Technical Support Document For the November 5, 2011, Lamar Exceptional Event

Colorado Department of Public Health and Environment

Prepared by the Technical Services Program
Air Pollution Control Division
Colorado Department of Public Health and Environment

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Executive Summary

In 2005, Congress identified a need to account for events that result in exceedances of the National Ambient Air Quality Standards (NAAQS) that are exceptional in nature[1] (e.g., not expected to reoccur or caused by acts of nature beyond man-made controls). In response, EPA promulgated the Exceptional Events Rule (EER) to address exceptional events in 40 CFR Parts 50 and 51 on March 22, 2007 (72 FR 13560). On May 2, 2011, in an attempt to clarify this rule, EPA released draft guidance documents on the implementation of the EER to State, tribal and local air agencies for review. The EER allows for states and tribes to "flag" air quality monitoring data as an exceptional event and exclude those data from use in determinations with respect to exceedances or violations of the NAAQS, if EPA concurs with the demonstration submitted by the flagging agency.

Due to the semi-arid nature of parts of the state, Colorado is highly susceptible to windblown dust events. These events are often captured by various air quality monitoring equipment throughout the state, sometimes resulting in exceedances or violations of the 24-hour PM_{10} NAAQS. This document contains detailed information about the large regional windblown dust event that occurred on November 5, 2011. The Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) has prepared this report for the U.S. Environmental Protection Agency (EPA) to demonstrate that the elevated PM_{10} concentrations were caused by a natural event.

On November 5 of 2011, a powerful autumn storm system caused an exceedance of the twenty-four hour PM_{10} standard in Lamar, Colorado, at the Power Plant monitor with a concentration of 192 $\mu g/ m^3$. This high reading and other twenty-four hour PM_{10} concentrations on November 5 across the southwestern United States are plotted on the map in Figure 1.

On November 5, 2011, the twenty-four-hour PM_{10} sample at Lamar Power (192 $\mu g/m^3$) exceeded the 99^{th} percentile value for any evaluation criteria and is the maximum value for all 2011 data. The statistical and meteorological data clearly shows that but for this high wind blowing dust event, Lamar would not have exceeded the 24-hour NAAQS on November 5, 2011. Since at least 2005, there has not been an exceedance that was not associated with high winds carrying PM_{10} dust from distant sources in Lamar. This is evidence that the event was associated with a measured concentration in excess of normal historical fluctuations including background.

The exceedance in Lamar was the result of a combination of synoptic and mesoscale weather events which generated very intense surface winds. In the synoptic scale, high winds were produced throughout much of the region displayed in Figure 1 by a vigorous cold front and surface low pressure system associated with an upper-level trough. The surface winds were predominantly out of a south to southwesterly direction and moved over dry soils that stretched from southeast Colorado southward into northern Mexico. Contributing at the smaller mesoscale were very strong outflow winds from collapsing thunderstorms in southeast Colorado and northeast New Mexico. This storm system transported PM_{10} dust into the southeastern portion of Colorado.

EPA's June 2012, Draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule states, "the EPA will accept a threshold of a sustained wind of 25 mph for areas in the west provided the agencies support this as the level at which they expect stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed…". In addition, in Colorado it has been shown that

[1] Section 319 of the Clear Air Act (CAA), as amended by section 6013 of the Safe Accountable Flexible Efficient-Transportation Equity Act: A Legacy for Users (SAFE-TEA-LU of 2005, required EPA to propose the Federal Exceptional Events Rule (EER) no later than March 1, 2006.

wind speeds of 30 mph or greater and gusts of 40 mph or greater can cause blowing dust (see Appendix A - *Lamar, Colorado, Blowing Dust Climatology* at the end of this report and the reference for the Technical Support Document for the April 3, 2009, Pagosa Springs Exceptional Event). For this blowing dust event, it has been assumed that sustained winds of 30 mph and higher or wind gusts of 40 mph and higher can cause blowing dust in southeast Colorado and the eastern half of New Mexico.

The Albuquerque, Flagstaff and Pueblo National Weather Service (NWS) forecast offices issue weather warnings and advisories for northeast Arizona, most of New Mexico and south-central and southeast Colorado. Several weather warnings, advisories and short-term forecasts issued by theses offices on November 5, 2011, are presented in Appendix B. It is evident from these text products that strong winds and areas of blowing dust were anticipated across the region on November 5.

The blowing dust climatology for Lamar (Appendix A) indicates that the Lamar area can be susceptible to blowing dust when winds are high. Landform imagery shows that northeastern Arizona and southeastern Utah in particular have experienced a long-term pattern of wind erosion and blowing dust when winds have been southwesterly and blowing into Colorado. Forecast products from the Navy Aerosol Analysis and Prediction System model provide evidence for a regional blowing dust event, suggesting that significant source regions for dust in Lamar were located in New Mexico and southeast Colorado. NOAA HYSPLIT forward and backward trajectories provide clear supporting evidence that dust from arid regions of southeast Colorado along with other areas further to the south and southwest which were experiencing extreme to exceptional drought conditions caused or contributed to the PM_{10} exceedances measured in Lamar on November 5, 2011.

The Drought Monitor reports for the western and southern United States as of November 1, 2011 (Figure 22 and Figure 23, respectively), reveal that drought conditions were widespread across southeast Colorado and points to the south and southwest just a few days before the November 5, 2011, dust event. This includes nearly all of New Mexico, Texas and the Oklahoma Panhandle. In fact, large portions of the region were classified as being in an "Exceptional" drought. Soils in southeast Colorado and areas upwind to the south and southwest were dry enough to produce blowing dust when winds were above the thresholds for blowing dust.

The surface weather associated with the storm system of November 5, 2011, is presented in Figure 2, Figure 3 and Figure 4; the surface analyses for 5 AM, 11 AM and 5 PM MST, respectively. The most significant surface features during this period of time included a cold front that swept across Colorado and the Desert Southwest. Additionally, an area of surface low pressure intensified along this cold front and moved through eastern Colorado. Surface weather maps show evidence of blowing dust and winds above the threshold speeds for blowing dust on November 5.

MODIS satellite imagery shows that southeast Colorado and points to the south and southwest of Colorado were source regions for blowing dust in Lamar on November 5, 2011. This is consistent with the climatology for many dust storms in Lamar as described in Appendix A at the end of this document. The observations of winds above blowing dust thresholds and restricted visibilities in the areas of concern demonstrate that this is a natural event that cannot be reasonably controlled or prevented.

Friction velocities provide a measure of the near-surface meteorological conditions necessary to cause blowing dust. Frictional velocity values were at or above the blowing dust threshold across much of southeast Colorado on November 5, 2011. The elevated friction velocities shown in Figure 33, the data on soil moisture conditions presented elsewhere in this report and the prevalence of winds above blowing dust thresholds (all occurring in traditional source regions in southeast Colorado and areas to the south and southwest of Colorado) prove that this dust storm was a natural event that was not reasonably controllable or preventable.

The PM_{10} exceedance in Lamar on November 5, 2011, would not have occurred if not for the following: (a) dry soil conditions over southeast Colorado, southern and eastern New Mexico, western Texas, and northern Mexico with 30-day precipitation totals below were near or below 0.5 inches (Figure 20 and Figure 21); (b) a combination of synoptic and mesoscale weather events; (In the synoptic scale, high winds were produced throughout much of the region by a vigorous cold front and surface low pressure system associated with an upper-level trough. Contributing at the smaller mesoscale were very strong outflow winds from collapsing thunderstorms.) (c) friction velocities over a wide area of southeast Colorado, southern and eastern New Mexico, western Texas and northern Mexico that were high enough to allow entrainment of dust from natural sources with subsequent transport of the dust to southeastern Colorado in strong winds.

These PM_{10} exceedances were due to an exceptional event associated with regional windstorm-caused emissions from erodible soil sources over southern and eastern New Mexico, western Texas, and northern Mexico. These sources are not reasonably controllable during a significant windstorm under abnormally dry or exceptional drought conditions.

APCD is requesting concurrence on exclusion of the PM_{10} value from the Lamar Power Plant (08-099-0001) on November 5, 2011.

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1.0 Exceptional Events Rule Requirements

In addition to the technical requirements that are contained within the EER, procedural requirements must also be met in order for EPA to concur with the flagged air quality monitoring data. This section of the report lays out the requirements of the EER and discusses how the APCD addressed those requirements.

1.1 Procedural Criteria

This section presents a review of the procedural requirements of the EER as required by 40 CFR 50.14 (Treatment of Air Quality Monitoring Data Influenced by Exceptional Events) and explains how APCD fulfills them.

The Federal EER requirements include public notification that an event was occurring, the placement of informational flags on data in EPA's Air Quality System (AQS), submission of initial event description, the documentation that the public comment process was followed, and the submittal of a demonstration supporting the exceptional events flag. ACPD has addressed all of these procedural and documentation requirements.

Public notification that event was occurring (40 CFR 50.14(c)(1)(i))
Warnings and advisories issued by the Albuquerque, Lubbock and Pueblo National Weather Service along with local storm and roads reports show that very strong winds and areas of blowing dust were expected and experienced across this region on November 5, 2011. CDPHE issued advisories can be viewed at: http://www.colorado.gov/airquality/report.aspx and are included in Appendix B.

Place informational flag on data in AQS (40 CFR 50.14(c)(2)(ii))
APCD and other applicable agencies in Colorado submit data into EPA's AQS. Data from both filter-based and continuous monitors operated in Colorado are submitted to AQS.

When APCD and/or another agency operating monitors in Colorado suspects that data may be influenced by an exceptional event, APCD and/or the other operating agency expedites analysis of the filters collected from the potentially-affected filter-based air monitoring instruments, quality assures the results and submits the data into AQS. APCD and/or other operating agencies also submit data from continuous monitors into AQS after quality assurance is complete.

If APCD and/or the applicable operating agency have determined a potential exists that the sample value has been influenced by an exceptional event, a preliminary flag is submitted for the measurement when the data is uploaded to AQS. The data are not official until they are certified by May 1st of the year following the calendar year in which the data were collected (40 CFR 58.15(a)(2)). The presence of the flag can be confirmed in AQS.

Notify EPA of intent to flag through submission of initial event description by July 1 of calendar year following event (40 CFR 50.14(c)(2)(iii))
In early 2011, APCD and EPA Region 8 staff agreed that the notification of the intent to flag data as an exceptional event would be done by submitting data to AQS with the proper flags and the initial event descriptions. This was deemed acceptable, since Region 8 staff routinely pull the data to review for completeness and other analyses.

On November 5, 2011, one sample value greater than 150 $\mu g/m^3$ was taken at Lamar Power Plant monitor (SLAMS) during the high wind event that occurred that day. This monitor is operated by APCD in partnership with local operators.

Document that the public comment process was followed for event documentation (40 CFR 50.14(c)(3)(iv))
APCD posted this report on the Air Pollution Control Division's webpage for public review. APCD opened a 30-day public comment period on November 20, 2013. A copy of the public notice certification (in cover letter), along with any comments received, will be submitted to EPA, consistent with the requirements of 40 CFR 50.14(c)(3)(iv).

Submit demonstration supporting exceptional event flag (40 CFR 50.14(a)(1-2))
At the close of the comment period, and after APCD has had the opportunity to consider any comments submitted on this document, APCD will submit this document, along with any comments received (if applicable), and APCD's responses to those comments to EPA Region VIII headquarters in Denver, Colorado.

1.2 Documentation Requirements

Section 50.14(c)(3)(iv) of the EER states that in order to justify excluding air quality monitoring data, evidence must be provided for the following elements:

a. The event satisfies the criteria set forth in 40 CFR 501(j) that:
   (1) the event affected air quality,
   (2) the event was not reasonably controllable or preventable, and
   (3) the event was caused by human activity unlikely to recur in a particular location or was a natural event;

b. There is a clear causal relationship between the measurement under consideration and the event;

c. The event is associated with a measured concentration in excess of normal historical fluctuations; and

d. There would have been no exceedance or violation but for the event.

2.0 Meteorological analysis of the November 5, 2011, blowing dust event and PM_{10} exceedance – Conceptual Model and Wind Statistics

On November 5 of 2011, a powerful autumn storm system caused an exceedance of the twenty-four hour PM_{10} standard in Lamar, Colorado, at the Power Plant monitor with a concentration of 192 µg/ m^3. This high reading and other twenty-four hour PM_{10} concentrations on November 5 across the southwestern United States are plotted on the map in Figure 1. The exceedance in Lamar was the result of a combination of synoptic and mesoscale weather events which generated very intense surface winds. In the synoptic scale, high winds were produced throughout much of the region displayed in Figure 1 by a vigorous cold front and surface low pressure system associated with an upper-level trough. The surface winds were predominantly out of a south to southwesterly direction and moved over dry soils that stretched from southeast Colorado southward into northern Mexico. Contributing at the smaller mesoscale were very strong outflow winds from collapsing thunderstorms in southeast Colorado and northeast New Mexico. This series of events led to the occurrence of blowing dust in and around Lamar during the late morning and early afternoon hours of November 5, 2011.

EPA's June 2012, Draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule states,"the EPA will accept a threshold of a sustained wind of 25 mph for areas in the west provided the agencies support this as the level at which they expect stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed…". In addition, in Colorado it has been shown that wind speeds of 30 mph or greater and gusts of 40 mph or greater can cause blowing dust (see Appendix A - Lamar, Colorado, Blowing Dust Climatology at the end of this report and the reference for the Technical Support Document for the April 3, 2009, Pagosa Springs Exceptional Event). For this blowing dust event, it has been assumed that sustained winds of 30 mph and higher or wind gusts of 40 mph and higher can cause blowing dust in southeast Colorado and the eastern half of New Mexico.

