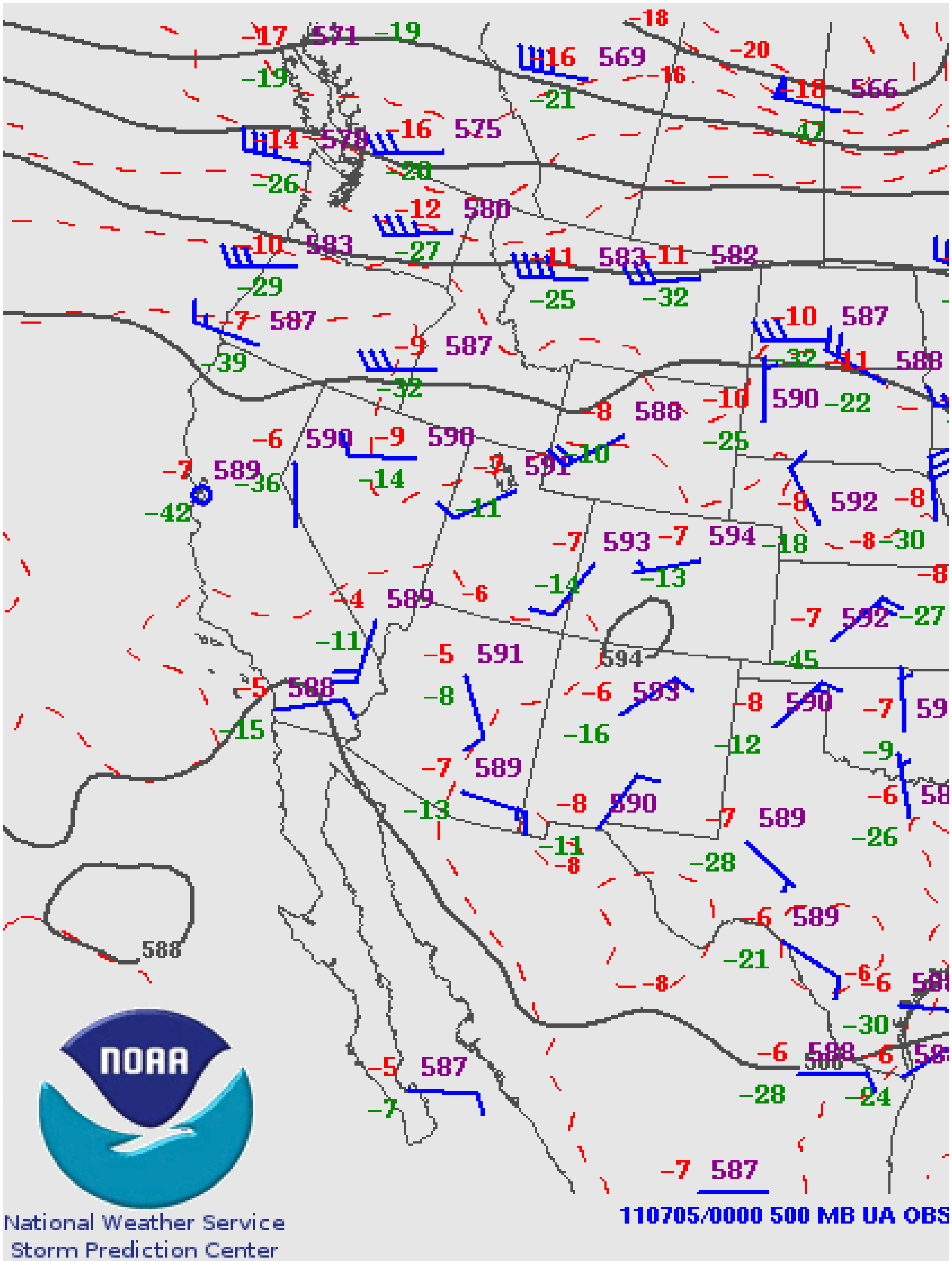


Figure 106. 500 MB after the event Weather chart July 5, 2011 00Z.

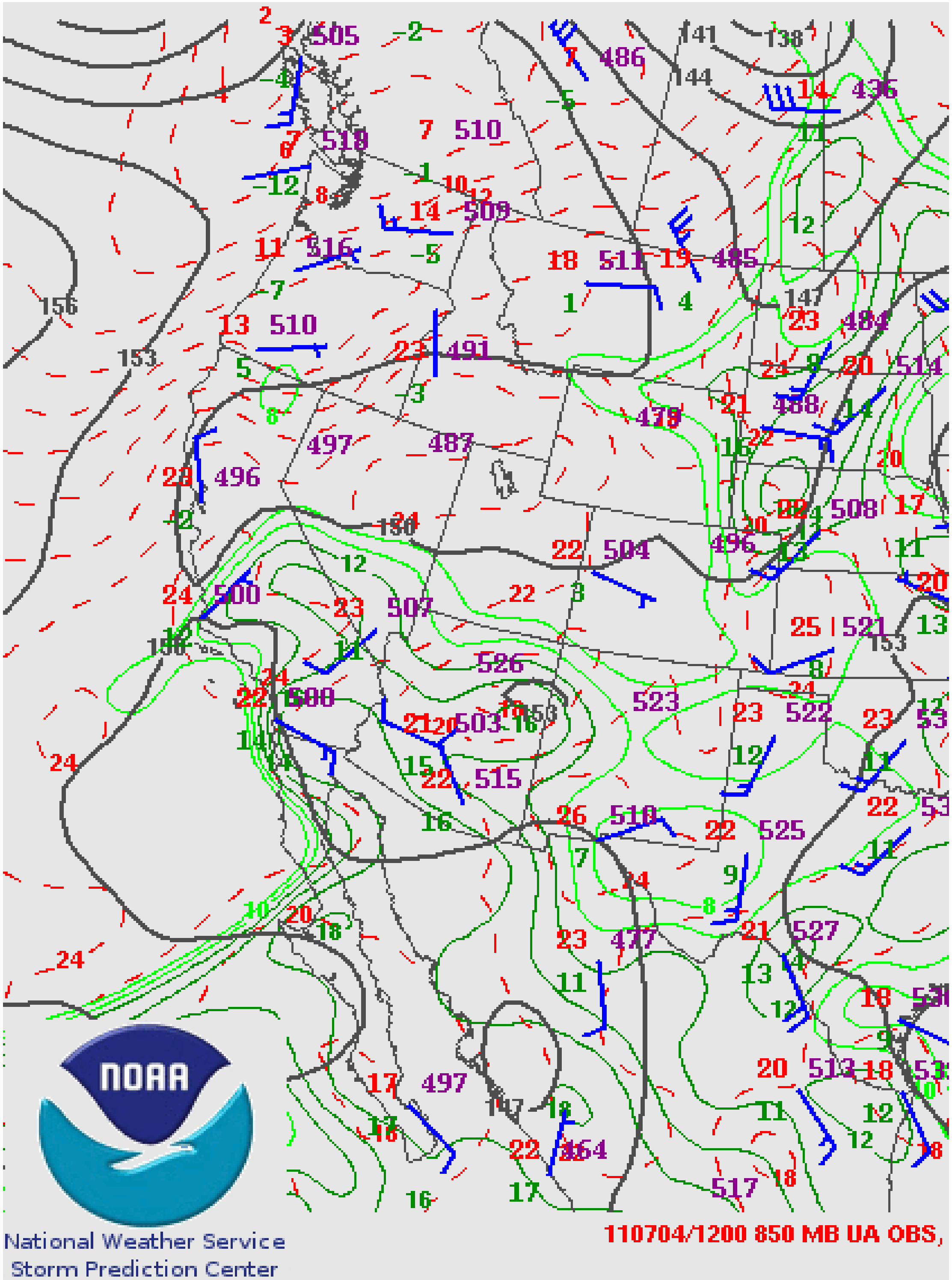


Figure 107.   850 MB after the event weather chart July 4, 2011 12Z.

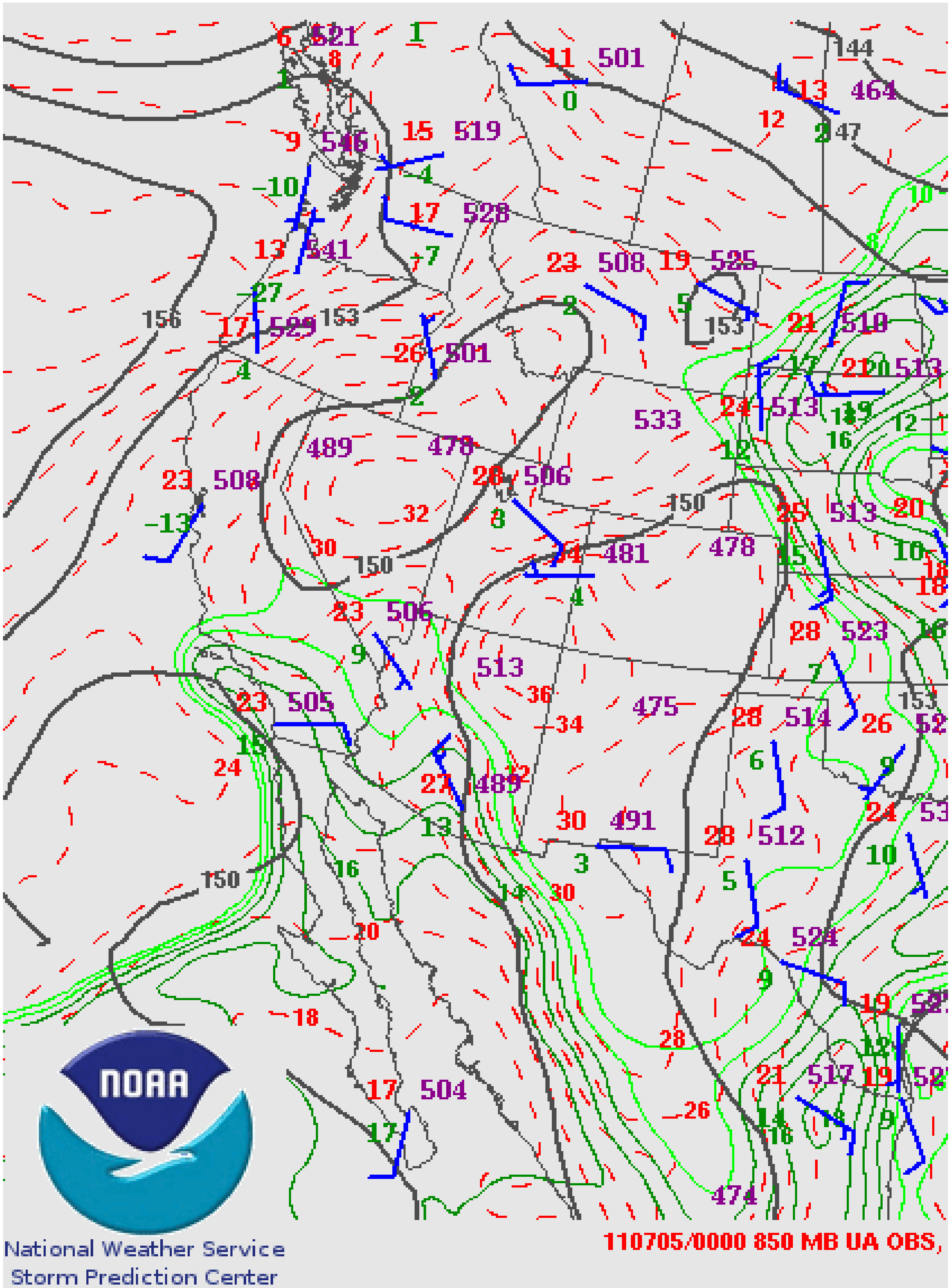


Figure 108. 850 MB after the event weather chart July 5, 2011 00Z.

Summary of Event

On July 3, 2011, in the early morning hours, a strong outflow boundary over the Bullhead City, Arizona area raised a large amount of dust reducing visibility down to 2 miles (as reported by the National Weather Service observations and forecast discussion). The large mass of suspended dust moved north and into parts of Clark County. Monsoonal flow continued to cause the transport of suspended dust into Bolder City and the central and eastern portions of the Las Vegas Valley throughout the remainder of the day. The orientation of the weak ridge prevented the suspended dust from reaching Jean and the western portions of the Las Vegas Valley. With the exception of Jean and the western portions of the Las Vegas Valley, all sites in Clark County on the eastern side of the valley that measure PM_{10} experienced very elevated or exceedance levels. The low wind speeds during the hours of maximum PM_{10} concentration deposits further indicates that there was a drifting of dust into the area caused by a high-wind event but that the high-wind event was not local. Thus, there is a clear causal relationship between the PM_{10} exceedance and the high-wind transported dust from the Laughlin, Nevada/Bullhead City, Arizona areas.

3.3 MEDIA COVERAGE OF HIGH-WIND TRANSPORTED DUST EVENT

Due to the lack of available media and news coverage for this high-wind transported dust event in Clark County, DAQ will use an exceptional event documentation package that EPA concurred with from Arizona (*State of Arizona Exceptional Event Documentation for the Events of July 2nd through July 8th 2011, for the Phoenix PM_{10} Nonattainment Area*) to show a causal connection between the events in Arizona and what occurred in Clark County on July 3, 2011. This media and news coverage for the events that occurred in Phoenix, Arizona, and locations southwest and northwest of that area connect those events with what occurred in Clark County.

The first evidence to draw a causal connection between the events in Phoenix and Las Vegas is the following video. This video contains information about the monsoon season, the formation of dust storms in Arizona, and the uniqueness of the 2011 monsoon season.

2011 Monsoon Season Summary and Review · http://bcove.me/krh3qk29

The second video continues to explain the weather phenomena. This video contains information about the 2011 monsoon season, focusing on the large number of dust storms that occurred and a discussion of why there were so many dust storms in 2011.

2011 Monsoon Season Review 2 · http://bcove.me/tc6otk0h

The next video continues the storm coverage and how the results from the "haboob" dust storm left a large dust mass in its wake and how a large scale cleanup is underway. The storm damaged pools and cars and knocked out power to a large number of residents in the Phoenix and adjacent areas.

http://www.azcentral.com/video/1041409766001

Video Links and news reports and articles from the Arizona exceptional event document that shows the effects of the multiple desert storms that occurred from July2 through July 8, 2011 and are applicable to the exceptional event that occurred in Clark County on July 3, 2011.

http://bcove.me/c3189kkd

http://bcove.me/pb5lmh1s

http://www.msnbc.msn.com/id/21134540/vp/43655453#43655453

http://www.cnn.com/2011/US/07/06/arizona.dust.storm/index.html?hpt=hp_t2

The Clark County visibility camera network images show the storm as it progressed through the Las Vegas Valley. These cameras are located at the North Las Vegas Airport and are focused on the valley from a north vantage to southwest and southeast. The complete day animation is available in Appendix D (NLV Visibility Camera Network & Satellite Imagery) of this document on CD. The following images are from key times of the high-wind transport dust event on July 3, 2011. Figure 109 is a still image from 9:30:13 am on July 3, 2011. Note that the mountains to the south are nearly obscured and few buildings are visible from the dust entering the valley. Figures 110 and 111 from 10:00:13 and 11:00:13 am on July 3, 2011, respectively, show most of the buildings obscured. Figure 112 taken at 4:00:13 pm on July 3, 2011, shows the valley starting to clear out from the effects of the high-wind dust transport event.

Figure 109. North Las Vegas Airport network visibility camera capture at 9:30 am on July 3, 2011.

Figure 110 . North Las Vegas Airport network visibility camera capture at 10:00 am on July 3, 2011.

Figure 111. North Las Vegas Airport network visibility camera capture at 11:00 am on July 3, 2011.

Figure 112. North Las Vegas Airport network visibility camera capture at 4:00 pm on July 3, 2011.

4.0 EMISSIONS SOURCES AND ACTIVITY

4.1 BOULDER CITY

The Boulder City monitoring site (CAMS-0601, EPA 32-003-0601) (Figure 113) is located in the northwestern part of the Eldorado Valley at the southeast entrance to the Las Vegas Valley (Figure 6), in a predominantly industrial business area with commercial amenities. Figures 114–117 provide aerial views of the site, whose purpose is to monitor neighborhood-scale spatial emissions of PM_{10} from individual sources in the area. The site's monitoring objective is classified as "population exposure," and it provides a good insight into predominant air quality trends for the citizens of the city. There is a major transportation route (U.S. highway 93) just 100 meters south of the monitoring site, and a lightly traveled road (Industrial Road) is approximately 50 meters north of the site.

Paved-road dust (particulate matter 2.5 microns or less in aerodynamic diameter ($PM_{2.5}$) and PM_{10} are moderate contributors to particulate matter emissions at the site. There is native desert and vacant, undeveloped land in the area of influence of the site, which has blocked accesses and is stabilized. The lack of current land development in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. The monitoring station is located inside a fenced compound, and the adjacent parking area is predominantly native desert and gravel. The predominant wind direction for this site is predominantly southwest. The wind direction for the July 3, 2011, transported dust event was from the southwest (northwestern Arizona) to the northeast of the Las Vegas Valley that which brought the bulk of the dust near this site. The site experienced the highest exceedance concentration values of the entire PM_{10} network for Clark County and measured a 24-hour PM_{10} value of 242 $\mu g/m^3$ on July 3, 2011, as a result of the high-wind transported dust event.

Figure 113. Boulder City monitoring site – street view.

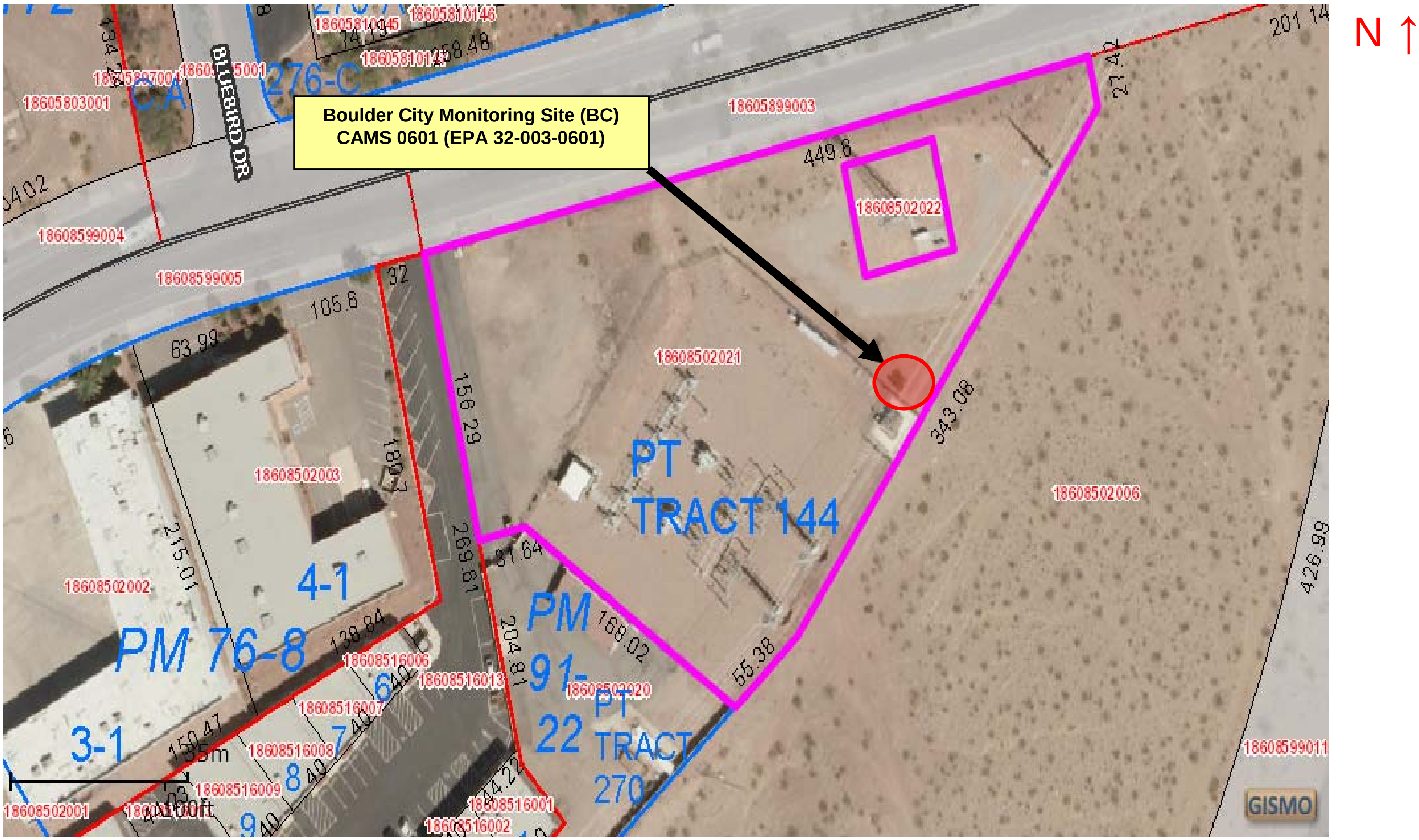


Figure 114. Boulder City monitoring site (EPA 32-003-0601), aerial view 1.

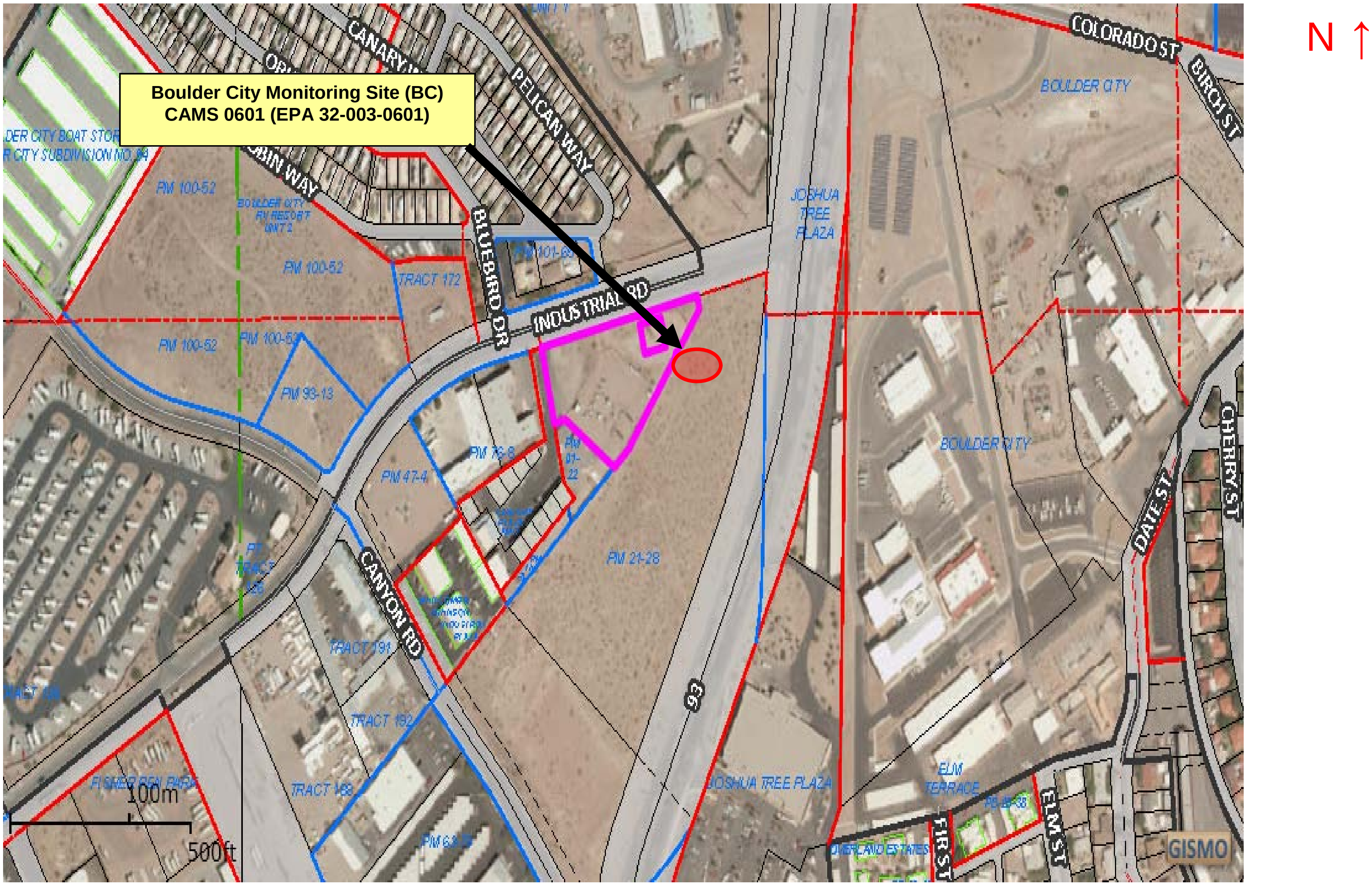


Figure 115 Boulder City monitoring site (EPA 32-003-0601), aerial view 2.

