SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

PLANNING, RULE DEVELOPMENT, AND AREA SOURCES

ANALYSIS OF NATURAL EVENTS CONTRIBUTING TO HIGH PM10 CONCENTRATIONS IN THE COACHELLA VALLEY IN 2007

Final Report
April 30, 2009

Author

Kevin R. Durkee
Senior Meteorologist

Reviewed By:

Michael Laybourn, Air Quality Specialist
Tracy A. Goss, P.E., Program Supervisor, PM Strategies
Joseph C. Cassmassi, Planning and Rules Manager
Elaine Chang, Deputy Executive Officer

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ANALYSIS OF NATURAL EVENTS CONTRIBUTING TO HIGH PM10 CONCENTRATIONS IN THE COACHELLA VALLEY IN 2007

1 INTRODUCTION

1.1 Purpose

This document substantiates the request by the South Coast Air Quality Management District (AQMD) to flag two violations of the 150 μg/m^3 PM10 24-hour National Ambient Air Quality Standard (NAAQS) in the Coachella Valley portion of the Salton Sea Air Basin as high-wind natural events under the U.S. Environmental Protection Agency (EPA) Regulation for the Treatment of Data Influenced by Exceptional Events (40 CFR, sections 50.1 & 51.14)[1]. The PM10 NAAQS violations occurred on Thursday, March 22, 2007 (210 μg/m^3) and Friday, April 6, 2007 (157 μg/m^3), both at the AQMD Coachella Valley 2 (Indio) air monitoring station. AQMD has submitted the PM10 data from this monitor on these days to EPA's AQS database and has placed the appropriate flags on the data indicating that the data was affected by exceptional events due to high winds.

1.2 Organization of this Document

This document is designed to provide summary information to the public as well as the specific detailed analyses to meet the requirements of Exceptional Events Rule. Section 1, Introduction, describes the purpose, exceptional event criteria, background of the Exceptional Event Rule and background information related to high wind events in the Coachella Valley, including:

- the geographic setting;
- the regulatory measures, showing that continuing reasonable controls are in effect in the Coachella Valley and that ongoing public education programs and event forecasting and notification plans are in place;
- an overview of high wind events and PM10 in the Coachella Valley:

[1] EPA 2007. Treatment of Data Influenced by Exceptional Events; Final Rule. 40 CFR Parts 50 and 51; Federal Register Vol. 72, No. 55; March 22, 2007. http://www.smartpdf.com/register/2007/Mar/22/13560A.pdf

- the natural blowsand process;
- meteorological mechanisms that influence Coachella Valley windblown PM10; and
- a historical perspective of high-wind PM10 natural events in the Valley.

Sections 2 and 3 of this document describe the analysis of each high wind natural event that occurred in the Coachella Valley in 2007:

- Section 2 – March 22, 2007;
- Section 3 – April 6, 2007.

For each event the Event Summary section summarizes the PM10 measurements and wind conditions that caused the NAAQS violation and documents how the event satisfies the criteria of the Exceptional Events Rule, that is,

- Affects Air Quality;
- Is Not Reasonable Controllable or Preventable; and
- Was a Natural Event.

Further discussion in the Event Summary will summarize:

- the causal connection between the high wind event and the measured PM10;
- how the measured concentration was in excess of the normal historical fluctuations, including background;
- how there would have been no exceedance "but for" the high wind event (the "But For" Test);
- that reasonable measures to control fugitive dust were in effect on the event day and how a public notification and education process was implemented to warn the public before and during the event through forecasts, advisories and real-time air quality data.

Following the Event Summary section, the Detailed Event Analysis describes the detailed meteorological analysis that led to the conclusions presented in the Event Summary section, including:

- a summary of the PM measurements;
- the synoptic meteorological setting;
- analysis of windblown dust and source influences;
- conclusions.

Supporting weather observations, documents and satellite imagery for the March 22, 2007 PM10 event analysis beyond what is included in the main document are provided in a separate Appendix.

1.3 Exceptional Event Criteria

The two events documented herein satisfy the criteria set forth in 40 CFR 50.1(j), which defines an exceptional event as an event that:

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

1.4 Exceptional Events Rule Background

Since 1977 the United States Environmental Protection Agency (EPA) has implemented policies to address the treatment of ambient air quality monitoring data that has been affected by exceptional or natural events. In 1996, EPA developed a guidance document entitled Areas Affected by PM-10 Natural Events, which provided criteria and procedures for States to request special treatment (i.e., flagging for exclusion from standard compliance consideration) for data affected by natural events (e.g., wildfire, high wind events, and volcanic and seismic activities). Since 1995, EPA has approved several requests made by the South Coast Air Quality Management District (AQMD) through the California Air Resources Board (CARB) to apply the Natural Events Policy in order to flag violations of the 24-Hour PM10 NAAQS in the Coachella Valley for natural events that involved uncontrollable high winds. Air quality has continued to improve through implementation of best available control technologies, required by AQMD rules and local government ordinances. AQMD also protects the public through the issuance of area-specific air quality forecasts and episode notifications, as well as daily high-wind and windblown dust forecasts and advisories for the Coachella Valley.

On March 14, 2007, EPA promulgated a formal rule, entitled: *The Treatment of Data Influenced by Exceptional Events*, known as the Exceptional Events Rule. Exceptional events are unusual or naturally occurring events that can affect air quality but are not reasonably controllable or preventable using techniques that tribal, state or local air agencies may implement in order to attain and maintain the NAAQS. These events are flagged in the EPA AIR Quality Subsystem (AQS) database as exceptional events. The data remains available to the public but are not counted toward attainment status. The EPA rulemaking:

- ensures that air quality measurements are properly evaluated and characterized with regard to their causes;

- identifies reasonable actions that should be taken to address the air quality and public health impacts caused by these types of events;
- avoids imposing unreasonable planning requirements on state, local and tribal air quality agencies related to violations of the NAAQS due to exceptional events;
- ensures that the use of air quality data, whether afforded special treatment or not, is subject to full public disclosure and review.

1.5 Geographic Setting

Southern California's Coachella Valley, shown in Figure 1-1, consists of approximately 2,500 square miles in central Riverside County, aligned northwest-southeast from the San Gorgonio Pass (often referred to as the Banning Pass) to the Salton Sea and bounded by the Little San Bernardino Mountains to the northeast and the San Jacinto Mountains to the southwest. The Santa Rosa Mountains are to the west of the northern part of the Salton Sea. The Coachella Valley is part of the Salton Sea Air Basin, under the jurisdiction of the South Coast Air Quality Management District (AQMD). The AQMD air quality monitoring stations in the Coachella Valley are located at Palm Springs and Indio. The nearest South Coast Air Basin station to the Coachella Valley is located at Banning Airport in the San Gorgonio Pass to the west of the Coachella Valley.

Figure 1-2 shows a broader view around the Coachella Valley to show the desert areas of southern California and stations used in the analysis of windblown dust due to thunderstorm activity in the southwestern deserts of the United States. Figure 1-3 shows the Coachella Valley with sand areas mapped along with the Coachella Valley Preserve system that are undisturbed for ecological purposes, such as the Fringe-Toed Lizard habitat. The sand areas along the Whitewater Wash to the north of Palm Springs and the preserve system are the main source areas for natural blowsand in the Coachella Valley. The urban sprawl has covered much of the former sand areas from Palm Springs down the Valley to Indio.

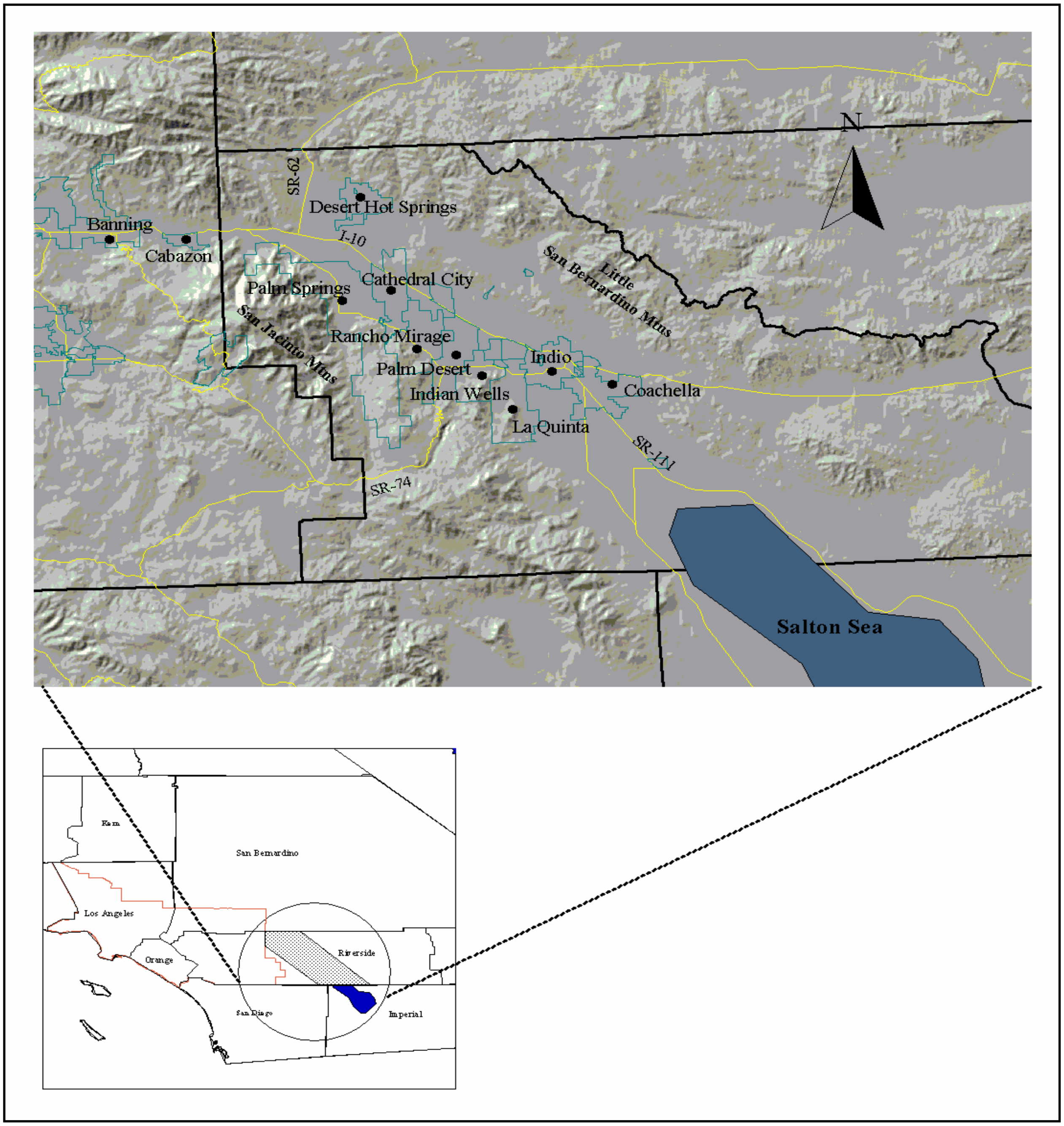


FIGURE 1-1

Location and Topography of the Coachella Valley

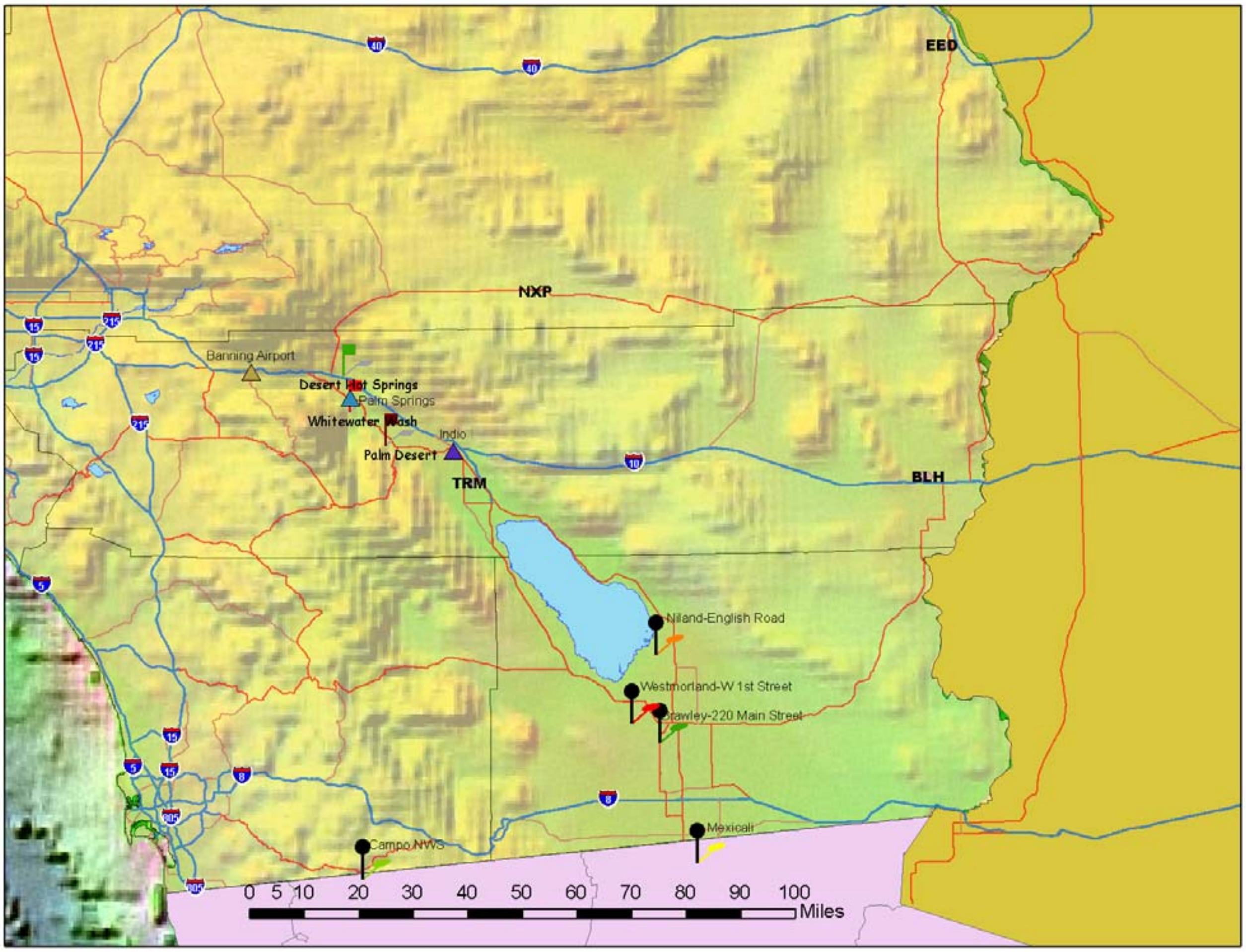


FIGURE 1-2

Map of Southern California Desert Areas Showing AQMD Air Quality Monitoring Stations (triangles), AQMD Coachella Valley Wind Network (flags), Imperial County Air Quality Monitoring Stations (circles), and NWS/FAA Airport Weather Stations
(TRM = Thermal Airport; BLH = Blythe Airport; EED = Needles Airport; NXP = Twentynine Palms MCAS; and PSP, not shown, is between the Palm Springs Air Monitoring Station and the Whitewater Wash Wind Station)

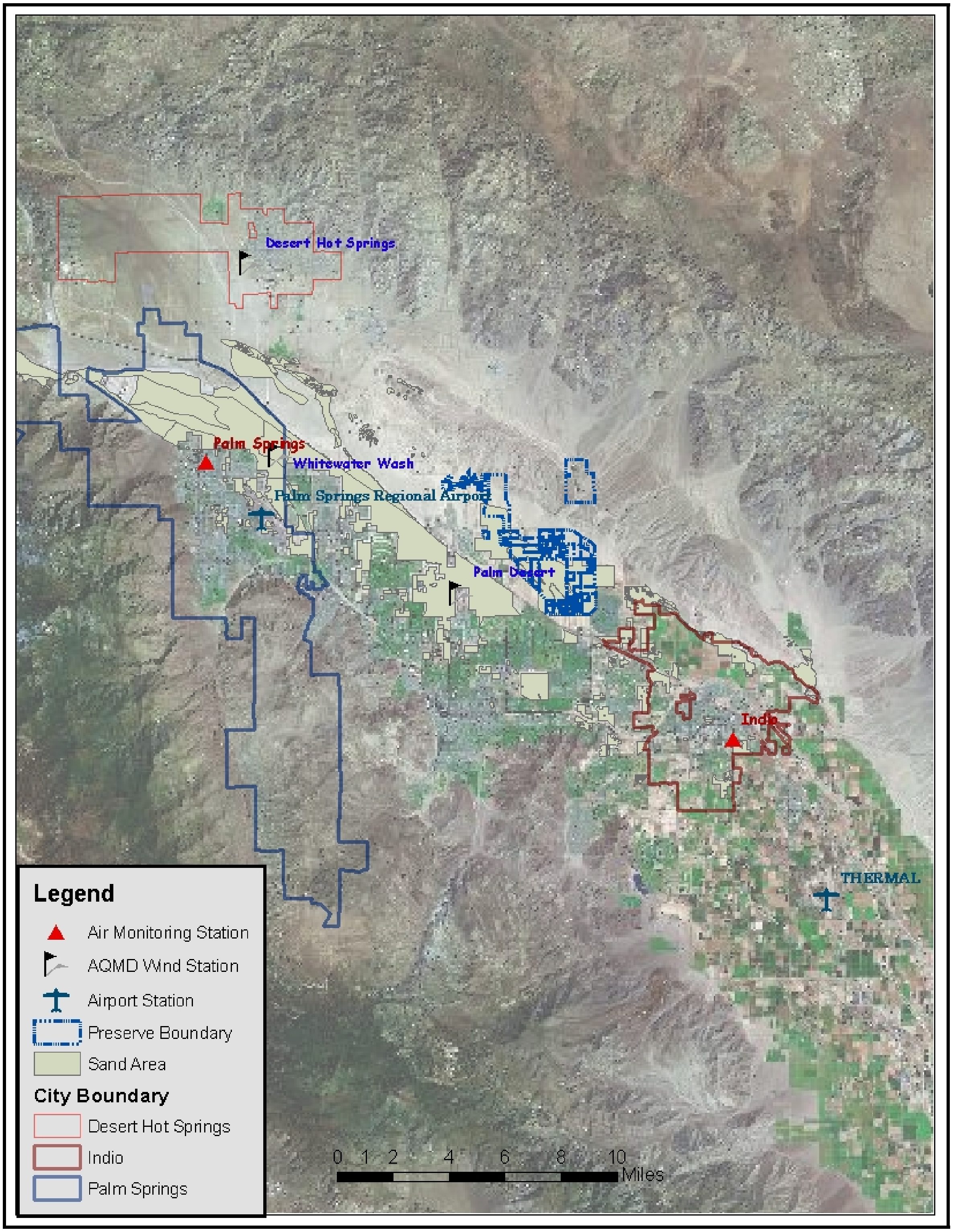


FIGURE 1-3

Map of Coachella Valley Showing Desert Sand Areas; Protected, Natural Preserve Areas; AQMD Air Quality Monitoring Stations (triangles); AQMD Coachella Valley Wind Network (flags); and NWS/FAA Airport Weather Stations

1.6 Regulatory Measures

AQMD has implemented regulatory measures to control emissions from fugitive dust sources in both the South Coast Air Basin and the Coachella Valley. Implementation of Best Available Control Measures (BACM) in the Coachella Valley has been carried out through dust control ordinances adopted by the local jurisdictions, along with AQMD Rules 403 (Fugitive Dust) and 403.1 (Supplemental Fugitive Dust Control Requirements for Coachella Valley Sources) serving as backstop regulations for the Valley's construction and agricultural activities. With its approvals of the South Coast and Coachella Valley PM10 Attainment Plans, EPA has concluded that this control strategy represented BACM and Most Stringent Measures (MSM) for each significant source category, and that the implementation schedule was as expeditious as practicable.[2,3]

The local dust control ordinances developed by Riverside County, Cathedral City, Coachella, Desert Hot Springs, Indian Wells, Indio, La Quinta, Palm Desert, Palm Springs and Rancho Mirage are based on a model fugitive dust control ordinance developed by the Coachella Valley Association of Governments (CVAG), local governments and the SCAQMD. The ordinances typically require: (1) Dust control plans for each construction project needing a grading permit; (2) plans to pave or chemically treat unpaved surfaces if daily vehicle trips exceed 150; (3) imposition of 15 mph speed limits for unpaved surfaces if daily vehicle trips do not exceed 150; (4) paving or chemical treatment of unpaved parking lots; and (5) actions to discourage use of unimproved property by off-highway vehicles.

AQMD Rule 403, Fugitive Dust, helps to establish performance criteria for the local dust ordinances and also serves as a backstop rule for the Valley. The Rule establishes best available fugitive dust control measures to reduce fugitive dust emissions associated with agricultural operations, construction/demolition activities (including grading, excavation, loading, crushing, cutting, planing, shaping or ground breaking), earth-moving activities, track-out of bulk material onto public paved roadways, and open storage piles or disturbed surface areas.

AQMD Rule 403.1, Supplemental Fugitive Dust Control Requirements for Coachella Valley Sources, establishes dust control requirements under high wind conditions in the Valley. The Rule consists of additional fugitive dust measures for agriculture, abandoned disturbed surface areas, and bulk material deposits entrained by high winds within the Valley.

---

[2] 40 CFR Parts 52 and 81, Federal Register Vol. 67, No. 242, December 17, 2002, 77204-77212, http://frwebgate4.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=901786489055+3+2+0&WAISaction=retrieve;

[3] CFR Part 52, Federal Register Vol. 70, No. 218, November 14, 2005, 69081-69085, http://frwebgate4.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=900986476034+3+2+0&WAISaction=retrieve

AQMD Rule 1186, PM10 Emissions from Paved and Unpaved Roads and Livestock Operations, requires rapid removal of paved road dust accumulations and establishes street sweeper procurement standards (including PM10-efficient sweepers), and design standards for new road construction. AQMD Rule 1186.1, Less-Polluting Sweepers, requires procurement of alternative-fueled equipment when governmental agencies replace street sweepers.

AQMD Rule 444, Open Burning, ensures that open burning is conducted in a manner that minimizes emissions and impacts, and that smoke is managed to protect public health and safety. This rule requires authorization for agricultural and prescribed fire, limited to days that are predicted to be meteorologically conducive to smoke dispersion and that will not contribute to air quality that is unhealthy for sensitive groups or worse. It also prohibits most waste burning and all residential burning.

1.7 High-Wind Events and PM10 in the Coachella Valley

Blowsand

In the Coachella Valley, there is a natural sand migration, called the blowsand process, caused by the action of winds on the vast areas of sand. This process produces PM10 in two ways: (1) by direct particle erosion and fragmentation (natural PM10), and (2) by secondary effects, as sand deposits on road surfaces are ground into PM10 by moving vehicles and resuspended in the air (anthropogenic PM10). Although the sand migration progress is somewhat disrupted by urban growth in the valley, the overall region of blowsand activity encompasses approximately 130 square miles extending from near Cabazon to Indio. The sand is supplied by weather erosion of the surrounding mountains and foothills. Transporting winds emanate from the San Gorgonio Pass and occur most frequently and with the greatest intensity during the spring and early summer months. The primary blowsand source areas, mainly in the alluvial floodplain of the Whitewater River (i.e., the Whitewater Wash), presently contain over two billion cubic yards of wind-deposited sand. The blowsand process varies considerably over time, depending on the availability of flood-provided sand, fluctuations in the transporting wind regime, and to a lesser extent, changes in vegetative cover within the Valley. On average, 180,000 cubic yards of sand are transported by wind sources annually.[4] The California desert areas to the east and south of the Coachella Valley, as well as desert areas of northern Mexico, Arizona and Nevada, also have significant natural processes that produce windblown PM10. In particular, high winds associated with gust fronts

[4] Weaver, Donald, Initial Blowsand Study for the Coachella Valley, October 1992. Included as Appendix A to the Coachella Valley PM10 Attainment Redesignation Request and Maintenance Plan, SCAQMD, December, 1996. http://www.aqmd.gov/aqmp/cvves/#download

from thunderstorms over the deserts of the southwestern US create windblown dust that is entrained in the atmosphere and transported to the Coachella Valley, under flow regimes from the east and south.

Meteorological Mechanisms for Coachella Valley High-Wind PM10 Events

For high PM10 events to occur in the Coachella Valley, widespread high winds must be sustained to suspend and transport the blowsand. These exceptional wind events occur infrequently in the Coachella Valley but are likely to be associated with unhealthful PM10 levels due to windblown dust. The strongest and most persistent winds typically occur immediately east of Banning Pass, in an area used primarily for wind power generation. Wind conditions in the remainder of the Coachella Valley are geographically distinct, with stronger winds in the open, middle portion of the valley and lighter winds closer to the foothills. Further to the southeast near Indio where the valley widens, wind velocities decrease. The lower wind velocities allow more deposition of the entrained particles to the surface in this area.

Three primary meteorological mechanisms were initially identified that lead to high winds and windblown dust in the Coachella Valley[5]. A relatively rare additional mechanism was identified in 2004. The four mechanisms are summarized as follows:

1. Strong pressure and density gradients between the marine-modified coastal air mass and the desert air mass;
2. Storm system/frontal passages (mainly associated with winter storms);
3. Strong downbursts and gust fronts from thunderstorm activity (mainly summertime);
4. Strong Santa Ana wind event (mainly in fall or early winter).

In Type 1 high-wind events, low surface pressures in the desert cause cooler and denser ocean-modified air to move through the San Gorgonio Pass into the Coachella Valley. As synoptic weather patterns reinforce the localized regime through wind-inducing surface pressure gradients, strong and widespread winds result that frequently exceed 30 mph. These winds can persist for many hours and are predominantly from the west-northwest. Type 1 events are most prevalent in the spring, but can occur at other times of the year.

In Type 2 events, the passage of storm systems can similarly induce strong winds through the San Gorgonio Pass, as frontal passages cause surface wind shifts (wind shear) and speed increases that can be reinforced by strong winds aloft. These storm

[5] Durkee, K.R. The EPA Natural Events Policy as Applied to High-Wind PM10 Exceedances in the Coachella Valley. Proceedings of the Air and Waste Management Assn. Annual Meeting, June 1998.

passages often produce little or no precipitation in the Coachella Valley. The winds typically last only a few hours and are most prevalent with dynamic, fast-moving winter storms.

Type 3 wind events involve strong winds generated by summertime thunderstorms. The convective activity produces strong downdrafts of cooler air, causing wind gusts that can exceed 60 mph. While the thunderstorms are usually localized events of short duration, the associated downbursts and outflows can suspend large amounts of natural desert soil in the atmosphere that can be transported over large distances, even though the gustiness subsides. Also, numerous thunderstorm cells can form thunderstorm complexes over the southwestern US deserts to produce widespread areas of windblown dust and complicated wind flows. The entrained dust can be deeply suspended to transport dust to the Coachella Valley from the Southern California deserts and areas of Mexico, Arizona and Nevada, even under relatively weak local wind regimes in the Coachella Valley. The typical weather pattern for producing such thunderstorms in the southwestern US and transport to the Coachella Valley is one in which tropical moisture is advected (transported) into the deserts from the south and southeast. Therefore, these Type 3 events are most often associated with the mid- to late-summer "monsoonal" conditions that bring light southeasterly winds to the Coachella Valley.

Type 4 wind events involve very strong Santa Ana wind events where high pressure and cold temperatures over the Great Basin causes strong northerly or north-northeasterly winds that accelerate downhill on the lee side of the San Bernardino Mountains. These relatively uncommon events move blowsand from the Morongo Valley and can cause very high PM10 concentrations at the Palm Springs air monitoring station, as well as at the Indio station. These strong Santa Ana wind events mainly occur in fall or early winter.

Historical Perspective

Table 1-1 summarizes the days with high PM10 in the Coachella Valley, defined as days exceeding 150 $\mu g/m^3$, between January 1, 1993 and December 31, 2008. The start year of 1993 was the beginning of the period considered when the EPA Natural Events policy was first implemented. The NAAQS violations, with PM10 exceeding 150 $\mu g/m^3$, that occurred during this period have been subject to previous natural events evaluations. Since 1993, no 24-hour NAAQS violations occurred in the Coachella Valley that were not associated with high wind events. Three days are shown in Table 1-1 that are close to 150 $\mu g/m^3$, but did not exceed the 24-hour PM10 standard. These three high values were also due to high wind natural events, but were not allowed to be submitted due to the EPA policy at the time requiring that the 24-hour short-term standard be exceeded to quality for flagging.

TABLE 1-1

Historical Summary of Coachella Valley SSI PM10 24-HourHigh Concentrations exceeding 150 μg/m³ since January 1, 1993 along with primary meteorological mechanisms associated with high-wind natural events

Event Date	Indio SSI PM10 (μg/m³)	Palm Springs SSI PM10 (μg/m³)	Meteorological Mechanism
June 2, 1995	**199**	39	1
January 16, 1996	**155**	88	2
July 26, 1996	**215**	130	3
March 17, 1997	**157**	35	2
April 28, 1997	**182**	32	1
June 16, 1998	**158**	53	1
April 21, 2000	**190**	*	1
May 15, 2000	**201**	*	2
September 21, 2000	**183**	*	1
June 3, 2001	**245**	*	1
June 12, 2001	**180**	*	1
July 3, 2001	**155**	*	3
August 17, 2001+++	**604**	**432**	3
August 20, 2001	149+	*	1
September 13, 2001	**165**	*	3
May 8, 2002	**177**	**	1
November 25, 2002	**276**	*	4
January 6, 2003	**178**	*	4
May 15, 2003	**227**	47	1
June 20, 2003	148++	28	1
June 23, 2003	**309**	*	1
October 9, 2004	**161**	*	2
July 16, 2006	**313**	**226**	3
March 22, 2007	**210**	*	3
April 6, 2007	**157**	64	1
April 12, 2007	146++	83	2

+ High PM10 concentration below PM10 24-hour NAAQS; submitted but not approved for natural event flagging (EPA Region 9 policy at the time).

++ High PM10 concentration below 150 μg/m³ 24-hour NAAQS; not submitted for natural event flagging.

+++ On August 17, 2001 Banning Airport also measured 219 μg/m³.

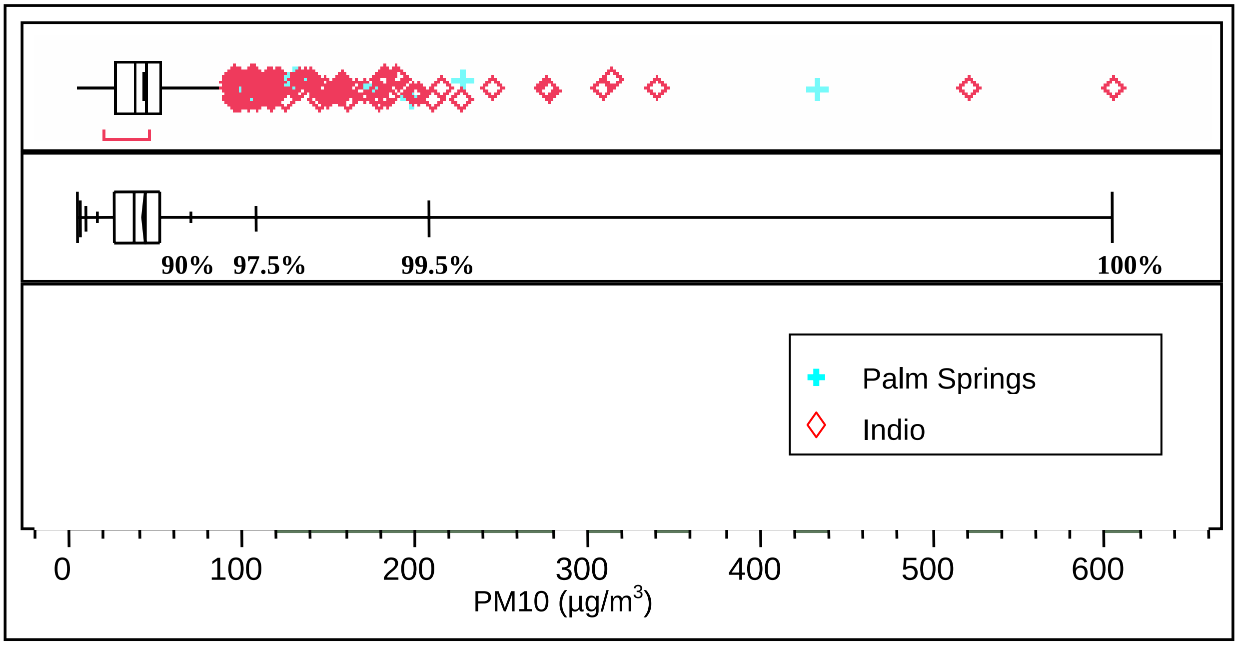
* 1-in-3 sampling day for Indio; no Palm Springs 1-in-6 day sample.

