IMPERIAL COUNTY
AIR POLLUTION CONTROL DISTRICT

Views into the land along the Pacific Crest Trail during a late Winter storm at Mount Laguna, California. April 2014. Where the Pacific Crest Trail east of Sunrise Highway leaves the trees, between Stevenson Peak and Garnet Peak, one gets a good view of the mesa-like landscape of Laguna Mountains. To the west, from where it gently rises, it borders the greens of Cuyamaca Rancho State Park, while to the north, the boundary is a high elevation portion of the otherwise dry and arid Anza Borrego Desert State Park. In this photo, a late Winter storm moved through in early April, bringing a little bit of snow and rain, and gusty winds that put an icing onto the chaparral bushes and trees.

March 30, 2014 and April 1, 2014
Exceptional Event Documentation
For the Imperial County PM_{10} Nonattainment Area

FINAL REPORT

February 3, 2017

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ACRONYM	DESCRIPTIONS
AQI	Air Quality Index
AQS	Air Quality System
BACM	Best Available Control Measures
BAM 1020	Beta Attenuation Monitor Model 1020
BLM	United States Bureau of Land Management
BP	United States Border Patrol
CAA	Clean Air Act
CARB	California Air Resources Board
CMP	Conservation Management Practice
DCP	Dust Control Plan
DPR	California Department of Parks and Recreation
EER	Exceptional Events Rule
EPA	Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GOES-W/E	Geostationary Operational Environmental Satellite (West/East)
HF	Historical Fluctuations
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory Model
ICAPCD	Imperial County Air Pollution Control District
ITCZ	Inter Tropical Convergence Zone
KBLH	Blythe Airport
KCZZ	Campo Airport
KIPL	Imperial County Airport
KNJK	El Centro Naval Air Station
KNYL/MCAS	Yuma Marine Corps Air Station
KPSP	Palm Springs International Airport
KTRM	Jacqueline Cochran Regional Airport (aka Desert Resorts Rgnl Airport)
LST	Local Standard Time
MMML/MXL	Mexicali, Mexico Airport
MPH	Miles Per Hour
MST	Mountain Standard Time
NAAQS	National Ambient Air Quality Standard
NCAR	National Center for Atmospheric Research
NCEI	National Centers for Environmental Information
NEAP	Natural Events Action Plan
NEXRAD	Next-Generation Radar
NOAA	National Oceanic and Atmospheric Administration
nRCP	Not Reasonably Controllable or Preventable
NWS	National Weather Service
PDT	Pacific Daylight Time
PM_{10}	Particulate Matter less than 10 microns
$PM_{2.5}$	Particulate Matter less than 2.5 microns

PST	Pacific Standard Time
QA/QC	Quality Assured and Quality Controlled
QCLCD	Quality Controlled Local Climatology Data
RACM	Reasonable Available Control Measure
RAWS	Remote Automated Weather Station
SIP	State Implementation Plan
SLAMS	State Local Ambient Air Monitoring Station
SMP	Smoke Management Plan

I Introduction

On March 30, 2014, the State and Local Ambient Air Monitoring Station (SLAMS) (AQS Sites Code 06-025-0007), located in Brawley, California recorded an exceedance of the National Ambient Air Quality Standard (NAAQS) when the Federal Referenced Method (FRM) Size-Selective Inlet (SSI) high volume sampler measured a (midnight to midnight) 24-hour (hr) average Particulate Matter less than 10 microns (PM_{10}) concentration of 220 µg/m^3. In addition, on April 1, 2014, the Federal Equivalent Method (FEM), Beta Attenuation Monitor Model 1020 (BAM 1020) also located in Brawley, California, measured a (midnight to midnight) 24-hr average concentration of 160.5 µg/m^3. PM_{10} 24-hr measurements recorded above the 150 µg/m^3 are exceedances of the NAAQS. The SLAMS in Brawley was the only station, in Imperial County to record exceedances of the PM_{10} NAAQS on March 30, 2014 and April 1, 2014.

TABLE 1-1
BRAWLEY CONCENTRATIONS OF PM_{10} ON MARCH 30, 2014 AND APRIL 1, 2014

DATE	MONITORING SITE	AQS ID	POC(s)	HOURS	24-HOUR CONCENTRATION ug/m^3	PM_{10} NAAQS ug/m^3
3/30/2014	Brawley	06-025-0007	1	24	220	150
4/01/2014	Brawley	06-025-0007	3	24	160.5	150

The Imperial County Air Pollution Control District (ICAPCD) has been submitting PM_{10} data from FRM SSI instruments since 1986 into the United States Environmental Protection Agency's (USEPA) Air Quality System (AQS). Most recently, since 2013 ICAPCD has been submitting continuous PM_{10} data from BAM 1020's. On March 30, 2014 and April 01, 2014 the Brawley monitor was impacted by elevated particulate matter caused by the entrainment of fugitive windblown dust from high winds associated with two strong low pressure systems passing through southern California and parts of the desert southwest, including Imperial County.

This report demonstrates that the exceedances observed on March 30, 2014 and April 01, 2014 were caused by a naturally occurring event which elevated particulate matter affecting air quality, was not reasonably controllable or preventable (nRCP), was in excess of normal historical fluctuations (HF) and would not have occurred "but for" the entrainment of fugitive windblown dust from outlaying deserts and mountains from the Sonoran Desert. The document further substantiates the request by the ICAPCD to flag PM_{10} 24-hour NAAQS exceedances of 220 µg/m^3 and 160.5 µg/m^3 as an exceptional event. This demonstration substantiates that this event meets the definition of the USEPA Regulation for the Treatment of Data Influenced by Exceptional Events (EER)[1].

I.1 Demonstration Contents

Section II - Describes the March 30, 2014 and April 01, 2014 event as it occurred in California and

[1] "Treatment of Data Influenced by Exceptional Events; Final Rule", 72 FR 13560, March 22, 2007

into Imperial County, providing background information of the exceptional event and explaining how the event affected air quality. Overall, this section provides the evidence that the event was a natural event.

Section III - Describes the normal historical fluctuations using data charts, summaries, and time-series graphs which demonstrate that the elevated concentrations of PM_{10} on March 30, 2014 and April 01, 2014 were in excess of normal historical fluctuations.

Section IV - Provides evidence that the event of March 30, 2014 and April 01, 2014 was not reasonably controllable or preventable despite the full enforcement and implementation of Best Available Control Measures (BACM).

Section V - Discusses and establishes the clear causal relationship between the exceedances at the Brawley station and the natural event which occurred on March 30, 2014 and April 01, 2014. This section provides evidence that the event affected air quality as a result of a natural event.

Section VI - Brings together the evidence presented within this report and shows a clear causal relationship between the natural event, the exceedance and how BACM was overwhelmed making it nRCP concluding that the exceedance which occurred March 30, 2014 and April 01, 2014 would not have occurred "but for" the natural event.

I.2 Requirement of the Exceptional Event Rule

The above sections combined comprise the technical requirements described under the Exceptional Events Rule (EER) under 40 CFR §50.14(c)(3)(iv). However, there are additional non-technical requirements that must be met in order for the USEPA to concur with flagged air quality monitoring data.

I.2.a Public Notification that a potential event was occurring

The ICAPCD and the National Weather Service (NWS) provided notification via the ICAPCD's webpage that high winds with gusts up to 30 miles per hour (mph) could strike Imperial County on March 30, 2014, and gusts up to 35 miles per hour (mph) could impact this region on April 1, 2014, potentially elevating particulate matter. Because of the potential for suspended particles and poor air quality, the ICAPCD issued a "No Burn" days in Imperial County for March 30, 2014, March 31, 2014, and April 1, 2014. In addition, the ICAPCD posted the notices issued by the National Weather Service (NWS) Phoenix office warning of potential blowing dust and sand. **Appendix A** contains copies of notices that were issued March 30, 2014 and April 1, 2014.

I.2.b Notification to USEPA of the intent to exclude a measured violation (40 CFR §50.14(c)(2)(I))

States are required under federal regulation to submit measured ambient air quality data into the AQS. AQS is the federal repository of Quality Assured and Quality Controlled (QA/QC) air

ambient data used for regulatory purposes. Ambient data that is potentially influenced by an exceptional event must be appropriately flagged and initially described and submitted to USEPA according to 40 CFR § 50.14(c)(2)(iii) no later than July 1st of the calendar year following the year in which the flagged measurement occurred.

The ICAPCD made a written request to the California Air Resources Board (CARB) to place preliminary flags on SLAMS measured concentrations in Brawley. The request dated May 14, 2014 requested an initial flag for the measurement from the PM_{10} SSI Hi Volume Gravimeter sampler in Brawley of 220 µg/m^3 and an initial flag the measurement from the BAM 1020 in Brawley of 160.5 µg/m^3. A brief description was included with the initial flags of the meteorological data which indicated a potential natural event had occurred on March 30, 2014 and April 01, 2014.

I.2.c Documentation that the public comment process was followed for the event demonstration that was flagged for exclusion (40 CFR §50.14(c)(3)(v))

The ICAPCD posted, for a 30-day public review, a draft version of this demonstration on the ICAPCD webpage and published a notice of availability in the Imperial Valley Press on January 4, 2017. The notice advised the public that comments were being solicited regarding this demonstration, which supports the request, by the ICAPCD to exclude the measured concentration of 190.9 µg/m^3, which occurred on March 30, 2014 and April 1, 2014 in Brawley. The final closing date for comments was February 3, 2017. **Appendix A** contains a copy of the public notice affidavit along with any comments received by the ICAPCD for submittal as part of the demonstration (40 CFR §50.14(c)(3)(i)).

I.2.d Documentation submittal supporting an Exceptional Event Flag (40 CFR §50.14(a)(1-2))

States that have flagged data as a result of an exceptional event and who have requested an exclusion of said flagged data are required to submit a demonstration that justifies the data exclusion to the USEPA no later than 3 years following the end of the calendar quarter in which the flagged concentration was measured or 12 months prior to the date that a regulatory decision must be made by USEPA.

The ICAPCD, after the close of the comment period and after consideration of the comments will submit this demonstration along with all required elements, including received comments and responses to USEPA Region 9 in San Francisco, California. The deadline for the submittal of this demonstration is March 31, 2017; however, it currently has regulatory implications for the PM10 SIP due in 2016.

I.2.e Necessary demonstration to justify an exclusion of data under (40 CFR§50.14(c)(3)(iv))

A This demonstration provides evidence that the event, as it occurred on March 30, 2014 and April 01, 2014, satisfies the definition in 40 CFR §50.1(j) and (k) for an exceptional event.

a The event "affects air quality"
b The event "is not reasonably controllable or preventable."
c The event is "caused by human activity that is unlikely to recur at a particular location or [is] a natural event."
d The event is a "natural event" where human activity played little or no direct causal role.

B This demonstration provides evidence that air quality was affected by the exceptional event in Imperial County. There is a clear causal relationship between the event and the measured concentrations in Brawley supporting that the event affected the air quality in Imperial County.

C This demonstration provides evidence that the measured concentration, caused by the event, is in excess of normal historical fluctuations.

D This demonstration provides evidence that "but-for" the event there would have been no exceedance (violation).

II March 30, 2014 and April 1, 2014 Conceptual Model

This section provides a summary description of the meteorological and air quality conditions under which the March 30, 2014 and April 01, 2014 event unfolded in Imperial County. The subsection elements include

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

II.1 Geographic Setting and Monitor Locations

According to the United States Census Bureau, Imperial County has a total area of 4,482 square miles of which 4,177 square miles is land and 305 square miles is water. Much of Imperial County is below sea level and is part of the Colorado Desert an extension of the larger Sonoran Desert (**Figure 2-1)**.

FIGURE 2-1
COLORADO DESERT AREA IMPERIAL COUNTY

Fig 2-1: 1997 California Environmental Resources Evaluation System. According to the United States Geological Survey (USGS) Western Ecological Research Center the Colorado Desert bioregion is part of the bigger Sonoran Desert Bioregion which includes the Colorado Desert and Upper Sonoran Desert sections of California and Arizona, and a portion of the Chihuahuan Basin and Range Section in Arizona and New Mexico (Forest Service 1994)

A notable feature in Imperial County is the Salton Sea which is at 235 feet below sea level. The Chocolate Mountains are located east of the Salton Sea and extend in a northwest-southeast direction for approximately 60 miles (**Figure 2-2)**. In this region, the geology is dominated by the transition of the tectonic plate boundary from rift to fault. The southernmost strands of the San Andreas Fault connect the northern-most extensions of the East Pacific rise. Consequently, the region is subject to earthquakes and the crust is being stretched, resulting in a sinking of the terrain over time.

FIGURE 2-2
SURROUNDING AREAS OF THE SALTON SEA

Fig 2-2: Image courtesy of the Image Science and Analysis Laboratory NASA Johnson Space Center, Houston Texas

All of the seven incorporated cities, along with the unincorporated city of Niland, are surrounded by agricultural fields to the north, east, west and south (**Figure 2-3)**. Together, these communities and agricultural fields make what is known as the Imperial Valley. Surrounding the Imperial Valley are desert areas found on the eastern and western portions of Imperial County.

FIGURE 2-3
LOCATION AND TOPOGRAPHY OF IMPERIAL COUNTY

Fig 2-3: Depicts the seven incorporated cities within Imperial Valley - City of Calipatria, City of Westmorland, City of Brawley, City of Imperial, City of El Centro, City of Holtville, City of Calexico. Niland is unincorporated. Mexicali, Mexico is to the south

Furthermore, portions of the Sonoran Desert located to the east and west of Imperial County expand to the southeast and southwest into Mexico (**Figure 2-4)**. Combined, these deserts are sources of dust emissions which impact the Imperial County during high wind events. Arid conditions preceding the event resulted in these soils being particularly susceptible to particulate suspension by the elevated gusty winds.

FIGURE 2-4
DESERTS IN CALIFORNIA, YUMA AND MEXICO

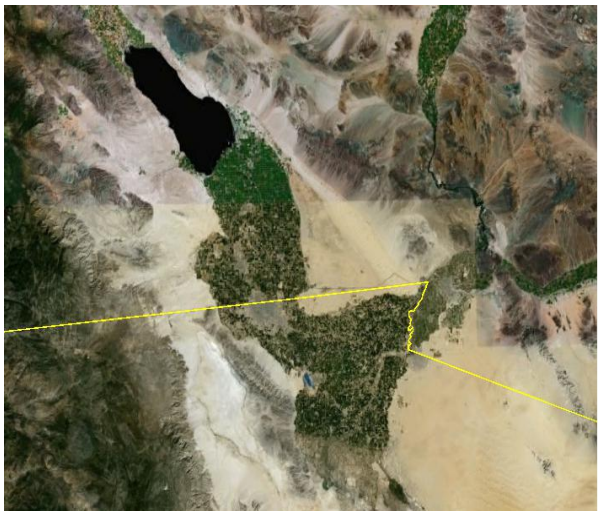

Fig 2-4: Depicts the Sonoran Desert as it extends from Mexico into Imperial County. Source: Google Earth

The air quality and meteorological monitoring stations used in this demonstration are shown in **Figure 2-5**. SLAMS in Imperial County are located in Calexico, El Centro, Westmorland, Brawley, and Niland. Each station measures air quality and meteorological data. The station located in Brawley only measures air quality and no meteorological data. Other air monitoring stations with air quality and meteorological data used for this demonstration include stations in eastern Riverside County and Yuma, Arizona (**Figure 2-5 and Table 2-1)**.

As mentioned above, the PM_{10} exceedances on March 30, 2014 and April 01, 2014, occurred at the Brawley station. The Brawley station is regarded as the "northern" monitoring site within the Imperial County air monitoring network. In order to properly analyze the contributions of meteorological conditions occurring on March 30, 2014 and April 1, 2014, other meteorological sites used in this demonstration include airports in eastern Riverside County, southern San Diego County, southwestern Yuma (Arizona) County, northern Mexico, and Imperial County, along with other sites relevant to the wind event (**Figure 2-5)**.