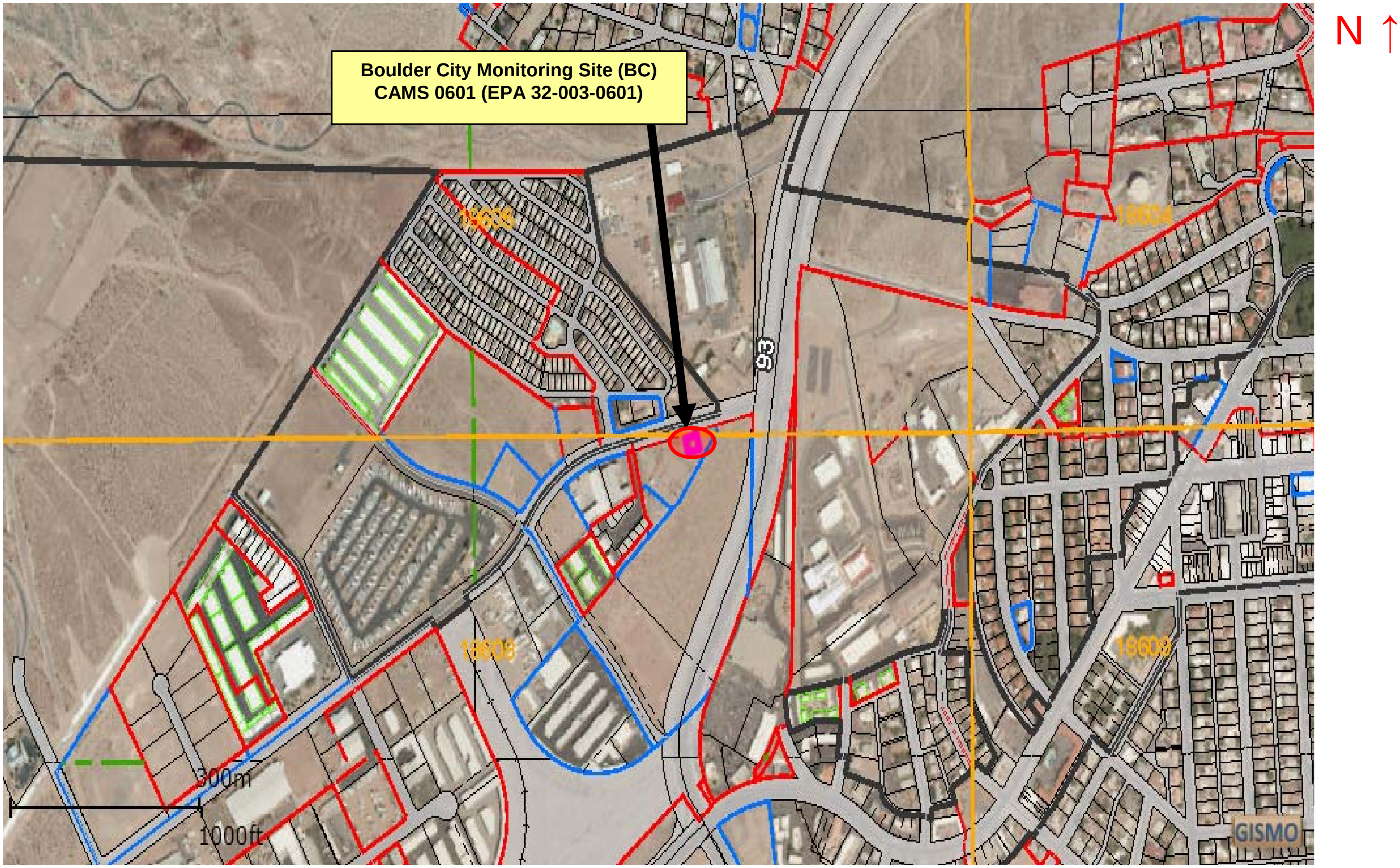


Figure 116. Boulder City monitoring site (EPA 32-003-0601), aerial view 3.

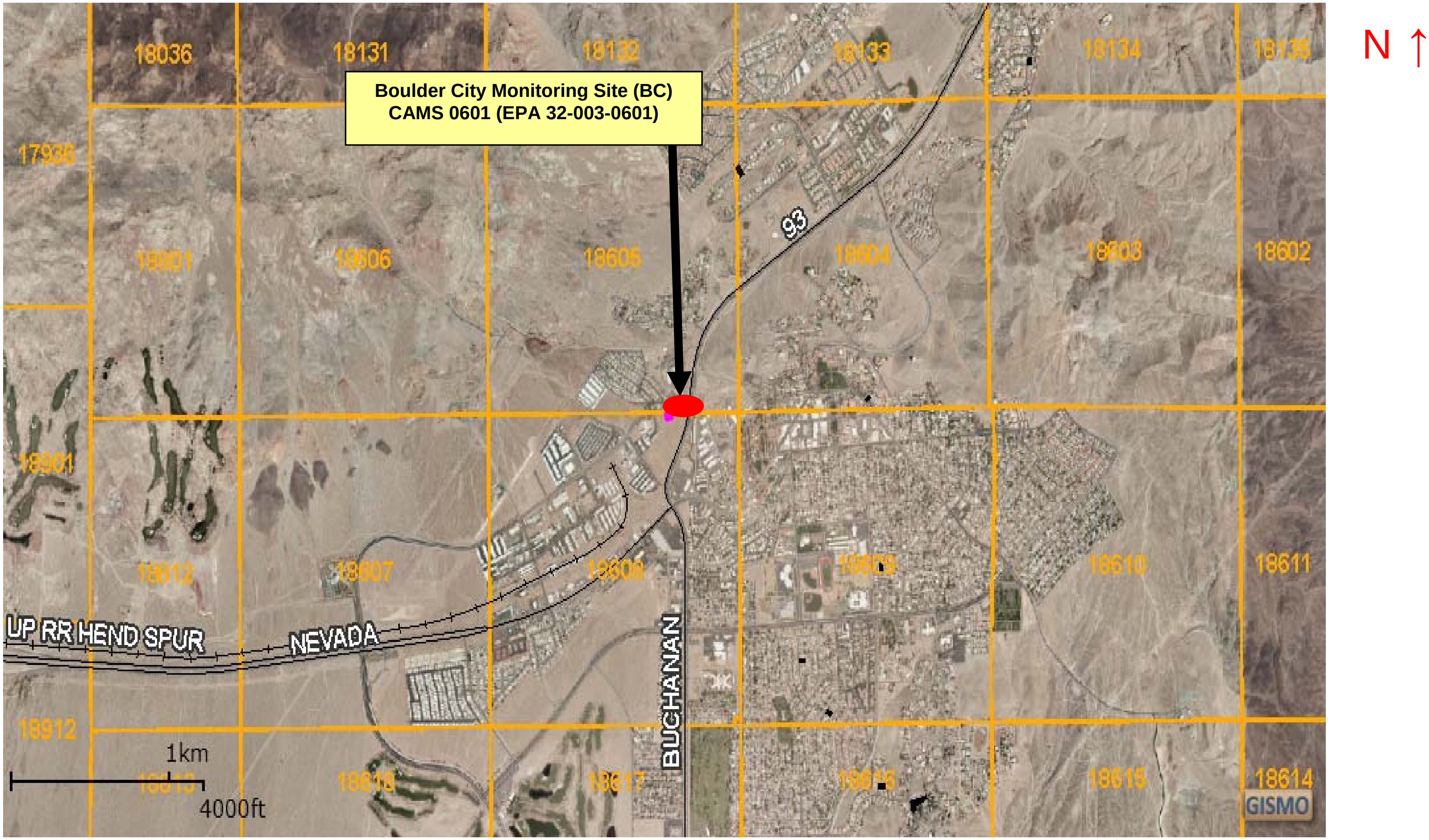


Figure 117. Boulder City monitoring site (EPA 32-003-0601), aerial view 4.

4.2 SUNRISE ACRES

The Sunrise Acres monitoring site (CAMS-0561, EPA 32-003-0561) (Figure 118) is located in the central part of the Las Vegas Valley (Figure 6) in a predominantly older urban development area. Most of the apartments and single-family housing units were built in the 1940s to early 1980s. Figures 119–122 provide aerial views of the site, whose purpose is to monitor neighborhood-scale spatial emissions of PM_{10} from sources in the area. The site's monitoring objective is classified as "population exposure," and it provides a good insight into predominant air quality trends. There are major transportation routes within the vicinity of the monitoring site. Eastern Boulevard, a major arterial, is located less than 576 feet to the west and US Highway 95 is located approximately 1,395 feet north of the monitoring site. Both roads are heavily traveled most of the day. Because there is a high amount of wood-burning fireplaces and wood boilers throughout a three-mile radius of the site, $PM_{2.5}$ runs high-moderate concentrations at various times during the winter months.

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a moderate contributor to particulate matter emissions at the site. A Clark County School District automotive maintenance yard is immediately north of the site. The lack of current new land development or redevelopment in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. The monitoring station is located inside a fenced compound, and the adjacent area is predominantly paved parking lots. The predominant wind direction for this site is southwest. The predominant wind direction for the July 3, 2011, transported dust event was from the southeast to the north-northeast with drifting to the northwest, i.e., from Arizona up through the Colorado River corridor and through the Eldorado Valley. Dust from the transported event affected the Sunrise Acres monitoring site, and the measured 24-hour PM_{10} NAAQS exceedance value was 191 $\mu g/m^3$ on July 3, 2011.

Figure 118. Sunrise Acres monitoring site, street view.

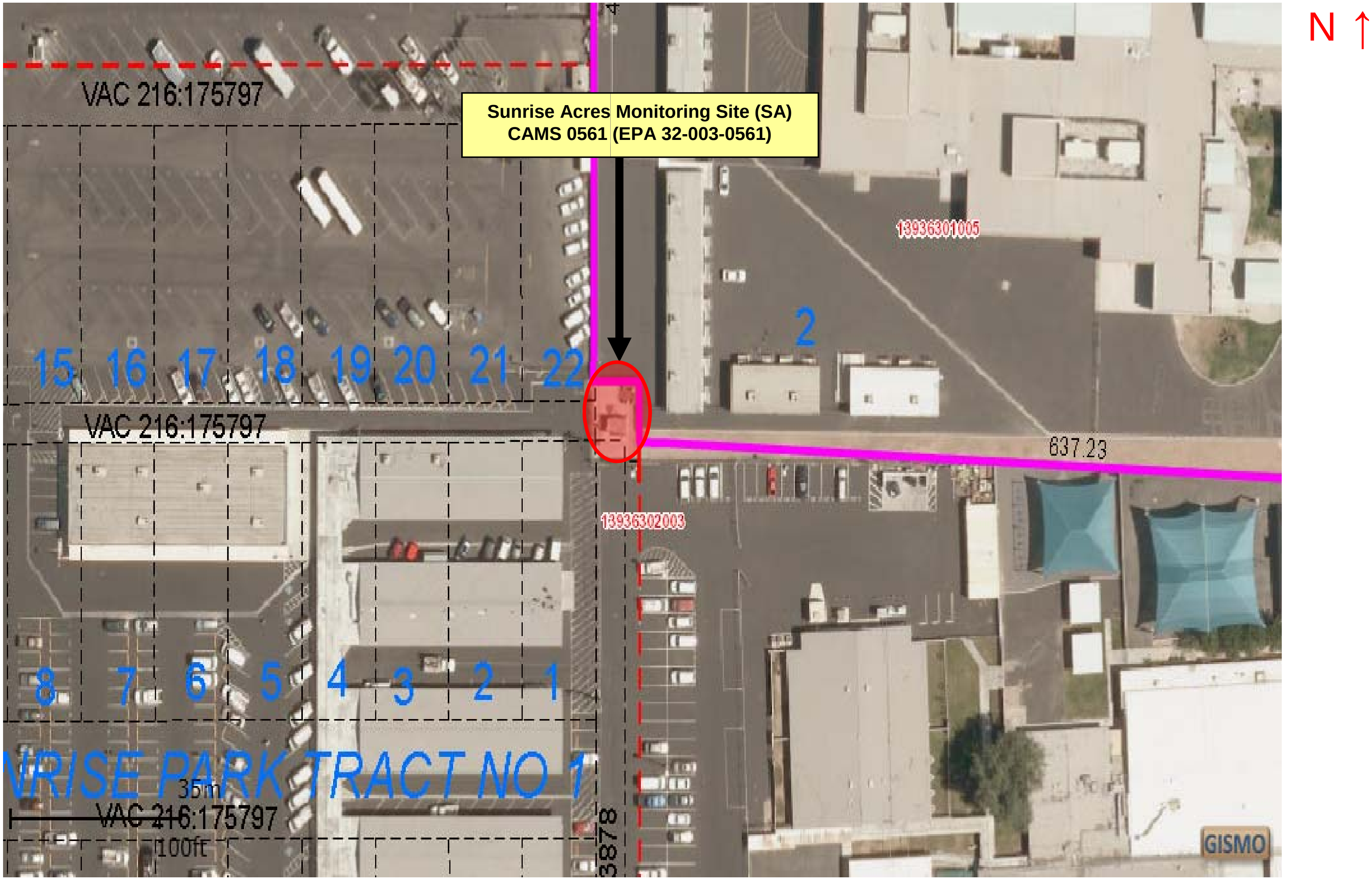


Figure 119. Sunrise Acres monitoring site (EPA 32-003-0561), aerial view 1.

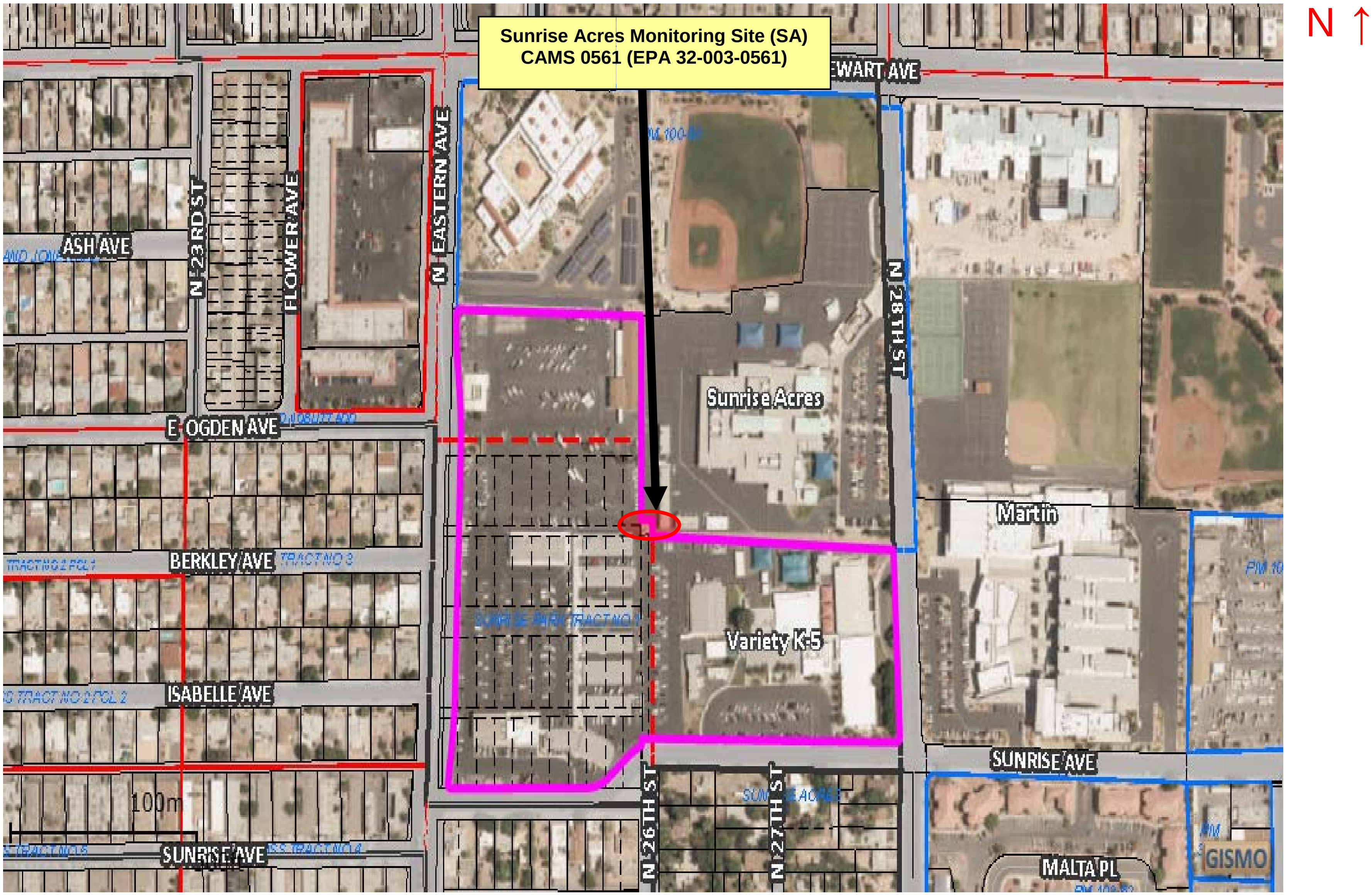


Figure 120. Sunrise Acres monitoring site (EPA 32-003-0561), aerial view 2.

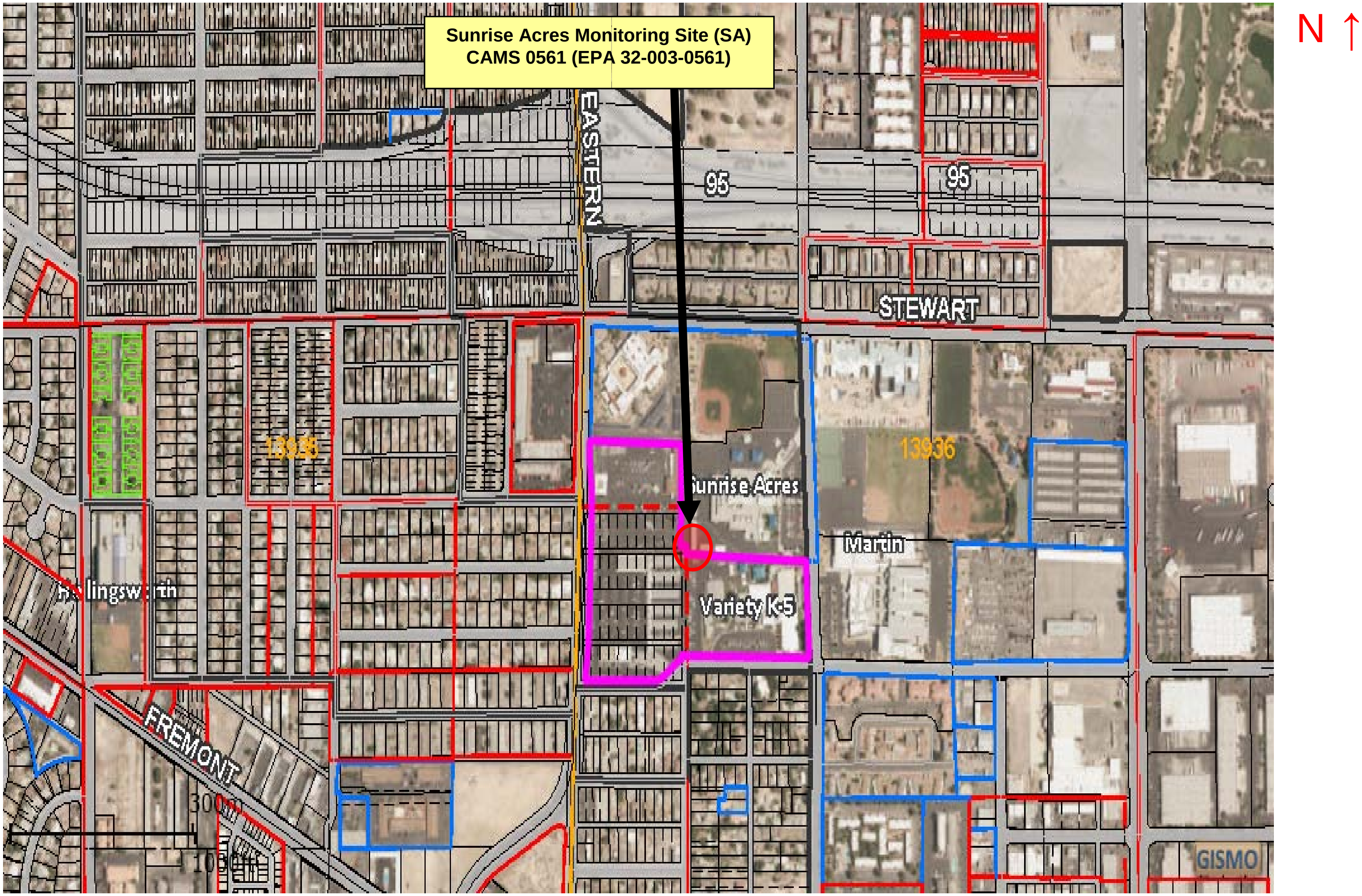


Figure 121. Sunrise Acres monitoring site (EPA 32-003-0561), aerial view 3.

