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Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate (PM₁₀) Concentration Events in the Buckeye Area on July 4, 2008

Background

The Arizona Department of Environmental Quality (ADEQ) issues Dust Control Action Forecasts for Phoenix and surrounding areas as part of their Natural Events Action Plan. On Thursday, July 3, 2008, ADEQ air quality forecasters issued the Maricopa County Dust Control Action Forecast calling for a moderate risk of wind-blown dust for Friday, July 4th, in Maricopa County. This moderate risk was due to the increased probability for thunderstorms developing over the Mogollon Rim and tending to drift toward the desert areas in the evening with the potential for gusty outflow winds to produce areas of dense blowing dust. The forecast did mention the possibility of strong gusty winds to 20 mph and possibly stronger in Maricopa County due to outflow from even distant thunderstorms. This potential wind-blown dust event equated to a moderate risk of exceeding the PM₁₀ National Ambient Air Quality Standards (NAAQS) in Maricopa County. The forecasts/advisories satisfy the requirement in 40 CFR 51.930(a)(1).

Similar to the July 1st event, strong north and northeasterly winds associated with an outflow boundary were observed during the evening hours of July 4, 2008. This outflow boundary also initiated isolated thunderstorm activity in the Valley, as can be seen in the satellite images of Figure 1.

The initialization of the wind-blown dust event is evident in the Phoenix visible camera images, the satellite imagery, as well as in the Arizona Meteorological Network (AzMET), Maricopa County (MC), and National Weather Service (NWS) monitors (see Fig. 1). 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.” A discussion of commonly employed Best Available Control Measures (BACM) for dust in Maricopa and Yuma counties can be found in “High Wind Exceptional Events and Control Measures for PM₁₀ Areas” (see “References”).

The significant wind event brought elevated ambient concentrations of PM₁₀ to the Buckeye and Phoenix areas. Due to the spatial variability of PM sources both within and outside of the Phoenix urban core, the PM₁₀ NAAQS was only exceeded at the Buckeye 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 PM₁₀ 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**
BUCKEYE AREA					
Buckeye (MC/TEOM)	04-013-4011*	223	2820	2000	RJ
PHOENIX METRO AREA					
Coyote Lakes (MC/TEOM)	04-013-4014*	111	1354	1900	None
West 43 rd Ave (MC/TEOM)	04-013-4009*	40	156	1900	None
Durango Complex (MC/TEOM)	04-013-9812*	32	109	1900	None
Greenwood (MC/TEOM)	04-013-3010*	29	44	0600	None
Higley (MC/TEOM)	04-013-4006*	43	139	0600	None
West Phoenix (MC/TEOM)	04-013-0019*	34	134	1900	None
Central Phoenix (MC/TEOM)	04-013-3002*	31	114	1900	None
JLG Supersite (ADEQ/TEOM)	04-013-9997*	30	110	1900	None

* EPA Air Quality System Identification Number

** 24-hr PM₁₀ 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. Following the stakeholders meetings, ADEQ supplemented and finalized the analysis and a public comment period was held from

October 15, 2009 through November 13, 2009. This finalized document and any comments received are being submitted to EPA to satisfy the requirements in 40 CFR 50.14(c)(3)(i).

127530 (112.31Wx33.67N)

MC - COYOTE LAKES

Hr	T(F)	PM	Spd	Max	Dir
1	90	20	5	13	W
2	91	36	5	17	E
3	89	31	1	7	E
4	88	51	2	6	E
5	85	29	0	5	NE
6	85	46	0	3	NE
7	89	56	2	5	N
8	95	38	2	6	N
9	100	33	1	7	NW
10	102	24	3	9	W
11	102	28	3	11	SW
12	103	29	4	13	SW
1	103	27	3	13	SW
2	105	26	5	16	SW
3	108	24	5	18	SW
4	109	23	7	20	SW
5	110	15	5	17	SW
6	110	18	5	15	SW
7	101	466	9	27	NE
8	93	1354	18	38	NE
9	89	167	13	28	N
10	90	99	10	27	N
11	88	46	11	29	NW
12	88	26	8	20	NW

