Analysis of PM_{10} Exceedances Caused by High Winds
January 1997 – June 2000
Doña Ana County, New Mexico

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Introduction

In a memorandum dated May 30, 1996, Mary D. Nichols of the Environmental Protection Agency (EPA) set forth the agency's policy for violations of the PM_{10} ambient air quality standard which are caused by natural events such as high winds. This policy allows for ambient air quality monitoring data affected by natural events to be excluded from determinations of attainment status, if certain requirements are met. One requirement is that the state or local air quality agency provide adequate documentation to show that the exceedances were caused by natural events and are therefore to be noted as such in the EPA Aerometric Information Retrieval System (AIRS).

In an earlier report, the New Mexico Air Quality Bureau presented an analysis of PM_{10} exceedances occurring during January 1995 – March 1997 in Doña Ana County, New Mexico. This report is an update and extension of that previous report, extending the period of coverage through June 2000 and correcting some information given in the previous report.

PM_{10} monitoring sites in Doña Ana County are listed in Table 1. A list of the exceedances documented in this report as having been caused by high wind is given in Table 2.

The Las Cruces PM_{10} monitoring site (AIRS number 35-013-1006) is not listed in Table 2 because it did not record any exceedances during the period covered by this report. This is the only site in the county which uses only a Wedding-type monitor instead of a continuous TEOM-type monitor, and monitoring is usually on an every-sixth-day schedule.

Corrections and changes to the previous report

This report reflects two kinds of corrections and changes to the previous report: corrections to the data values, and changes in the attributed cause of exceedances at one monitoring site (Santa Teresa).

A number of data values from 1997 onwards have been changed as a result of corrections implemented to remedy a limitation of our data recording system. Short-term periods of high PM_{10} concentration sometimes exceed the maximum recordable value of the data logger which stores and reports the data from TEOM-type monitors. The monitor's own recording system, which is independent of the data logger, has a capacity for greater short-term values and is not affected by this problem. When a daily average was found to be derived from hourly data affected by this problem, corrected daily averages were calculated by substituting data from the monitor's own recording system for the affected hourly data. In some cases where data from the monitor recording system were not available, the value from the data logger has been reported as the best available estimate of the true value. Although some values for the period January 1997 – March 1997 were

not changed by these corrections, for the sake of completeness we have included all exceedances for that period in this report.

In the previous report, PM_{10} exceedances at the Santa Teresa Border Crossing monitoring site during October 1996 – March 1997 were attributed to construction activities and were flagged as such in AIRS. We have since reexamined the PM_{10} and wind data for this site and now believe that these exceedances are more accurately characterized as caused by high wind. Flagging of these exceedances in AIRS has been changed accordingly. Wind data to support our conclusion that these were high wind events are included in the present report.

Climate, Vegetation and Soils

Features of Doña Ana County's natural environment that are conducive to wind erosion and windblown dust generation when high winds occur are: aridity, sparse vegetation cover, and large areas of highly wind-erodible soil. These factors were discussed in detail in the previous report.

High Wind Conditions

In the previous report, a variety of evidence was presented to support the conclusion that PM_{10} exceedances were caused by high winds: wind roses, newspaper reports, time-lapse video photography, and time series plots of hourly PM_{10} concentration and wind speed. In this report, we present what we believe is the most compelling evidence, which is the co-occurrence in time of high winds and high PM_{10} concentrations as demonstrated by time series plots of PM_{10} and wind speed as hourly average and peak gust (see Appendix).

As shown by the example in Fig. 1, a common pattern observed in the time series plots (Appendix) is an abrupt rise in PM_{10} concentrations when wind speed rises above some threshold value, and an equally abrupt fall in PM_{10} when wind speeds fall below the apparent threshold. Depending on site and day, the apparent threshold hourly average wind speed may vary from about 6 meters per second to 12 meters per second or more. Maximum hourly PM_{10} concentration usually occurs in the same hour as maximum wind speed. When wind speeds are below the apparent threshold for a given site and day, PM_{10} concentrations are generally low (<100 micrograms per cubic meter) and vary more or less independently of wind speed.

For comparison, a very different pattern is evident in the time series plots for two exceedances which were not caused by high winds. These exceedances were recorded at Sunland Park City Yard on November 5 (Fig. 2) and November 10 (Fig. 3) of 1999. On these days, hourly average wind speeds never rose above 3 meters per second, and the highest PM_{10} levels occurred in the early morning and evening hours when it is likely that at an atmospheric inversion condition existed. Local fire department personnel suggest

that these exceedances were caused by smoke and dust drifting northward from the Mexican communities of San Geronimo and Anapra, which are adjacent to the international border less than a mile away from the monitoring station.

