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PRELIMINARY DOCUMENTATION

Assessment of Qualification for Treatment under the Arizona Natural and Exceptional Events Policy for the High Particulate Concentration Event in the Nogales, Arizona Area on December 20, 2008

Background

The Arizona Department of Environmental Quality (ADEQ) operates monitors at the Post Office in Nogales, Arizona for PM₁₀ and PM_{2.5} and at the Fire Station in Nogales, Sonora for PM₁₀. Federal Reference Method (FRM) filter based samples are collected at both locations. Two Beta-Attenuation Monitor Systems (BAMS) collect hourly PM₁₀ and PM_{2.5} concentration data at the Post Office site.

During the evening of December 20, 2008, a strong nighttime temperature inversion set up in the Nogales area. With no significant ventilating winds available to break up the surface inversion, the inversion intensified and set up a drainage flow from the higher terrain to the south in Mexico through Nogales, Sonora and into Nogales, Arizona.

The event brought significant elevated ambient concentrations of PM_{2.5} that exceeded the National Ambient Air Quality Standards (NAAQS) at the ADEQ Nogales Post Office monitor. The fact that ambient concentrations exceeded the NAAQS satisfies the criteria in 40 CFR 50.1(j) that the event “affects air quality.” Preliminary indications were that emissions from sources in

Mexico, which are not subject to control by the Arizona State Implementation Plan (SIP), may have contributed to the event.

A PM₁₀ SIP exists for Nogales, Arizona. All appropriate 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,” if in fact emissions from Mexico caused the exceedance.

Elevated PM₁₀ and PM_{2.5} concentrations were measured in the Nogales area. The table below shows the key PM monitor readings for the monitors examined in this report. The PM₁₀ data were included in this analysis for informational purposes only. These data are particularly useful for the Event Contribution Analysis contained in Figure 1, as well as identifying the type of PM that may have been present, as discussed in section 2. While the PM_{2.5} BAM did exceed the PM_{2.5} NAAQS, this monitor is not an EPA approved federal reference or equivalent method. For this reason, the request exclusion flag cannot be used for this monitor; therefore, the informational flag (Other – IL) was used instead.

Monitor (Operator/Type)	AQS ID*	24-hr Avg PM ₁₀ or PM _{2.5}	1-hr Max PM ₁₀ or PM _{2.5}	Time of Max 1-hr	Flag**
NOGALES AREA – 12/20					
Nogales AZ Post Office PM ₁₀ (ADEQ/BAM)	04-023-0004 (3)	93	292	2000	None
Nogales AZ Post Office PM _{2.5} (ADEQ/BAM)	04-023-0004 (3)	37.4	108	2200	IL
Nogales AZ Post Office PM ₁₀ (ADEQ/FRM)	04-023-0004 (1)	84	N/A	N/A	None
Nogales AZ Post Office PM _{2.5} (ADEQ/FRM)	04-023-0004 (1)	35.8	N/A	N/A	RL
Nogales AZ Post Office PM _{2.5} (ADEQ/FRM)	04-023-0004 (2)	37.3	N/A	N/A	RL

* EPA Air Quality System Identification Number

** 24-hr PM₁₀ concentration influenced by exceptional event (international transport) to be flagged.

Type Abbreviations: BAM – Beta-Attenuation Mass Monitor (Continuous monitor)

The preliminary findings from this analysis were presented at a stakeholders meeting on 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).

NWS-Nogales Int Airport

Hr	T(F)	VR	Dust	Spd	Gust	Dir
1	36	10	0	0	0	N
2	34	10	0	0	0	N
3	34	10	5	5	5	NE
4	34	10	3	3	3	E
5	31	10	5	5	5	NE
6	33	10	7	7	7	NE
7	33	10	5	5	5	S
8	32	10	6	6	6	E
9	38	10	3	3	3	S
10	46	10	3	3	3	S
11	53	10	0	0	0	N
12	59	10	3	3	3	SW
1	63	10	5	5	5	W
2	63	10	3	3	3	NW
3	64	10	3	3	3	NW
4	63	10	6	6	6	VR
5	61	10	3	3	3	W
6	50	10	3	3	3	NE
7	47	10	9	9	9	E
8	42	10	0	0	0	N
9	40	10	5	5	5	E
10	36	10	3	3	3	N
11	37	10	3	3	3	SE
12	34	10	3	3	3	E