NWS-Luke AFB

Hr	T(F)	VR	Dust	Spd	Gust	Dir
1	93	10		17	17	SW
2	93	10		14	14	S
3	91	10		6	6	E
4	90	10		7	7	SE
5	88	10		7	7	W
6	86	10		7	7	NW
7	90	10		7	7	N
8	93	10		5	5	N
9	94	10		3	3	VR
10	96	10		11	11	S
11	97	10		9	9	S
12	99	10		10	10	S
1	101	10		7	17	S
2	102	10		15	22	S
3	103	10		11	11	SW
4	104	10		15	15	SW
5	105	10		0	0	N
6	105	10		14	22	SW
7	99	6		24	39	NE
8	94	6		28	39	NE
9	89	10		16	28	N
10	89	10		30	34	NW
11	87	10		15	21	NW
12	90	10		17	26	NW

21525 (112.62Wx33.37N)

MC - BUCKEYE

Hr	T(F)	RH	PM	Spd	Max	Dir
1	92	40	52	9	21	SW
2	90	48	43	10	20	W
3	87	54	41	4	11	N
4	87	54	35	2	10	W
5	85	58	57	3	9	NW
6	83	63	116	6	9	NW
7	85	61	54	6	10	NW
8	90	49	78	6	10	NW
9	93	44	39	4	8	W
10	94	43	33	2	9	SW
11	97	40	26	7	13	W
12	98	38	21	5	15	W
1	102	34	22	7	15	W
2	104	31	17	7	15	W
3	106	28	17	9	17	W
4	106	28	25	9	17	W
5	106	28	16	9	14	W
6	105	28	24	7	12	SW
7	103	32	33	6	12	SW
8	100	33	315	5	40	NE
9	94	35	2820	24	51	NE
10	89	47	1440	19	48	N
11	86	52	38	18	31	NW
12	89	38		12	24	NW

Event Contrib. Analysis

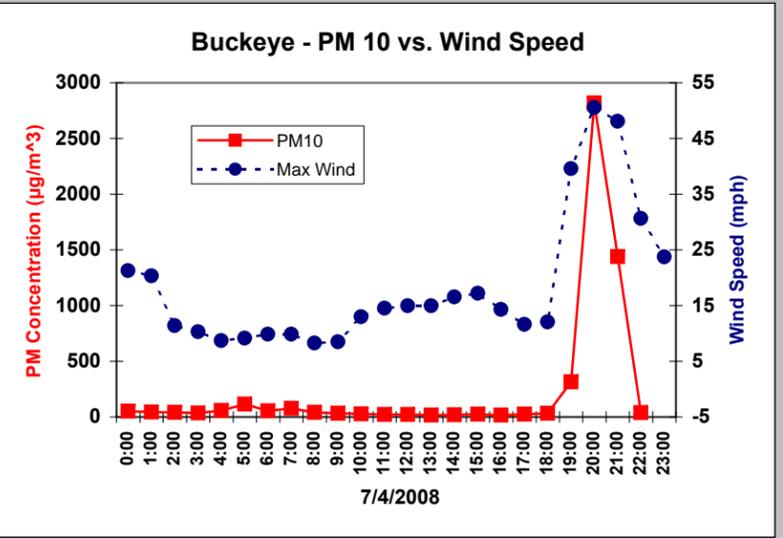
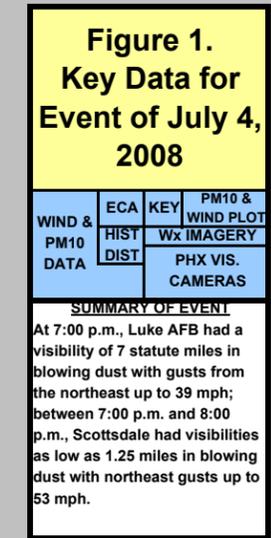
Hourly PM₁₀ Conc. (µg/m³)

MONITORS:	Hr	1
1-Buckeye	1	52.4
	2	43.9
	3	41.2
	4	35.4
	5	57.8
	6	116
	7	54.9
	8	78
	9	39.8
	10	33.2
	11	26.9
	12	21.7
	1	22.3
	2	17.8
	3	17.9
	4	25.3
	5	16.9
	6	24.7
	7	33
	8	315
	9	2820
	10	1440
	11	38.5
	12	N/A

24-Hr. Avg PM₁₀ with w/o
Monitor: Event Event
1-Buckeye 233 39

> NAAQS < NAAQS
Pink=Event Contrib.

