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PRELIMINARY DOCUMENTATION

Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM_{10}) Concentration Events in the Phoenix Area on April 16, 2008

Background

The Arizona Department of Environmental Quality (ADEQ) issues Dust Control Action Forecasts as part of the Natural Events Action Plan for the Phoenix area. On Tuesday, April 15, 2008, despite a tightening pressure gradient associated with a trough of low pressure and dry cold front situated over Arizona, the Maricopa County Dust Control Action Forecast, issued by ADEQ air quality forecasters, called for a low risk of wind-blown dust leading to an exceedance of the 24-hour PM_{10} health standard in Phoenix for Wednesday, April 16th. While "occasional periods of blowing dust" were forecast in particular for the West Valley for Wednesday, April 16th, in both the Dust Control Forecast and the Daily Air Quality Forecast, winds were not expected to remain strong enough throughout the day to cause an exceedance of the PM_{10} health standard in Phoenix. Dust Control Forecasts for Yuma did call for a moderate risk for exceeding the 24-hour PM_{10} health standard, though no exceedance occurred there. The forecasts/advisories satisfy the requirement in 40 CFR 51.920(a)(1).

The forecast for April 16th mentioned the possibility for strong winds capable of producing occasional periods of wind-blown dust. This potential wind-blown dust event equated to a low, yet still significant, risk of exceeding the PM_{10} National Ambient Air Quality Standards (NAAQS) in Maricopa County. During the late afternoon to early evening hours of April 16th, strong and at times gusty westerly winds generated blowing dust which moved into portions of the Phoenix Metro area from the west. All appropriate State Implementation Plan (SIP) control measures were in place during the event demonstrating, per 40 CFR 50.1(j), that the event "is not reasonably controllable or preventable."

The initialization of the wind-blown dust event is evident in the Phoenix visible camera images as well as the Arizona Meteorological Network (AzMET) and National Weather Service (NWS) monitors (see Fig. 1). Strong winds gusting to near 30 mph were reported between the 12:00 p.m. and 7:00 p.m. hours at several Phoenix area monitoring locations. In addition, trained weather spotters at the Goodyear Airport NWS station reported several hours of blowing dust during the event. Due to the spatial variability of PM sources both within and outside of the Phoenix urban core, the PM_{10} NAAQS was only exceeded at the West 43rd Ave. monitor operated by Maricopa County (see Section 2 for more detail). The fact that ambient concentrations exceeded the NAAQS satisfies the criteria in 40 CFR 50.1(j) that the event "affects air quality." The following are the key PM_{10} monitor readings for the monitors examined in this report:

Monitor (Operator/Type)	AQS ID	24-hr Avg PM_{10}	1-hr Max PM_{10}	Max Time	Flag**
PHOENIX METRO AREA					
West 43rd Ave (MC/TEOM)	**04-013-4009***	**155**	**639**	**1400**	**RJ**
Durango Complex (MC/TEOM)	**04-013-9812***	**85**	**238**	**1400**	None
Greenwood (MC/TEOM)	**04-013-3010***	**70**	**144**	**1400**	None
Higley (MC/TEOM)	**04-013-4006***	**61**	**108**	**2000**	None
West Phoenix (MC/TEOM)	**04-013-0019***	**69**	**146**	**2000**	None
Central Phoenix (MC/TEOM)	**04-013-3002***	**69**	**123**	**1400**	None
JLG Supersite (ADEQ/TEOM)	**04-013-9997***	**51**	**83**	**1800**	None
Coyote Lakes (MC/TEOM)	**04-013-4014***	**62**	**122**	**1200**	None
South Phoenix (MC/TEOM)	**04-013-4003***	**105**	**277**	**1800**	None

* EPA Air Quality System Identification Number
** 24-hr PM_{10} concentration influenced by natural or exceptional event to be flagged
Type Abbreviations: TEOM – Tapered Element Oscillating Microbalance Monitor (Continuous monitor)

The preliminary findings from this analysis were presented at stakeholders meetings on November 19, 2008, and March 19, 2009, in Phoenix, Arizona. This document is being submitted to EPA to satisfy the requirements of 40 CFR 50.14(c)(2)(iii), and will be supplemented and made available for public comment to satisfy the requirements of 50.14(c)(3)(i).