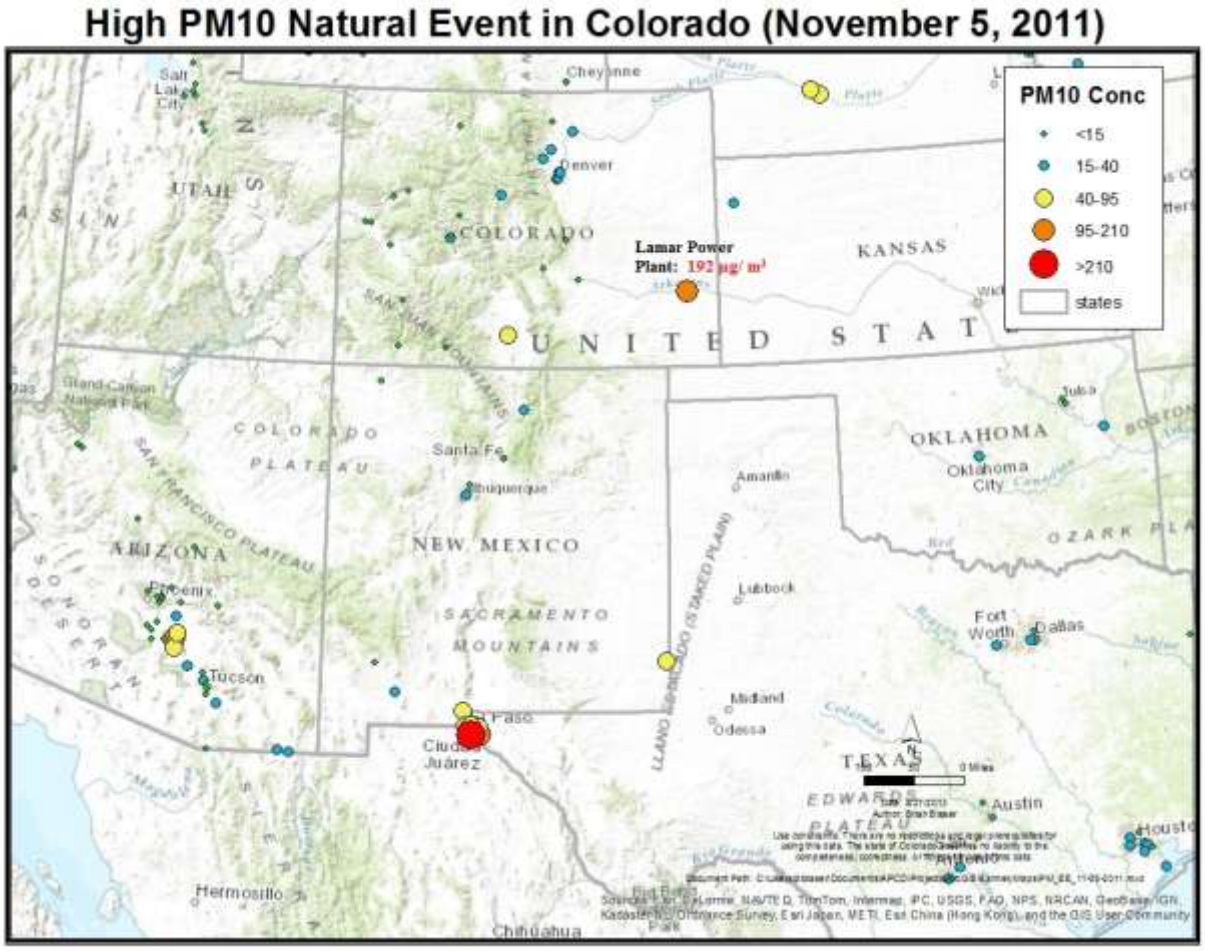


Figure 1: 24-hour PM_{10} concentrations for November 5, 2011.
(data source: http://webapps.datafed.net/datafed.aspx?dataset=AQS_D&parameter=pm10)

The surface weather associated with the storm system of November 5, 2011, is presented in Figure 2, Figure 3 and Figure 4; the surface analyses for 5 AM, 11 AM and 5 PM MST, respectively. Significant surface features during this period of time included a cold front that swept across Colorado and the Desert Southwest. Additionally, an area of surface low pressure intensified along this cold front and moved through eastern Colorado.

The upper level trough associated with this storm system is shown in Figure 5 through Figure 8. Figure 5 and Figure 6 show the 700-mb height analysis maps for 5 AM and 5 PM MST on November 5, 2011, while Figure 7 and Figure 8 display the 500 mb height analysis maps for the same time period. The 700 mb level is roughly 3 kilometers above mean sea level (MSL) and the 500 mb level is generally located approximately 6 kilometers above MSL. These four charts show that a deep trough of low pressure was present in the upper levels of the atmosphere preceding and during the blowing dust event of November 5, and that it was moving over the southwestern United States.

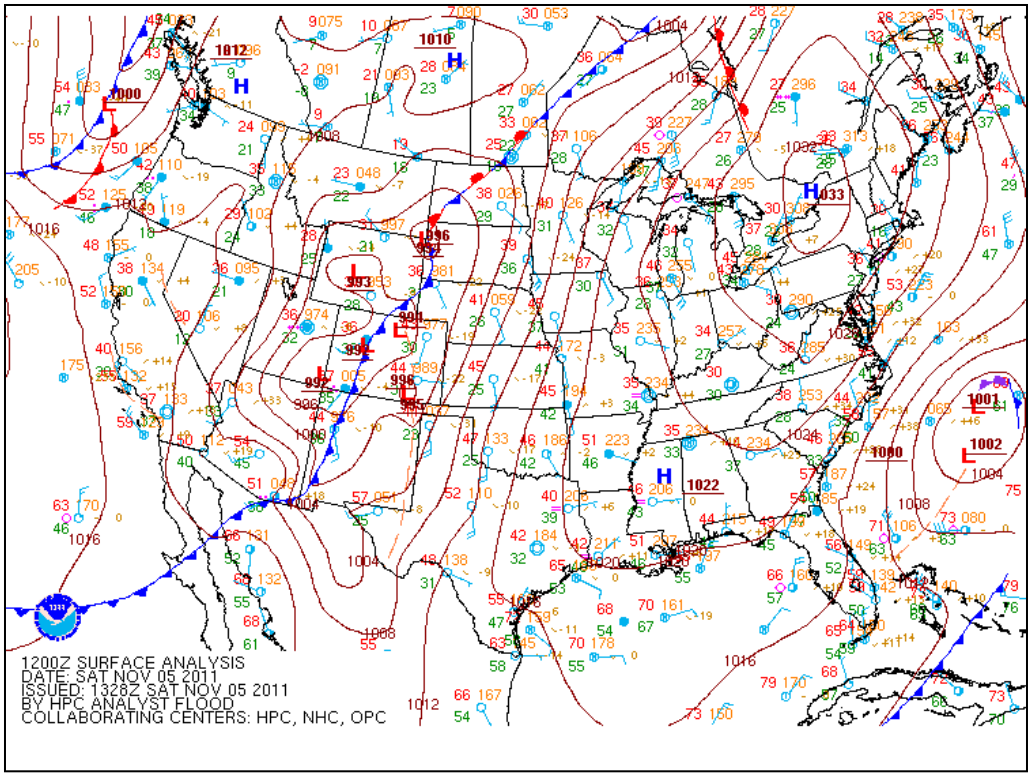


Figure 2: Surface Analysis for 12Z November 5, 2011, or 5 AM MST November 5, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

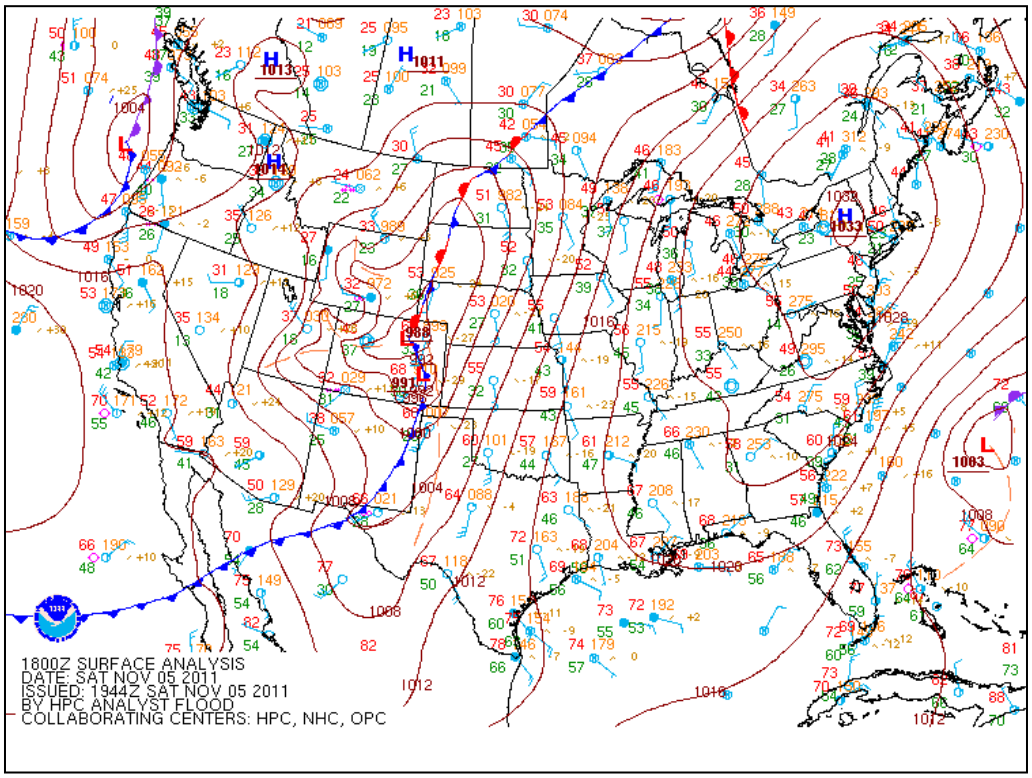


Figure 3: Surface Analysis for 18Z November 5, 2011, or 11 AM MST November 5, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

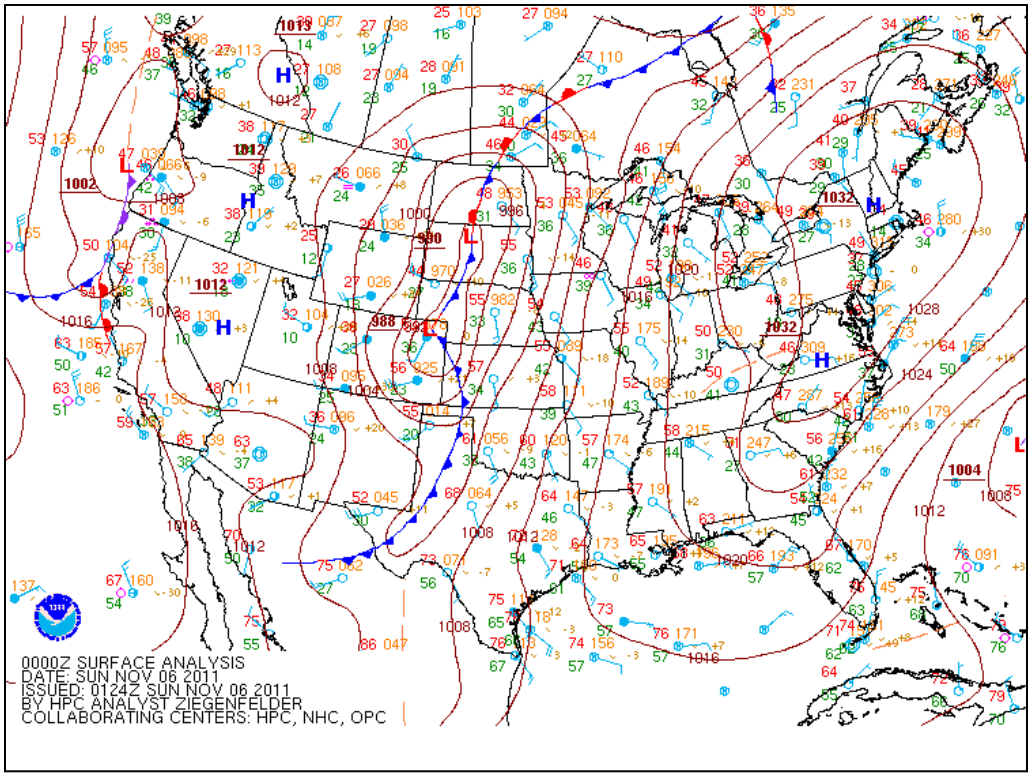


Figure 4: Surface Analysis for 00Z November 6, 2011, or 5 PM MST November 5, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

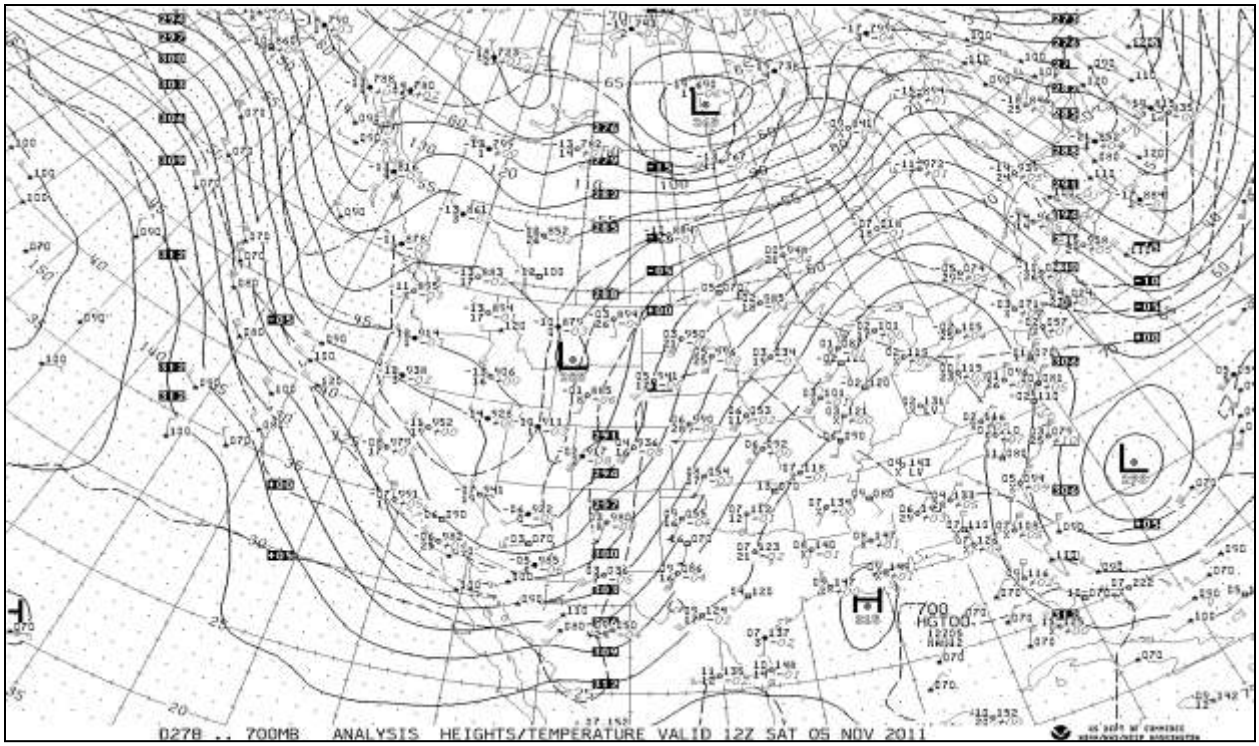


Figure 5: 700 mb (about 3 kilometers above mean sea level) analysis for 12Z November 5, 2011, or 5 AM MST November 5, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