NWS-Tucson Int Airport

Hr	T(F)	VR	Dust	Spd	Gust	Dir
1	40	10	0	0	0	SE
2	39	10	0	0	0	N
3	37	10	6	5	5	SE
4	37	10	5	5	5	SE
5	36	10	7	7	7	SE
6	36	10	7	7	7	SE
7	38	10	8	8	8	SE
8	38	10	6	6	6	SE
9	42	10	6	6	6	S
10	47	10	3	3	3	SE
11	53	10	0	0	0	N
12	56	10	0	0	0	N
1	60	10	3	3	3	VR
2	62	10	6	6	6	NW
3	63	10	0	0	0	N
4	63	10	6	6	6	VR
5	61	10	7	7	7	N
6	54	10	7	7	7	N
7	51	10	0	0	0	N
8	47	10	6	6	6	W
9	46	10	5	5	5	W
10	44	10	0	0	0	N
11	41	10	6	6	6	SE
12	38	10	5	5	5	SE

ADEQ-Nogales P.O.

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	N/A	N/A	-	1	1	S
2	N/A	N/A	-	1	1	S
3	N/A	N/A	-	1	1	NE
4	N/A	N/A	-	1	1	S
5	N/A	N/A	-	1	1	NE
6	N/A	N/A	-	1	1	E
7	N/A	N/A	-	2	2	SE
8	N/A	N/A	-	2	2	E
9	N/A	N/A	-	1	1	NE
10	N/A	N/A	-	1	1	N
11	N/A	N/A	-	1	1	N
12	N/A	N/A	-	3	3	N
1	N/A	N/A	-	4	4	N
2	N/A	N/A	-	3	3	N
3	N/A	N/A	-	4	4	N
4	N/A	N/A	-	4	4	N
5	N/A	N/A	-	3	3	N
6	N/A	N/A	-	2	2	S
7	N/A	N/A	-	2	2	S
8	N/A	N/A	-	1	1	S
9	N/A	N/A	-	1	1	S
10	N/A	N/A	-	1	1	S
11	N/A	N/A	-	1	1	S
12	N/A	N/A	-	0	0	S

Event Contrib. Analysis

Hourly PM Conc. (µg/m³)

MONITORS:	Hr	1	2
1-Nogales PM10	1	63	24
2-Nogales PM2.5	2	52	26
	3	55	25
	4	47	31
	5	49	24
	6	53	24
	7	34	15
	8	46	21
	9	58	29
	10	52	23
	11	46	23
	12	30	0
	1	5	0
	2	2	0
	3	0	0
	4	0	0
	5	1	0
	6	82	20
	7	286	92
	8	288	100
	9	292	106
	10	241	104
	11	251	108
	12	216	102

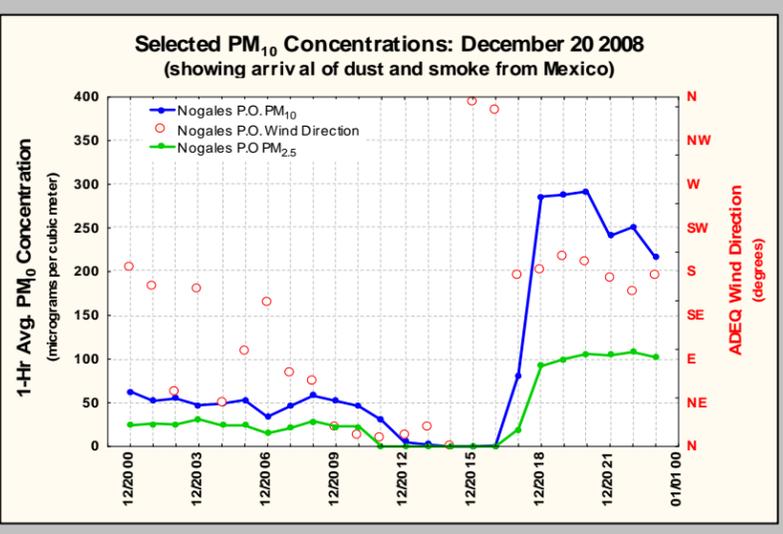
24-Hr. Avg PM₁₀ with W/O: 5.49, 24
 Monitor: Event Even: 7.34, 15
 1-Nogales: 93, 34
 2-Nogales: 37.4, 15
 > NAAQS < NAAQS
 Pink=Event Contrib.
 Conclusion: As shown above, the PM₁₀ concentration would have been below the NAAQS "BUT FOR" the event contribution (hours highlighted in pink).



Figure 1. Key Data for Event of December 20, 2008

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

SUMMARY OF EVENT
 Winds over southern Arizona were 12 mph or less between 1:00 p.m. and 6:00 p.m. From 7:00 p.m. to midnight, it was clear over southern Arizona. Winds were mostly light or calm statewide during this timeframe.