** 1-in-6 sampling day for Palm Springs, but sample did not run.

Throughout the 16 year period, 23 days exceeded the 150 μg/m³ NAAQS concentration at Indio, for an overall average of just under 1.5 violations per year. A total of 34 days exceeded the 120 μg/m³ threshold at Indio, all associated with high wind natural events. Starting March 22, 2000, the frequency of SSI samples at Indio was increased to every three days to better capture the windblown dust events that occur in the Coachella Valley. During the nine years with 1-in-3-day data, 17 days exceeded the 24-hour PM10 NAAQS, for an average of 1.9 violations per year. In all cases, Indio had higher PM10 concentrations than Palm Springs, on the 1-in-6 sampling days when data was available from both stations. Palm Springs only exceeded the NAAQS on two days and only exceeded 120 $\mu g/m^3$ on one additional day during this period.

On 12 of the 24 days that exceeded 150 $\mu g/m^3$, Type 1 mechanisms were the primary cause of the high winds and windblown PM10. On these days, strong onshore flow and a deep marine layer over the South Coast Air Basin led to winds through the San Gorgonio Pass, suspending sand from the natural blowsand source areas. Due to the geography of the Coachella Valley, this mechanism does not cause high PM10 at Palm Springs, which is sheltered from these flows by the San Jacinto mountains. Four days during this period were primarily caused by Type 2 mechanisms, where fast-moving storm systems and frontal passages created strong winds through the San Gorgonio Pass. The Type 3 mechanism, where thunderstorm outflows created strong winds in the desert, caused six high PM10 days, including the highest 24-hour average PM10 (604 $\mu g/m^3$) measured in the Coachella Valley during this period. Dust generated from thunderstorm outflows was responsible for all three high PM10 concentrations measured at Palm Springs, as relatively light southeasterly "monsoonal" wind flows brought dust generated from thunderstorm outflows over the deserts of northern Mexico and Arizona to the entire Coachella Valley. Two events were associated with the Type 4 mechanism, where strong Santa Ana winds brought high winds to the Coachella Valley, entraining dust from the Morongo Valley.

Figure 1-4 shows the distribution of all Federal Reference Method (FRM) Size-Selective Inlet (SSI) PM10 measurements at the Coachella Valley air monitoring stations (Indio and Palms Springs) from January 1990 through June 2008. The plotted values for Indio and Palms Springs are considered statistical outliers. Concentrations above the 97.5 percentile value (108 $\mu g/m^3$ and above) are above the normal range of data for the Coachella Valley and any value that exceeds the 24-hour federal PM10 standard of 150 $\mu g/m^3$ is well outside the normal range. As was shown in Table 1-1, all concentrations exceeding the federal PM10 standard in the Coachella Valley since January 1, 1993 have been attributed to high wind events. Furthermore, PM10 sulfate and nitrate measurements on high PM10 days in the Coachella Valley are low, as compared to such measurements in the South Coast Air Basin, indicating primarily crustal material contributing to PM10 and minimal transport from urban areas.



Quantiles		PM10 (µg/m³)
100.0%	maximum	604.00
99.5%		208.96
97.5%		108.00
90.0%		70.00
75.0%	quartile	53.00
50.0%	median	38.00
25.0%	quartile	26.00
10.0%		16.00
2.5%		9.00
0.5%		6.12
0.0%	minimum	4.00

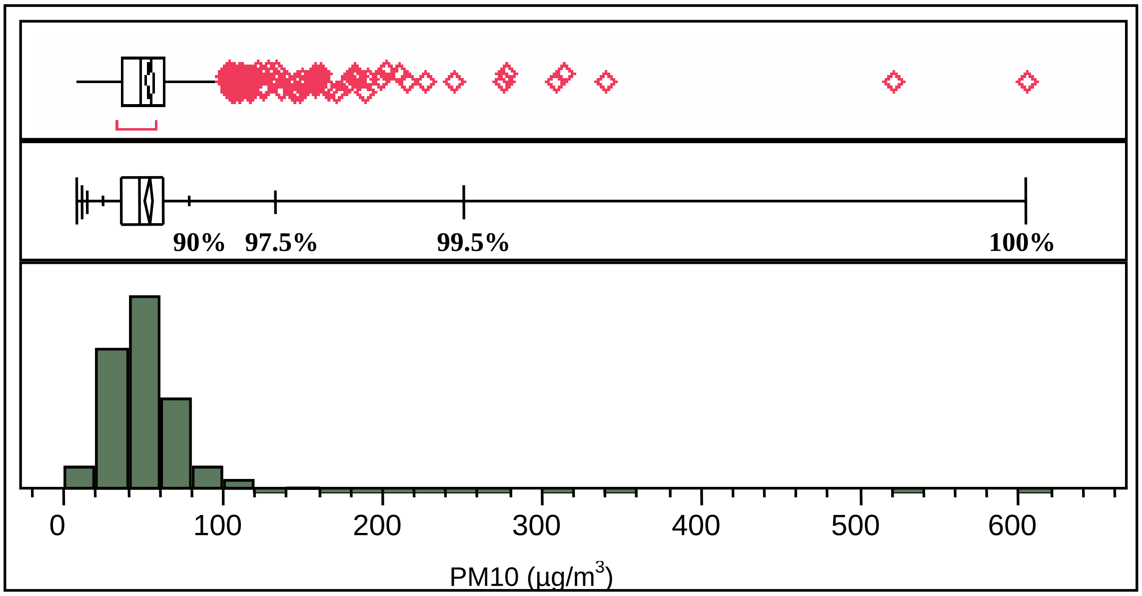
Moments	PM10 (µg/m³)
Mean	43.331426
Std Dev	32.76256
Std Err Mean	0.6398254
upper 95% Mean	44.586041
lower 95% Mean	42.076812
N	2622

FIGURE 1-4

Distribution of SSI PM10 Concentrations at Indio and Palm Springs from January 1990 through June 2008

(Diamond and plus sign symbols show statistically outlying PM10 concentrations for Indio and Palm Springs, respectively.)

Figure 1-5 shows the distribution of all FRM SSI PM10 measurements from the Indio air monitoring station alone, from January 1990 through June 2008. The plotted concentrations for Indio are considered statistical outliers. Concentration above the 97.5 percentile value (132 $\mu g/m^3$ and above) are outside the normal range of the data. Therefore any value that exceeds the 24-hour federal PM10 standard of 150 $\mu g/m^3$ is clearly outside the normal range of data for Indio.



Quantiles		PM10 (µg/m^3)
100.0%	maximum	604.00
99.5%		251.20
97.5%		132.00
90.0%		79.00
75.0%	quartile	62.00
50.0%	median	48.00
25.0%	quartile	36.00
10.0%		25.00
2.5%		15.00
0.5%		11.00
0.0%	minimum	8.00

Moments	PM10 (µg/m^3)
Mean	53.130853
Std Dev	35.479182
Std Err Mean	0.8985672
upper 95% Mean	54.893382
lower 95% Mean	51.368325
N	1559

FIGURE 1-5

Distribution of SSI PM10 Concentrations
at Indio from January 1990 through June 2008
(Diamond symbols show statistically outlying Indio PM10 concentrations.)

1.8 Coachella Valley PM10 Natural Events Action Plan (NEAP)

In December 1996 AQMD adopted a Natural Events Action Plan (NEAP)[6] for the Coachella Valley, as required under the EPA Natural Events Policy, to address PM10 events by:

- establishing public notification and education programs;
- minimizing public exposure to high concentrations of PM10 due to natural events;
- abating or minimizing appropriate controllable sources of PM10;
- identifying, studying and implementing practical mitigating measures as necessary; and
- periodically reevaluating: (a) the conditions causing violations of the PM10 NAAQS in the area, (b) the status of implementation of the NEAP, and (c) the adequacy of the actions being implemented.

While not specifically required by the new Exceptional Events Regulation, the Coachella Valley NEAP remains a blueprint for warning and educating the public about PM10 events and health-protective actions, as well as for minimizing the effects of high wind PM10 events through the use of appropriate mitigation measures. The NEAP was developed in conjunction with stakeholders affected by the plan, including the Coachella Valley Association of Governments, Coachella Valley local municipalities, business and community leaders, the building industry, farm associations, the news media and the public. Public education and outreach to information about the health impacts, AQMD PM10 regulatory activities, and ways to minimize exposure to PM10 are accomplished through public meetings, distribution of pamphlets and dust advisory information, press releases, web-based and telephone-based information and forecasts, and public outreach by AQMD Inspectors and other staff.

Through the efforts defined by the NEAP, local ordinances were developed for the mitigation of windblown dust and AQMD Rules 403 and 403.1 have been strengthened. The NEAP provides for public notification of ambient PM10 levels. This is accomplished through the availability of current ambient PM measurements and Air Quality Index (AQI) by telephone (AQMD Interactive Voice Response System) and web-based services (AQMD, ARB and EPA AirNow web sites). AQMD air quality forecasts, high wind day forecasts and windblown dust advisories are available to the public by email (AQMD and EPA EnviroFlash), web (AQMD and AirNow sites), and telephone services (AQMD IVR System and daily recorded forecast messages).

Under the requirements of AQMD Rule 403.1 certain activities in the Coachella Valley are required to determine wind conditions and, in some cases, alter their activity plans

[6] Coachella Valley PM10 Attainment Redesignation Request and Maintenance Plan, Chapter 6, SCAQMD, December, 1996. http://www.aqmd.gov/aqmp/cvves/#download

during high wind conditions. In support of this rule, AQMD has a daily wind forecasting system that determines when wind conditions are expected to be greater than 25 mph in the Coachella Valley. During forecasted dust advisories, where PM10 is expected to exceed 150 $\mu g/m^3$ in the Coachella Valley, everyone is encouraged to limit outdoor exertion and people with respiratory ailments are encouraged to avoid outdoor exertion. The wind and windblown dust forecasts are based on current and predicted pressure gradients, weather conditions such as approaching storms, fronts or thunderstorms, and predictions, watches, warnings or advisories of high winds, blowing dust, or thunderstorm activity as obtained through the National Weather Service and other sources.

2 HIGH-WIND NATURAL EVENT ANALYSIS: March 22, 2007

2.1 Event Summary

March 22, 2007 PM10 Exceptional Event at the Indio Station

A violation of the PM10 NAAQS was recorded in the Coachella Valley at the Indio air monitoring station on March 22, 2007, with a 24-hour PM10 mass concentration of 210 $\mu g/m^3$. This event meets the criteria for natural events as defined in the EPA Exceptional Events Rule. Thunderstorm activity over the southern California deserts and Arizona, caused strong downdraft winds and windblown dust. This event is rather complex, with winds generated from a series of fast-moving thunderstorms over the open desert as an upper level low pressure system moved through. Windblown dust sources include natural source areas, BACM-controlled anthropogenic areas and likely some contribution from the deserts of Arizona. In Arizona, the Pinal County Air Quality Control District (PCAQCD) recorded two NAAQS violations on March 21. These PCAQCD violations were reported to be caused by high wind natural events associated with the upper level low pressure system and surface front, causing winds in excess of 25 mph in the evening of March 21. This material contributed to the PM10 measured at Indio on March 22, under an easterly overall flow regime along with additional dust generated by the thunderstorm activity across the Arizona and southeastern California deserts through the afternoon of March 22.

Wind speeds measured at Blythe Airport reached 31 mph sustained, with 43 mph gusts, from thunderstorms that were observed from this location just before noon (Pacific Standard Time) on March 22. Little rain was associated with the thunderstorm activity in California on this day; more significant rainfall was recorded in parts of Arizona. As these thunderstorms progressed toward the Coachella Valley, reports of windblown sand and dust were issued by the National Weather Service and the California Highway Patrol for the open desert areas between Blythe and Indio, as documented in the Detailed Event Analysis (Section 2.2).

The timing of the this event is verified with the hourly BAM data in conjunction with the windblown dust reports and high-wind observations, as well as satellite imagery of the thunderstorm activity. The thunderstorms entrained sand and dust with downdraft winds as they moved through the desert. In just over three hours after the peak gusts were measured at Blythe, the thunderstorm activity had progressed across the desert, reaching the Coachella Valley and causing wind gusts to 43 mph measured at Thermal Airport near the time of the peak BAM PM10 at Indio, as is shown in Figure 2-19. This timing is consistent with the motion of the thunderstorms, reported to be approximately 25 mph toward the west by the National Weather Service from Doppler Radar analysis. Winds in the northern part of the Coachella Valley, from Indio north, were not as strong as those measured to the south and east. The one-minute averaged winds at Indio peaked at 24 mph, indicating that localized windblown PM10 at the Indio station was not as significant as that generated in the desert areas.

The gust front and thunderstorm activity continued to progress toward the west, across the mountains west of the Coachella Valley. The severe weather continued into San Diego County where 35 mph thunderstorm winds were reported as a factor in the capsizing of a boat on Lake Henshaw in the Cleveland National Forest at 1530 PST (NCDC Event Record). Sporadic thunderstorm activity continued between Blythe and the southern Coachella Valley until the evening of March 22 when the gusty winds subsided and the hourly PM10 concentrations returned to background levels. Easterly transport flow throughout the day within the first 3000 feet of the atmosphere was confirmed by the hourly time-height plot of winds (Figure 2-20) from the AQMD Moreno Valley radar wind profiler, the nearest upper air station to the Coachella Valley. With overall wind flows from the east, backward trajectory analyses using the NOAA HYSPLIT Model with the NCEP North American Model (NAM) meteorological fields (Figure 2-21) confirm that the source of the PM10 was primarily the open deserts east of Indio. With the weight of evidence provided, AQMD concludes that the PM10 exceedance would not have occurred without the high winds and wind-entrained dust.

Flagging of Data

AQMD has submitted the PM10 data from this monitor to the EPA AQS database and has placed the appropriate flags on the data indicating that the data was affected by an exceptional event due to high winds (Flag RJ, requesting exclusion due to high winds). Such flagging ensures that the air quality data is properly represented in the overall air quality process.

Exceptional Event Criteria Summary

40 CFR 50.1(j) of the Exceptional Events Regulation defines an exceptional event as an event that:

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

The following sections describe how the first three criteria are met for the March 22, 2007 natural event at Indio.

Affects Air Quality

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

The documentation provided herein for the March 22, 2007 natural event at Indio provides the required information to establish a causal connection between the high winds from thunderstorm activity in the desert and the high concentration measured at the Indio monitor. The measured 24-hour PM10 concentration of 210 $\mu g/m^3$ at Indio shows that air quality was affected. Concentrations were low on the days before and after the high wind event, as is shown in Table 2-2. The hourly PM10 concentrations increased rapidly as the windblown dust generated from the thunderstorm outflows reached the Indio monitor, as is shown in Figure 2-20. As was shown previously in Section 1.7, in over 16 years of analyzed data such high concentrations are not reached in the Coachella Valley except when caused by high winds. Section 2.2, Detailed Event Analysis, includes meteorological data showing a clear correlation between strong, gusty winds in the desert and increasing hourly PM10 at the Indio station. The documentation also includes available National Weather Service (NWS) warning and forecasts of high winds and windblown dust, related California Highway Patrol (CHP) weather logs, and National Climatic Data Center (NCDC) storm event record reports. The measured exceedance on March 22, 2007 is in excess of normal fluctuations, as is discussed further below.

Is Not Reasonably Controllable or Preventable

This requirement is met by demonstrating that despite reasonable and appropriate measures in place, the March 22, 2007 wind event caused the exceedance. During this event, there were no other unusual dust-producing activities occurring in the Coachella Valley and anthropogenic emissions were approximately constant before, during and after the event. In addition, reasonable and appropriate measures were in place, as has been described in Section 1.6, Regulatory Measures. A Rule 403.1 High Wind Day forecast was issued by AQMD on both March 21 and 22, requiring curtailment of dust-producing agricultural and construction activities and the increased use of mitigation measures on disturbed soil. On March 22, PM10 sulfate and nitrate measurements at Indio, as well as PM2.5 measurements at Indio and Palm Springs were low, indicating primarily crustal material comprising the PM10 mass, not transported or locally generated urban pollution.

A survey of the available complaint records and inspection reports indicated no evidence of unusual emissions on March 22, 2007, other than the windblown dust event. Based on a review of the AQMD CLean Air Support System (CLASS) database for complaints and compliance actions, there were no complaints, notices of violation or notices to comply issued for dust-related events on March 22, 2007 in or around the Coachella Valley. Smoke from wildfires, agricultural or residential burning did not appear to have added any significant amount of PM10 to the concentration recorded at Indio. PM10 could have been emitted from some BACM-controlled sources (mainly agricultural and construction activities) as BACM controls were likely locally overwhelmed by the high winds. Due to the AQMD High Wind Day forecasts issued for March 21 and 22, dirt moving construction and agricultural operations were minimal in the Coachella Valley on this day. The primary source of the windblown dust on March 22 was the natural open desert areas that were most impacted by the natural event.

Was a Natural Event

Under the Exceptional Event Rule, ambient particulate matter concentrations due to dust being raised by unusually high winds will be treated as due to uncontrollable natural events where (1) the dust originated from non-anthropogenic sources; or (2) the dust originated from anthropogenic sources within the State that are determined to be reasonable well controlled at the time the event occurred; or (3) from anthropogenic sources outside the State. Based on previous analyses of windblown dust in the Coachella Valley, wind gusts over 22 mph are sufficient to entrain windblown dust in the atmosphere. In the preamble to the Exceptional Events Rule, EPA also explains states must provide appropriate documentation to substantiate why the level of wind speed associated with the event in question should be considered unusual for the affected area during the time of year that the event occurred. On average, the conditions that lead to high wind natural events in the Coachella Valley, including strong winds and dry soil-moisture conditions, occur only two to three times per year. EPA also notes in the Exceptional Event Rule that natural events (e.g., high winds, wildfires, etc.) may recur, sometimes frequently. The event on

March 22 was a natural event in which human activity played little or no direct causal role.

On March 22, 2007, the wind entrained dust originated primarily from non-anthropogenic natural sources within California, i.e., primarily from open desert areas. A portion of the wind-entrained dust may have also originated from anthropogenic sources, including some agricultural operations and construction activities, that are well controlled in the Coachella Valley as described in Section 1.6, Regulatory Measures. Given the scale and severity of the widespread thunderstorm activity in this case over Southern California, Arizona, Nevada, and Mexico, some wind entrained dust may also have been generated outside the state of California.

Weather charts and satellite imagery indicate significant thunderstorm activity over Arizona and the southern California deserts between Blythe and the Coachella Valley, progressing toward the west. Wind speeds in the desert to the east of the Indio air monitoring station were high on March 22, 2007. Meteorological data from the limited weather stations in the desert indicate that sustained wind speeds of 31 mph were recorded at Blythe during the thunderstorm activity and wind gusts to 43 mph occurred at both Blythe and Thermal. In addition, the NWS now-casts and advisories and CHP weather logs also describe strong winds and blowing dust in the desert, providing substantial weight-of-evidence for the sequence of events in the desert areas where wind measurements are sparse.

Causal Connection

This documentation shows a clear causal connection between the PM10 measured at Indio and the high winds related to thunderstorm activity in the lower deserts of southern California, particularly in the open deserts between Indio and Blythe on March 22, 2007. Table 2-11 and Figure 2-19 show that winds in the Blythe area were low through much of the morning of March 22 until an initial series of thunderstorms moved through from the east and north of Blythe toward the west and northwest between 1118 PST and 1259 PST, causing sustained winds measured to 31 mph and wind gusts to 43 mph. Approximately three hours later, as the thunderstorm gust front reached the Coachella Valley, wind gusts to 43 mph were also recorded at Thermal Airport, further south from Indio, along with reduced visibility and haze before light rain was reported. At this time, the highest hourly PM10 was measured at Indio. Thunderstorm activity and erratic winds in the area kept PM10 elevated until 1900 PST when the conditions improved. The causal connection is demonstrated by the dramatic increase in hourly PM10 concentrations that coincided with the transport of dust entrained by thunderstorm outflows to Indio by the easterly transport flows.

Concentration was in Excess of Normal Historical Fluctuations

The 210 μg/m^3 24-hour PM10 concentration measured at Indio on March 22, 2007 is higher that the 99.5 percentile value of 208.96 μg/m^3 for all Coachella Valley FRM measurements (Indio and Palm Springs) since 1990, as shown previously in Section 1.7, Figure 1-4. Figure 1-5 shows the distribution of all FRM SSI PM10 measurements at the Indio air monitoring station alone, from January 1990 through June 2008. The plotted concentrations for Indio are considered statistical outliers. Concentration above the 97.5 percentile value (132 μg/m^3 and above) are outside the normal range of the data. Therefore any value that exceeds the 24-hour federal PM10 standard of 150 μg/m^3 is clearly outside the normal range of data for Indio. All concentrations exceeding the federal 24-hour PM10 standard at Indio since January 1, 1993 have been attributed to high wind events, as was shown previously in Table 1-1. The concentration measured on March 22, 2007 is the eighth highest PM10 event at Indio since 1993 and events of this magnitude occur approximately every two years, on average.

The "But For" Test

To qualify as an exceptional event, it is necessary to demonstrate that there would have been no exceedance "but for" the event. To meet this "but for" requirement, it must first be shown that no unusual anthropogenic activities occurred in the affected areas that could have resulted in the exceedances. Activities that generate anthropogenic PM10 were approximately constant in the Coachella Valley immediately preceding, during and after the event. Activity levels in the Coachella Valley were typical for the time of year and PM10 emissions control programs were being implemented, not only for fugitive dust-generating activities, but also for agricultural burning in the Coachella Valley. There were reasonable and appropriate measures in place to control PM10 in the Coachella Valley in March 22, 2007, including AQMD Rules 403, 403.1, 444, 1186 and local ordinances. Moreover, EPA has approved AQMD's BACM demonstration for all significant sources of PM10 in the Coachella Valley. The AQMD Natural Event Action Plan (NEAP) also addresses the reasonable and appropriate measures that AQMD has implemented to address high wind events in the Coachella Valley. Furthermore, due to the AQMD forecast for high winds on March 21 and 22, dust producing activities were restricted during high winds and mitigation methods like watering and soil stabilization would have been increased.

Examining the make-up of Indio PM10 on this day using Indio's FRM PM2.5 data, the coarse particles (PM10-2.5), which are associated with windblown dust, represent over 95% of the total PM10 mass collected at Indio. PM10 sulfates, nitrates and chloride components were also low on the Indio FRM sample. Based on the data provided in this report, AQMD concludes that there would not have been an exceedance of the PM10

NAAQS at Indio on March 22, 2007 if high winds were not present. The causal connection of the thunderstorm generated winds and PM10 at Indio, along with the high contribution of fugitive dust to the PM10 mass at Indio indicate that but for the wind event these exceedances would not have occurred.

Reasonable Measures

AQMD issued a Coachella Valley Rule 403.1 High Wind Day forecast, indicating the potential for blowing dust and sand, on March 21 and 22, 2007. This prediction was based on the predicted unsettled weather pattern, along with NWS predictions of gusty winds with blowing dust and sand. As a result of this forecast, the strictest controls were in place on dust producing activities in the Coachella Valley along with mitigation requirements for disturbed soil surfaces.

Public Notification

The South Coast Air Quality Management District (AQMD) has prepared this documentation to demonstrate that this exceedance was due to a high wind natural event, in accordance with the EPA Exceptional Event Rule. Upon transmittal of this document to the California Air Resources Board (ARB), this document will be posted on the AQMD website, requesting review and comment by the public for a minimum of 30 days. Notice of its availability will also be sent to known interested parties.

Checklist of Exceptional Event Requirements

AQMD Flagging of Data	✓
Exceptional Event Criteria Summary:	
Affects Air Quality	✓
Is Not Reasonably Controllable or Preventable	✓
Was a Natural Event	✓
Causal Connection	✓
Concentration in Excess of Normal Historical Fluctuations	✓
The "But For" Test	✓
Reasonable Measures	✓
Public Notification	✓*

* 30 day public comment period starts upon transmittal of this document to ARB

2.2 Detailed Event Analysis

PM10 Summary

On March 22, 2007, the federal reference method (FRM) size-selective inlet (SSI) sampler at the Indio air monitoring station measured a 24-hour PM10 mass concentration of 210 μg/m^3. The sulfate , nitrate and chloride mass loadings on the Indio filter on this day were 1.6, 2.5 and 0.3 μg/m^3, respectively, indicating that the PM10 mass was primarily crustal material. The FRM 24-hour PM2.5 was 9.8 and 3.7 μg/m^3, respectively, at Indio and Palm Springs on March 22, well within the PM2.5 federal standard and indicating that the wind blown sand and dust were the primary components with little influence from combustion processes.

The Indio FRM sampler operates on a one-in-three-day schedule. Since this PM10 sample did not also fall on the standard one-in-six-day schedule, no supporting SSI data was available from the Coachella Valley 1 (Palm Springs) air monitoring station. The continuous, hourly Beta Attenuation Monitor (BAM)[7] data from Indio and Palm Springs are shown in Table 2-1, starting at 1200 PST on March 21 before the concentrations started to increase and ending at 0600 PST on March 23 after the elevated concentrations ended. Concentrations exceeding 150 μg/m^3 are highlighted in bold type. The Indio BAM measured a 24-hour average PM10 concentration of 75.8 μg/m^3, which is significantly lower than the SSI measurement but provides timing information for this event. Such discrepancies between the SSI and BAM measurements can be indicative of a blowsand event that caused a large amount of particulates in a relatively short time period. The hourly Indio BAM PM10 concentrations started to climb after noon on March 22, reaching 207 μg/m^3 for the 1400 PST hour and peaking at 502 μg/m^3 for the hour starting at 1500 PST. The Indio PM10 dropped again to low values starting at 1900 PST, after 5 hours with concentrations exceeding 150 μg/m^3.

[7] The AQMD has only used the BAM measurements for forecasting purposes and public notification of PM10 events. While the U.S. EPA accepts the BAM measurements as an equivalent federal reference method, these instruments have not historically been relied upon for determining NAAQS compliance in the South Coast Air Basin or Coachella Valley.

TABLE 2-1

Hourly BAM and 24-hour SSI PM10 Measurements at the AQMD Indio and Palm Springs Air Monitoring Stations in the Coachella Valley Between 1200 PST March 21 and 0600 PST March 23, 2007

		Indio Monitoring Station			Palm Springs Monitoring Station	
DATE	HOUR (PST)	BAM Hourly PM10 (μg/m^3)	24-Hour Average PM10 (μg/m^3) (midnight to midnight)		BAM Hourly PM10 (μg/m^3)	24-Hour Average PM10 (μg/m^3) (midnight to midnight)
			BAM	SSI		BAM
3/21/07	1200	8			4	
	1300	4			3	
	1400	100			6	
	1500	**177**			12	
	1600	28			13	
	1700	22			17	
	1800	15			20	
	1900	21			29	
	2000	13			19	
	2100	12			24	
	2200	15			14	
	2300	21	25.1		29	15.4
3/22/07	0000	5			38	
	0100	14			54	
	0200	21			36	
	0300	17			30	
	0400	23			28	
	0500	13			20	
	0600	10			1	
	0700	20			0	
	0800	11			0	
	0900	11			2	
	1000	14			2	
	1100	26			2	
	1200	61			8	
	1300	117			11	
	1400	**207**			7	
	1500	**502**			24	
	1600	**161**			23	
	1700	**311**			37	
	1800	**189**			20	
	1900	35			58	
	2000	18			36	
	2100	3			13	
	2200	16			18	
	2300	15	75.8	**210**	11	20.0
3/23/07	0000	15			21	
	0100	8			25	
	0200	18			16	
	0300	13			8	
	0400	26			12	
	0500	17			17	
	0600	40	23.3		17	18.2

The Palm Springs BAM data remains relatively low throughout March 22, peaking at 58 μg/m^3 for the 1900 PST hour, although the extremely low PM10 concentrations in the morning and early afternoon cast some doubt on the quality of these measurements. The 24-hour average of the Palm Springs BAM data is only 20 μg/m^3. It should be noted that the AQMD Atmospheric Measurements group has recommended invalidating the Palm Springs BAM PM10 data during this period. A calibration indicated that the BAM was 12.8 % low for mass and no further adjustment of the instrument was possible.

The PM10 and PM2.5 concentrations measured in the Coachella Valley (Indio and Palm Springs) and the two nearest South Coast Air Basin stations in Riverside County (Banning and Riverside-Rubidoux) on the seven days surrounding March 22 are summarized in Table 2-2. These show that all particulate concentrations were relatively low on the days before and after the high wind event. The elevated PM10 was only found in the Coachella Valley on March 22, showing that the windblown dust event did not affect the South Coast Air Basin and that PM10 transport from the urban South Coast Air Basin was not a significant factor in the Coachella Valley. The low PM10 concentrations before and after March 22 demonstrate that the exceedance would not have occurred if not for the high wind natural event. The relatively low PM2.5 at all the stations on March 22 indicates that urban transport from the South Coast and combustion sources, such as fires, were not significant to this PM10 event.

TABLE 2-2

24-Hour SSI and BAM PM10 Measurements (μg/m³) from Coachella Valley (Indio and Palm Springs) and Nearest South Coast (Banning Airport and Rubidoux) Air Monitoring Stations between March 19 and March 25, 2007

Station	Type	19-Mar	20-Mar	21-Mar	22-Mar	23-Mar	24-Mar	25-Mar
Indio	PM10 SSI FRM	78			**210**			41
Indio	PM10 BAM	51.3	59.3	25.1	75.8	23.3	29.3	29.8
Indio	PM2.5 FRM	9.0			9.8			11.1
Palm Springs	PM10 SSI FRM	32						27
Palm Springs	PM10 BAM	35.2	56.8	15.4	20.0	18.2	41.8	28.1
Palm Springs	PM2.5 FRM	20.5			3.7			17.8
Banning Airport	PM10 SSI FRM	29						38
Banning Airport	PM2.5 BAM	24.3	30.9	9.2	18.0	13.0	20.5	26.9
Rubidoux	PM10 SSI FRM	48	43		35			55
Rubidoux	PM10 TEOM	21.6	19.7	12.3	22.8	26.1	26.5	36.0
Rubidoux	PM2.5 FRM	30.1	28.5	7.9	6.2	9.7		30.7
Rubidoux	PM2.5 BAM	36.5	37.4	11.9	11.0	13.5	20.5	39.8

Hourly BAM PM10 measurements collected by the Imperial County Air Pollution Control District near the Salton Sea showed some elevated concentrations in the afternoon of March 22 as the thunderstorm activity moved through, but neither exceeded the 24-hour NAAQS. The March 22 hourly BAM PM10 data are shown in Table 2-3 for the Westmorland station, south of the Salton Sea, and the Niland station, at the southeastern edge of the Salton Sea. Westmorland reached a peak hourly concentration of 101 μg/m^3 for the hour starting at 1400 PST, with a 24-hour average of 31.7 μg/m^3. Niland reached 717 μg/m^3 at 1400 PST, dropped to 22 μg/m^3, then spiked to 996 μg/m^3, with a 24-hour average of 83.3 μg/m^3.