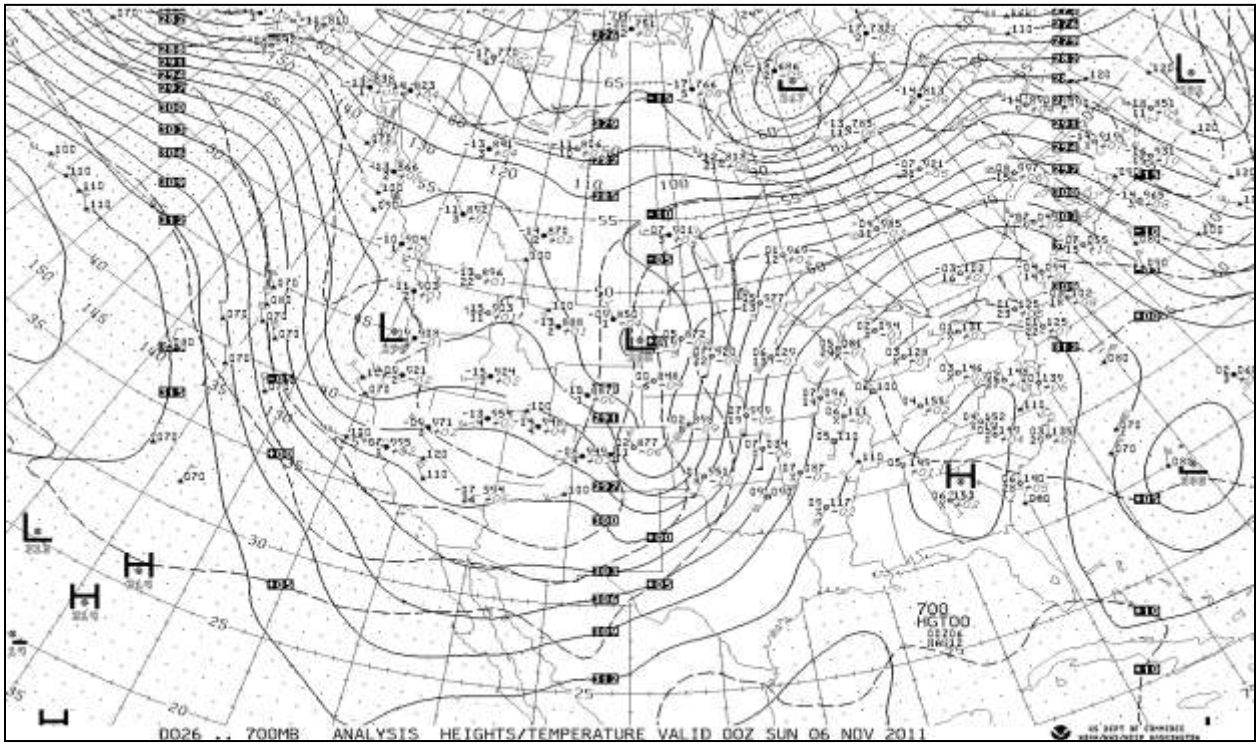


Figure 6: 700 mb (about 3 kilometers above mean sea level) analysis for 00Z November 6, 2011, or 5 PM MST November 5, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

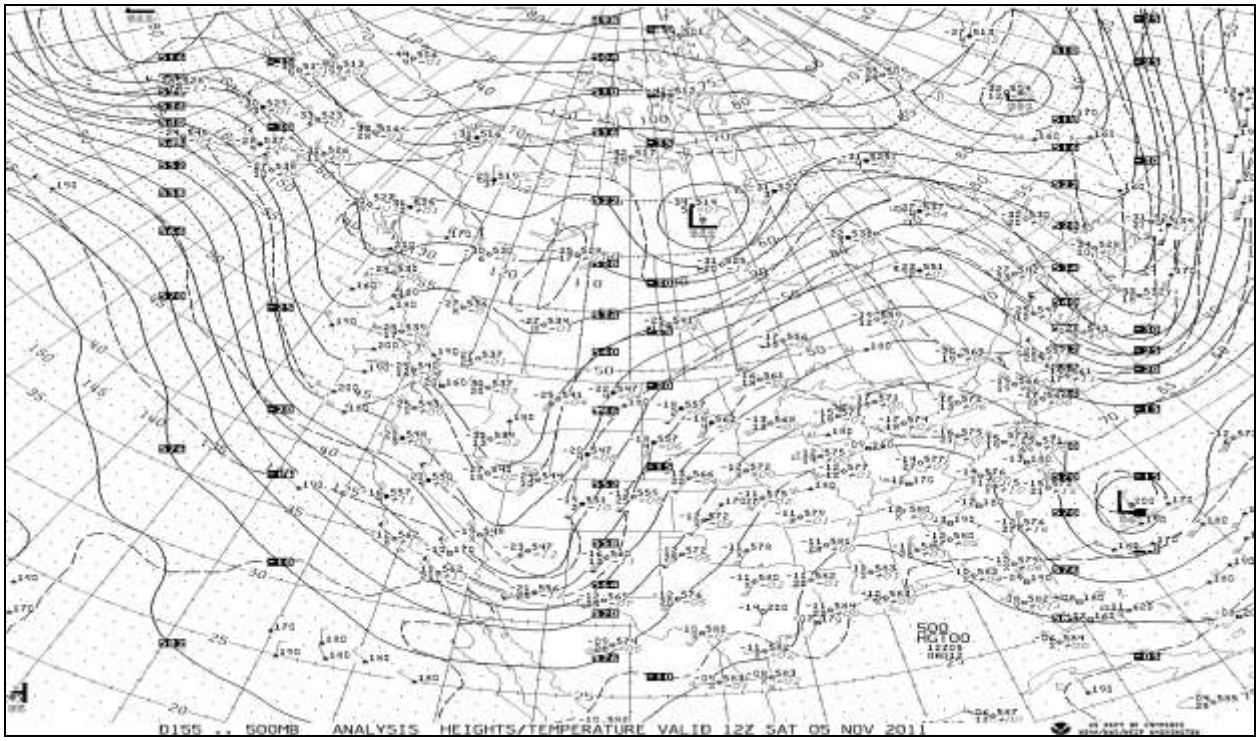


Figure 7: 500 mb (about 6 kilometers above mean sea level) analysis for 12Z November 5, 2011, or 5 AM MST November 5, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

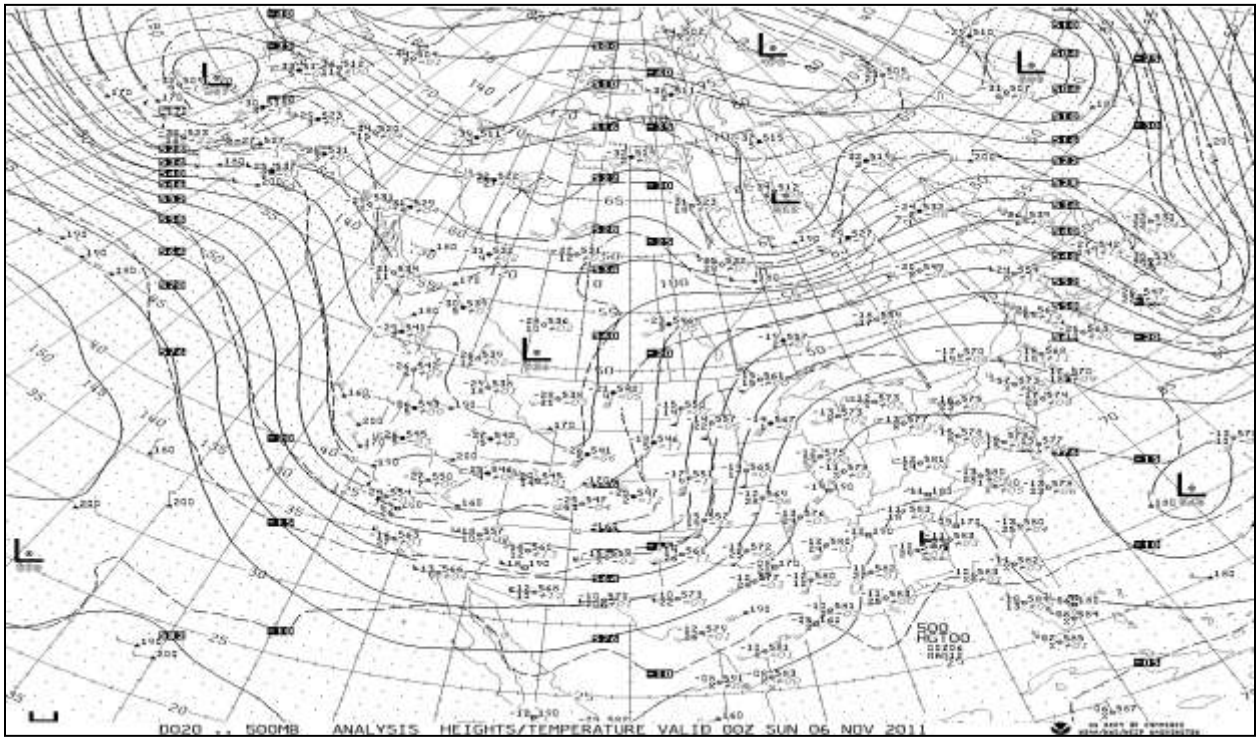


Figure 8: 500 mb (about 6 kilometers above mean sea level) analysis for 00Z November 6, 2011, or 5 PM MST November 5, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

In order to fully evaluate the synoptic meteorological scenario of November 5, 2011, regional weather maps were derived from individual station observations during the height of the event in question. Figure 9 provides a reference map containing the location of all the stations utilized for this analysis. Lamar is denoted in bold and caps.

Figure 10 through Figure 12 present the surface stations from Figure 9 and the corresponding weather observations for 10:13 AM, 11:36 AM and 12:40 PM MST on November 5, 2011, respectively. The observations include surface wind direction (the direction from which the wind is blowing in degrees; e.g., 225 would represent a southwesterly wind, and 315 would represent a northwesterly wind) and sustained speed and gusts (mph) in blue, visibility (statute miles) in red and observed weather in black (if applicable). These maps cover southeast Colorado and areas of New Mexico, Texas, Oklahoma and Kansas that experienced winds which were intense enough to create blowing dust based on the criteria established earlier in this paper. These surface analyses illustrate that winds above 30 mph with gusts above 40 mph occurred in many areas that were in advance of the cold front and in the wake of the cold front shown in Figure 2 through Figure 4.

On the map in Figure 10 the station observation for Raton, New Mexico, located less than 10 miles south of the Colorado state line in northeast New Mexico, shows winds sustained at 40 mph, gusts to 61 mph, and a reduced visibility of 5 statute miles with the weather symbol of infinity (∞). The infinity sign is the weather symbol for haze. Haze is often reported during dust storms, and in dry and windy conditions haze typically refers to blowing dust (see the following link for the description of haze published by the National Oceanic and Atmospheric Administration (NOAA): http://www.crh.noaa.gov/lmk/?n=general_glossary). At this time, Lamar was reporting sustained winds of only 22 mph with gusts to 29 mph and no decrease in visibility (10 statute miles).

However at 11:36 AM MST (Figure 11), Lamar reported a significant increase in wind speed to 54 mph with gusts to 68 mph. Haze was also observed at this time with visibility being reduced to 5 statute miles. Visibility briefly recovered to 8 statute miles before a second round of haze was reported in Lamar a little over an hour later (12:40 PM MST, Figure 12) with winds sustained at 45 mph, gusts to 58 mph and visibility decreasing again to 6 statute miles. Additional surface weather maps not included here show that high winds and haze were also reported in other parts of Colorado, New Mexico, Texas and Kansas.

Surface weather maps show evidence of blowing dust and winds above the threshold speeds for blowing dust on November 5, 2011.

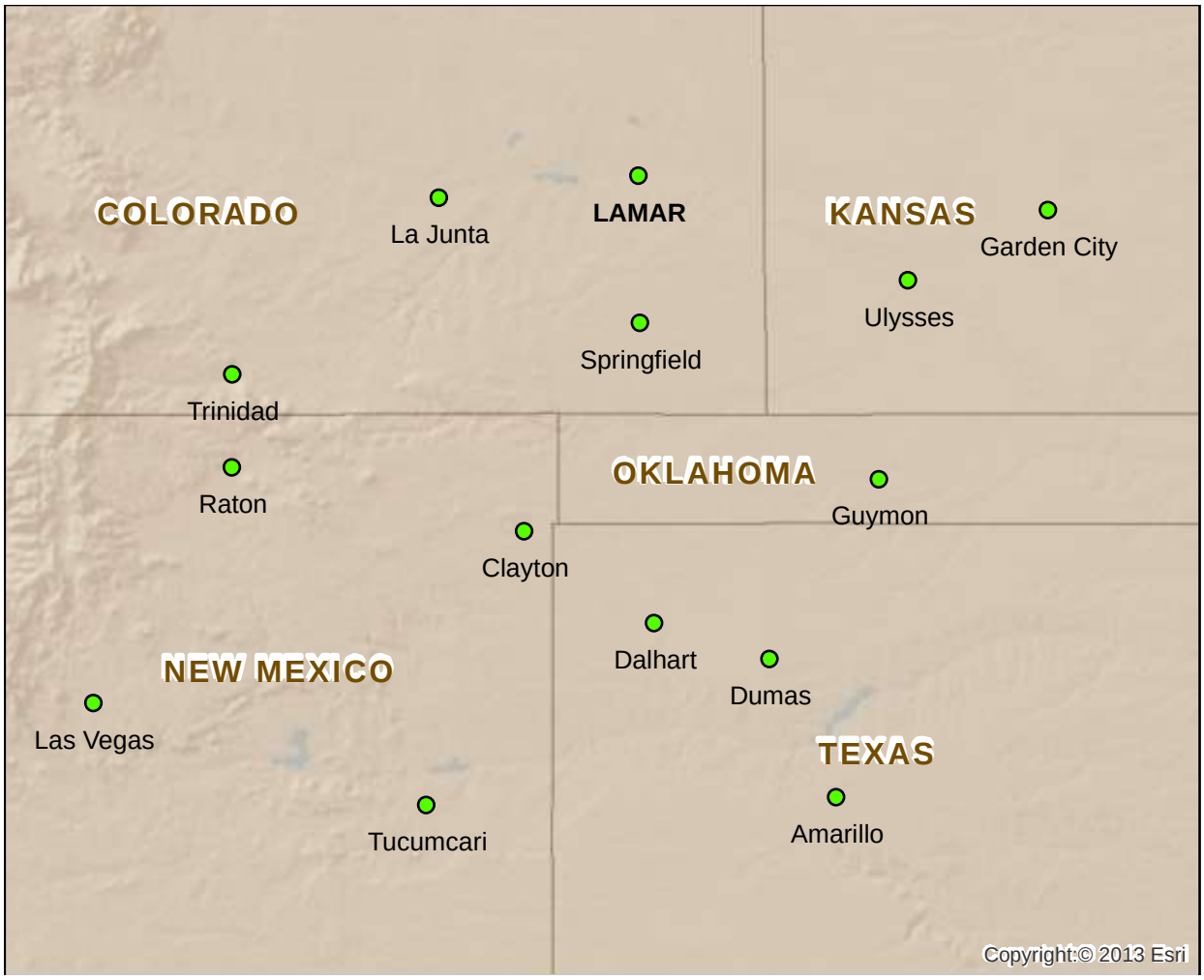


Figure 9: Weather observation stations for November 5, 2011, synoptic meteorological analysis.