Conclusion: As shown above, the PM₁₀ concentration would have been below the NAAQS "BUT FOR" the event contribution (hours highlighted in pink).



19550 (112.34Wx33.64N)

MC - DYSART

Hr	T(F)	RH	NF	Spd	Max	Dir
1	91	28	7	7	19	SW
2	92	28	7	6	19	E
3	91	28	10	4	11	E
4	90	32	9	3	9	E
5	88	35	6	2	7	SE
6	87	37	6	3	6	N
7	88	37	6	4	7	N
8	91	33	8	4	8	N
9	93	32	5	1	8	NW
10	94	31	5	2	9	W
11	95	31	5	4	15	SW
12	97	29	5	5	17	S
1	99	28	5	7	17	S
2	100	26	5	9	20	S
3	102	24	5	9	22	SW
4	104	21	5	9	23	SW
5	104	20	4	7	19	SW
6	104	19	4	5	13	SW
7	100	20	11	9	32	NE
8	94	26	26	21	40	NE
9	89	33	9	16	40	N
10	90	31	6	14	31	N
11	87	39	4	18	31	NW
12	86	40	3	14	29	NW

16375 (112.12Wx33.43N)

MC - DURANGO COMPLEX

Hr	T(F)	PM	Spd	Max	Dir
1	88	22	3	16	N
2	89	27	4	14	NE
3	88	32	4	13	NE
4	87	32	6	13	E
5	84	42	1	7	SW
6	84	38	2	4	NW
7	86	47	1	5	E
8	93	31	1	7	NW
9	96	28	5	11	W
10	97	25	6	15	W
11	100	18	5	13	W
12	102	20	4	13	SW
1	102	23	4	13	SW
2	104	20	5	14	W
3	106	20	5	16	W
4	108	21	7	16	W
5	107	20	9	18	W
6	106	22	9	17	W
7	105	31	7	15	W
8	99	109	9	28	N
9	91	57	7	20	N
10	91	26	10	24	N
11	89	38	10	26	NW
12	88	18	3	17	NW

16659 (112.14Wx33.41N)

MC - WEST FORTY THIR

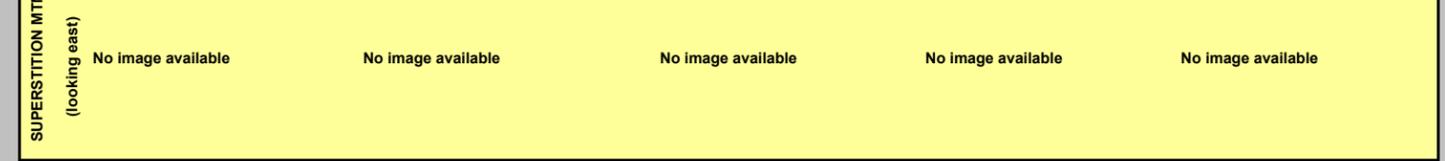
Hr	T(F)	PM	Spd	Max	Dir
1	84	28	4	16	N
2	87	23	6	14	NE
3	87	39	6	14	NE
4	86	42	4	14	E
5	84	42	2	4	W
6	83	32	2	4	N
7	85	47	2	6	E
8	89	38	2	6	SE
9	94	33	4	11	SW
10	96	23	6	13	W
11	99	27	4	11	W
12	100	23	3	13	SW
1	102	17	3	11	SW
2	104	24	3	13	W
3	106	52	5	15	W
4	108	60	8	19	W
5	108	20	9	20	W
6	107	26	9	17	W
7	105	33	8	15	W
8	99	155	14	35	N
9	92	80	13	26	N
10	92	23	9	23	NW
11	90	58	13	30	NW
12	86	19	4	13	W

Historical Distribution

5-Yr. Dist. of Values (µg/m³)