FIGURE 2-5
MONITORING SITES IN AND AROUND IMPERIAL COUNTY

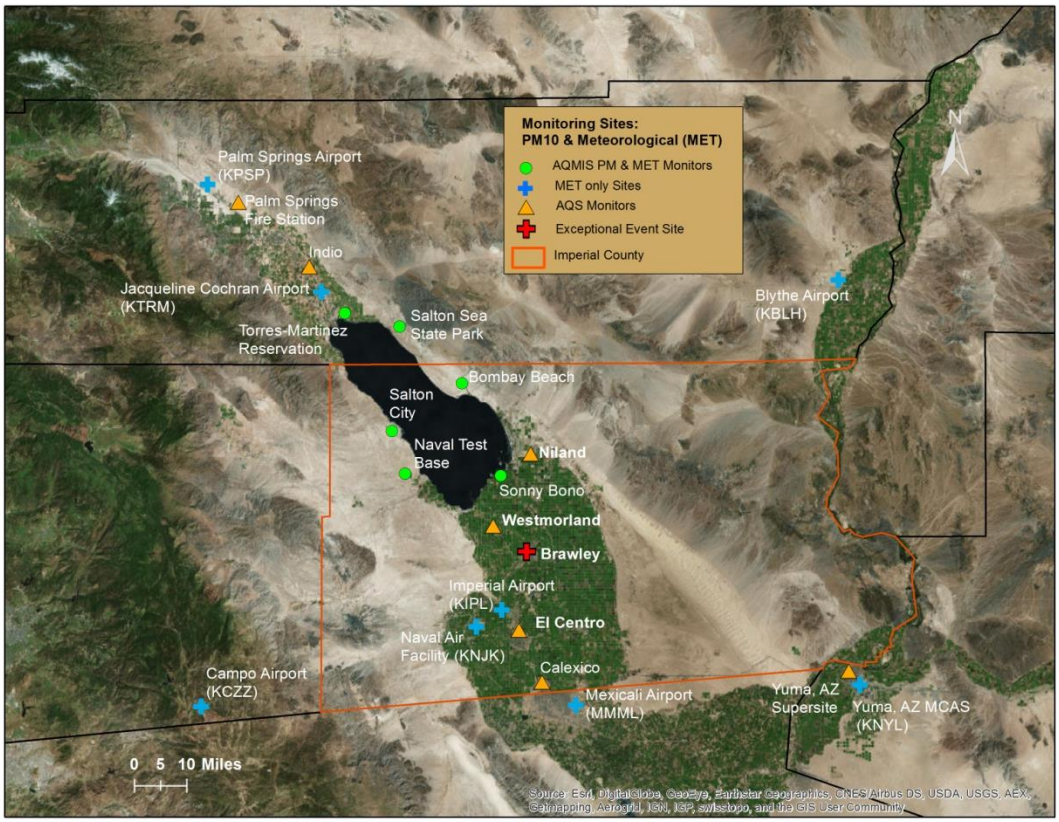

Fig 2-5: Depicts a select group of meteorological and PM_{10} monitoring sites in Imperial County, eastern Riverside County, southern San Diego County, southwestern Yuma (Arizona) County, and northern Mexico. The image exemplifies the regional area impacted by the exceptional event which occurred on March 30, 2014 and April 1, 2014

TABLE 2-1
MONITORING SITES IN IMPERIAL COUNTY, RIVERSIDE COUNTY AND ARIZONA
MARCH 30, 2014 AND APRIL 1, 2014

Monitor Site Name	Operator	Monitor Type	AQS ID	AQS PARAMETER CODE	ARB Site Number	Elevation (meters)	Day	24-hr PM_{10} (ug/m^3) Avg	1-hr PM_{10} (ug/m^3) Max	Time/ Hour of Max Reading	Max Wind Gust (mph)	Time of Max Wind Gust
IMPERIAL COUNTY												
Calexico-Ethel Street	CARB	Hi-Vol Gravimetric	06-025-0005	(81102)	13698	3	30th	64.0	-	-	19.6	5:00
							1st	-	-	-	18.6	17:00
El Centro-9th Street	ICAPCD	Hi-Vol Gravimetric	06-025-1003	(81102)	13694	9	30th	57.0	-	-	13.5	5:00
							1st	-	-	-	13.2	15:00
Brawley-Main Street #2	ICAPCD	BAM 2010	06-025-0007	(81102)	13701	-15	30th	151.0	741.0	7:00	-	-
		BAM 2010					1st	160.5	724.0	23:00	-	-
		Hi-Vol Gravimetric					30th	220.0	-	-	-	-
Westmorland	ICAPCD	BAM 2010	06-025-4003	(81102)	13697	-43	30th	-	-	-	-	-
		BAM 2010					1st	-	-	-	-	-
		Hi-Vol Gravimetric					30th	102.0	-	-	-	-
Niland-English Road	ICAPCD	BAM 2010	06-025-4004	(81102)	13997	-54	30th	81.0	371.0	5:00	24.1	4:00
		BAM 2010					1st	102.4	293.4	22:00	25.0	14:00
		Hi-Vol Gravimetric					30th	84.0	-	-	-	-
RIVERSIDE COUNTY												
Palm Springs Fire Station	SCAQMD	TEOM	06-065-5001	(81102)	33137	174	30th	81.0	309.0	11:00	39.1	11:00
							1st	20.5	47.0	2:00	34.5	16:00
Indio (Jackson St.)	SCAQMD	TEOM	06-065-2002	(81102)	33157	1	30th	109.8	635.0	10:00	19.0	10:00
							1st	18.0	31.0	8:00	10.0	22:00
ARIZONA – YUMA												
Yuma Supersite	ADEQ	TEOM	04-027-8011	(81102)	N/A		30th	175.5	951.0	8:00	27.6	14:00
							1st	73.0	163.0	23:00	26.5	23:00

CARB = California Air Resources Board
IID = Imperial Irrigation District
ICAPCD = Air Pollution Control District, Imperial County
SCAQMD = South Coast Air Management Quality District
ADEQ =Arizona Department of Environmental Quality

II.2 Climate

As mentioned above, Imperial County is part of the Colorado Desert, which is a subdivision of the larger Sonoran Desert (**Figure 2-6**) encompassing approximately 7 million acres (28,000 km^2). The desert area encompasses Imperial County and includes parts of San Diego County, Riverside County, and a small part of San Bernardino County.

FIGURE 2-6
SONORAN DESERT REGION

Fig 2-6: Depicts the magnitude of the region known as the Sonoran Desert. Source: Desertmuseum.org

The majority of the Colorado Desert lies at a relatively low elevation, below 1,000 feet (300 m), with the lowest point of the desert floor at 275 feet (84 m) below sea level at the Salton Sea. Although the highest peaks of the Peninsular Range reach elevations of nearly 10,000 feet (3,000 m), most of the region's mountains do not exceed 3,000 feet (910 m).

In the Colorado Desert (Imperial County), the geology is dominated by the transition of the tectonic plate boundary from rift to fault. The southernmost strands of the San Andreas Fault connect to the northern-most extensions of the East Pacific Rise. Consequently, the region is subject to earthquakes, and the crust is being stretched, resulting in a sinking of the terrain over time.

The Colorado Desert's climate distinguishes it from other deserts. The region experiences greater summer daytime temperatures than higher-elevation deserts and almost never experiences frost. In addition, the Colorado Desert experiences two rainy seasons per year (in the winter and late summer), especially toward the southern portion of the region; the more northerly Mojave Desert usually has only winter rains.

The west coast Peninsular Ranges, or other west ranges, of Southern California–northern Baja California, block most eastern Pacific coastal air and rains, producing an arid climate. Other short or longer-term weather events can move in from the Gulf of California to the south, and are often active in the summer monsoons. These include remnants of Pacific hurricanes, storms from the southern tropical jet stream, and the northern Inter Tropical Convergence Zone (ITCZ).

The arid nature of the region is demonstrated when historic annual average precipitation levels in Imperial County average 3.11" (**Figure 2-7)**. During the 12 month period prior to April 1, 2014, Imperial County recorded total annual precipitation of 2.12 inches.

FIGURE 2-7
IMPERIAL COUNTY HISTORICAL WEATHER

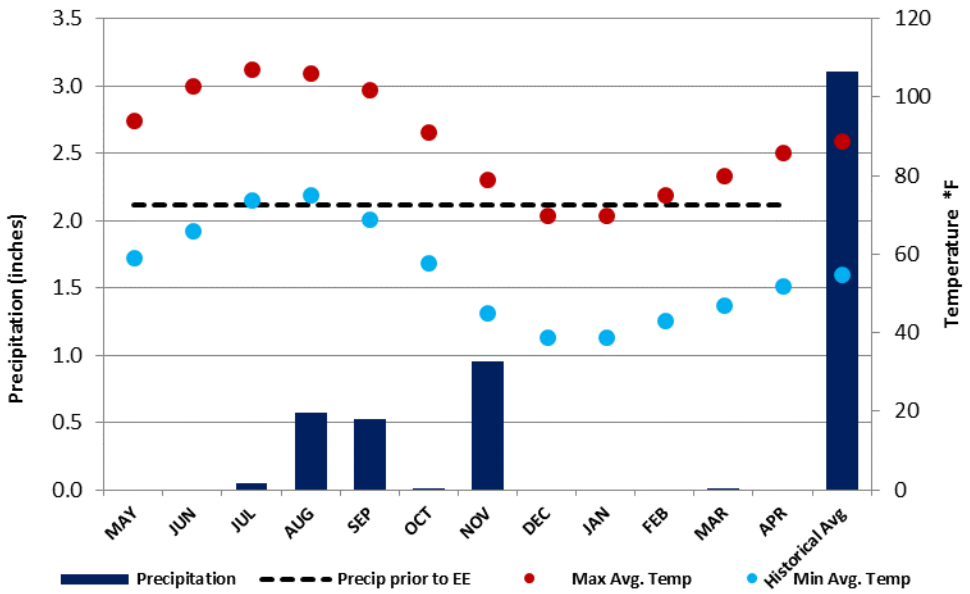

Fig 2-7: Historical Imperial County weather. Prior to April 1, 2014, the region had suffered abnormally low precipitation of 2.12 inches. Average annual precipitation is 3.11 inches. MET data courtesy of Weather Underground, California Observed Climate Normals, and Western Regional Climate Center (WRCC)

While windblown dust events in Imperial County during the summer monsoon season are often due to outflow winds from thunderstorms, windblown dust events in the fall, winter, and spring are usually due to strong winds associated with low-pressure systems and cold fronts moving southeast across California. These winds are the result of strong surface pressure gradients between the approaching low-pressure system, accompanying cold front, and higher pressure ahead of it. As the low-pressure system and cold front approaches and passes, gusty southwesterly winds typically shift to northwesterly. The strong winds can loft dust into the air and transport it over long distances, especially if soils in the region are dry.

II.3 Event Day Summary

The exceptional event for March 30, 2014 and April 1, 2014, was caused by two strong low pressure systems that moved through southern California. The first system moved in during the late evening on March 29, 2014, and continued through March 30, 2014. A second system moved in during the afternoon on March 31, 2014 and continued through the region on April 1, 2014. Both systems brought strong and gusty westerly winds across the mountains and deserts during the four-day period. Figures **2-8 through 2-10** illustrate the breadth and progression of the weather system responsible for the exceptional event that affected the Brawley monitoring site on March 30, 2014 to April 1, 2014.

FIGURE 2-8
SATELLITE SURFACE COMPOSITE MAPS MARCH 30, 2014 TO APRIL 1, 2014

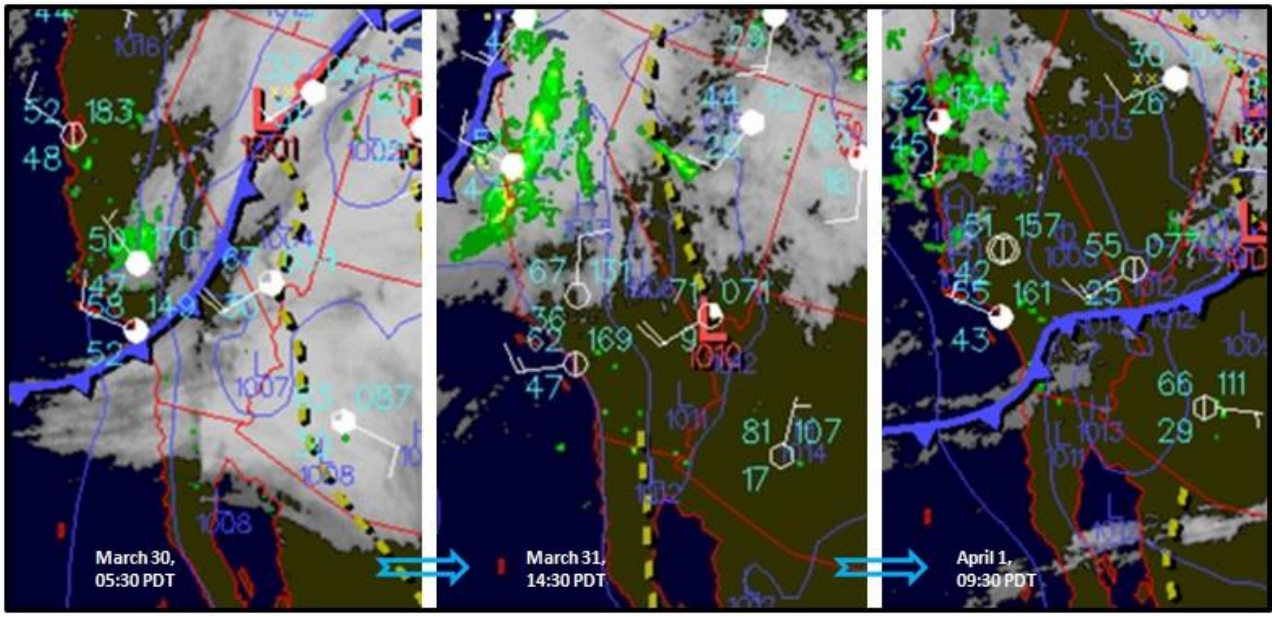

Fig 2-8: A set of three satellite surface composite maps on March 30, 2014, March 31, 2014, and April 1, 2014 demonstrate the series of weather events that took place over a multi-day period. On March 30, 2014 (05:30), a strong weather disturbance moved into the area and brought high winds to southeastern California. A strong low pressure system dipped into the region from Nevada, Utah, and Arizona. A low pressure trough is just to the east. A cold front (blue line with triangles) is moving in from the northwest with intense storm cells (green-yellow areas) just behind it. Low pressure remained over the region on March 31, 2014 (14:30) with isolated patches of storm cells remaining in the area. On April 1, 2014 (09:30) a second cold front moved across southeastern California. The unsettled air brought high winds to the region. Image courtesy of Unisys and the National Center for Atmospheric Research

FIGURE 2-9
INFRARED SATELLITE SEA LEVEL PRESSURE ANALYSIS MARCH 30, 2014 TO APRIL 1, 2014

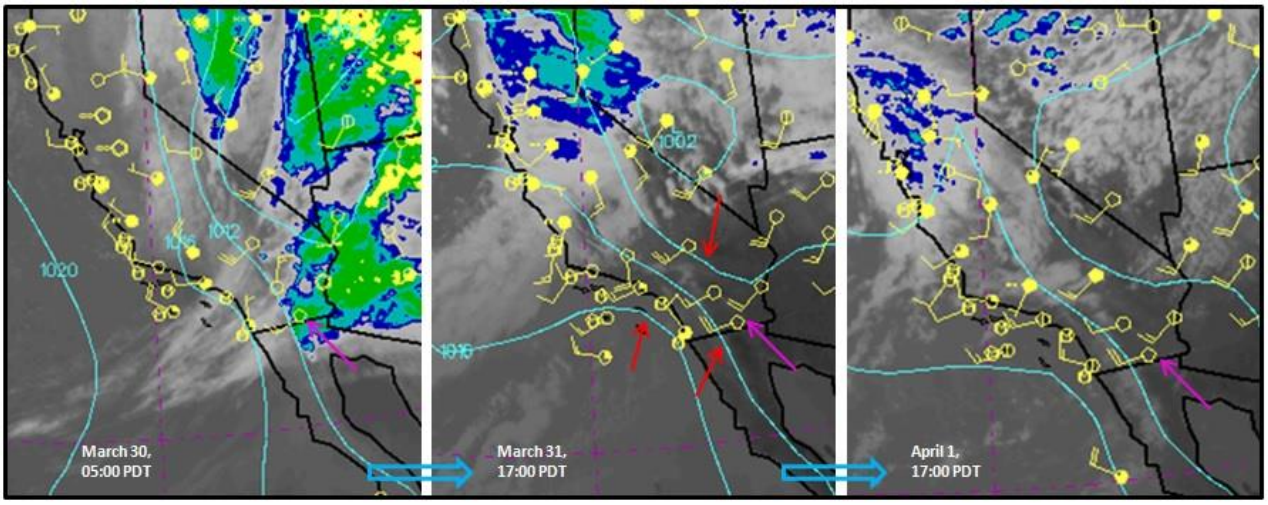

Fig 2-9: A series of GOES-W infrared sea level pressure analysis composite satellite images spanning a three-day period shows the weather system that moved through southeastern California. The image on the left shows a large storm that moved through the region, initiating the multi-day high wind event. Wind barbs (indicated by maroon arrows) show winds approaching ~20 mph-25 mph during the three days. Some packing of pressure gradients (red arrows) are seen in the March 31, 2014 image. Images courtesy of SFSU Meteorology Department and California Regional Weather Server

The strong low pressure systems resulted in elevated winds over a regional area from San Diego, San Bernardino, and Riverside counties, eastward to the lower Colorado River valley and beyond to Tacna, Dateland, and Wellton in southwestern Arizona. The wind event was not only regional, but spanned multiple days. The weather systems prompted the NWS (National Weather Service) San Diego office to issue wind advisories[2] on March 29, 2014 at 03:22 for the San Bernardino County mountains, the Riverside County mountains, the San Diego County mountains, the Apple and Lucerne valleys, the Coachella Valley, and the San Diego County deserts that border Imperial County on the west. The wind advisories predicted west winds of 20 to 30 mph with gusts up to 50 mph and isolated gusts up to 60 mph. On April 1, 2014 at 11:08 PST, the NWS Phoenix office issued an urgent weather message that contained a wind advisory for Imperial County. Winds of 25 mph to 35 mph with gusts up to 40 mph were predicted. Additionally, multiple Hazardous Weather Outlooks were issued for southeastern California and southwestern Arizona along the lower Colorado River valley beginning March 30, 2014 and continuing through April 1, 2014. One Urgent Weather Message was issued on April 1, 2014 at 13:17 PST for Imperial County. Warnings of patchy blowing sand or blowing dust for the same area were carried in the advisories and forecasts. See **Appendix A** for advisories and forecast.