TABLE 2-3

Hourly BAM PM10 Measurements at the Imperial County APCD Westmorland and Niland Air Monitoring Stations on March 22, 2007

		Westmorland Monitoring Station		Niland Monitoring Station	
DATE	HOUR (PST)	BAM Hourly PM10 (μg/m^3)	24-Hour Average PM10 (μg/m^3) (midnight to midnight)	BAM Hourly PM10 (μg/m^3)	24-Hour Average PM10 (μg/m^3) (midnight to midnight)
			BAM		BAM
3/22/07	0000	11		12	
	0100	9		11	
	0200	9		12	
	0300	19		13	
	0400	16		12	
	0500	31		24	
	0600	84		22	
	0700	47		26	
	0800	38		30	
	0900	21		9	
	1000	25		9	
	1100	29		19	
	1200	61		15	
	1300	52		8	
	1400	101		**717**	
	1500	35		22	
	1600	70		**996***	
	1700	17		7	
	1800	16		9	
	1900	10		6	
	2000	12		2	
	2100	13		6	
	2200	18		9	
	2300	16	31.7	4	83.3

* Possible instrument error code

Further south, the Imperial County APCD Brawley and the Mexican Mexicali air monitoring stations also had peak BAM PM10 hourly concentrations with the afternoon thunderstorm activity. These stations are shown in Table 2-4. The 24-hour averages for Brawley and Mexicali were 33.9 μg/m^3 and 57.5 μg/m^3, respectively, thus they did not exceed the 24-hour NAAQS. Brawley peaked at 1500 PST with an hourly average of 188 μg/m^3 and Mexicali peaked at 1500 PST with an hourly average of 401 μg/m^3, followed by 150 μg/m^3 at 1600 PST.

TABLE 2-4

Hourly BAM PM10 Measurements at the Imperial County APCD Brawley and Mexican Mexicali Air Monitoring Stations on March 22, 2007

		Brawley Monitoring Station		Mexicali Monitoring Station	
DATE	**HOUR (PST)**	**BAM Hourly PM10 (μg/m^3)**	**24-Hour Average PM10 (μg/m^3) (midnight to midnight)**	**BAM Hourly PM10 (μg/m^3)**	**24-Hour Average PM10 (μg/m^3) (midnight to midnight)**
			BAM		**BAM**
3/22/07	0000	17		23	
	0100	23		23	
	0200	10		8	
	0300	18		17	
	0400	16		17	
	0500	25		16	
	0600	40		24	
	0700	57		34	
	0800	49		44	
	0900	21		63	
	1000	17		22	
	1100	23		24	
	1200	33		24	
	1300	31		38	
	1400	34		56	
	1500	**188**		**401**	
	1600	62		**150**	
	1700	21		64	
	1800	33			
	1900	23		58	
	2000	15		52	
	2100	18		44	
	2200	17		80	
	2300	21	33.9	41	57.5

The following sections describe the meteorological setting and the analysis of the events leading to high PM10 at Indio on March 22, including windblown dust transported from afternoon thunderstorm outflows over the Arizona and southern California lower deserts.

Meteorological Setting

Previous natural event analyses defined four primary meteorological mechanisms that lead to high-wind PM10 events in the Coachella Valley, including: (1) strong pressure and density gradients forcing high winds through the San Gorgonio Pass, (2) storms and frontal passages, (3) thunderstorm outflow winds, and (4) Santa Ana wind events. The overall meteorological conditions over the southwestern U.S. on March 22, included the movement of a winter storm system south of the Coachella Valley that spawned strong thunderstorms. This PM10 NAAQS violation was primarily due to the Type 3 high-wind event, that is, strong downbursts and gust fronts from thunderstorm activity, although the thunderstorms were the result of a Type 2 winter storm condition in this case. The thunderstorms developed out of a rigorous winter storm system, instead of the more typical pattern of afternoon thunderstorms associated with summertime "monsoonal" conditions that bring tropical moisture and thunderstorms to the deserts. Strong convective activity produces strong downdrafts of cooler air, causing wind gusts that can locally exceed 60 mph. While the thunderstorms are usually localized events of relatively short duration, the associated downbursts and outflows can suspend large amounts of natural desert soil in the atmosphere that can be transported over large distances, even though the gustiness subsides. The movement of thunderstorms, sometimes in excess of 25 mph, can make it problematic to measure sustained high winds in a given location.

A separate Appendix to this document provides supporting documents for the March 22, 2007 high wind natural event beyond what is included in this text, including:

- Surface Weather Observations (Tables A-1 through A-10);
- California Highway Patrol (CHP) Weather Logs
- Newspaper Articles;
- National Weather Service (NWS) Short Term Forecasts (Now-Casts) from the San Diego and Phoenix Forecast Offices;
- NWS Forecast Discussions from the San Diego, Los Angeles and Phoenix Forecast Offices;
- Flash Flood Warnings issued by the NWS Phoenix Forecast Office; and
- A full sequence of Infrared Satellite Images, showing the progression of convective activity (Figures A-1 through A-29).

A trough of low pressure aloft extended southwest across the region with the air mass saturated to 10,000 feet on Wednesday, March 21. Figure 2-1 shows the height analysis chart of the 500 millibar (MB) pressure level at 0400 PST, March 21. This shows the upper level trough centered over California and extending toward the south and west, with heights of 5530 meters (m) over central California. The National Weather Service (NWS) forecast discussions covering southern California predicted that this system would bring clouds and showers on that day. Northerly winds at 500 MB reached 81 mph (70 knots) over southern Oregon and 63 mph (55 knots) over California on the back side of the trough.

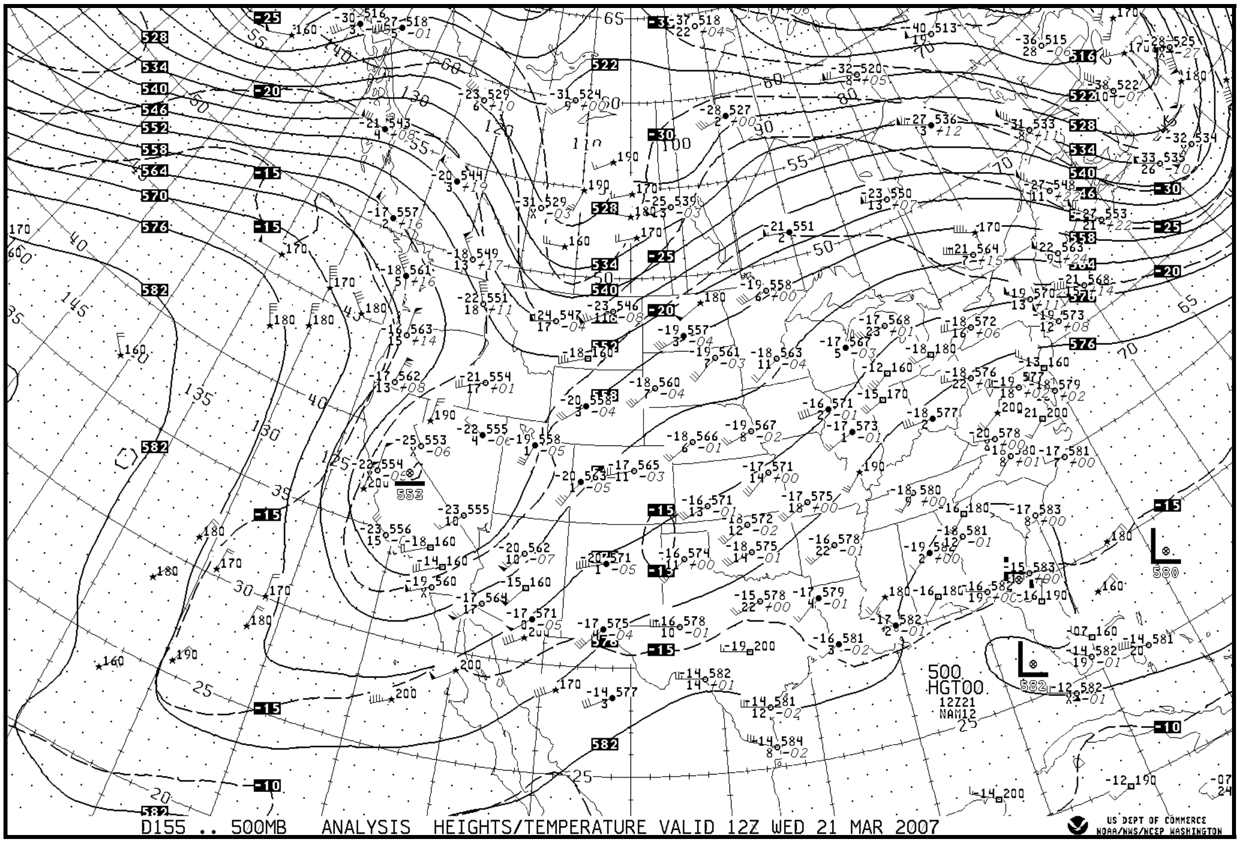


FIGURE 2-1

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 0400 PST Wednesday, March 21, 2007

Figure 2-2 shows the 500 MB analysis chart at 1600 PST on Wednesday, March 21. The northerly jet of strong winds had dropped southward along the central California coast, helping to form an upper level closed low. The 5540 m center was offshore, to the south of Point Conception, at this time. The NWS San Diego Forecast Office forecast discussion in the evening of March 21 predicted the low to move south through Wednesday night, causing a shift to strong easterly flow throughout southern California. The gusty easterly winds at low and mid levels winds across the mountains produced some mountain wave/rotor activity in the vicinity of Palm Springs airport in the afternoon of March 21. The Desert Sun newspaper in the Coachella Valley reported that strong winds had knocked down 14 power poles in North Palm Springs, north of Interstate 10 between 18th and 20th Avenues, in the afternoon of March 21. The easterly winds gusted to 40 mph, through some of the southern California mountain passes on Wednesday. The low was predicted to move south, then to track slowly across north central Baja California.

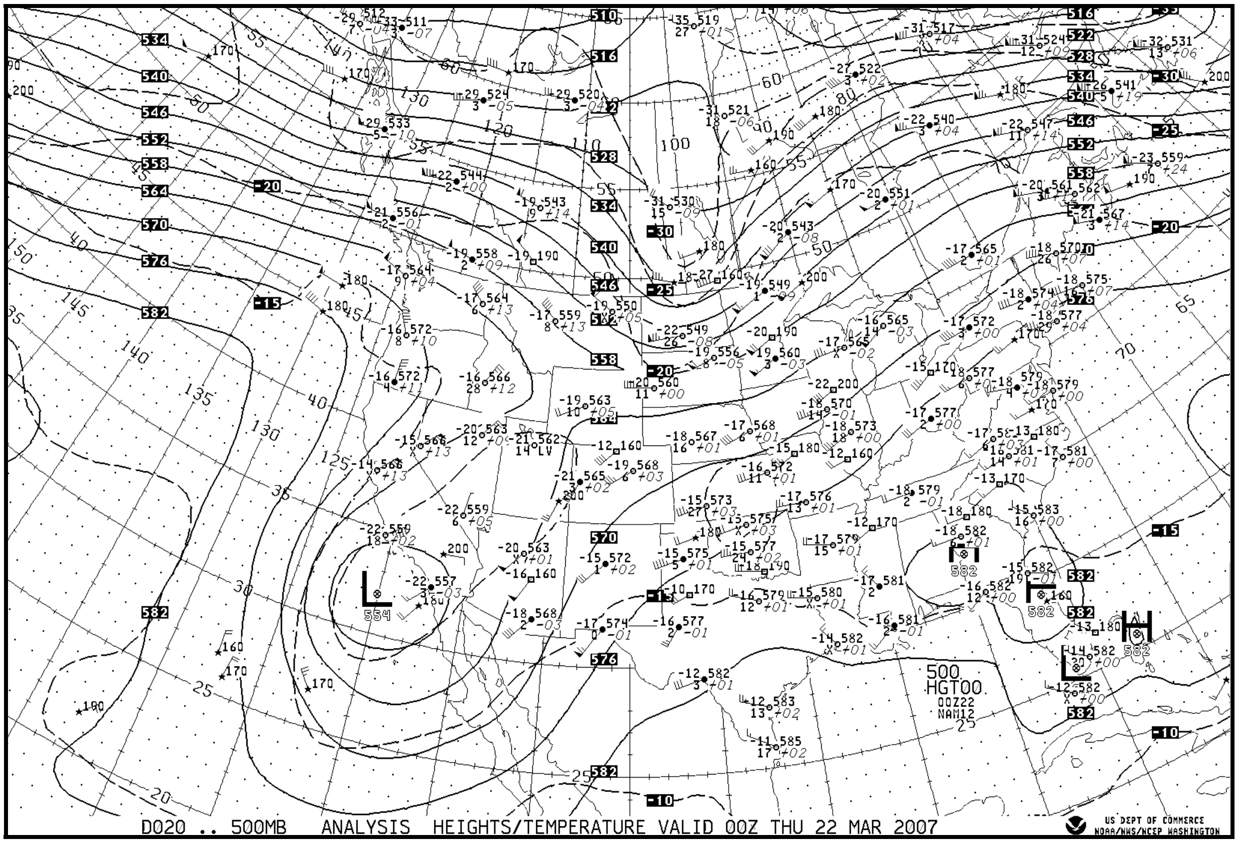


FIGURE 2-2

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 1600 PST Wednesday, March 21, 2007

Figure 2-3 shows the NWS surface analysis at 1900 PST March 21, depicting the moist flow from the south over much of Arizona. Surface trough lines extend northward through the California central valley and southward from Arizona into Mexico. Isolated shower activity was reported across the Antelope Valley and the interior San Gabriel and San Bernardino mountain slopes in the evening of March 21 and the morning of March 22 as the upper level low moved southward. At 1905 PST on March 21, NWS Los

Angeles noted scattered showers over the eastern San Gabriel and San Fernando valleys. At 2000 PST there were brief, heavy showers 5 miles west of Glendale, moving west at 30 mph, with gusty winds in the vicinity of the storms. NWS San Diego reported precipitation varying greatly across the south, ranging from no rain to a trace (< 0.01 inch) in the deserts to over 0.42 inches in the San Diego County mountains on March 21.

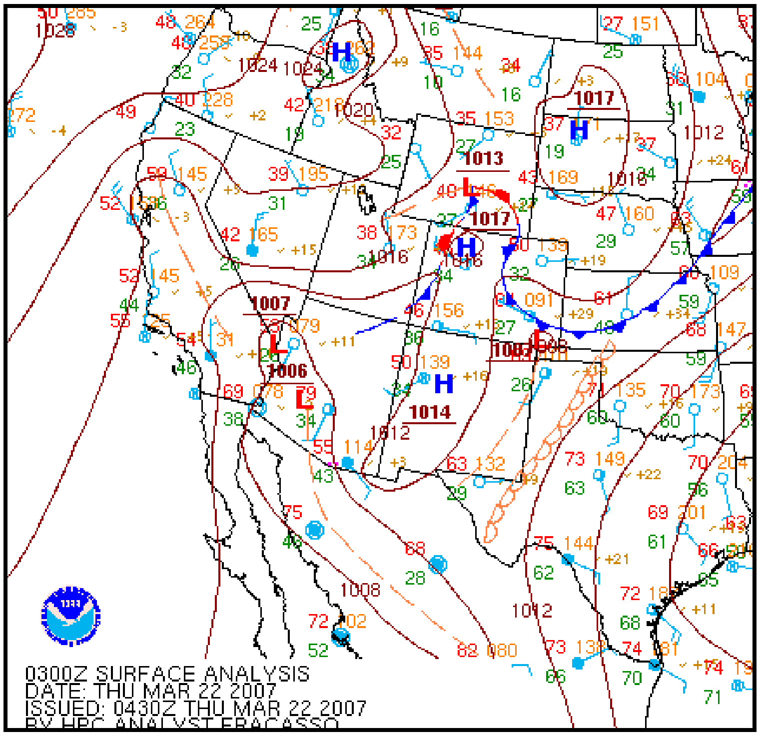


FIGURE 2-3

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 1900 PST Wednesday, March 21, 2007

The Pinal County Air Quality Control District (PCAQCD), located in south-central Arizona between Phoenix and Tucson, reported two NAAQS violations on Wednesday, March 21, with 24-hour TEOM concentrations of 273.2 and 184.3 $\mu g/m^3$ at their Combs and PCH sites, respectively. This was reported by PCAQCD to be caused by strong winds associated with an upper level low pressure system and surface front that transported dust from outside Pinal County. Winds in Pinal County over 25 mph were reported in the evening, peaking at 35 mph and coinciding with the highest hourly PM10 concentrations. The 500 MB analysis for 0400 PST in the morning of Thursday, March 22 (Figure 2-4) shows the low center had moved farther south, near northern Baja. At

0400 PST, the position of the closed low was near 30N/117W, beginning to make an eastward turn, with several vorticity centers rotating around its perimeter, according to the NWS Phoenix forecast discussion at 0845 PST. The upper level wind speeds were strongest, 57 to 81 mph (50 to 70 knots), around the southern quadrants of the low, over Baja mainland Mexico. The cyclonic circulation around the upper-level low, and a prolonged period of low-level easterly flow, caused moisture to wrap around the low and to move across the lower deserts and up against the east slopes of the southern California mountains. This increased the threat of thunderstorms in the eastern part of California and Arizona. Thunderstorm activity had already affected southwestern Arizona, starting in the evening of March 21, and continued on March 22.

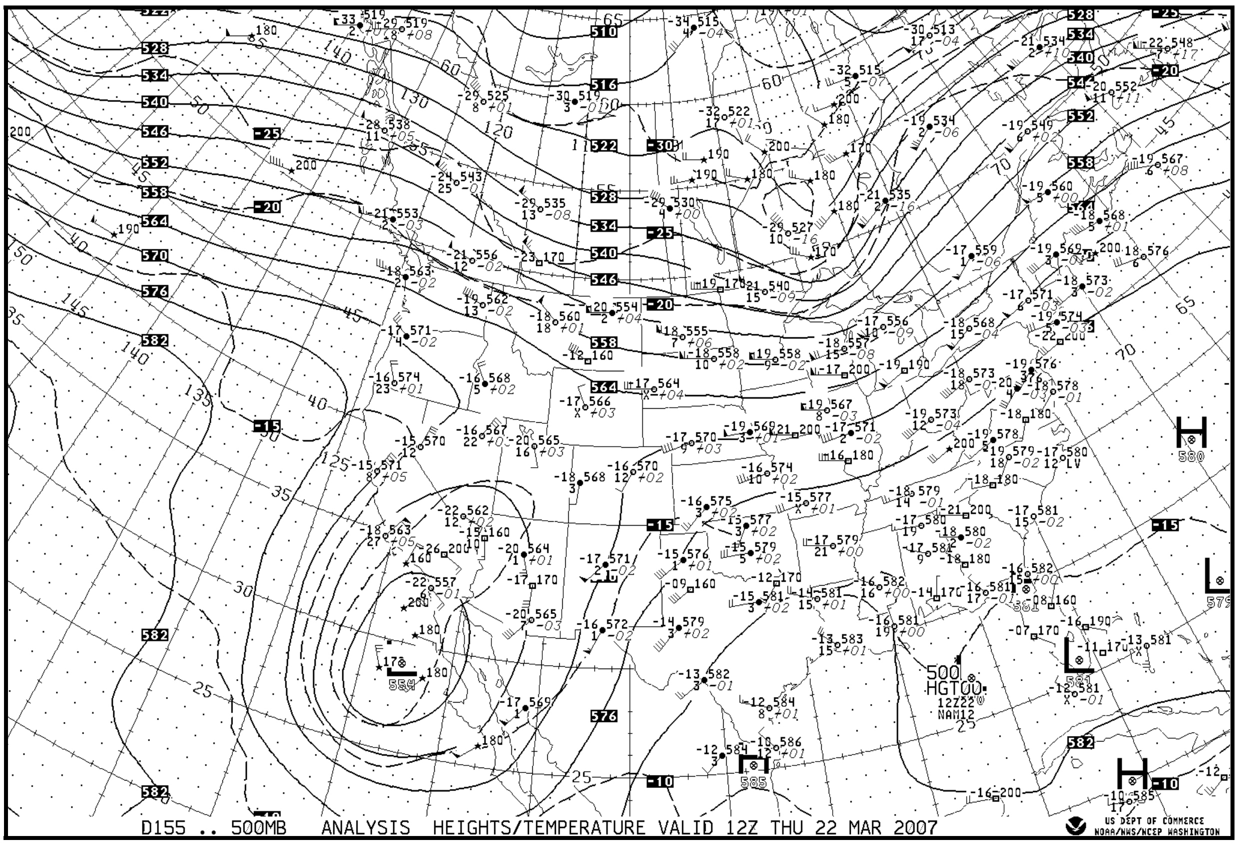


FIGURE 2-4

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 0400 PST Thursday, March 22, 2007

The surface analysis at 0400 PST (Figure 2-5) shows moist southwesterly flow over southern Arizona and easterly flow further north. The surface trough (dashed line) extends southward through the Gulf of California. According the NWS forecast discussions, a subtropical moisture plume was well established ahead of the low, part of which was pulled back toward the west across Arizona. Surface dewpoints had risen 10 to 20 degrees over much of Arizona overnight. Showers and thunderstorms were already occurring over Sonora, Mexico and Arizona, with moderate rain reported in southern Arizona at 0400 PST. Increased instability of the airmass and moisture wrapping around the north side of the low were predicted by the NWS to bring a chance of showers and thunderstorms by early afternoon to southern California, mainly along and east of the mountains and in the low deserts with the afternoon heating. A band of cumulus castellanus clouds were observed by NWS spotters in the lower California desert, moving up from the southeast in the morning of March 22, according to the NWS San Diego forecast discussion issued at 0800 PST. These clouds have multiple towers at the top, indicative of significant vertical air movement and of likely thunderstorm development. According to the NWS Phoenix forecast discussion at 0845 PST, convection increased after sunrise in the Phoenix area. The heaviest precipitation at this time was through southern Gila County where spotters and NWS Remote Automated Weather Stations (RAWS) reported 0.30 to 0.45 inches of rain by 0500 PST and areas of blowing dust were reported in Tonopah, Arizona, in Maricopa County.

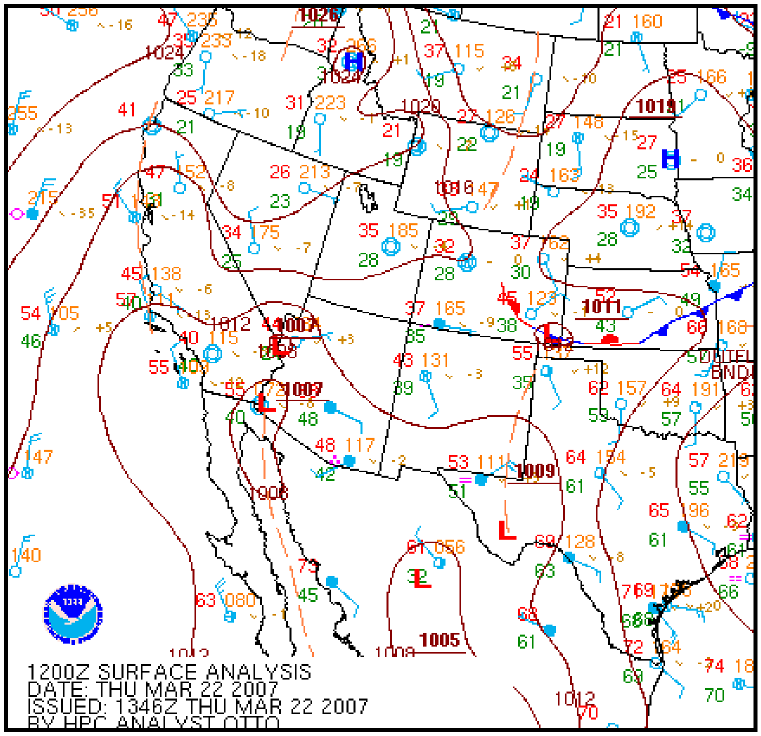


FIGURE 2-5

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 0400 PST Thursday, March 22, 2007

Surface pressures in the Great Basin were increasing, enhancing northeasterly offshore flow, especially through and below the passes and canyons of coastal southern California. According to the NWS Los Angeles 0825 PST forecast discussion, there were some isolated wind gusts above 50 mph in the Los Angeles County mountains in the morning of March 22. Wind advisories, for winds greater than 35 mph, were issued by NWS Los Angeles through the morning for Santa Barbara and the mountains of Ventura and Los Angeles Counties. Conditions were warmer and drier in the Los Angeles Basin, in response to the offshore flow over the mountains. This diminished the chance of precipitation in the Basin, but helped set the stage for moisture transport and thunderstorm development over the southern deserts.

Figure 2-6 shows the surface analysis for 1000 PST with the 1008 MB surface low located at the top of the Gulf of California and 1022 MB high pressure over the Great Basin. The cyclonic flow around the low was evident over Arizona and the winds speeds increased. Figure 2-7 shows the infrared satellite image at 1000 PST. At this time, the position of the upper level closed low was near the west coast of Baja, with a solid fetch of moisture northward from Sonora, Mexico. A large thunderstorm is evident over the central western half of Arizona.

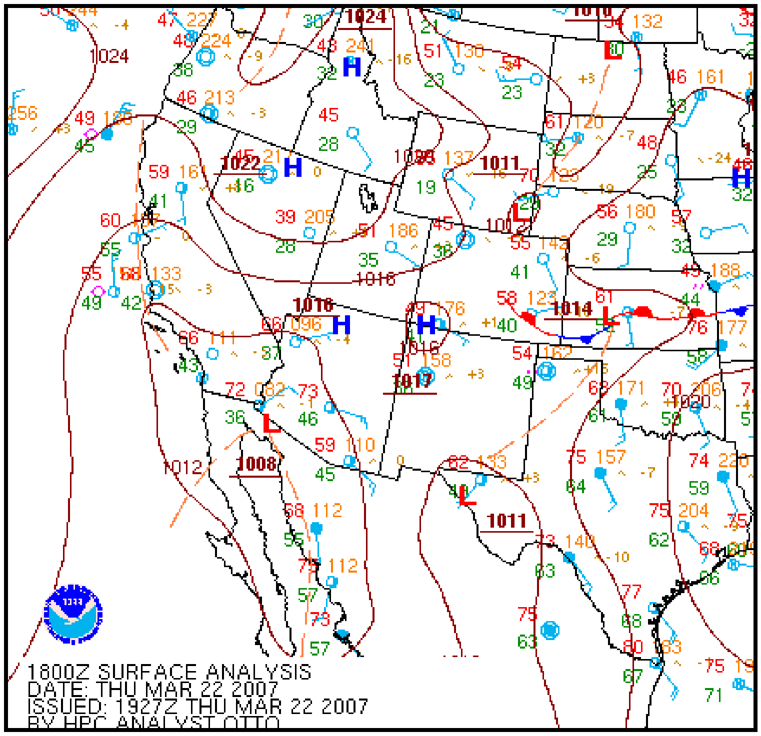


FIGURE 2-6

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 1000 PST Thursday, March 22, 2007

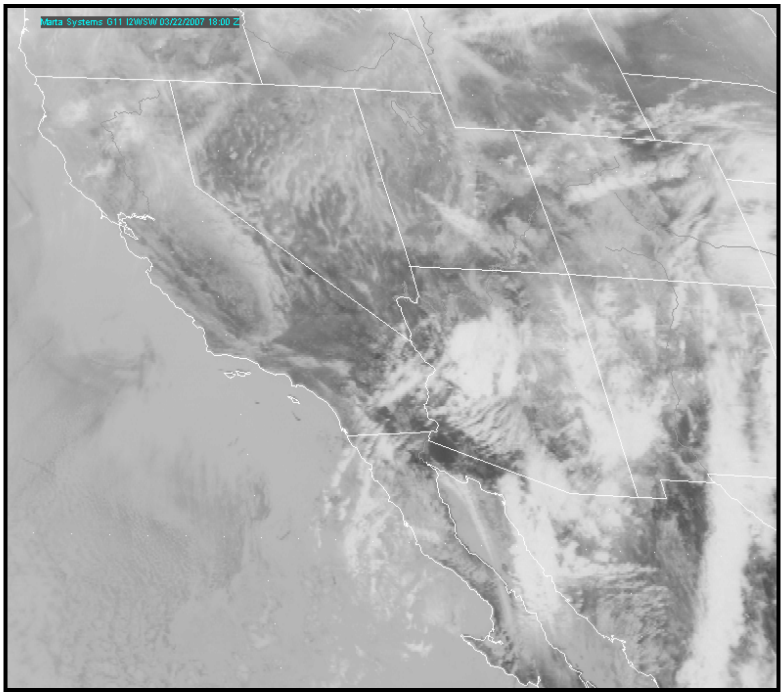


FIGURE 2-7

Infrared Satellite Image for 1000 PST Thursday, March 22, 2007

The thunderstorms over western Arizona spread up the Colorado River Valley in the afternoon, drifting toward the California desert and mountain areas. Figure 2-8 shows the infrared satellite image at 1215 PST along with a color enhanced infrared image to highlight the coldest (highest) thunderstorm cloud tops (strongest thunderstorm cells are orange in this case). Convective cells can be seen into southeastern California, across the border from Arizona, as well as over northwestern Arizona and across southern Arizona and northern Mexico. Moisture and convection continued to wrap toward the north and west into southeastern California, with Blythe having heavy thunderstorms at mid-day. NWS Phoenix issued a flash flood warning for east central Riverside County at 1214 PST, valid through 1415 PST, noting that at 1211 PST, trained spotters had reported flash flooding from a thunderstorm over the Blythe area moving west at 10 mph. The National Climatic Data Center's (NCDC) Event Record[8] documented heavy rain and hail from a severe thunderstorm near Blythe that occurred between 1130 and 1230 PST on March 22, as follows:

Event Description:	***Heavy Rain***
Location:	*Blythe, California (Riverside County)*

[8] National Climatic Data Center's Event Record: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

Date/Time: March 22, 1130 – 1230 PST
Brief heavy rain and hail accompanied thunderstorms that moved through parts of Blythe. Some streets became flooded as a result of the downpour. Showers and thunderstorms developed rapidly on Thursday March 22, affecting portions of Eastern Riverside County.