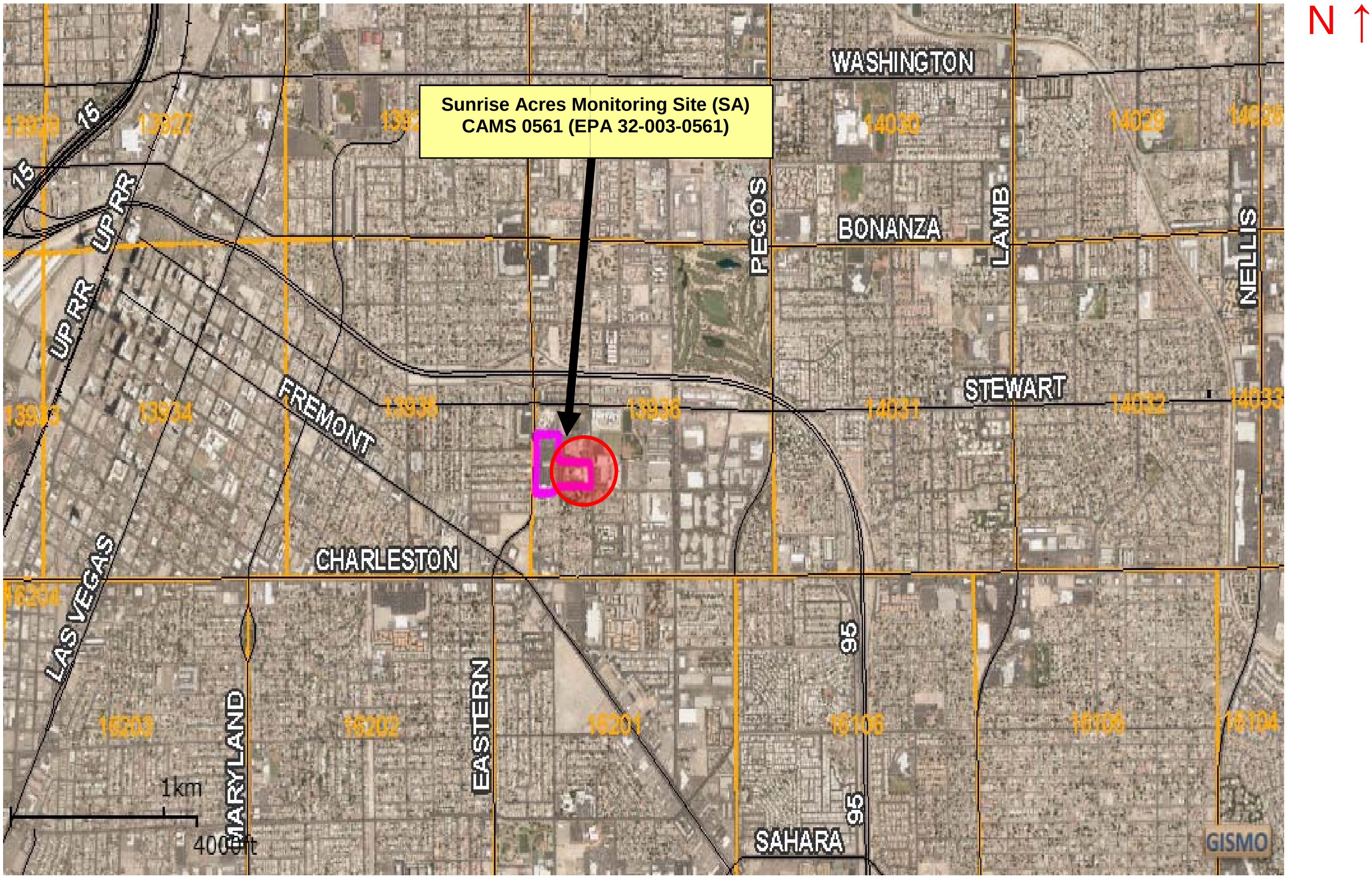


Figure 122. Sunrise Acres monitoring site (EPA 32-003-0561), aerial view 4.

4.3 J. D. SMITH

The J. D. Smith monitoring site (CAMS-2002, EPA 32-003-2002) (Figure 123) is located in the northeast part of the Las Vegas Valley (Figure 6) in a predominantly residential area. Figures 124–127 provide aerial views of the site, whose purpose is to monitor spatial-scale neighborhood emissions of PM_{10} from individual sources in the area. The nearest cross streets are Tonopah and Bruce, which get their traffic influences primarily from personal vehicles and small trucks delivering to the three schools in the area.

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a small contributor to particulate matter emissions at the site, whose monitoring objective is classified as "population exposure." The lack of current new land development or redevelopment in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. DAQ checked nearby sources to ensure they are fenced and stabilized. Some sources and land uses to the north, east, southeast, and west, even though well stabilized, may cause elevated dust conditions when high-wind thresholds occur. On July 3, 2011, however, there were low wind speeds, and the transported dust traveled with the prevailing wind currents that brought copious amounts of dust directly through the monitoring site on its way out of the valley in the north to northeast direction. As a result of constant low sustained winds there were measurable amounts of dust drifting to the northwest and some drifting southwest. The site exceeded the NAAQS with a 24-hour PM_{10} concentration of 185 $\mu g/m^3$.

Figure 123. J. D. Smith monitoring station, street view.

Figure 124. J. D. Smith monitoring site (EPA 32-003-2002), aerial view 1.

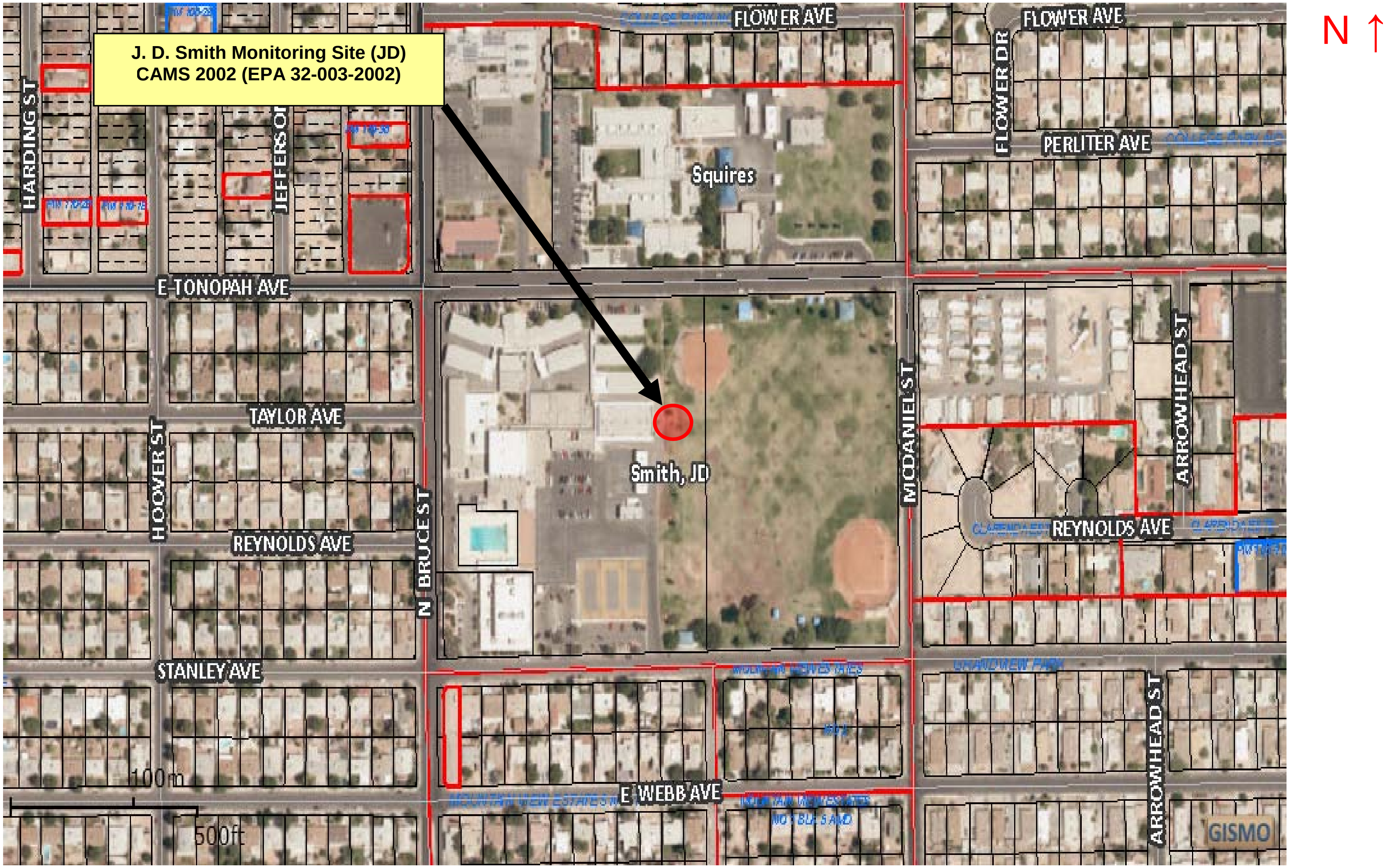


Figure 125. J. D. Smith monitoring site (EPA 32-003-2002), aerial view 2.

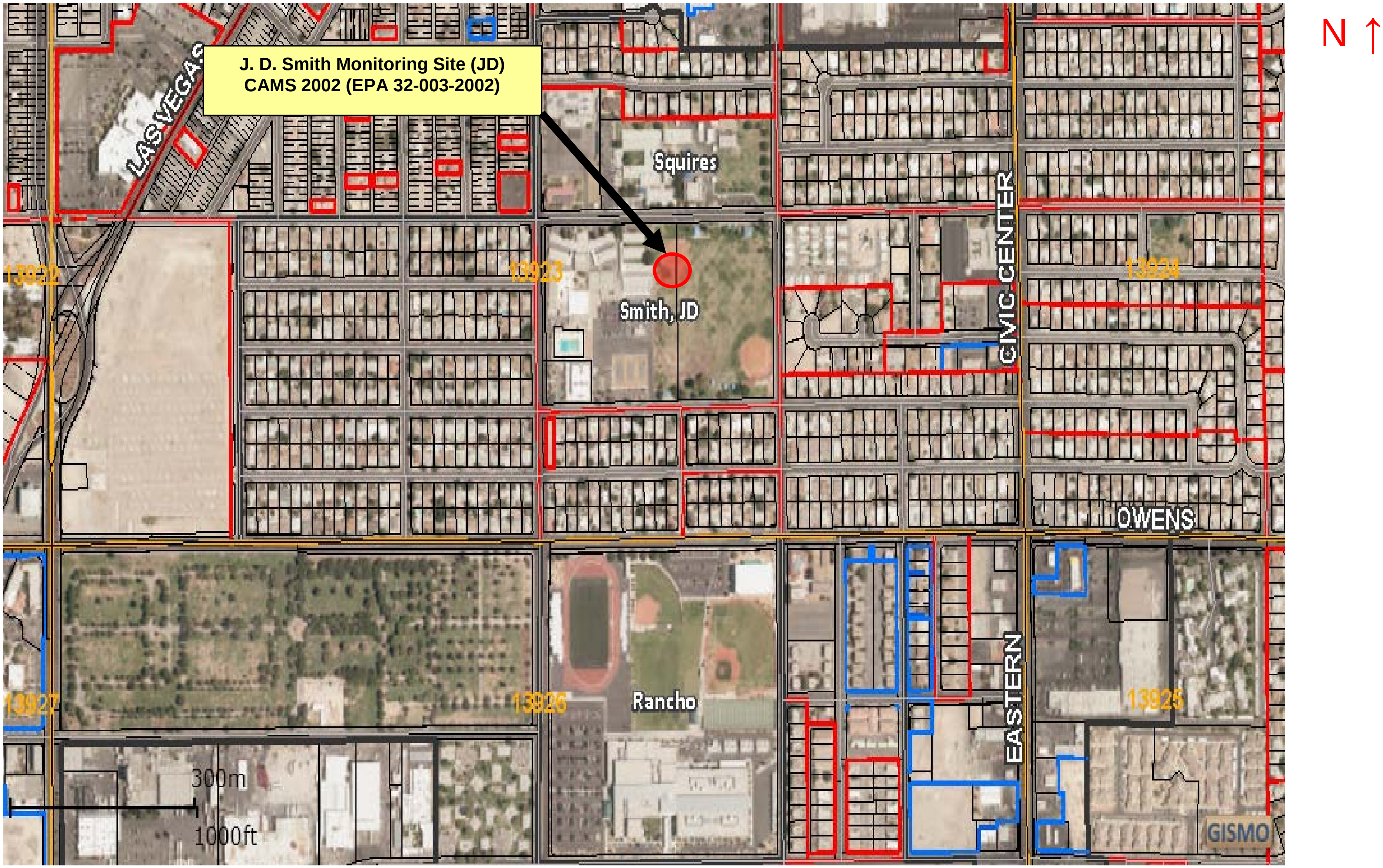


Figure 126. J. D. Smith monitoring site (EPA 32-003-2002), aerial view 3.

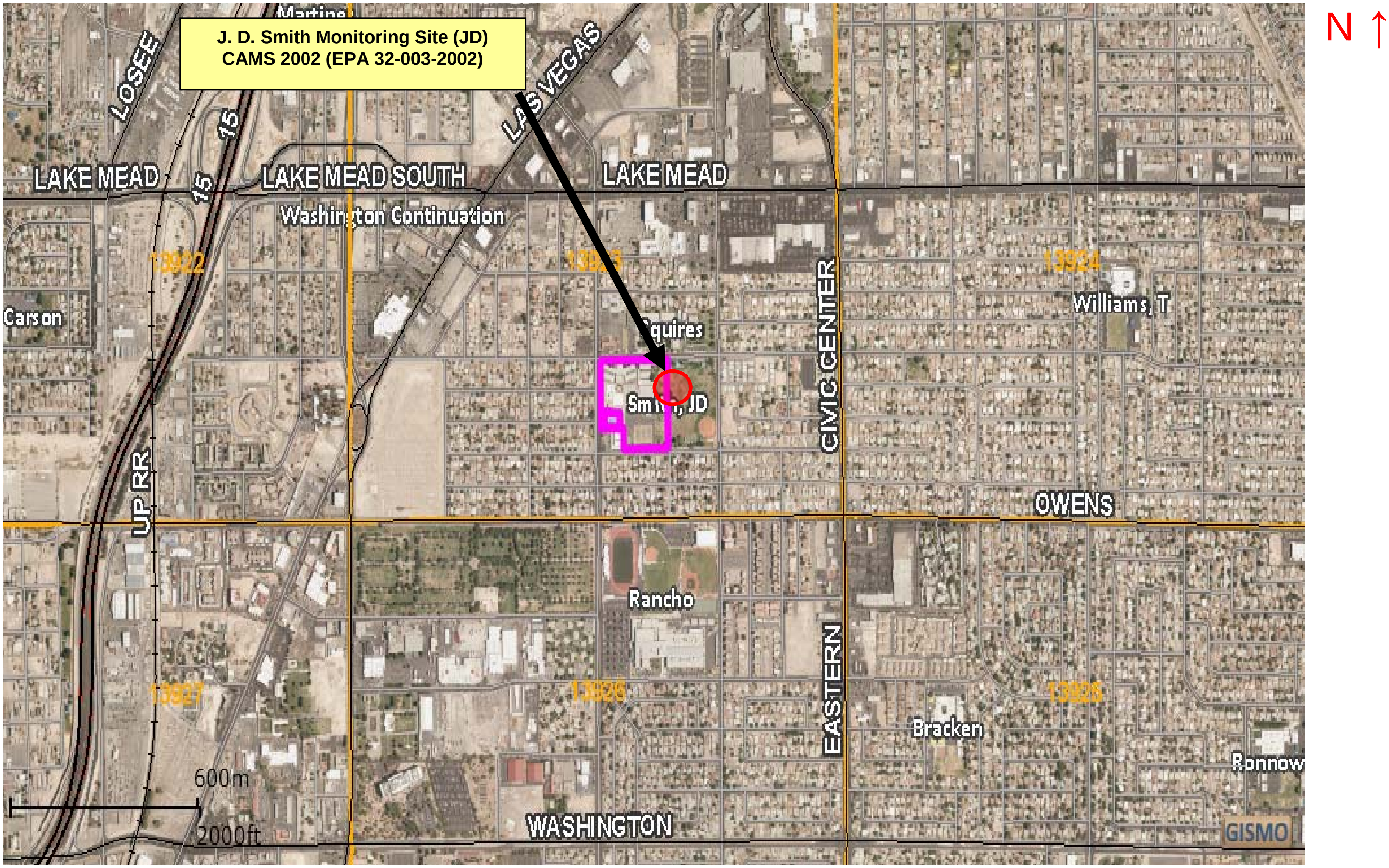


Figure 127. J. D. Smith monitoring site (EPA 32-003-2002), aerial view 4.

4.4 GREEN VALLEY

The Green Valley monitoring site (CAMS-0298, EPA 32-003-0298) (Figure 128) is located in the most southern part of the Las Vegas Valley (Figure 6) in a predominantly residential area with commercial amenities. Figures 129–132 provide aerial views of the site, whose purpose is to monitor middle-scale spatial emissions of PM_{10} from individual sources in the area. A large sports complex/city park and community center surround the site, whose monitoring objective is classified as "population exposure." There is no major transportation route in the area.

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a small contributor to particulate matter emissions at the site. There is vacant and undeveloped land in the area of influence around the site, which has blocked access and is stabilized. A major drainage easement/flood basin area nearby also has blocked access and is stabilized. The lack of current new land development or redevelopment in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. DAQ checked nearby sources to ensure they are fenced and stabilized. The sports park has the required soils to keep dust levels down during events, and shows signs of appropriate upkeep. The monitoring station is located inside a fenced compound, and the adjacent parking area is paved. The predominant wind direction is southwest. The predominant wind direction for the July 3, 2011, transported dust event was from the southeast to the northeast. The wind flows brought a significant amount of the transported dust through this site. However; a small mountain ridge located approximately 2.5 miles east of the Green Valley site appears to have funneled a portion of the PM_{10} laden airflow southeast to the northeast of this site, resulting in lower particulate measurements at this site than those recorded at Boulder City, Sunrise Acres, and J.D. Smith (Figure 2.). The site experienced elevated concentrations in the high-moderate level from the peripheral of the dust travel direction but did not have a measured PM_{10} exceedance on July 3, 2011. The site measured a 143 $\mu g/m^3$ concentration on July 3, 2011.

Figure 128. Green Valley monitoring station, street view.

Figure 129. Green Valley monitoring site (EPA 32-003-0298), aerial view 1.

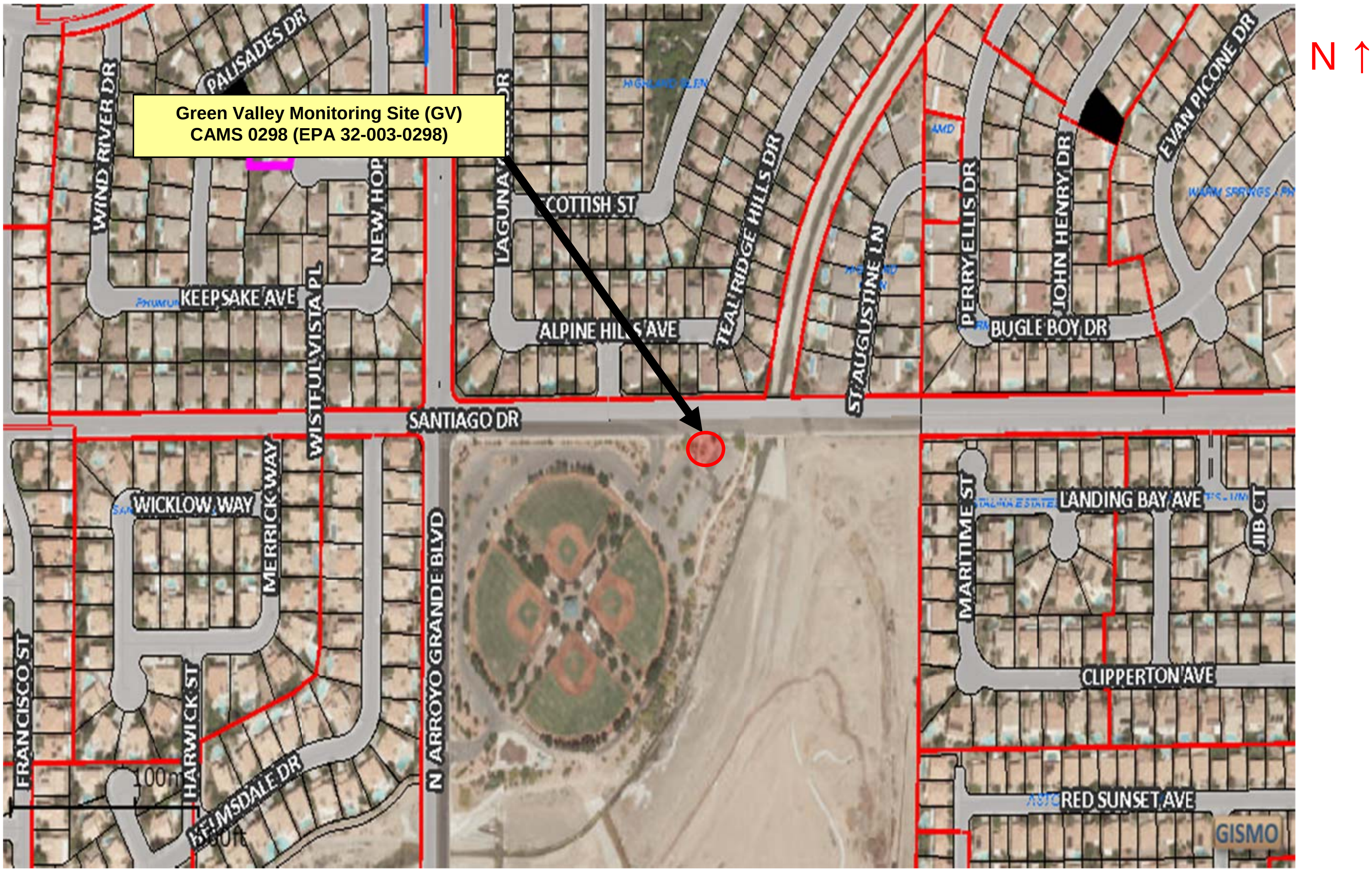


Figure 130. Green Valley monitoring site (EPA 32-003-0298), aerial view 2.