MONITORS:	Column Index
1-BUCKEYE	Yr - All Data (5-Yrs)
	Sea - Data for Summer season only (5-Yrs)
Cum. Freq.	Mon 1
Min	5 14
0.5%	7 15
1.0%	9 15
2.5%	13 17
5%	16 21
10%	22 25
25%	33 34
50%	48 49
75%	67 68
90%	83 86
97.5%	120 115
99.0%	159 131
99.5%	260 155
Max	289 195
Flagged Value	233

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



16329 (112.05Wx33.46N)

MC - CENTRAL PHOENIX

Hr	T(F)	PM	Spd	Max	Dir
1	88	12	3	11	N
2	87	31	4	14	NE
3	87	42	5	12	E
4	87	23	4	12	SE
5	85	23	1	4	E
6	84	34	2	6	NW
7	89	36	2	6	E
8	97	30	1	6	N
9	99	34	4	13	NW
10	101	30	5	15	W
11	101	29	6	18	W
12	101	23	5	18	W
1	101	27	6	17	SW
2	102	25	7	21	SW
3	104	20	7	22	W
4	106	23	7	19	W
5	107	21	8	20	W
6	106	27	8	17	W
7	104	28	6	14	W
8	96	114	11	41	N
9	91	34	9	29	N
10	91	22	12	26	N
11	89	27	12	29	NW
12	88	21	5	19	NW

16380 (111.87Wx33.41N)

MC - MESA

Hr	T(F)	RH	Spd	Max	Dir	
1	89	36		7	15	S
2	89	37		9	18	SE
3	88	36		9	18	SE
4	86	37		9	13	SE
5	87	39		1	4	SE
6	86	45		2	4	N
7	86	45		3	5	NE
8	90	38		1	7	NE
9	92	36		4	10	W
10	94	34		4	13	W
11	97	32		6	17	W
12	98	31		6	17	W
1	100	28		6	16	W
2	102	25		6	17	W
3	102	23		6	18	W
4	103	23		7	1	

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 PM₁₀ readings from the Buckeye monitor were valid for July 4th. Audits of the analyzers revealed operations were within acceptable tolerance. No local sources were reported as significantly contributing to the air quality episode.

2. Review suspected contributing sources. The NWS and MC surface data for Arizona, along with the visible camera images in Phoenix, provide a good explanation of the meteorological conditions that were in place on July 4th. Strong north and northeasterly winds associated with a thunderstorm outflow boundary occurred in and around the Phoenix area between the 6:00 p.m. and 9:00 p.m. hours. While the highest wind gust of 51 mph occurred at the MC Buckeye monitoring site, wind speeds gusted between 20 and 50 mph at various other Valley locations during that time, causing spikes in PM₁₀ concentrations at multiple monitoring sites around the Phoenix area. Large spikes in PM₁₀ concentration occurred within that same time period in Buckeye, which led to the NAAQS exceedance there. Similar spikes, such as the 1354 µg/m³ reading at Coyote Lakes, occurred at the same time throughout the Valley. These spikes, however, were not large enough to cause additional exceedances of the 24-hr NAAQS. While the outflow boundary affected the entire Phoenix Metro area, PM sources are spatially diverse. Therefore, the locations of higher PM₁₀ concentrations (West Valley) are likely an indication that these locations (or areas upwind of these locations) contain greater sources of PM than the urbanized core of the Phoenix Metropolitan area.

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 measured concentrations in excess of normal historical fluctuations, including background (i.e., concentrations greater than the 95th percentile). Additionally, the winds associated with the elevated PM₁₀ concentrations may be characterized as unusual as described in “Impact of Exceptional Events’ ‘Unusual Winds’ on PM₁₀ Concentrations” (see “References”).

4. Examine the meteorological conditions before and during the event. 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. The MC Buckeye station experienced hourly max wind speeds greater than 15 mph beginning during the 10:00-11:00 a.m. hour, with a maximum gust of 51 mph occurring during the 8:00-9:00 p.m. hour. The Luke AFB NWS station reported wind gusts of 39 mph and reduced visibility to 6 miles (see Fig. 1). Other Phoenix area locations reported reduced visibilities and blowing dust as well. The timing of the reduced visibilities and wind gusts correspond to the onset of elevated PM₁₀ concentrations recorded at Buckeye.