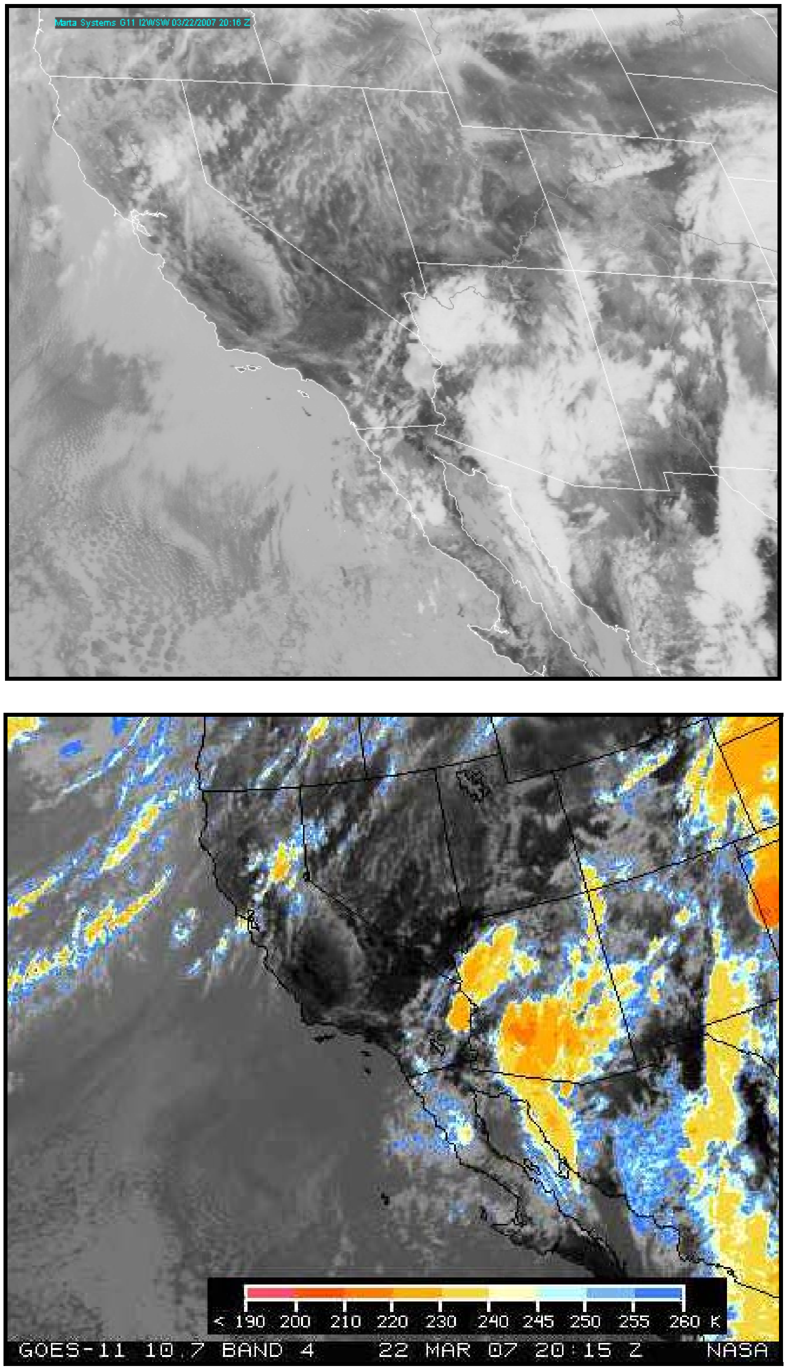


FIGURE 2-8

Infrared Satellite Images for 1215 PST Thursday, March 22, 2007

(the second image includes color enhancement to highlight colder/higher clouds)

At 1202 PST a short-term forecast (now-cast) issued by NWS Phoenix reported scatted thunderstorms affecting southwest Maricopa County, including the Gila Bend area. These were predicted to continue through at least 1330 PST, producing wind gusts in excess of 40 mph, small hail and brief heavy rain. Individual storms were moving toward the north-northwest at 25 mph. Local areas of dense blowing dust were predicted, with visibilities briefly falling well below 1 mile. NWS Las Vegas also reported clusters of thunderstorm activity in the late morning and afternoon of March 22. These were observed by the Las Vegas Doppler radar and by lightning detection, over the southwestern US deserts: near Kingman, Arizona and near Needles and toward Yucca Valley in California. These thunderstorms were accompanied by gusty winds and brief heavy rain with rates of up to 1/3 of an inch per hour.

At 1210 PST, the NWS Phoenix now-cast reported a strong thunderstorm 10 miles northwest of Blythe that was expected to produce small hail and gusty winds to 45 mph as it continued to move to the northwest in the open desert of eastern Riverside County. Areas of blowing dust were predicted along Interstate 10 in that area. The leading edge of the moisture had moved west across San Diego County and the Riverside County Mountains by 1230 PM PST. Light rain showers were reported near central San Bernardino County at that time, along the northern edge of the moisture. A line of thunderstorms was near the Colorado River Valley, moving steadily west-northwestward. These were predicted to reach the Coachella Valley and eastern San Diego County by 1530 PST, according to the NWS San Diego forecast discussion issued at 1230 PST. Dry lightning and gusty downdraft winds were the main concerns as the thunderstorms continued to develop and move across the deserts toward the west.

Figures 2-9 and 2-10 show the 1300 PST NWS surface analysis and infrared satellite images, respectively. At this time, the 1005 MB surface low was more defined and had shifted toward the California/Arizona/Mexico border. A large thunderstorm complex was over a significant portion of the eastern California Deserts, from north of Needles to south of Blythe, and extending to the west. At 1300 PST, the NWS San Diego now-cast reported showers and thunderstorms over Imperial County and eastern Riverside County, moving west at 20 mph. These thunderstorm cells were predicted to bring strong downdraft wind gusts over 35 mph as they moved across the Anza Borrego Desert, the San Diego Mountains, the Coachella Valley, and the eastern slopes of the Riverside County mountains, with dry lightning and only light rainfall amounts. The NCDC Event Record also documented heavy rains and strong winds related to the severe thunderstorms near Phoenix that occurred between 1300 and 1330 PST on March 22, as follows:

Event Description:	***Heavy Rain***
Location:	*Maricopa County, Arizona*
Begin Location:	*12 Miles South of Phoenix*
End Location:	*Mesa*

Date/Time: March 22, 1300 – 1330 PST
Torrential downpour in Ahwatukee left 1.5 inches in just 30 minutes. Other areas around Phoenix also had very heavy rains. A slow-moving low pressure system off the coast of Baja California forced considerable moisture into Southwest and South-Central Arizona. Brief heavy rainfall, hail, and locally strong winds affected some desert areas. Flight delays and cancellations were reported at Phoenix Sky Harbor airport, and about 3,000 SRP customers were left without power as thunderstorms moved across the Phoenix area.

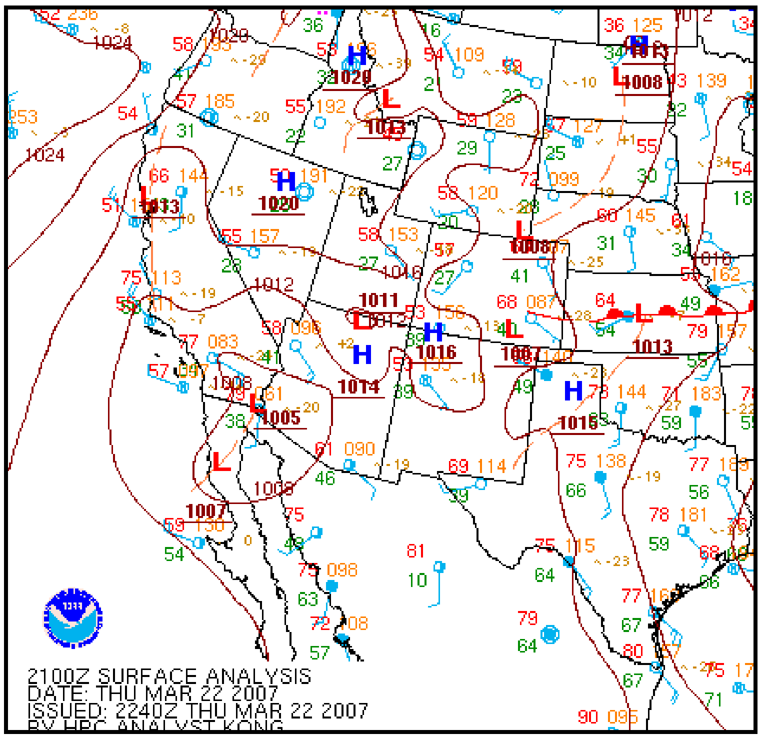


FIGURE 2-9

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 1300 PST Thursday, March 22, 2007

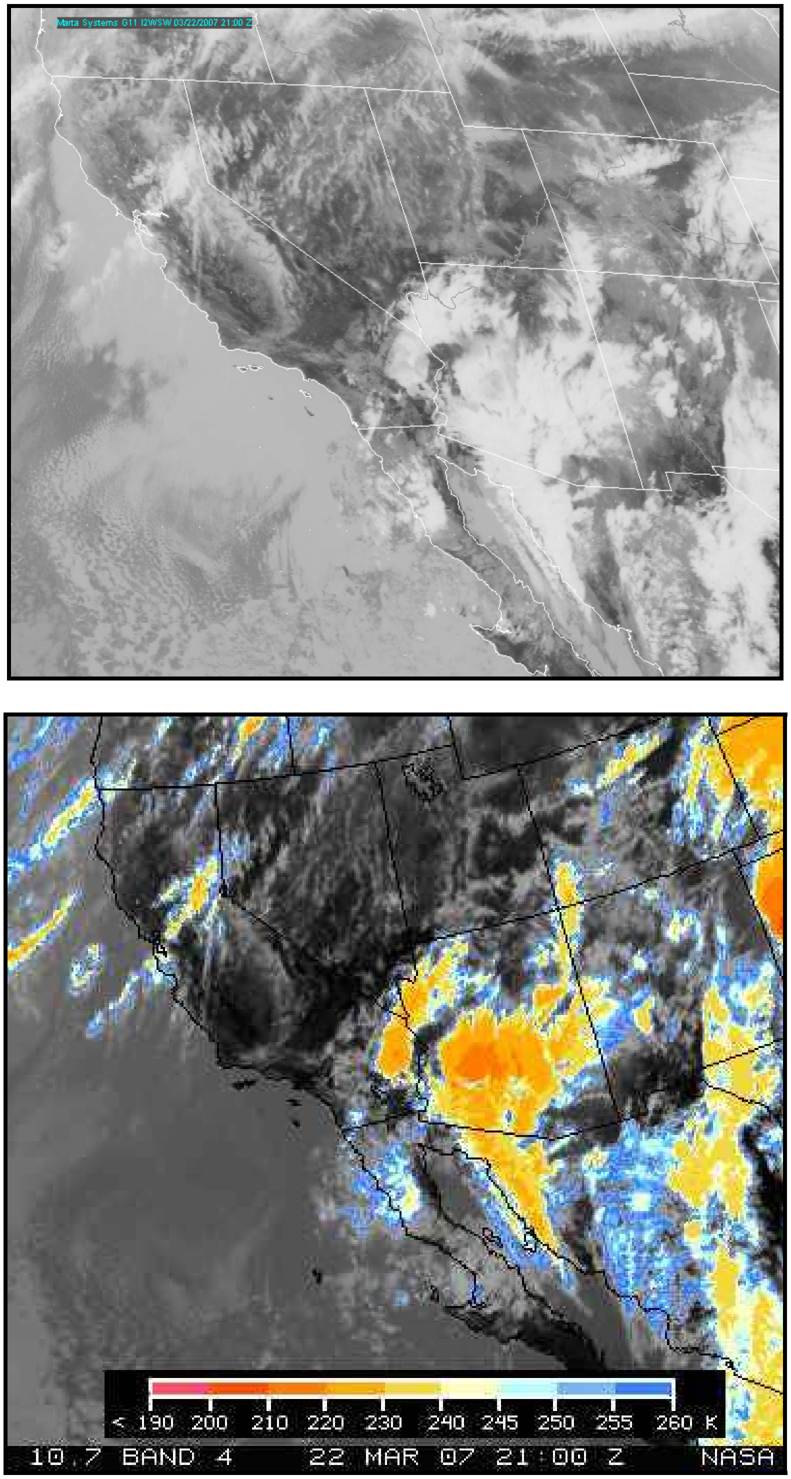


FIGURE 2-10

Infrared Satellite Images for 1300 PST Thursday, March 22, 2007

(the second image includes color enhancement to highlight colder/higher clouds)

The north-south pressure gradient component slowly weakened in the afternoon as the surface high pressure over the Great Basin weakened, enhancing flows across southwest California from the east. At 1343 PST, a now-cast by NWS Phoenix reported scattered thunderstorms affecting northwest Maricopa County, with wind gusts in excess of 40 mph and blowing dust. The afternoon thunderstorms also affected Arizona's Yuma and La Paz Counties, according to NWS Phoenix forecast discussions and now-casts. In a now-cast issued at 1422 PST, NWS San Diego reported that the Doppler radar had detected a strong thunderstorm over the northern Salton Sea at 1415 PST, near the town of Desert Shores. This storm was moving east at 25 mph and was predicted to bring gusty downdraft winds, lightning and brief rain to the Coachella Valley and the Anza Borrego Desert through 1530 PST. This cell shows up well in the color enhanced infrared satellite image at 1415 PST (Figure 2-11).

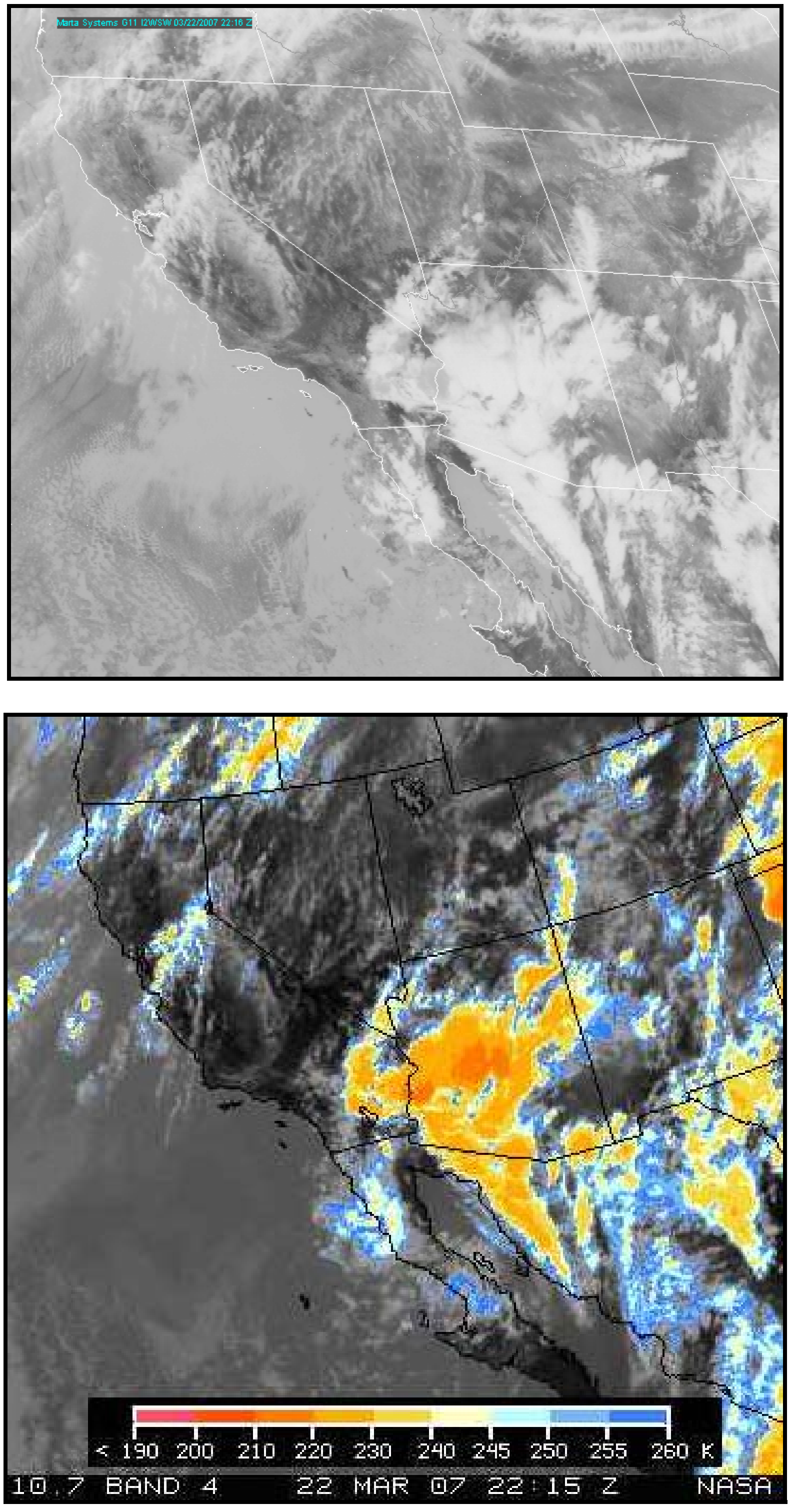


FIGURE 2-11

Infrared Satellite Images for 1415 PST Thursday, March 22, 2007

(the second image includes color enhancement to highlight colder/higher clouds)

The NCDC Event Record documented strong winds and a reported funnel cloud in the Phoenix area related to the thunderstorm activity at 1443 PST on March 22, as follows:

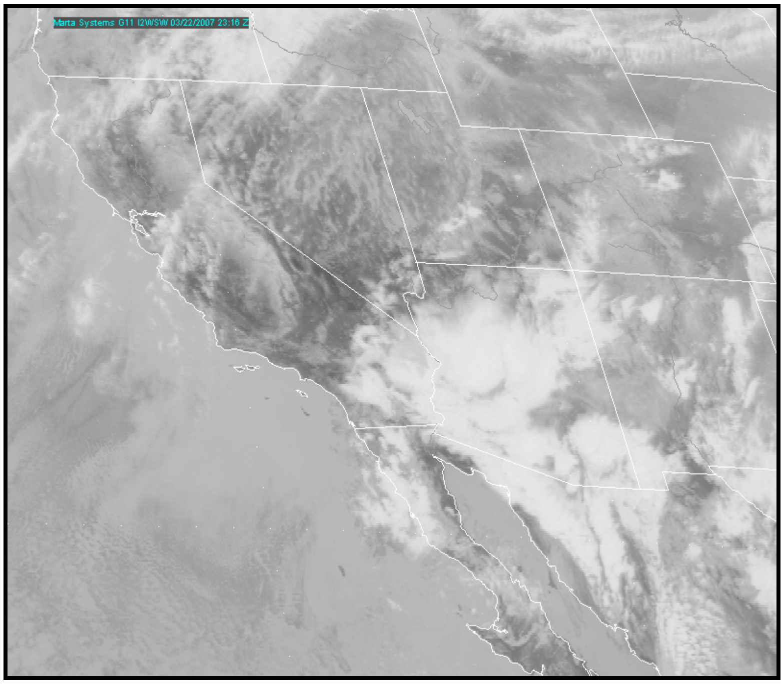
Event Description:	***Funnel Cloud***
Location:	*4 Miles South West of Chandler Airport*
	Maricopa County, Arizona
Date/Time:	*March 22, 1443 – 1447 PST*

Brief funnel cloud reported at Chandler Heights and Alma School Road. A slow-moving low pressure system off the coast of Baja California forced considerable moisture into Southwest and South-Central Arizona. Brief heavy rainfall, hail, and locally strong winds affected some desert areas. Flight delays and cancellations were reported at Phoenix Sky Harbor airport, and about 3,000 SRP customers were left without power as thunderstorms moved across the Phoenix area.

A now-cast issued by NWS San Diego at 1455 PST reported that the Doppler radar had detected a thunderstorm at 1450 PST in the afternoon over the southern Coachella Valley. The storm was moving west at 25 mph toward Santa Rosa Mountain, with gusty downdraft winds to 40 mph producing areas of blowing dust, lightning and brief rain. This is near the time of the peak hourly PM10 concentration, 502 $\mu g/m^3$, measured by the Indio BAM for the 1500 PST hour and these nearby storms apparently contributed to the windblown dust and PM10 measured at Indio, along with dust transported from the deserts to the east of Indio from thunderstorm activity that moved from Blythe to the Coachella Valley over the previous three hours. Also at this time, the NWS San Diego now-cast reported showers and isolated thunderstorms in the Mojave Desert between Baker and Twentynine Palms, moving west toward the Apple and Lucerne Valleys and the San Bernardino Mountains, again producing gusty downdraft winds to 40 mph and areas of blowing dust. The scattered showers and thunderstorms were predicted to continue to intensify and move west toward the San Diego and Riverside County mountains through 1600 PST. The infrared satellite images from 1515 PST (Figure 2-12) show the cold cloud tops that developed over much of the California low deserts from the thunderstorms near Blythe and near the Salton Sea, as well as the significant convection over Arizona. The NCDC Event Record documented the following thunderstorm wind event around 1530 PST on March 22, as the thunderstorm activity crossed the mountains from the Coachella Valley to the Cleveland National Forest in San Diego County.

Event Description:	***Thunderstorm Winds***
Location:	*Lake Henshaw, CA (San Diego County)*
Date/Time:	*March 22, 1530 PST*
Fatalities:	*3*
Magnitude:	*35 mph (30 knots)*

A closed low over northern Baja created conditions favorable for the formation of high based convection across southern California. Thunderstorms initiated over the deserts in the afternoon and then quickly moved westward over the mountains and towards the coast. An inverted V signature was noted above the 950 mb level on the 00 UTC KNKX sounding that afternoon, indicative of the potential for thunderstorms to produce microbursts. Three elderly fishermen drowned after their overloaded, 12-foot motorboat capsized on Lake Henshaw while trying to outrun an approaching thunderstorm. Eyewitness accounts and observations support the idea that this thunderstorm may have produced a minor, sub-severe microburst. This was probably all that was needed to capsize the small, overloaded boat. A friend of the fishermen was the first to notice the capsized boat, however he did not actually see the boat flip over. It is still not completely known if the boat capsized before or after the thunderstorm moved across the lake.



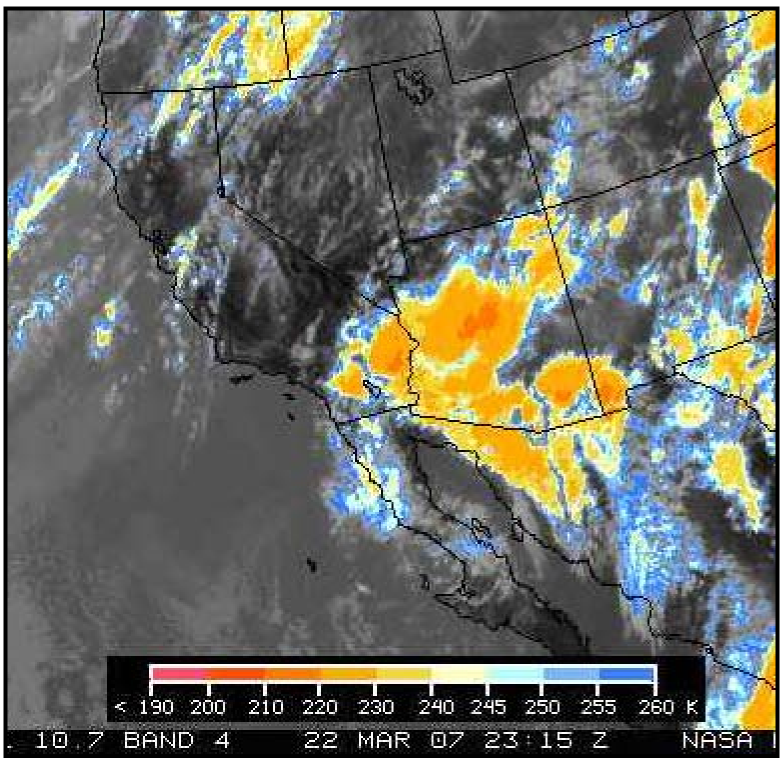


FIGURE 2-12

Infrared Satellite Images for 1515 PST Thursday, March 22, 2007

(the second image includes color enhancement to highlight colder/higher clouds)

Figure 2-13 shows the NWS 500 MB analysis for 1600 PST in the afternoon of March 22. The center of the upper level low moved slightly to the east since the 0400 PST analysis and strong winds continued, to 86 mph (75 knots), from the south around the eastern flank of the low. The low pressure center shown in the surface analysis at this time (Figure 2-14) is less defined that it was 3 hours previously and the 1005 MB low has moved closer to the southern California coast. This is a result of higher pressure (to 1012 MB) that developed over south central Arizona as a result of thunderstorm outflow boundaries, depicted in the NWS surface analysis. Low level flows from the south and east continued to affect the Coachella Valley at this time. At 1555 PST, NWS San Diego reported that the thunderstorms over the deserts were moving to the west toward the mountains at 25 mph with gusty downdrafts to 40 mph producing areas of blowing dust. This activity was predicted to continue through 1700 PST. Similarly, the showers and isolated thunderstorms between Ludlow Arizona and Yucca Valley were moving west at this time toward the Apple Valley, Lucerne Valley and the San Bernardino mountains, with gusty downdraft winds to 40 mph and areas of blowing dust. At 1556 PST, the NWS Phoenix now-cast described scattered thunderstorms affecting eastern Riverside County, including Interstate 10 and Imperial County, especially to the north and west of Calipatria and over the Salton Sea. These were predicted to move west at 25 mph, producing wind gusts in excess of 40 mph, areas of dense blowing dust with visibility below 1 mile, small hail, and brief heavy rain. The infrared satellite images at 1545 PST (Figure 2-15) show that the cloud masses have extended to the west to cover much of the California lower deserts and into San Diego County, with large areas of very high, cold clouds from the continuing thunderstorms.

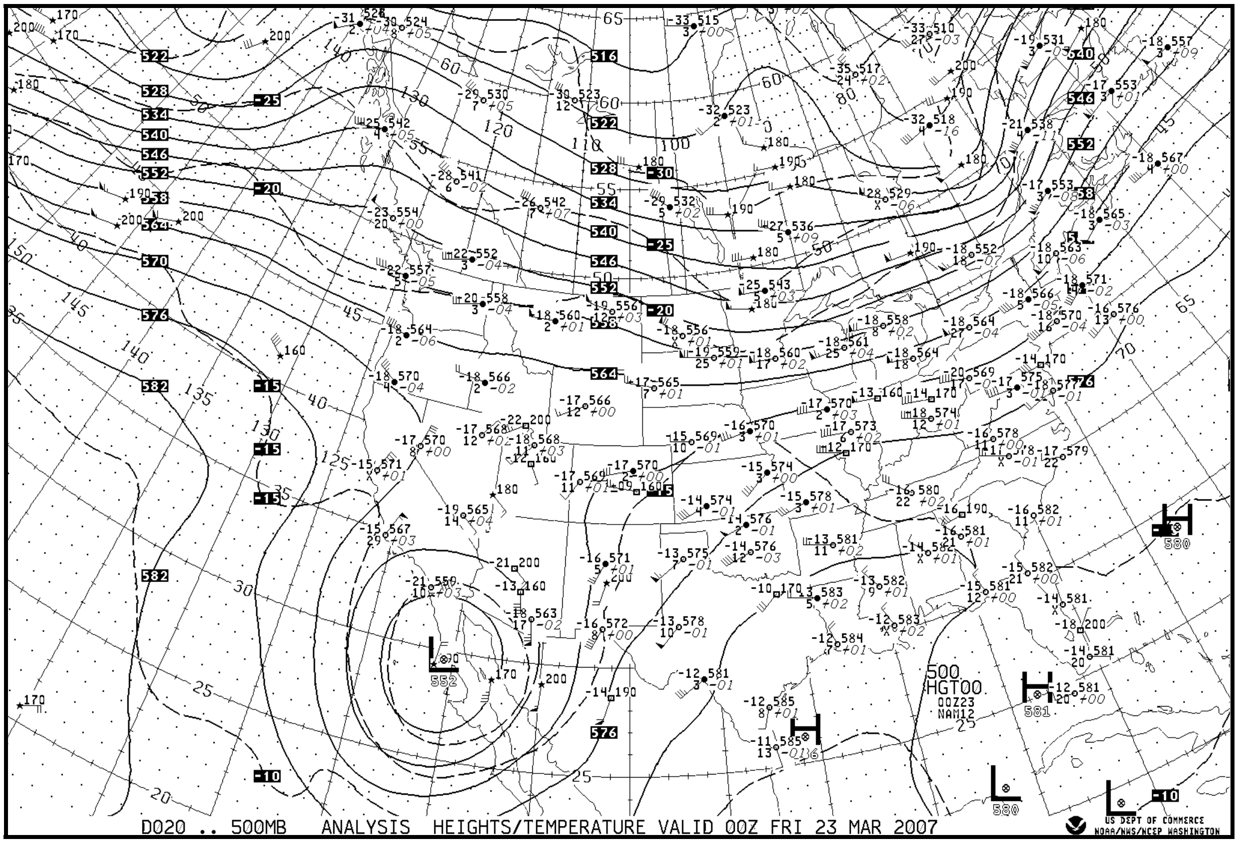


FIGURE 2-13

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 1600 PST Thursday, March 22, 2007

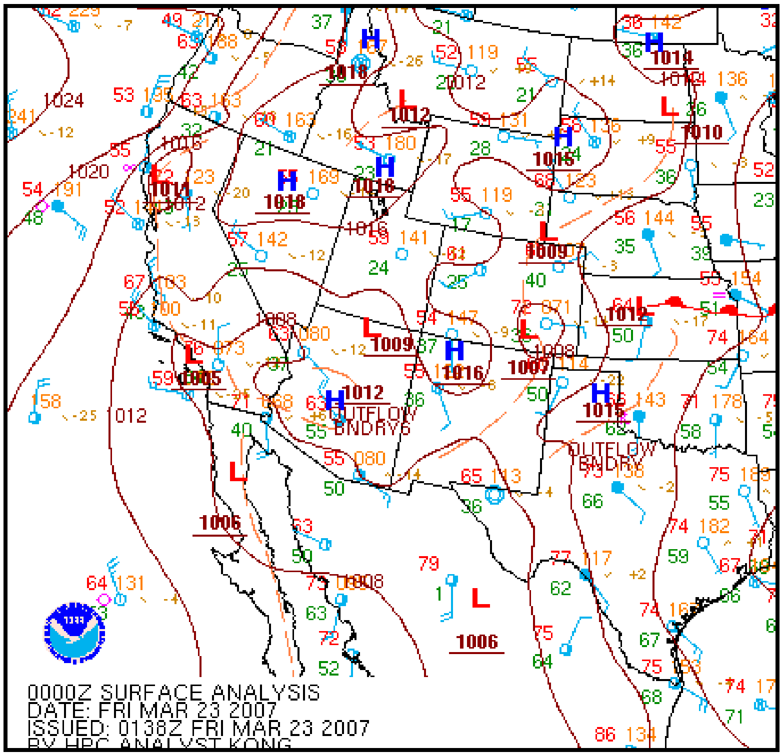


FIGURE 2-14

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 1600 PST Thursday, March 22, 2007

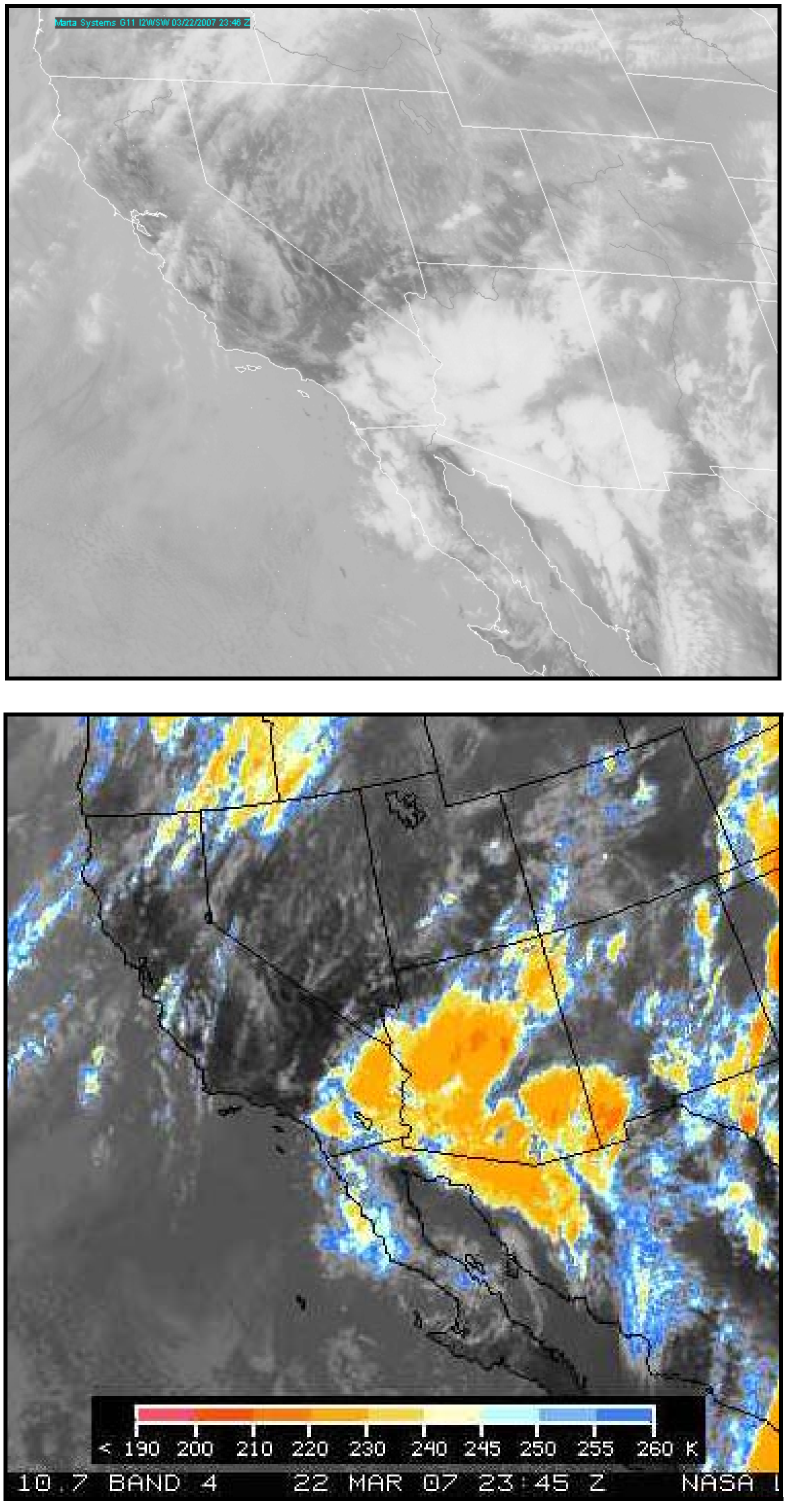


FIGURE 2-15

Infrared Satellite Images for 1545 PST Thursday, March 22, 2007

(the second image includes color enhancement to highlight colder/higher clouds)

The thunderstorm activity continued through 1715 PST, although the California storms started to diminish as can be seen in the infrared satellite image (Figure 2-16). A significant thunderstorm cell is still evident north and west of the Salton Sea at this time that was still influencing the 311 $\mu g/m^3$ PM10 BAM concentration at Indio for the hour starting at 1700 PST. The timing of this thunderstorm development and PM10 is consistent with the distance the secondary gust front traveled that was observed at Blythe approximately three hours earlier. The thunderstorms were reported by NWS to be traveling at approximately 25 mph toward the west from Blythe, so they would have reached the 86 miles to Indio in just over three hours.