[2] A wind advisory is issued when the following conditions are met for one (1) hour or longer: 1) sustained winds of 31 to 39 mph, and/or; 2) wind gusts of 46 to 57 mph for any duration. Source: NWS, 2016; http://www.weather.gov/lwx/WarningsDefined#WindAdvisory

FIGURE 2-10
SURFACE PRESSURE ANALYSIS MAPS MARCH 30, 2014 TO APRIL 1, 2014

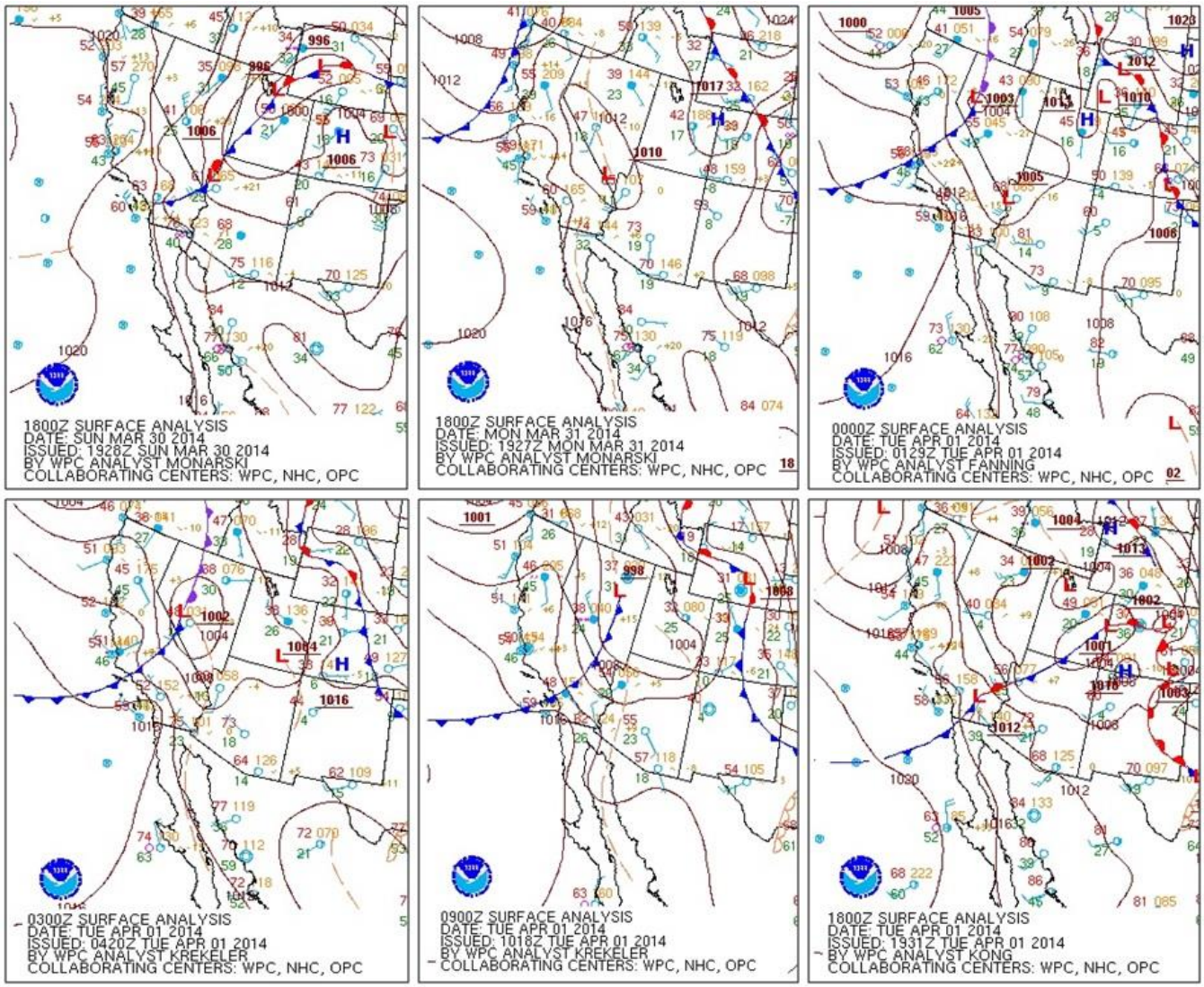

Fig 2-10: A series of surface pressure analysis composite satellite images spanning a three-day period shows the weather system that moved through southeastern California, and a corresponding tightening of pressure gradients. Top, from left: as the system moves into southern California, a tightening of the pressure gradient is noticeable on April 1, 2014 at 0000Z / March 31, 2014 16:00 (top right). The gradient continues to tighten on March 31, 2014 19:00 / April 1, 2014 0300Z (bottom left), and on April 1, 2014 01:00 / 0900Z (bottom middle). Images from the NWS Weather Prediction Center

As the weather systems moved into Imperial County, strong winds did in fact occur. Winds at Imperial Airport (KIPL) reached 24 mph on March 30, 2014. On March 31, 2014 winds exceeded the 25 mph threshold for multiple hours. On April 1, 2014 winds again reached 25 mph for one hour. El Centro NAF (KNJK) recorded winds at or above the 25 mph threshold for multiple hours on March 30, 2014, March 31, 2014, and April 1, 2014. The chain of events is visually

demonstrated in **Figure 2-11**. During the 22:00 hour on March 29, 2014, winds at Imperial Airport (KIPL) shifted from eastwardly/southerly to westerly. During that same period, winds at El Centro NAF (KNJK) shifted from variable-southerly to westerly. On March 30, 2014 winds at KIPL and KNJK ranged from WSW to WNW as speed increased and gusts began. Winds at both locations had shifted to WNW by 11:00, then returned to westerly by 17:00 hours. At 02:53 on March 30, 2014 KIPL experienced winds of 22 mph with gusts of 29 mph. KNJK saw winds increase to 25 mph at 00:56, then rise to 32 mph with gusts up to 40 mph at 03:56.

FIGURE 2-11
KEY WIND EVENTS

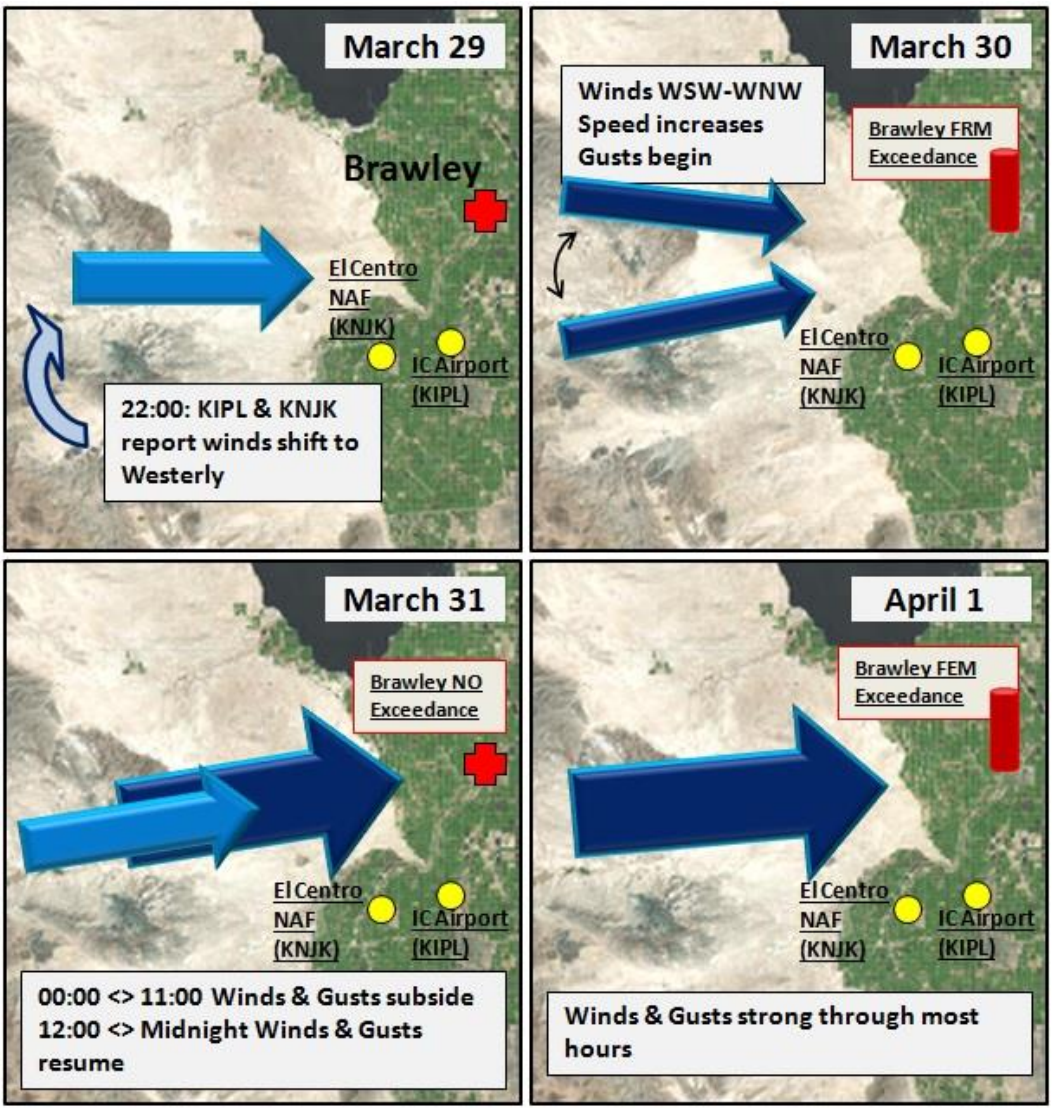

Fig 2-11: The graphic shows the key moments over a four-day period as the weather systems passed through southeastern California. Winds began to ramp up late on March 29, 2014. Following a brief lull during the morning of March 31, 2014, winds and gusts resumed. They remained strong for most hours during April 1, 2014. Wind data from the NCEI's QCLCD data bank. Base map from Google Earth

On March 31, 2014 winds decreased and remained moderately light though 11:00. During the 12:00 hour, both sites experienced an increase in winds and gusts. By 14:53 KIPL had winds of 25 mph and gusts of 32 mph. At 18:56 KNJK had winds of 32 mph and gusts of 43 mph. Winds and gusts remained strong throughout the remainder of March 30, 2014 at both locations. The Brawley FEM monitor recorded an exceedance of the PM_{10} standard on March 30, 2014. The Brawley FEM monitor recorded a 24-hour maximum of 584.5 µg/m^3 during 05:00 on March 30, 2014, but did not exceed.

On April 1, 2014, winds and gusts remained strong through most hours. Wind direction shifted slightly to the WSW at El Centro NAF, while winds at Imperial County Airport were generally westerly. At 00:06 KNJK had winds of 31 mph with gusts of 46 mph. At 13:53 KIPL recorded winds of 25 mph with gusts of 34 mph. The Brawley FEM monitor recorded an exceedance on April 1, 2014. The maximum 24-hour concentration of 723.8 µg/m^3 occurred during the 23:00 hour.

The National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory HYSPLIT back-trajectory model,[3] **Figures 2-12 and 2-13**, indicate the direction of air flow in the hours prior to impacting the Brawley monitor at 05:00 (LST) on March 30, 2014, and at 23:00 (LST) on April 1, 2014, respectively. The air passed over a wide fetch of dry soils to the west near the border of San Diego and Imperial counties before reaching Brawley. Winds were already strong before entering Imperial County. **Appendix A** contains forecasts and wind advisories warning of high winds and gusts in the mountains and deserts of eastern San Diego County. Rainfall in the preceding 12 months was an inch below the annual average. As a result, the largely barren desert soils west of Imperial County were abnormally arid and highly susceptible to entrainment. Strong winds and gusts that started late on March 30, 2014 and continued through April 1, 2014 with only a brief pause on March 31, 2014, lofted and transported dust particles from this region. The dust impacted PM_{10} monitors throughout southeastern California and Yuma, Arizona. The elevated levels of PM_{10} concentrations measured in Riverside, Imperial, and Yuma counties illustrate the regional nature of the event (**Tables 2-1 and 2-2**). This chain of meteorological events resulted in steep increases in PM_{10} concentrations in Imperial County, heavily impacting the Brawley monitoring site. As a result, exceedances were recorded on March 30, 2014 (FRM monitor) and April 1, 2014 (FEM monitor).

[3] The Hybrid Single Particle Lagrangian Integrated Trajectory Model (**HYSPLIT**) is a computer model that is a complete system for computing simple air parcel trajectories to complex dispersion and deposition simulations. It is currently used to compute air parcel trajectories and dispersion or deposition of atmospheric pollutants. One popular use of HYSPLIT is to establish whether high levels of air pollution at one location are caused by transport of air contaminants from another location. HYSPLIT's back trajectories, combined with satellite images (for example, from NASA's MODIS satellites), can provide insight into whether high air pollution levels are caused by local air pollution sources or whether an air pollution problem was blown in on the wind The initial development was a result of a joint effort between NOAA and Australia's Bureau of Meteorology.

FIGURE 2-12
HYSPLIT MODEL MARCH 30, 2014

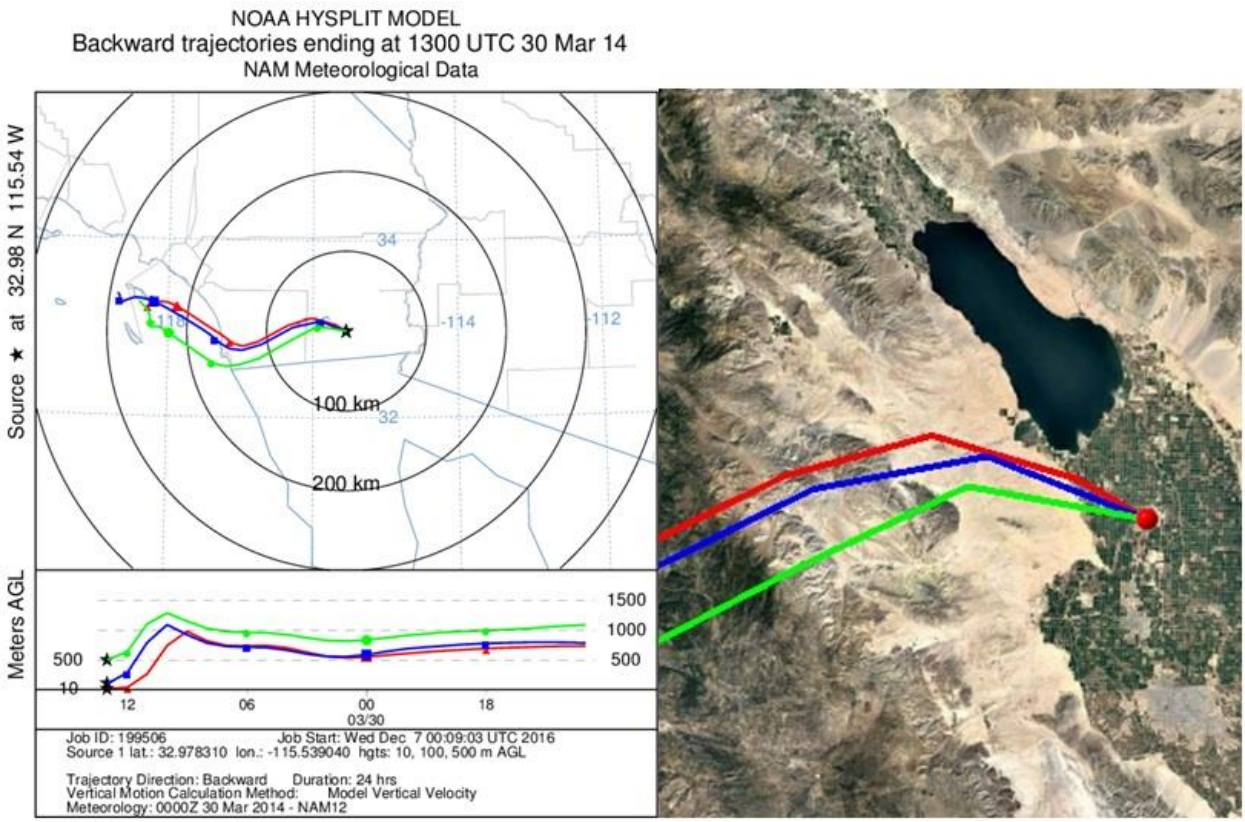

Fig 2-12: A 24-hour back-trajectory ending at Brawley at 05:00 LST on March 30. Red indicates air flow at 10 meters AGL (above ground level); blue=100m; green=500m. The Brawley FRM monitor recorded an exceedance on this day. Since the FRM monitor does not record hourly PM_{10} concentrations, the time of trajectory was based up the maximum hourly concentration recorded by the FEM monitor. It should be noted that modeled winds can differ substantially from local conditions. Data used in the HYSPLIT model has a horizontal resolution of 12 km and is integrated every three hours. Thus, the HYSPLIT model may differ from local observed surface wind speeds and directions. Generated through NOAA Air Resources Laboratory HYSPLIT