5. Perform a qualitative attribution to emission source(s). All evidence indicates the elevated PM₁₀ concentrations in the Buckeye area can be attributed to soil emissions that were transported over a broad area. 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 July 4th. Observational reports of blowing dust from trained officials in the Phoenix area, along with reduced visibility, provide further proof that the elevated PM₁₀ concentrations in Buckeye were attributed to soil emissions. These reports, in addition to the visual evidence of reduced visibility seen in the Phoenix visibility images located in the lower right portion of Figure 1, provide proof that elevated PM₁₀ concentrations in and around Phoenix are attributable to soil emissions. The thunderstorm activity and movement of the outflow boundary from the northeast toward the southwest through the Phoenix and Buckeye areas are also apparent in the satellite images located in the right-center portion of Figure 1.

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 a 40 CFR 50.14(c)(3)(iii)(B) requirement. 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 exceedances or violations but for the event (i.e., the contribution during the event overwhelmed the 24-hour averages).

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 concentrations at the Buckeye monitoring site was attributed to a natural event.

Conclusion

Transport of dust from soils by high winds. The elevated PM₁₀ concentrations that occurred in the West Valley on July 4, 2008, was the result of the transport of dust and soils from 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 readings 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.

ATTACHMENTS AND REFERENCES
FOR EXCEPTIONAL EVENTS ANALYSIS

The following are supplemental materials helpful in understanding the exceptional event summarized in the main report. In addition, the reader is referred to the following references.

REFERENCES

Arizona Department of Environmental Quality (ADEQ), *Air Quality Exceptional and Natural Events Policy*, Policy Number 2009.002 (April 28, 1999; revised January 10, 2006 and June 22, 2007).

Arizona Department of Environmental Quality (ADEQ), *Technical Criteria Document for Determination of Natural Exceptional Events for Particulate Matter Equal to or Less Than Ten Microns in Aerodynamic Diameter (PM₁₀)* (May 31, 2000).

Arizona Department of Environmental Quality (ADEQ), *Technical Criteria Document for Determination of Natural and Exceptional Events* (December 12, 2005).

Arizona Department of Environmental Quality (ADEQ), *Impact of Exceptional Events 'Unusual Winds' on PM₁₀ Concentrations* (October 14, 2009).

Arizona Department of Environmental Quality (ADEQ), *High Wind Exceptional Events and Control Measures for PM₁₀ Areas* (October 14, 2009).

Environmental Protection Agency (EPA), *The Treatment of Data Influenced by Exceptional Events (Exceptional Event Rule)*, 73 FR 70597; 40 CFR Parts 50 and 51 (November 21, 2008).



**MARICOPA COUNTY
 DUST CONTROL ACTION FORECAST
 ISSUED THURSDAY, JULY 03, 2008**

Three-day weather outlook:

NOTE: During active summer monsoon episodes, outflows from even distant thunderstorms have the potential to cause periods of gusty winds and dense blowing dust.