PARKER

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	39	97	-	2	2	NE
2	40	94	-	3	3	N
3	37	96	-	2	2	NE
4	38	96	-	1	1	E
5	38	96	-	2	2	NW
6	37	95	-	2	2	SE
7	34	98	-	1	1	E
8	33	99	-	2	2	E
9	35	98	-	3	3	E
10	42	92	-	5	5	NE
11	48	77	-	6	6	N
12	51	69	-	7	7	N
1	52	67	-	4	4	NE
2	55	59	-	4	4	N
3	57	57	-	4	4	N
4	57	56	-	4	4	N
5	55	59	-	7	7	NW
6	52	66	-	7	7	NW
7	50	68	-	9	9	NW
8	48	75	-	7	7	NW
9	46	77	-	5	5	NW
10	46	78	-	6	6	N
11	45	78	-	6	6	N
12	45	78	-	5	5	NW

BUCKEYE

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	42	93	-	3	3	N
2	40	95	-	2	2	N
3	40	94	-	4	4	NE
4	40	93	-	4	4	N
5	38	96	-	2	2	NE
6	37	96	-	3	3	NE
7	36	98	-	2	2	N
8	36	98	-	2	2	N
9	39	95	-	0	0	NE
10	42	92	-	1	1	NW
11	47	82	-	1	1	W
12	51	74	-	1	1	SE
1	55	67	-	2	2	NW
2	56	61	-	2	2	NW
3	58	53	-	2	2	N
4	59	50	-	2	2	W
5	58	51	-	2	2	SW
6	53	72	-	2	2	SW
7	48	81	-	1	1	W
8	47	84	-	3	3	NW
9	46	88	-	4	4	N
10	44	92	-	5	5	NW
11	38	95	-	3	3	W
12	42	90	-	5	5	N

MARICOPA

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	41	95	-	2	2	S
2	40	97	-	3	3	S
3	40	97	-	4	4	S
4	39	97	-	3	3	S
5	39	98	-	4	4	S
6	36	98	-	2	2	NW
7	33	99	-	1	1	NE
8	34	100	-	2	2	N
9	36	100	-	1	1	SE
10	41	95	-	3	3	W
11	46	85	-	2	2	W
12	50	78	-	2	2	N
1	53	71	-	2	2	N
2	55	63	-	4	4	N
3	57	54	-	5	5	N
4	58	48	-	4	4	N
5	57	48	-	3	3	NW
6	54	60	-	2	2	NW
7	49	71	-	1	1	NW
8	47	77	-	1	1	W
9	45	83	-	2	2	S
10	44	92	-	2	2	S
11	40	92	-	2	2	S
12	39	93	-	3	3	S

Historical Distribution

5-Yr. Dist. of Values (µg/m³)

MONITORS:	Column Index
1-Nogales PM2.5 FR	Yr - All Data (5-Yrs)
2-Nogales PM2.5 FR	Sea - Data for Winter season only (5-Yrs)
3-Nogales PM2.5 BA	

Cum. Freq.	Mon 1	Mon 2	Mon 3
Min	2	2	1
0.5%	3	2	2
1.0%	3	2	2
2.5%	4	3	3
5%	4	3	3
10%	5	5	5
25%	8	7	7
50%	11	10	10
75%	15	15	16
90%	21	21	24
95%	28	28	29
97.5%	31	32	36
99.0%	47	45	69
99.5%	53	52	86
Max	80	103	141

Flagged Value: 35.8, 37.3, 37.4
 Conclusion: Flagged Value is exceptional in nature (ie greater than 95% of all data)



YUMA

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	43	90	-	3	3	NE
2	45	85	-	3	3	NE
3	42	89	-	2	2	S
4	38	98	-	1	1	SW
5	38	99	-	1	1	SW
6	37	99	-	1	1	SE
7	42	84	-	6	6	NE
8	43	80	-	7	7	NE
9	44	82	-	6	6	NE
10	47	78	-	3	3	N
11	51	61	-	10	10	NE
12	54	58	-	9	9	NE
1	56	54	-	9	9	N
2	58	49	-	9	9	N
3	58	51	-	10	10	NE
4	57	53	-	9	9	NE
5	56	55	-	8	8	NE
6	53	61	-	6	6	NE
7	50	74	-	5	5	NE
8	50	71	-	4	4	NE
9	49	74	-	3	3	N
10	47	76	-	1	1	NW
11	48	69	-	3	3	N
12	48	67	-	3	3	N