FIGURE 2-13
HYSPLIT MODEL APRIL 1, 2014

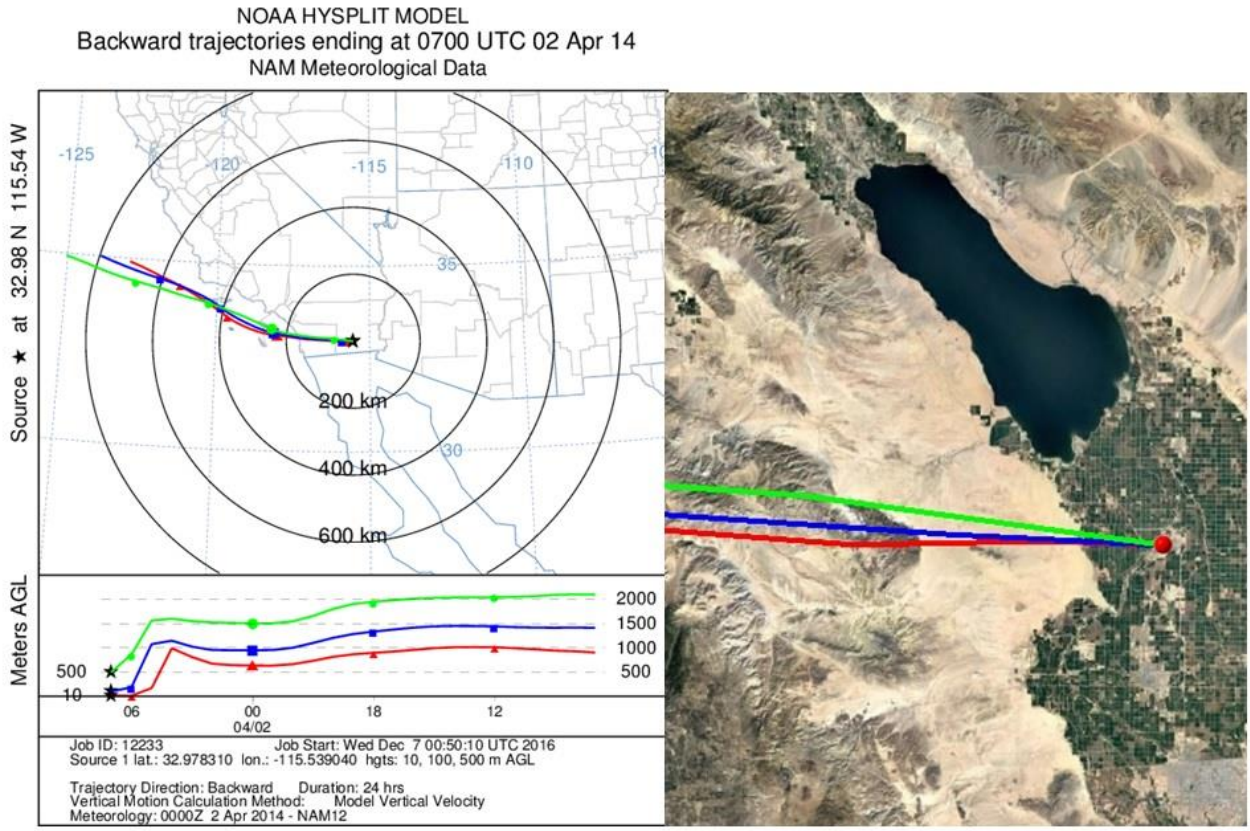

Fig 2-13: A 24-hour back-trajectory ending at Brawley at 23:00 LST on April 1, 2014. Red indicates air flow at 10 meters AGL (above ground level); blue=100m; green=500m. The time of trajectory was based up the maximum hourly concentration recorded by the FEM monitor. It should be noted that modeled winds can differ substantially from local conditions. Data used in the HYSPLIT model has a horizontal resolution of 12 km and is integrated every three hours. Thus, the HYSPLIT model may differ from local observed surface wind speeds and directions. Generated through NOAA Air Resources Laboratory HYSPLIT

Figure 2-14 illustrates the elevated levels of PM_{10} concentrations measured by FEM (hourly) monitors in Riverside, Imperial and Yuma Counties. **Figure 2-15** compares FRM monitors in Imperial County over a three-run day period. The entrained dust particles resulted in a (midnight to midnight) 24-hr average concentration of 220 µg/m^3 and 160.5 µg/m^3 at the Brawley monitor. Best Available Control Measures (BACM) was overwhelmed by the suddenness and intensity of the meteorological event.

Table 2-2 presents a summary of wind speeds, wind gusts, and wind direction at monitors in Imperial County, Riverside County, Yuma, Arizona, and Mexicali. For detailed meteorological station graphs see **Appendix B**.

TABLE 2-2
WIND SPEEDS ON MARCH 30, 2014 AND APRIL 1, 2014

Station Monitor Airport Met Data	Day	Maximum Wind Speed (WS) (mph)	Wind Direction during Max WS (degrees)	Time/Hour of Max Wind Speed	24 hr Maximum Wind Gust (WG) (mph)	Time (Hour) of Max WG	PM_{10} correlated to Time/Hour of Max Wind Speed	Hourly Maximum Observed PM_{10} (ug/m3)
Imperial Airport (KIPL)	30	24	260	05:00	34	05:00	-	-
	1	25	240	08:00	34	13:00	-	-
Naval Air Facility (KNJK)	30	32	230	03:00	40	03:00	-	-
	1	31	230	14:00	46	00:00	-	-
Calexico (Ethel St)	30	19.6	291	05:00	-	-	-	-
	1	18.6	288	17:00	-	-	-	-
El Centro -9th Street	30	13.5	261	05:00	-	-	-	-
	1	13.2	267	15:00	-	-	-	-
Westmorland	30	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-
Niland	30	24.1	260	04:00	-	-	-	371
	1	25	261	14:00	-	-	144	293
RIVERSIDE COUNTY								
Blythe Airport (KBLH)	30	19.6	220	08:00	31.1	09:00	-	-
	1	25.5	240	18:00	36.8	14:00	-	-
Palm Springs Airport (KPSP)	30	21.9	310	11:00	39.1	11:00	309	309
	1	25.3	320	16:00	34.5	16:00	9	47
Jacqueline Cochran Regional Airport (KTRM) - Thermal	30	25.3	320	07:00	34.5	07:00	-	-
	1	21.9	250	11:00	32.2	11:00	-	-
ARIZONA – YUMA								
Yuma MCAS (KNYL)	30	17.3	310	10:00	27.6	14:00	396	951
	1	17.3	270	14:00	26.5	23:00	42	163
MEXICALI - MEXICO								
Mexicali Int. Airport (MMML)	30	24.2	290	09:00	-	-	-	-
	1	20.7	230	12:00	-	-	-	-

FIGURE 2-14
72 HOUR PM_{10} CONCENTRATIONS AT AQS SITES
ON MARCH 29, 2014 THROUGH APRIL 2, 2014

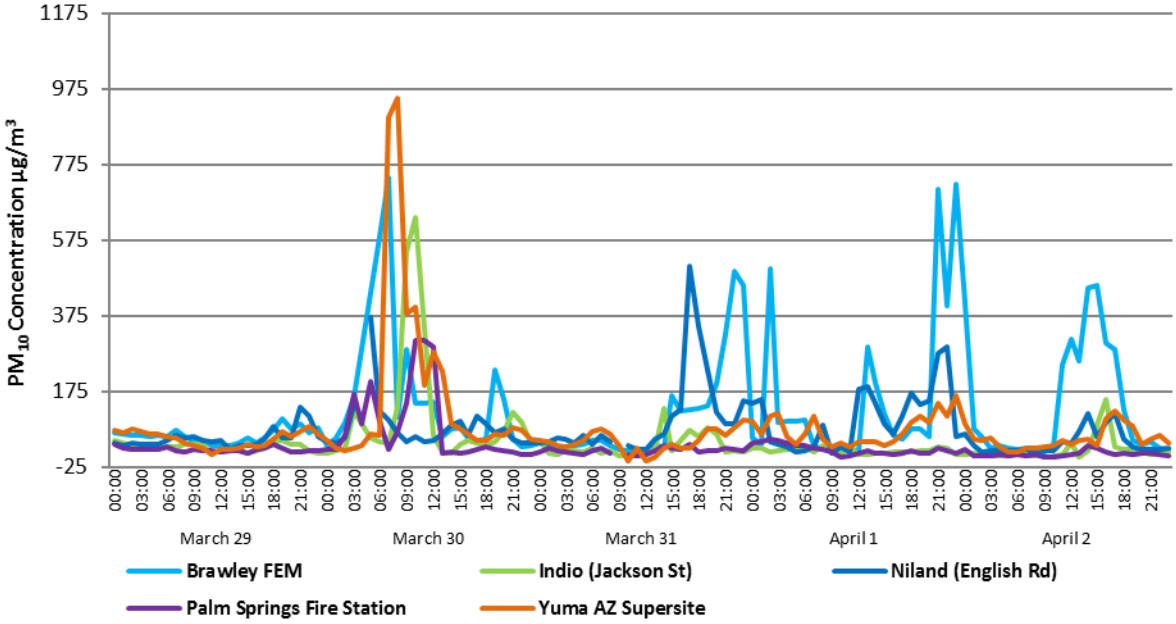

Fig 2-14: The graphical representation of the five-day relative PM_{10} concentrations at regional FEM monitoring locations throughout Riverside, Imperial, and Yuma counties. The graph clearly demonstrates the elevation of PM_{10} concentrations over a regional area on March 30, 2014 and April 1, 2014. Air quality data from the EPA's AQS data bank

FIGURE 2-15
FRM PM_{10} CONCENTRATIONS AT AQS SITES

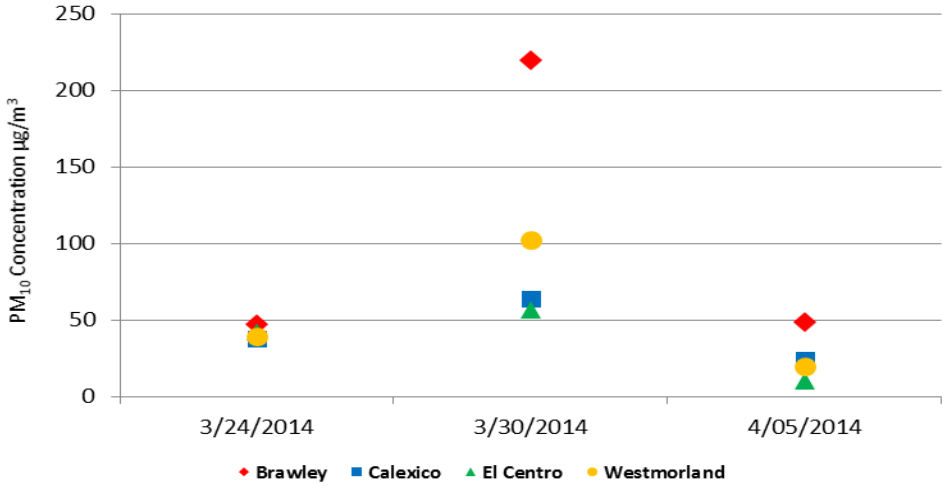

Fig 2-14: A three-run day span of FRM monitors in Imperial Valley. Brawley is significantly higher on March 30, 2014. Air quality data from the EPA's AQS data bank

III Historical Norm

III.1 Analysis

While naturally occurring high wind events may occur seasonally and at times frequently and qualify for exclusion under the EER, historical fluctuations of the particulate concentrations provide insight into the frequency of events within an identified area. The following time series plots illustrate that PM_{10} concentrations measured at the Brawley monitor on March 30, 2014 and April 1, 2014, were unusual and in excess of normal historical fluctuations. The analysis also provides convincing evidence that the event affected air quality.

Figures 3-1 shows the time series of available FRM and BAM 24-hr PM_{10} concentrations at the Brawley monitor for the period of January 1, 2010 through April 1, 2014. Note that prior to 2013, BAM data was not FEM therefore not reported into AQS. In order to properly establish the variability of the event, as it occurred on March 30, 2014 and April 1, 2014, 24-hour averaged PM_{10} concentrations between January 1, 2010 and April 1, 2014 were compiled and plotted as a time series. All figures illustrate that the exceedance, which occurred on March 30, 2014 and April 1, 2014, were outside the normal historical concentrations when compared to event and non-event days. Air quality data for all graphs obtained through the EPA's AQS data bank.

FIGURE 3-1
BRAWLEY HISTORICAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 1, 2010 TO APRIL 1, 2014

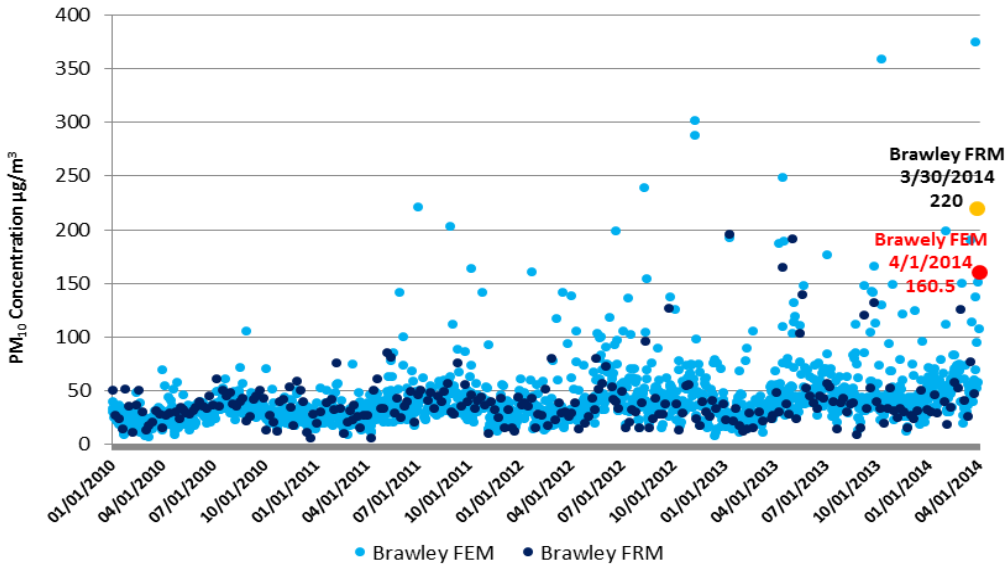

Fig 3-1: A historical comparison of PM_{10} concentrations demonstrates that the March 30, 2014 and April 1, 2014, 220 µg/m^3 and 160.5 µg/m^3 measured concentrations from the Brawley FRM and BAM 1020 PM_{10} monitors were outside the normal historical measurements. Air quality data from the EPA's AQS data bank

The time series, **Figure 3-1**, for Brawley includes 1,552 sampling days (January 1, 2010 through April 1, 2014). During this period, the Brawley station measured a total of 1,803 credible samples, measured by either FRM or FEM monitors between January 1, 2010 and April 1, 2014. Overall, the time series illustrates that of the 1,803 credible samples measured within the 1,552 sampling days there were 21 exceedance days, which is less than a 1.5% occurrence rate. Of the total 21 exceedance days. The other nine exceedances occurred during the third and fourth quarters. No exceedances of the standard occurred during 2010.