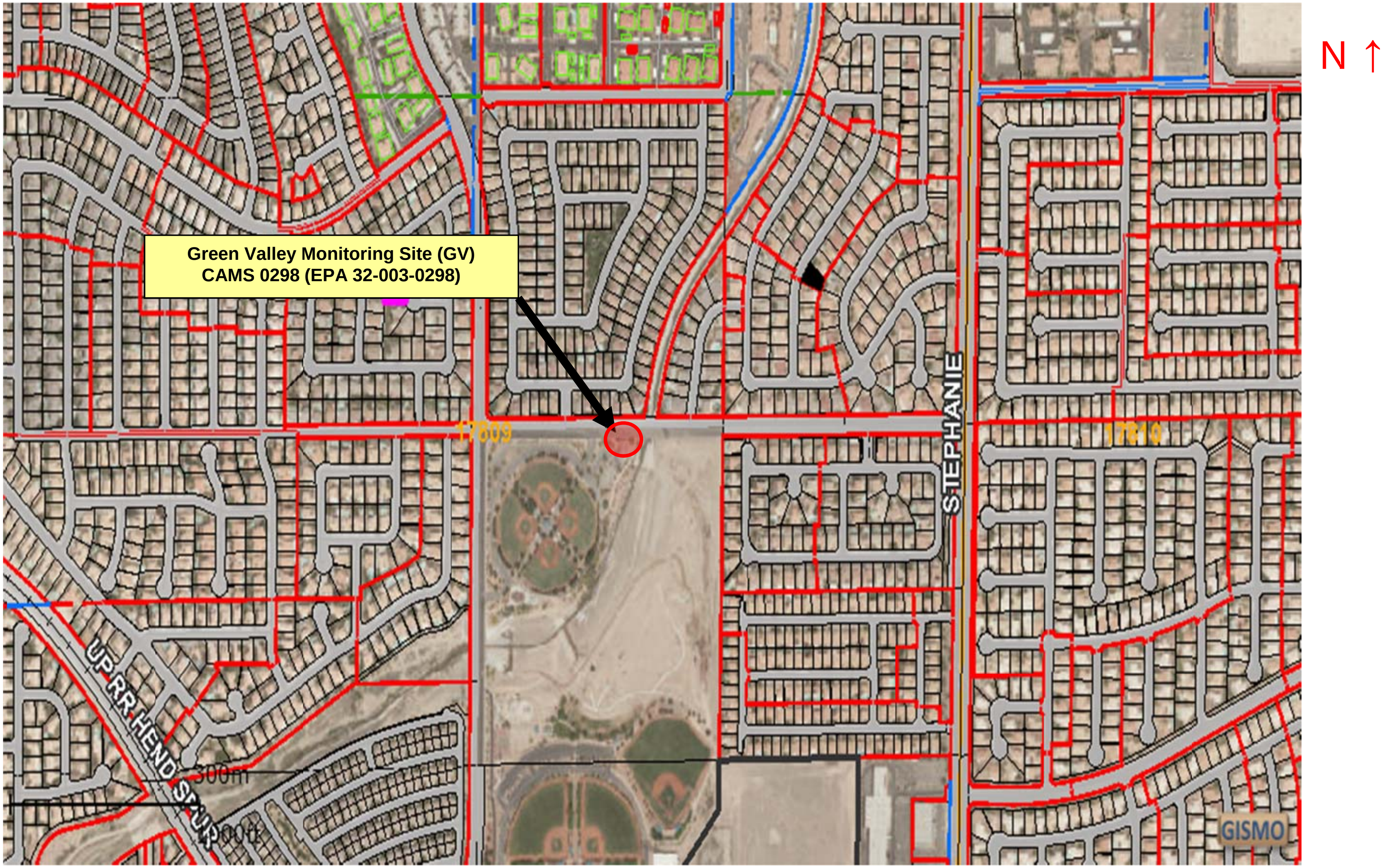


Figure 131. Green Valley monitoring site (EPA 32-003-0298), aerial view 3.

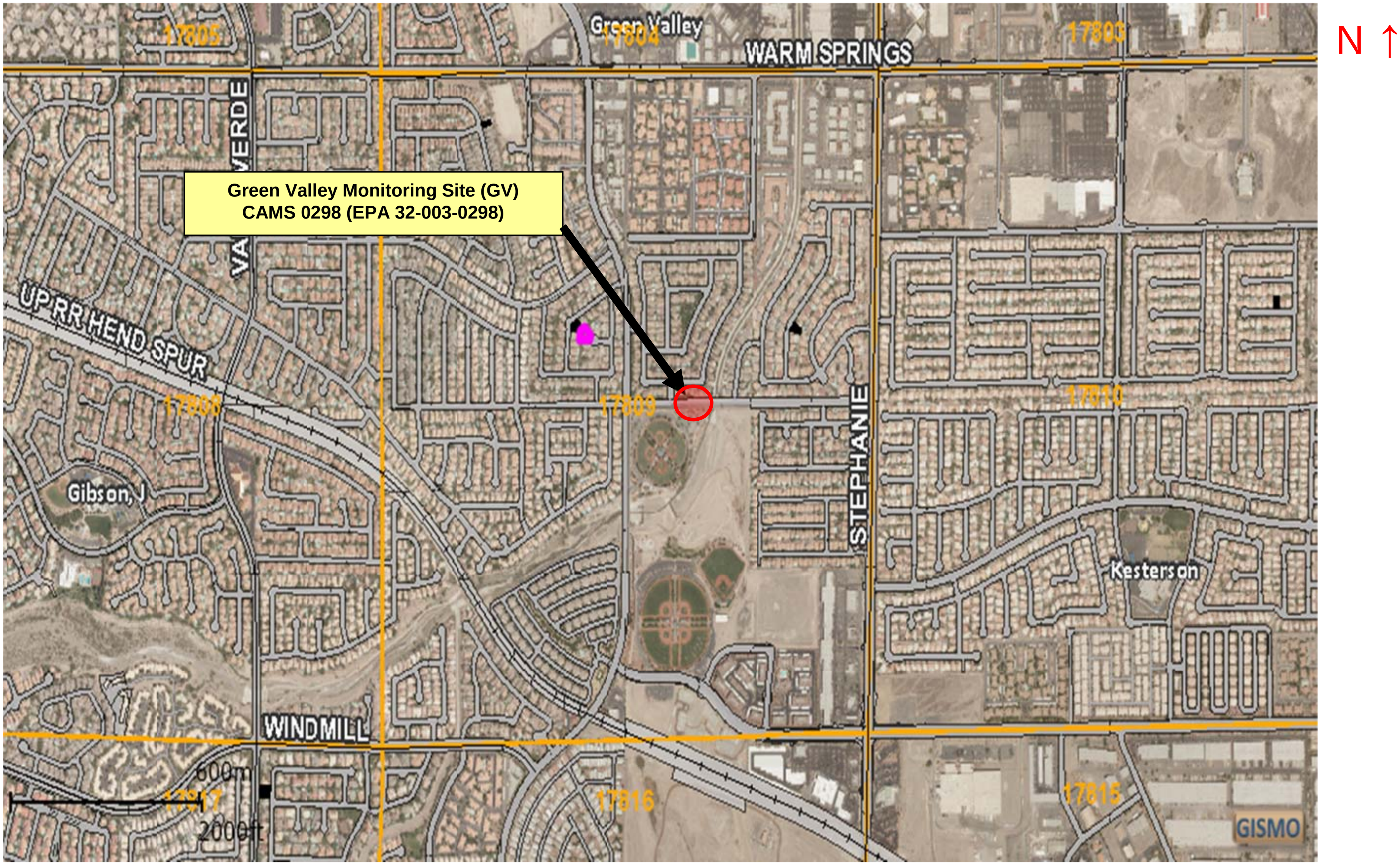


Figure 132. Green Valley monitoring site (EPA 32-003-0298), aerial view 4.

4.5 JOE NEAL

The Joe Neal monitoring site (CAMS-0075, EPA 32-003-0075) (Figure 133) is located in a city park next to a middle school in the northwestern part of the Las Vegas Valley (Figure 6). The area is predominantly residential, with commercial amenities nearby. Figures 134–137 provide aerial views of the site, whose purpose is to monitor neighborhood-scale spatial emissions of PM_{10} from individual sources in the area. The site's monitoring objective is classified as "population exposure," and it provides a good insight into predominant air quality trends for the citizens northwest of the city of Las Vegas. There are major transportation routes (U.S. highway 95) approximately 1.3 miles northwest of the monitoring site and a heavily traveled beltway (U. S highway 215) approximately 423 meters due north of the site.

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a moderate contributor to particulate matter emissions at the site. There is native desert and vacant, undeveloped land in the area of influence around the site, which has blocked accesses, is fenced, and is stabilized. The lack of current new land development or redevelopment in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. DAQ checked nearby sources to ensure they are fenced and stabilized. The monitoring station is located inside a fenced compound, and adjacent areas surrounding the site are a city park and the large grass playing area at the middle school. The predominant wind direction for this site is northwest. The predominant wind direction for the July 3, 2011, transported dust event was from the southeast to the north-northeast, so lower levels of dust drifted to this site compared to some of the other sites. Due to earlier disposition of dust at sites southeast of its location, Joe Neal experienced a high-moderate concentration. The site measured a 24-hour PM_{10} concentration of 130 $\mu g/m^3$ on July 3, 2011.

Figure 133. Joe Neal monitoring station, street view.

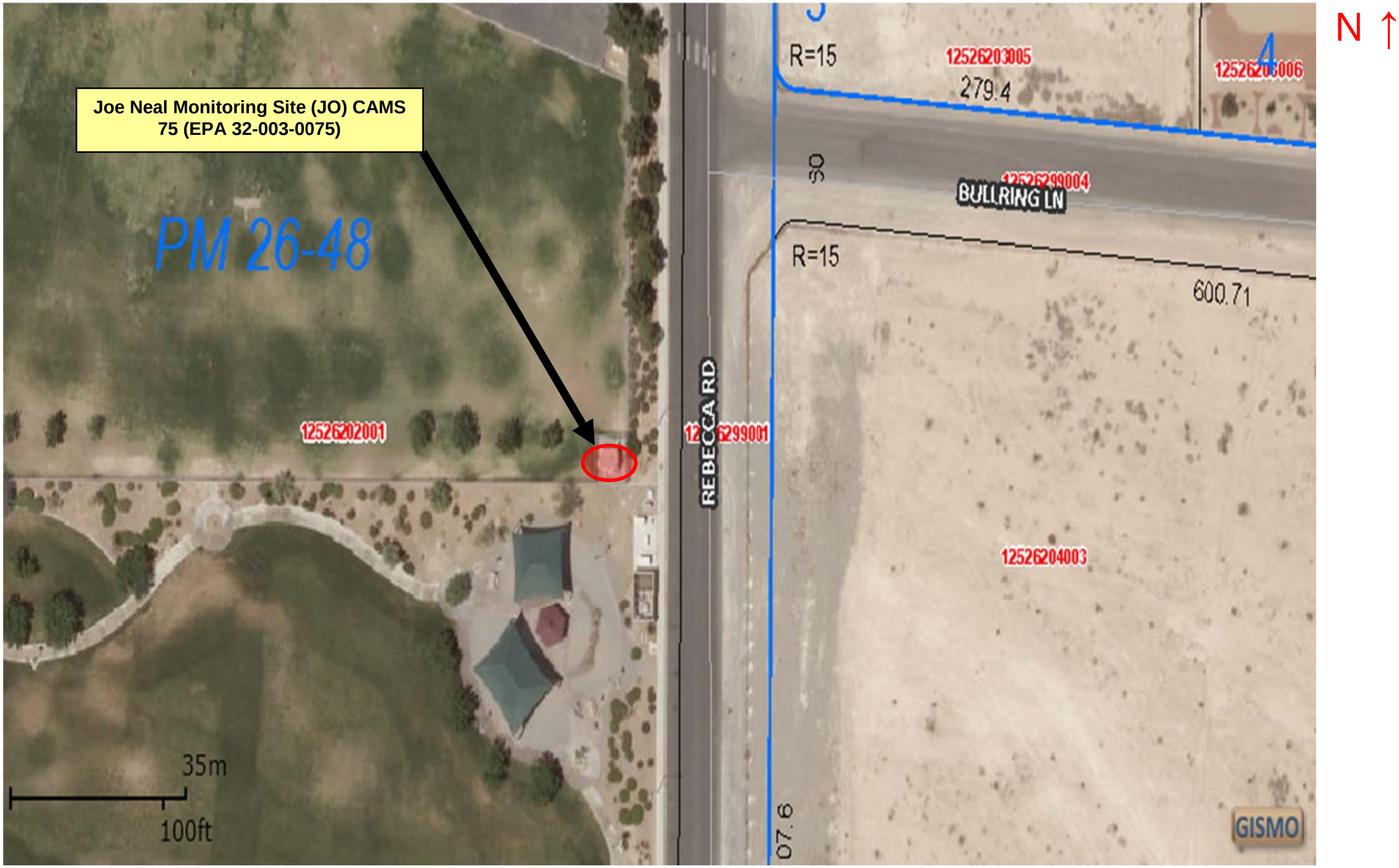


Figure 134. Joe Neal monitoring site (EPA 32-003-0075), aerial view 1.

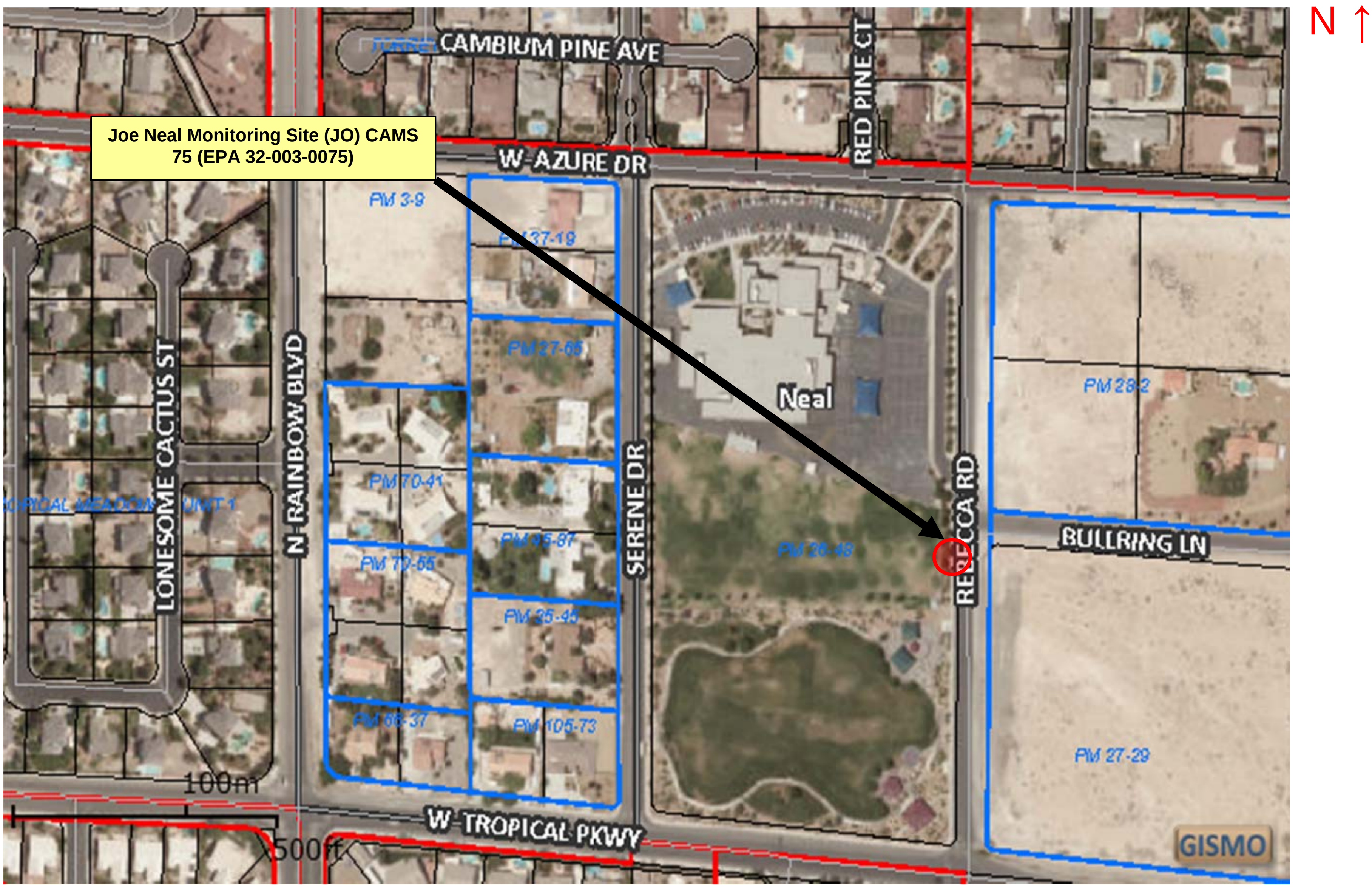


Figure 135. Joe Neal monitoring site (EPA 32-003-0075), aerial view 2.

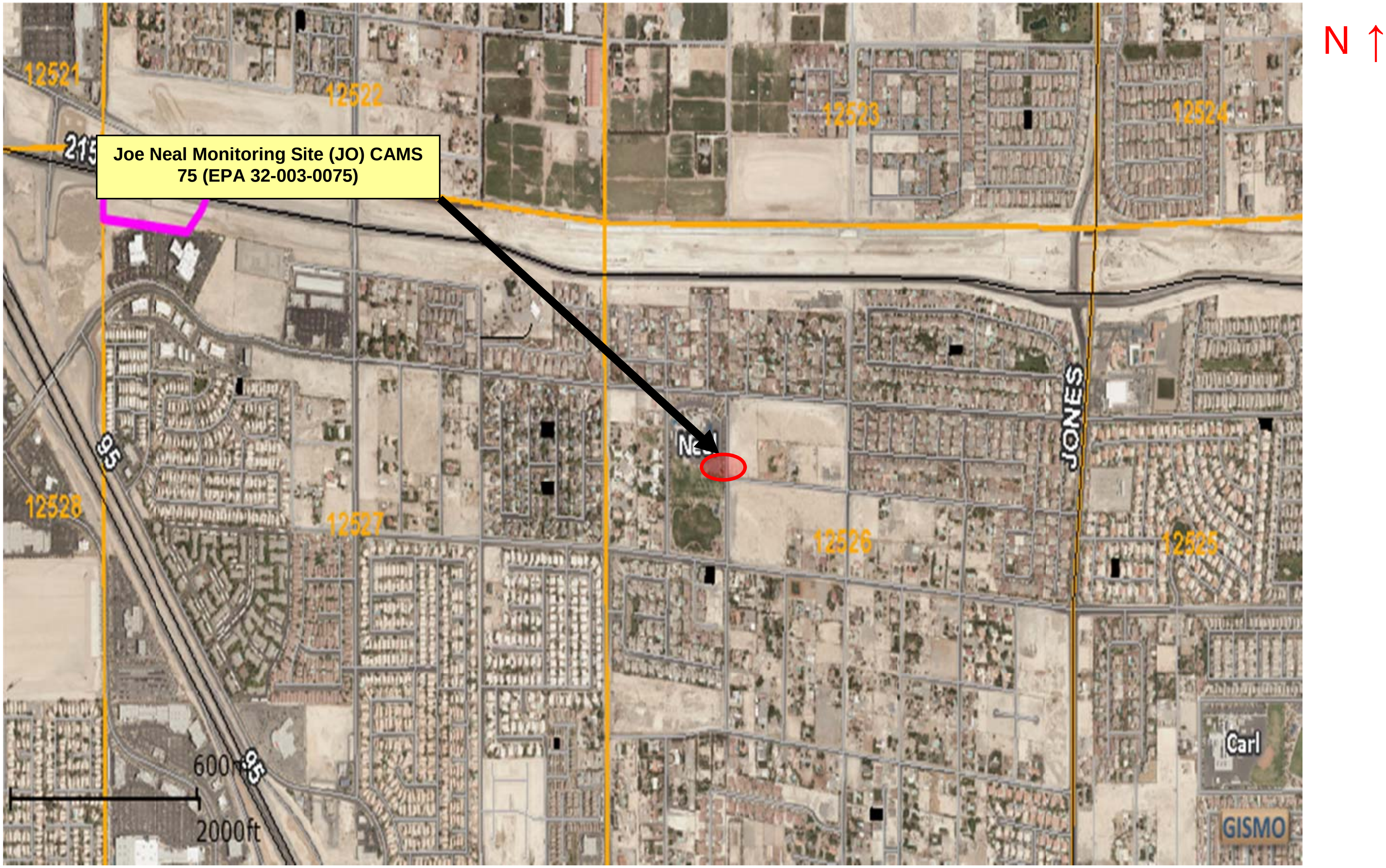


Figure 136. Joe Neal monitoring site (EPA 32-003-0075), aerial view 3.

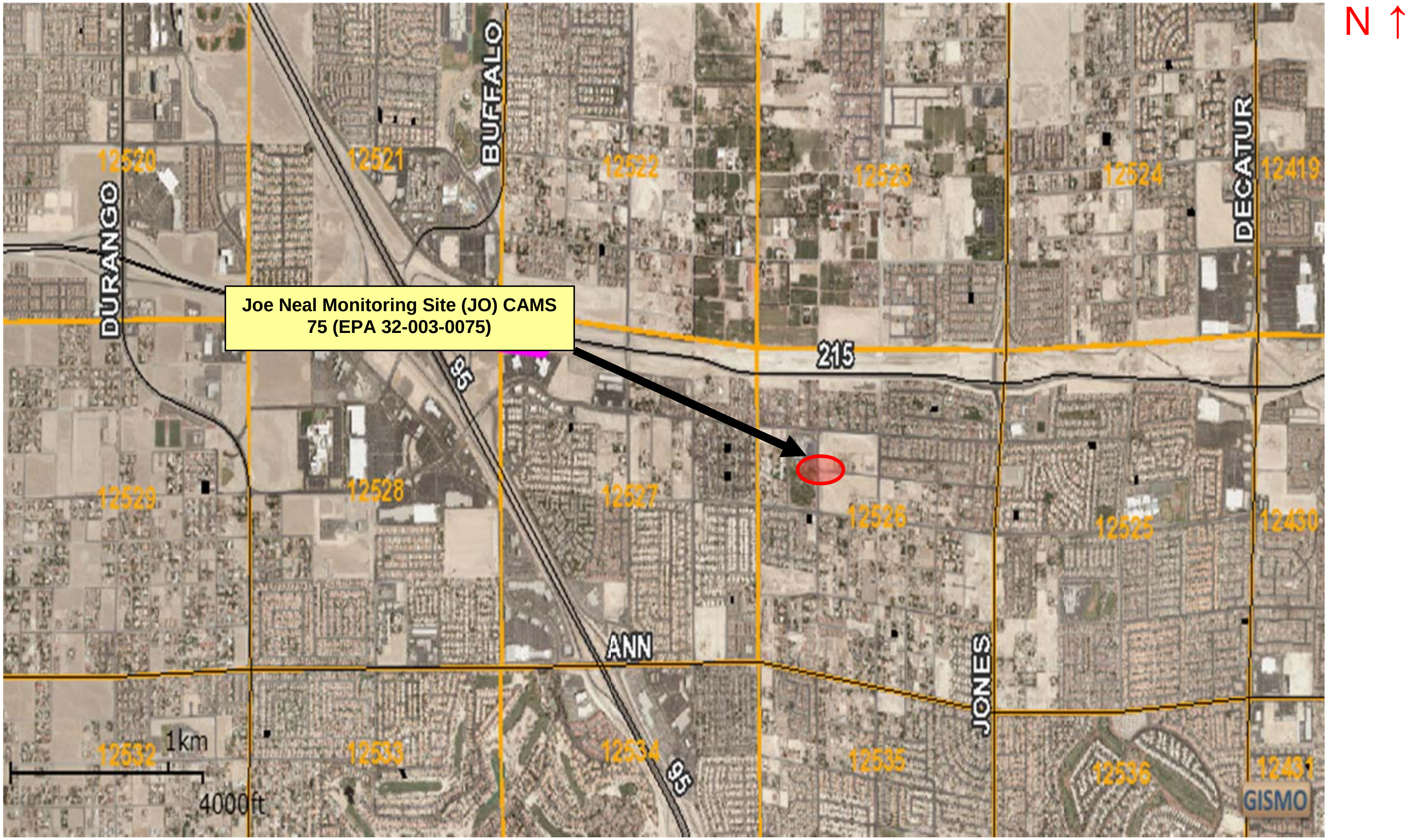


Figure 137. Joe Neal monitoring site (EPA 32-003-0075), aerial view 4.