A minimum threshold of about 6 meters per second (for hourly average wind speed) is in agreement with other studies (Saxton et al, 2000). The apparent wind threshold for dust emission varies because it is affected by many environmental factors, including vegetation cover, soil moisture content, soil particle size distribution, soil structure (crusts and clods), surface roughness. Dust-emitting potential varies over the landscape, so even a shift in wind direction may result in changes in PM_{10} concentration at a monitoring site. The number and variability of factors affecting the threshold (and dust emission at a given wind speed) make it impractical to determine a wind speed which will always distinguish exceedances due to high wind events from those with other causes.

References

Aaboe, Erik. 1997. Analysis of PM_{10} Exceedances, January 1995 – March 1997, Doña Ana County, New Mexico. Report published by Air Quality Bureau, New Mexico Environment Department.

Saxton, K., D. Chandler, L. Stetler, B. Lamb, C. Claiborn, and B.-H. Lee. 2000. Wind erosion and fugitive dust fluxes on agricultural lands in the Pacific northwest. Transactions of the ASAE 43:623-630.

Table 1. PM_{10} monitoring sites in Doña Ana County; only Wedding monitor at Las Cruces, all others with continuous (TEOM) monitor.

Site Name	Start	End	AIRS Number	Lat (d-m-s)	Long (d-m-s)
Roadrunner	3/1/88	...	35-013-0018	32-20-30.64	106-45-37.07
Holman*	10/25/95	...	35-013-0019	32-25-29.69	106-40-26.62
Chaparral*	2/20/96	...	35-013-0020	32-02-27.48	106.24-33.09
Anthony	3/1/88	...	35-013-0016	32-00-11.54	106-35-57.67
Sunland Park*	2/21/89	...	35-013-0017	31-47-49.91	106-33-24.17
Desert View	2/13/96	5/27/98	35-013-0021	31-47-46.32	106-35-02.13
Santa Teresa*	1/19/96	5/27/98	35/013-0022	31-47-15.77	106-40-58.36
La Union**	1/1/79	...	35-013-0008	31-55-06.03	106-37-58.99
Las Cruces	11/18/89	...	35-013-1006	32-19-08	106-46-16

* meteorological monitoring at these sites
** no PM_{10} monitoring, meteorological monitoring data is used for comparison with Anthony PM_{10}

Table 2. PM_{10} exceedances documented in this report as resulting from high wind. Values are 24-hour average PM_{10} concentrations in micrograms per cubic meter.

	SITE						
DATE	Roadrunner	Holman	Chaparral	Anthony	Sunland Park	Desert View	Santa Teresa
1996							
3-Oct							294
18-Oct							268
21-Oct							201
25-Oct							215
27-Nov							181
1997							
3-Jan			237				
12-Jan							594
13-Jan							360
6-Feb				217			162
24-Feb		208		192	227	492	1264
25-Feb							183
28-Feb					190	307	452
12-Mar							167
14-Mar							215
24-Mar			157	157			
25-Mar				158			
30-Mar							179
9-Apr						241	184
10-Apr			405	314	314	445	458
24-Apr			201	248	428	593	658
9-May				168			164
26-Jun							221
4-Jul				175		224	351
6-Jul							190
20-Sep		161				227	486
1998							
3-Feb		331		231			173
7-Feb			350				
16-Feb			275				
24-Feb	408	429		528	562	1033	334
26-Feb			360				
27-Feb			303				
7-Mar	211		462		246	242	251
11-Mar							196
26-Mar	240	161	1841*	205	320	375	191
2-Apr			330				
6-Apr			356				
12-Apr			519	237	248	274	232
15-Apr			197				
21-Apr							
25-Apr			165	208	175	201	168
8-May		176	267	156	162	189	

	SITE						
DATE	Roadrunner	Holman	Chaparral	Anthony	Sunland Park	Desert View	Santa Teresa
4-Jun			369				
9-Nov	206	173	445	385	432		
10-Dec				169			
1999							
20-Jan			247				
21-Jan	458	286	1013	238	354		
10-Feb			211	189	254		
7-Mar	251	478	415	454	394		
1-Apr	379	523	367	451	338		
2-Apr	406	444	661	483	471		
4-Apr			502	266	232		
7-Apr	570	713	396	505	451		
9-Apr		224			203		
21-Apr				168	236		
22-Apr		226	364	358	422		
3-May	159	248	297	238	322		
4-May	281	448	734	459	281		
4-Jun		187	164	188	235		
3-Dec			233	219	200		
8-Dec			186	205	177		
2000							
17-Feb		234	356	300	300		
24-Feb					247		
25-Feb		182					
28-Feb			217	237	322		
7-Mar					204		
18-Mar			311	297			
20-Mar	206	259	231	498	188		
7-Apr		187		199	222		
8-Apr				212	295		
14-Apr			327				
15-Apr			199				
18-Apr			165	176	157		
19-Apr			194				
22-Apr		216	373				
11-May			289	235			
15-May		155					
16-May			189	179	155		
30-May			259				
31-May		157		200			

*Appears as 1550 micrograms per cubic meter in AIRS because maximum recordable hourly value in AIRS was exceeded.