Figure 1. Key Data for Event of April 16, 2008

NORTH PHOENIX

12-PHX Greenway

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	72	13	-	3	7	SW
2	67	18	-	2	4	S
3	67	16	-	2	6	SW
4	63	21	-	2	4	S
5	63	19	-	2	6	S
6	60	20	-	2	6	SW
7	60	21	-	1	5	SW
8	63	21	-	3	8	SW
9	65	20	-	6	11	SW
10	68	18	-	5	9	SW
11	71	16	-	5	12	SW
12	74	14	-	8	14	SW
1	77	12	-	8	18	SW
2	79	8	-	12	23	W
3	79	8	-	11	19	W
4	79	8	-	11	20	W
5	78	8	-	11	20	NW
6	77	7	-	12	23	W
7	74	7	-	12	22	W
8	71	7	-	11	21	NW
9	68	9	-	9	19	NW
10	67	9	-	8	17	NW
11	65	10	-	9	18	N
12	63	11	-	6	12	N

CENTRAL PHOENIX

15-Phx Encanto

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	74	13	-	4	9	W
2	72	15	-	5	9	W
3	69	16	-	4	7	W
4	64	23	-	1	3	NE
5	60	29	-	2	4	N
6	60	24	-	2	5	W
7	62	20	-	3	6	W
8	66	20	-	3	8	W
9	68	21	-	6	12	W
10	70	19	-	5	11	W
11	73	17	-	5	10	W
12	75	16	-	7	14	W
1	77	13	-	8	17	W
2	79	12	-	10	19	W
3	81	10	-	10	18	W
4	80	9	-	10	21	W
5	79	9	-	11	20	NW
6	78	8	-	10	19	NW
7	74	9	-	11	21	NW
8	71	10	-	8	17	NW
9	69	10	-	9	17	NW
10	66	12	-	7	15	NW
11	65	11	-	8	15	N
12	63	65	-	3	7	E

NWS-Goodyear

NWS-Goodyear

Hr	T(F)	VR	Dust	Spd	Gust	Dir
1	n/a			n/a		n/a
2	n/a			n/a		n/a
3	n/a			n/a		n/a
4	n/a			n/a		n/a
5	n/a			n/a		n/a
6	55	40		7	7	W
7	n/a	10		7	7	W
8	66	10		11	11	SW
9	72	20		11	11	SW
10	n/a	20		15	15	SW
11	n/a	10		14	14	SW
12	n/a	10		14	14	W
1	79	10		14	23	W
2	86	20	BLDU	17	29	W
3	86	20	BLDU	23	29	SW
4	88	20	BLDU	23	29	NW
5	86	20	BLDU	21	29	W
6	82	20	BLDU	23	29	W
7	79	20	BLDU	17	26	W
8	72	20		14	17	NW
9	70	20		17	17	NW
10	n/a			n/a		n/a
11	n/a			n/a		n/a
12	n/a			n/a		n/a

Event Contrib. Analysis

Hourly PM_{10} Conc. ($\mu g/m^3$)

MONITORS:

1-West 43rd Ave.
2-Mon 2
3-Mon 3

24-Hr. Avg PM_{10}

Monitor:	with Event	w/o Event
1-W43rd	155	75

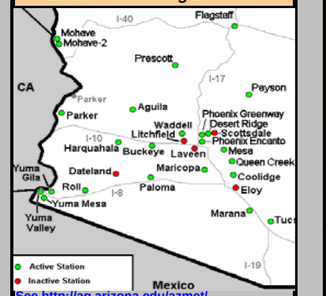
> NAAQS | < NAAQS

Pink=Event Contrib.

Conclusion: As shown above, the PM_{10} concentration would have been below the NAAQS "BUT FOR" the event contribution (hours highlighted in pink).

Hr	1	2	3
1	29.9		
2	49.8		
3	29.3		
4	37.7		
5	46.7		
6	88.2		
7	127		
8	153		
9	111		
10	84.6		
11	90.7		
12	118		
1	265		
2	338		
3	639		
4	540		
5	279		
6	131		
7	254		
8	109		
9	90.7		
10	52.7		
11	28.2		
12	34.3		