FIGURE 3-2
BRAWLEY SEASONAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 1, 2010 TO APRIL 1, 2014

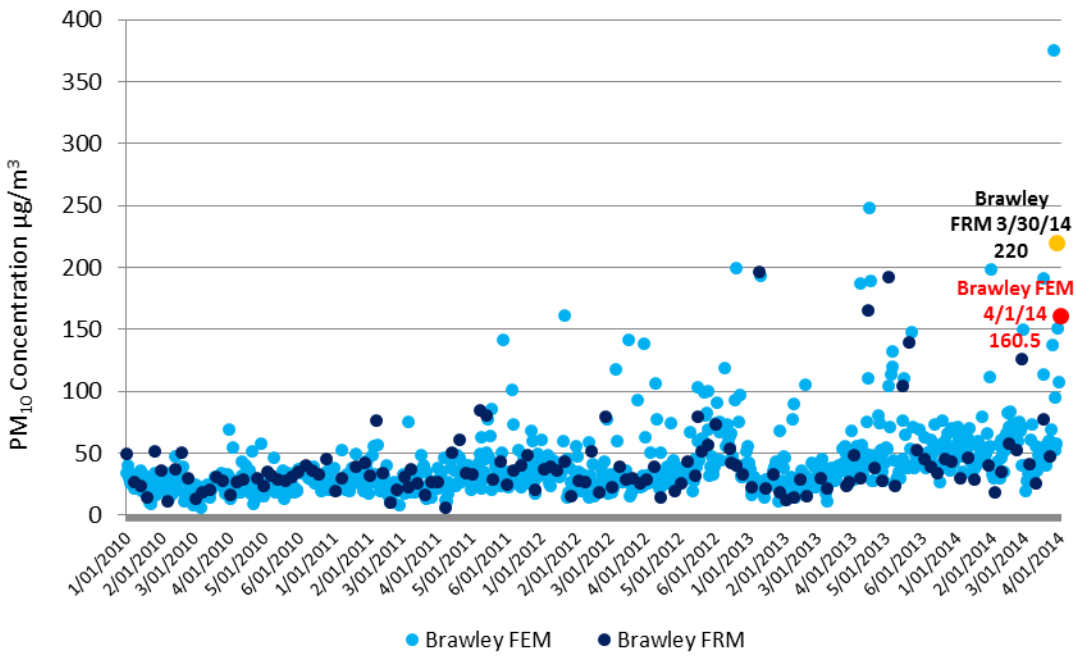

Fig 3-2: The seasonal comparison using the months of January through June for the years 2010 through 2014 supports that the measured exceedances at the Brawley monitor on March 30, 2014 and April 1, 2014 were outside the historical norm. Air quality data from the EPA's AQS data bank

Figure 3-2 for Brawley illustrates the seasonal pattern for the months January through June for the years 2010 through 2014. Of the 948 credible samples measured, only six exceedances occurred during the January to June time period between 2010 and 2014. Three exceedances occurred during the first quarter (January-March) and the other three exceedances occurred during the second quarter (April-June).

Figure 3-3 shows the percentile rankings for the historical period between January 1, 2010 through June 30, 2014. For the combined FRM and FEM annual 2010 through June 30, 2014

Brawley dataset, the FRM concentration of 220 µg/m^3 is above the 99th percentile, and the FEM concentration of 160.5 µg/m^3 is above the 98th percentile ranking. **Figure 3-4** shows percentile rankings for the seasonal period of months January through June, years 2010 through 2014. The FRM concentration of 220 µg/m^3 is in excess of the 99th percentile, while the FEM concentration of 160.5 µg/m^3 falls on the 98th percentile. Looking at the annual time series concentrations, the seasonal time series concentrations, and the percentile rankings, the March 30, 2014 and April 1, 2014 measured exceedances of 220 µg/m^3 and 160.5 µg/m^3 are clearly in excess of normal historical fluctuations, with seasonal exceedances of the NAAQS not occurring frequently.

FIGURE 3-3
BRAWLEY HISTORICAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 1, 2010 TO JUNE 30, 2014

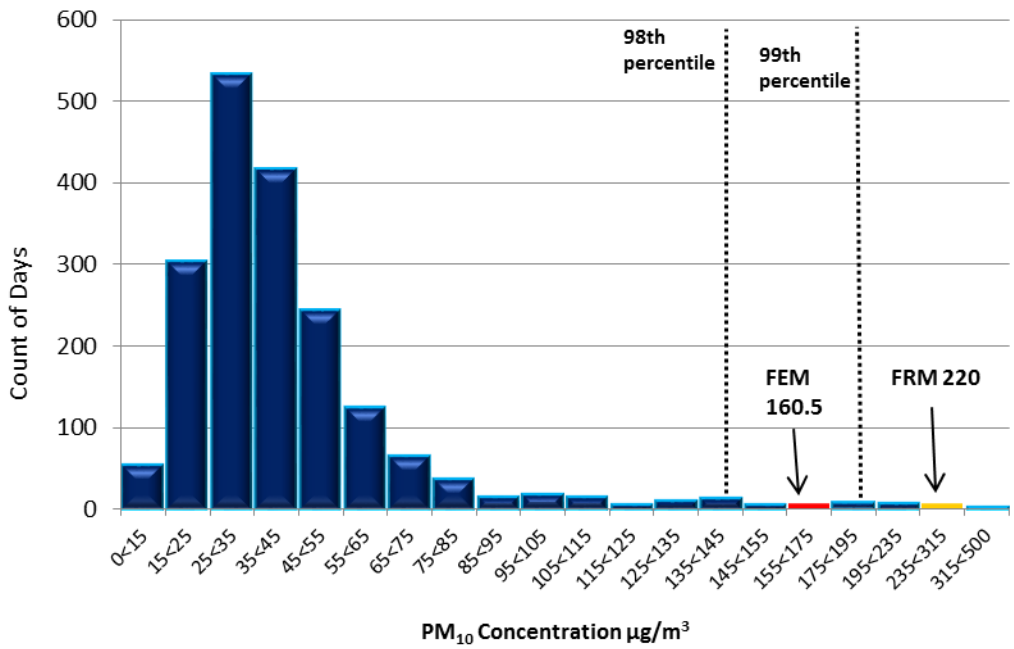

Fig 3-3: The 24-hr average PM_{10} concentrations measured at the Brawley monitoring site demonstrates that the March 30, 2014 exceedance was in excess of the 99th percentile, and that the April 1, 2014 exceedance was in excess of the 98th percentile. Air quality data from the EPA's AQS data bank

FIGURE 3-4
BRAWLEY SEASONAL
PM_{10} 24 HR FRM & FEM CONCENTRATIONS
JANUARY 1, 2010 TO JUNE 30, 2014

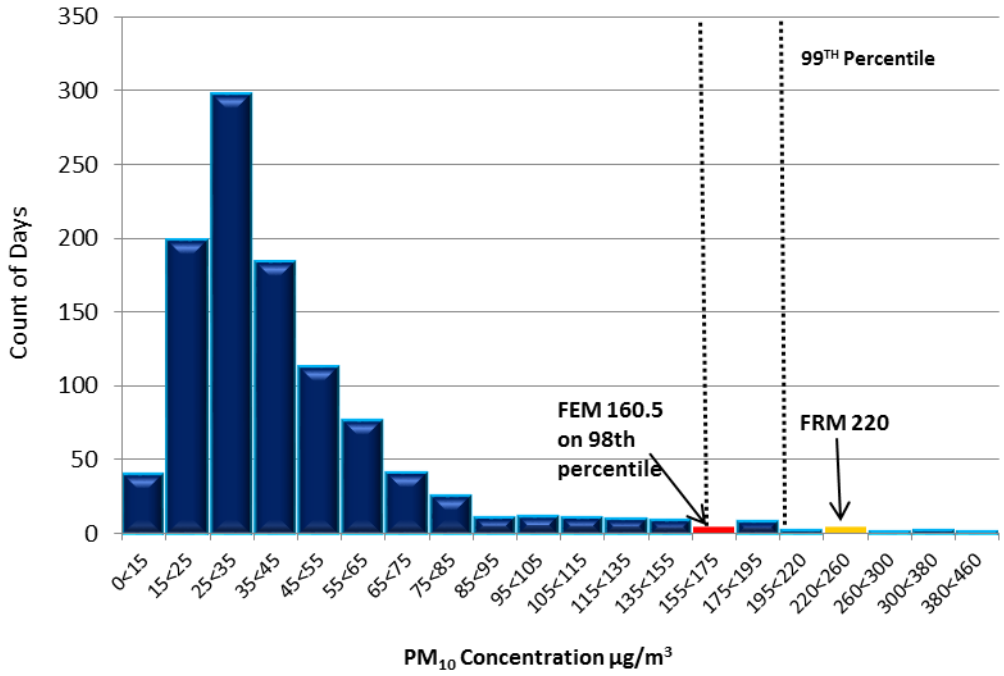

Fig 3-4: The 24-hr average PM_{10} concentrations at the Brawley monitoring site demonstrates that the March 30, 2014 exceedance of 220 µg/m^3 was above the 99th percentile, while the April 1, 2014 exceedance fell on the 98th percentile. Air quality data from the EPA's AQS data bank

III.2 Summary

The information provided above by the historical time series plots, seasonal time series plots, and the percentile rankings illustrate that the PM_{10} concentrations observed on March 30, 2014 and April 1, 2014 occur infrequently. When comparing the measured PM_{10} levels on March 30, 2014 and April 1, 2014 and following USEPA EER guidance, this demonstration provides supporting evidence that the measured exceedances at the Brawley monitoring site were outside the normal historical fluctuations. This historical concentration data and the demonstration found under the clear causal relationship supports that the measured exceedances on March 30, 2014 and April 1, 2014 were an exceptional event and that it affected air quality.

IV Not Reasonably Controllable or Preventable

IV.1 Background

Inhalable particulate matter (PM_{10}) contributes to effects that are harmful to human health and the environment, including premature mortality, aggravation of respiratory and cardiovascular disease, decreased lung function, visibility impairment, and damage to vegetation and ecosystems. Upon enactment of the 1990 Clean Air Act (CAA) amendments, Imperial County was classified as moderate nonattainment for the PM_{10} NAAQS under CAA sections 107(d)(4)(B) and 188(a). By November 15, 1991, such areas were required to develop and submit State Implementation Plan (SIP) revisions providing for, among other things, implementation of reasonably available control measures (RACM).

Partly to address the RACM requirement, ICAPCD adopted local Regulation VIII rules to control PM_{10} from sources of fugitive dust on October 10, 1994, and revised them on November 25, 1996. USEPA did not act on these versions of the rules with respect to the federally enforceable SIP.

On August 11, 2004, USEPA reclassified Imperial County as a serious nonattainment area for PM_{10}. As a result, CAA section 189(b)(1)(B) required all BACM to be implemented in the area within four years of the effective date of the reclassification, i.e., by September 10, 2008.

On November 8, 2005, partly to address the BACM requirement, ICAPCD revised the Regulation VIII rules to strengthen fugitive dust requirements. On July 8, 2010, USEPA finalized a limited approval of the 2005 version of Regulation VIII, finding that the seven Regulation VIII rules largely fulfilled the relevant CAA requirements. Simultaneously, USEPA also finalized a limited disapproval of several of the rules, identifying specific deficiencies that needed to be addressed to fully demonstrate compliance with CAA requirements regarding BACM and enforceability.

In September 2010, ICAPCD and the California Department of Parks and Recreation (DPR) filed petitions with the Ninth Circuit Federal Court of Appeals for review of USEPA's limited disapproval of the rules. After hearing oral argument on February 15, 2012, the Ninth Circuit directed the parties to consider mediation before rendering a decision on the litigation. On July 27, 2012, ICAPCD, DPR and USEPA reached agreement on a resolution to the dispute which included a set of specific revisions to Regulation VIII. These revisions are reflected in the version of Regulation VIII adopted by ICAPCD on October 16, 2012 and approved by USEPA April 22, 2013. Since 2006 ICAPCD had implemented regulatory measures to control emissions from fugitive dust sources and open burning in Imperial County

FIGURE 4-1
REGULATION VIII GRAPHIC TIMELINE DEVELOPMENT

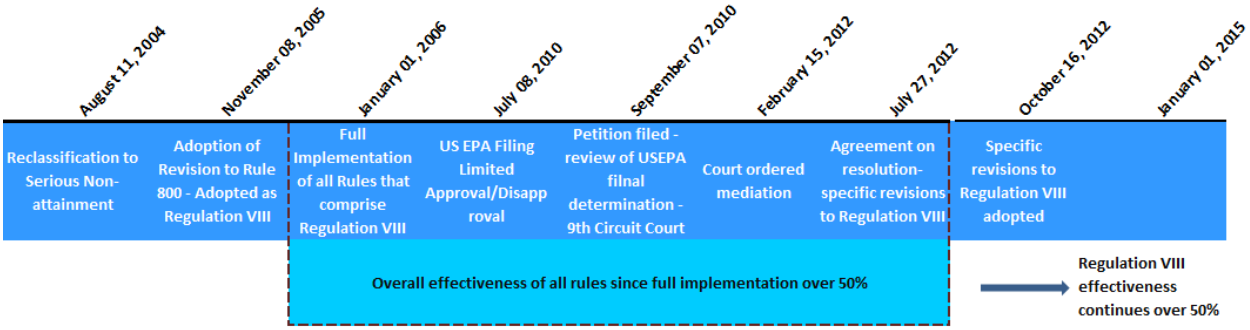

Fig. 4-1: Regulation VIII Graphic Timeline

IV.1.a Control Measures

A brief summary of Regulation VIII which is comprised of seven fugitive dust rules is found below. The complete set of rules can be found in **Appendix D**.

ICAPCD's Regulation VIII consists of seven interrelated rules designed to limit emissions of PM_{10} from anthropogenic fugitive dust sources in Imperial County.

Rule 800, General Requirements for Control of Fine Particulate Matter, provides definitions, a compliance schedule, exemptions and other requirements generally applicable to all seven rules. It requires the United States Bureau of Land Management (BLM), United States Border Patrol (BP) and DPR to submit dust control plans (DCP) to mitigate fugitive dust from areas and/or activities under their control. Appendices A and B within Rule 800 describe methods for determining compliance with opacity and surface stabilization requirements in Rules 801 through 806.

Rule 801, Construction and Earthmoving Activities, establishes a 20% opacity limit and control requirements for construction and earthmoving activities. Affected sources must submit a DCP and comply with other portions of Regulation VIII regarding bulk materials, carry-out and track-out, and paved and unpaved roads. The rule exempts single family homes and waives the 20% opacity limit in winds over 25 mph under certain conditions.

Rule 802, Bulk Materials, establishes a 20% opacity limit and other requirements to control dust from bulk material handling, storage, transport and hauling.

Rule 803, Carry-Out and Track-Out, establishes requirements to prevent and clean-up mud and dirt transported onto paved roads from unpaved roads and areas.

Rule 804, Open Areas, establishes a 20% opacity limit and requires land owners to prevent vehicular trespass and stabilize disturbed soil on open areas larger than 0.5 acres in urban areas, and larger than three acres in rural areas. Agricultural operations are exempted.

Rule 805, Paved and Unpaved Roads, establishes a 20% opacity limit and control requirements for unpaved haul and access roads, canal roads and traffic areas that meet certain size or traffic thresholds. It also prohibits construction of new unpaved roads in certain circumstances. Single-family residences and agricultural operations are exempted.

Rule 806, Conservation Management Practices, requires agricultural operation sites greater than 40 acres to implement at least one conservation management practice (CMP) for each of several activities that often generate dust at agricultural operations. In addition, agricultural operation sites must prepare a CMP plan describing how they comply with Rule 806, and must make the CMP plan available to the ICAPCD upon request.

IV.1.b Additional Measures

Imperial County Natural Events Action Plan (NEAP)

On August 2005, the ICAPCD adopted a NEAP for the Imperial County, as was required under the former USEPA Natural Events Policy, to address PM_{10} events by:

- Protecting public health;
- Educating the public about high wind events;
- Mitigating health impacts on the community during future events; and
- Identifying and implementing BACM measures for anthropogenic sources of windblown dust.

Smoke Management Plan (SMP) Summary

There are 35 Air Pollution Control Districts or Air Quality Management Districts in California which are required to implement a district-wide smoke management program. The regulatory basis for California's Smoke Management Program, codified under Title 17 of the California Code of Regulations is the "Smoke Management Guidelines for Agricultural and Prescribed Burning" (Guidelines). California's 1987 Guidelines were revised to improve interagency coordination, avoid smoke episodes, and provide continued public safety while providing adequate opportunity for necessary open burning. The revisions to the 1987 Guidelines were approved March 14, 2001. All air districts, with the exception of the San Joaquin Valley Air Pollution Control District (SJAPCD) were required to update their existing rules and Smoke Management Plans to conform to the most recent update to the Guidelines.

Section 80150 of Title 17 specifies the special requirements for open burning in agricultural operations, the growing of crops and the raising of fowl or animals. This section specifically

requires the ICAPCD to have rules and regulations that require permits that contain requirements that minimize smoke impacts from agricultural burning.