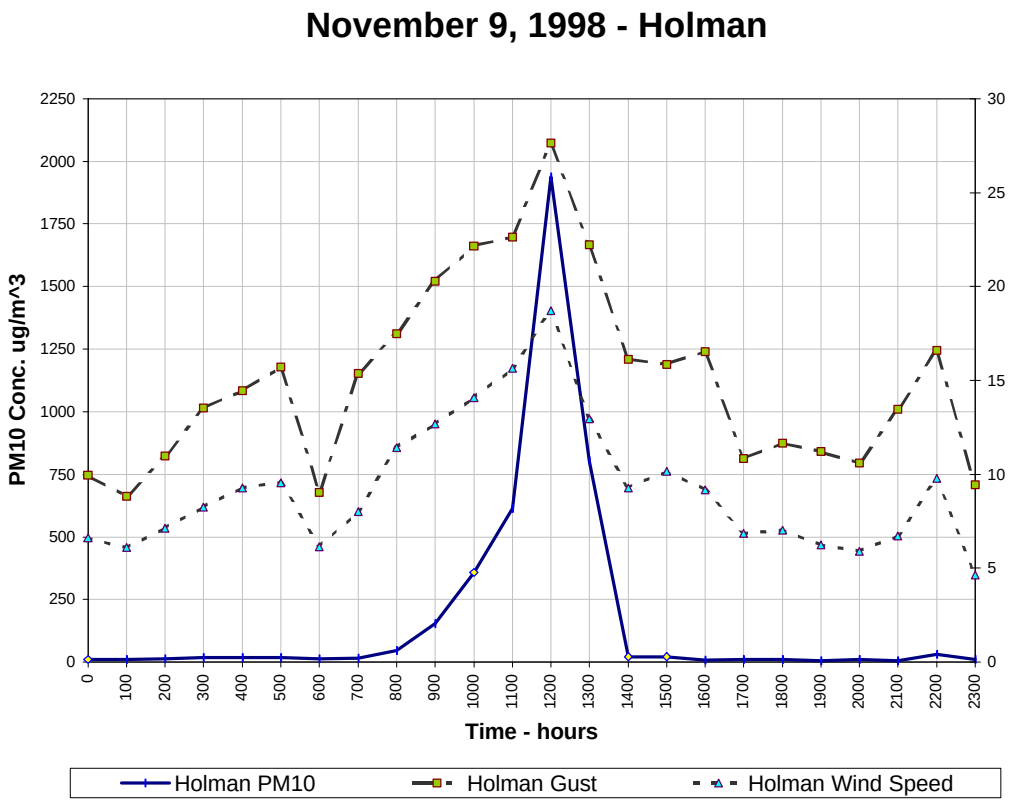

Figure 1. Example of an exceedance caused by high wind: hourly average PM_{10} concentration, hourly average wind speed, and peak gust for Holman monitoring site, November 8, 1998.