AZMET Monitoring Locations



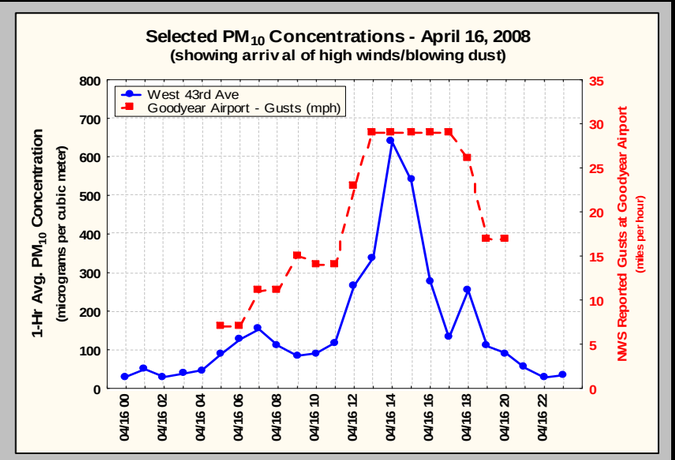
See http://ag.arizona.edu/azmet/
wnd @3m agl / Dir corrected to true north

HIGHLIGHTING	Col.	Parameter
Max Wind	T(F)	Temp. (Deg. F.)
> 15 mph	RH	Rel Humidity %
>25 mph	Rn	Rain (Inches/hr)
HR - Time (End)	Spd	Avg Speed mph
A.M.	Max	Max Speed mph
P.M.	Dir	Wind Dir. (from)

PHX WINDS	KEY	PM10 PLOT
CEN. AZ WINDS		SAT IMAGES
SO AZ WINDS		PHX VIS. CAMERAS

SUMMARY OF EVENT

Between 1:00 p.m. to 6:00 p.m., skies over the valley became increasingly dusty. At 1:00 p.m., winds were out of the southwest, gusting up to 28 mph at Luke AFB. At 2:00 p.m., winds valley-wide were out of the west between 12 and 23 mph, gusting up to 22 to 32 mph.



PARKER

08-Parker

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	67	26	-	13	26	W
2	67	22	-	18	24	NW
3	65	22	-	13	22	W
4	63	19	-	17	26	NW
5	61	19	-	16	21	NW
6	60	20	-	17	25	NW
7	59	20	-	15	22	NW
8	62	21	-	8	13	NW
9	68	17	-	9	20	N
10	71	12	-	18	27	N
11	73	11	-	17	24	N
12	76	11	-	16	23	N
1	76	11	-	19	26	N
2	77	10	-	18	25	N
3	78	10	-	16	21	N
4	79	10	-	17	23	N
5	78	12	-	16	22	N
6	76	13	-	14	20	N
7	70	20	-	7	15	NE
8	64	24	-	7	15	NE
9	58	34	-	2	9	NE
10	57	29	-	3	8	S
11	56	31	-	2	6	S
12	55	26	-	3	7	SE

BUCKEYE

26-Buckeye

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	66	21	-	3	8	SW
2	65	19	-	4	6	SW
3	61	25	-	4	7	SW
4	56	27	-	5	8	NW
5	55	27	-	2	7	NW
6	51	37	-	1	4	NE
7	53	34	-	2	6	W
8	59	37	-	1	5	W
9	65	33	-	3	6	W
10	70	25	-	3	6	W
11	73	19	-	4	10	W
12	76	18	-	4	10	W
1	77	20	-	10	18	W
2	76	18	-	13	20	W
3	77	17	-	13	21	W
4	78	14	-	14	24	NW
5	76	13	-	14	23	NW
6	76	9	-	16	24	NW
7	73	9	-	16	22	NW
8	70	9	-	16	23	NW
9	68	9	-	17	25	N
10	65	10	-	13	22	NW
11	63	12	-	9	15	NW
12	61	12	-	6	11	N

COOLIDGE

05-Coolidge

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	55	46	-	4	6	SW
2	52	49	-	4	6	S
3	50	55	-	4	6	SW
4	51	52	-	4	6	SW
5	53	38	-	5	6	SW
6	49	51	-	4	7	S
7	47	62	-	3	6	SE
8	59	49	-	2	5	S
9	67	36	-	7	13	SW
10	70	31	-	7	12	W
11	72	27	-	7	13	W
12	74	24	-	9	17	W
1	75	22	-	12	20	W
2	75	19	-	11	19	W
3	76	18	-	11	18	W
4	76	16	-	10	20	W
5	76	13	-	12	20	W
6	75	12	-	12	18	W
7	73	10	-	13	18	W
8	69	11	-	10	19	W
9	67	10	-	11	21	NW
10	66	10	-	13	23	NW
11	64	11	-	13	21	NW
12	60	14	-	8	16	N