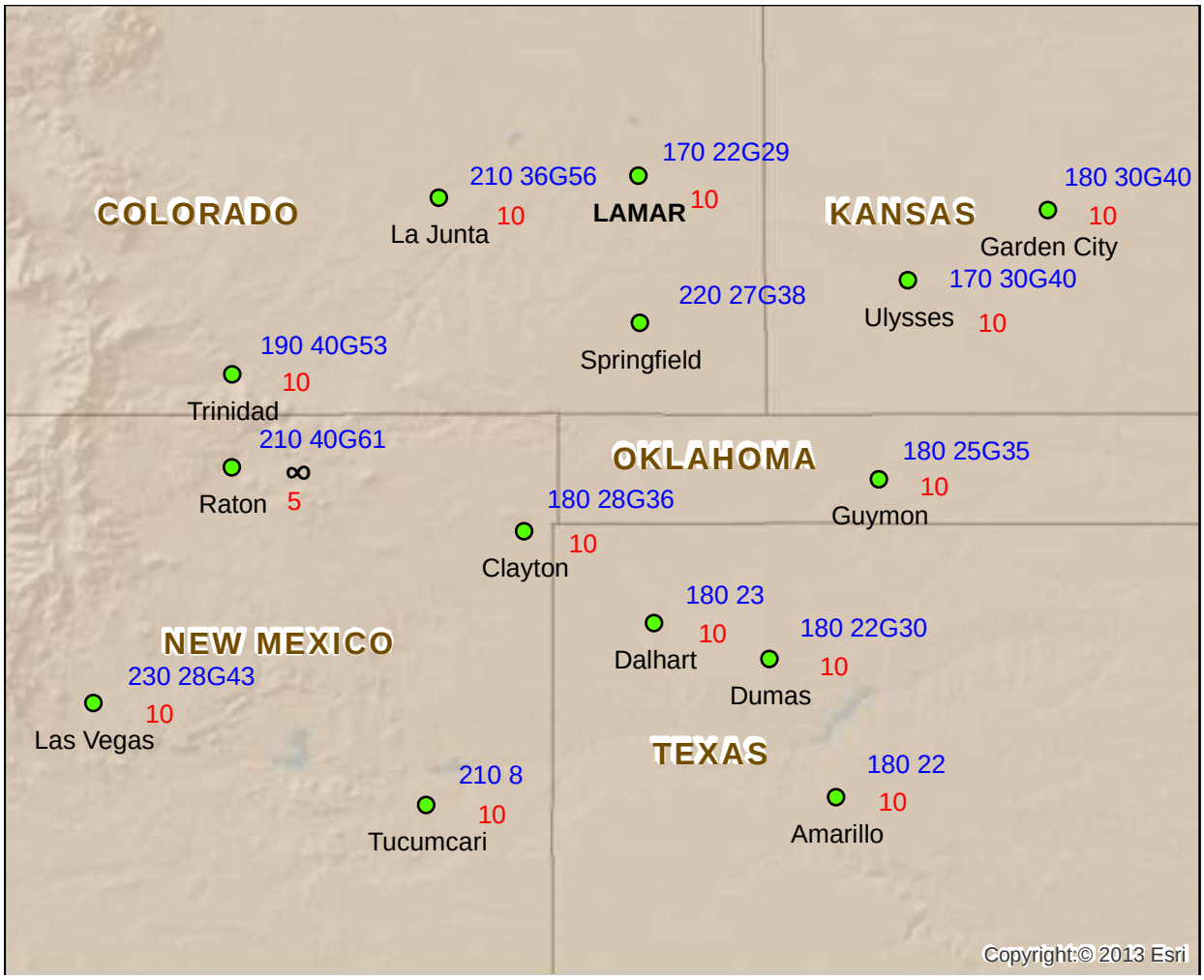


Figure 10: Surface Analysis for 10:13 AM MST (1713Z), November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

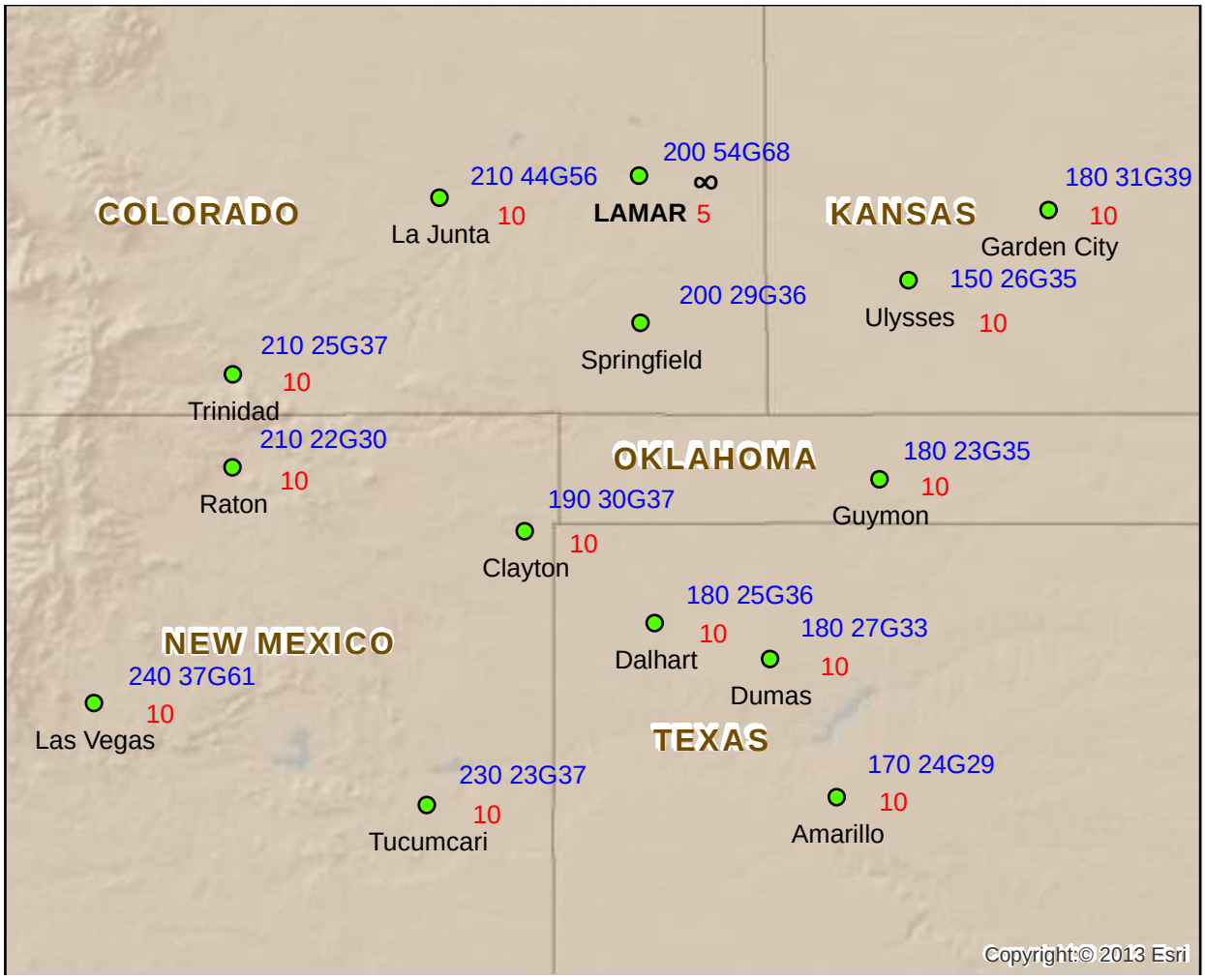


Figure 11: Surface Analysis for 11:36 AM MST (1836Z), November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

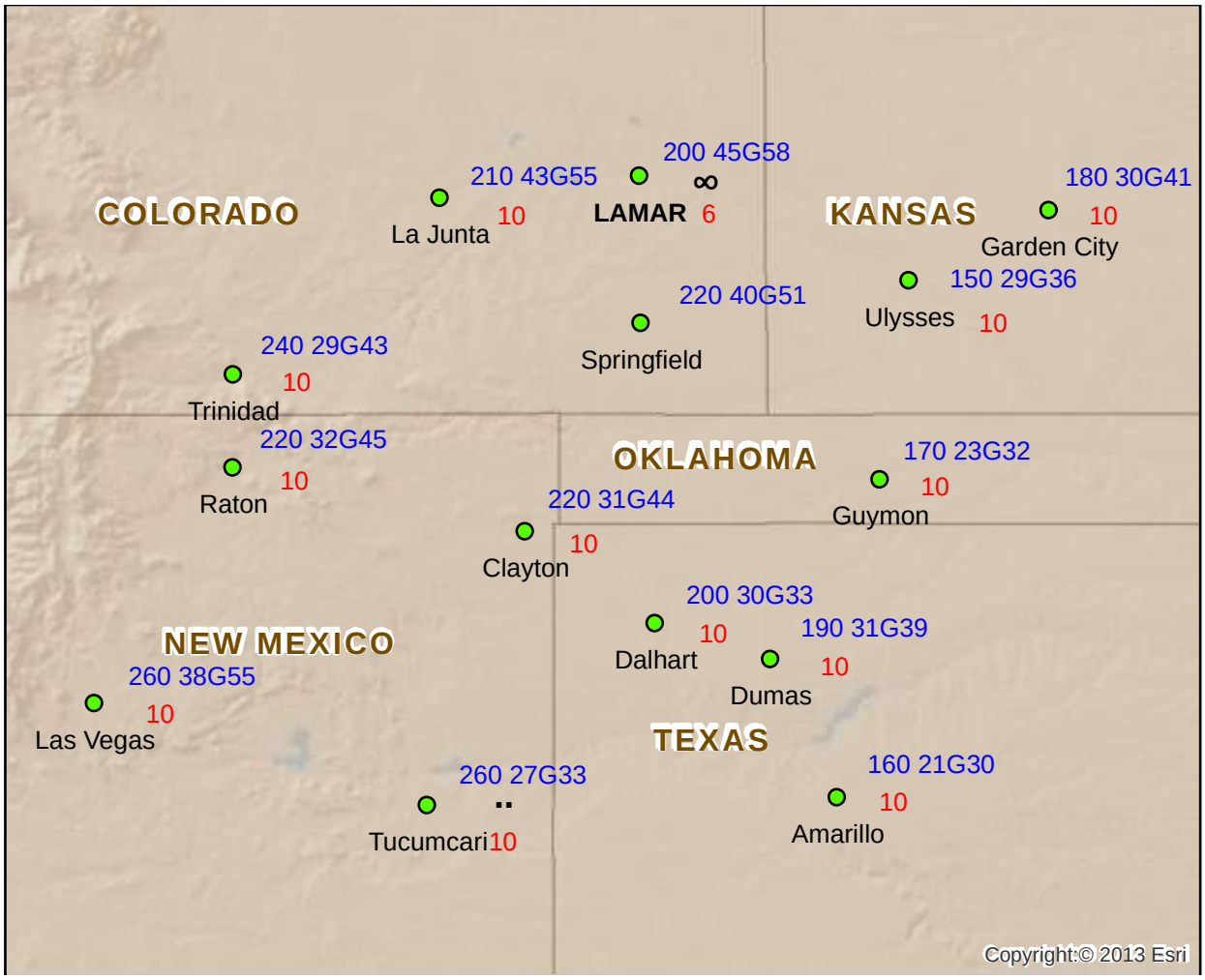


Figure 12: Surface Analysis for 12:40 PM MST (1940Z), November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

To expand on the data from these synoptic maps, hourly surface weather observations were gathered from each of the reporting stations displayed in Figure 9. Table 1 lists observations for the PM_{10} exceedance location of Lamar. Observations that are climatologically consistent with blowing dust conditions are highlighted in yellow. Table 2 through Table 14 contain the surface observations from sites that are in close vicinity to Lamar, or are in or near areas that are known sources for blowing dust in Lamar (see Appendix A).

Collectively these weather observation sites experienced several hours of reduced visibility along with sustained wind speeds and gusts at or above the thresholds for blowing dust.

Observations of sustained wind speeds and gust speeds above the blowing dust thresholds and reduced visibilities on November 5, 2011, at weather stations in southeast Colorado, eastern New Mexico, western Texas, western Kansas and far western parts of the Oklahoma Panhandle show that a regional dust storm event occurred under south to southwesterly flow in the vicinity of a cold front. The observations contribute to the body of evidence that shows that a regional dust storm caused the PM_{10} exceedances at the monitoring sites in question.

Table 1: Weather observations for Lamar, Colorado, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	51	44	14		180		10
1:53	48	49	6		170		10
2:53	48	49	9		170		10
3:53	47	52	7		120		10
4:53	45	53	14		130		10
5:53	41	62	13		110		10
6:53	38	67	16		120		10
7:53	43	55	16		110		10
8:53	51	42	16		110		10
9:46	66	24	22	29	160		10
9:53	67	24	22	29	170		10
10:53	72	19	38	60	200		8
11:36	72	20	54	68	200	haze	5
11:53	72	20	50	66	210		8
12:09	70	21	47	61	200		8
12:40	70	21	45	58	200	haze	6
12:53	68	24	35	55	210		10
13:53	67	24	32	43	230		10
14:53	62	18	33	51	210		10
15:53	58	17	30	40	240		10
16:53	57	22	29	40	230		10
17:53	54	28	23		220		10
18:53	54	27	25	33	240		10
19:53	54	26	23	33	240		10
20:53	50	54	13		340		10
21:53	45	68	4		10		10
22:53	42	73	5		50		10
23:53	40	76	4		100		10

Table 2: Weather observations for La Junta, Colorado, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	56	37	21	33	210		10
1:53	53	43	9		260		10
2:53	52	46	6		190		10
3:53	45	60	6		90		10
4:53	44	60	6		90		10
5:53	40	70	9		90		10
6:53	39	72	9		100		10
7:53	44	62	6		80		10
8:53	53	50	5		140		10
9:53	67	25	36	56	210		9
10:53	68	24	44	56	210		10
11:53	65	30	43	55	210		10
12:53	65	32	25	35	220		10
13:53	63	20	32	46	210		10
14:53	58	17	38	46	220		10
15:53	54	34	25	46	270		10
16:53	56	28	29	41	250		10
17:53	53	29	29	37	240		10
18:53	51	32	30	37	240		10
20:53	46	37	14		250		10
21:53	43	43	12		260		10
22:53	39	50	8		310		10
23:53	39	52	4		150		10

Table 3: Weather observations for Springfield, Colorado, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:56	45	45	20	28	220		
1:56	45	45	23	30	210		
2:56	46	42	28		210		
3:56	46	43	18	28	220		
4:56	45	45	20	30	210		
5:56	42	49	25	32	200		
6:56	42	46	28	39	210		
7:56	46	42	24	38	220		
8:56	53	32	31	43	210		
9:56	60	26	27	38	220		
10:56	62	24	29	36	200		
11:56	66	21	40	51	220		
12:56	63	27	36	58	230		
13:56	60	22	35	50	220		
14:56	61	12	35	53	250		
15:56	57	18	29	46	250		
16:56	54	24	33	45	240		
17:56	51	29	17	31	240		
18:56	48	34	23	33	240		
19:56	47	34	17	25	240		
20:56	44	38	12		230		
21:56	39	46	9		260		
22:56	36	50	9		250		
23:56	34	56	0				

Table 4: Weather observations for Trinidad, Colorado, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:54	49	39	22	27	240		10
1:54	50	37	23	31	240		10
2:54	48	40	24	32	240		10
3:54	48	40	24	33	240		10
4:54	46	45	17	24	240		10
5:54	55	35	29	43	210		10
6:54	55	31	25	48	200		10
7:54	56	33	36	55	190		10
8:54	55	34	38	50	190		10
9:54	55	37	40	53	190		10
10:54	53	48	25	37	210		10
11:54	54	30	29	43	240		10
12:54	52	19	31	52	240		10
13:54	50	25	25	38	240		10
14:54	51	24	38	51	240		10
15:54	50	27	51	63	250		10
16:54	46	35	39	55	240		10
17:54	45	34	29	38	260		10
18:54	44	29	15	21	250		10
19:54	43	24	20	27	220		10
20:54	41	29	13	21	280		10
21:54	40	30	7		280		10
22:54	32	45	6		310		10
23:54	30	51	9		190		10