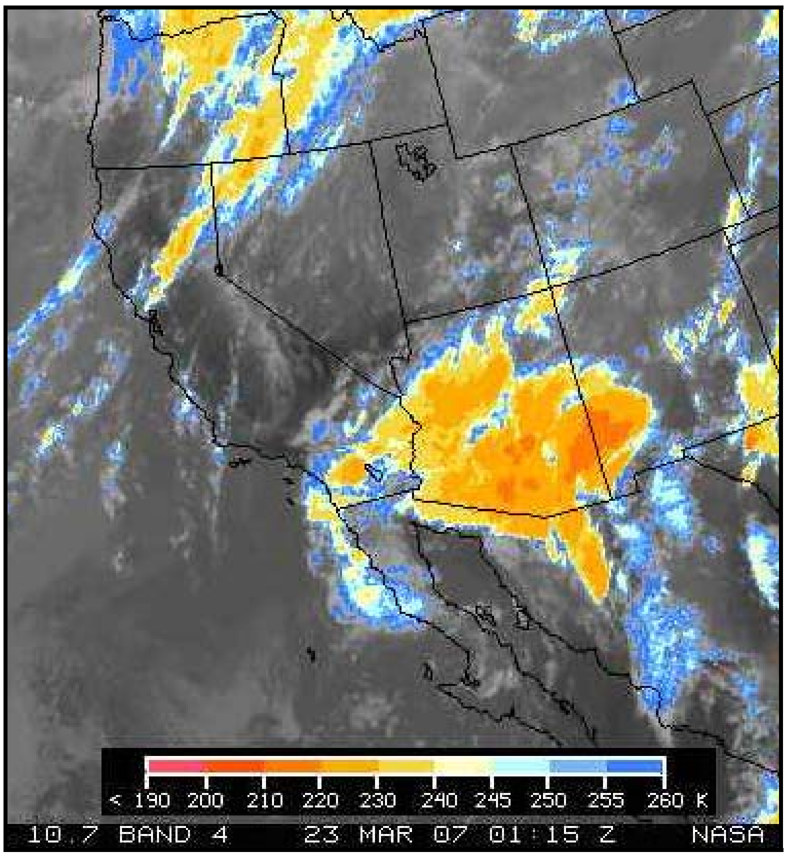


FIGURE 2-16

Infrared Satellite Images for 1715 PST Thursday, March 22, 2007

(this image includes color enhancement to highlight colder/higher clouds)

As sunset approached and the temperatures cooled, the convection in California continued to decrease. By 1815 PST (Figure 2-17) some small convection is still evident around the Coachella Valley, but the large thunderstorms are mainly confined to Arizona and along the Arizona/California border. Convection and light precipitation continued near Blythe through the end of the day as well as in Arizona. Precipitation ended in Imperial County by 2000 PST. Table 2-5 shows the hourly and daily total precipitation throughout the California lower deserts. Stations near the Coachella Valley measured only small amounts of precipitation, indicating that the thunderstorms were relatively dry with little rain reaching the ground. Thermal Airport, the precipitation station closest to Indio only recorded trace amounts of rain in the afternoon and the daily total was less than 0.01 inches (trace). Blythe Airport reported a total of 0.22 inches of precipitation in the afternoon, the highest of the California lower desert stations. Rain amounts in Arizona were higher; Phoenix recorded 0.80 inches. While the thunderstorms in Arizona probably contributed dust from outflows to the PM10 measured at Indio, the drier California desert thunderstorms had the greatest impacts. The temperature at Thermal Airport in the Coachella Valley had reached 85 degrees F in the afternoon of March 22. The maximum temperature at Palm Springs was 82 degrees F. The temperatures in Blythe, Needles and the Imperial County stations were several degrees cooler, due to the more persistent cloud cover.

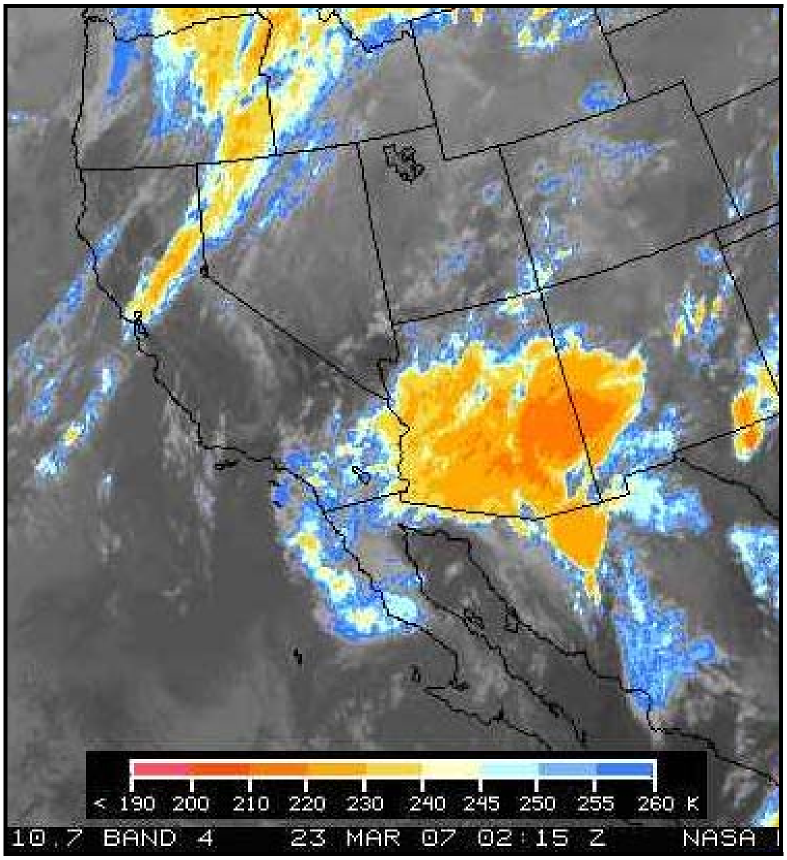


FIGURE 2-17

Infrared Satellite Images for 1815 PST Thursday, March 22, 2007

(this image includes color enhancement to highlight colder/higher clouds)

TABLE 2-5

Hourly Precipitation (in inches; T = Trace = < 0.01 inches) Measured on March 22, 2007

Hourly Precipitation (inches)								
DATE	**HOUR (PST)**	**Palm Springs Airport**	**Thermal Airport**	**Blythe Airport**	**Needles Airport**	**Imperial**	**El Centro NAF**	**Campo**
3/22/07	0000							
	0100							
	0200							
	0300							
	0400							
	0500							
	0600							
	0700							
	0800							
	0900				T			
	1000						0.11	
	1100			T				
	1200				0.04			
	1300				T			
	1400		T	0.04				
	1500	T	T	0.08				
	1600	0.01		0.03				
	1700		T	0.02		T	T	
	1800		T	T		T	0.01	0.02
	1900					T	T	0.02
	2000							
	2100							
	2200			0.02				
	2300			0.03				
Total		**0.01**	**T**	**0.22**	**0.04**	**T**	**0.12**	**0.04**

Windblown Dust Analysis

The wind data from the AQMD Coachella Valley air monitoring stations (Table A-1) and the supplemental Coachella Valley Meteorological Network (Table A-1) for March 22, 2007 are listed in the Appendix, Supporting Documents, Section A.1 Surface Weather Observations. Tables A-3 through A-10 in Section A.1 show the National Weather Service (NWS)/Federal Aviation Administration (FAA) weather observations throughout the southern California deserts. The wind data from Thermal Airport (Table A-4) and Blythe Airport (Table A-5) best show the progression of this event and are referenced most in this section.

The previous section described the synoptic meteorological conditions that induced thunderstorm activity that moved through the lower deserts toward the west, from Arizona to the coast. The thunderstorm activity was reported to advance at approximately 25 mph with multiple gust fronts, moisture, afternoon heating, instability and terrain working together to cause gusty winds that brought two significant PM10 peaks to Indio. The winds near the surface in the Coachella Valley and the surrounding desert areas were rather complex on March 22, as is illustrated in Figure 2-18, which shows a time series of the hourly wind vectors at each weather station in and near the Coachella Valley. Banning Airport (BNAP) show consistently strong easterly flow throughout the afternoon. The winds in the northern half of the Coachella Valley, Palm Springs (PSP and PLSP), Whitewater Wash (WWW), Desert Hot Springs (DHS) and Palm Desert (PDT) are generally not as strongly affected by thunderstorms, but become easterly in the afternoon.

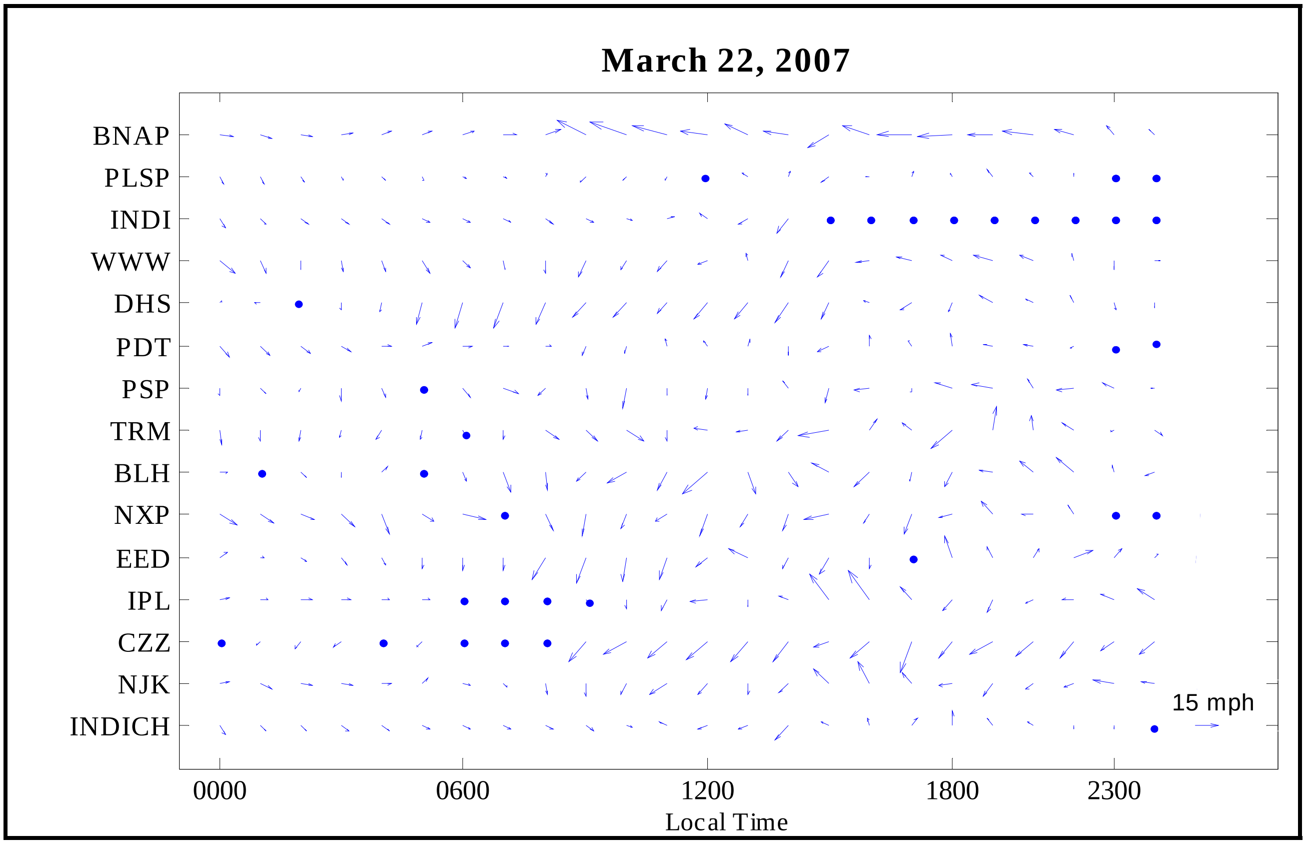


FIGURE 2-18

Time Series of Hourly Wind Vectors for Meteorological Stations in and near the Coachella Valley on March 22, 2007

(AQMD Stations: BNAP = Banning Airport, PLSP = Palm Springs, INDI = Indio, WWW = Whitewater Wash, DHS = Desert Hot Springs, PDT = Palm Desert, INDICH = Indio reprocessed Chessell recorder data; NWS/FAA Stations: PSP = Palm Springs Airport, TRM = Thermal Airport, BLH = Blythe, NXP = Twentynine Palms, EED = Needles, IPL = Imperial, CZZ = Campo, NJK = El Centro NAF)

Winds at Blythe Airport (BLH) and Thermal Airport (TRM) were more directly impacted by the thunderstorms. Therefore, winds at these locations were erratic and gusty as individual storm cells formed and decayed and outflow boundaries developed in the unstable atmosphere, enhanced by topographic effects. Thermal Airport, approximately 7.5 miles southeast of Indio, shows sustained easterly flows at the times of the peak PM10 measurements at Indio, the hours starting at 1500 and 1700 PST. This is consistent with the direction from which the thunderstorms approached the Coachella Valley from the Blythe area. The data logger at Indio (INDI) did not report winds in the afternoon of March 22, but instantaneous values measured every minute by an electronic strip chart recorder were averaged (INDICH). The winds at Indio are somewhat lighter than those at Thermal, which is typical of this location.

The winds at the AQMD Indio air monitoring station (Table A-1) were light from the west-northwest through the morning of March 22, with hourly averages to 8 mph and wind gusts to 10 mph. Wind shifts occurred before noon, becoming east-southeasterly with gusts increasing to 13 mph. The thunderstorm activity that had affected Arizona reached Blythe by 1200 PST, creating downdrafts and wind gusts in the open desert near and entraining dust into the atmosphere. Figure 2-19 shows the hourly wind speeds and gusts, when reported, for Blythe Airport and Thermal Airport, along with the Indio BAM hourly PM10. The NWS winds from Blythe Airport (see also Table A-5) increased to 18 mph sustained with gusts to 24 mph from the east-northeast for the routine observation at 1150 PST. Thunderstorms were reported in the vicinity along with lightning to the north and northeast. Special observations were issued for Blythe at 1153 PST and 1200 PST with sustained wind speeds increasing to 22 mph and 31 mph, respectively, and gusts to 26 and 43 mph. The peak wind of 43 mph occurred at 1157 PST.

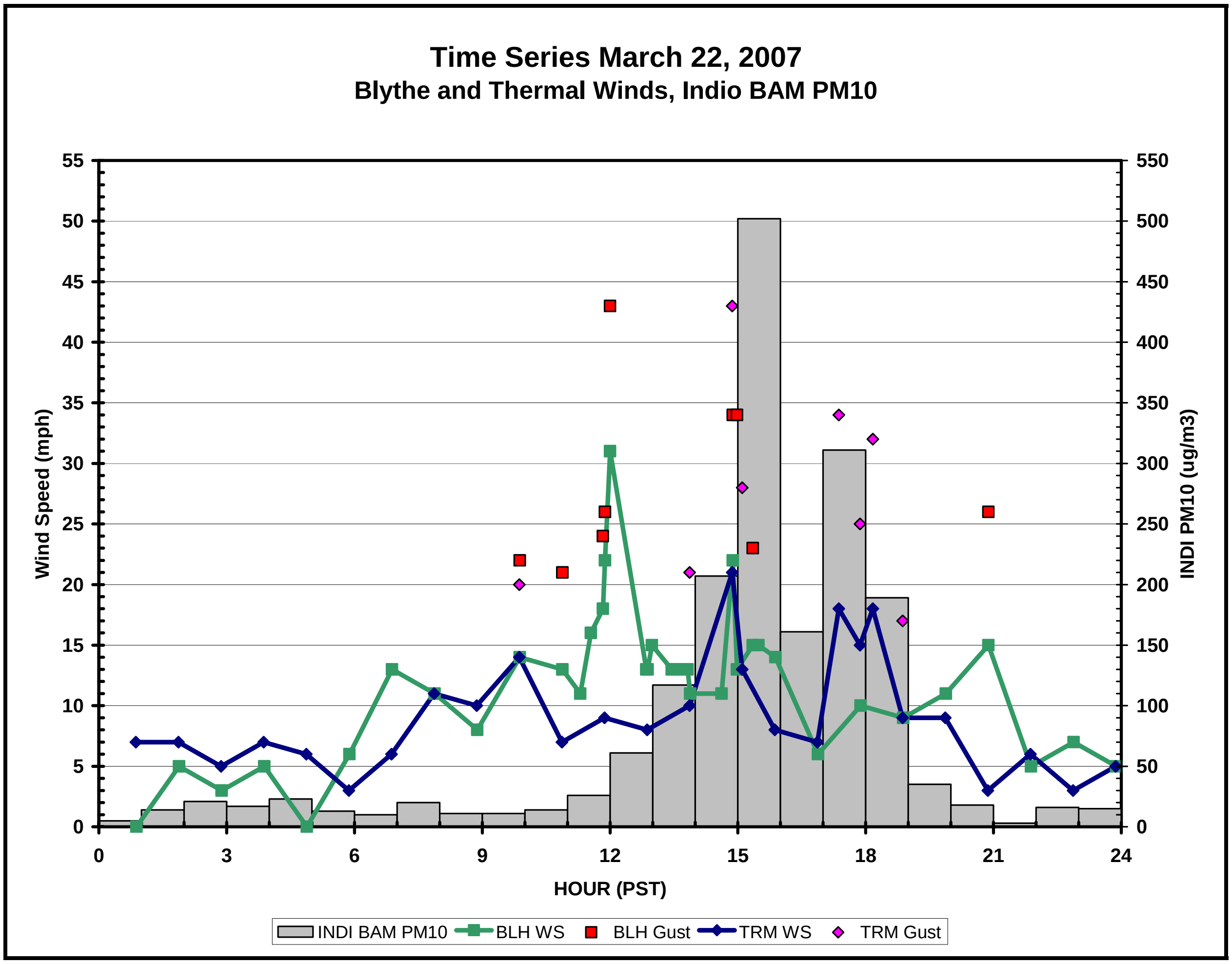


FIGURE 2-19

Time Series of Hourly Wind Speeds (mph) and Gusts, when reported, for NWS Weather Stations at Blythe and Thermal with Hourly BAM PM10 (μg/m^3) from Indio, on March 22, 2007

The sustained wind of 31 mph and gust of 43 mph measured at Blythe were the highest recorded in the southern California deserts during this storm event, although it is likely that higher winds occurred in the open desert where wind measurement are scarce. The winds at Blythe decreased by 1300 PST as the strongest thunderstorms moved to the west and northwest. The hourly BAM PM10 at Indio was still low at this time, but started to increase. The Indio station is approximately 86 miles west of Blythe Airport, so the movement of gust fronts and developing thunderstorms at 25 mph would be expected to peak at Indio in just over three hours, bringing dust from the desert areas in between. Consistent with this, the peak BAM PM10 at Indio occurred during the 1500 PST hour.

At 1210 PST, the NWS Phoenix now-cast reported a strong thunderstorm 10 miles northwest of Blythe that was predicted to produce gusty winds to 45 mph as it continued to move northwest in the open desert of eastern Riverside County. They also predicted areas of blowing dust along Interstate 10, which runs east-west between Indio and Blythe. Further north at Needles (Table A-6), the winds had peaked at 37 mph from the southeast, at 1236 PST, as the thunderstorm activity in that area peaked. By the routine observation at 1256 PST, the Needles wind gust had dropped to 29 mph as the thunderstorms moved to the west.

At 1300 PST, the NWS San Diego now-cast reported thunderstorm activity over Imperial County, in addition to the eastern Riverside County deserts, moving west at 20 mph, and predicted to bring downdraft wind gusts to 35 mph as they moved across the Anza Borrego Desert, the San Diego County mountains, the Coachella Valley and the eastern slopes of the Riverside County mountains. The BAM PM10 at Indio climbed to over 200 $\mu g/m^3$ during the hour starting at 1400 PST. The hourly averaged winds at Indio were northeasterly during the hour starting at 1400 PST. Further north in the Coachella Valley, the AQMD Whitewater Wash station (Table 2-8) measured wind gusts that peaked at 29 mph during the 1400 PST hour, from the north-northeasterly direction.

The Niland PM10 BAM in Imperial County (Table 2-3), east of the southern Salton Sea, spiked to 717 $\mu g/m^3$ during the hour beginning at 1400 PST, under relatively weak northerly flow. In a 1422 PST now-cast, NWS San Diego reported that the Doppler radar had detected a strong thunderstorm at 1415 PST over the northern Salton Sea, near the town of Desert Shores, which is on the west side of the northern part of the lake, just south of the Riverside/Imperial County border. This storm was moving at 25 mph and was expected to bring gusty downdraft winds to the Anza Borrego Desert and Coachella Valley through 1530 PST.

In their 1455 PST now-cast, NWS San Diego reported that the Doppler radar had detected a thunderstorm at 1450 PST over the southern Coachella Valley. It was moving west at 25 mph toward the Santa Rosa Mountains, which are on the west side of the southern portion of the Coachella Valley. The NWS predicted this thunderstorm to produce gusty downdraft winds to 40 mph with areas of blowing dust. The peak 1-instantaneous wind speed at Indio was 24 mph, as measured once per minute by the electronic strip chart recorder, occurred at 1457 PST. About 5 miles further north from Indio on the I-10 at Jefferson Street, the Caltrans District 8 Road Weather Information System (RWIS) measured easterly winds at this time, recording the highest wind of the day at that location and the only gust over 25 mph. The RWIS 10-minute averaged wind speed starting at 1501 PST was 25 mph, with a peak gust of 29 mph during that period. The hourly averaged winds at Indio during the 1500 PST hour were easterly at 7 mph, with a 1-minute peak of 21 mph from the east-northeast at 1501 PST. The Indio BAM

PM10 peaked during the 1500 hour, measuring 502 μg/m^3, with significant windblown dust due to the thunderstorms to the east and the south of the station.

In the Coachella Valley south of Indio, the Thermal Airport winds (Figure 2-19 and Table A-4) were easterly at the routine observation at 1452 PST, with a sustained wind of 21 mph. A peak wind gust of 43 mph had occurred at 1450 PST, the same as the peak gust measured earlier at Blythe. Visibility at Thermal dropped to 2.5 miles at this time and haze (HZ) was reported, due to the entrained dust. The automated weather stations often report haze instead of blowing dust. No rain had fallen at Thermal at this time, but light rain began at 1457 PST with only trace amounts measured. Further east at Blythe (Figure A-5), the wind gusts peaked again to 34 mph at 1457 PST, as a strong thunderstorm again developed in the area. Visibility at Blythe dropped to 4 miles with rain falling. The PM10 BAMS at Brawley and Mexicali in Imperial County, peaked at 188 and 401 μg/m^3, respectively, during the hour starting at 1500 PST (Table 2-4).

In their 1555 PST now-cast, NWS San Diego reported as of 1550 PST the thunderstorms over the southern California deserts were moving west toward the mountains at 25 mph, with gusty downdraft winds to 40 mph producing blowing dust. At 1556 PST, the NWS Phoenix now-cast described scattered thunderstorms affecting eastern Riverside County, including Interstate 10 and Imperial County, especially north and west of Calipatria and into the Salton Sea area. These were moving west at 25 mph, producing wind gusts in excess of 40 mph and areas of dense blowing dust with visibility below 1 mile. The Indio hourly averaged winds for the 1600 PST hour shifted to southeasterly and weakened to 5 mph with a 1-minute instantaneous peak of 15 mph. This briefly shifted the flow to Indio away from the main thunderstorm activity to the east and the BAM PM10 concentration for the hour dropped to 161 μg/m^3.

During the 1700 PST hour, the Indio BAM PM10 spiked again to 311 μg/m^3, as the winds shifted to southerly at an hourly average of 7 mph and a peak 1-minute instantaneous wind speed of 14 mph. A strong thunderstorm cell was still evident north and west of the Salton Sea at this time (Figure 2-16), which contributed windblown dust to the Indio PM10. An observation from Thermal Airport (Table A-2) noted a wind shift that occurred at 1702 PST from southeasterly (130 degrees) to northeasterly (50 degrees). The Thermal wind gusts peaked again at 1714 PST to 34 mph, with sustained winds northeasterly at 18 mph. The thermal winds shifted again at 1750 PST to southerly (190 degrees) with peak wind gusts to 25 mph and 32 mph, measured at 1752 and 1805 PST, respectively. The Caltrans RWIS system at I-10 and Jefferson measured a peak gust of 25 mph during the 10 minute average that started at 1650 PST with sustained winds of 20 mph from the east. The RWIS winds during the 1700 PST hour were from the south and southeast and relatively light.

During the 1800 PST hour the RWIS winds were southerly and below 16 mph for the peak gust. The Indio winds were also southerly during the 1800 PST hour, increasing to

10 mph for the hourly average with a peak 1-minute instantaneous speed of 16 mph. The Indio BAM PM10 at this time was 189 $\mu g/m^3$. After this, the Indio and Thermal winds remained light and the BAM PM10 concentrations remained low for the rest of the night as the thunderstorm activity decayed.

Since wind measurements in the desert between Blythe and Indio are sparse, weather logs were obtained from the California Highway Patrol (CHP) Indio Dispatch Center, whose patrol officers report weather conditions that affect highway travel. These are summarized in Table 2-6 and are reproduced in the Appendix, Section A.2. No CHP weather logs were available near 1200 PST when the strongest winds were measured at Blythe. At approximately 1500 PST, heavy winds, rain and limited visibility were reported from the desert area along I-10 from Blythe Airport westward to Wiley's Well Road, a stretch of highway approximately ten miles long. This timing coincides with the second period of gusty winds measured at Blythe Airport when sustained winds reached 22 mph and gusts exceeded 35 mph with thunderstorms reported. A few minutes later, another CHP weather log reported strong winds with blowing dust from near the eastern edge of the City of Indio to the State Route 86 South Expressway near Coachella, which runs to the south of 1-10 close to Thermal Airport. This coincides with the timing of the strongest winds measured at Thermal, 21 mph sustained and gusts to 43 mph, and visibilities reduced. The 1513 PST CHP weather log reported hail and heavy rain with visibilities reduced to 500 feet between Desert Center and Blythe as thunderstorm activity in that area had progressed to the west almost 25 miles. Around the same time, rain was reported in Indio and limited visibility due to blowing dust was reported on I-10 at Washington Street near the City of Bermuda Dunes, about 6 miles northwest of Indio. At 1814 PST, strong gusty winds and light rain were reported at near Thermal Airport. At this time Thermal Airport reported sustained winds of 18 mph and peak gusts to 32 mph. This was just after the secondary PM10 peak measured by the Indio BAM of 311 $\mu g/m^3$ measured during the 1700 PST hour.

TABLE 2-6

Summary of California Highway Patrol Weather Logs from the Indio Dispatch Center (Coachella Valley to Blythe) on March 22, 2007
(MM = Mile Marker, starting from Riverside County Line, increasing to east or north;
I = Interstate, SR = State Route)

Report Time (PST)	Location	Event Detail
1459	Blythe: I-10 between MM 135 and 145 (from Wiley's Well Road to Mesa Drive on west side of Blythe, near Airport)	**Heavy wind** and rain, **limited visibility** on I-10 between mile marker 135 and 145
1502	East end of Indio & SR86 near Coachella (South of I-10)	**Strong winds** on east end; SR86 South Expressway has a lot of **dust**
1513	I-10, MM 121 (between Corn Springs Road & Ford Dry Lake Road, between Desert Center & Blythe	Hail and heavy rain, **visibility** down to **500 feet**
1516	I-10 at Washington near Bermuda Dunes (NW of Indio) and Indio	**Limited visibility due to blowing sand** at Washington; raining in Indio
1520	Banning	Overcast and **windy** in Banning Scattered showers, overcast and cold
1534	All	CHP Indio updated road condition recording
1736	Blythe, SR 78 at 22nd	Blythe area flooding on SR78 at 22nd
1752	Hwy 62 & south	Light to moderate rain from Hwy 62 to the south
1814	Thermal, at Airport	Light rain but **strong gusty winds** in Thermal
0036 (3/23/07)	Indio	Indio Area Clear

The strong winds measured at Blythe and Thermal, as well as the reports of thunderstorm winds and blowing dust, support that the PM10 at Indio was due to windblown dust generated from the surrounding desert areas, mainly from the east and also form the south near the Salton Sea. The winds at the AQMD Banning Airport air monitoring station (Table 2-7) in the San Gorgonio Pass, which is open to east-west flows, remained easterly after mid-morning and through the afternoon, confirming the overall easterly transport flow. The Banning 1-minute-averaged maximum wind from each hour reached or exceed 25 mph during 10 of the 12 hours between 0900 and 2000

PST, related to the continuing thunderstorm activity to the east near the Colorado River Valley.

Hourly winds aloft, below 10,000 feet (3000 meters), are shown in Figure 2-20 from the AQMD radar wind profiler at Moreno Valley in Riverside County, the closest upper air station. This station is west of the mountains from the Coachella Valley in the South Coast Air Basin. Winds near 1200 feet (400 meters) were westerly through the morning, since the low-level flow west of the mountains were not yet affected by the easterly winds aloft. Above 1200 feet, the flows aloft were consistently from the east through the day, supporting the transport of entrained dust from the deserts east of Indio. Wind speeds were over 35 mph in the morning, weakening considerably in the afternoon by 1500 PST and through the evening. The easterly winds at Moreno Valley mixed down to the surface in the afternoon, remaining strong for the 1200 and 1300 PST hourly averages.