Historical Distribution

5-Yr. Dist. of Values ($\mu g/m^3$)

MONITORS:

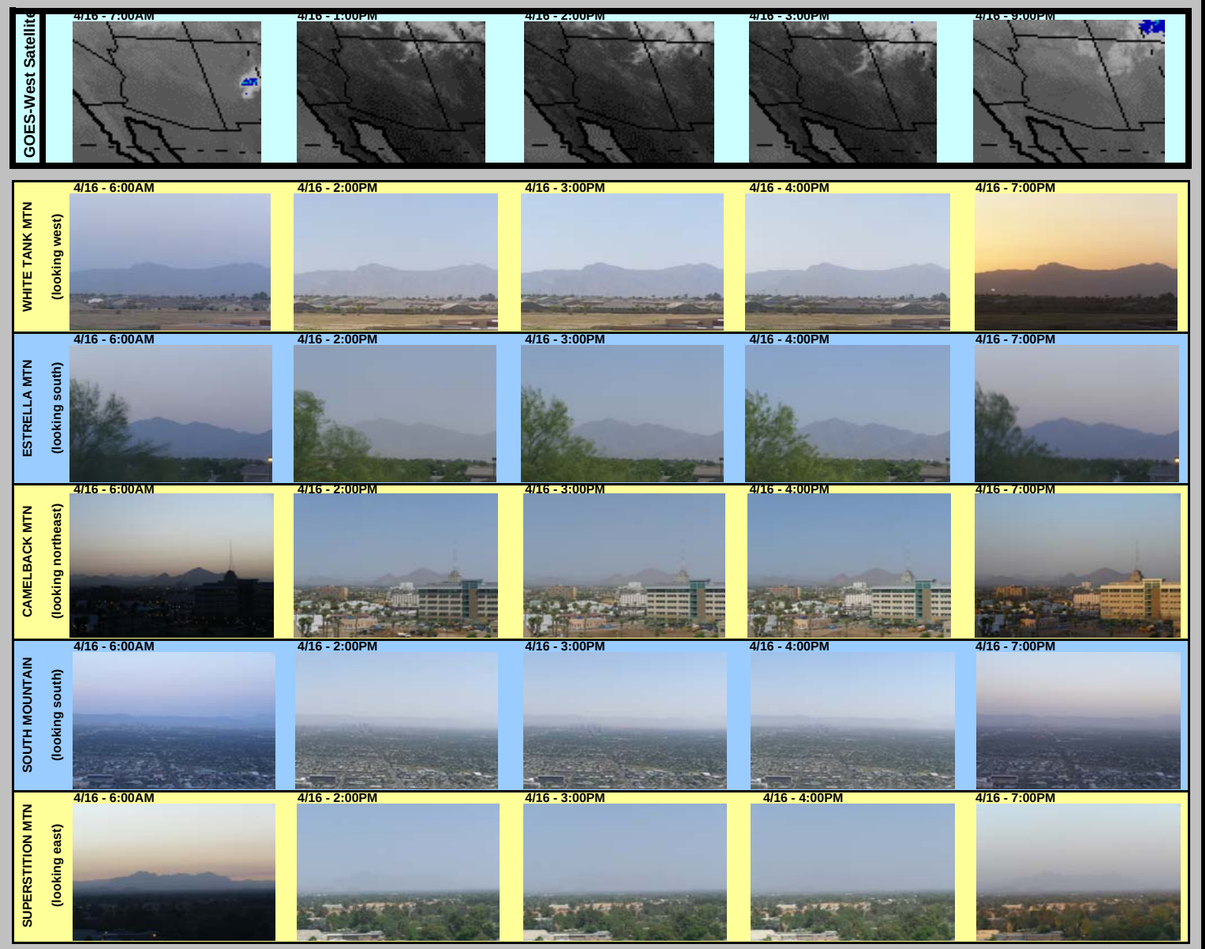
1-WEST 43RD AVE.