Table 5: Weather observations for Garden City, Kansas, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:54	42	46	15	25	160		10
1:54	40	50	13		160		10
2:54	40	48	13		170		10
3:54	40	48	15		170		10
4:54	40	48	15		160		10
5:54	39	48	17	24	160		10
6:54	39	48	17		150		10
7:54	39	50	12		160		10
8:54	44	41	17	29	160		10
9:54	49	34	30	40	180		10
10:54	52	32	31	39	180		10
11:54	59	26	30	41	180		10
12:54	61	24	28	41	170		10
13:54	62	24	33	41	180		10
14:54	64	24	31	41	180		10
15:54	64	24	25	39	170		10
16:54	61	28	21	33	170		10
17:54	62	26	28	37	190		10
18:54	58	27	24	35	190		10
19:54	56	25	24	33	190		10
20:54	55	26	23	35	210		10
21:54	52	31	18		210		10
22:54	51	32	21	27	230		10
23:54	48	37	13		290		10

Table 6: Weather observations for Ulysses, Kansas, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
8:54	46	36	29	37	160		10
9:24	52	35	25	32	160		10
9:54	52	32	29	39	160		10
10:24	55	30	29	38	160		10
10:54	55	30	30	39	150		10
11:24	57	28	32	37	160		10
11:54	59	27	31	38	150		10
12:24	61	27	29	37	160		10
12:54	63	25	23	33	160		10
13:25	64	24	24	36	160		10
13:54	66	22	37	41	170		10
14:24	72	20	32	41	180		10
14:54	72	22	44	52	200		3
15:25	70	26	38	48	200		3
15:54	66	26	32	45	190	haze	5
16:25	64	26	36	44	200	haze	10
16:54	64	22	36	43	200	haze	7
17:24	64	16	41	48	200		5
17:54	63	17	35	47	210		4
18:25	61	18	30	43	200		7
18:54	59	21	28	35	200	haze	10

Table 7: Weather observations for Clayton, New Mexico, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:55	43	47	12		200		10
1:55	43	47	10		200		10
2:55	43	47	10		200		10
3:55	43	47	10		210		10
4:55	41	51	13		190		10
5:55	37	54	14		190		10
6:55	36	56	14		200		10
7:55	44	43	18		200		10
8:55	51	35	22		190		10
9:55	55	30	28	36	180		10
10:55	55	29	30	37	190		10
11:55	56	35	31	44	220		10
12:55	57	22	36	53	230		9
13:04	57	23	36	56	220		8
13:55	56	18	33	52	220		10
14:55	56	20	31	51	230		10
15:55	53	24	35	47	220		10
16:55	50	28	21	33	220		10
17:55	48	31	13	20	260		10
18:55	46	34	9	20	240		10
19:55	43	36	22	30	200		10
20:55	43	29	20	29	220		10
21:55	40	31	12	21	230		10
22:55	37	33	9		250		10
23:55	35	36	9		250		10

Table 8: Weather observations for Las Vegas, New Mexico, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	35	64	13		230		10
1:53	34	67	12		210		10
2:53	34	67	13		200		10
3:53	34	67	14		200		10
4:53	29	78	12		190		10
5:53	32	72	13		160		10
6:53	35	66	10		170		10
7:53	41	55	15		170		10
8:53	41	57	20		190	lt rain	10
9:04	36	80	24	38	200	lt snow	2
9:13	37	81	28	37	220	lt rain	5
9:53	39	82	28	39	230		10
10:00	37	75	28	43	230		10
10:53	38	54	37	61	240		10
11:53	41	44	38	55	260		10
12:53	43	38	39	58	260		10
13:53	43	41	38	47	260		10
14:53	43	41	30	37	240		10
15:53	41	39	27	44	250		10
16:53	38	48	20	30	260		10
17:53	37	42	8		250		10
18:53	36	40	8	17	240		10
19:53	34	41	16		240		10
20:53	33	43	25	30	230		10
21:53	33	41	28	36	260		10
22:53	33	38	14	20	270		10
23:53	27	46	5		130		10

Table 9: Weather observations for Raton, New Mexico, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	40	55	6		260		10
1:53	40	53	5		190		10
2:53	38	57	4		250		10
3:53	39	55	5		260		10
4:53	40	53	0				10
5:53	38	54	5		210		10
6:53	37	56	4		190		10
7:53	42	49	4		250		10
8:53	47	42	12		210		10
9:53	46	45	13		270		10
10:13	46	66	40	61	210	haze; squalls	5
10:53	48	71	22	30	210		10
11:53	50	29	32	45	220		10
12:53	50	24	37	46	230		10
13:53	49	29	28	43	240		10
14:53	49	31	28	38	240		10
15:53	47	33	25	39	260		10
16:53	41	48	27	32	210		10
17:53	39	50	22	30	230		10
18:53	38	50	22	30	210		10
19:53	39	37	17	23	230		10
20:53	36	42	0				10
21:53	36	40	6				10
22:53	34	40	7		140		10
23:53	34	41	17		250		10

Table 10: Weather observations for Tucumcari, New Mexico, on November 5, 2011. (data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	50	37	14		180		10
1:53	50	34	13		200		10
2:53	47	40	4		240		10
3:53	47	40	9		230		10
4:53	43	47	5		260		10
5:53	42	46	10		220		10
6:53	40	53	8		230		10
7:53	47	40	14		170		10
8:53	50	37	8		180		10
9:53	58	29	8		210		10
10:53	60	26	23	37	230		10
11:53	52	52	23	36	260	lt rain	10
12:53	56	42	27	33	240		10
13:53	61	24	43	51	260		10
14:53	61	20	37	50	260		10
15:53	60	16	29	44	250		10
16:53	57	21	25	36	270		10
17:53	54	26	22	28	260		10
18:53	51	28	21	28	250		10
19:53	49	30	18		250		10
20:53	49	31	17		260		10
21:53	48	34	20	27	270		10
22:53	47	34	21	28	240		10
23:53	48	31	29	37	240		10

Table 11: Weather observations for Guymon, Oklahoma, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	47	39	17	25	180		10
1:53	45	40	12		180		10
2:53	42	44	8		180		10
3:53	41	48	8		170		10
4:53	40	50	7		170		10
5:53	41	48	13		160		10
6:53	43	45	16		170		10
7:53	43	45	16		170		10
8:53	46	40	23	30	180		10
9:53	49	37	25	35	180		10
10:53	54	32	23	35	180		10
11:53	59	28	23	32	170		10
12:53	64	26	25	37	180		10
13:53	68	23	29	40	190		10
14:53	68	25	30	43	220		10
15:53	63	29	35	44	230		10
16:53	62	28	27	41	220		10
17:53	60	22	30	44	220		10
18:53	58	25	24	38	230		10
19:53	56	25	20		230		10
20:53	54	28	23	30	230		10
21:53	51	32	16		230		10
22:53	49	36	17		230		10
23:53	47	39	16		230		10

Table 12: Weather observations for Amarillo, Texas, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	43	45	14		160		10
1:53	45	38	17		170		10
2:53	43	43	18		160		10
3:53	42	44	20		160		10
4:53	39	50	17		150		10
5:53	40	50	17		150		10
6:53	40	50	20		150		10
7:53	39	52	21		160		10
8:53	40	53	17		160		10
9:53	46	42	22		180		10
10:53	55	31	24	29	170		10
11:53	60	27	21	30	160		10
12:53	67	22	29	38	180		10
13:53	68	21	27	39	170		10
14:45	64	26	22	50	280		8
14:53	63	29	28	37	270		9
15:00	64	30	21	35	260		9
15:53	63	34	35	45	240		10
16:53	63	31	29	37	240		10
17:53	61	26	22	39	240		7
18:53	58	24	23		260		10
19:53	56	26	21	28	250		10
20:53	53	29	14		250		10
21:53	51	32	15		250		10
22:53	50	33	14		240		10
23:53	47	37	13		250		10

Table 13: Weather observations for Dalhart, Texas, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	46	40	18		190		10
1:53	42	46	8		200		10
2:53	45	42	13		190		10
3:53	45	40	13		180		10
4:53	45	40	18		180		10
5:53	44	43	21		170		10
6:53	43	43	22	29	180		10
7:53	42	44	23		180		10
8:53	44	43	22	29	180		10
9:53	49	37	23		180		10
10:53	53	32	25	36	180		10
11:53	60	26	30	33	200		10
12:53	64	24	23	32	230		10
13:53	58	42	33	44	240		9
14:53	59	33	31	41	240		10
15:53	61	25	36	43	240		10
16:53	59	20	35	45	240		10
17:53	55	25	24	36	230		10
18:53	53	25	21	31	220		10
19:53	50	29	18		220		10
20:53	49	31	18		240		10
21:53	46	37	14		220		10
22:53	43	43	12		220		10
23:53	41	46	16		220		10

Table 14: Weather observations for Dumas, Texas, on November 5, 2011.
(data source: http://www.met.utah.edu/mesowest/)

Time MST November 5	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:55	43	45	7		200		10
1:55	43	45	13		170		10
2:55	43	45	13		180		10
3:55	43	45	13		170		10
4:55	45	42	22		180		10
5:55	43	42	15		180		10
6:55	43	45	16		180		10
7:55	41	48	16		170		10
8:55	45	42	20	25	180		10
9:55	50	34	22	30	180		10
10:55	54	32	25	33	170		10
11:55	61	27	27	37	190		10
12:55	66	24	27	38	190		10
13:55	63	27	29	45	260		7
14:55	61	36	31	41	240		10
15:55	59	36	30	39	240		10
16:55	61	29	33	38	240		10
17:55	57	23	22	30	240		10
18:55	55	24	20	27	240		10
19:55	52	28	14		250		10
20:55	48	32	10		230		10
21:55	46	34	15		220		10
22:55	43	42	12		200		10
23:55	46	36	14		230		10

Continuing our synoptic analysis, Figure 13 and Figure 14 show the NARR (North American Regional Reanalysis) jet stream maximum winds rotating around the base of the 700 mb trough at 8 AM and 11 AM MST November 5, 2011, respectively. At the 700 mb level, peak winds stretched from northern Mexico northeastward across New Mexico, western Texas and the Oklahoma panhandle into eastern Colorado and western Kansas. This jet streak included a broad area of 50-70 knot winds with some of the most intense wind bands located over southeast Colorado and extreme northeast New Mexico. Figure 15 and Figure 16 show the 500 mb trough and corresponding wind speeds at 8 AM and 11 AM MST on November 5, respectively. A very strong band of 500 mb winds near the base of the trough can be found traversing New Mexico and extending northeastward into southeast Colorado. Winds at this level ranged from 60 to 90 knots.

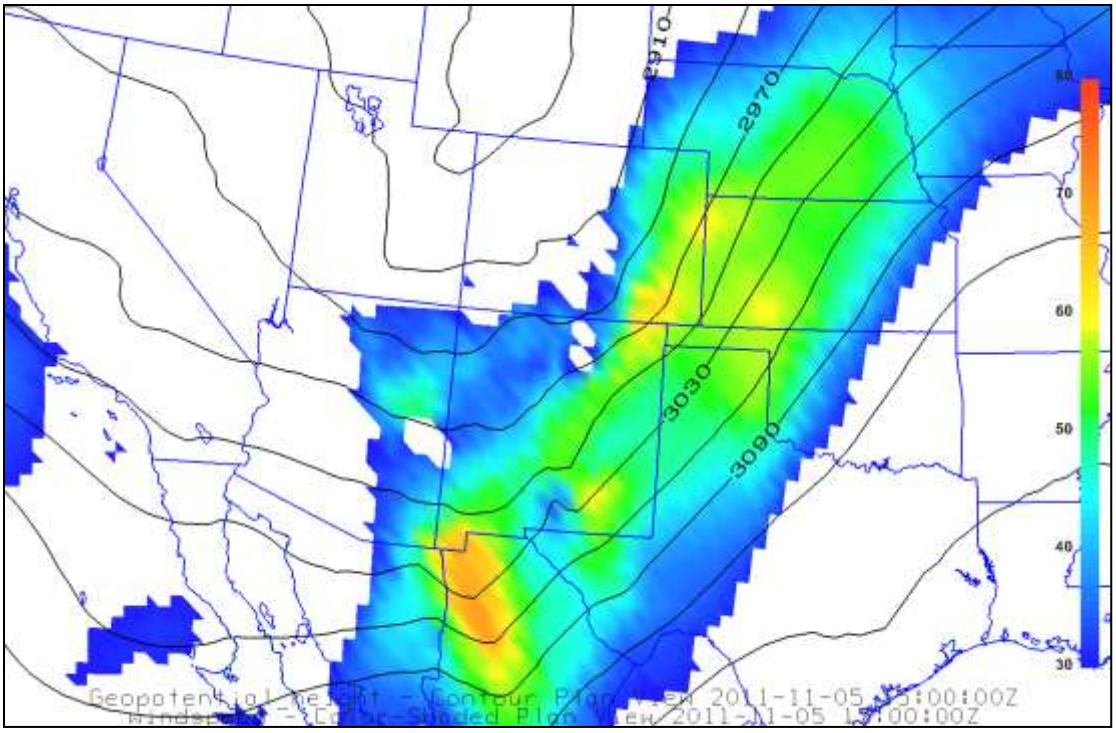


Figure 13: NARR 700 mb analysis for 15Z November 5, 2011, or 9 AM MST November 5, 2011, showing wind speeds in knots. Only speeds above 30 knots are shown.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

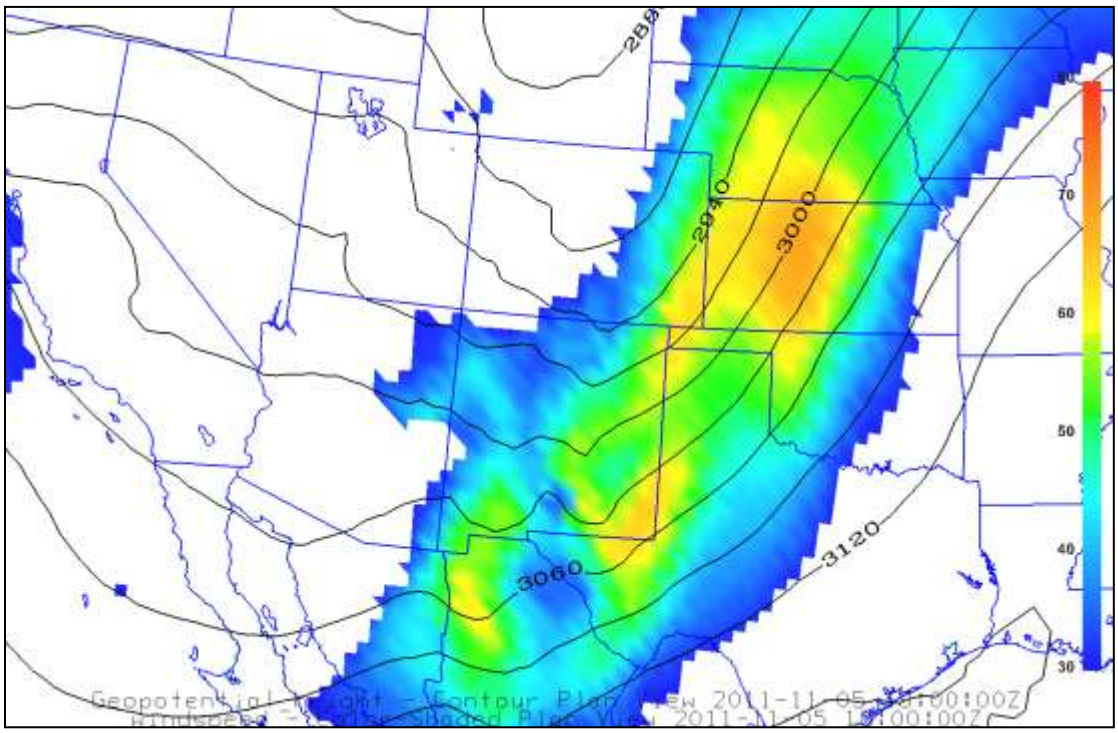


Figure 14: NARR 700 mb analysis for 18Z November 5, 2011, or 11 AM MST November 5, 2011, showing wind speeds in knots. Only speeds above 30 knots are shown.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