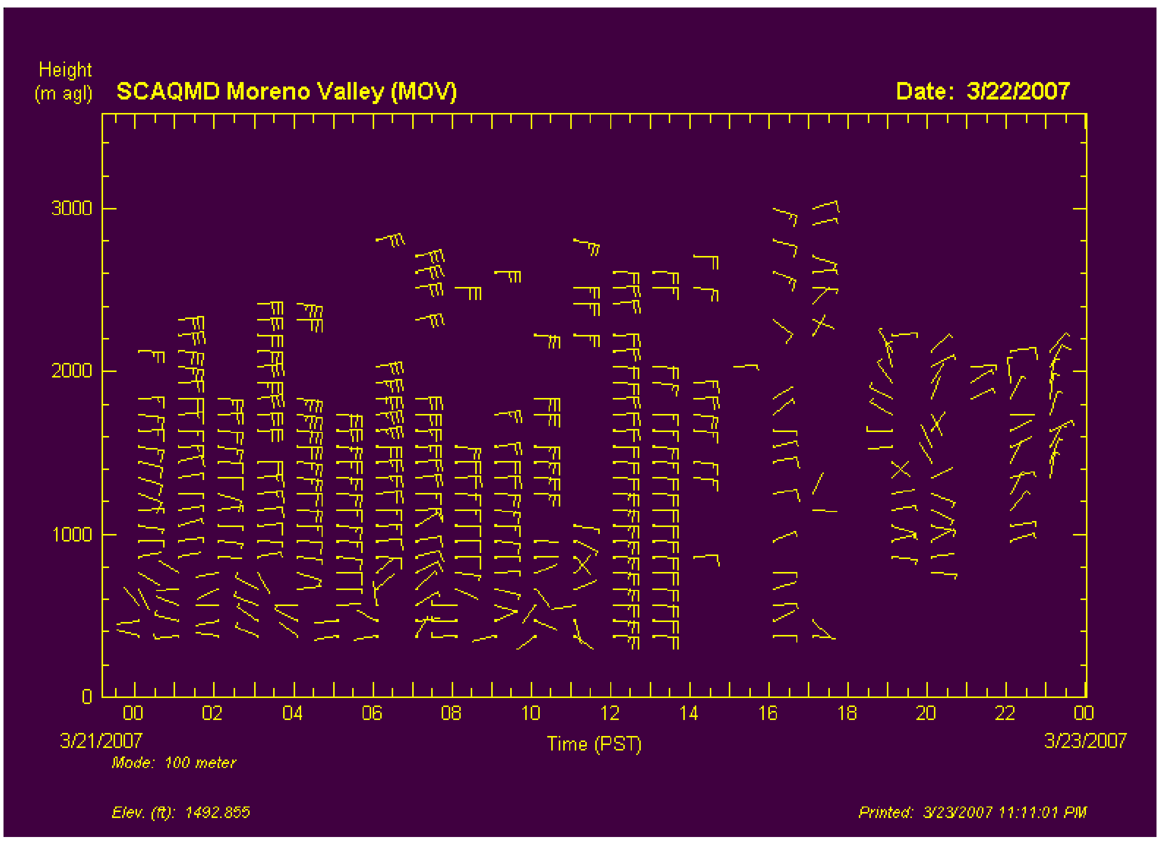


FIGURE 2-20

Time Series of Hourly Wind Barbs with Height for the AQMD Moreno Valley Upper Air Station on March 22, 2007

Figure 2-21 shows the back trajectories calculated using the NOAA Hysplit trajectory model with the 40 km grid resolution EDAS North American Model (NAM) meteorological data. Each chart shows the origin of the airmass over a 24-hour period that reached the Indio monitoring station at the time shown in the afternoon of March 22, that is, for each hour between 1500 PST (23 UTC) and 1800 PST (02 UTC, March 23). This is the time range when the peak PM10 concentrations were measured by the Indio BAM. The trajectories show that the airmass that impacted Indio during this time period originated over western Arizona and traveled over the eastern California lower deserts. This provides further evidence that most of the windblown dust that influenced the Indio PM10 measurements was transported from the thunderstorm activity in Arizona and California along the Colorado River Valley and in the eastern lower deserts of California between Blythe and Indio. The primary transport route was along the Interstate 10 corridor from the Arizona border into the Coachella Valley.

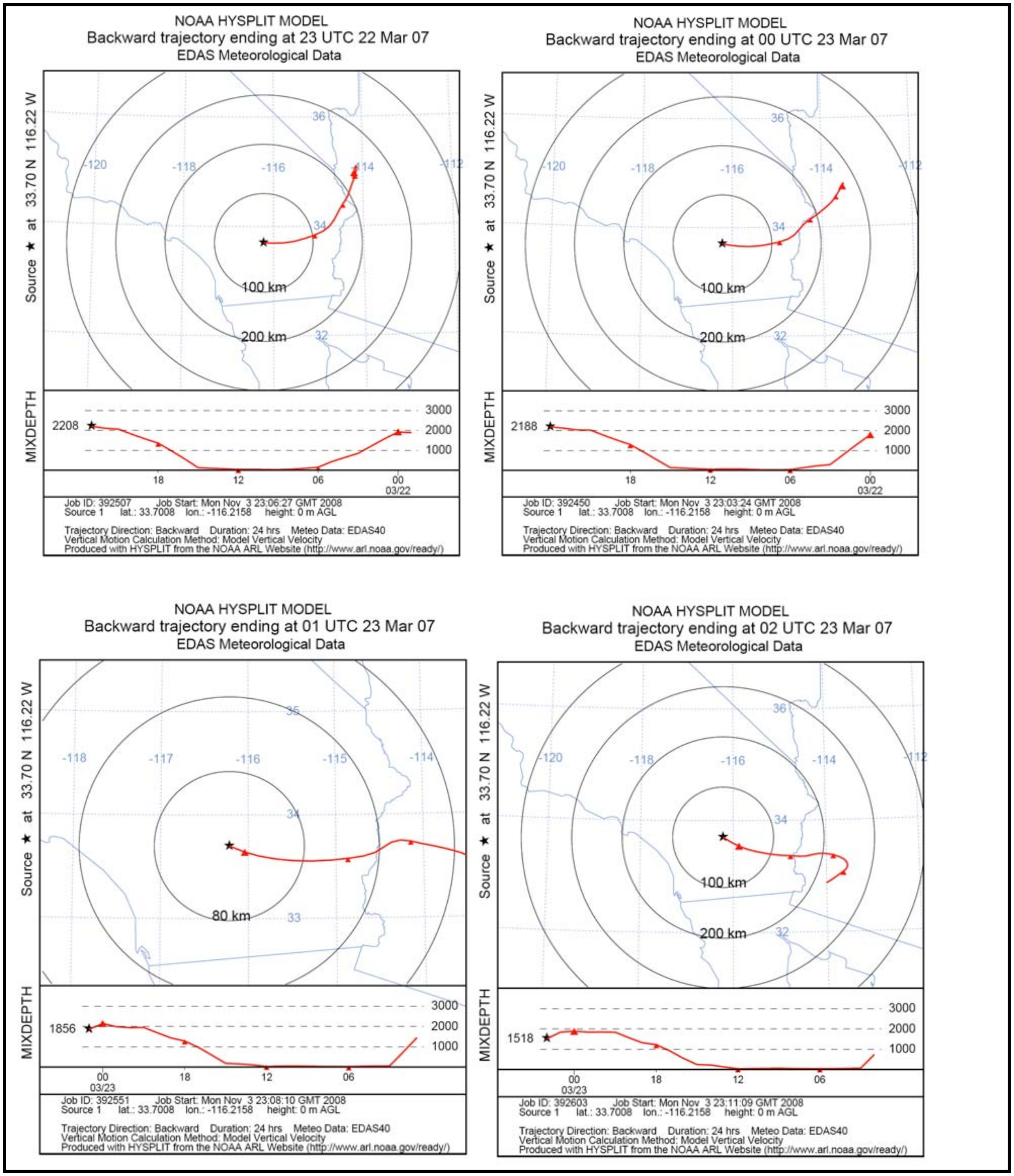


FIGURE 2-21

24-Hour Back Trajectories indicating potential source of air reaching the Indio Station at 1500 PST (23 UTC), 1600 PST (00 UTC), 1700 PST (01 UTC) and 1800 PST (02 UTC) on March 22, 2007, from NOAA Hysplit Model using EDAS Meteorological Inputs

Conclusion

While the analysis of this event is somewhat complex, with erratic, shifting winds and entrainment and transport of dust from thunderstorm outflows over the open desert, this episode is well supported as a high-wind natural event under the U.S. EPA exceptional events regulation. Windblown dust transported from thunderstorm activity over Arizona and the eastern California deserts, including the southern Coachella Valley, played a strong causal role in the measured PM10 exceedance at Indio on March 22. The timing of this windblown dust event has been illustrated with sequential satellite imagery, event record reports, meteorological observations, and the BAM hourly PM10 measurements at Indio. Sustained winds of 31 mph were recorded at Blythe, with gusts to 43 mph at both Blythe and Thermal.

The wind measurements, satellite imagery, NWS forecasts and advisories, and CHP weather logs document the thunderstorm movement and windblown dust events. It is very likely that even stronger winds occurred in the open desert where there are no wind measurements. The easterly transport flow aloft, as shown by profiler winds and back-trajectories, also show transport to Indio from the deserts further east. Reports of reduced visibilities, winds and blowing dust near Thermal and strong thunderstorms further south in the Coachella Valley show that PM10 was generated in the southern Coachella Valley, along with the transported particles from the east. If not for this high wind event, the PM10 NAAQS violation measured at Indio would not have occurred. Therefore, AQMD staff recommends the flagging of the PM10 NAAQS violation at the Indio air monitoring station on March 22, 2007 as a high wind natural event in the U.S. EPA Air Quality System.

3. HIGH-WIND NATURAL EVENT ANALYSIS: April 6, 2007

3.1 Event Summary

April 6, 2007 PM10 Exceptional Event at the Indio Station

A violation of the PM10 NAAQS was recorded in the Coachella Valley at the AQMD Indio air quality monitoring station on April 6, 2007. The 24-hour mass concentration was 157 $\mu g/m^3$, as measured with a federal reference method (FRM) size-selective inlet (SSI) filter-based PM10 sampler. This event meets the criteria for high wind natural events as defined in the EPA Exceptional Events Rule. As an upper level trough moved through, a deep marine layer west of the San Gorgonio Pass and strong onshore pressure gradients caused flows through the Pass and high winds along the Coachella Valley northwest of the Indio station. For AQMD Rule 403.1, the AQMD Meteorology Secton had issued a High Wind Day forecast on the previous day, valid for April 6.

The source of the windblown dust was primarily the natural blowsand source area, but BACM-controlled anthropogenic sources also contributed. The PM10 measured at Indio on April 6 occurred, under northwesterly, along-valley wind flows that prevailed throughout the day. The timing of the this event is verified with the high wind observations and reports of reduced visibility, in conjunction with the hourly BAM PM10 data from Palm Springs, used since the Indio BAM was not operational on this day. The highest one-minute averaged winds at Indio peaked at 19 mph on April 6, indicating that windblown PM10 from localized sources close to the Indio station were not as significant as that generated further upwind in the northwestern Coachella Valley.

This wind event was relatively widespread throughout the Valley, but the strongest winds were measured at the AQMD Whitewater Wash wind station, located near the centerline of the valley southeast of the San Gorgonio Pass. Hourly averaged sustained wind speeds, primarily over the natural desert blowsand source areas in the northwestern Coachella Valley, exceeded 25 mph throughout much of the day on April 6, as shown by the Whitewater Wash wind data. The strongest winds were measured in the afternoon and evening with wind gusts over 45 mph during every hour. The winds peaked for the day in the Whitewater Wash area at 1900 PST with an hourly average of 34 mph and a peak gust of 53 mph. This timing coincided with the time that the Palm Springs BAM PM10 peaked. Gusty winds to 34 mph and reduced visibilities were also recorded at the National Weather Service (NWS) station at Thermal Airport, located approximately 8.6 miles further downwind from the Indo monitor. Reports of strong winds in the evening near the eastern end of Indio were recorded in the California Highway Patrol (CHP) weather log. A now-cast issued by the NWS San Diego forecast office later that evening reported that strong winds in the Coachella Valley had reduced visibility to ¼ mile in blowing dust in the Thousand Palms area, downwind of the blowsand source area and upwind of the Indio station near the Coachella Valley Preserve. With the weight of evidence provided, AQMD concludes that the PM10 exceedance would not have occurred without the high winds and wind-entrained dust.

Flagging of Data

AQMD has submitted the PM10 data from this monitor to the EPA AQS database and has placed the appropriate flags on the data indicating that the data was affected by an exceptional event due to high winds (Flag RJ, requesting exclusion due to high winds). Such flagging ensures that the air quality data is properly represented in the overall air quality process.

Exceptional Event Criteria Summary

40 CFR 50.1(j) of the Exceptional Events Regulation defines an exceptional event as an event that:

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

The following sections describe how the first three criteria are met for the April 6, 2007 high wind natural event at Indio.

Affects Air Quality

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

The documentation provided herein for the April 6, 2007 natural event at Indio provides the required information to establish a causal connection between the high winds in the Coachella Valley and the high concentration measured at the Indio monitor. The measured 24-hour PM10 concentration of 157 $\mu g/m^3$ at Indio shows that air quality was affected. Concentrations were low on the days before and after the high wind event, as is shown in Table 3-2 . The hourly PM10 concentrations in the Coachella Valley increased rapidly as the winds peaked, as is shown in Figure 3-11. As was shown previously in Section 1.7, in over 16 years of analyzed data such high 24-hour PM10 concentrations are not reached in the Coachella Valley except when caused by high winds. Section 3.2, Detailed Event Analysis, includes meteorological data showing a clear correlation between strong, gusty winds and increased hourly PM10 at the Palm Springs station. The supporting documentation also includes a National Weather Service (NWS) now-cast of high winds and windblown dust and related California Highway Patrol (CHP) weather logs. The measured exceedance on April 6, 2007 is in excess of normal fluctuations, as is discussed further below.

Is Not Reasonably Controllable or Preventable

This requirement is met by demonstrating that despite reasonable and appropriate measures in place, the April 6, 2007 wind event caused the NAAQS violation. During this event, there were no other unusual PM10-producing activities occurring in the Coachella Valley and anthropogenic emissions were approximately constant before, during and after the event. In addition, reasonable and appropriate measures were in place, as has been described in Section 1.6, Regulatory Measures. A Rule 403.1 High Wind Day forecast was issued by AQMD on April 6, requiring curtailment of dust-producing agricultural and construction activities and the use of mitigation measures on disturbed soil. On April 6, PM10 sulfate and nitrate measurements at Indio, as well as PM2.5 measurements at Indio and Palm Springs were relatively low, indicating primarily crustal material comprising the PM10 mass, not transported or locally generated urban pollution or combustion sources.

A survey of the available complaint records and inspection reports indicated no evidence of unusual emissions on April 6, 2007, other than related to the windblown dust event. No notices of violation or notices to comply were issued for dust-related events on April 6, 2007 in or around the Coachella Valley. Based on a review of the AQMD CLean Air Support System (CLASS) database for complaints and compliance actions, two complaints were logged by AQMD for the Coachella Valley. The first, Complaint # 190307, was regarding a 10,000 square foot site at 200 W. Oasis Road in Palm Springs. An inspection by an AQMD Compliance Division Inspector on April 10 noted that the small lot had been cleared for weed abatement and that the soil stabilizing may have been inadequate for the high wind conditions. This location is approximately 22 miles from the Indio air monitoring station. No notices of violation or notices to comply were issued in this case. The second, Complaint # 190308, was an active construction site located at 73-081 Fred Warning Drive in Palm Desert. This site is located approximately 10 miles from Indio. The complaint was followed up by an AQMD Inspector. The construction site had two water trucks on the 25 acre site, posted signs and anti track-out devices as required by Rule 403.1. The Dust Control Supervisor was certified, having attended a Rule 403.1 Fugitive Dust Class. He stated that he had gotten complaints directly from neighbors also on that weekend due to high winds and was doing his best to limit dust from leaving the site. Most pads had been stabilized and some model homes were already constructed. The AQMD Inspector considered the site in compliance at the time of inspection. PM10 at the Palm Springs air monitoring station, the closest to these complaints, did not exceed the federal standard on this day. Furthermore, the PM10 contribution from these relatively small locations was not significant, compared to the main blowsand source areas, the Whitewater River Wash and the Coachella Valley Preserve.

Smoke from wildfires, agricultural or residential burning did not appear to have added any significant amount of PM10 to the concentration recorded at Indio. PM10 was emitted from some BACM-controlled sources (mainly agricultural and construction activities) as BACM controls were locally overwhelmed by the high winds. Due to the AQMD High Wind Day forecasts issued for April 6, dirt moving construction and agricultural operations were minimal in the Coachella Valley on this day. The primary source of the windblown dust on April 6 was the natural blowsand preserve areas that were most impacted by the strong winds.

Was a Natural Event

Ambient particulate matter concentrations due to dust being raised by unusually high winds will be treated as due to uncontrollable natural events where (1) the dust originated from non-anthropogenic sources, or (2) the dust originated from anthropogenic sources within the State that are determined to be reasonable well controlled at the time the event occurred, or from anthropogenic sources outside the State. Based on previous analyses of windblown dust in the Coachella Valley, wind gusts over 22 mph are sufficient to entrain windblown dust in the atmosphere. In the preamble to the Exceptional Events Rule, EPA also explains states must provide appropriate documentation to substantiate why the level of wind speed associated with the event in question should be considered unusual for the affected area during the time of year that the event occurred. On average, the conditions that lead to high wind natural events for the Coachella Valley, including strong winds and dry soil-moisture conditions, occur only two to three times per year. EPA also notes in the Exceptional Event Rule that natural events (e.g., high winds, wildfires, etc.) my recur, sometimes frequently. The event on April 6, 2007 was a natural event in which human activity played little or no direct causal role.

On April 6, 2007, the wind entrained dust originated primarily from non-anthropogenic natural sources within the Coachella Valley, mainly the natural blowsand source areas of the Whitewater Wash and Coachella Valley Preserve System. A portion of the wind-entrained dust may have also originated from anthropogenic sources, including some agricultural operations and construction activities, that are well controlled in the Coachella Valley as described in Section 1.6, Regulatory Measures.

The analysis of the meteorological setting, including weather charts, pressure gradients and satellite imagery, indicate significant potential for strong winds in the Coachella Valley on April 6, 2007. Wind speeds in the Coachella Valley upwind of the Indio air monitoring station were high on this day, with sustained hourly-averaged wind speeds of 34 mph recorded at the AQMD Whitewater Wash station and peak wind gusts to 53 mph. Gusty northeasterly winds, reduced visibilities and reports of haze from the NWS Thermal Airport weather station, approximately 8.6 miles southeast of Indio, support the presence of windblown dust at the Indio monitor, especially in the evening of April 6. In addition, a NWS now-cast and CHP weather log also describe strong winds and blowing dust in the Coachella Valley, providing substantial weight-of-evidence for the sequence of events.

Causal Connection

This documentation shows a clear causal connection between the PM10 measured at Indio and the high winds in the Coachella Valley upwind of Indio on April 6, 2007. Figure 3-11 shows that winds in the northweatern Coachella Valley increased in the afternoon of April 6, causing increased hourly PM10 as measured by the Palm Springs BAM monitor. Hourly wind speeds of 34 mph and wind gusts to 53 mph were also recorded at Whitewater Wash and reduced visibilities and haze were reported at Thermal Airport, further south from Indio. The 24-hour wind speed at Whitewater Wash, averaged over the whole day, exceeded 27 mph from the northeast on April 6, providing windblown dust downwind to the Indio 24-hour PM10 filter sample. The causal connection is demonstrated by the dramatic increase in hourly PM10 concentrations that coincided with the transport of dust entrained by strong winds and northeasterly flows.

Concentration was in Excess of Normal Historical Fluctuations

The 157 $\mu g/m^3$ 24-hour PM10 concentration measured at Indio on April 6, 2007 is higher than the 97.5 percentile value of 108.0 $\mu g/m^3$ for all Coachella Valley FRM measurements (Indio and Palm Springs) since 1990, as shown earlier in Section 1.7, Figure 1-4. Figure 1-5 shows the distribution of all FRM SSI PM10 measurements at the Indio air monitoring station alone, from January 1990 through June 2008. The plotted concentrations for Indio are considered statistical outliers. Concentration above the 97.5 percentile value (132 $\mu g/m^3$ and above) are outside the normal range of the data. Therefore any value that exceeds the 24-hour federal PM10 standard of 150 $\mu g/m^3$ is clearly outside the normal range of data for Indio. All concentrations exceeding the federal 24-hour PM10 standard at Indio since January 1, 1993 have been attributed to high wind events, as was shown previously in Table 1-1. The concentration measured on April 6, 2007 is the 20th highest PM10 event at Indio since 1993 and events of this magnitude occur approximately 1.25 times per year, on average.

The "But For" Test

To qualify as an exceptional event, it is necessary to demonstrate that there would have been no exceedance "but for" the event. To meet this "but for" requirement, it must first be shown that no unusual anthropogenic activities occurred in the affected areas that could have resulted in the exceedances. Activities that generate anthropogenic PM10 were approximately constant in the Coachella Valley immediately preceding, during and after the event. Activity levels in the Coachella Valley were typical for the time of year and PM10 emissions control programs were being implemented, not only for fugitive dust-generating activities, but also for agricultural burning in the Coachella Valley. There were reasonable and appropriate measures in place to control PM10 in the Coachella Valley on April 6, 2007, including AQMD Rules 403, 403.1, 444, 1186 and local ordinances. Moreover, EPA has approved AQMD's BACM demonstration for all significant sources of PM10 in the Coachella Valley. The AQMD Natural Event Action Plan (NEAP) also addresses the reasonable and appropriate measures that AQMD has implemented to address high wind events in the Coachella Valley. Furthermore, due to the AQMD forecast for high winds on April 6, dust producing activities were restricted during high winds and mitigation methods like watering and soil stabilization would have been increased.

Examining the make-up of Indio PM10 on this day using Indio's FRM PM2.5 data, the coarse particles (PM10-2.5), which are associated with windblown dust, represent over 89% of the total PM10 mass collected at Indio. PM10 sulfates, nitrates and chloride components were also low on the Indio FRM sample, indicating primarily crustal material in the sample. Based on the data provided in this report, AQMD concludes that there would not have been an exceedance of the PM10 NAAQS at Indio on April 6, 2007 if high winds were not present. The causal connection of the measured strong winds in the Coachella Valley and PM10 at Indio, along with the high contribution of fugitive dust to the PM10 mass at Indio indicate that but for the high wind event this NAAQS violation would not have occurred.

Reasonable Measures

As discussed previously, approved BACM measures as in place for the Coachella Valley, as well as the South Coast Air Basin. AQMD issued a Coachella Valley Rule 403.1 High Wind Day forecast on April 6, 2007, indicating the potential for blowing dust and sand. This prediction was based on the weather pattern with an approaching upper level trough, a deep marine layer predicted in the South Coast Air Basin west of the San Gorgonio Pass, and strong predicted onshore pressure gradients. These components define the model used by the AQMD Meteorology Section for the daily high wind forecast issued for the Coachella Valley in relation to AQMD Rule 403.1. As a result of this forecast, the strictest measures were in place on dust producing activities in the Coachella Valley along with mitigation requirements for disturbed soil surfaces.

Public Notification

The South Coast Air Quality Management District (AQMD) has prepared this documentation to demonstrate that this exceedance was due to a high wind natural event, in accordance with the EPA Exceptional Event Rule. Upon transmittal of this document to the California Air Resources Board (ARB) for concurrence and forwarding to EPA, this document will be posted on the AQMD website, requesting review and comment by the public for a minimum of 30 days. Notice of its availability will also be sent to known interested parties.

Checklist of Exceptional Event Requirements

AQMD Flagging of Data	✓
Exceptional Event Criteria Summary:	
Affects Air Quality	✓
Is Not Reasonably Controllable or Preventable	✓
Was a Natural Event	✓
Causal Connection	✓
Concentration in Excess of Normal Historical Fluctuations	✓
The "But For" Test	✓
Reasonable Measures	✓
Public Notification	✓*

* 30 day public comment period starts upon transmittal of this document to ARB

3.2 Detailed Event Analysis

PM10 Summary

On April 6, 2007, the FRM size-selective inlet (SSI) sampler at the Indio air monitoring station measured a 24-hour PM10 mass concentration of 157 μg/m^3. The sulfate , nitrate and chloride mass loadings on the Indio filter on this day were 5.2, 6.4 and 0 μg/m^3, respectively, indicating that the PM10 mass was primarily crustal material on this day. The FRM 24-hour PM2.5 was 16.6 and 18.8 μg/m^3, respectively, at Indio and Palm Springs on March 22, within the PM2.5 24-hour federal standard and again indicating that the wind blown sand and dust were the primary components with only a small influence from combustion sources.

The Indio FRM PM10 sampler operates on a one-in-three-day schedule. Since measurement was also on the standard one-in-six-day schedule, SSI data was available from the Coachella Valley 1 (Palm Springs) air monitoring station, which measured 64 μg/m^3. The sulfate , nitrate and chloride mass loadings on the Palm Springs filter on this day were 4.1, 4.1 and 0.1 μg/m^3, respectively, indicating that the PM10 mass was primarily crustal material on this day. The Palm Springs monitoring station is sheltered from the strong winds by the San Jacinto Mountains and PM10 concentration are typically lower that those at Indio.

The continuous, hourly Beta Attenuation Monitor (BAM)[9] data from Palm Springs is shown in Table 3-1, starting at 1200 PST on April 5 before the concentrations started to increase and ending at 0600 PST on April 7 after the elevated concentrations ended. Concentrations exceeding 150 μg/m^3 are highlighted in bold type. The Indio BAM was not operational after 1300 PST on April 5, so this cannot be used to assess the timing of this event. The Palm Springs BAM measured a 24-hour average PM10 concentration of 83.3 μg/m^3. The hourly Palms Springs BAM concentrations were relatively low through the morning, then started to climb after noon on April 6. The PM10 hourly measurements reached 152 μg/m^3 for the 1900 PST hour, peaked at 200 μg/m^3 for the 2000 PST hour, then gradually dropping to 175, 169 and 107 μg/m^3 for the next three hours to the end of the day. Low concentrations were measured at Palm Springs throughout the day on April 7. It should be noted that the AQMD Atmospheric Measurements group is considering invalidating the Palm Springs BAM PM10 data during this period. A calibration indicated that the BAM was 12.8 % low for mass and no further adjustment of the instrument was possible.

[9] The AQMD has only used the BAM measurements for forecasting purposes and public notification of PM10 events. While the U.S. EPA accepts the BAM measurements as an equivalent federal reference method, these instruments have not historically been relied upon for determining NAAQS compliance in the South Coast Air Basin or Coachella Valley.

TABLE 3-1

Hourly BAM and 24-hour SSI PM10 Measurements at the AQMD Indio and Palm Springs Air Monitoring Stations in the Coachella Valley Between 1200 PST April 5 and 0600 PST April 7, 2007

(Indio BAM instrument was not operational after 1300 PST April 5)

		Indio Monitoring Station			Palm Springs Monitoring Station		
DATE	**HOUR (PST)**	**BAM Hourly PM10 (μg/m³)**	**24-Hour Average PM10 (μg/m³) (midnight to midnight)**		**BAM Hourly PM10 (μg/m³)**	**24-Hour Average PM10 (μg/m³) (midnight to midnight)**	
			BAM	**SSI**		**BAM**	**SSI**
4/5/07	1200		**225**		24		
	1300		74		8		
	1400				12		
	1500				5		
	1600				3		
	1700				45		
	1800				102		
	1900				81		
	2000				42		
	2100				47		
	2200				45		
	2300				36	43.0	
4/6/07	0000				47		
	0100				66		
	0200				73		
	0300				49		
	0400				42		
	0500				44		
	0600				45		
	0700				38		
	0800				34		
	0900				34		
	1000				28		
	1100				38		
	1200				63		
	1300				95		
	1400				83		
	1500				110		
	1600				83		
	1700				83		
	1800				142		
	1900				**152**		
	2000				**200**		
	2100				**175**		
	2200				**169**		
	2300			**157**	107	83.3	64
4/7/07	0000				75		
	0100				74		
	0200				55		
	0300				61		
	0400				40		
	0500				44		
	0600				84	54.0	

The PM10 and PM2.5 concentrations measured in the Coachella Valley (Indio and Palm Springs), as well as the two nearest South Coast Air Basin stations in Riverside County (Banning and Riverside-Rubidoux), on the seven days surrounding April 6 are summarized in Table 2-2. These show that the PM10 concentrations were relatively low on the days before and after the high wind event at all locations. The elevated PM10 was only found in the Coachella Valley on April 6, showing that the windblown dust event did not affect the South Coast Air Basin and that PM10 transport from the urban South Coast Air Basin was not a significant factor. While the Palm Springs PM10 was higher on April 6 than on the surrounding days due to the winds in the Coachella Valley, the lower measurement at Palm Springs shows that most of the PM10 measured at Indio was generated in the Valley, upwind of Indio but not upwind of Palm Springs. The low PM10 concentrations before and after April 6 demonstrate that the NAAQS violation would not have occurred if not for the high wind natural event. While the PM2.5 was high at the South Coast Air Basin sites, it was relatively low in the Coachella Valley, only increasing slightly with the wind event on April 6. This indicates that urban transport from the South Coast and combustion sources, such as wildfires, were not significant to this PM10 event.

TABLE 3-2

24-Hour SSI and BAM PM10 Measurements (μg/m^3) from Coachella Valley (Indio and Palm Springs) and Nearest South Coast (Banning Airport and Rubidoux) Air Monitoring Stations between April 3 and April 9, 2007

Station	Type	3- Apr	4- Apr	5- Apr	6-Apr	7-Apr	8-Apr	9-Apr
Indio	PM10 SSI FRM	53			**157**			69
Indio	PM10 BAM	32.8	48.4	N/A	N/A	N/A	N/A	N/A
Indio	PM2.5 FRM	9.3			16.6			11.1
Palm Springs	PM10 SSI FRM				64			
Palm Springs	PM10 BAM	22.7	35.6	43.0	83.3	54.0	67.0	41.8
Palm Springs	PM2.5 FRM	8.5			18.8			14.0
Banning Airport	PM10 SSI FRM				58			
Banning Airport	PM2.5 BAM	17.0	30.5	45.9	42.9	32.0	27.1	26.9
Rubidoux	PM10 SSI FRM	53			52			40
Rubidoux	PM10 TEOM	31.8	48.5	41.8	28.5	19.6	22.1	24.1
Rubidoux	PM2.5 FRM				29.2	20.6	25.0	18.9
Rubidoux	PM2.5 BAM	30.5	50.4	51.3	32.6	23.8	30.6	26.1

Hourly BAM PM10 measurements collected by the Imperial County Air Pollution Control District near the Salton Sea did not exceed the 24-hour NAAQS. The April 6 hourly BAM PM10 data are shown in Table 3-3 for the Westmorland station, south of the Salton Sea, and the Niland station, at the southeastern edge of the Salton Sea. Westmorland reached a peak hourly concentration of 119 μg/m^3 for the hour starting at 1700 PST, with a 24-hour average of 55.0 μg/m^3. Niland reached 996 μg/m^3 at 1200 PST, then remained relatively low until it spiked to 202 μg/m^3 at 2200 PST with a 24-hour average of 98.5 μg/m^3.