4.6 PAUL MEYER

The Paul Meyer monitoring site (CAMS-43, EPA 32-003-0043) (Figure 138) is located in the western part of the Las Vegas Valley (Figure 6) in a predominantly residential area with commercial amenities, a sports/city park, a community center, and a school. Figures 139–142 provide aerial views of the site, whose purpose is to monitor spatial-scale neighborhood emissions of PM_{10} from individual sources in the area. The park and community center surround the site, whose objective is classified as "population exposure," with a Christian academy and school nearby. There is no major transportation route in the area.

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a small contributor to particulate matter emissions at the site. There is no vacant or undeveloped land in the area of influence around the site; the lack of current land development in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. The sports park is maintained with the required soils to keep dust levels down during events, and shows signs of appropriate upkeep. The school and academy grounds are paved with asphalt. The monitoring station is located within a fenced compound inside the park, and the adjacent parking area is paved. The predominant wind direction is southwest. The predominant wind direction for the July 3, 2011, transported dust event was from the southeast to the north-northeast. The low wind speeds caused a significant amount of the high-wind transported dust to drift through this site. The site experienced an elevated reading in the high-moderate level. The measured 24-hour PM_{10} concentration value was 103 $\mu g/m^3$ on July 3, 2011.

Figure 138. Paul Meyer monitoring station, street view.

Figure 139. Paul Meyer monitoring site (EPA 32-003-0043), aerial view 1.

N ↑

Figure 140. Paul Meyer monitoring site (EPA 32-003-0043), aerial view 2.

Figure 141. **Paul Meyer monitoring site (EPA 32-003-0043), aerial view 3.**

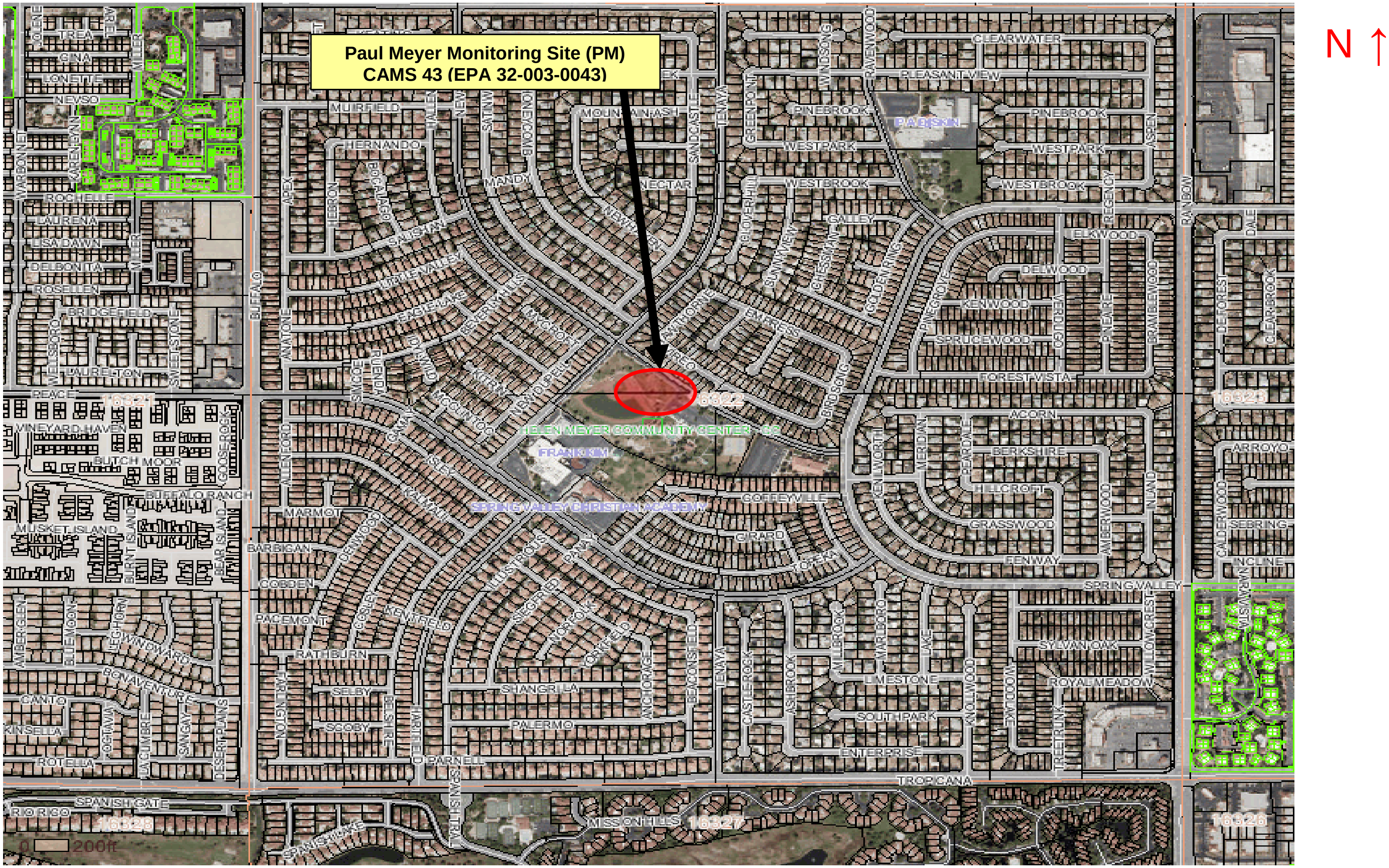


Figure 142. Paul Meyer monitoring site (EPA 32-003-0043), aerial view 4.

4.7 PALO VERDE

The Palo Verde monitoring site (CAMS-73, EPA 32-003-0073) (Figure 143) is located in the extreme western part of the Clark County Monitoring Network in the Las Vegas Valley (Figure 6) in a predominantly residential area with commercial amenities, a major sports park, a community center, a city library, and a high school. Figures 144–147 provide aerial views of the site, whose purpose is to monitor middle spatial-scale neighborhood emissions of PM_{10} from individual sources in the area. The sports park and community center are immediately west of the site, whose objective is classified as "population exposure," with a high school directly south of the site. There is a major transportation route, Clark County Highway 215 (Beltway), which is 415 meters directly west of the site. There is a major arterial (North Pavilion Center Drive and South Pavilion Center Drive) that runs parallel to the site

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a moderate contributor to particulate matter emissions at the site. There is no vacant or undeveloped land in the area of influence around the site, and the lack of current land development in the immediate vicinity has resulted in a decrease of particulate matter emissions in the area. The sports park is maintained with the required soils to keep dust levels down during events, and shows signs of appropriate upkeep. The school grounds are paved with asphalt. The monitoring station is located within a fenced compound inside the main parking area for students, and all adjacent parking areas are paved. The predominant wind direction for the site is southwest. The predominant wind direction for the July 3, 2011, transported dust event was from the southeast to the north-northeast, so no significant amount of the transported dust came through this site. The site experienced an elevated reading in the high-moderate level, although it registered the second lowest concentration value of the entire PM_{10} network for Clark County. The measured 24-hour PM_{10} concentration value was 89 $\mu g/m^3$ on July 3, 2011.

Figure 143. Palo Verde monitoring site, street view.

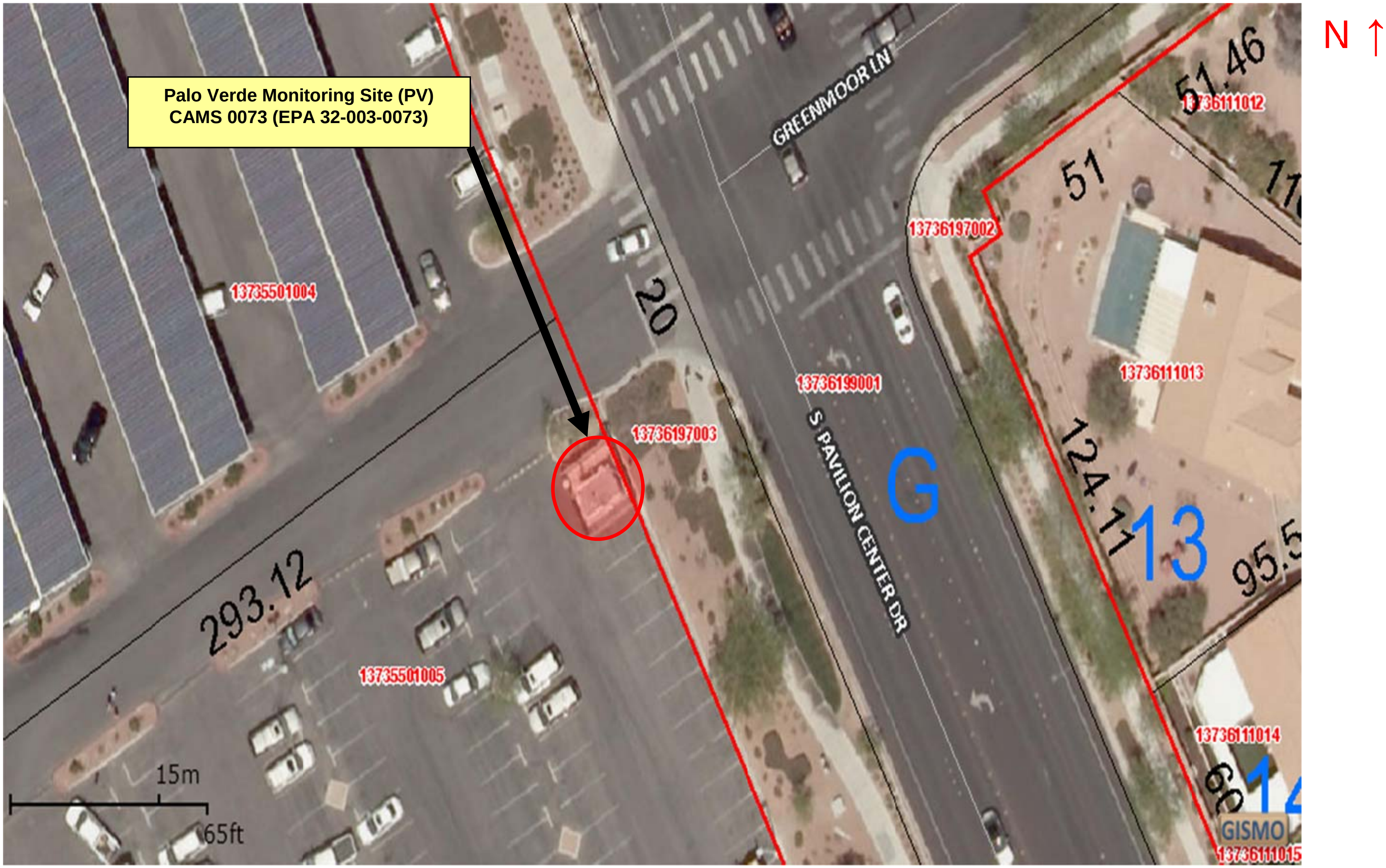


Figure 144. Palo Verde monitoring site (EPA 32-003-0073), aerial view 1.

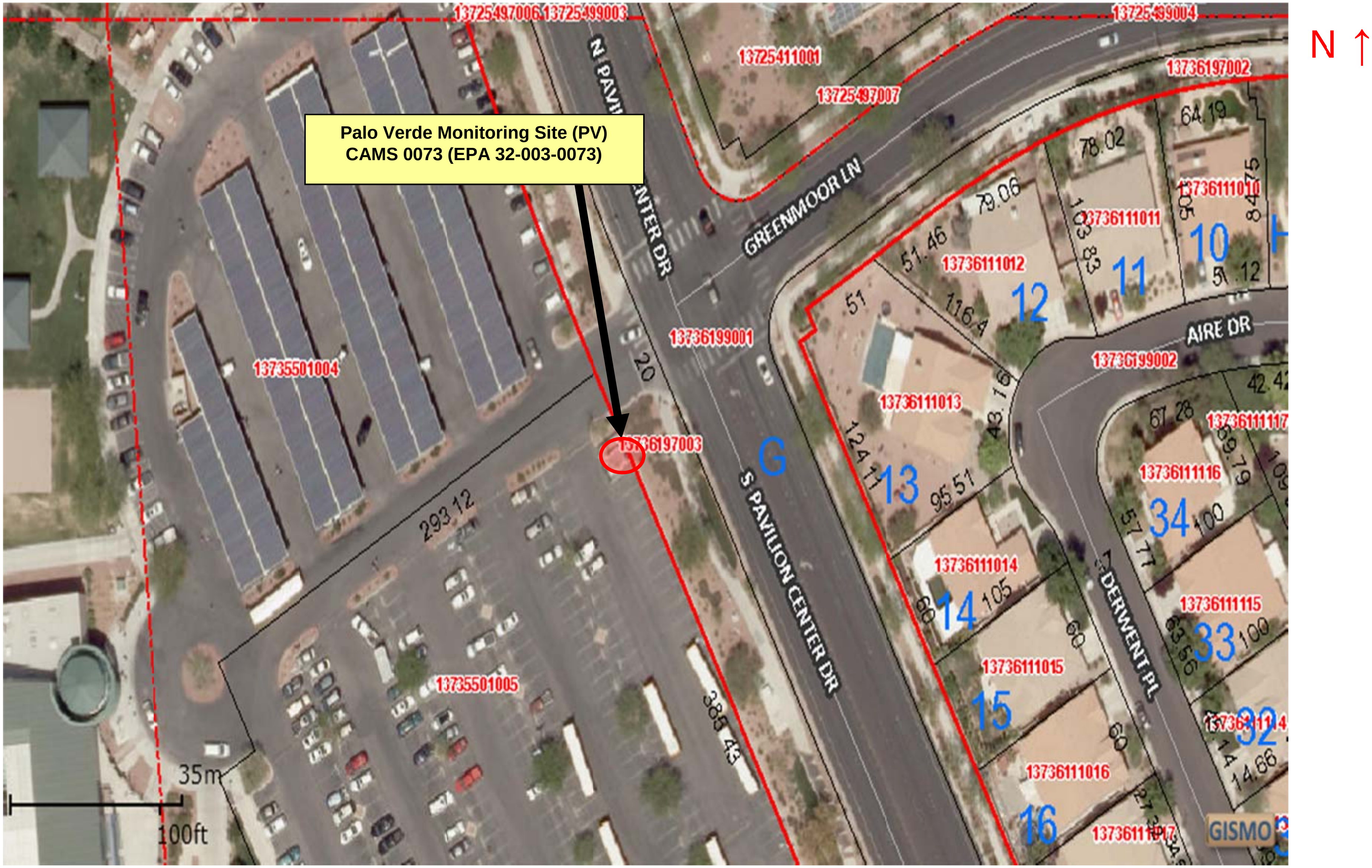


Figure 145. Palo Verde monitoring site (EPA 32-003-0073), aerial view 2.

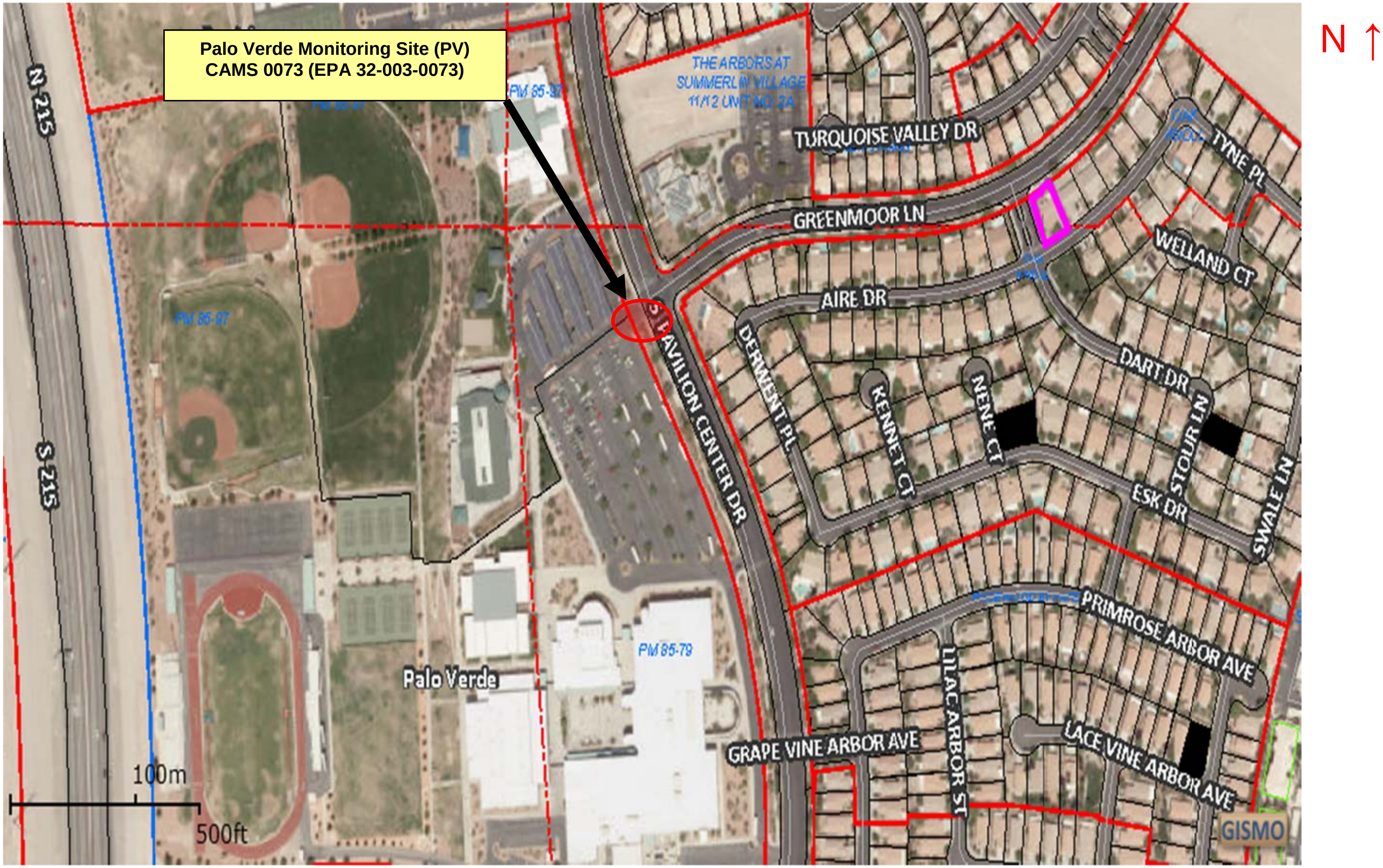


Figure 146. Palo Verde monitoring site (EPA 32-003-0073), aerial view 3.

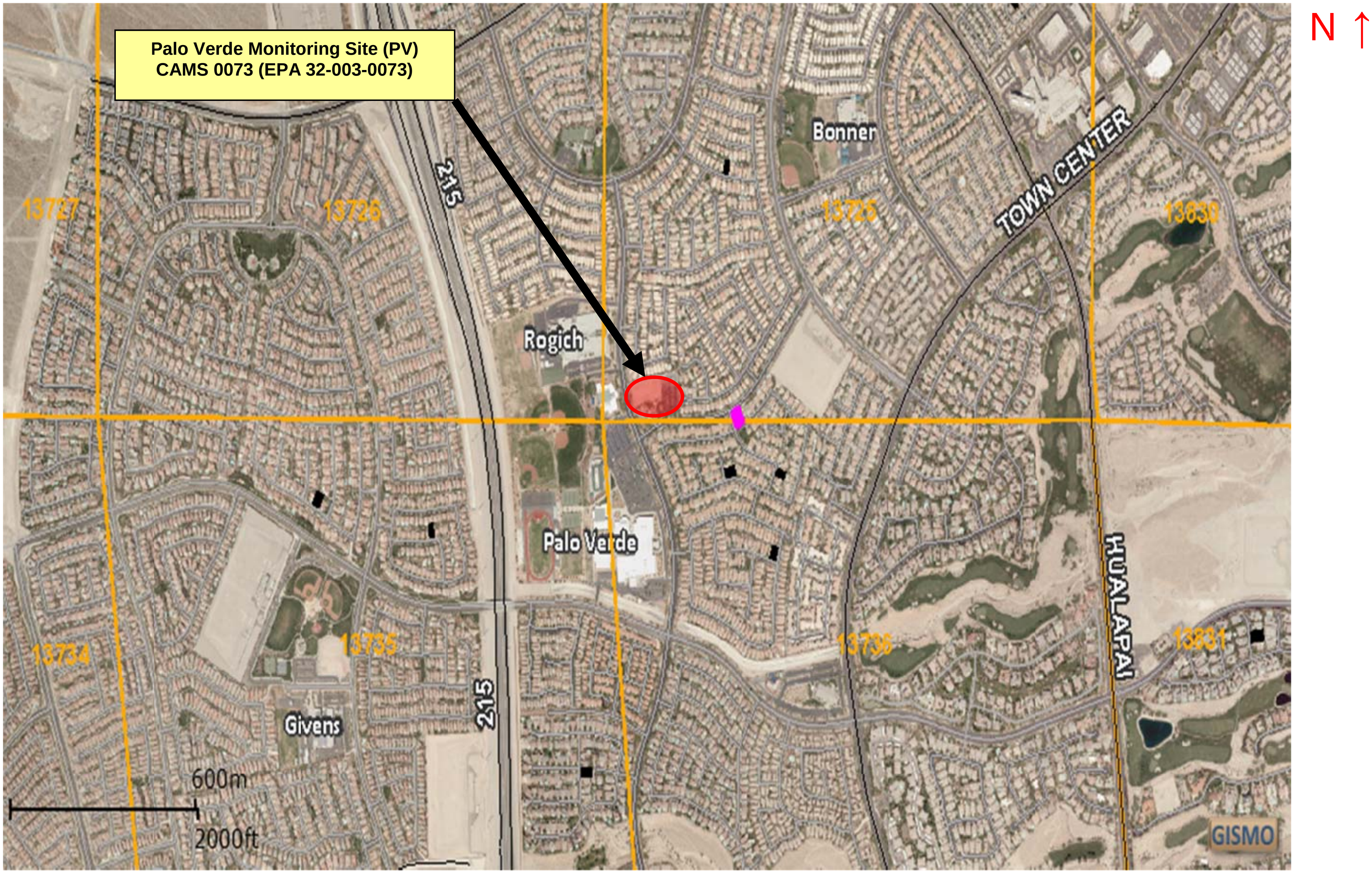


Figure 147. Palo Verde monitoring site (EPA 32-003-0073), aerial view 4.