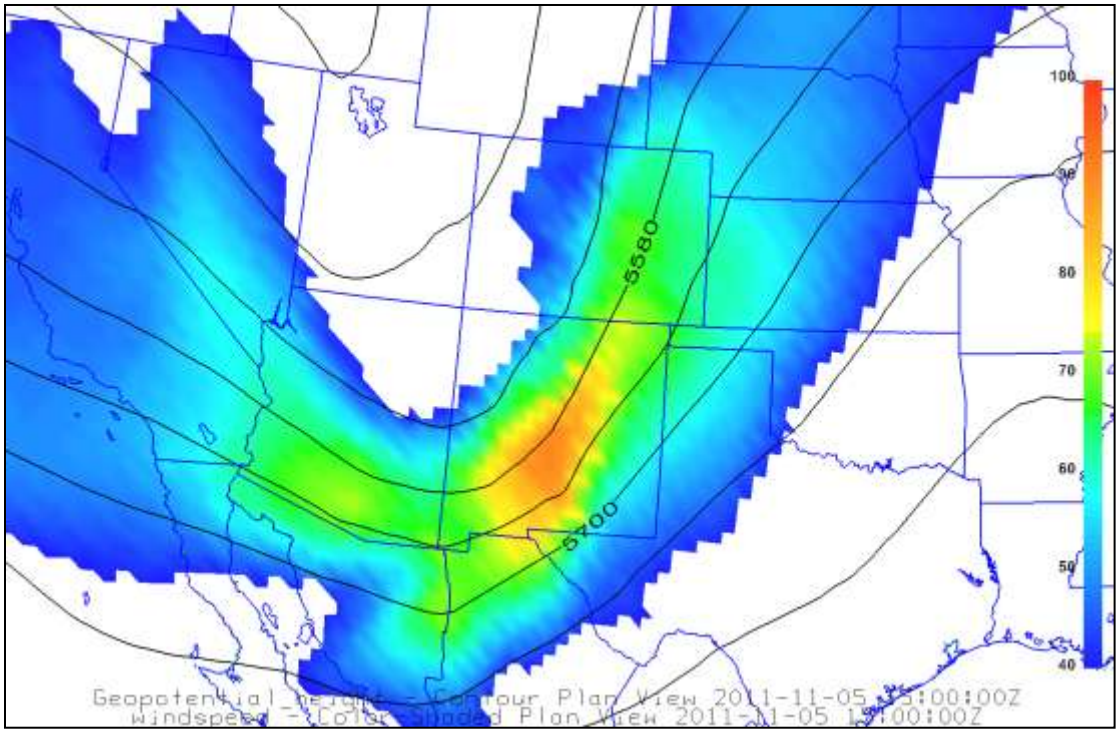


Figure 15: NARR 500 mb analysis for 15Z November 5, 2011, or 8 AM MST November 5, 2011, showing wind speeds in knots. Only speeds above 40 knots are shown.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

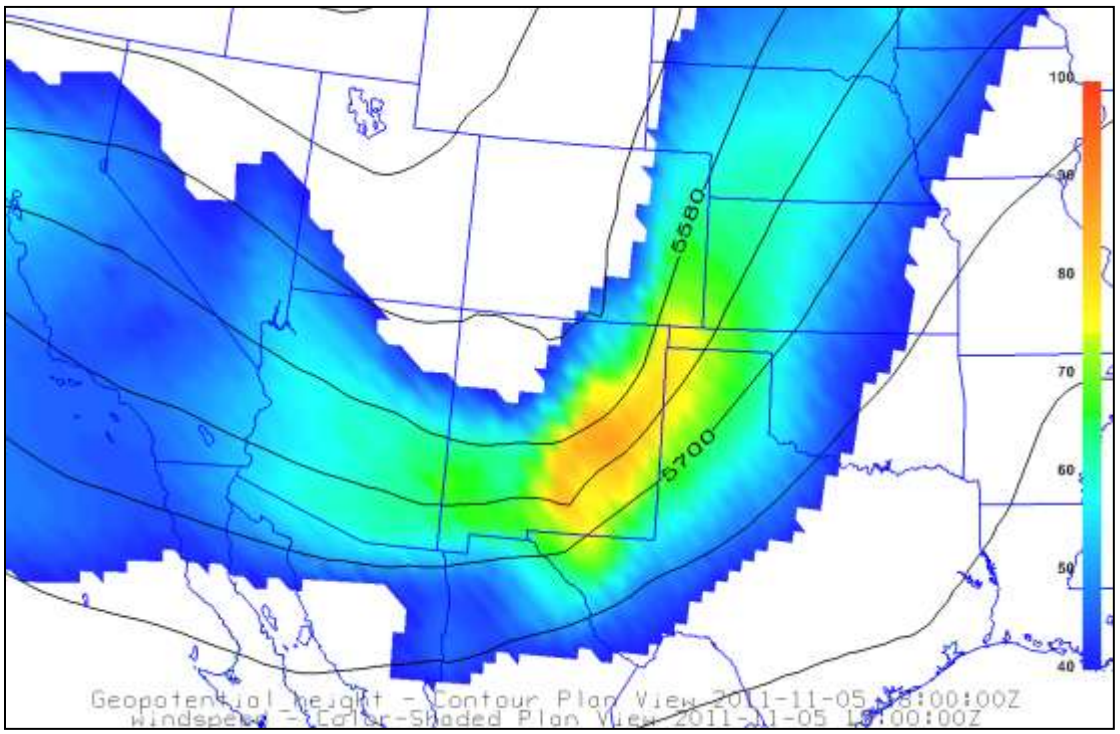


Figure 16: NARR 500 mb analysis for 18Z November 5, 2011, or 11 AM MST November 5, 2011, showing wind speeds in knots. Only speeds above 40 knots are shown.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

The upper level trough (observed at both the 700 and 500 mb level) affected winds near the surface in two ways. First, it intensified a surface low-pressure system in eastern Colorado (as shown in Figure 2, Figure 3 and Figure 4) with tight pressure gradients which produced strong winds at the surface. Second, momentum associated with the strong winds aloft at the base of the trough was transferred to the surface because of deep vertical mixing in the same area as the strong winds aloft. Figure 17 shows the height of the top of the mixed layer in kilometers above MSL at 11 AM on November 5, 2011. Mixing of 3 to 6 kilometers above MSL can be observed over southeast Colorado and northeast New Mexico. Mixing to this degree would have been sufficient to transfer momentum to the surface from the zone of intense winds at 700 mb located over this region in Figure 14 (40-60 knots).

It is also reasonable to believe that with mixing as deep as 5 to 6 km in parts of southeast Colorado and northeast New Mexico, the even stronger winds found at 500 mb shown in Figure 16 (60-90 knots) may have been transported to the surface. By observing Figure 16 and Figure 17 it appears that at 18Z, or 11 AM MST (36 minutes before Lamar had its worst visibility -- Table 1), the combination of strong 500 mb winds and deep mixing was most intense directly upwind of Lamar (south-southwest) from the Colorado/New Mexico border southward into east-central New Mexico. In this area, 500 mb winds were approximately 75 knots and mixing was as deep at 5 to 6 km. This is an area known to be a source region for blowing dust events in Lamar (see Appendix A). When blowing dust occurs with strong winds at the surface and aloft combined with deep mixing as was observed during the November 5 event, dust can be suspended for many hours and transported long distances. These conditions are the hallmarks of a regional dust transport event.

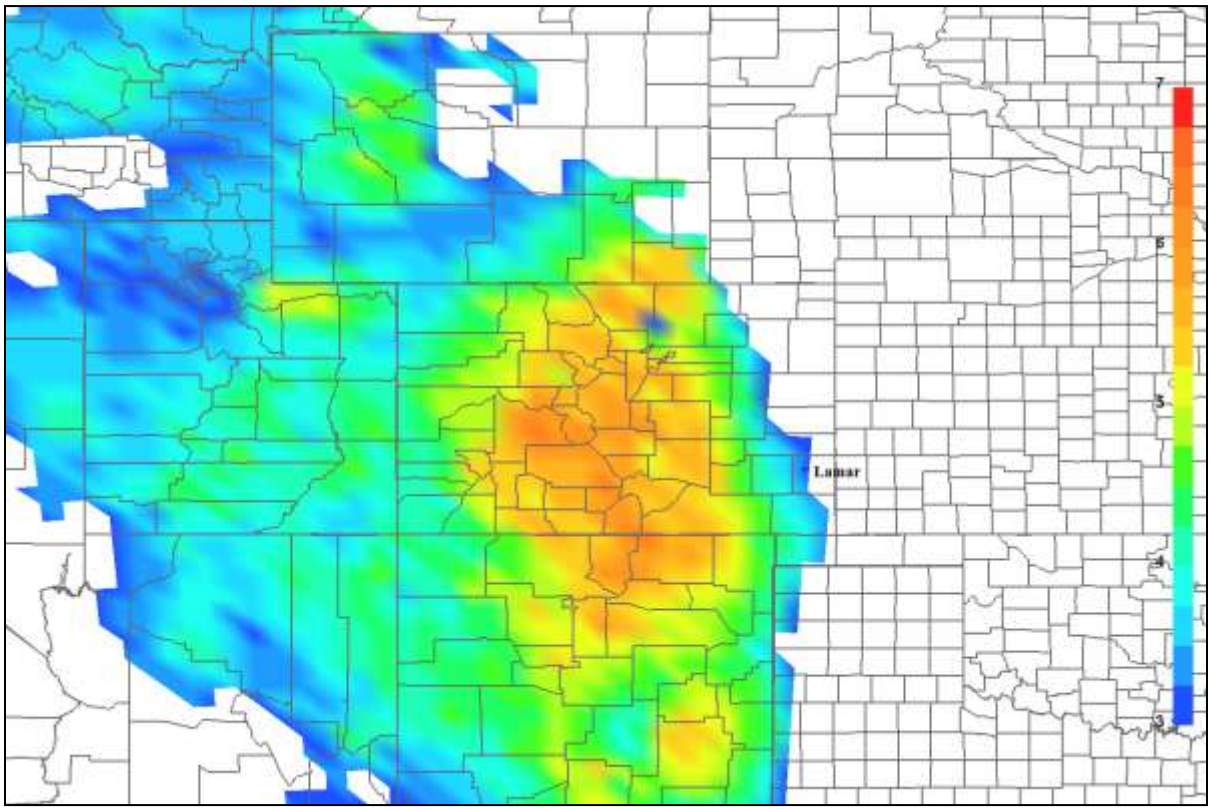


Figure 17: Height of the mixed layer in kilometers above mean sea level from the NARR at 18Z November 5, 2011, or 11 AM MST November 5, 2011. Only mixing heights above 3 kilometers are shown.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

As stated earlier in this paper, weather at the mesoscale (sub-regional scale) also likely contributed to the elevated PM_{10} concentrations in Lamar on November 5, 2011. Collapsing thunderstorms producing strong outflow appear to have been a significant mesoscale factor in the production of blowing dust in southeast Colorado. This outflow is often referred to as a downburst, which is a strong downdraft that causes outflow of damaging winds at or near the surface. Downbursts are capable of producing winds well in excess of 100 mph (see the following link from the National Oceanic and Atmospheric Administration (NOAA) for additional information on downbursts: http://www.srh.noaa.gov/jetstream/tstorms/wind.htm).

Figure 18 and Figure 19 show the 13 km RUC (Rapid Update Cycle) analysis at 9 AM and 12 PM MST on November 5, 2011, respectively. Weather variables displayed within this analysis include maximum composite radar reflectivity, surface pressure and surface wind speed gusts. In Figure 18, a cluster of thunderstorms can be observed in south-central Colorado and north-central New Mexico with radar measurements in its most intense bands approaching 40 dBZ. Three hours later in Figure 19, those thunderstorms had either weakened or dissipated entirely with radar returns decreasing to less than 30 dBZ. Note the band of high wind gusts (in excess of 50 mph) that increased in southeast Colorado in advance of the collapsing thunderstorms. At 12 PM MST in Figure 19, the strongest winds are located approximately 50 miles to the southwest of Lamar. Between 12:09 PM MST and 12:40 MST, Lamar reported sustained winds of 45 to 47 mph, gusts to 58 to 61 mph, haze, and visibility dropping from 8 to 6 statute miles. If indeed these collapsing thunderstorms produced blowing dust in Lamar, the contributing source region was likely to the south and southwest of Lamar within parts of Baca, Bent and Las Animas counties along with northeastern parts of New Mexico. However it should be noted that it is quite difficult to say with certainty where the source region was precisely located. This is due to gaps in the spatial coverage of radar data and the overall lack of monitoring stations within the general source area.

The synoptic-scale combination of strong winds aloft, deep mixing and the tight pressure gradients associated with the surface low pressure system caused very intense surface winds in Lamar on November 5. Contributing at the mesoscale was a cluster of collapsing thunderstorms producing downbursts to the south and southwest of Lamar. This scenario allowed surface winds in Lamar to reach sustained speeds of 54 mph with gusts to 68 mph, and for locations upwind of Lamar to receive sustained winds in excess of 40 mph with gusts over 50 mph. Winds of this strength can easily cause blowing dust if soils are dry. Recall that wind speeds of 30 mph or greater and/or gusts of 40 mph or higher have been shown to cause blowing dust in southeast Colorado (see Appendix A).

The synoptic and mesoscale weather conditions on November 5, 2011, (illustrated in Figure 2 through Figure 19) show that the conditions necessary for widespread strong gusty winds and transport of blowing dust were in place over the area of concern.