On a daily basis, the ICAPCD reviews surface meteorological reports from various airport agencies, the NWS, State fire agencies and CARB to help determine whether the day is a burn day. Using a four quadrant map of Imperial County allowed burns are allocated in such a manner as to assure minimal to no smoke impacts safeguarding the public health. Finally, all permit holders are required to notice and advise members of the public of a potential burn. This noticing requirement is known as the Good Neighbor Policy. On March 30, 2014 and April 1, 2014 the ICAPCD declared a No Burn day **(Appendix A).** No complaints were filed for agricultural burning on March 30, 2014 and April 1, 2014.

IV.1.c Review of Source-Permitted Inspections and Public Complaints

A query of the ICAPCD permit database was compiled and reviewed for active permitted sources throughout Imperial County and specifically around Brawley during the time of the March 30, 2014 and April 1, 2014 PM_{10} exceedances. An evaluation of all inspection reports, air quality complaints, compliance reports, and other documentation indicate no evidence of unusual anthropogenic-based PM_{10} emissions. March 30, 2014 and April 1, 2014 were officially designated as "No Burn Days." No complaints were filed on March 30, 2014 and April 1, 2014 related to agricultural burning, however one dust complaint was filed on April 1, 2014. The complaint asserted that dust was impacting a residence across from a vacant lot in Imperial. The follow up investigation by certified personnel concluded the dust emissions were due to strong winds at the area and not from the vacant lot. No violation was issued. **Appendix A** contains copies of the issued "No Burn" notices and the Complaint notice on April 1, 2014.

IV.2 Forecasts and Warnings

During the wind event wind advisories, hazardous weather outlooks, urgent weather messages, and forecasts (some of which included warnings of blowing dust and sand) were issued by the Phoenix and San Diego offices of the National Weather Service. The ICAPCD issued web-based Air Quality Indices.

At 11:08 pST on April 1, 2014, the Phoenix office of the NWS issued an Urgent Weather Message that included a Wind Advisory lasting to 05:00 for all of Imperial County. Winds of 25 mph to 35 mph with gusts up to 40 mph were predicted. The advisory warned reduced visibility could result from blowing dust and sand. At 13:18 PST on April 1, 2014 a Hazardous Weather Outlook was issued that renewed the wind advisory from 19:00 through midnight. Dangerous gusty winds were expected to result in blowing sand or dust. The San Diego office of the NWS also issued wind advisories for a multi-county area. At 04:15 on March 29, 2014, the San Diego office issued a wind advisory for the San Bernardino mountains, the Riverside County mountains, the Apple and Lucerne valleys, the Coachella Valley, and the San Diego mountains and deserts. Wind advisories continued to be issued through April 1, 2014. **Appendix A** contains copies of the issued

NWS notices during the wind event.

On March 30, 2014, March 31, 2014, and April 1, 2014, web-based Air Quality Indices for Brawley were issued by the ICAPCD. Air quality was in the Yellow or Moderate range of 51 to 101 µg/m^3. This category carries the following advisement: "Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms[4]."

IV.3 Wind Observations

Wind data during the event were available from airports in eastern Riverside County, southeastern San Diego County, southwestern Yuma County (Arizona), northern Mexico, and Imperial County. Both Imperial County Airport (KIPL) and El Centro NAF (KNJK) recorded winds of at least 25 mph with gusts over 40 mph at various hours starting March 30, 2014 through April 1, 2014. On March 31, 2014 and April 1, 2014 both stations reported multiple hours with winds at or above 25 mph. Wind speeds of over 25 mph are normally sufficient to overcome most PM_{10} control measures. During the March 30, 2014 and April 1, 2014 event wind speeds were above the 25 mph threshold overcoming the BACM in place.

IV.4 Summary

The weather and air quality forecasts and warnings outlined in this section demonstrate that strong winds associated with two strong low pressure systems caused uncontrollable PM_{10} emissions. The BACM list as part of the control measures in Imperial County for fugitive dust emissions were in place at the time of the event. These control measures are required for areas designated as "serious" non-attainment for PM_{10}, such as Imperial County. Thus, the BACM in place at the time of the event were beyond reasonable. In addition, surface wind measurements upstream and neighboring Brawley during the event were high enough (at or above 25 mph, with wind gusts over 40 mph) that BACM PM_{10} control measures would have been overwhelmed.

Finally, a high wind dust event can be considered as a natural event, even when portions of the wind-driven emissions are anthropogenic, as long as those emissions have a clear causal relationship to the event and were determined to be not reasonably controllable or preventable. This demonstration has shown that the event that occurred on March 30, 2014 and April 1, 2014 was not reasonably controllable or preventable despite the strong and in force BACM within the affected areas in Imperial County. This demonstration has similarly established a clear causal relationship between the exceedances and the high wind event timeline and geographic location.

[4] The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health affects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country. https://airnow.gov/index.cfm?action=aqibasics.aqi

The March 30, 2014 and April 1, 2014 event can be considered an exceptional event under the requirements of the exceptional event rule.

V Clear Causal Relationship

V.1 Discussion

Meteorological observations identified high winds associated with two strong low pressure systems as the cause for a multi-day wind event that brought gusts exceeding 40 mph to the mountains and deserts of southeastern California, and resulted in an exceedance at the Brawley monitoring station on March 30, 2014 and on April 1, 2014. A series of Pacific weather disturbances moved through southern California starting March 29, 2014 and continued through April 1, 2014. The strong and gusty westerly winds associated with the systems lofted dust in desert regions to the west of Imperial County and transported it downstream. As a result, the Brawley FRM monitor recorded an exceedance on March 30, 2014, and the Brawley FEM monitor recorded an exceedance on April 1, 2014. **Figure 5-1** shows wind speeds at key upstream sites and local airfields at different times over a period of several days.

FIGURE 5-1
UPSTREAM WIND SPEEDS OVER SOURCE AREAS

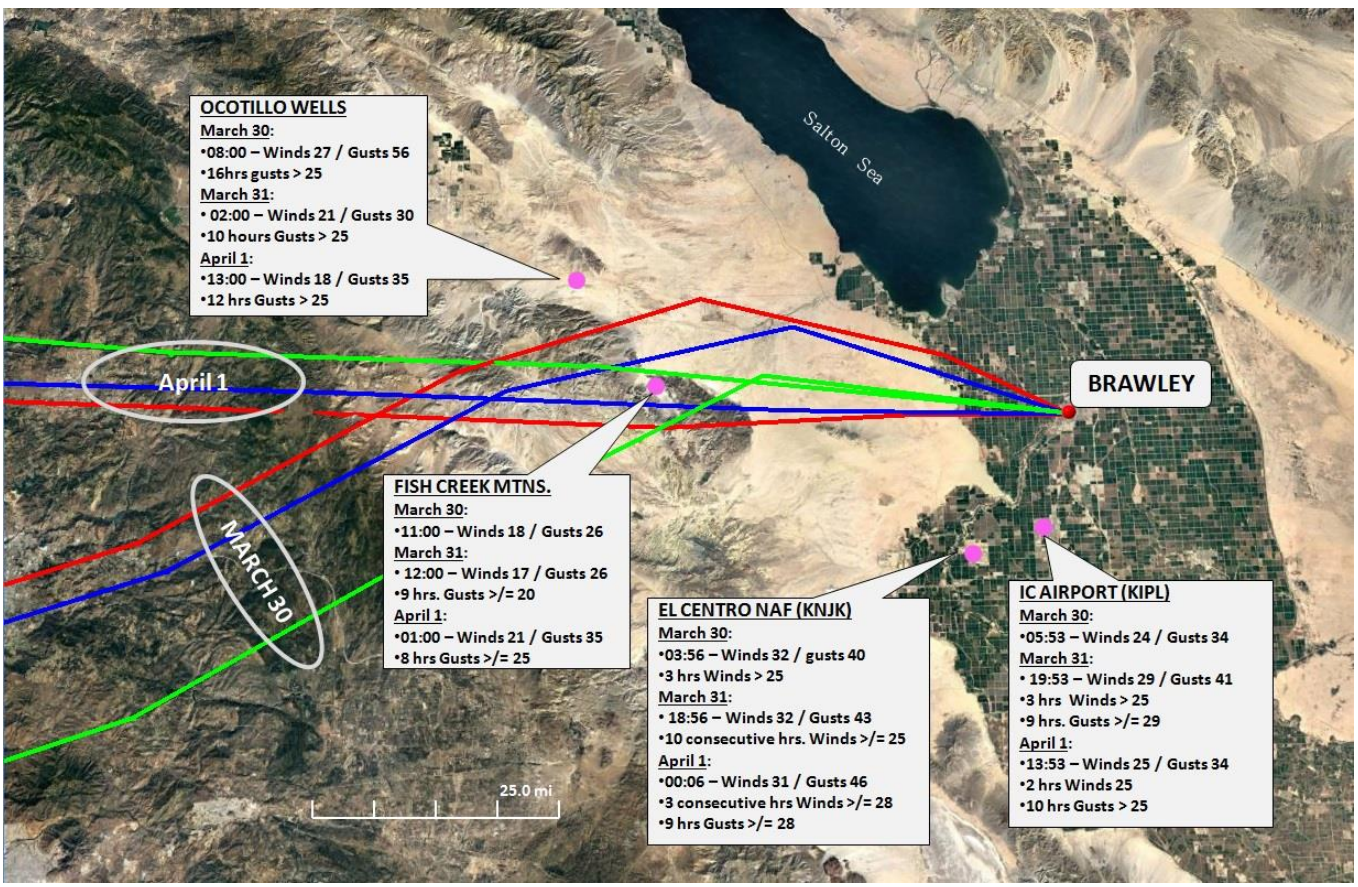

Fig 5-1: Upstream wind speeds at key times during the multi-day wind event. Wind data from the University of Utah's MesoWest data bank and the NCEI's QCLCD data bank. Base map from Google Earth

Figure 5-1 replicates the back-trajectories shown in **Figures 2-12** and **2-13.** The path of air flow shifted slightly over the three-day period, as indicated by the dates inside the ovals. Air passed across arid, mostly barren soils to the west of Imperial County on the western edge of the Sonoran Desert near the border of San Diego County. In the 12 months prior to the wind event, the region had experienced about one inch less precipitation than normal. Both Ocotillo Wells and the Fish Creek Mountains, located upstream and on the western edge of the Sonoran Desert, experienced high winds and gusts during the multi-day period. These winds lofted dust and transported it downstream to Brawley.

Two local airfields, Imperial County Airport (KIPL) and El Centro NAF (KNJK), also upstream of Brawley, recorded multiple and consecutive hours of winds above the 25 mph on March 31, 2014 and April 1, 2014. El Centro recorded winds at or above the 25 mph for three consecutive hours on March 30, 2014 as well, while at Imperial Airport winds reached 24 mph for one hour. Wind speeds of over 25 mph are normally sufficient to overcome most PM_{10} control measures. For much of March 29, 2014, wind direction at KIPL and KNJK was variable, with winds tracking anywhere from westerly to easterly to southerly. Starting at 22:00, winds shifted to the west west-southwest. By 00:56 on March 30, 2014, KNJK was recording winds of 25 mph. From 02:56 through 04:56, winds were at or above 25 mph for three consecutive hours. Gusts peaked at 40 mph at 03:56. At KIPL, winds reached 24 mph by 05:53 while gusts reached 34 mph. From 04:53 through 06:53, gusts were 28 mph and above.

Both Fish Creek Mountains and Ocotillo Wells experienced a similar increase in wind speeds. By 04:00, winds at Ocotillo Wells reached 22 mph with gusts of 36 mph. An hour later winds were 24 mph and gusts were 40 mph. By 08:00, winds had reached 27 mph and gusts hit 56 mph. During the above periods, wind direction at Ocotillo Wells was WNW, which placed air flow directly on a path toward Brawley. This matches the trajectory of the HYSPLIT shown in **Figure 5-1** in the hours before winds reached Brawley. The Fish Creek Mountains recorded powerful gusts as well on March 30, 2014. From 10:00 through 13:00, gusts were at or above 31 mph, and during two hours reached 36 mph.

Winds at KIPL and KNJK dropped to around 10 mph by 21:00 on March 30, 2014, and remained light to moderate through 11:00 on March 31, 2014. As the second system moved into the area on March 30, 2014, winds experienced a significant jump in speed. At 12:53, KIPL had winds of 20 mph and gusts of 24 mph. By 14:53, winds reached 25 mph while gusts hit 32 mph. From 19:53 through 21:53, winds were at or above 28 mph. From 19:53 through 22:53, gusts were at 36 mph or above, while reaching a peak of 41 mph at 19:53. By 12:56 on March 31 2014, winds at KNJK reached 21 mph while gusts hit 29 mph. From 14:56 through 23:56, winds remained at or above 25 mph while gusts were 31 mph or above. The peak gust was 43 mph at 18:56. The Fish creek Mountains and Ocotillo Wells, both upstream of Brawley, saw powerful gusts as well. By 14:00 on March 31 2014, gusts were at 30 mph, and an hour later gusts reached a peak of 33 mph. During the 17:00 and 19:00 hours, gusts at Ocotillo Wells hit 30 mph.

Winds remained strong going into April 1, 2014. At 00:06 winds at El Centro NAF (KNJK) were 31

mph while gusts were 46 mph. Wind speed at both locations did experience a reduction roughly from 02:00 through 05:00, but then picked up. At KNJK winds were 28 to 29 mph between 12:56 and 14:56. Gusts remained between 32 and 37 mph from 13:56 though 16:56. At Imperial County Airport (KIPL), winds hit 25 mph at 13:53, with the peak gust for the day reaching 34 mph during that same hour. From 12:53 though 16:53, gusts ranged from 26 mph to 34 mph.

Gusts at Ocotillo Wells and the Fish Creek Mountains also remained strong during April 1, 2014. At 02:00, gusts at Ocotillo Wells hit 29 mph. Between 10:00 and 19:00, gusts of 26 mph and above were recorded, with a peak gust of 35 mph. At the Fish Creek Mountains stations, gusts remained at 23 mph between 02:00 and 03:00. From 13:00 through 18:00, gusts were 27 mph or above, with gusts peaking at 33 mph for two consecutive hours from 14:00 through 15:00.

The strong winds and powerful gusts at these upstream stations lofted dust from the desert areas on the western edge of the Sonoran Desert near the San Diego border, and transported it downstream. These strong westerly winds associated with the weather systems swept across the mountains and deserts of southeastern California and were directly responsible for the high PM_{10} concentrations observed in Imperial County on March 30, 2014 and April 1, 2014. **Figures 5-2 through 5-3** help corroborate that particulate matter was suspended in the air over parts of southeastern California over a multi-day period.

FIGURE 5-2
DUST-HAZE OVER THE SALTON SEA

Fig 5-2: MODIS Aqua satellite image on March 30, 2014 (~13:30 LST) shows entrained particulate matter suspended over the northern portion of the Salton Sea. Source: MODIS Today

Figure 5-3 captures the aerosol optical depth over the region. NOAA's Satellite Information Service issued a Smoke Text Product for March 31, 2014 (0215Z) stating that GOES satellite imagery confirmed "a large amount of blowing dust" over areas of the southwest, including southern California. The notice said a "strong frontal boundary moving through the Southwest with gusty winds was the cause of the blowing dust." A notice for April 1, 2014 (0015Z) stated that satellite images confirmed that "unknown aerosols" were "drifting east across southern California…" and that "based on satellite imagery and the presence of strong surface winds that dust/sand is being blown to the east originating from an area just west of the Salton Sea." See **Appendix A** for copies of the notices.