4.8 JEAN

The Jean, Nevada monitoring site (CAMS-1019, EPA 32-003-1019) (Figure 148) is located in the southwestern part of the Ivanpah Valley approximately 30 miles at the southwest entrance to the Las Vegas Valley (Figure 6) in a predominantly rural area. Figures 149–152 provide aerial views of the site, whose purpose is to monitor regional-scale spatial emissions of PM_{10} from sources in the area. The site's monitoring objective is classified as "background," and it provides a good insight into predominant air quality trends and background. There is a major transportation route (U.S. highway 161) just 1,287 meters north of the monitoring site, and heavily traveled Interstate 15 is approximately 3,082 meters east of the site.

Paved-road dust (both $PM_{2.5}$ and PM_{10}) is a moderate contributor to particulate matter emissions at the site. There is native desert and vacant, undeveloped land in the area of influence around the site, which has blocked accesses and is stabilized. The lack of land development or redevelopment in the immediate vicinity or any disturbed native desert sources have resulted in a decrease of particulate matter emissions in the area. The monitoring station is located inside a fenced compound, and the adjacent parking area is predominantly native desert and gravel. The predominant wind direction for this site is southeast. The predominant wind direction for the July 3, 2011, transported dust event was from the southeast to the north-northeast, i.e., from Arizona up the Colorado River corridor and up through the Eldorado Valley. No significant amount of dust from the transported event affected the Jean monitoring site. The site experienced an elevated reading in the high-moderate level, and it registered the lowest concentration value of the entire PM_{10} network for Clark County. The measured 24-hour PM_{10} concentration value was 79 $\mu g/m^3$ on July 3, 2011.

Figure 148. Jean monitoring site, street view.

Figure 149. Jean monitoring site (EPA 32-003-1019), aerial view 1.

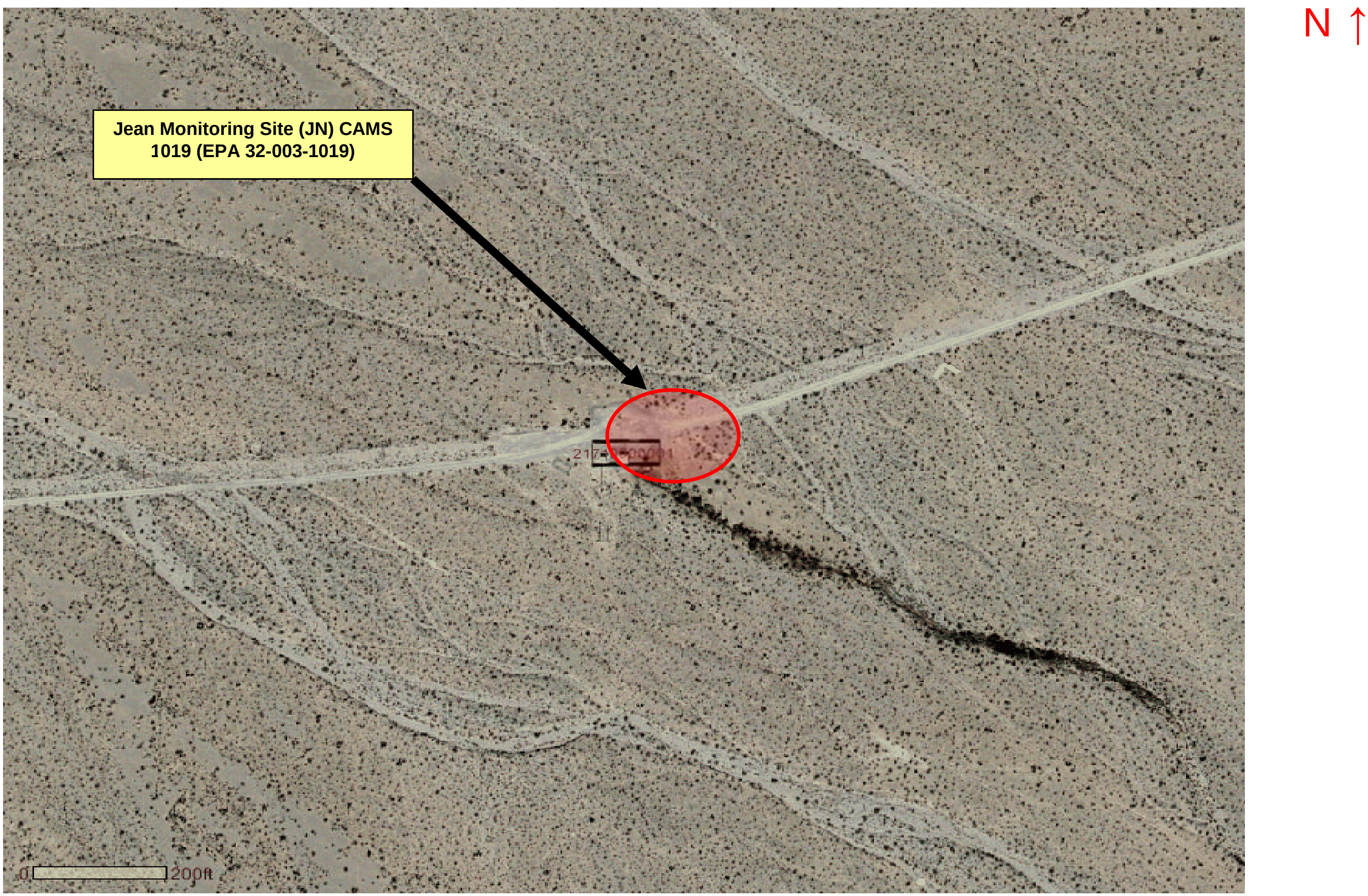


Figure 150. Jean monitoring site (EPA 32-003-1019), aerial view 2.

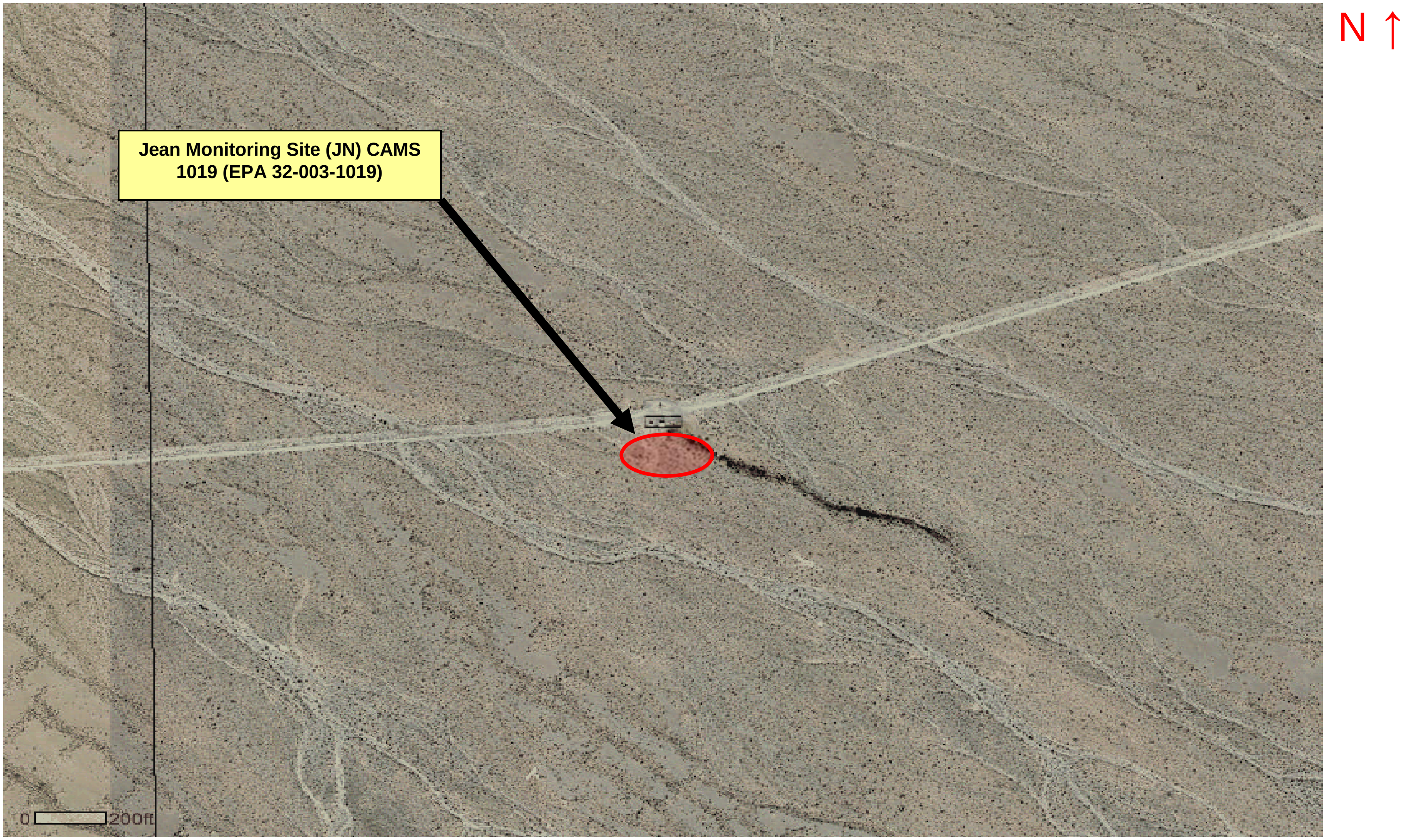


Figure 151. Jean monitoring site (EPA 32-003-1019), aerial view 3.

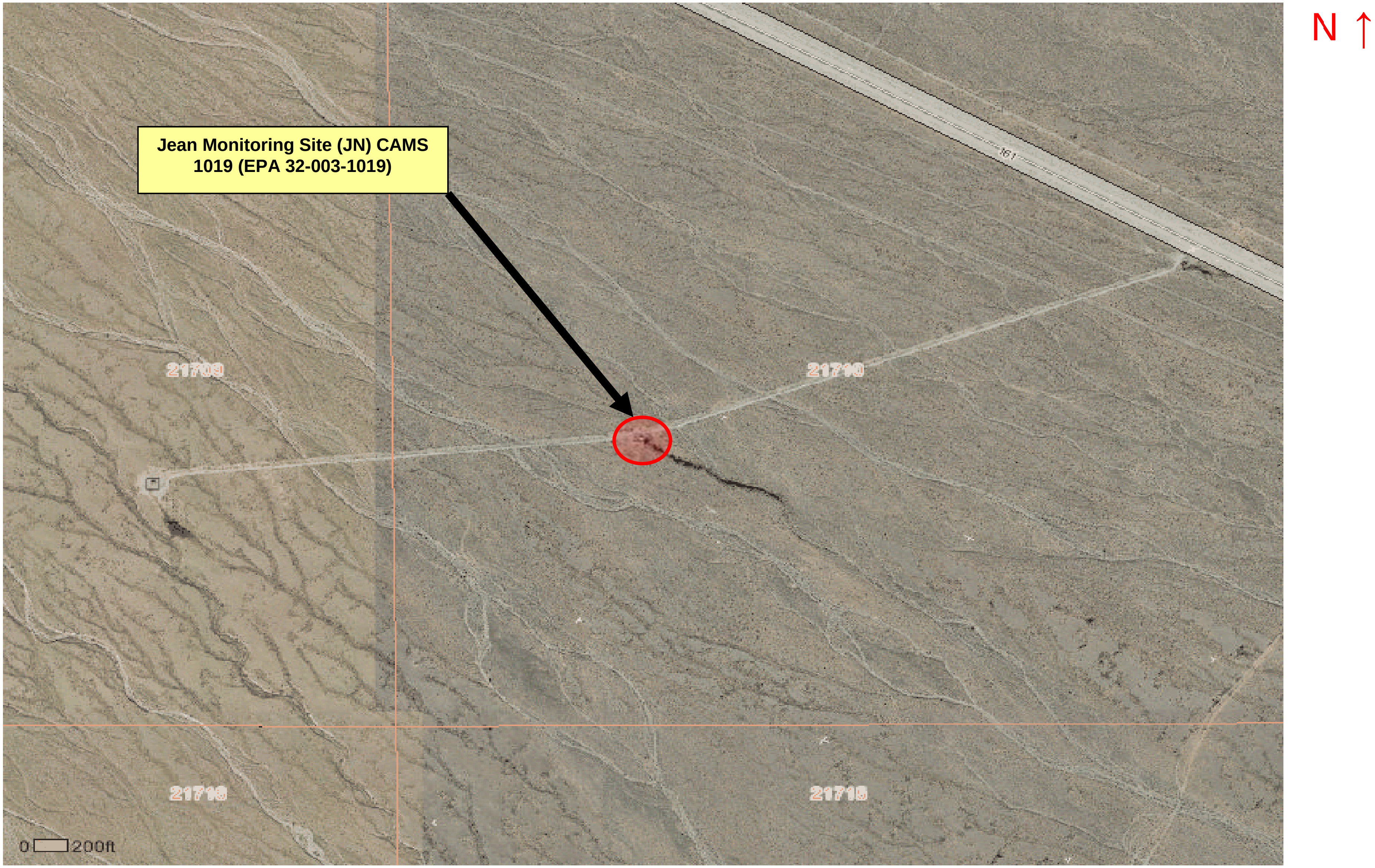


Figure 152. Jean monitoring site (EPA 32-003-1019), aerial view 4.

5.0 COMPLIANCE AND ENFORCEMENT ACTIVITY

5.1 BEST AVAILABLE CONTROL MEASURES

AQR Sections 90, 91, 92, 93, and 94 cover the BACM applicable to the two exceedance sites in the Las Vegas Valley. These regulations require stabilization of open areas and disturbed vacant lands; stabilization of unpaved roads; stabilization of unpaved parking lots; stabilization of unpaved shoulders on paved roads; and use of soil-specific best management practices for construction activities. Section 94 is the only one of these rules that is applicable to the Eldorado Valley, where the Boulder City site is located.

The DAQ follows a proven standard procedure, detailed in its existing NEAP, for handling potential transported dust events and wind events. This procedure requires maximum enforcement activity a day before the potential dust event to the extent possible, with a major focus on areas where dust violations have previously occurred. Figure 153 shows a map of the Las Vegas and Eldorado Valleys with Enforcement/Compliance sector and name assignments during exceptional event inspection and compliance responses. However, DAQ models did not forecast elevated PM_{10} concentrations on July 3, 2011, due to the moderate wind speeds forecast for Clark County. Since this event was an unforeseen high-wind/transported dust event, there were no pre-event and event enhanced Enforcement/Compliance actions. The Enforcement/Compliance activities were further impeded by the fact that the unforeseen event occurred on a Sunday, and the following Monday was a national holiday.

The department normally faxes a Construction Notice to permitted construction firms and selected stationary sources 12–24 hours before the expected arrival of high dust conditions from a high-wind or transported event. There was no Construction Notice sent out for this event because the event was not predicted by Clark County forecast models. During a weekend where high concentrations or potentially high concentrations of a criteria pollutant is forecast, staff would have been assigned to monitor the air quality, issue dust advisories as warranted, and initiate Enforcement/Compliance activities with on-call staff. However, none of these conditions were applicable at the time of the July 3, 2011, exceptional event, and no dust advisory was issued.

Due to the unforeseen nature of the exceptional event and the resulting lack of field Enforcement/Compliance activities, staff was forced to rely on an assessment of valley-wide activities and informal staff observations that took place on the day of the event to determine if BACM was effectively implemented and if any local sources may have significantly contributed to the event. Staff did not identify any unique or unusual activities taking place on July 3, 2011, that could have generated sufficient emissions to contribute to the elevated concentrations of PM_{10} that occurred on this date. Moreover, several staff members traveling on the east side of the valley on the morning of July 3, 2011, noted that the dust appeared to be coming into the valley from the southeast, the direction of Boulder City. Based on the activity assessment and informal personal observations of dust entering the valley from the southeast, DAQ staff concluded that BACM was effectively implemented for all applicable emissions sources and that local sources did not significantly contribute to the elevated PM_{10} concentrations measured at the Boulder City, Sunrise Acres, and J.D. Smith monitoring sites. The weight of evidence of the activity assessment, informal field observations, and moderate local wind speeds validate BACM rule penetration, rule effectiveness, and overall BACM control reductions contained in the 2001 PM_{10} SIP.

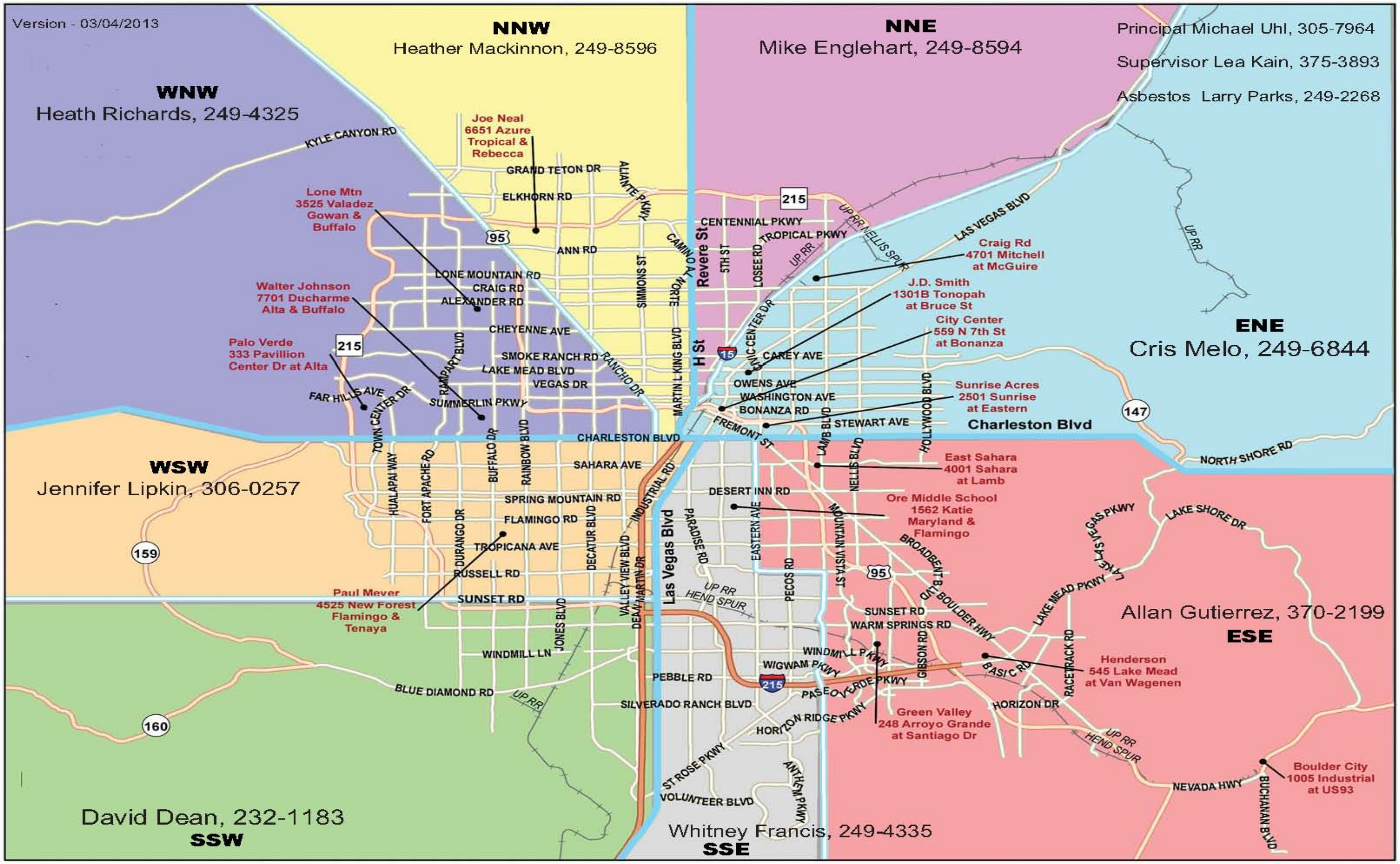


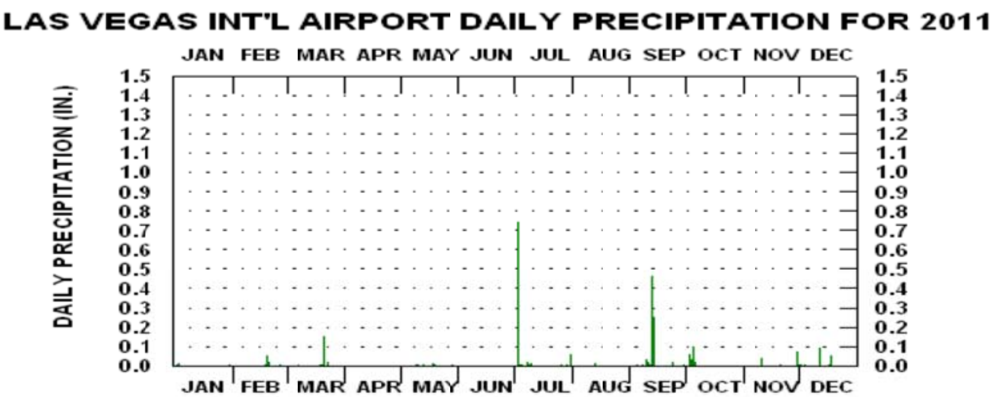
Figure 153. Enforcement/compliance exceptional event response sector map, Clark County, NV.

5.2 PRECIPITATION IN POTENTIAL FUGITIVE DUST SOURCE REGION

Figure 154 illustrates the small amount of rain Las Vegas had received by the end of July 2011. According to National Weather Service records, the Las Vegas Valley had received only 0.80 inches of measurable precipitation from January through July 3, 2011. During July 2011 the Las Vegas Valley and surrounding areas received .40 inches of measurable precipitation (Table 39).

Moisture content of soils is a factor for a high-wind or a transported dust event. Table 41, which provide precipitation data for the southwest region (lower Colorado), demonstrates that soils during the period preceding the transported dust event were not damp enough to limit blowing dust where soil crust has been disturbed. The last rain event before July 3, 2011 event was in March 2011, where .24 inches was measured. Late July 2011 0.4 inches was recorded. Figure 155 shows that no measurable precipitation occurred on July 3, 2011, the exceedance day.

This absence of local measurable precipitation increased the susceptibility of fugitive dust generation from native desert soil during the transported dust event; however, due to generally low sustained wind speeds and considering the low velocity wind gusts experienced in the late afternoon of the exceedance day, the additional amount of fugitive dust would have added to the mix of pollution experienced on July 3, 2011.



Source: NOAA/National Climatic Data Center, 151 Patton Avenue, Asheville, NC 28801-5001

Figure 154. Daily precipitation in Las Vegas Valley, 2011.