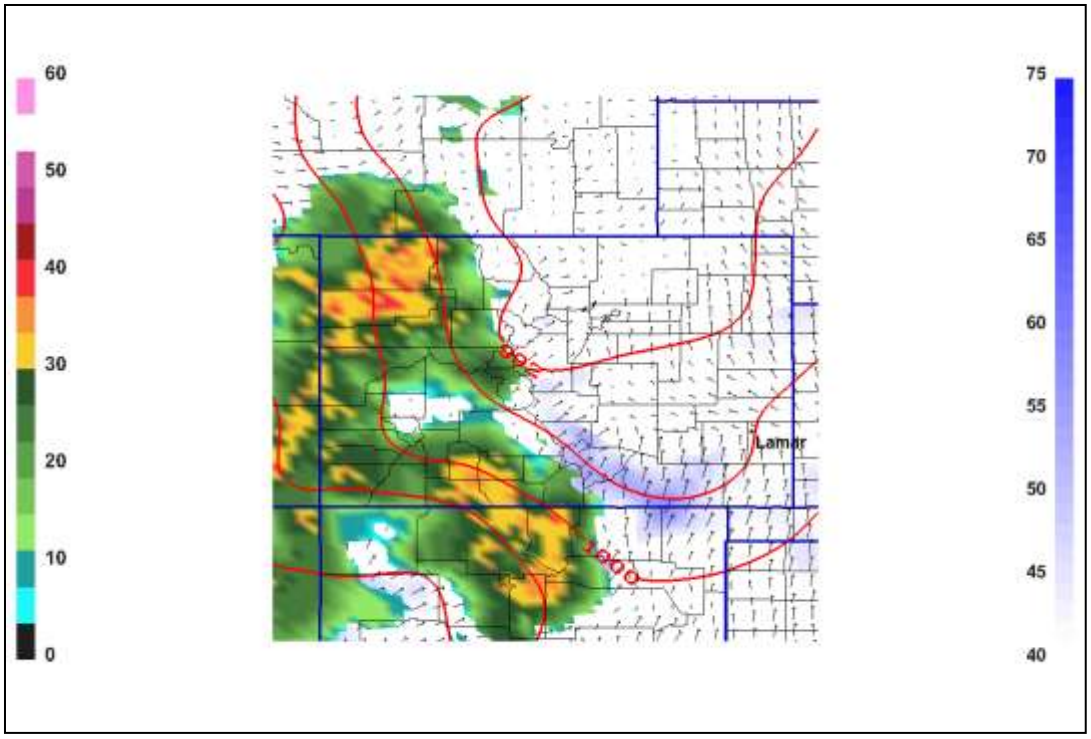


Figure 18: 13 km RUC radar, pressure and surface wind gust analysis at 16Z November 5, 2011, or 9 AM MST November 5, 2011. Gusts above 40 mph are shaded in blue.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

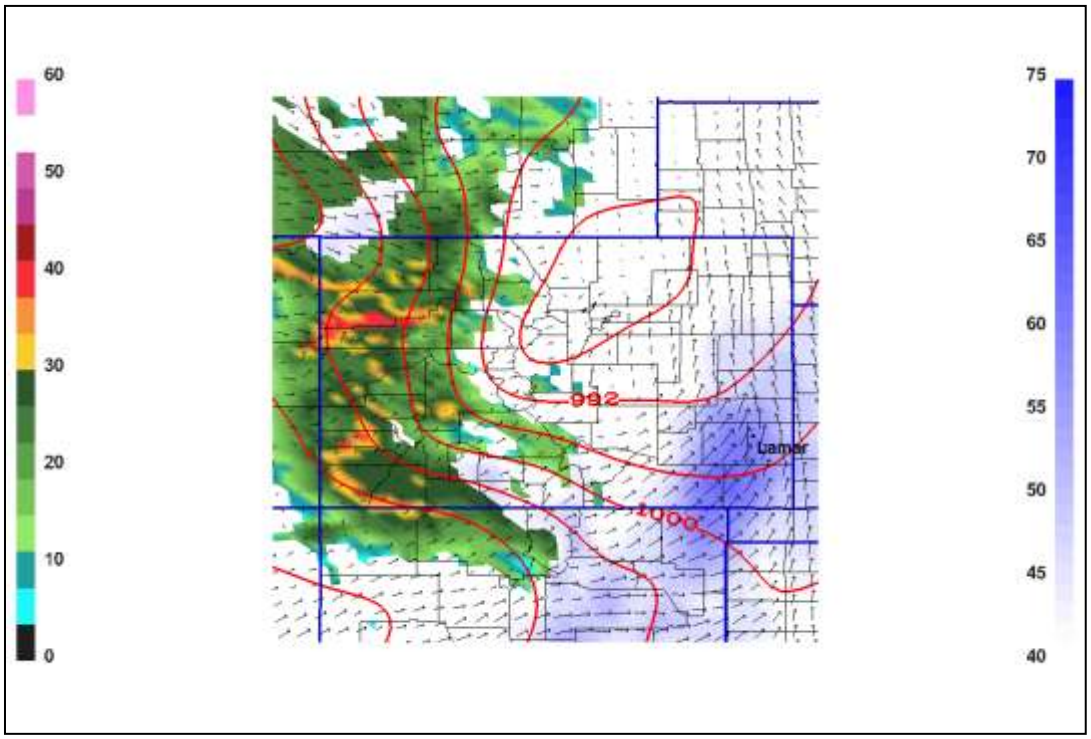


Figure 19: 13 km RUC radar, pressure and surface wind gust analysis at 19Z November 5, 2011, or 12 PM MST November 5, 2011. Gusts above 40 mph are shaded in blue.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

The Albuquerque, Lubbock and Pueblo National Weather Service (NWS) forecast offices issue weather information and alerts for much of New Mexico, western Texas and southeast Colorado. Several weather warnings, advisories and short-term forecasts issued by theses offices on November 5, 2011, are presented in Appendix B. It is evident from these text products that strong winds and areas of blowing dust were anticipated across the region.

Additionally, in Appendix B is a preliminary local storm report (LSR) from the Pueblo NWS office and a Colorado roads report issued by the Denver NWS office. In the LSR, note the 12:00 PM entry of a semi-truck blown off Highway 50 approximately 10 miles east of Lamar. The 12:00 PM MST Colorado roads report confirms this closure under the "Southeast" section with US 50 reported closed due to a rolled semi trailer. This closure would continue on the 12:30 PM MST Colorado roads report before Highway 50 was reported open again at 1:00 PM MST. According to Saiidi and Maragakis (1995)(as cited in Schmidlin et al., 2003), the minimum overturning wind speed for a 13,600 kg semi-trailer is 33 m/s (73 mph). Although the exact type of semi-truck in this particular incident is unknown, we can assume that wind gusts well exceeding the minimum blowing dust criteria of 40 mph caused this accident.

Warnings and advisories issued by the NWS along with local storm and roads reports show that very strong winds and areas of blowing dust were expected and experienced across this region on November 5, 2011.

Figure 20 and Figure 21 show the total precipitation in inches for October 2011 for the southwestern and south-central United States, respectively. Figure 20 shows that a large portion of southeast Colorado and northeast New Mexico received less than 0.5 inches of precipitation during October 2011. Additionally, from Figure 21 we can see that parts of the Oklahoma and Texas panhandles along with southern New Mexico and far western Texas also received less than 0.5 inches of precipitation during October 2011. Based on previous research, 0.6 inches of precipitation has been found to be the approximate threshold, below which, blowing dust exceedances at Lamar are more likely to occur when combined with high winds. This precipitation threshold is reported in Appendix A at the end of this document.

Furthermore, the Drought Monitor reports for the western and southern United States as of 5:00 AM MST November 1, 2011 (Figure 22 and Figure 23, respectively), reveal that drought conditions were widespread across southeast Colorado and points to the south and southwest. This includes nearly all of New Mexico, Texas and the Oklahoma Panhandle. In fact, large portions of the region were classified as being in an "Exceptional" drought. According to the National Drought Mitigation Center, the definition of an exceptional drought includes, "Exceptional and widespread crop/pasture losses", which would imply high rates of erosion and an increase in vulnerability to particulate suspension (see the following link for more information on drought severity classification from the National Drought Mitigation Center: http://droughtmonitor.unl.edu/classify.htm).

Soils in southeast Colorado and areas upwind to the south and southwest were dry enough to produce blowing dust when winds were above the thresholds for blowing dust on November 5, 2011.

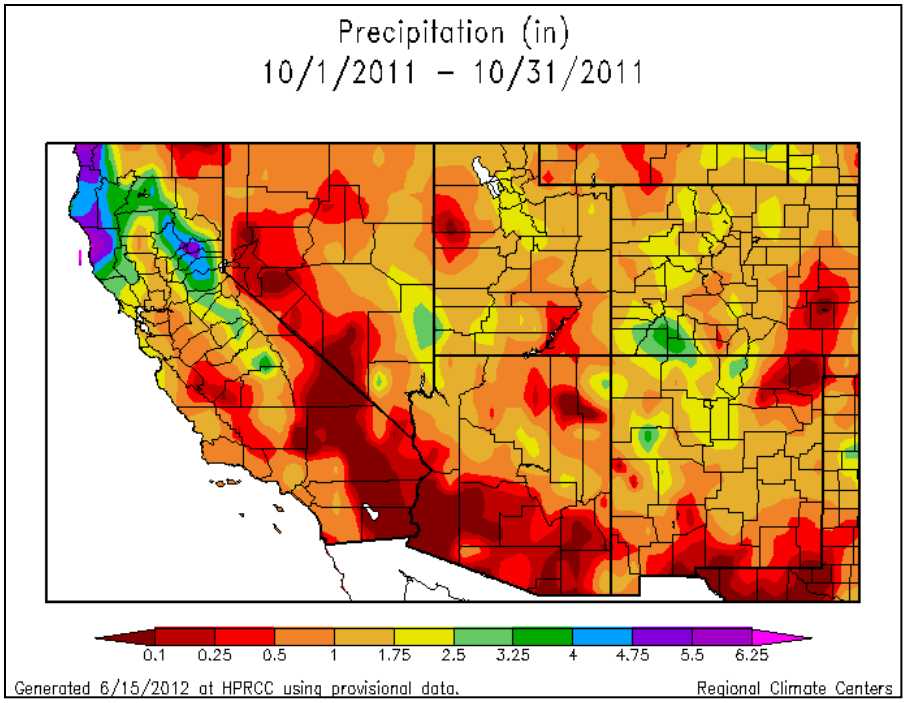


Figure 20: Total precipitation in inches for October 2011, for the southwestern United States. (source: http://www.hprcc.unl.edu/maps/current/index.php?action=update_region&state=SW&region=WRCC).

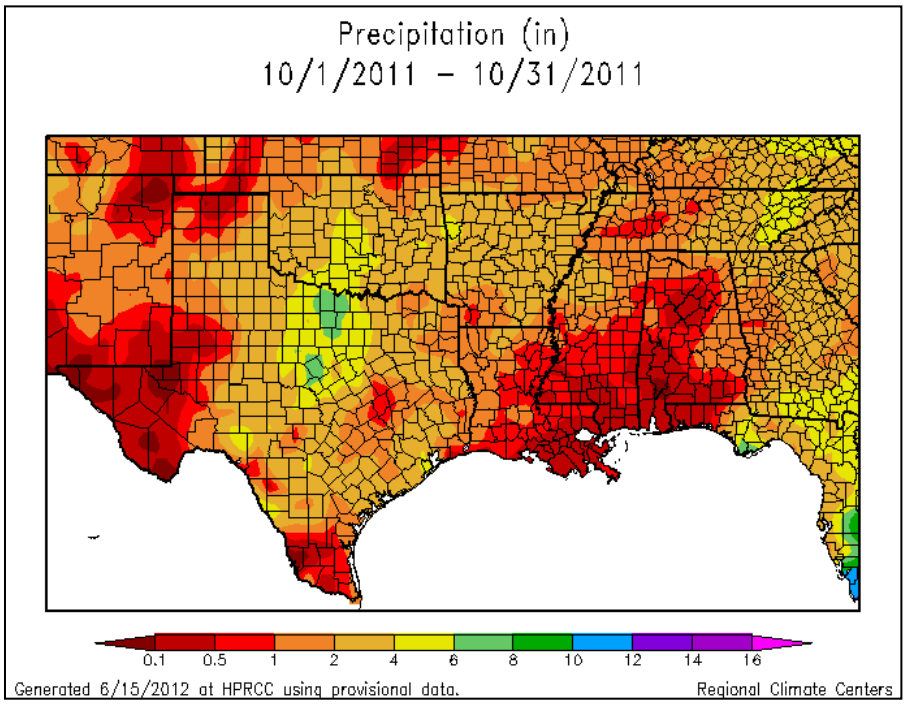


Figure 21: Total precipitation in inches for October 2011, for the south-central United States. (source: http://www.hprcc.unl.edu/maps/current/index.php?action=update_region&region=SRCC).

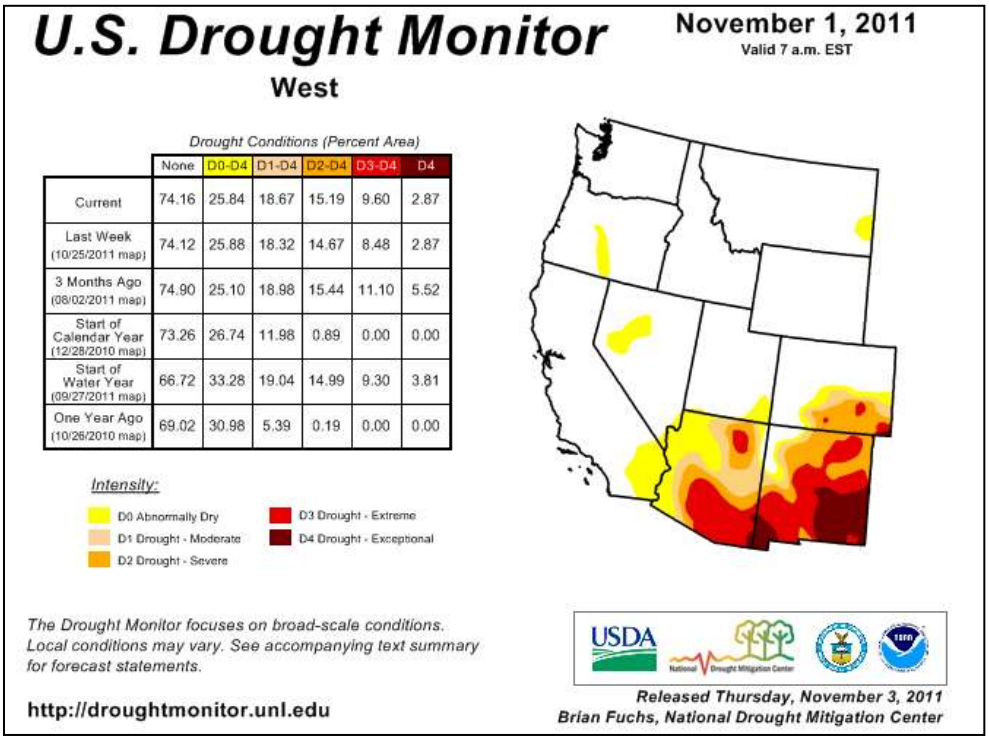


Figure 22: Drought conditions for the western United States at 5 AM MST November 1, 2011. (source: http://droughtmonitor.unl.edu/archive.html)

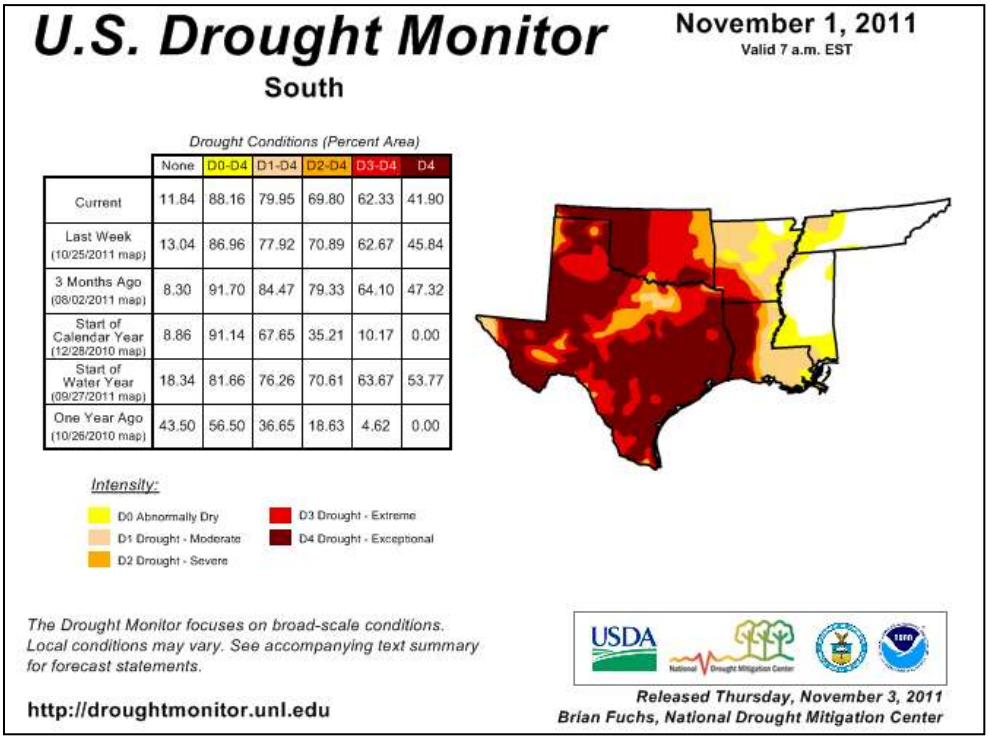


Figure 23: Drought conditions for the southern United States at 5 AM MST November 1, 2011. (source: http://droughtmonitor.unl.edu/archive.html)

Figure 24 shows the NOAA HYSPLIT 6-hour forward matrix trajectories (Draxler and Rolph, 2012) for northeast New Mexico and parts of the Texas and Oklahoma Panhandles starting at 5 AM MST and ending at 11 AM MST November 5, 2011, (see the following link for more information on HYSPLIT from the NOAA Air Resources Laboratory: http://ready.arl.noaa.gov/HYSPLIT.php). These areas were experiencing "Severe" to "Exceptional" drought conditions according to Figure 22 and Figure 23. This trajectory analysis clearly shows the transport of air from these drought-stricken areas into southeast Colorado during the morning of November 5.