FIGURE 5-3
SUSPENDED AEROSOLS OVER SOUTHEASTERN CALIFORNIA

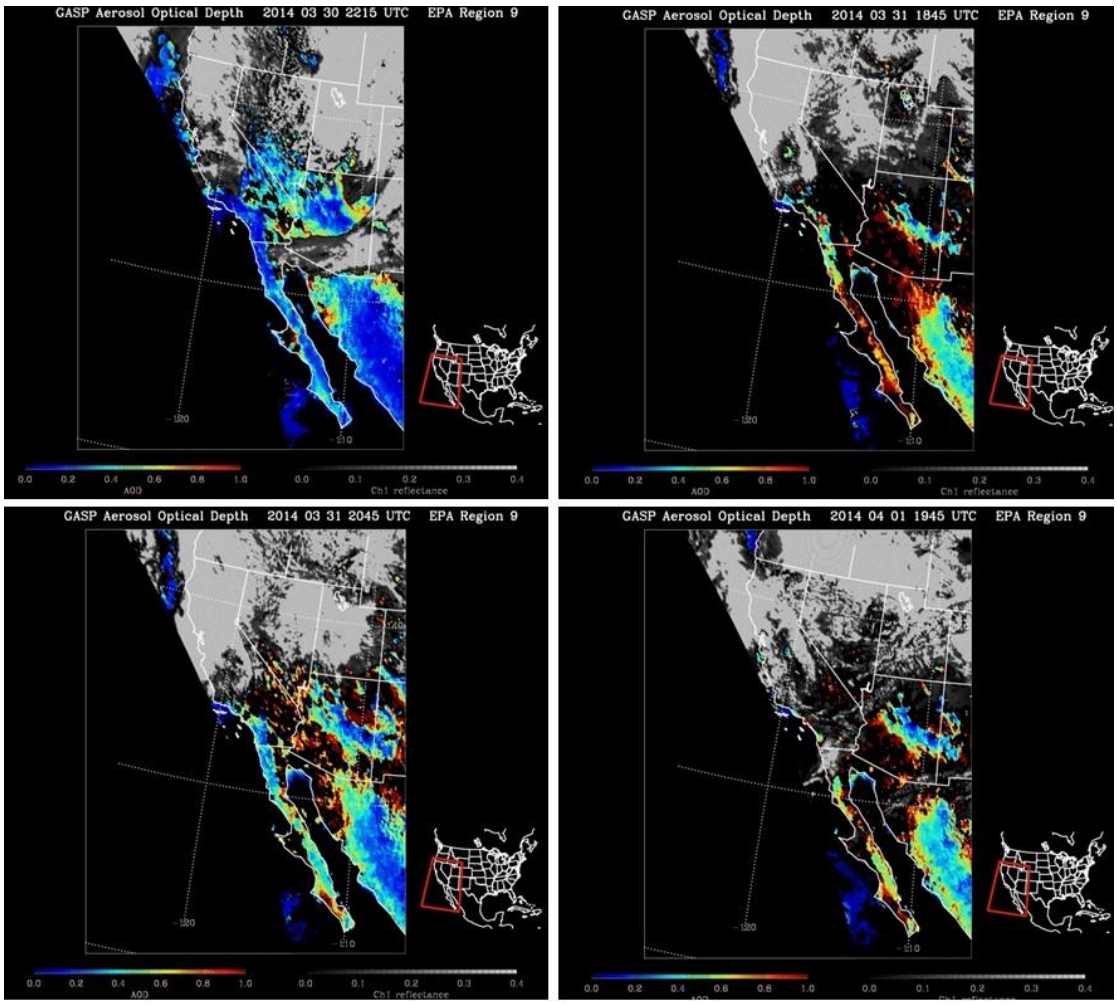

Fig 5-3: Four GASP (GOES Aerosol Satellite Product) images confirm the presence of aerosols over the southwestern United States and southeastern California. The April 1, 2014 image (lower right) shows a small but strong AOD over southeastern California. Source: IDEA, http://www.star.nesdis.noaa.gov/smcd/spb/aq

The high winds in Imperial County from March 30, 2014 through April 1, 2014 were part of a regional event. **Figure 5-4** encapsulates key forecasts, advisories, and messages issued by the National Weather Service for a wide area of southeastern California and portions of western Arizona. Upstream sites like Palm Springs International Airport (KPSP), Jacqueline Cochran Regional Airport (KTRM), and Campo Airfield (KCZZ) all had winds of 25 mph or above, with gusts over 30 mph, as did Blythe airport (KBLH) downstream from Imperial County. See **Tables 2-2 and 2-2** for additional wind data. For detailed meteorological station graphs see **Appendix B.**

FIGURE 5-4
KEY WIND NOTICES

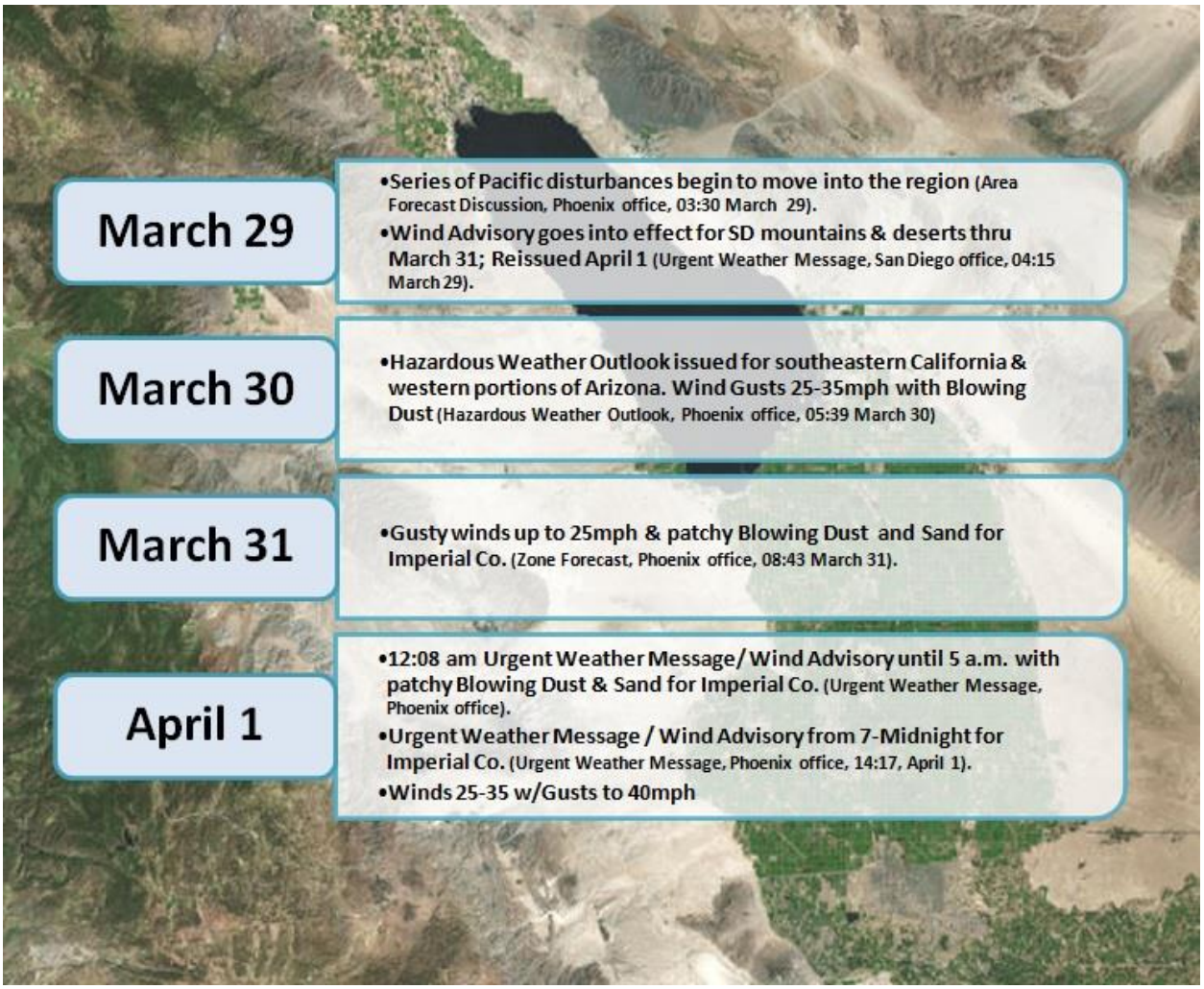

Fig 5-4: Key forecasts, advisories, and weather messages issued by the Phoenix and San Diego offices of the NWS during the multi-day regional wind event. See **Appendix A** for complete notices. Source: Iowa Environmental Mesonet

As seen in **Figure 5-4**, the NWS issued wind advisories identifying Imperial County and parts of eastern San Diego County and western Arizona as the affected areas (see notices in **Appendix A**).

Wind advisories are issued by the NWS when winds[5] of 30 to 39 mph are expected for one (1) hour or longer. **Figure 5-5** is an illustration of the wind speeds throughout Imperial County beginning with March 29, 2014 and ending April 2, 2014. The consistency for all stations is evident. The first system moved in the late evening on March 29, 2014 and continued through March 30, 2014, and a second system moved in during the afternoon on March 31, 2014 and continued through April 1, 2014. Although winds rose again on April 2, 2014, no exceedances occurred.

FIGURE 5-5
5 DAY TIME SERIES WIND SPEEDS AT REGIONAL SITES MARCH 29, 2014 TO APRIL 2, 2014

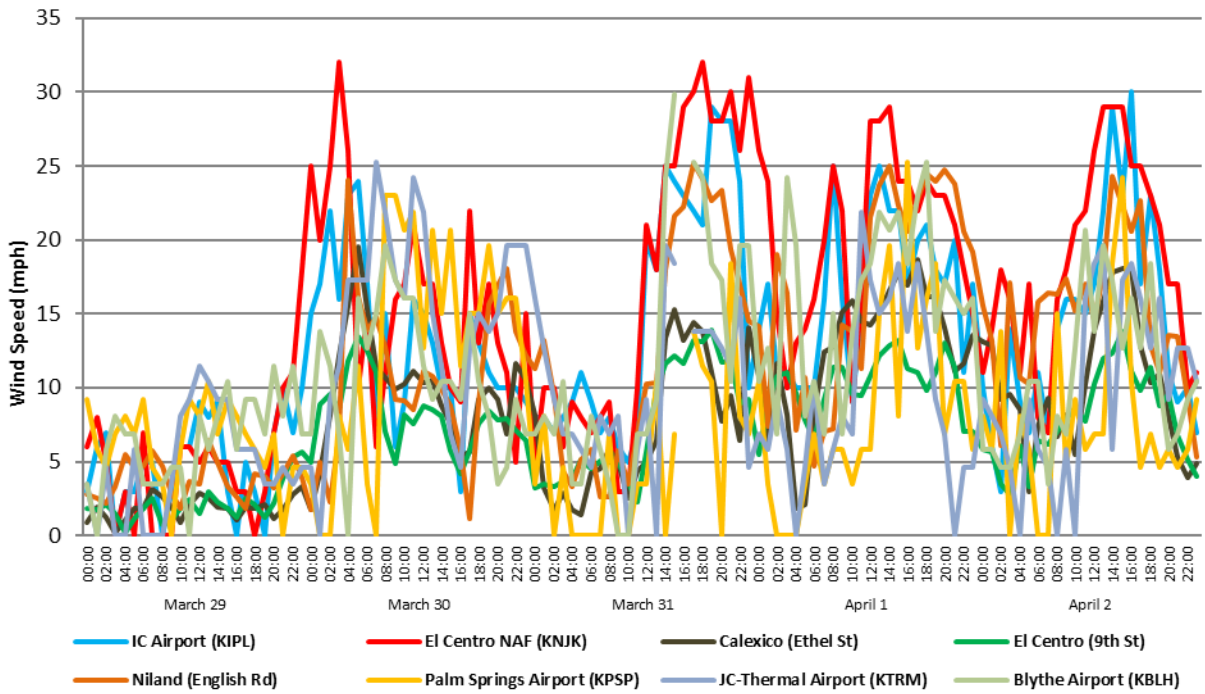

Fig 5-5: Meteorological data collected from sites within the Imperial and Riverside counties over a 5-day period from March 29, 2014 to April 2, 2014 shows a uniform spike in wind speed during the March 30, 2014 and April 1, 2014 exceptional event

Figure 5-6 demonstrates the spatial and temporal relationship between the high winds and the transported entrained dust impacting the Brawley monitor on March 30, 2014 and April 1, 2014. The correlation of hourly BAM 1020 data from the Brawley air monitoring station and the elevated wind speeds on March 30, 2014 and April 1, 2014 indicates that as wind speeds increased so did concentrations of PM_{10}. On March 30, 2014, the peak hourly PM_{10} concentration occurred throughout the morning hours which are associated with the high peak winds and gusts measured at the different stations in Imperial County. On April 1, 2014, hourly PM_{10}

[5] National Weather Service; NOAA's Glossary – Wind Speed: The rate at which air is moving horizontally past a given point. It may be a 2-minute average speed (reported as wind speed) or an instantaneous speed (reported as a peak wind speed, wind gust, or squall)[http://w1.weather.gov/glossary/index.php?letter=w]

concentrations saw three major peaks. These occurred during the 02:00, 13:00, and 23:00 hours. Imperial County Airport, El Centro NAF, Ocotillo Wells, and the Fish creek Mountains saw gusty winds throughout much of April 1, 2014. **Appendix C** contains graphs from monitoring sites within Imperial and Riverside counties on March 30, 2014 through April 1, 2014, illustrating the relationship between elevated PM_{10} concentrations and high wind speeds.

FIGURE 5-6
72 HOUR BRAWLEY FEM PM_{10} CONCENTRATIONS & WIND SPEEDS

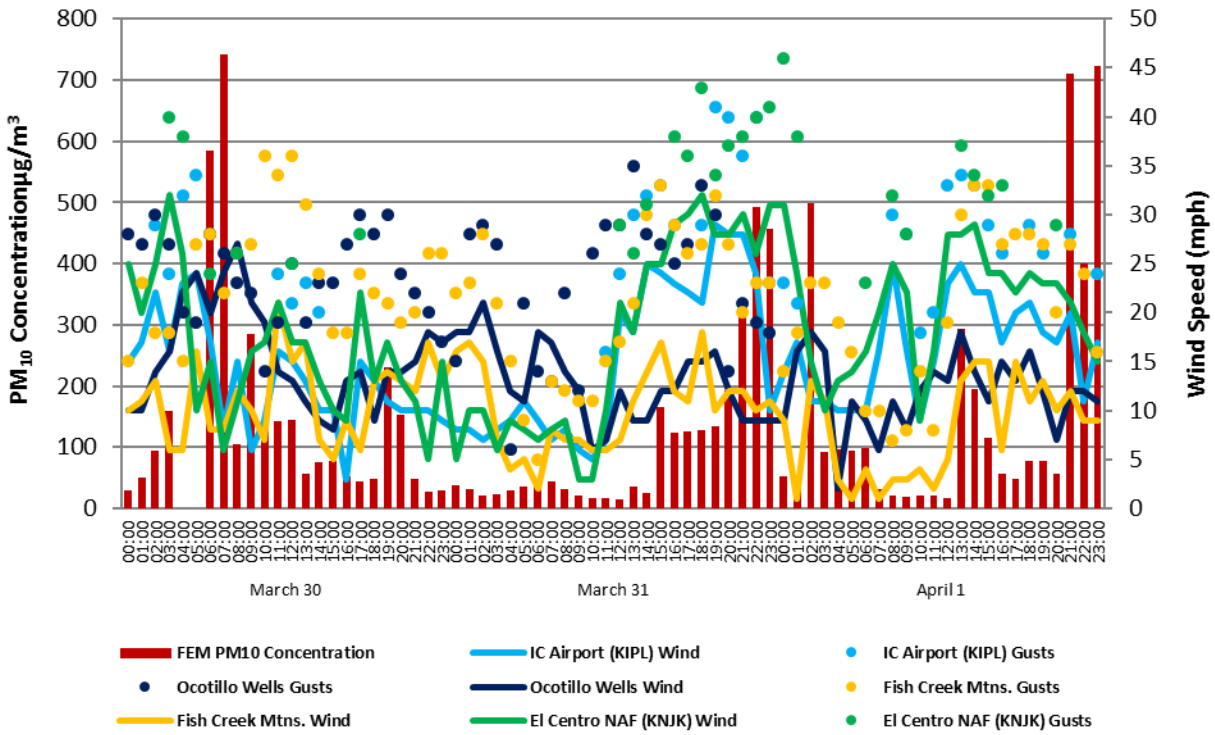

Fig 5-6: Brawley hourly concentrations are paired with upstream wind speeds from four local sites. Brawley PM_{10} concentrations rose and fell in response to increases and decreases in wind speeds. The Brawley FRM monitor recorded an exceedance on March 30, 2014. However, this monitor does not record hourly concentration levels. Hourly concentrations from the FEM monitor were used for comparison purposes. Air quality data from the EPA's AQS data bank. Wind data is from the NCEI's QCLCD data bank and the University of Utah's MesoWest data bank

Figure 5-7 is a five-day depiction of hourly PM_{10} concentrations at regional monitors and wind speeds at Imperial County Airport and El Centro NAF. Both the Brawley and Niland monitors show a similar rise and fall in relationship to wind speeds. The Indio (Jackson St) monitor in eastern Riverside County shows a similar increase on March 30, 2014 as the first system moved through the area. For the first system on March 29, 2014 the Brawley station showed lower concentrations levels as winds remained light. However, as the winds began to increase during the morning and afternoon hours on March 30, 2014, concentrations showed a similar increase. For the second system on March 31, 2014, the Brawley station showed lower levels of

concentrations as winds remained light during the morning. As winds began to increase during the late afternoon and evening hours, concentrations showed a similar rise. Concentrations rose and fell on April 1, 2014. This was due to the strong initial winds around midnight, followed by a lull of several hours before wind speeds and gusts ramped up again. As winds subsided to relatively light conditions during the morning hours on April 2, 2014, so did concentrations