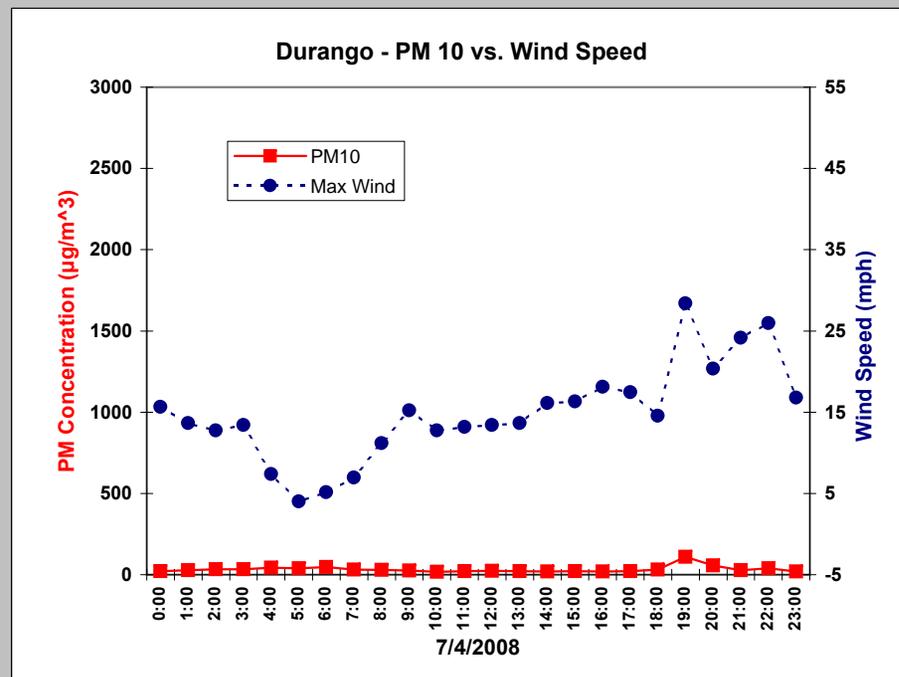
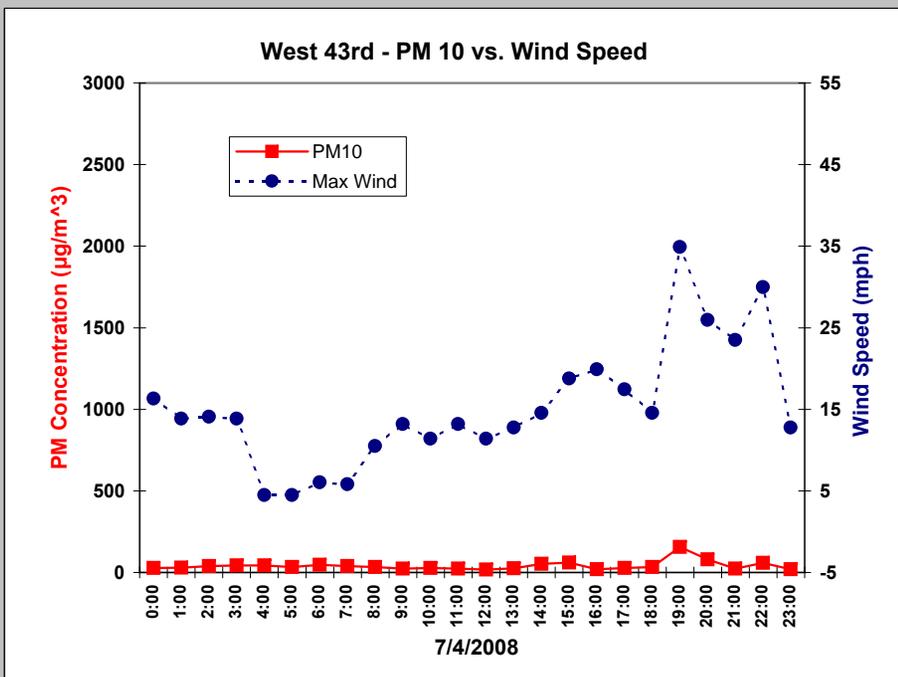
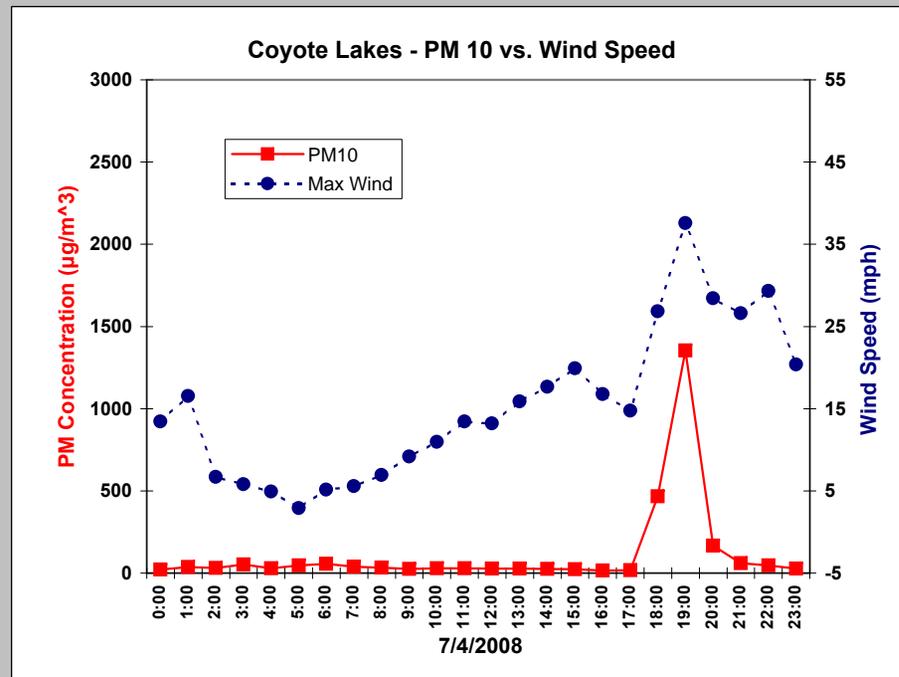
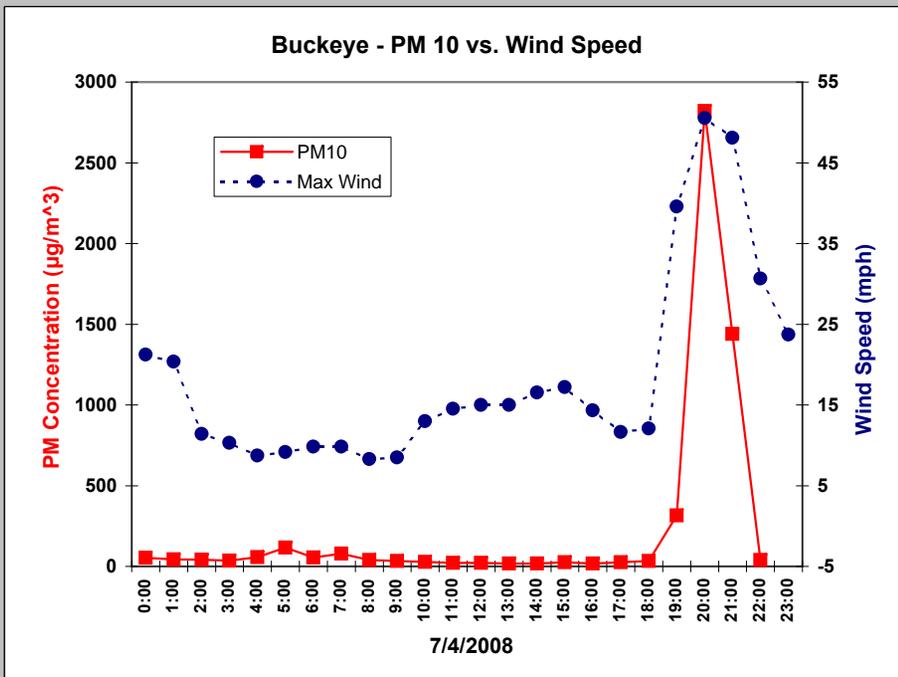
A strong high-amplitude ridge aloft has become established over the western U.S. An anticyclonic center of circulation is forecast to remain positioned over or near northern Arizona thru this forecast period. Thunderstorms that develop over the Rim will tend to drift toward the desert areas each evening, and gusty outflow winds will have the potential to produce areas of dense blowing dust, mainly over the east and southeast Valley each evening; hence, a moderate risk level thru this forecast period.