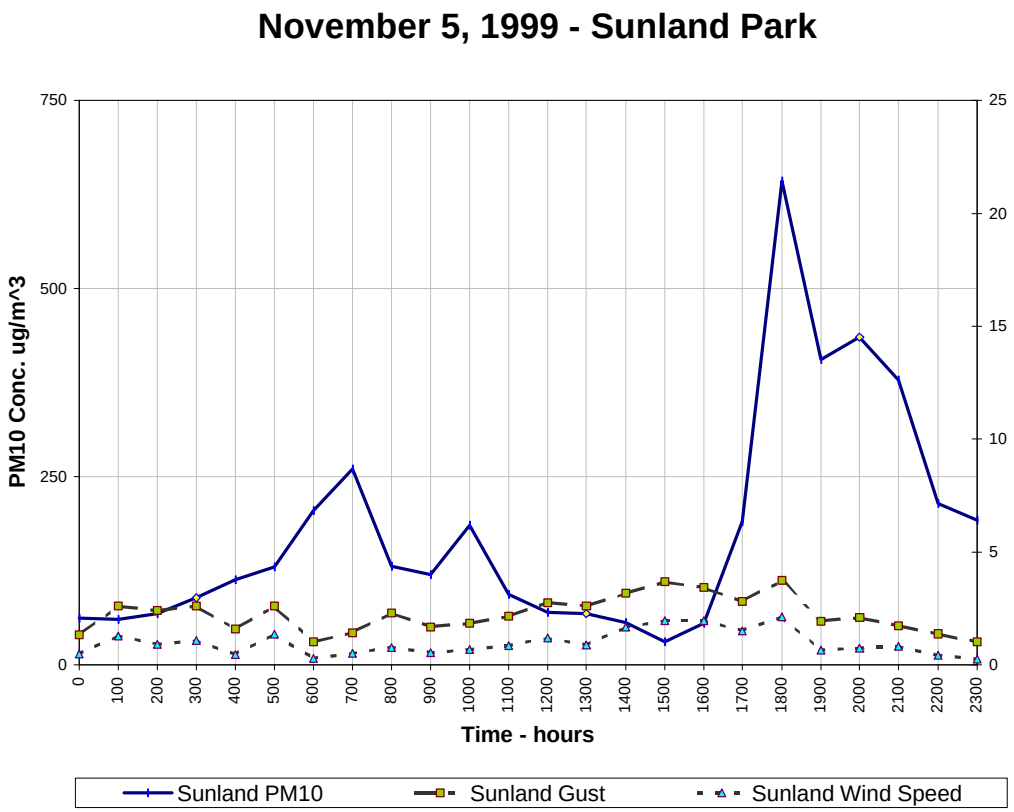

Figure 2. Example of an exceedance not caused by high wind: hourly average PM_{10} concentration, hourly average wind speed, and peak gust for Sunland Park monitoring site, November 5, 1999.

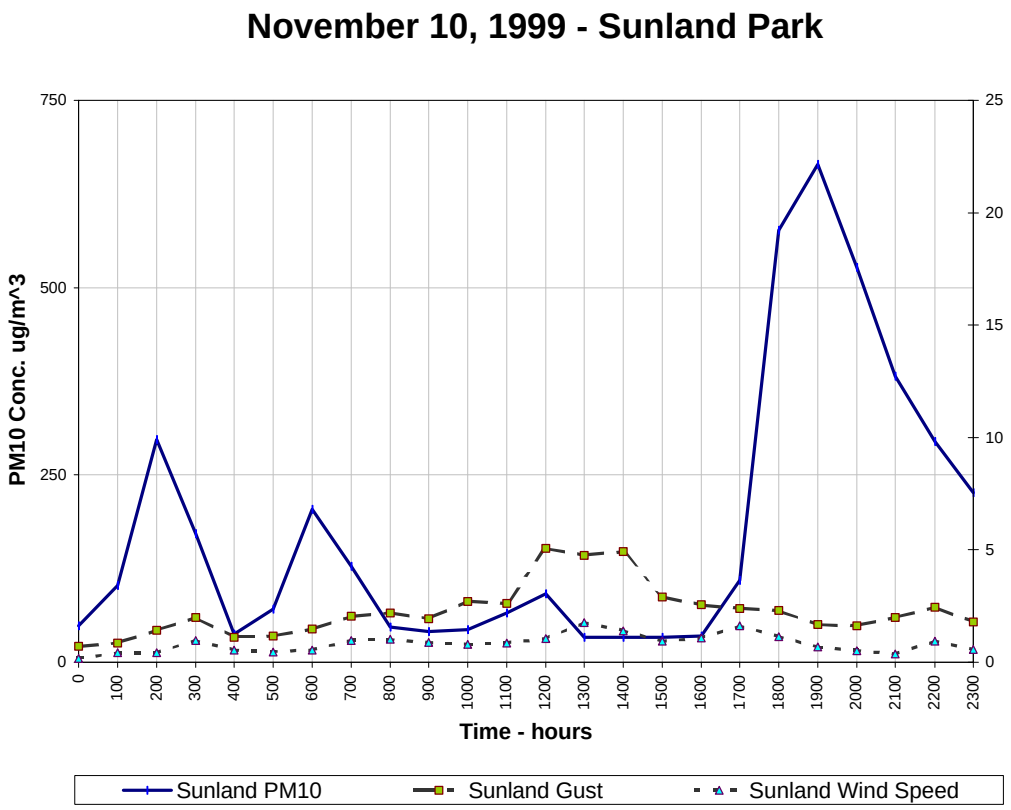

Figure 3. Example of an exceedance not caused by high wind: hourly average PM_{10} concentration, hourly average wind speed, and peak gust for Sunland Park monitoring site, November 10, 1999.