Column Index

Yr - All Data (5-Yrs)
Sea - Data for Spring season only (5-Yrs)

Cum. Freq.	Mon 1 Yr	Mon 1 Sea				
Min	5	8				
0.5%	9	9				
1.0%	11	11				
2.5%	15	13				
5%	19	19				
10%	29	28				
25%	44	46				
50%	65	63				
75%	91	82				
90%	121	107				
95%	139	125				
97.5%	157	134				
99.0%	192	194				
99.5%	227	220				
Max	313	313				
Flagged Value	155					

Conclusion: Flagged Value is exceptional in nature (ie greater than 95% of all data)



YUMA

02-YumaValley

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	67	16	-	12	22	NW
2	65	19	-	11	19	NW
3	65	21	-	16	23	NW
4	65	23	-	17	24	NW
5	64	39	-	16	22	NW
6	63	49	-	11	21	NW
7	61	53	-	6	11	NW
8	63	52	-	2	5	S
9	71	23	-	4	11	N
10	73	15	-	10	17	N
11	75	14	-	10	17	N
12	77	13	-	10	15	N
1	79	12	-	10	17	N
2	81	11	-	10	17	N
3	82	12	-	10	19	N
4	83	10	-	10	18	NW
5	83	10	-	12	18	N
6	81	10	-	10	18	N
7	78	11	-	8	14	N
8	74	12	-	7	17	N
9	70	14	-	6	11	N
10	69	16	-	6	10	N
11	66	16	-	3	7	N
12	66	16	-	3	6	N

PALOMA

19-Paloma

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	60	30	-	4	6	SW
2	55	41	-	5	7	W
3	54	37	-	7	11	SW
4	55	27	-	7	10	SW
5	53	31	-	6	9	SW
6	49	45	-	4	7	SW
7	49	44	-	4	6	SW
8	60	28	-	7	12	SW
9	67	25	-	10	14	SW
10	72	19	-	10	15	W
11	74	16	-	9	13	W
12	78	14	-	10	16	W
1	77	19	-	11	19	NW
2	77	19	-	12	20	NW
3	77	18	-	13	21	NW
4	77	18	-	13	22	NW
5	76	15	-	14	22	NW
6	73	15	-	14	21	NW
7	69	15	-	11	21	NW
8	62	26	-	6	11	NW
9	60	23	-	7	16	N
10	60	21	-	8	12	NW
11	54	40	-	4	7	N
12	52	39	-	5	8	NW

MARANA

13-Marana

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	64	12	-	2	5	E
2	62	13	-	4	7	E
3	62	13	-	4	6	E
4	59	15	-	3	6	E
5	58	17	-	2	5	NE
6	55	20	-	2	6	W
7	57	21	-	2	9	SE
8	67	15	-	6	11	SW
9	71	14	-	7	11	SW
10	74	13	-	7	14	W
11	77	10	-	8	14	W
12	79	9	-	10	20	W
1	80	9	-	12	20	W
2	82	9	-	13	22	W
3	82	9	-	14	27	W
4	81	10	-	14	22	NW
5	79	10	-	14	20	NW
6	77	10	-	11	18	NW
7	72	12	-	9	15	NW
8	67	14	-	7	13	NW
9	63	16	-	6	10	NW
10	61	15	-	6	9	NW
11	57	18	-	5	8	NW
12	56	17	-	3	10	NW

TUCSON

01-Tucson

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	60	16	-	2	6	E
2	58	18	-	3	6	E
3	58	17	-	4	9	E
4	59	16	-	3	5	E
5	55	23	-	2	4	E
6	54	23	-	3	6	E
7	58	20	-	3	6	E
8	66	18	-	3	6	E
9	71	14	-	2	6	E
10	74	12	-	3	10	NW
11	75	10	-	8	15	W
12	77	10	-	8	20	W
1	78	8	-	11	21	NW
2	80	8	-	13	24	NW
3	80	8	-	15	24	W
4	80	9	-	15	24	NW
5	78	10	-	15	28	NW
6	76	9	-	15	23	NW
7	74	8	-	12	20	NW
8	71	9	-	12	18	NW
9	68	10	-	11	17	NW
10	65	11	-	11	16	NW
11	62	11	-	10	17	NW
12	60	12	-	10	15	NW

Prepared by S. Kendall, A. Juniel, B. Busby and B. Paris/ ADEQ 3/19/09

Assessment under the Technical Criteria Document (TCD)

1. Properly qualify and validate the air quality measurement to be flagged. As this was not a filter sampling date (1-in-6 run day), only data from the continuous analyzers were examined. The air quality monitoring data were reviewed by the agency responsible for operation of the monitor. All hourly PM_{10} readings from the West 43rd Ave. monitoring site were valid for April 16th. Audits of the analyzers revealed operations were within acceptable tolerance. No local sources were reported as significantly contributing to the air quality episode. Exceedances of the NAAQS were recorded at the West 43rd Ave. monitoring site operated by Maricopa County.