Further south, the Imperial County APCD Brawley and the Mexican Mexicali air monitoring stations also had relatively low BAM PM10 hourly concentrations throughout the day. These stations are shown in Table 3-4. The 24-hour averages for

Brawley and Mexicali were 51.7 μg/m^3 and 60.2 μg/m^3, respectively, thus they did not exceed the 24-hour NAAQS. No hours at either station exceeded 150 μg/m^3.

The following sections describe the meteorological setting and the analysis of the events leading to high PM10 at Indio on April 6.

TABLE 3-3

Hourly BAM PM10 Measurements at the Imperial County APCD Westmorland and Niland Air Monitoring Stations on April 6, 2007

		Westmorland Monitoring Station		Niland Monitoring Station	
DATE	HOUR (PST)	BAM Hourly PM10 (μg/m^3)	24-Hour Average PM10 (μg/m^3) (midnight to midnight) BAM	BAM Hourly PM10 (μg/m^3)	24-Hour Average PM10 (μg/m^3) (midnight to midnight) BAM
4/6/07	0000	39		36	
	0100	44		29	
	0200	38		37	
	0300	31		40	
	0400	23		36	
	0500	24		46	
	0600	61		42	
	0700	112		33	
	0800	68		43	
	0900	57		135	
	1000	35		71	
	1100	39		33	
	1200	24		**996***	
	1300	35		22	
	1400	33		22	
	1500	27		21	
	1600	104		23	
	1700	119		42	
	1800	58		93	
	1900	56		63	
	2000	60		77	
	2100	46		114	
	2200	91		**202**	
	2300	97	55.0	108	98.5

* Possible instrument error code

TABLE 3-4

Hourly BAM PM10 Measurements at the Imperial County APCD Brawley and Mexican Mexicali Air Monitoring Stations on April 6, 2007

		Brawley Monitoring Station		Mexicali Monitoring Station	
DATE	**HOUR (PST)**	**BAM Hourly PM10 (μg/m^3)**	**24-Hour Average PM10 (μg/m^3) (midnight to midnight)**	**BAM Hourly PM10 (μg/m^3)**	**24-Hour Average PM10 (μg/m^3) (midnight to midnight)**
			BAM		**BAM**
4/6/07	0000	61		49	
	0100	36		88	
	0200	54		86	
	0300	25		68	
	0400	66		53	
	0500	64		52	
	0600	66		36	
	0700	48		62	
	0800	43		94	
	0900	39		105	
	1000	37		52	
	1100	27		47	
	1200	33		51	
	1300	25		52	
	1400	55		34	
	1500	37		26	
	1600	60		29	
	1700	124		43	
	1800	95		60	
	1900	82		88	
	2000	55		58	
	2100	38		97	
	2200	41		49	
	2300	29	51.7	66	60.2

Meteorological Setting

Previous natural event analyses defined four primary meteorological mechanisms that lead to high-wind PM10 events in the Coachella Valley, including: (1) strong pressure and density gradients forcing high winds through the San Gorgonio Pass, (2) storms and frontal passages, (3) thunderstorm outflow winds, and (4) Santa Ana wind events. The meteorological conditions on April 6 can be classified primarily as a Type 1 event with strong pressure and density gradients between the desert and coastal air masses. This was enhanced by the synoptic weather pattern with low pressure at the surface over the Great Basin and a strong Pacific High in the eastern Pacific Ocean, as well as coupled along-valley flow aloft.

On Thursday, April 5, an upper level trough of low pressure was moving slowly eastward toward southern California. At 1400 PST in the afternoon on April 5, NWS Los Angeles noted in their forecast discussion that the upper level front was propagating over the California bight. Figure 3-1 shows the height analysis chart of the 500 millibar (MB) pressure level at 1600 PST, April 5. In their forecast discussion on Thursday afternoon, NWS San Diego predicted that the low and mid level flow was expected to become cyclonic Thursday night, eroding the capping subsidence inversion on the marine layer and allowing this moisture to be lifted upward through the lower 6500 feet. Coastal eddy development was expected Thursday night to help deepen the marine layer. The airmass was predicted to be near saturation below 3000 feet west of the southern California mountains, which along with upward vertical motion, was expected to cause drizzle along the foothills and over the inland valleys overnight. The low pressure center was predicted to move inland along the California/Mexico border on Friday, April 6 to bring convection and a chance of a few showers, mainly over the mountains from mid-morning through early afternoon. By late Friday afternoon, the center of the low was predicted to be near Yuma, Arizona, resulting in west to northwest flow across southwest California and net subsidence and drying. Weak high pressure was predicted to rebuild Friday night and the marine layer was expected to be reestablished west of the mountains with a depth around 2000 feet.

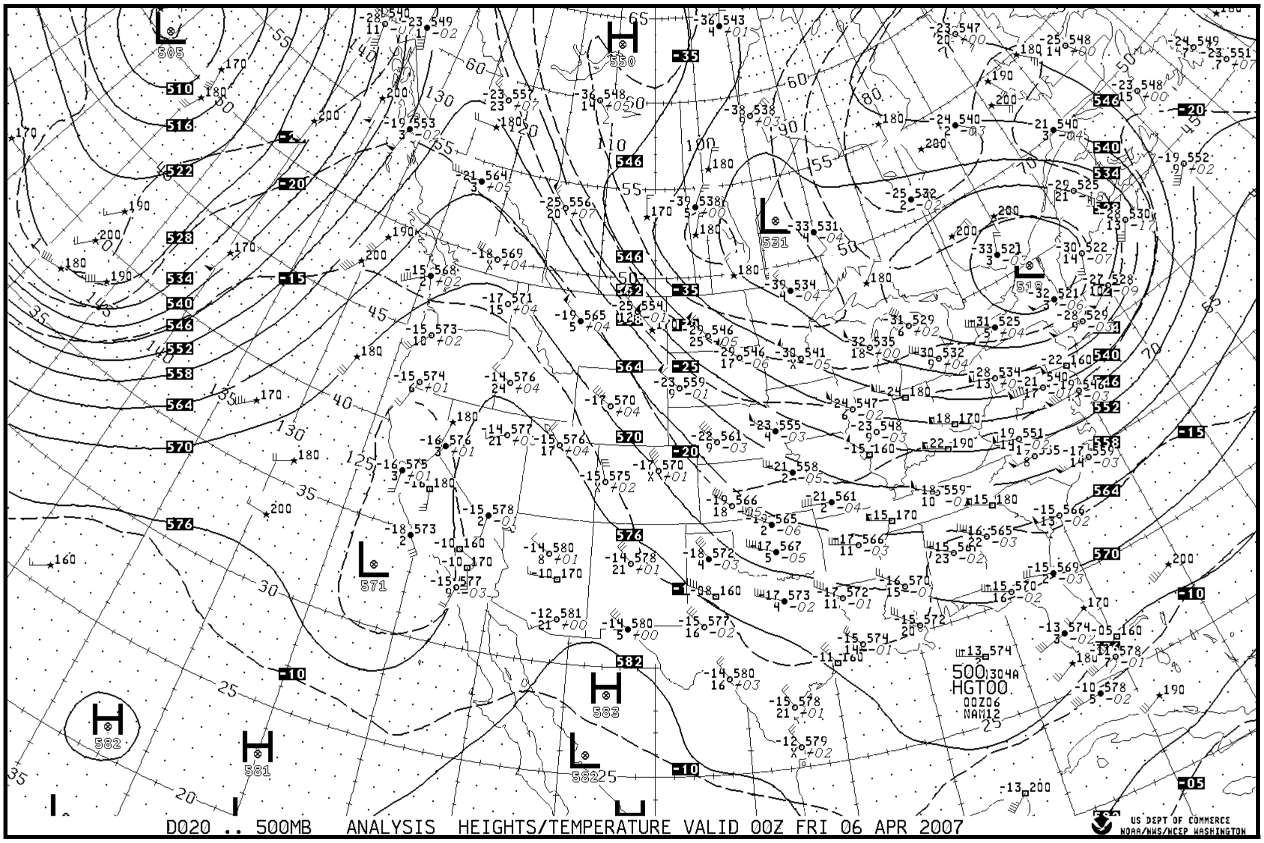


FIGURE 3-1

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 1600 PST Thursday, April 5, 2007

The trough deepened the marine layer overnight and brought some drizzle and light rain west of the mountains overnight on Thursday, although the capping inversion did not deepen as much as was predicted. The inversion base from the 0400 PST morning sounding on Friday, April 6 at San Diego (NKX) was at approximately 2800 feet above mean sea level. Morning ACARS aircraft soundings in the coastal plain of the Basin west of the mountains indicated that the marine layer depth was between 2500 and 3000 feet deep. Stratus, with bases around 2000 feet MSL covered the coast and most of the inland valleys of southern California, west of the mountains.

A criteria used by the AQMD Meteorology Section to forecast high winds and windblown dust events in the Coachella Valley in accordance with AQMD Rule 403.1, Wind Entrainment of Fugitive Dust, requires:

(1) 0700 PST Pressure Gradient Index (PGI) > 17 mb,

where PGI = the 0700 PST Summation Pressure Gradient [SPG = (SAN-LAS)[10] + (LGB-DAG)[11] + (RIV-DAG)[12]] + the 24-hour change in the SPG from the previous day;

and

(2) 0400 PST Coastal Temperature Inversion Base > 1500 feet;

or

0700 PST (SFO-TRM)[13] Pressure Gradient ≥ 8 mb.

On the morning of April 6, the 0700 PST Summation Pressure Gradient (SPG) was 14.9 mb. The 24-hour change in the SPG was 9.0 mb, giving a Pressure Gradient Index (PGI) of 23.9 mb. The coastal inversion base at 0400 PST on April 6 was 2800 feet. The San Francisco to Thermal pressure gradient was 8.0 mb. Thus, the conditions favored strong winds through the San Gorgonio Pass on this day. The AQMD Meteorology Section predicted this on the previous day and issued a Rule 403.1 high wind forecast for April 6. The AQMD high-wind forecast is available to the public and facilities subject to AQMD Rule 403.1 as part of the AQMD daily air quality forecast, available on the web at http://www.aqmd.gov/telemweb/Forecast.aspx. A section of the text forecast valid April 6 was as follows:

```
--------------------------------------------------------------------------

 Coachella Valley Rule 403.1 Wind Forecast:  High Wind Day
--------------------------------------------------------------------------
```

A daily recorded message is also available through 1-800-CUT-SMOG or directly at 909-396-2399. The wording for the Rule 403.1 high-wind advisory forecast message on April 6 was as follows:

> The following forecast is valid for Friday, April 6, 2007.
>
> The South Coast Air Quality Management District has designated Friday April 6 as a Rule 403.1 High Wind Day in the Coachella Valley. This means that localized wind gusts are expected to exceed 25 miles per hour throughout the valley.

---

10 Sea Level Pressure difference between San Diego and Las Vegas
11 Sea Level Pressure difference between Long Beach and Daggett
12 Sea Level Pressure difference between Riverside and Daggett
13 Sea Level Pressure difference between San Francisco and Thermal

The upper level trough of low pressure was centered off the southern California coast in the morning on April 6, as is shown in the 500 mb chart at 0400 PST (Figure 3-2). The heights at the center of the low were 5700 meters, which are not conducive for a rainfall event for southern California. The 500 mb winds over southern California were south-southeasterly at approximately 23 mph (20 knots). Figure 3-3 shows the mean sea level pressure analysis at 0400 PST. A 1004 mb low is centered over the California/Arizona border at this time and the surface winds are light.

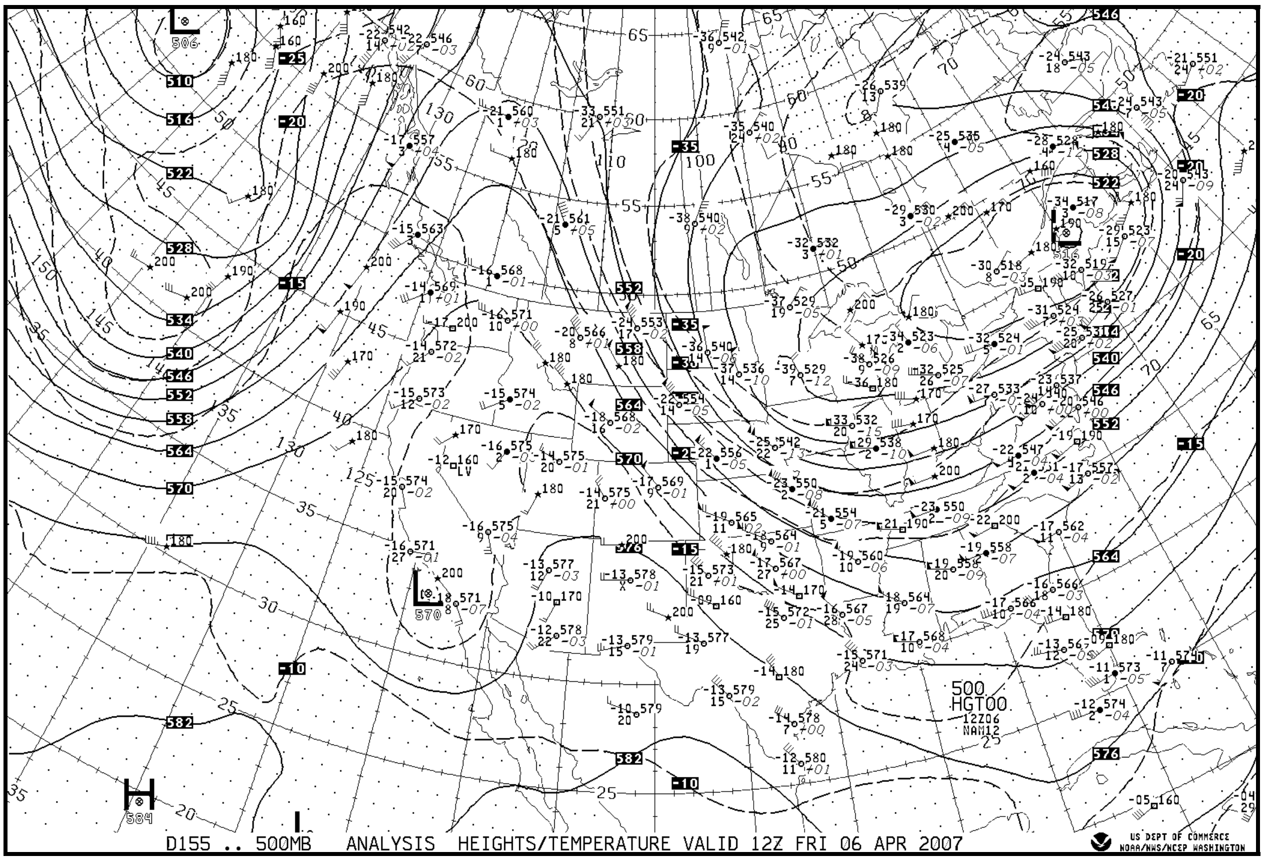


FIGURE 3-2

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 0400 PST Friday, April 6, 2007

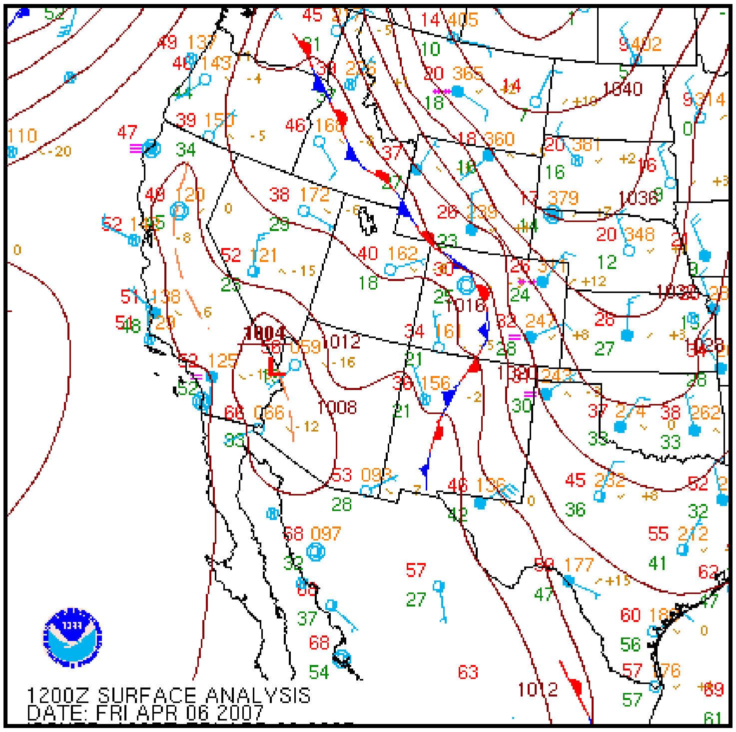


FIGURE 3-3

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 0400 PST Friday, April 6, 2007

The NWS Los Angeles forecast discussion at 0755 PST on April 6 mentioned that the upper low was over Catalina Island at this time, with southeast flow aloft and elevated instability across Los Angeles County. Visible satellite pictures and observation revealed high-based altocumulus clouds and virga, but not much vertical growth of the convection. The marine layer was over 3000 feet over the Los Angeles basin, with onshore pressure gradients throughout the day and increasing through Saturday.

The NWS San Diego forecast discussion at 0830 PST on April 6 predicted that the low pressure system would move east across southern California through the day, possibly causing thunderstorms over the mountains and high deserts and a few sprinkles west of the mountains. Moisture in the system was limited, so precipitation amounts were expected to be only a few hundredths of an inch, at most. The upper level cutoff low was centered over San Diego at 0700 PST and moving east at around 15 knots, which extrapolated to be near Yuma by 1600 PST. The convection was predicted to end quickly in the mid afternoon once the low moved over Imperial County and the wind flows shifted to northwesterly.

The NWS San Diego forecast discussion issued at 1245 PST reported that the cutoff low was centered near the town of Jacumba, along the US/Mexico border in eastern San Diego County, at 1100 PST and was still moving east at around 15 knots. Satellite and radar observations since 1000 PST indicated a few showers/thunderstorms forming in the northern portion of the low, impacting Riverside and San Bernardino County mountains and deserts, but not the Coachella Valley. No lightning strikes were observed by this time. The NWS forecast discussion mentioned that aircraft soundings indicated that the marine layer depth remained around 3000 feet deep in the afternoon over the coastal plain. Stratus was well entrenched over the area from the coastal slopes to offshore in the coastal waters. The movement of the low pressure center was still predicted to move across Imperial County in the afternoon, reaching Yuma, Arizona by 1600 PST and to be over southwest Arizona in the evening.

At 1342 PST, NWS Los Angeles forecast discussion reported that most of the afternoon convection was over the Sierras, although some cumulus clouds developed over the Ventura and Los Angeles County mountains. The marine layer was up to 3200 feet at this time. The onshore pressure gradients increased. At 1540 PST the NWS Los Angeles forecast discussion reported that the upper low was moving onshore across southern California in the afternoon with wrap around moisture and instability expected to remain over the forecast area through early evening. Only isolated convection was expected in the LA/Ventura mountain areas.

The 500 mb analysis at 1600 PST (Figure 3-4) shows the 5690 m closed low centered over the California/Arizona Border. The winds aloft surrounding the low at this pressure level were 35 mph (30 knots) or lower. The 1001 mb surface low, shown in Figure 3-5, had expanded into Arizona at this time and onshore pressure gradients were increasing along the southern California coast. The visible satellite image at 1646 PST (Figure 3-6) shows the marine layer offshore and starting to penetrate the coastal plain west of the mountains. At this time, the convection over southern California had mostly ended. The surface analysis three hours later at 1900 PST (Figure 3-7) shows a continued tightening of the onshore pressure gradient, indicating strong surface flows primarily from the northwest over most of southern California.

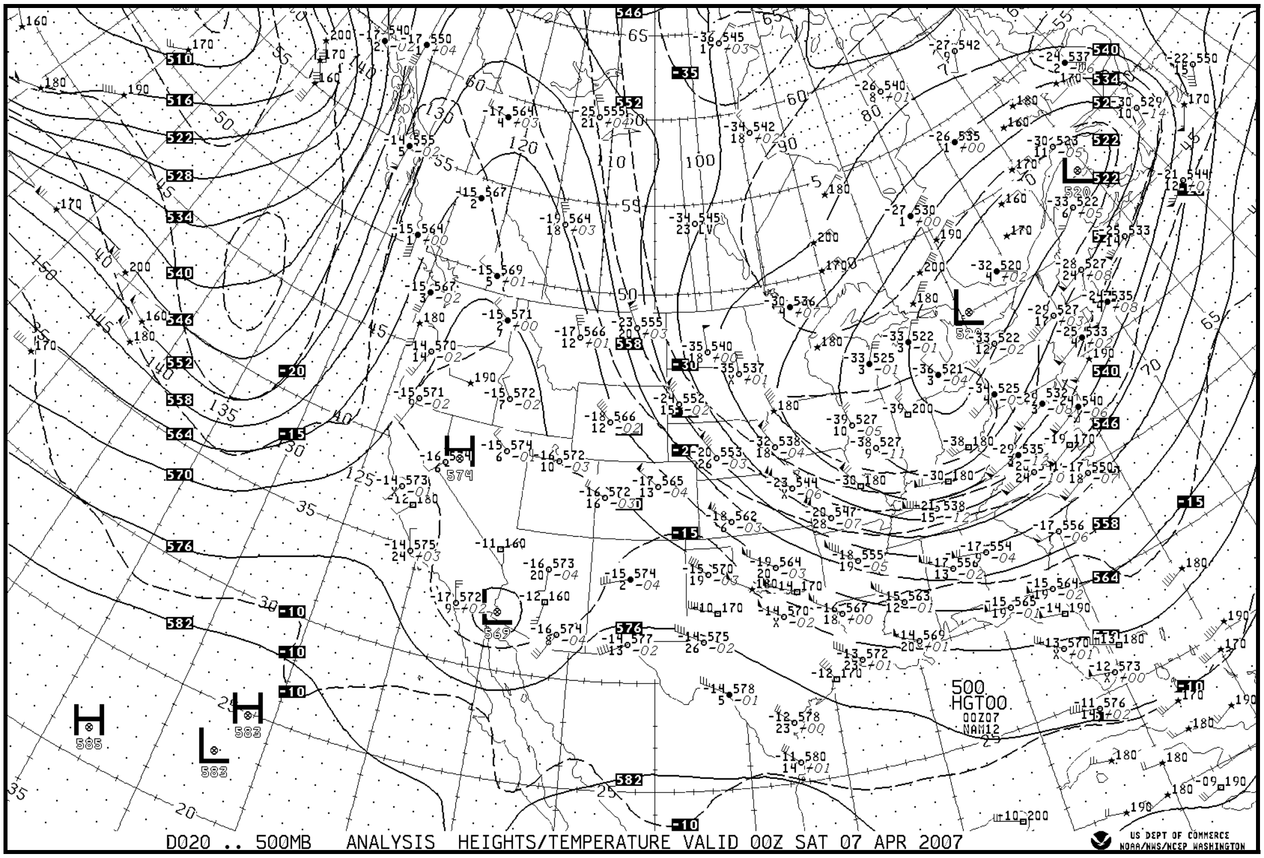


FIGURE 3-4

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 1600 PST Friday April 6, 2007

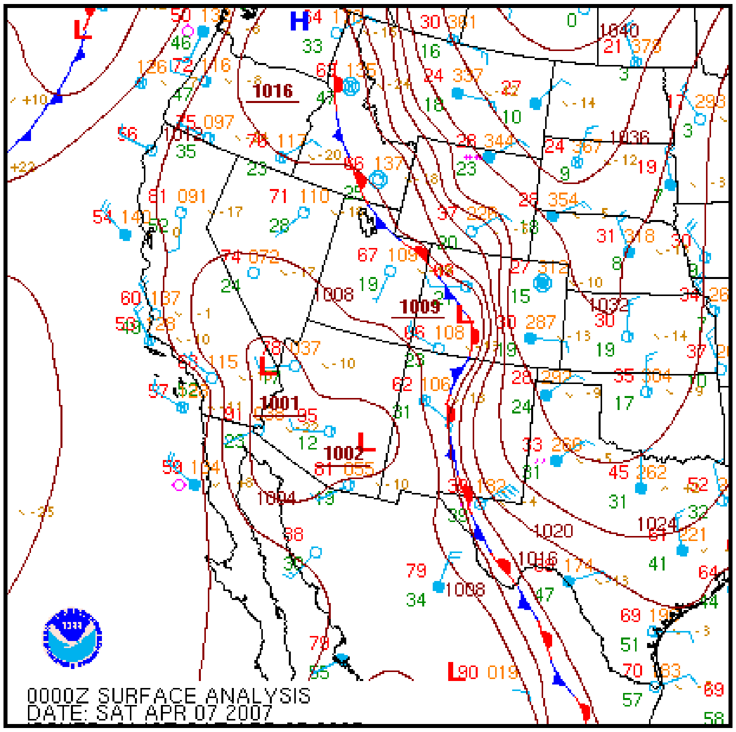


FIGURE 3-5

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 1600 PST Friday, April 6, 2007

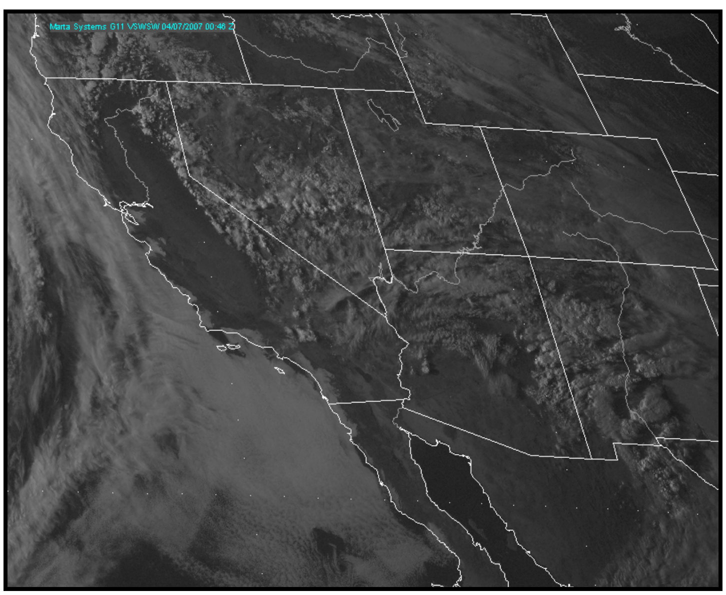


FIGURE 3-6

Visible Satellite Image for 1646 PST Friday, April 6, 2007

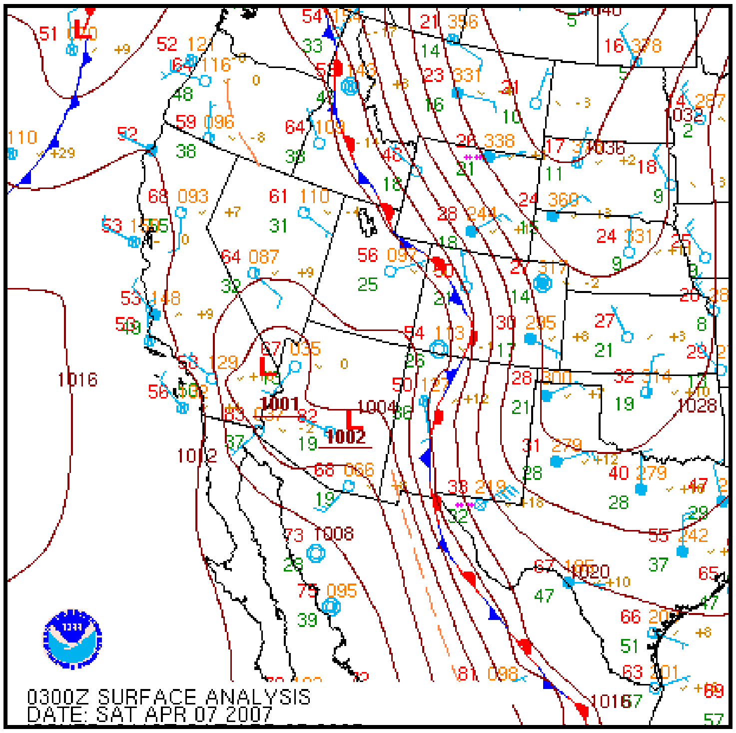


FIGURE 3-7

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 1900 PST Friday, April 6, 2007

The NWS Los Angeles forecast discussion at 1930 PST described that isolated convection had developed across Kern County during the afternoon and had drifted southward into the Antelope Valley and mountains of Los Angeles and Ventura Counties. The convective activity had diminished as the upper low shifted to the east and across Arizona. Low clouds quickly filled in across most coastal and valley areas west of the mountains in the evening. NWS reported that aircraft sounding data showed the marine layer depth around 3500 feet at 1930 PST and it was expected to reach 4000 feet overnight. This was predicted to bring low clouds and fog well into the lower coastal slopes and some localized drizzle was expected west of the mountains overnight. With the strong onshore flow, gusty winds were predicted in the mountains and deserts through Sunday.

In their weather forecast discussion issued at 2035 PST, the NWS San Diego predicted that high pressure would build over southwest California Friday night, but that the marine layer would remain deep with extensive clouds west of the mountains. The weak high pressure building behind the departing upper level low over Arizona was already getting weakened by the next pacific shortwave. This, along with a coastal eddy, would keep the marine layer deep through Saturday, April 7 west of the mountains.

At 2100 PST on April 6, the NWS San Diego issued a short-term forecast or now-cast for the Coachella Valley, describing strong winds in the valley and reporting quarter-mile visibility and blowing dust at Thousand Palms, which is located between Palm Springs and Indio, as follows:

FPUS76 KSGX 070506
NOWSGX
SHORT TERM FORECAST
NATIONAL WEATHER SERVICE SAN DIEGO CA
1000 PM PDT FRI APR 6 2007 **[2100 PST]**

CAZ061-070700-
COACHELLA VALLEY-
1000 PM PDT FRI APR 6 2007

.NOW...
AT 10 PM...STRONG WINDS IN THE COACHELLA VALLEY HAD REDUCED VISIBILITY TO ONE QUARTER MILE IN BLOWING DUST AT THOUSAND PALMS. STRONG WINDS AND AREAS OF BLOWING DUST AND SAND WILL CONTINUE THROUGH MIDNIGHT. THE WINDS WILL SLOWLY SUBSIDE BETWEEN MIDNIGHT AND 3 AM.
$$
MOEDE

At 2200 PST Friday, April 6, the surface analysis, depicted in Figure 3-8, shows that the 1002 mb closed low pressure center was centered over the California/Nevada/Arizona border area. The high pressure increased offshore to keep a relatively strong onshore pressure gradient over southern California. The coastal winds weakened while the winds in the Coachella Valley increased. As is shown in the next section, the winds in and near the Coachella Valley peaked around this time. A cold front is seen off the coast to the north from the next storm system that is approaching. By 0100 PST on Saturday, April 7, the surface analysis (Figure 3-9) shows the onshore pressure gradient starting to diminish as the approaching trough starts to erode the high surface pressure off the southern California coast and the low inland starts to fill. Winds in the Coachella Valley were diminishing at this time. The 500 mb analysis at 0400 PST in the morning of April 7 (Figure 3-10) shows the upper level trough centered over southeastern Arizona with weak ridging and northwesterly flow aloft over southern California.