PALOMA

Hr	T(F)	RH	Rn	Spd	Max	Dir
1	43	93	-	2	2	S
2	41	94	-	2	2	S
3	38	98	-	2	2	S
4	36	99	-	2	2	N
5	36	99	-	2	2	E
6	37	100	-	2	2	SE
7	36	99	-	2	2	SE
8	35	99	-	1	1	S
9	39	93	-	2	2	SE
10	44	87	-	2	2	E
11	48	82	-	2	2	N
12	53	69	-	3	3	N
1	55	62	-			

Assessment Under the Technical Criteria Document (TCD)

1. Properly qualify and validate the air quality measurement to be flagged. As this was a filter sampling date (1-in-6 run day), data from the continuous and filter based analyzers were examined. The air quality monitoring data were reviewed by ADEQ, the agency responsible for operation of the monitor. All hourly PM₁₀ and PM_{2.5} readings from the Nogales BAMS monitors were found to be valid for December 20th. The three 24-hr measurements from the filter based analyzers were also found to be valid. No specific local sources were reported as significantly contributing to the air quality episode.

2. Review suspected contributing sources. The event began on the evening of December 20th. Contrary to previous international transport events during the fall of 2008, this event was characterized by a significant amount of PM_{2.5} measured during this episode. While this is not typical for the arid southwest, it has become more common when cold temperatures are in place during the Christmas and New Year holidays. It is suspected that these elevated PM_{2.5} concentrations are due to excessive fireplace use during the festive holidays. Lack of any significant transport winds would indicate that the emissions were probably from nearby the monitor. The plot of hourly PM₁₀ and PM_{2.5} concentration data in the upper right corner of Figure 1, in conjunction with the wind direction data, confirms the identical timing of the transport from the south across the border when the elevated PM concentrations began. It is clear from the PM₁₀ and PM_{2.5} data presented in the Event Contribution Analysis table that there was a significant contribution from wood fire smoke. This event appears to have had similar characteristics to the January 1, 2008, and January 1, 2009, episodes. In the January 1st episodes, nearly half of the PM₁₀ concentration could be attributed to fine particulate matter, most likely in the form of smoke. This event saw approximately one-third of the total PM₁₀ concentration as PM_{2.5}.

3. Examine all air quality monitoring information. Data from all monitors in the network were reviewed. Monitors from the Nogales area 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).

4. Examine the meteorological conditions before and during the event. Figure 1 includes a map showing the terrain and drainage patterns of the Nogales area. Cold air forming in the mountains south of the border flows northward into the Santa Cruz River Drainage Basin. National Weather Service (NWS) data from the Nogales Airport, northeast of the city, showed calm to light and variable winds in the evening hours from the east or south. The data from ADEQ’s wind monitor are also included in Figure 1. At the Post Office, winds shifted from north to south at approximately 6:00 p.m. and remained very light. It was at this time that PM concentrations significantly increased. PM₁₀ and PM_{2.5} concentrations remained elevated throughout the remainder of the evening on December 20th, as light winds continued out of the south. It appears the source was coming from Mexico, since there are no sources in the United States between the monitor and the border.

5. Perform a qualitative attribution to emission source(s). All evidence indicates the elevated PM₁₀ and PM_{2.5} concentrations in the Nogales, Arizona area can be attributed to dust and smoke emissions from sources south of Nogales, Arizona in Nogales, Sonora. The data available for this analysis do not allow for development of a source specific emission allocation. The hourly concentration data do not show any significant source other than the drainage smoke associated with the event.

6. Estimation of Contribution from Source or Event. The primary source appears to be drainage dust and smoke from Mexico for which there is no 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 exceedances or violations 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 concentrations at the Nogales Post Office monitor were attributed to an exceptional event caused by international transport of emissions into the United States.

Conclusion

International transport of emissions. The elevated PM₁₀ event on December 20, 2008, in Nogales, Arizona was the result of emissions from Mexico which were transported into the United States in a slow moving drainage flow originating in the mountains south of Nogales, Sonora. The fact that all appropriate SIP control measures were in place and emissions from international transport caused the exceedance demonstrates, per 40 CFR 50.1(j), that the

event “is not reasonably controllable or preventable.” The “other” (RL or IL) flag was applied to the PM_{2.5} measurements as the monitors would have been below the NAAQS but for the contribution of the event. The “other” flag is being used because there is not an appropriate flag available for use in the Air Quality System (AQS) database that describes this event (“international transport”).