2. Review suspected contributing sources. The NWS and AzMET surface data for Arizona, along with the visible camera images in Phoenix, provide a good explanation as to what meteorological conditions were in place on April 16th. Strong westerly winds were occurring in the Phoenix area due to a low pressure system approaching from the west with a cold front situated over Arizona. The plot of hourly PM_{10} concentration data in the upper right corner of Figure 1 confirms the nearly identical timing of elevated PM_{10} at the West 43rd Ave. monitor and strong wind gusts at Goodyear Airport. The high wind event was a regional phenomenon that affected the entire Phoenix metro area. However, PM sources are highly variable across space; therefore, the locations of higher PM_{10} concentrations (namely the Salt River channel) are likely an indication that these locations (or areas upwind of these locations) contain greater sources of PM than other locations within the Phoenix metropolitan area. While no specific source allocation can be determined for this particular day, the 2005 ADEQ revised PM_{10} SIP for the Salt River area (attached) contains modeled source contributions on high wind days (see section 4.2 – Source Categories). Results estimate that approximately 76% of PM_{10} concentrations can be attributed to windblown dust, of which 21% is from agricultural fields, 15% from alluvial channels, and 21% from vacant lots. It is not clear whether similar source allocations can be assumed for this April 16, 2008, high wind event.

3. Examine all air quality monitoring information. Data from all monitors in the network were reviewed. Monitors from the affected areas are summarized in the table in the Background section of this assessment. Pursuant to 40 CFR 50.14(c)(3)(iii)(C), the "Historical Distribution" Table in Figure 1 has been included to demonstrate that the event is associated with a measured concentration in excess of normal historical fluctuations, including background (i.e., concentrations greater than the 95th percentile). The monitor with readings greater than that of the NAAQS on April 16, 2008, which should be flagged, is West 43rd Ave.

4. Examine the meteorological conditions before and during the event. The AzMET meteorological data are summarized in Figure 1. The wind data are highlighted yellow if the max wind speed in the hour exceeds 15 mph and orange if it exceeds 25 mph. As can be seen in Figure 1, wind speeds did not pick up in central Arizona until approximately 12:00 p.m., when several stations reported gusty winds that approached 30 mph. This timing corresponds to the onset of elevated PM_{10} concentrations recorded at the West 43rd Ave. monitoring site, which remained elevated through the afternoon hours until winds decreased to below 20 mph.

5. Perform a qualitative attribution to emission source(s). All evidence indicates the elevated PM_{10} concentrations in the Phoenix area can be attributed to soil emissions that were transported over portions of the Phoenix Metro area in Maricopa County. No source specific emission allocation is possible based on the data available for analysis. The hourly concentration data do not show any significant source other than the wind-blown dust event occurring on April 16, 2008. Observational reports of blowing dust by trained weather spotters in portions of the Phoenix Metro area is further proof that the elevated PM_{10} concentrations were attributed to soil emissions transported by high wind gusts (see attachments). These reports, as well as visual evidence of reduced visibility (Figure 1), provide proof that the elevated PM_{10} concentrations in Phoenix can be attributed to soil emissions.

6. Estimation of Contribution from Source or Event. The primary source appears to be wind-blown dust over central Arizona for which there is not an effective or efficient method to estimate the relative contributions from specific sources. The demonstration analysis contained in this report establishes the linkage between the measurements to be flagged and the event, thus satisfying the requirement in 40 CFR 50.14(c)(3)(iii)(B). Pursuant to 40 CFR 50.14(c)(3)(iii)(D), the "Event Contrib. Analysis" Table in Figure 1 has been included to demonstrate that there would have been no exceedance or violation but for the event (i.e., the contribution during the event overwhelmed the 24-hour average).

7. Determination that a Natural or Exceptional Event Contributed To an Exceedance. Based on this analysis, the event satisfies the requirement in 40 CFR 50.1(j) that the elevated concentration in West 43rd Ave. was attributed to a natural event.

Conclusion

Long-range transport of dust from soils. The elevated PM_{10} event on April 16, 2008, in Maricopa County was the result of the transport of dust and soils from high winds that suspended natural soils and soils from areas where Best Available Control Measures are in place and should be flagged for air quality planning purposes. The "high wind" (RJ) flag should be applied to the monitor reading indicated in the table at the beginning of this report, as the monitor would have been below the NAAQS but for the contribution of the event.