R I S K F A C T O R S

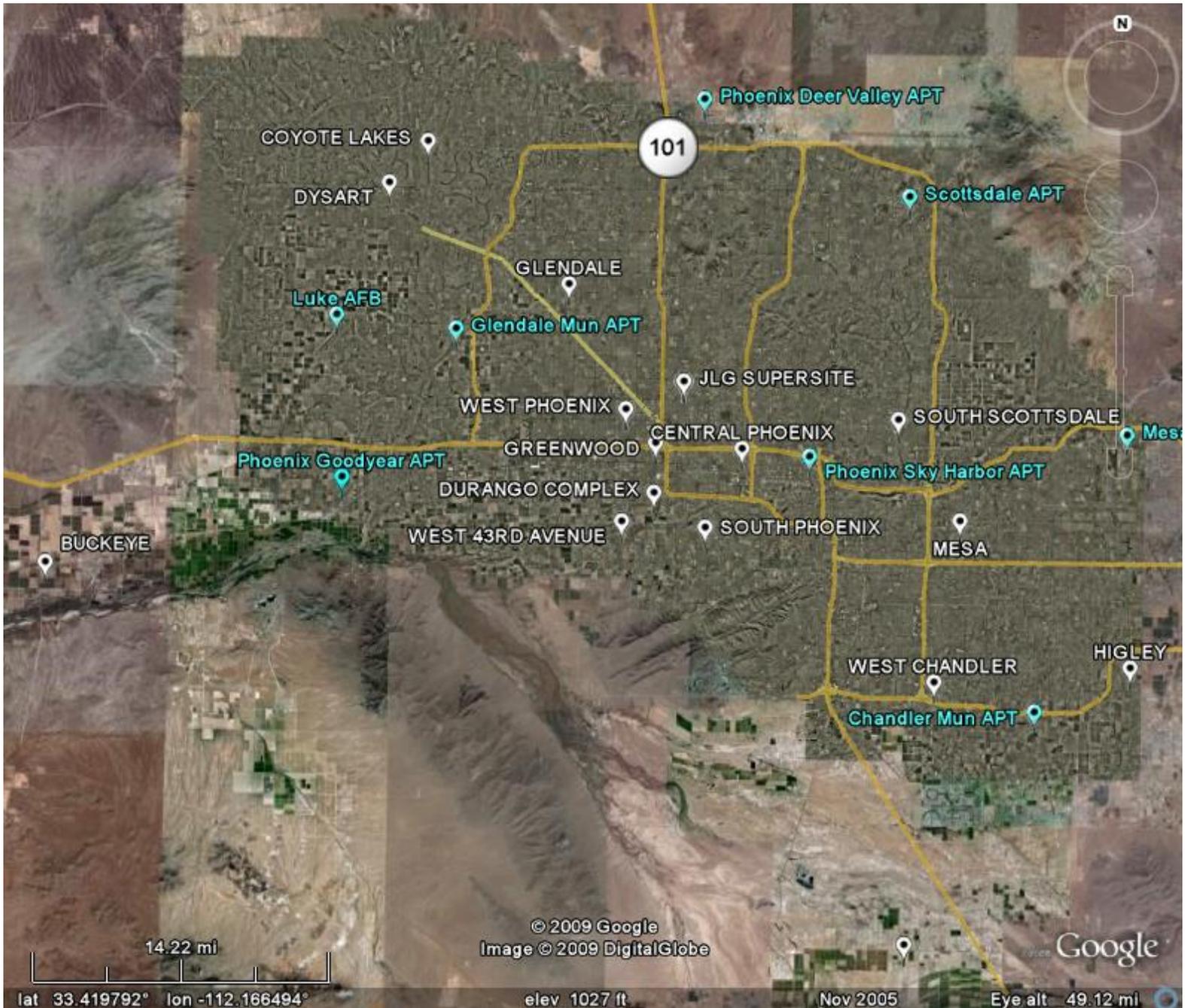
	<u>WINDS</u>	+	<u>STAGNATION</u>	=	<u>RISK LEVEL</u>
Day #1: Fri 07/04/2008	Westerly 5-15 mph with gusts to 20 mph during the afternoon hours except strong and gusty due to outflow from thunderstorms.		Somewhat stagnant during the morning hours.		MODERATE
Day #2: Sat 07/05/2008	Westerly 10-20 mph with gusts to 25 mph during the afternoon hours except strong and gusty due to outflow from thunderstorms.		Somewhat stagnant during the morning hours.		MODERATE
Day #3: Sun 07/06/2008	Westerly 15-25 mph during the afternoon hours except strong and gusty due to outflow from thunderstorms.		Somewhat stagnant during the morning hours.		MODERATE

The Maricopa County Dust Control Action Forecast is issued to assist in the planning of work activities to help reduce dust pollution. To review the complete air quality forecast for the Phoenix metropolitan area and the health effects of air pollution, please see ADEQ's Air Quality Forecast at <http://www.azdeq.gov/environ/air/ozone/ensemble.pdf>, or call 602-771-2367 for recorded forecast information.

07/04/2008 - ADDITIONAL GRAPHS



Phoenix Area PM₁₀ and Meteorological Monitors



Source: US EPA, ADEQ, & Google Earth