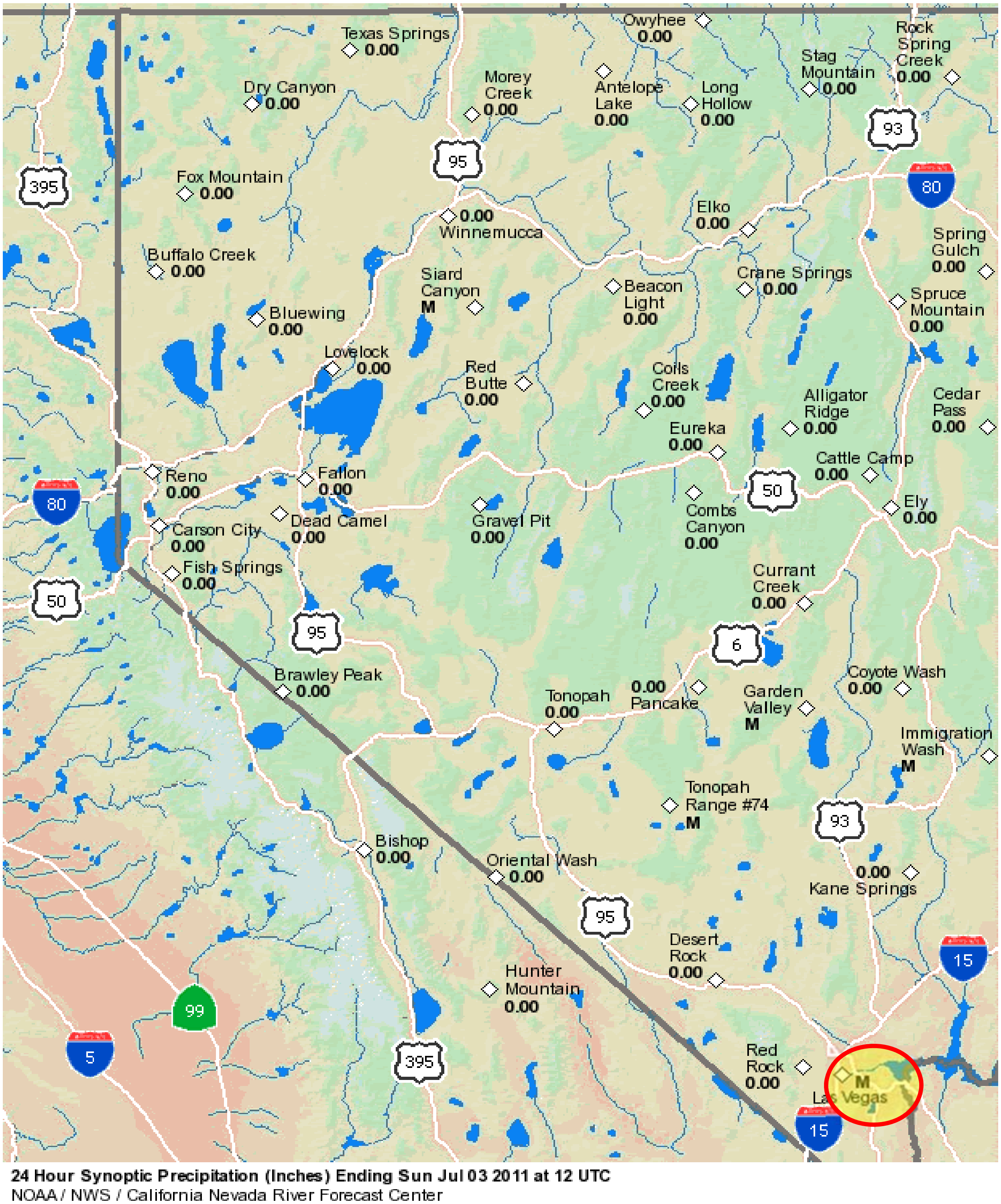


Figure 155. Lack of precipitation at McCarran International Airport and surrounding area on July 3, 2011.

Table 41. Water Year: October 1, 2010–September 30, 2011

LOWER COLORADO																
ID	**Location**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**WY to Date**	**Pct Avg to Date**	**Pct Tot WY**
BLH	BLYTHE	0.27	0.00	0.57	0.00	1.17	0.06	0.00	0.00	0.00	1.64	0.00	0.09	3.80	95	95
BULA3	BULLHEAD CITY	1.20	0.00	2.38	0.00	0.17	0.06	0.05	0.00	0.00	0.00	0.00	1.65	5.51	94	94
CALN2	CALIENTE	1.23	0.00	3.13	M	M	M	0.33	2.13	0.00	0.28	0.54	0.47	M		
DNWN2	DESERT NTL WILDLIFE REF	M	M	2.10	0.00	0.26	0.09	M	M	M	M	M	1.46	M		
EED	NEEDLES	0.37	0.00	1.20	0.00	0.72	0.08	0.09	0.45	0.00	0.17	0.04	1.10	4.22	83	83
EGNN2	ELGIN	2.43	0.54	6.90	0.00	1.30	1.24	M	M	M	M	M	0.31	M		
GUNU1	GUNLOCK PH	M	M	M	M	1.95	1.53	1.03	M	0.00	1.07	0.14	1.03	M		
HIKN2	HIKO	2.16	0.34	4.02	0.10	0.59	0.62	0.08	0.49	0.00	0.78	0.27	0.43	9.88	172	172
LAUN2	LAUGHLIN	1.01	0.06	1.47	0.00	1.43	0.15	0.15	0.00	0.00	0.25	0.00	1.11	5.63	134	134
LAVU1	LA VERKIN	2.71	1.28	6.07	0.06	2.26	1.55	1.56	0.78	0.00	0.22	0.04	1.31	17.84	149	149
LHCA3	LAKE HAVASU CITY	0.60	0.00	1.03	0.02	1.16	0.05	0.26	0.13	0.00	0.91	0.00	0.80	4.96	NA	NA
LUNN2	LUND	1.51	1.16	2.91	0.10	0.91	0.74	1.37	2.45	0.11	1.08	0.09	1.09	13.52	123	123
PWMN2	PAHRANAGAT WILDLIFE REF	0.35	1.08	0.38	0.10	0.15	0.84	0.04	0.95	0.00	0.48	0.48	0.50	5.35	81	81
SGUU1	ST. GEORGE	2.54	0.61	4.56	0.02	1.26	0.54	0.36	0.27	0.00	1.11	0.00	0.40	11.67	133	133
SPVN2	SPRING VALLEY STATE PA	2.94	0.91	6.62	0.03	0.87	0.85	0.45	1.26	0.00	0.06	0.98	1.32	16.29	133	133
SRCN2	SEARCHLIGHT	1.98	0.07	5.41	0.00	1.51	0.15	0.13	0.18	0.00	0.29	0.24	0.75	10.71	129	129
SUNN2	SUNNYSIDE	1.76	0.05	2.57	0.24	0.02	0.42	1.01	1.26	0.90	0.90	0.24	0.90	10.27	99	99
VEF	LAS VEGAS	1.25	0.04	1.90	0.03	0.06	0.24	0.00	0.07	0.00	0.40	0.02	0.72	4.73	103	103
VEYU1	VEYO POWER HOUSE	1.30	0.53	M	0.40	1.77	1.46	1.37	M	0.00	0.84	0.08	1.04	M		
VOFN2	VALLEY FO FIRE SP	1.95	0.06	4.12	0.01	1.97	0.40	0.05	0.34	0.00	0.23	0.00	0.43	9.56	147	147
WUPA3	WIKIEUP	1.56	0.28	2.27	0.00	1.58	0.00	0.00	M	0.00	0.51	0.08	0.90	M		
YUM	YUMA	M	M	M	M	M	M	M	M	M	M	M	M	M		

Source: US Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service-California-Nevada River Forecast Center 3310 El Camino Avenue, Room 227, Sacramento, CA 95821-6373

6.0 CONCLUSION

The DAQ investigated emission-generating activities during and after the transported dust event and found that PM_{10} emissions for BACM-controlled sources were well controlled. Native desert areas experienced some dust entrainment when wind speeds increased in the late afternoon; however, BACM controls limiting disturbance of developed areas prevented large-scale emissions that would have significantly impacted the particulate concentrations measured at the DAQ's monitoring sites. Low sustained wind speeds and wind gusts assisted in diluting and blowing the bulk of the dust out of the Eldorado and Las Vegas Valleys. The DAQ, therefore, concludes that the PM_{10} exceedance would not have occurred *but for* the high-wind transported dust from the multiple Arizona desert storms. Based on the evidence of a high-wind transported dust event set forth in this report, Clark County through its DAQ requests that EPA support the flagging of the PM_{10} exceedance at the Boulder City, Sunrise Acres, and J.D. Smith monitoring sites on July 3, 2011, in the EPA AQS and give a concurrence finding.

Appendix A

Clark County, Nevada

A-1: Summary of Refined PM_{10} Aeolian Emission Factors for Native Desert & Disturbed Vacant Land Areas-Final Report

A-2: Clark County Wind Tunnel Studies, Sections 1 – 5, including Executive Summary (CD)

Appendix A-1

Clark County, Nevada

Summary of Refined PM_{10} Aeolian Emission Factors for Native Desert and Disturbed Vacant Land Areas

Final Report

June 30, 2006

Executive Summary

Refined PM_{10} Aeolian Emission Factors for Native Desert and Disturbed Vacant Land Areas

Department of Civil and Environmental Engineering

University of Nevada, Las Vegas

4505 Maryland Parkway Mail Stop 45-4015

Las Vegas NV 89154-4015

Rosangela Wacaser, MS, David James, PhD PE

Hyunju (Judy) Jeong, MS, Srinivas Pulurgurtha, PhD PE

Final Report – June 30, 2006

Revision of July 8, 2005 draft report in response to changes requested by Clark County Department of Air Quality and Environmental Management

Executive Summary

The purpose of this report is to document the development of improved emissions factors for the PM-10 fraction of wind-blown dust emitted from vacant lands in metropolitan portions of Clark County, Nevada. The Clark County Department of Air Quality and Environmental Management (DAQEM) contracted with the Department of Civil and Environmental Engineering, University of Nevada, Las Vegas (UNLV) to conduct field studies to generate refined wind-blown PM-10 emissions factors (EF's). The refined EF's will be utilized for future updates of the Clark County emissions inventories. The PM-10 State Implementation Plan (SIP) contains a commitment to refine the emissions factors for native desert and disturbed open land areas by 2005.

Field work for this project was conducted at 32 field sites located in nine Wind Erodibility Groups (WEG) in Clark County in the summer of 2004. Each site was first characterized for its stability, then measured by a portable wind tunnel, first on the native surface, and then measured again on a freshly-raked surface, created to represent a "worst-case" scenario for unstable surfaces. Thirty-one of the 32 sites were rated as "stable" in their native condition.

Stable PM-10 emissions factors (EF's) generally trended from 0.001 ton/acre/hour for low wind speed bands to 0.020 ton/acre/hour for high wind speed bands. Stable EF's for WEG 3 and 4L did not exceed 0.01 ton/acre/hour in any wind speed band. Unstable PM-10 EF's tended to be higher than stable EF's in each Wind Erodibility Group. Wind Erodibility Group 6, (about 0.10 ton/acre/hour) exhibited higher unstable EF's than the other Wind Erodibility Groups.

Measured geometric mean stable PM-10 emissions factors (fluxes) averaged over all Wind Erodibility Groups varied from 0.0016 ton/acre/hr at low (15-20 mph) wind speed bands to 0.013 ton/acre/hour at high (45-50mph) wind speed bands (Figure ES-1, Table 34). Averaged over all Wind Erodibility Groups, geometric mean unstable PM-10 emissions factors (fluxes) varied from 0.0013 ton/acre/hr at low (15-20 mph) speeds to 0.031 ton/acre/hour in the high (45-50 mph) wind speed bands (Figure ES-1, Table 34).

Generally speaking, unstable emissions factors were similar in magnitude to stable emissions factors in the 10-15 mph and 15-20 mph wind bands. Unstable EF's were 1.5 times larger in the 20-25 mph wind band. At wind speeds above 25 mph, unstable emissions factors were, when averaged together, a factor of 2.4 higher than stable emissions factors.

The 2004 UNLV stable EF's values are similar values reported by Nickling and Gillies (1989) for total suspended particulates emitted from undisturbed surfaces. UNLV 2004 unstable EF's are a factor of 2.4 higher than values reported by Nickling and Gillies. UNLV stable PM-10 flux data are a factor of 8 higher than values reported by Gillette and Passi (1988), a factor of 80 higher Shao et al (1993), and a factor of 4.4 higher than values reported by Stetler and Saxton (1996) for fugitive dust emitted from the Columbia plateau.

Averaged over all Wind Erodibility Groups, the 2004 UNLV PM-10 stable emissions factors are 82% of the 1995 stable PM-10 EF's in the 15-20 mph wind band, 220% of the 1995 stable EF in the 20-25 mph wind band, and 400% of the 1995 stable EF in the 25-30 mph wind band. However, because 1995 EF data were derived from small sample sizes, the 15-20 mph and 20-25 mph ratios should be considered to be unreliable. For reliable data, geometric mean 2004 stable erosion rates were, on average, a factor of 3.14 higher than 1995 unstable erosion of rates, with multipliers ranging from 01.89 to 4.03.. When considered by themselves, all 2004 PM-10 stable EF's have sufficiently large sample sizes to be considered to be reliable for all wind bands except for 45-50 mph.

Averaged over all Wind Erodibility Groups, the 2004 UNLV PM-10 unstable emissions factors are 26% of the 1995 unstable PM-10 EF in the 15-20 mph wind band, 89% of the 1995 unstable EF in the 20-25 mph wind band, and 344% of the 1995 unstable EF in the 25-30 mph wind band. Again, because 1995 EF data were derived from small sample sizes, the 15-20 mph and 20-25 mph ratios should be considered to be unreliable. Reliable unstable 2004 erosion rates were on average 3.86x higher than 1995 erosion rates in the 25-40 mph wind bands, with ratios ranging from 3.44 to 4.00. When considered by themselves, all 2004 PM-10 unstable EF's have sufficiently large sample sizes to be considered to be reliable for all wind bands except for 45-50 mph.

Larger data sets were obtained in the 2004 study, because the wind tunnel was operated in three locations at each study site, and, at each location, measured emission from both stable and unstable soil. At each location, the tunnel was operated at four or five wind speeds, producing 12 to 15 data points for each soil stability condition at each site. During the 1995 study, the tunnel was used on one location at each site. The soil was tested in the as-found condition (stable or unstable). At each 1995 site, the tunnel was operated at three or four wind speeds, yielding three to four data points for only one stability condition at each site.

The higher 2004 stable EF's likely occurred because of differences in sampling methods. The 2004 field study employed shorter periods (4.0 minute) of steady-state erosion at each velocity compared to the 1995 study (10 minutes), so that the average erosion rate was calculated on a surface that had not been depleted of erodible particles for as long a period as during the 1995 study.

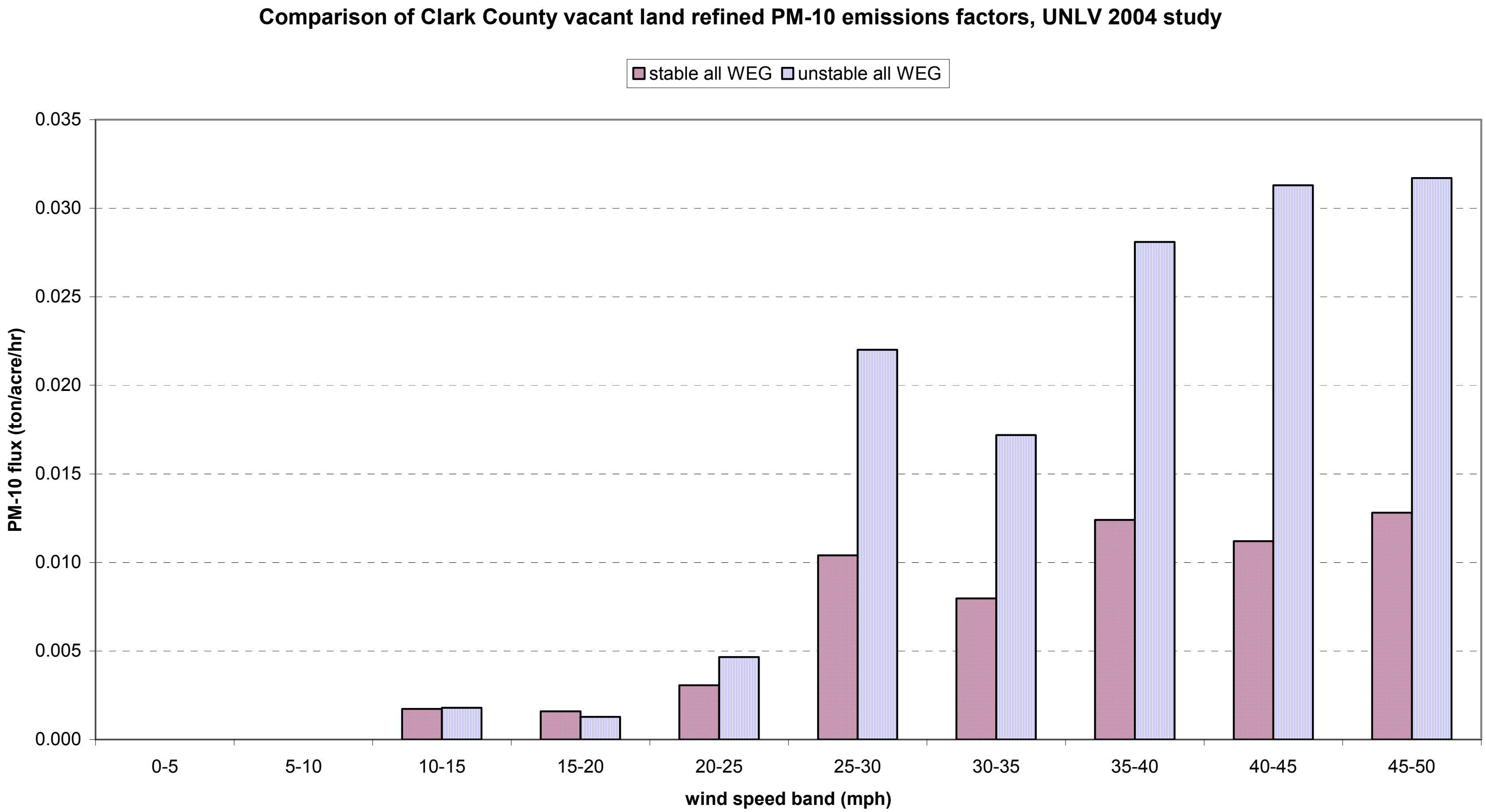
Higher 2004 unstable EF's likely occurred because unstable surfaces were intentionally created by disrupting soil crust with a metal garden rake. In the 1995 field study, unstable surfaces were measured "as found" without additional mechanical destabilization. The 2004 unstable PM-10 emission factor data represent a worst-case scenario of wind-borne PM-10 emissions from a freshly disturbed surface that had not been treated with dust palliatives.

In 2004, the average ratio of Unstable/Stable erosion rate was 1.12 in the 10-25 mph wind bands, and 2.36 in the 25-50 mph wind bands. Figure ES-1 shows that stable and unstable PM-10 EF's are similar in magnitude in the 10-15 and 15-20 mph wind bands. Unstable PM-10 EF's start increase relative to stable EF's in the 20-25 mph and 25-30 mph wind bands. Unstable PM-10 EF's hit a plateau at about 2.3x stable PM-10 EF's in the 35-40, 40-45 and 45-50 mph wind bands.

A change in wind tunnel field measurement technique resulted in measurable PM-10 emissions rates for all wind speeds down to the minimum velocities observed in the wind tunnel with the damper wide open. The minimum velocities were 10.3 mph for stable surfaces and 11.4 mph for unstable surfaces. Because of this change in technique, threshold velocities for initiation of PM-10 erosion are not available from the 2004 field study.

However, scatter plots of both stable and unstable PM-10 flux data against 10-meter velocity indicate significant non-linear increases in measured PM-10 emissions factors at wind speeds above 25 mph. When considering geometric means in each wind band, PM-10 Emissions Factors for velocities above the 20-25 mph wind band are about one order of magnitude higher than PM-10 Emissions Factors for velocities below the 20-25 mph wind band. The 20-25 mph wind band represents a transitional zone between the "low" and "high" PM-10 emissions wind bands. The order-of-magnitude shift in PM-10 emissions that occurs from 15-20 mph to 25-30 mph leads us to conclude that 25 mph could serve as a threshold value for a Natural Events Action plan.

Figure ES-1 – Summary of wind-blown geometric mean PM-10 Emissions factors, averaged over all wind erodibility groups. UNLV 2004 wind tunnel field study. Error bars omitted to clarify differences between wind speed bands.



Appendix A-2

Clark County, Nevada

County Wind Tunnel Studies, Sections 1 – 5, including Executive Summary (CD)

Appendix B

Clark County, Nevada

News Release Advisory

Appendix B - News Release Advisory

News Release

Office of Public Communications • (702) 455-3546 • FAX (702) 455-3558 • www.ClarkCountyNV.gov

Contact: Stacey Welling
Sr. Public Information Officer

Phone: (702) 455-3201
Cell: (702) 249-3823
E-mail: stac@ClarkCountyNV.gov

For Immediate Release **Friday, July 1, 2011**

Air Quality Advisory Issued For Smoke & Ozone July 4 through July 5 Due to Fireworks

Clark County Department of Air Quality and Environmental Management (DAQEM) is issuing an advisory that will be in effect from **July 4 through July 5th for potentially elevated levels** of smoke and ozone over the Independence Day holiday due to local fireworks and outdoor barbeques. Air Quality officials say smoke is made of small dust particles and other pollutants that can aggravate respiratory diseases, and contribute to ground-level ozone formation.

At this time, unhealthy levels of air pollution are not occurring. Air Quality officials will continue to monitor conditions and will post an alert on the forecast page of the DAQEM website if unhealthy levels actually occur. A link to the forecast page is located at http://redrock.co.clark.nv.us/forecast/. Detailed air quality conditions are posted in the monitoring section of the DAQEM website. You can receive free air quality forecasts and advisories via e-mail or text message through Enviroflash service. Subscription information is available at www.enviroflash.org.

ADDITIONAL INFORMATION ABOUT OZONE:

Ozone is a gas that occurs naturally in the upper atmosphere and protects earth from the sun's harmful ultraviolet rays. At ground level, ozone is a key ingredient of urban smog during the hottest months of the year in Clark County. Ground-level ozone can build up during the afternoon hours due to a combination of several factors, including strong sunlight, hot temperatures, and pollutants from automobiles and other sources such as transport, wildfires and fireworks. Unhealthy doses of ground-level ozone can reduce lung function and worsen respiratory illnesses such as asthma or bronchitis. Exposure to ozone also can induce coughing, wheezing and shortness of breath even in healthy people. When ozone levels are elevated, everyone should limit strenuous outdoor activity, especially people with respiratory diseases. If you are experiencing breathing difficulties or medical conditions that you think are related to air quality, see your doctor. Officials suggest these tips to help reduce the formation of ground-level ozone:

- Fill up your gas tank after sunset.
- Try not to spill gasoline when filling up, and don't top off your gas tank.
- Keep your car well maintained.
- Use mass transit or carpool.
- Don't idle your car engine.
- Mow your lawn after sunset.