FIGURE 5-7
120 HOUR PM_{10} CONCENTRATIONS & WIND SPEEDS: REGIONAL SITES

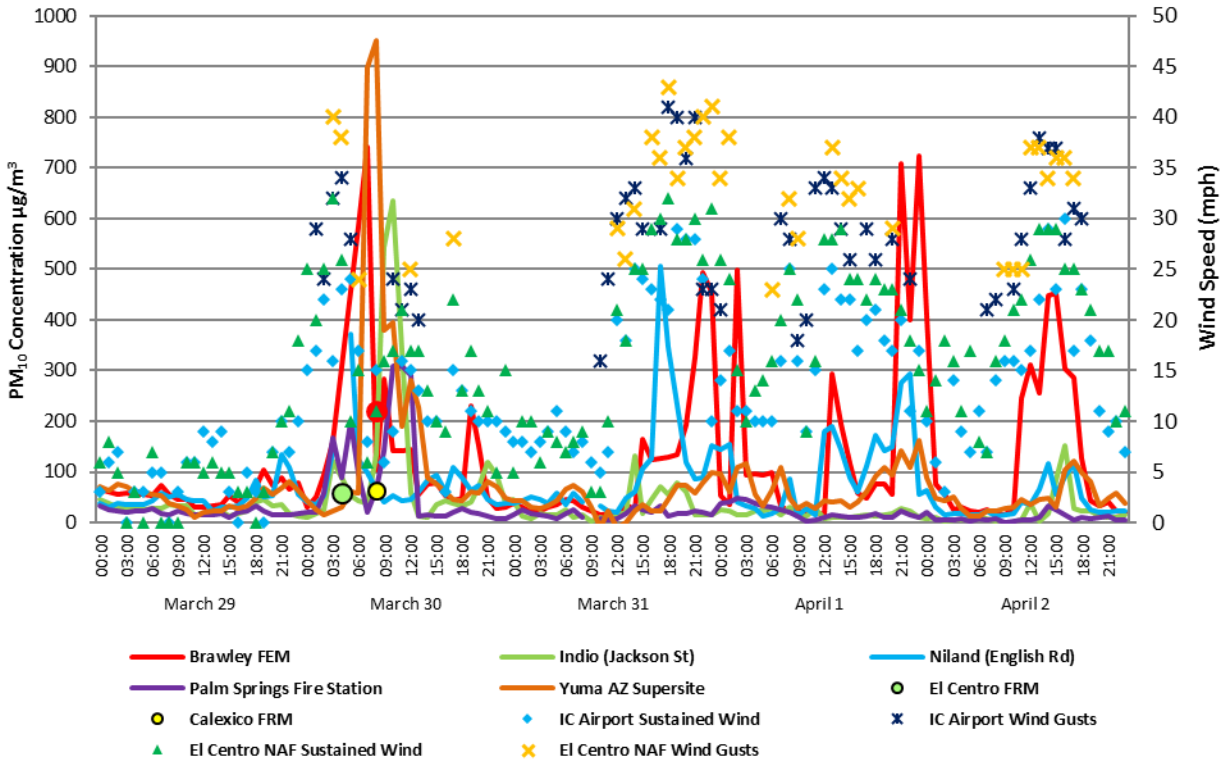

Fig 5-7: This graph illustrates the concentration levels at regional AQS monitors over a five-day period. Brawley and Niland monitors, along with the Indio and Yuma (Arizona) Supersite monitors, saw a spike on March 30, 2014. Air quality data from the EPA's AQS data bank. Wind data is from the NCEI's QCLCD data bank and the University of Utah's MesoWest data bank

Figure 5-8 compares the observed visibility at Imperial County Airport and El Centro NAF to the hourly concentration levels at Brawley and other regional sites. Drops in visibility at both airfields match increased levels of PM_{10} concentrations at Brawley on March 30, 2014 and March 31, 2014. On March 30, 2014 between 08:51 and 09:02, visibility at Imperial County Airport dropped to 2.5 miles with haze reported during that period. That same day between 08:14 and 08:48, visibility at El Centro NAF was reduced to 1.75 miles, with haze reported during this period. This, together with **Figures 5-2** and **5-3**, demonstrates that there was particulate matter in the air during this period.

FIGURE 5-8
120 HOUR TIME SERIES PM_{10} CONCENTRATIONS AND VISIBILITY AT LOCAL AIRFIELDS

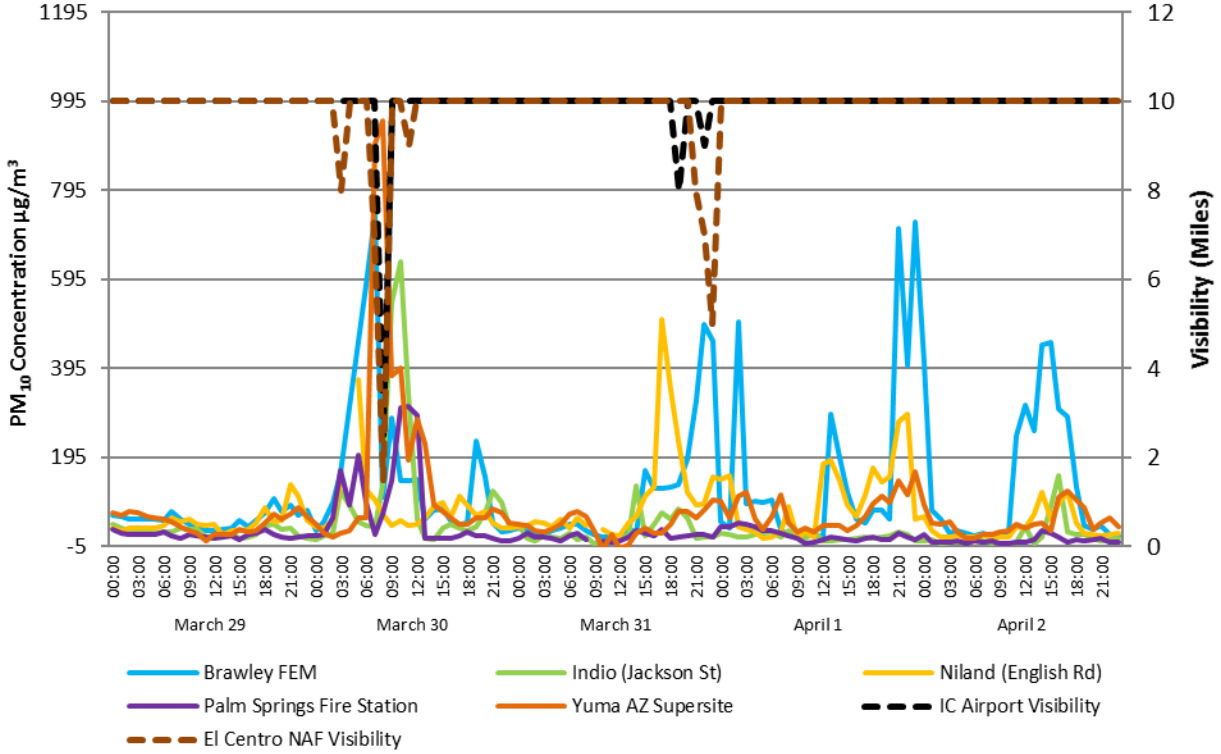

Fig 5-8: Illustrates the relative visibility level at IC Airport and El Centro NAF in relative to hourly PM_{10} levels at regional monitors. Drops in visibility at both airfields is associated with increases of PM_{10} on March 30, 2014 and March 31, 2014. Air quality data from the EPA's AQS data bank. Visibility data is from the NCEI's QCLCD data bank

The NWS issued a forecast for Imperial County at 4:30 a.m. PDT on Sunday, March 30, 2014, valid through Tuesday, April 1, 2014, advising of blowing sand and dust for Imperial County (**Appendix A**). An air quality notification based on the Air Quality Index (AQI)[6] was issued in Imperial County for March 30, 2014 and April 1, 2014, advising of moderately unhealthy conditions for sensitive groups such as the elderly and children. **Figures 5-9 and 5-10** are the resultant Air Quality Index (AQI) for March 30, 2014 and April 1, 2014. The Air Quality Index for both days remained in the "Moderate" or Yellow category confirming the quality of air in Imperial County had been impacted by transported dust. Smoke Text Products issued by NOAA's Satellite and Information Service identified "a large amount of blowing dust" over southern California and other portions

[6] The AQI is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country. Source: https://airnow.gov/index.cfm?action=aqibasics.aqi

of the Southwest on March 31, 2014. On April 1, 2014, aerosols identified as most likely dust was captured by satellites drifting over Southern California. See **Appendix A** for these notices.

FIGURE 5-9
IMPERIAL VALLEY AIR QUALITY INDEX IN BRAWLEY MARCH 30, 2014

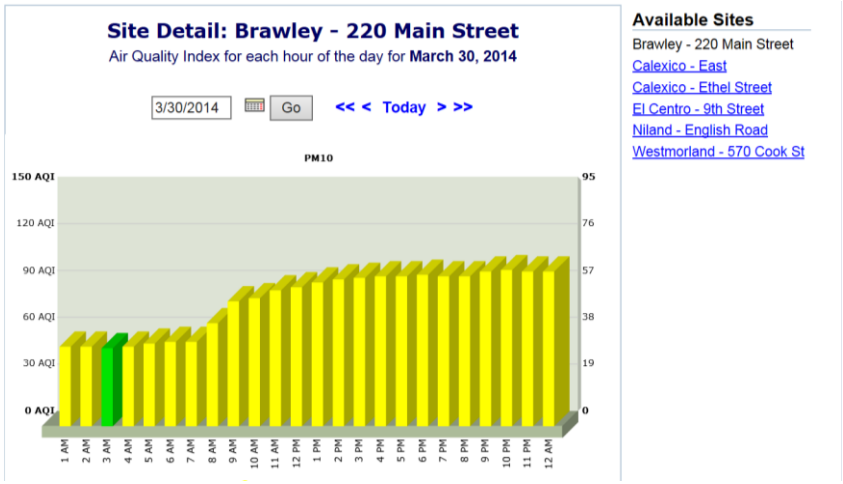

Fig 5-9: Demonstrates that air quality in Imperial County on March 30, 2014, was affected by dust transported in the area that coincided with a wind event. Brawley monitor did not register a FEM PM_{10} exceedance on March 30, 2014, although the FRM monitor did record an exceedance. Source: ICAPCD webpage

FIGURE 5-10
IMPERIAL VALLEY AIR QUALITY INDEX IN BRAWLEY APRIL 1, 2014

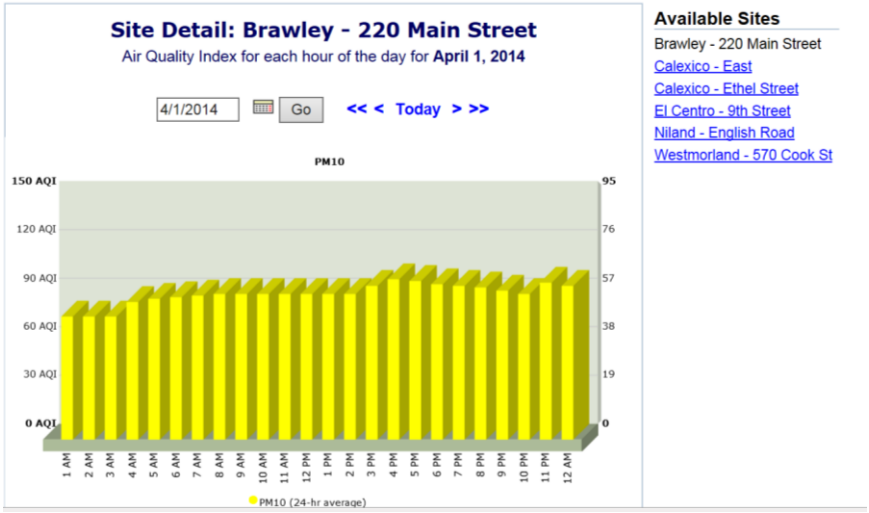

Fig 5-10: Demonstrates that air quality in Imperial County on April 1, 2014, was affected by dust transported in the area that coincided with a wind event. Source: ICAPCD webpage

V.2 Summary

The preceding discussion, graphs, figures, and tables provide wind speed and PM_{10} concentration data illustrating the impact on air quality from high winds associated with a series of Pacific weather disturbances that moved through the region over a period of several days. The information provides a clear causal relationship between the entrained windblown dust and the PM_{10} exceedances measured at the Brawley monitor on March 30, 2014 and April 1, 2014. Furthermore, the advisories and issued air quality indices illustrate the affect upon air quality within the region extending from all of Imperial County and the southern portion of Riverside County and Yuma, Arizona. Large amounts of coarse particles (dust) and PM_{10} were carried aloft by strong westerly winds into the lower atmosphere. The area of origin is the western edge of the Sonoran Desert near the border of San Diego and Imperial counties. Combined, the information demonstrates that the elevated PM_{10} concentrations measured on March 30, 2014 and April 1, 2014 coincided with high wind speeds and that strong winds were experienced over the southern portion of Riverside County and all of Imperial County.

VI Conclusions

The PM_{10} exceedance that occurred on March 30, 2014 and April 1, 2014, satisfies the criteria of the EER which states that in order to justify the exclusion of air quality monitoring data evidence must be provided for the following elements:

TABLE 6-1[7] TECHNICAL ELEMENTS EXCEPTIONAL EVENT DEMONSTRATION FOR HIGH WIND DUST EVENT (PM_{10})		DOCUMENT SECTION
1	whether the event was **not reasonably controllable or preventable** (nRCP)	25-30
2	whether there was **a clear causal** relationship (CCR) "There is a clear causal relationship between the measurement under consideration and the event…	31-41
3	whether the event **affects air quality** (AAQ) ...the event that is claimed to have affected the air quality in the area";	21-24; 45
4	whether the event was caused by human activity unlikely to recur or was a natural event (HAURL / **Natural Event**) "The event satisfies the criteria set forth in 40 CFR §50.1(j)" for the definition of an exceptional event (see above);	12-20; 31-41

VI.1 Affects Air Quality

The preamble to the EER states that an event is considered to have affected air quality if it can be demonstrated that there is a clear causal relationship between the monitored exceedance and the event, and that the event is associated with a measured concentration in excess of normal historical fluctuations. Given the information presented in this demonstration, particularly section V, we can reasonably conclude that the event in question affected air quality.

VI.2 Not Reasonably Controllable or Preventable

In order for an event to be defined as an exceptional event under section 50.1(j) of 40 CFR Part 50 an event must be "not reasonably controllable or preventable." This requirement is met by demonstrating that, despite BACM in place in Imperial County, high winds overwhelmed all BACM controls. The PM_{10} exceedances measured at the Brawley monitor and discussed within this report was caused by naturally occurring strong gusty winds that transported fugitive dust into Imperial County and other parts of southern California from areas located within the Sonora Desert regions to the west of Imperial County. These facts provide strong evidence that the PM_{10} exceedances on March 30, 2014 and April 1, 2014, were not reasonably controllable or preventable.

[7] *40 CFR §50.1

VI.3 Natural Event

As discussed within this demonstration, the PM_{10} exceedance which occurred in Brawley on March 30, 2014 and April 1, 2014, were caused by transport of fugitive dust into Imperial County by strong predominantly WSW winds associated with two large low pressure systems. The event therefore qualifies as a natural event.

VI.4 Clear Causal Relationship

The time series plots of PM_{10} concentrations at different areas in Imperial, Riverside and Yuma Counties monitors demonstrates a consistency of elevated gusty winds and concentrations of PM_{10} at regional monitors on March 30, 2014 and April 1, 2014 (Section V). In addition, these time series plots and graphs demonstrate that the high PM_{10} concentrations and the gusty winds were an event that was widespread, regional, and uncontrollable. Arid conditions preceding the event resulted in soils that were particularly susceptible to particulate suspension by the elevated gusty winds. Finally, days immediately before and after the high wind event had PM_{10} concentrations well below the NAAQS.

VI.5 Historical Norm

The historical annual and seasonal 24-hr average PM_{10} values measured at the Brawley monitor were historically unusual compared to a multi-year data set (Section III).

Appendix A: Public Notification that a potential event was occurring (40 CFR §50.14(c)(1)(i))

This section contains wind advisories and forecasts issued by NOAA and Imperial County on March 30, 2014 and April 1, 2014. The forecasts and advisories support that this was a regional and natural event. Copies of Smoke Text Products from satellites are also included to support that particulate matter was suspended over southeastern California.

Appendix B: Meteorological Data

This appendix contains the time series plots, graphs, wind roses, and tabular data for selected monitors in southeastern California. These graphs demonstrate the speed of the winds and the regional impact of the wind event.

Appendix C: Correlated PM_{10} Concentrations and Winds

This appendix contains the graphs depicting the correlations between PM_{10} concentrations and elevated wind speeds for selected monitors in Imperial and Riverside counties. These graphs show an increase in PM_{10} concentrations in Imperial County coincident with the arrival of high wind speeds and wind gusts.

Appendix D: Regulation VIII – Fugitive Dust Rule

This appendix contains the compilation of the BACM adopted by the Imperial County Air Pollution Control District and approved by the United States Environmental Protection Agency. A total of seven rules numbered 800 through 806 comprise the set of Regulation VIII Fugitive Dust Rules.