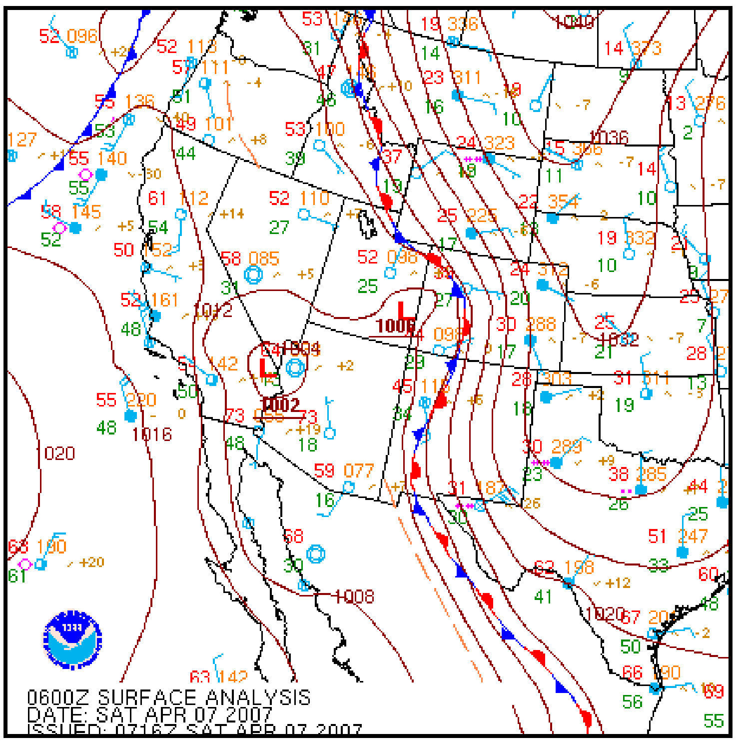


FIGURE 3-8

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 2200 PST Friday, April 6, 2007

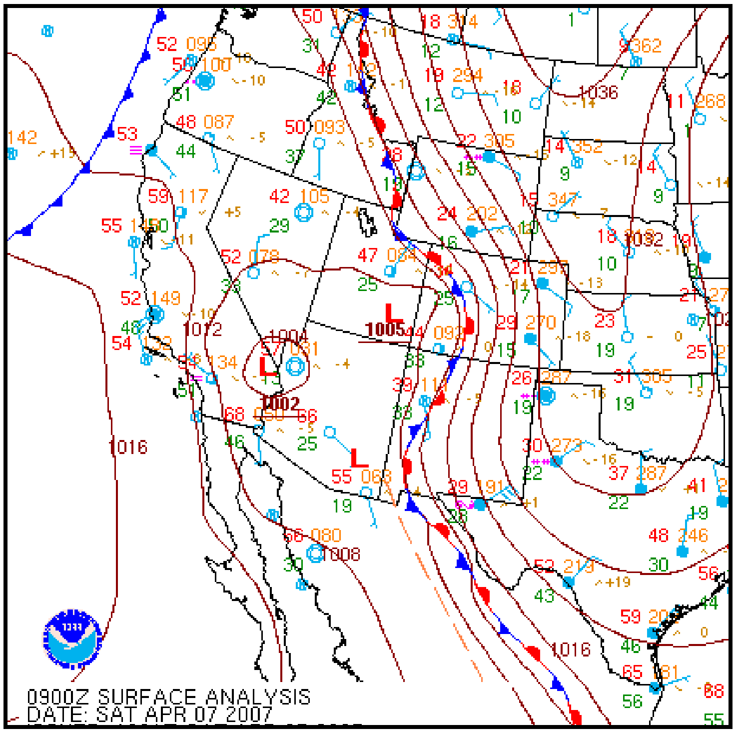


FIGURE 3-9

National Weather Service Sea-Level Pressure Analysis (contours every 4 millibars) for 0100 PST Saturday, April 7, 2007

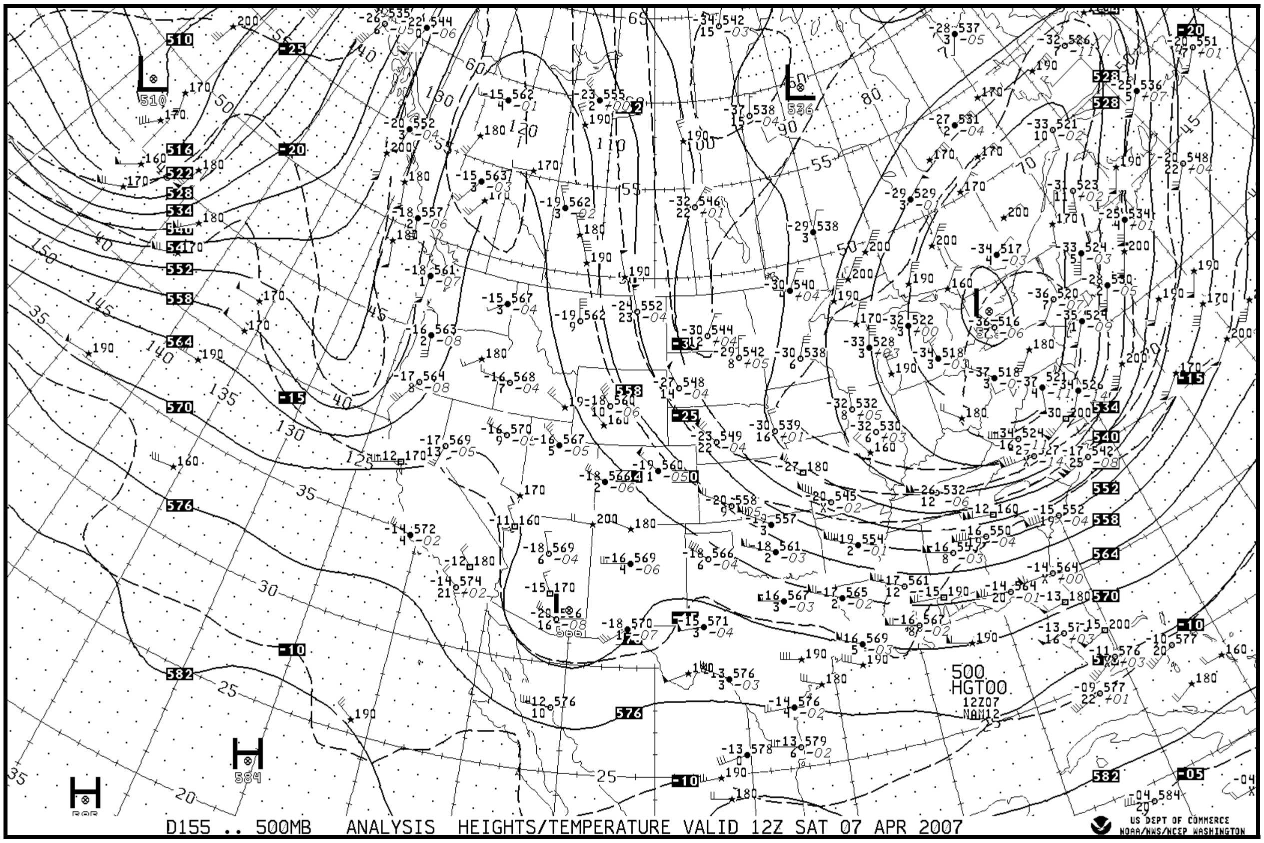


FIGURE 3-10

National Weather Service Height Analysis (solid contours in tens of meters) of the 500 Millibar Pressure Surface for 0400 PST Saturday, April 7, 2007

Windblown Dust Analysis

The winds at the AQMD Indio air monitoring station (Table 3-5) were relatively light from the northwest through the morning of April 6, with hourly averages to 10 mph and 1-minute averages to 15 mph. By 1000 PST, the winds shifted to westerly for three hours and speeds decreased. This was followed by northerly, then north-northeasterly winds with speeds increasing to 12 mph at 1700 PST and a 1-minute peak of 18 mph during the 1800 PST hour. Indio winds remained slightly elevated through the end of the day with 1-minute averages of 19 and 20 mph, respectively occurring at 2300 PST and 0000 PST on April 7. Instantaneous gusts would be higher at Indio, if they were available, but the Indio wind speeds do not indicate locally windblown dust near the station contributing to the PM10 measurement. Thus, the PM10 was primarily generated further upwind, i.e., further up the Valley toward the Banning Pass.

TABLE 3-5

Hourly Wind Directions (degrees), Wind Speeds (mph) and Maximum 1-Minute Average Speed for each Hour (mph) for AQMD Air Quality Monitoring Stations in the Coachella Valley and San Gorgonio Pass on April 6, 2007

		Banning Airport Monitoring Station (BNAP)			Palm Springs Monitoring Station (PLSP)			Indio Monitoring Station (INDI)		
DATE	**HOUR (PST)**	**WD (deg)**	**WS (mph)**	**Maximum 1-Minute Avg. (mph)**	**WD (deg)**	**WS (mph)**	**Maximum 1-Minute Avg. (mph)**	**WD (deg)**	**WS (mph)**	**Maximum 1-Minute Avg. (mph)**
4/5/07	2100	277	11	14	5	7	10	317	7	9
	2200	258	7	12	12	6	10	312	7	10
	2300	265	9	13	14	5	8	320	7	9
4/6/07	0000	277	13	17	354	6	12	317	8	11
	0100	279	11	16	20	9	14	322	8	14
	0200	273	11	14	25	8	13	326	10	15
	0300	278	12	14	16	9	12	331	10	14
	0400	263	9	12	10	8	11	313	9	12
	0500	243	9	13	19	7	11	321	8	12
	0600	241	7	10	19	6	9	327	8	12
	0700	272	12	16	10	6	9	318	6	10
	0800	253	12	16	14	6	9	326	5	8
	0900	256	12	15	20	6	10	303	4	6
	1000	276	14	19	15	7	10	261	3	7
	1100	255	15	19	20	8	11	281	3	6
	1200	246	15	18	7	10	15	288	3	6
	1300	268	14	18	21	12	15	349	4	7
	1400	257	13	18	14	11	15	356	7	11
	1500	250	12	18	360	12	17	356	10	14
	1600	260	12	18	2	11	15	346	11	17
	1700	239	11	15	13	12	18	342	12	16
	1800	258	12	16	3	11	17	332	11	18
	1900	263	13	18	1	13	17	320	10	15
	2000	256	12	18	348	13	17	336	12	16
	2100	256	14	18	349	11	16	329	10	15
	2200	284	15	18	339	11	15	326	11	15
	2300	277	15	19	332	10	13	320	14	19
4/7/07	0000	277	14	19	338	11	14	319	15	20

Just upwind of the San Gorgonio Pass, the AQMD Banning Airport (BNAP) air monitoring station winds (Table 3-5) remained westerly throughout the day, with 1-minute maximum winds of 18-19 mph occurring from late morning through the evening. This is consistent with the onshore pressure gradients and wind forcing through the Pass. The winds at the AQMD Palm Springs (PLSP) air monitoring station (Table 3-5) were more northerly with 1-minute averages reaching 18 mph at 1700 PST. The westerly and northwesterly winds through the San Gorgonio Pass and the northern Coachella Valley are typically deflected and weakened at Palm Springs by the San Jacinto Mountains. Further to the east of PLSP, the winds at the NWS Palm Springs Airport (PSP) station (Table 3-6) became northwesterly and increased in the afternoon. Average speeds reached 18 mph for the 1553 PST and 1953 PST observations. Gusts of 23 mph were recorded for the 1553 PST and 1853 PST observations. The hourly BAM PM10 measurements at PLSP (Table 3-1) jumped to 142 $\mu g/m^3$ for the 1800 PST hour, followed by 152, 200, 175, and 169 $\mu g/m^3$ through the 2200 PST hour, respectively. The automated visibility at PSP decreased slightly from 10 miles to 9 miles for the observations at 1953 and 2053, followed by decreasing wind speeds.

TABLE 3-6

Hourly Wind Directions (degrees), Wind Speeds (mph), Wind Gusts (mph) when reported, Visibilities (statute miles), Weather Conditions and Observer Remarks for the National Weather Service Palm Springs Airport Station on Friday, April 6, 2007

HZ = Haze, BLDU = Blowing Dust, BLSA = Blowing Sand, WSHFT = Wind Shift followed by time in UTC, PK WND = Peak Wind since last hour (direction &speed in knots/time in UTC), LTG = Lightning, TS = Thunderstorm, RA = Rain, + = Heavy, - = Light, SH = Shower, CB = Cumulonimbus Clouds, B = Begin time, E = End time, P = Precipitation amount since last observation in hundredths of inches (P0000 = Trace)

Palm Springs Airport (PSP)							
DATE	**HOUR (PST)**	**WD (deg)**	**WS (mph)**	**Gust (mph)**	**VIS (miles)**	**Weather**	**Remarks**
4/5/07	2053	VRB	3		10		
	2153	310	7		10		
	2253	CALM	CALM		10		
	2353	CALM	CALM		10		
4/6/07	0053	CALM	CALM		10		
	0153	150	6		10		
	0253	240	3		10		
	0353	CALM	CALM		10		
	0453	220	3		10		
	0553	170	3		9		
	0653	CALM	CALM		10		
	0753	130	3		10		
	0853	180	5		10		
	0953	VRB	5		10		
	1053	CALM	CALM		10		
	1153	330	15		10		
	1253	320	13	20	10		
	1353	330	14	18	10		
	1453	330	15	21	10		
	1553	320	18	23	10		
	1653	320	10		10		
	1753	320	14		10		
	1853	320	16	23	10		
	1953	320	18		9		
	2053	320	13		9		
	2153	VRB	5		10		
	2253	320	6		10		
	2353	CALM	CALM		9		

The strongest winds typically occur through the centerline of the Coachella Valley, just below the San Gorgonio Pass, weakening with distance toward the southeast as the Valley widens before Indio. These strong winds are often observed along the I-10 corridor and near the Whitewater Wash, especially near the Coachella Valley Preserve where much of the blowsand that affects the Valley is generated. This case was as expected in that strong winds were measured at the AQMD Whitewater Wash Blowsand wind station (WWW), part of the supplemental AQMD Coachella Valley Meteorological Network. This data is shown in Table 3-7. The winds were consistently from the west-northwest throughout the day on April 6. The 24-hour averaged wind at WWW was 27.25 mph.

TABLE 3-7

Hourly Wind Directions (degrees) and Speeds with Peak Gusts (mph) for the AQMD Coachella Valley Meteorological Network Stations on April 6, 2007

		Whitewater Wash Blowsand Site (WWW)			Desert Hot Springs Wind Station (DHS)			Palm Desert Wind Station (PDT)		
DATE	**HOUR (PST)**	**WD (deg)**	**WS (mph)**	**Gust (mph)**	**WD (deg)**	**WS (mph)**	**Gust (mph)**	**WD (deg)**	**WS (mph)**	**Gust (mph)**
4/5/07	2100	300	20	**30**	314	5	9	316	9	22
	2200	297	22	**32**	340	3	7	314	11	22
	2300	306	19	**29**	338	5	9	312	11	21
4/6/07	0000	302	24	**38**	327	5	9	314	12	**27**
	0100	294	**28**	**42**	293	12	24	318	14	**28**
	0200	297	**27**	**39**	310	10	23	321	11	23
	0300	298	**27**	**41**	313	6	16	317	12	25
	0400	298	**26**	**40**	330	5	10	312	11	23
	0500	299	24	**37**	331	4	11	305	11	23
	0600	299	**25**	**42**	19	3	11	313	12	**25**
	0700	296	22	**34**	91	3	7	315	9	19
	0800	292	20	**30**	273	6	16	220	4	9
	0900	293	20	**32**	251	12	20	236	3	6
	1000	293	23	**34**	257	14	24	270	3	8
	1100	296	24	**34**	263	16	**30**	283	3	12
	1200	300	24	**39**	265	18	**35**	338	8	18
	1300	296	**29**	**46**	274	18	**35**	329	9	20
	1400	293	**31**	**47**	264	20	**36**	321	9	19
	1500	294	**29**	**45**	270	22	**41**	322	10	23
	1600	294	**28**	**45**	265	21	**42**	324	10	**25**
	1700	293	**31**	**47**	263	19	**37**	326	11	23
	1800	295	**30**	**47**	282	11	**26**	325	17	**35**
	1900	302	**34**	**53**	286	11	21	323	18	**39**
	2000	300	**32**	**47**	303	5	20	318	20	**39**
	2100	298	**31**	**47**	2	4	19	317	18	**36**
	2200	297	**33**	**50**	294	8	23	319	15	**35**
	2300	296	**32**	**51**	302	13	**28**	321	16	**31**
4/7/07	0000	296	**34**	**48**	305	7	20	319	14	**29**

The hourly averaged winds at WWW exceeded 25 mph in the early morning, peaking at 28 mph at 0100 PST. Wind gusts reached 42 mph at 0100 and 0600 PST and remained high throughout the day. Gusts reached 30 mph during every hour of the day on April 6 and gusts of 45 mph or higher were measured during every hour of the day after 1300 PST. The hourly averaged winds decreased below 25 mph between 0700 and 1300 PST, then increased through the afternoon and evening in response to the stronger onshore flow and deepening marine layer to the west of the San Gorgonio Pass. After 1700 PST, the WWW hourly averages did not fall below 30 mph through the rest of the day. The wind gusts peaked during the 1900 PST hour at 53 mph and gusts of 50 and 51 mph occurred during the 2200 PST and 2300 PST hours. The highest sustained wind, an hourly average of 34 mph, also occurred during the 1900 PST hour. The hourly wind speeds and gusts from WWW are illustrated in Figure 3-11, along with the hourly BAM PM10 data from PLSP.

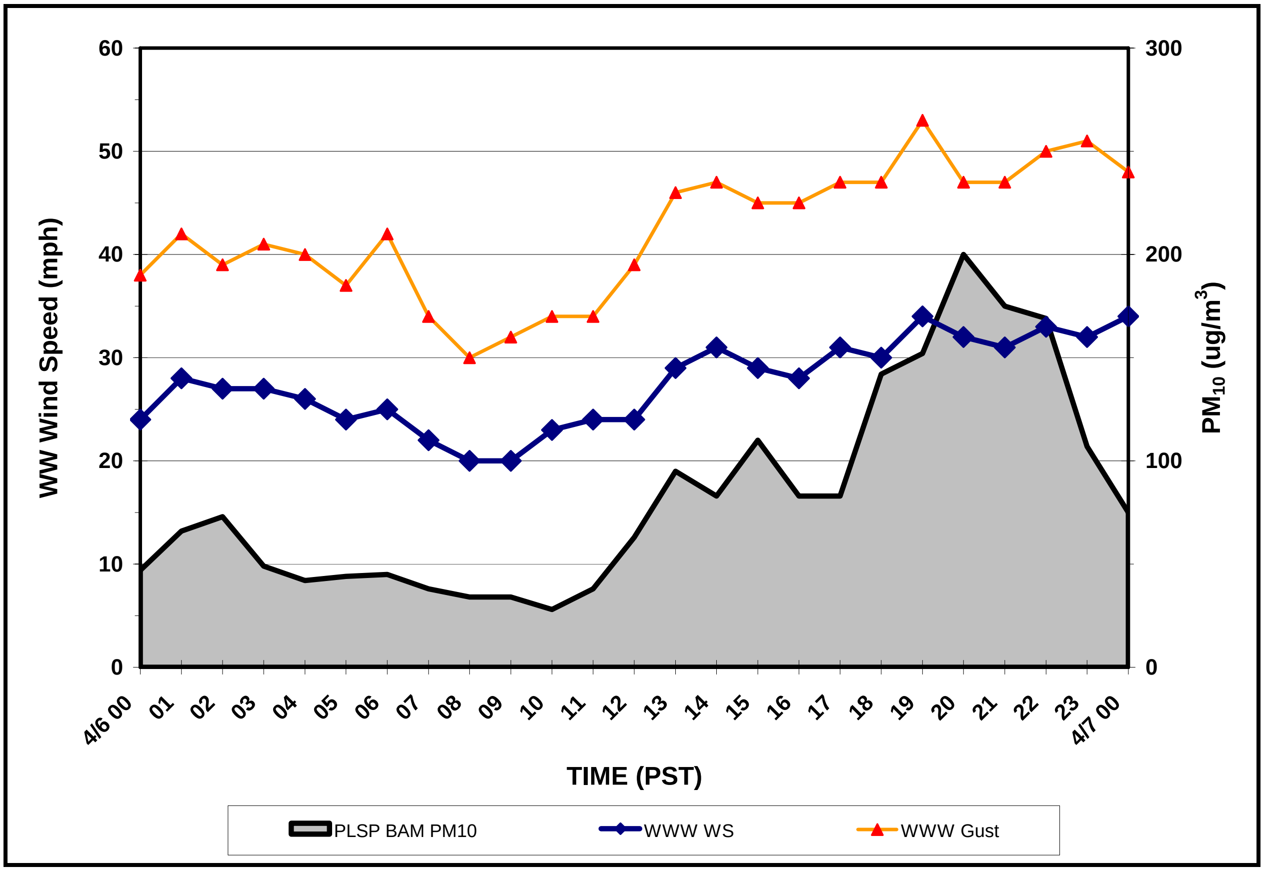


FIGURE 3-11

Time Series of Whitewater Wash Wind Speeds (Hourly Average and Gust) and Hourly PM10 (μg/m^3) from the Palm Springs BAM on April 6, 2007

Given the consistently gusty winds throughout the day at WWW, windblown dust was generated from the Coachella Valley all day, although the strongest winds and most consistent transport to the Indio PM10 SSI monitor occurred through the afternoon and evening. It is expected that the Indio BAM would have supported this conclusion, had it been operational. A weather log recorded by the California Highway Patrol office in Indio at 1734 PST from patrol officers confirmed that the west end of Indio had high winds and that the east end of Indio had 20 mph winds, under clear skies. This coincides with the time that the PM10 was increasing, as indicated in the PLSP BAM. The PSLP BAM peak of 200 $\mu g/m^3$ for the hour beginning at 2000 PST coincides well with the NWS San Diego short term forecast (now-cast) issued at 2100 PST that reported visibility to ¼ mile with blowing dust and strong winds near Thousand Palms. Thousand Palms is about 9 miles from PLSP, toward the center of the Valley, and approximately 12 miles northwest of Indio. This now-cast, the only one issued for the Coachella Valley on April 6, was reproduced in the previous section.

The AQMD Desert Hot Springs meteorological station (DHS) is further east from the centerline of the Valley and the WWW station. As a result, DHS winds (Table 3-7) were more westerly and weaker as they flowed around the Morongo Mountains, north of the Coachella Valley. The hourly averages did not exceed 25 mph, although wind gusts of 30 mph or more occurred during each hour through the afternoon, peaking at 42 mph during the 1600 PST hour, after which the DHS winds mostly diminished. Further southeast, down the Valley from the Palm Springs and Whitewater Wash stations, the winds at the AQMD Palm Desert (PDT) wind station (Table 3-7) were weaker that those measured at WWW. This is due to the widening of the Coachella Valley and the distance from the San Gorgonio Pass. No hourly averages at PDT exceeded 25 mph, peaking at 20 mph for the 2000 PST hour. Instantaneous wind gusts exceeded 30 mph during every hour starting at 1800 PST through the end of the day, peaking at 39 mph during both the 1900 and 2000 PST hours. That the winds were strongest in the Whitewater Wash area than the other locations throughout the Coachella Valley indicates that this was the primary source area for PM10 that was measured at Indio. This is also a significant natural blowsand source area, as noted in several similar high wind natural events.

A few miles southeast of Indio, the NWS weather station at Thermal Airport (TRM) reported wind gusts starting with the 1952 PST observation through the end of the day (Table 3-8). Peak winds of 36 mph (31 knots) 2020 PST and 33 mph (29 knots) at 2134 PST. No sustained averages over 25 mph were recorded, with the highest average of 24 mph reported at 2052 PST. The winds remained northwesterly through the afternoon and evening. Visibilities reported at TRM started decreasing at 1652 PST, dropping to 5 miles for the 2052 PST observation and remaining relatively low through the evening. Haze was reported for the last five observations of the day. This supports the conclusion that the windblown dust that was measured at Indio mainly occurred in the evening of April 6.

TABLE 3-8

Hourly Wind Directions (degrees), Wind Speeds (mph), Wind Gusts (mph) when reported, Visibilities (statute miles), Weather Conditions and Observer Remarks for the National Weather Service Thermal Airport Station on Friday, April 6, 2007

Thermal Airport (TRM)							
DATE	**HOUR (PST)**	**WD (deg)**	**WS (mph)**	**Gust (mph)**	**VIS (miles)**	**Weather**	**Remarks**
4/5/07	2052	330	10		10		
	2152	330	11		10		
	2252	320	8		10		
	2352	350	8		10		
4/6/07	0052	320	7		10		
	0152	330	13		10		
	0252	330	16		10		
	0352	330	9		10		
	0452	330	10		10		
	0552	320	9		8		
	0652	310	7		8		
	0752	330	5		10		
	0852	250	5		9		
	0952	210	7		10		
	1052	CALM	CALM		10		
	1152	VRB	3		10		
	1252	VRB	6		10		
	1352	VRB	3		10		
	1452	CALM	CALM		10		
	1552	340	14		10		
	1652	340	17		9		
	1752	330	17		9		
	1852	330	16		8		
	1952	330	22	**29**	**6**	**HZ**	
	2052	340	24	**34**	**5**	**HZ**	PK WND 32031/0420
	2152	340	17	**26**	**6**	**HZ**	PK WND 33029/0534
	2252	320	16	**26**	**6**	**HZ**	
	2352	310	16	**26**	**6**	**HZ**	
4/7/07	0052	330	11	21	**7**		
	0152	330	15		**7**		
	0252	320	15		**7**		
	0352	340	18	**25**	**7**		
	0452	330	11		9		
	0552	310	13		8		
	0652	330	10		10		

Analysis of Source Influence

A statistical model relating wind speeds at the blowsand source area (WWW) to the PM10 measured at the Indio air monitoring station has been presented for several previous Coachella Valley natural event evaluations. Figure 3-12 shows this model graphically. The statistical model further illustrates that the April 6 exceedance of the PM10 NAAQS at Indio qualifies as a high-wind natural event, with the windblown dust emanating mainly from the natural PM10 source area of the Whitewater Wash Blowsand Area. Using the 24-hour, 10-meter wind speed of 27.25 mph from the Whitewater Wash site, the predicted PM10 concentration is 76.2 $\mu g/m^3$ on the best-fit curve of Whitewater 24-hour averaged wind speed versus Indio 24-hour averaged PM10 (Figure 3-12). The 45 $\mu g/m^3$ local background that the model estimates at Indio regardless of wind is then subtracted to give 31.2 $\mu g/m^3$ that would be contributed by blowsand from the Whitewater Wash Blowsand source area. In other words, the blowsand source model is unable to distinguish whether this 45 $\mu g/m^3$ average is caused by wind action on the blowsand, so it is conservatively assumed to be primarily anthropogenic and not from the natural source and it is removed from consideration as part of the windblown dust from the natural source. Therefore, without the high-wind event entraining dust from the natural source, PM10 concentrations of approximately 126 $\mu g/m^3$ (157 $\mu g/m^3$ measured minus 31 $\mu g/m^3$ blowsand) would have been expected at Indio on April 6, below the 24-hour PM10 NAAQS. This conservatively estimated PM10 source influence at Indio on April 6, 2007 is summarized in Table 3-9.

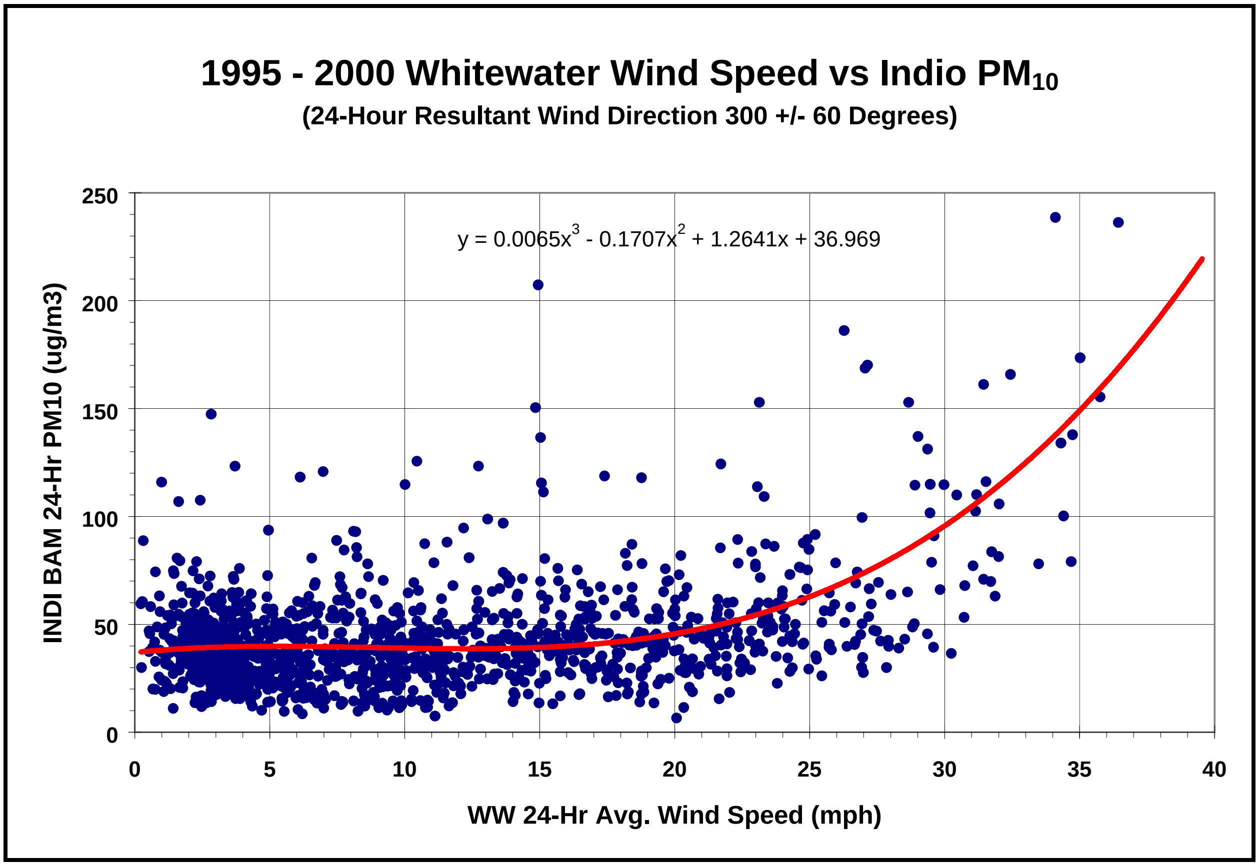


FIGURE 3-12

Plot of Paired 1995 - 2000 Whitewater Wash 24-Hour Averaged Wind Speeds (mph) versus Indio 24-Hour Averaged BAM PM10 Concentrations (µg/m3) for winds through the Banning Pass
Plotted curve is best-fit polynomial to data

TABLE 3-9

Estimated PM10 Source Influence at Indio on April 6, 2007 using the 24-Hour Period with High Winds and PM10 Concentrations

PM10 Origin	PM10 Concentration
Total Measured PM10 (24-hour SSI Sampler)	**157.0 μg/m^3**
Model-Estimated PM10 (27.25 mph 24-Hour Avg. Wind)	76.2 μg/m^3
Avg. Local Background PM10 (24-Hour)	45.0 μg/m^3
Natural Source PM10 (24-Hour)	**31.2 μg/m^3**
PM10 without Natural Event	**125.8 μg/m^3**

Conclusion

The PM10 NAAQS violation on April 6, 2007 is a typical example of a Type 1 high wind event in the Coachella Valley, where strong pressure and density gradients force high winds through the San Gorgonio Pass creating strong, gusty winds along the centerline of the Coachella Valley near the AQMD Whitewater Wash site and in the Coachella Valley Preserve areas. This flow pattern was enhanced by the synoptic weather pattern with low pressure at the surface over the Great Basin and a strong Pacific High in the eastern Pacific Ocean, as well as coupled along-valley flow aloft. The evidence presented supports that this episode is a high-wind natural event under the U.S. EPA exceptional events regulation with sustained winds to 34 mph (hourly average) and wind gusts to 53 mph at the Whitewater Wash station. If not for the high wind event, PM10 concentrations would not have exceeded the federal standard in this case. Therefore, AQMD staff recommends the flagging of the PM10 NAAQS violation at the Indio air monitoring station on April 6, 2007 as a high wind natural event in the U.S. EPA Air Quality System.