News Release

ADDITIONAL INFORMATION ABOUT DUST & SMOKE:

Airborne smoke and dust is a form of inhalable air pollution called particulate matter, or PM, which aggravates respiratory diseases such as bronchitis and asthma. It may be best for children, the elderly, and people with respiratory diseases to stay indoors. Other suggestions include:

- If you work outdoors, consider wearing a painter's mask or surgical mask. This will help reduce your exposure to dust and particulates.
- Limit outdoor exertion. Exercise, for example, makes you breathe heavier and increases the amount of particulates you are likely to inhale.
- Keep windows closed. Run your air conditioner inside your house and car. Your air conditioner filters out dust and particulates.
- Consider changing your indoor air filters if they are dirty.
- Use your prescription allergy medication or over-the-counter hay fever or sinus medications if you experience symptoms of itchy eyes, a runny nose, or congestion.

###

Appendix C

Clark County, Nevada

1. Section 1: DAQ Web Posting

2. Section 2: Public Comments & DAQ Responses to Comments

Appendix C

Clark County, Nevada

Section 1: DAQ Web Posting

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Friday, February 21, 2014

Clark County > Departments > Air Quality

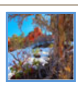
Air Quality

The Department of Air Quality is the air pollution control agency for all of Clark County, Nevada. Established by the Clark County Board of County Commissioners in 2001, Air Quality administers a variety of programs to improve the health and welfare of our citizens by ensuring that the quality of the air in Clark County meets healthful, regulatory standards.

Announcements

- High Wind Exceptional Event on July 3, 2011
  Public comment period for draft High Wind Exceptional Event Package *More Information*
- 30-Day Public Notice
  Public comment period on revised Sections 0, 12.0, 12.1, 12.2, 12.3, and 12.4 and the repeal of Section 1 of the Clark County Air Quality Regulations. *More Information*
- Business Impact Notice Comments
  The Clark County Board of County Commissioners is proposing modifications to Clark County Air Quality Regulation 12.1, "Permit Requirements for Minor Sources." *More Information*

How We're Serving You



Small Business Assistance
Need help with your stationary source permit application or a compliance issue?
More Information

Air Quality

High-Wind Transported Dust Exceedance Event on July 3, 2011

The Clark County Department of Air Quality (DAQ) developed an exceptional event documentation package for a National Ambient Air Quality Standard (NAAQS) exceedance on July 3, 2011. Clark County was impacted by a high-wind regionally transported dust event, which resulted in two air quality monitoring sites in the Las Vegas Valley and one monitoring site in the Eldorado Valley exceeding the PM10 24-Hour NAAQS. This exceptional event document was processed in accordance with the U. S. Environmental Protection Agency (EPA) Exceptional Event Rule, dated March 22, 2007, which defines exceptional events as "… events for which the normal planning and regulatory process established by the federal Clean Air Act (CAA) is not appropriate." EPA's exceptional event rule and CAA sections 319(b)(3)(B) and 107(d)(3) grant authority to exclude air quality monitoring data from regulatory determinations related to exceedances or violations of the NAAQS, thus avoiding redesignation of an area to a nonattainment status if a State (Clark County, as designated) adequately demonstrates that an exceptional event has caused an exceedance or violation of the NAAQS.

The document will undergo a 30-day public comment period commencing on Monday, February 24, 2014, and ending on Friday, March 28, 2014, at 5:00 p.m.

The public has the opportunity to review and comment on the Draft July 3, 2011 Exceptional Event document. The main document and supporting appendices are downloaded separately below:

- Exceptional Event Documentation for the July 3, 2011, PM10 High-Wind Exceedance Event
- Appendix A-1 –Summary of Refined PM10 Aeolian Emission Factors for Native Desert and Disturbed Vacant Land Areas-Final Report
- Appendix A-2 –Clark County Wind Tunnel Studies, Section 1 through 5 including Executive Summary (CD) (Sect 1, Sect 2, Sect 3, Sect 4, Sect 5)
- Appendix B –Clark County News Release Advisory dated July 1, 2011
- Appendix C –DAQ Web Posting & 30-day Public Comment Period
- Appendix D –NLV Visibility Camera Network, Satellite Imagery & MODIS AOD Trajectory (CDs) (Satellite Animation, NLV Visibility Photos, MODIS Trajectory)

These documents are also available for inspection at the front counter of the DAQ office, located at 4701 W. Russell Road, Suite 200, Las Vegas, NV 89118. DAQ is located on the second floor of the Clark County Building Department building. Comments must be submitted in writing to the DAQ at the address above and to the attention of Russell Merle, Senior Air Quality Planner. Mr. Merle can be reached at 455-1662. Comments can also be submitted by email to: MERLE@ClarkCountyNV.gov. All comments must be received by 5:00 pm Friday, March 28, 2013, the close of the 30-day comment period. Written comments will be retained and considered prior to the submittal of the Exceptional Event Package to the EPA, Region 9, San Francisco, California, on Friday, April 4, 2014.

Air Quality

Exceptional Events

Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that agencies implement in order to attain and maintain the National Ambient Air Quality Standards. Exceptional events are events for which the normal planning and regulatory process established by the Clean Air Act (CAA) is not appropriate.

One type of exceptional event is a natural event. EPA defines a "natural event" as an event in which human activity plays little or no direct causal role to the event in question. For example, a natural event could include such things as high winds, wild fires, and seismic/volcanic activity. The Natural Events Action Plan describes the actions and programs to mitigate effects of high winds.

Federal regulations (40 Code of Federal Regulations Part 50.14 (b)(2)) also allow states to exclude data from regulatory determinations on a case-by-case basis for monitoring stations whose exceedances or violations are caused by emissions from fireworks displays. DAQ submits Exceptional Event Demonstrations to EPA when ambient air monitoring data is affected by exceptional events.

Exceptional Events Demonstrations Available for Public Comment

Date	Pollutant	Location	Value	Type	End of Comment Period
July 3, 2011	PM10	Multiple	242 µg/m3	High Winds	March 28, 2014

Demonstrations Submitted to EPA

Date	Pollutant	Monitor	Value	Type	Status
May 10, 2012	PM10	Multiple	314 µg/m3	Transport Dust	
May 21, 2008	PM10	Craig Road	168 $\mu g/m^3$	High Winds	EPA Review
Feb 13, 2008	PM10	Craig Road	203 $\mu g/m^3$	High Winds	EPA Review
29-30 June 05	Ozone	Valley Wide	85 ppb	Wildfire	EPA Review

For more information or questions about exceptional events that are out for public comment contact:
Particulate Matter: Russell Merle (702)455-1662
Ozone: Jean-Paul Huys (702)455-1684

Appendix C

Clark County, Nevada

Section 2: Public Comments &
DAQ Responses to Comments

APPENDIX C: SECTION 2

PUBLIC COMMENTS & DAQ RESPONSES TO THE COMMENTS

Exceptional Event Documentation for the July 3, 2011,
PM_{10} High-Wind Exceedance Event

One commenter, EPA Region 9, submitted comments on this document during the 30-day comment period. The EPA comments and Clark County responses are detailed below:

EPA Comment 1:

Thank you for giving EPA an opportunity to review your draft version of the July 3rd, 2011 PM_{10} Exceptional Event package. We identified some issues and provided comments with the intent to work collaboratively to develop a package that we can efficiently reach concurrence on. There are three main components of the comments provided, which are broken down into identifying the source area, characterizing the monitors affected, and other issues with the data that are used to portray the event.

Source area:

The identified source area provides the link for the *"clear causal connection between the exceedances and the event."*

The origin of the dust is termed slightly different throughout the document. This does appear to be a storm that did not have a single pin-pointed source spatially, but the general source area should be consistent through the document. One suggestion is to define the source area at the beginning of the document. Subsequently the term "source area" could be used in place of specific locations where it makes sense. Below are examples of the identified source area with some alternative ways to describe it. Sometimes California is identified, and sometimes only Arizona. Also, wind data from the Phoenix area is not included but is identified as a source area from descriptions as well as the hysplit trajectories.

- "…large thunderstorm cells out of the southwestern, northwestern and central Arizona of the source area" (*DAQ Response: Fixed pg. 1, Section 1.1*)
- "…high winds from the source area" (*DAQ Response:* Fixed *pg. 1, Section 1.2*)
- "…thunderstorms in the source area, specifically, southwest to northwest and at times northeast Arizona" (pg. 3 (*DAQ Response: Now pg.4, Section 1.3 third paragraph*)
- "…transported dust from the desert storm in the southwestern to northwestern Arizona area" (pg. 10) *(DAQ Response: Now pg.11, Section 2.1 first paragraph*)
- "…storm cell out of the southwest and central Arizona/southeast California (pg. 14) *(DAQ Response: Now pg.15, Section 2.4.1. subsection 2.4.1.1)*

- “…another storm cell from the northwestern and central (Phoenix-Buckeye) Arizona that merged with the storm cell from southeaster California (Blythe)/Southwestern Arizona in the Laughlin, Nevada/Bullhead City, Arizona area…” (pg. 14) (Now pg. 15, Section 2.4.1, subsection 2.4.1.1- *DAQ Response: Do not agree description to remain as written for clarity purposes.)*
- “…high-wind transported dust from the multiple storm cells in the southwest and the northwest desert areas of Arizona and the outflow boundary that occurred in the northwestern Arizona and southeaster California …” (pg. 77) (*DAQ Response: Now pg.82, Section 2.4.2)*
- “…multiple desert storms in northwestern Arizona and southeastern California” (pg. 78) *(DAQ Response: Now pg.83, Section 2.4.4, First paragraph)*
- “…wind direction was predominantly from the southeast from Blythe/Needles, California to the southwest desert storm cells from Phoenix, Arizona” (pg. 112) *(DAQ Response: Now pg.117, Section 3.0, First paragraph)*
- “…numerous storm cells and outflow boundaries out of southwest Arizona, the Southern California border, and northwestern Arizona…” (pg. 112) *(DAQ Response: Now pg.117, Section 3.1, First paragraph)*
- “…highwind/transported dust from the Laughlin/Bullhead City, Arizona area” (pg. 113) *(DAQ Response: Now pg.117/118, Section 3.1.1, Second paragraph)*

Clark County Response: Overall, Clark County agrees the draft document contains some inconsistencies in describing the source areas throughout. Accordingly, we have implemented EPA’s suggestion to define the source area at the beginning of the document and we illustrate this graphically with Figure 1. The document has been edited throughout to utilize the “source area” designation convention, and specifically addresses the bulletined examples provided by EPA with one exception. This exception, originally contained on Page 14 (Now page 15), pertains to the merger of storm cells from the northwestern and central (Phoenix-Buckeye) Arizona desert with cells from the southeastern California (Blythe)/southwestern Arizona in the Laughlin, Nevada/Bullhead City area. In this instance some of the storm air flows under discussion did not originate from the primary source area, and so the original language is retained.

As noted by EPA, wind data from Arizona was considered in our analysis but not included in the document. *Clark County Response: Accordingly, we have added wind speed data from the Sky Harbor Airport in central Phoenix (Table 4) and Deer Valley Airport (Table 5) located in the northern portion of the Phoenix metropolitan area.*

EPA Comment 2:

Table 1 (pg. 18-*Now page 19*) indicates that Blythe Airport experienced high sustained winds (>25mph) from 00:45-01:24 from the South with the weather type as “Haze” from 00:45-4:52. The second highest wind speed from that day was the first recording at 00:45 and it would be helpful to understand the magnitude of the storm to also include data from the previous hours on July 2nd. Table 2 and Table 3 (pg. 19-20 (*Now pg. 19-21)*, met data from Needles Airport and Bullhead City/Laughlin) indicate no winds above the high wind threshold, however there were a few readings that were close (24mph and 20 mph, respectively) and the wind was still coming from the South (and SSE, SE, SSW) with the timing concurrent with a pattern of the wind coming from Blythe as well as "Haze" for the expected time periods. There may be an error on Table 2, 7/3/2011 5:27AM, ND for wind speed and gust, but a recorded wind direction of "000" and "N" which may be true, but since the primary wind direction for all the surrounding hours is from the South, I suspect this may be ND for the wind direction as well.

Clark County Response: Clark County has added wind data from Needles Airport for July 2, 2011 to Table 1 as requested. The wind direction error identified in Table 2 for the 5:56 a.m. measurement has been corrected.

<u>EPA Comment 3</u>:

Monitors Affected:

Since this is a regional wind event with dust transported from other areas, it would be helpful to see further rationale as to why only 3 of the 8 monitors exceeded. The transported dust did affect all monitors in the area as they all experienced elevated concentrations which followed the same trend throughout the day, which was clearly portrayed in your document. The information about the one unaffected monitor (Jean) is explained clearly that it was not within the path of the storm:

- "Jean, Nevada (CAMS 1019) which was not in the predominant wind and dust flow corridor" (pg. 3-*Now pg. 4*)
- "The orientation of the weak ridge kept most of the suspended dust from reaching the Jean, Nevada, monitoring site and the western portions of the Las Vegas Valley" (Pg. 113 (*Now pg. 120 top*) and 180 (*Now pg. 188*)

Local meteorology may describe the flow on a more micro-scale using the wind data from the monitors available in the area and this analysis would be helpful to identify the reasoning as to why the other monitors did not exceed. The Green Valley monitor is between Boulder City (242 µg/m3) and Sunrise Acres (191 µg/m3), however it experienced a 24-hour concentration of 143 µg/m3, which is 48 µg/m3 less than Sunrise Acres. It does appear from the map that Green Valley is slightly west of a straight line path from Boulder City to Sunrise Acres, but a fuller explanation of the difference would give a better picture.

Clark County Response: Clark County has added discussion on the micro scale topography which influenced the PM_{10} concentrations recorded throughout the Las Vegas Valley. The additional discussion can be found on Pages 4, 15 (new Figure 2), 17, and 210. A mountain ridge is located in close proximity (approximately 2.5 miles) to the east of the Green Valley site and was positioned to divert a significant part of particulate laden airflow into the valley from the southeast away from this site, resulting in lower particulate concentrations than the Sunrise Acres and J.D. Smith sites. This is illustrated in Figure 2, which shows the *predominant dust flow route into the Las Vegas Valley and the locations of the Boulder City, Green Valley and subject mountain ridge, Sunrise Acres, and J.D. Smith monitoring sites. In addition, the general southeast to northeast directionality of the particulate laden airflow that are shown in the HYSPLIT model outputs kept the highest particulate concentrations confined primarily to the east side of the Las Vegas Valley adjacent to the Black Mountains.*

<u>EPA Comment 4</u>:

Issues with the data:

Tables 7-9 (*Now tables 9-11*) and Figure 21(*Now figure 23*) (pg. 42-46) (*Now pg. 47-51*) which are all related to Sunrise Acres is described in one paragraph on page 15 (Now pg.16). Embedded in this paragraph are two sentences about Jerome Mack meteorological data, which is not provided elsewhere within the document.

Clark County Response: Clark County has removed the references to the Jerome Mack meteorological data from the document.

"Table 9 (*Now table 11*) and Figure 21 (*Now figure 22*) show that hourly PM_{10} concentrations increased rapidly, concurrently with the arrival of the transported dust from the Eldorado Valley into the Las Vegas Valley from the Jerome Mack monitoring site direction, most significantly between the hours of 8:00 am and 5:00 pm. Note that Jerome Mack does not monitor particulate matter 10 or 2.5, but has meteorology data." (pg. 15)(*Now pg. 16*)

Clark County Response: Clark County has removed the references to the Jerome Mack meteorological data from the document.

According to Table 9 (*Now table 11*), when the PM_{10} concentration at Sunrise Acres began to spike the wind was from the NW (326 degrees) which is in conflict with the description of winds coming from the south. The following 3 hours, when the PM_{10} continued to increase, winds were either coming from the W, E, or NW (281, 89, 321), all wind directions are in opposition to the statement that the dust came into the area from the south.

Clark County Response: Clark County has removed the wind direction information in Table 11 and other tables throughout the document for wind speeds of < 4mph in accordance with the EPA aerminute user guide. Low microscale wind speeds tend to be variable. Further, QA'd and AQS data has replaced inconsistencies with these data.

According to Table 12 (*Now table 14*), when the PM_{10} concentration at JD Smith began to spike the wind was from the NW (310 degrees) which is in conflict with the description of winds coming from the south. The following 3 hours, when the PM_{10} continued to increase, winds were coming WNW (292, 290, 290) which is in opposition to the statement that the dust came into the area from the south. (*Further, QA'd and AQS data has replaced inconsistencies with these data.)*

Clark County Response: Clark County has removed the wind direction information in Table 14 and other tables throughout the document for wind speeds of < 4mph in accordance with the EPA aerminute user guide. Low microscale wind speeds tend to be variable.

The same overall message from above applies the Green Valley (Table 15) (*Now table 17*), Joe Neal (Table 18) (*Now table 20*), Paul Meyer (Table 21) (*Now table 23*), and Palo Verde (Table24) (*Now table 26*) monitoring sites (pgs. 54, 59, 64, 69) *(Now pgs. 59, 64, 69, 74)* (*Further, QA'd and AQS data has replaced inconsistencies with these data.)*

Clark County Response: Clark County has removed the wind direction information in tables throughout the document for wind speeds of < 4mph in accordance with the EPA aerminute user guide. Low microscale wind speeds tend to be variable.

In looking at the wind speeds, they were low (1-3mph). Generally, when winds are below 3 knots (3.45mph), they are termed calm winds and reporting the wind direction is not appropriate especially considering that the value is an hourly average of vectors and is most likely indicating that there was no primary wind direction when the wind was that still. Reporting these wind direction values are in conflict with the source of the wind into the area and may therefore be misleading. This EPA program indicates winds less than 3 knots (3.45 mph) as "calm winds":

Clark County Response: Clark County has removed the wind direction information in tables throughout the document for wind speeds of < 4mph in accordance with the EPA aerminute user guide. Low microscale wind speeds tend to be variable.

The direction that the wind was coming from for each hourly concentration indicated by the pollution roses provided on Figures 60-65 (*Now figures 61-66*) do not correspond with the wind data provided in the previous tables sited above. (*Further, QA'd and AQS data has replaced inconsistencies with these data.)*

For example:

JD Smith Monitoring site pollution rose indicates that the 646 µg/m3 concentration corresponds with winds coming from the East, when the data in Table 12 (Now table 14) (pg. 49) (*Now pg., 54*) indicates that for that hour, the wind was coming from the west (290 degrees). *(Corrected with AQS and QA'd data and tables, now match)*

Also, for Sunrise Acres, the pollution rose indicates that the 601 µg/m3 concentration came from the east as well, whereas Table 9 (*Now table 11*) (pg. 44) (*Now page 49*) states that for that hour, the wind came from the northwest (321 degrees). *(Corrected with AQS and QA'd data and tables now match)*

- This may not be the issue, but as a note, the convention for pollution roses is to indicate where the wind is coming from. It appears to be the opposite in these pollution and wind roses (*All Fixed*). As for the reliability of the hourly averaged vectors for wind speed, the comment above applies. For calm winds, indicating a wind direction may not be appropriate. Also, the resolution on all the wind/pollutions roses are decent enough to zoom in (electronically) and read except for the Green Valley site (pg.121) (*Now pg. 127*), which cannot be read as it is too pixilated.

Clark County Response: Clark County has removed the wind direction information in tables throughout the document for wind speeds of < 4mph in accordance with the EPA aerminute user guide. In addition, pixilated wind/pollution roses have been enhanced for readability. All data is now presented in 00:00 to 23:00 PST time increments to correct the previous misalignments.

Figures 89-94 (*Now figures 90-95*) (pg. 158-161)(*Now pg. 164-169*) indicate that they represent wind speed from KLAS (McCarran Intl Airport) as well as each monitoring site, totaling 6 figures. The data do not correspond to the data found in the tables previously given.

Clark County Response: Clark County has revised the tables to present all data in 00:00 to 23:00 PST time increments. Further, corrected with AQS and QA'd data and tables now match)

For example:

Figure 89 (*Now figure 90)* (Green Valley) indicates that the sustained wind speed is 10 mph at 10am, where the table indicates that it is 3 mph.

Clark County Response: Clark County has corrected the figure and data. (Further, corrected with AQS and QA'd data and tables now correctly align)

Not only do the data not correspond, but when looking at all 6 figures, 5 of them appear to look identical (Figures 90-94) (*Now 91-95*).

Clark County Response: Clark County has corrected the figures and data. (Further, corrected with AQS and QA'd data and tables now are correctly align)

The data from Table 36 and 37 (*Now tables 38 and 39*) (pg. 162-163) (*Now pgs. 170-171*) are from the JD Smith and Sunrise Acres monitoring sites and McCarran airport. However, data from Sunrise Acres and JD Smith are also given on pages 44 and 49 for July 3rd and the data are different. (*Clark County Response: Clark County has corrected the* tables and *Data with AQS and QA'd data and tables now are correctly align)*

For example:

At 11:00am at JD Smith, Table 12 (*Now table 14*) indicates that the wind speed was 2 mph and the wind direction was 290 degrees and the concentration was 646.49 µg/m3. Table 36, *(Now table 38)* however, states that at 11:00 am, the wind speed was 5 mph, wind direction 116, and the concentration was 672.49 µg/m3. (Incorrect-646.49 concentration, wind speed 8 mph and wind direction is 111 is what Table 38 now has. *(Corrected with AQS and QA'd data and tables now match)*

The first error is simple; the times start at 00:00 in Table 12 (*Now table 14*), whereas they start at 1:00 on Table 36 (Now table 38). However, even if the values are shifted down so that the correct concentrations align, the wind speeds and directions are still significantly different. *(Tables fixed with QA'd and AQS data and tables now match including the differentials)*

Clark County Response: Clark County has removed the wind direction information in tables throughout the document for wind speeds of < 4mph in accordance with the EPA aerminute user guide. In addition, pixilated wind/pollution roses have been enhanced for readability. All data is now presented in 00:00 to 23:00 PST time increments. All PM_{10} concentrations shown in Tables 38 and 39 have been corrected with QA'd and AQS data and now match other tables in the document. During the 17:56 through 19:56 time period, multiple wind speed and direction observations were taken at McCarran Airport during each hour. Tables 38 and 39values reflect an average value for each hour during which multiple readings were recorded at McCarran Airport do to changing wind speeds and directions.

Appendix D

Clark County, Nevada

1. North Las Vegas Airport Visibility Camera Network (CD)
2. Satellite Imagery (CD)
3. MODIS AOD Trajectory (CD)

Appendix D

Clark County, Nevada

1. **North Las Vegas Airport Visibility Camera Network (CD)**

Appendix D

Clark County, Nevada

2. Satellite Imagery (CD)

Appendix D

Clark County, Nevada

3. MODIS AOD Trajectory (CD)