Perhaps more telling are the HYSPLIT 12-hour back trajectories for 11 AM MST November 5, 2011, for Lamar (approximately when visibility started to deteriorate – see Table 1) which are presented in Figure 25. This figure visibly illustrates that parts of southeast Colorado along with the areas shown in Figure 24 were source regions for air transported into Lamar. Additionally, Figure 25 also suggests that areas much further to the south contributed to air transported into Lamar on the morning of November 5. This source region included large parts of southern New Mexico, far west Texas and even as far to the southwest as northern Mexico. This was an area that was also suffering extreme to exceptional drought (Figure 26).

NOAA HYSPLIT forward and backward trajectories provide clear supporting evidence that dust from arid regions of southeast Colorado along with other areas further to the south and southwest which were experiencing extreme to exceptional drought conditions caused or contributed to the PM_{10} exceedances measured in Lamar on November 5, 2011.

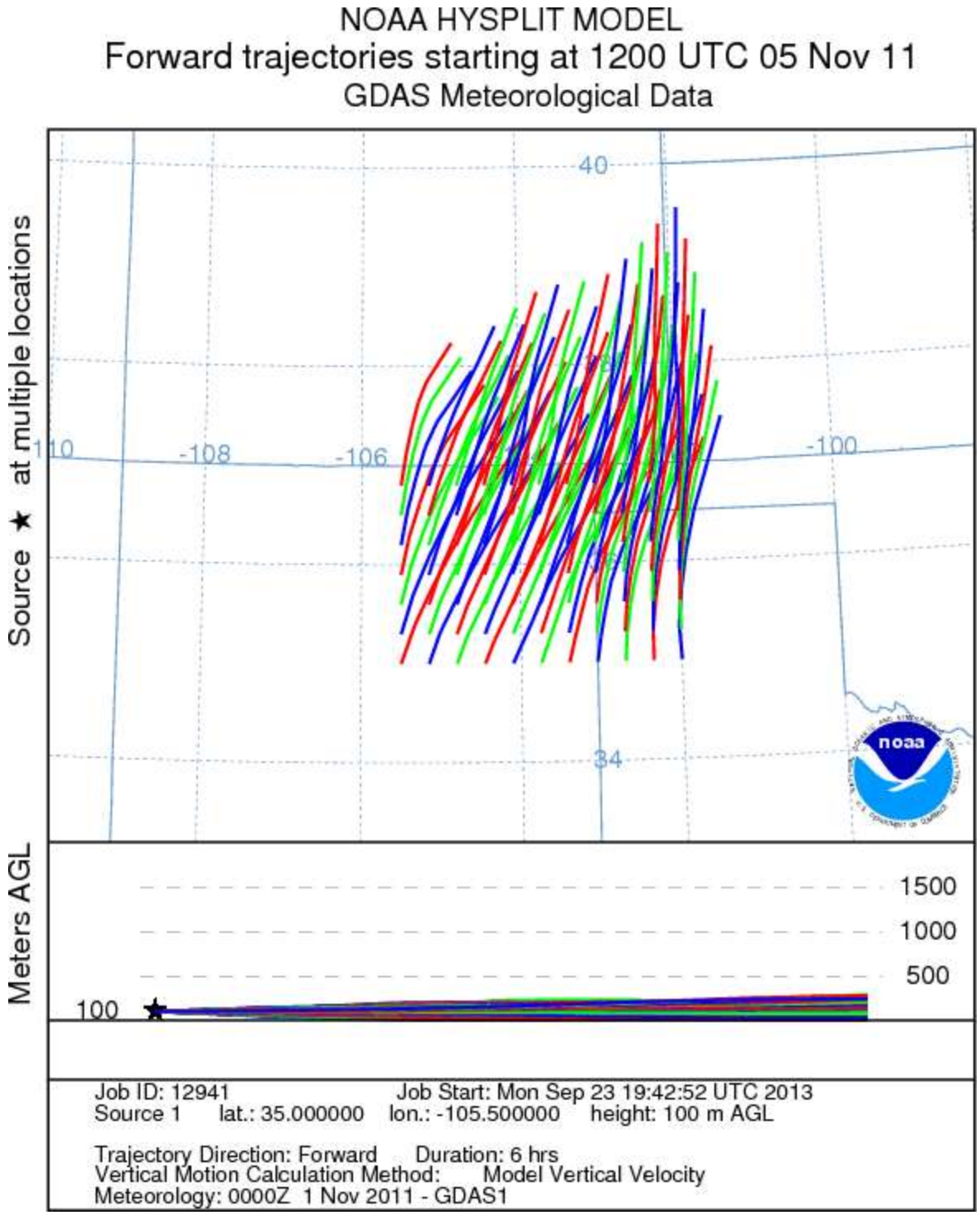


Figure 24: NOAA HYSPLIT 6-hour forward trajectories for northeast New Mexico and parts of the Oklahoma and Texas panhandles for 5 AM MST November 5 (12Z November 5), 2011, to 11 AM MST November 5, 2011.
(source: http://ready.arl.noaa.gov/HYSPLIT.php)

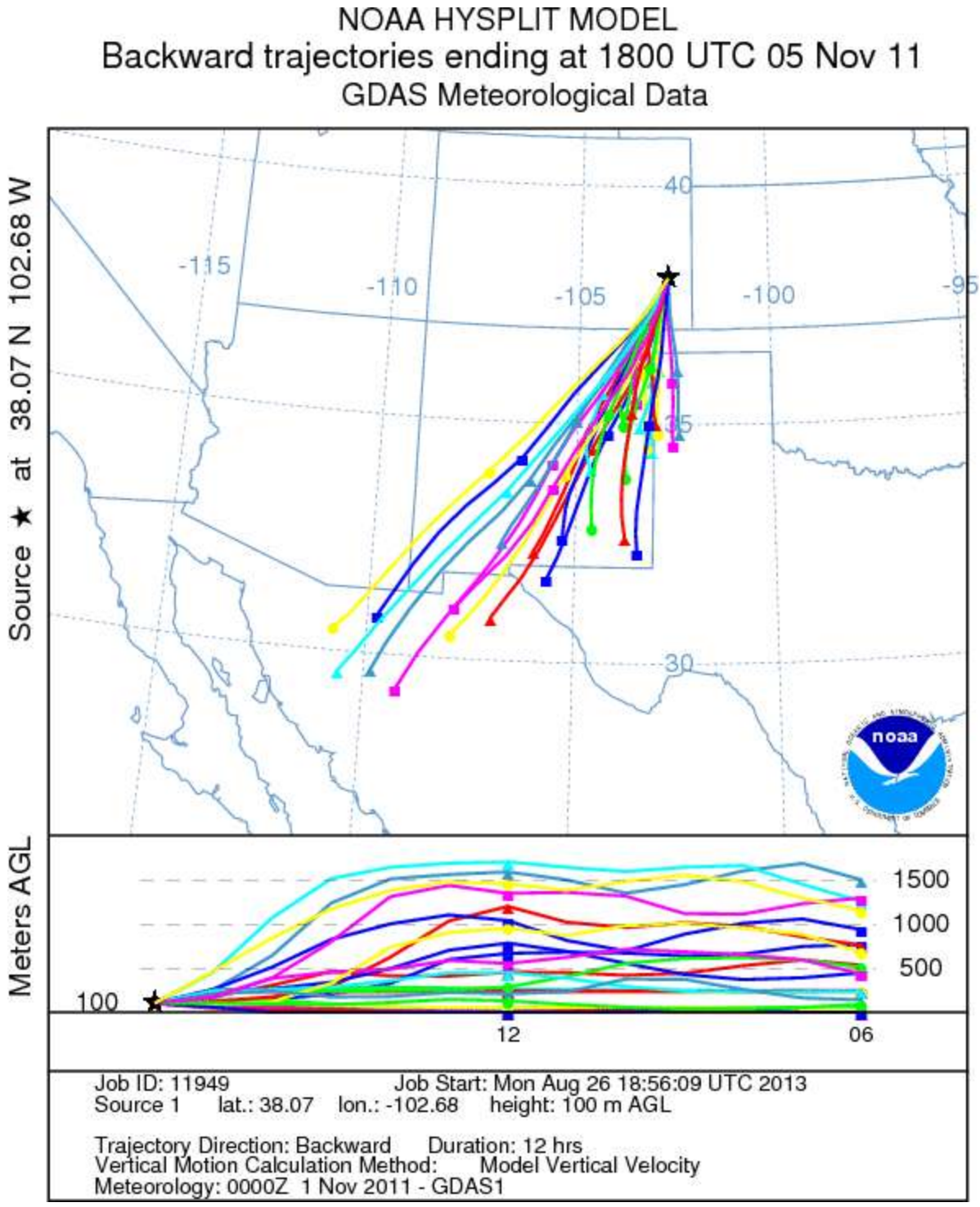


Figure 25: NOAA HYSPLIT 12-hour back trajectories for Lamar, Colorado, for 11 PM MST November 4, 2011, to 11 AM MST November 5 (18Z November 5), 2011.
(source: http://ready.arl.noaa.gov/HYSPLIT.php)

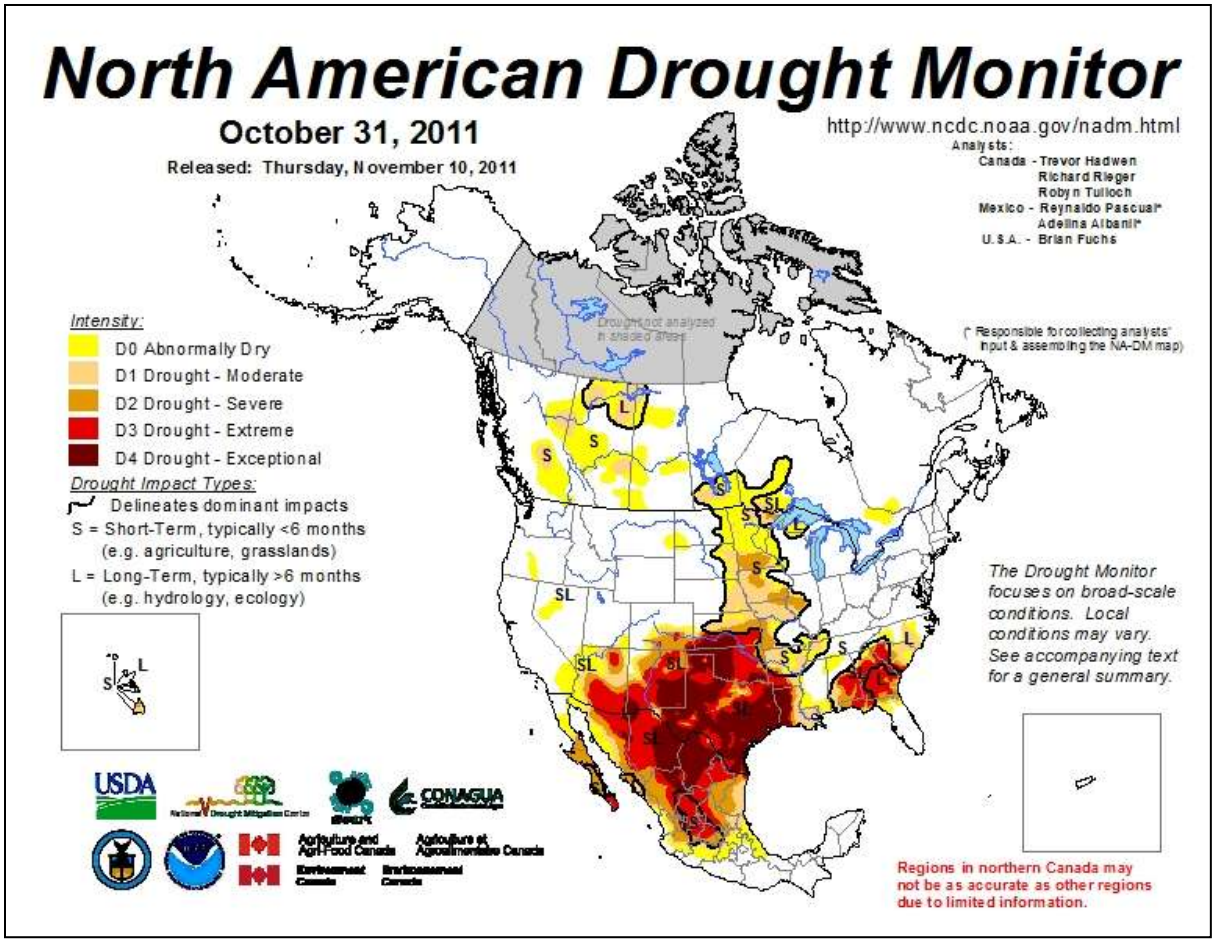


Figure 26: Drought conditions for North America on October 31, 2011.
(source: http://www.ncdc.noaa.gov/temp-and-precip/drought/nadm/nadm-maps.php)

Figure 27 and Figure 28 show the MODIS Terra False Color satellite image for southeast Colorado on November 4 and November 5, 2011, respectively. In Figure 27, a reddish-brown surface area (circled) located in Baca County, Colorado, can be observed about 50 miles to the south-southwest of Lamar one day before the dust event. Darker reds and browns are often signatures of low soil moisture on MODIS False Color imagery (for additional information on MODIS imagery from the National Aeronautics and Space Administration: https://earthdata.nasa.gov/data/near-real-time-data/faq/rapid-response#rapid4).

On the next day in Figure 28, several thin plumes of dust can be seen originating from this low soil moisture area. These appear to be moving northeastward in the general direction of Lamar. It should be noted that the image in Figure 28 was taken at approximately 11:15 AM MST. By 11:36 AM MST, Lamar reported haze and a reduced visibility of 5 statute miles (Table 1).

This same storm system also produced significant blowing dust in northern Mexico, southern New Mexico and western Texas during the early morning hours of November 5, 2011. The MODIS Aqua satellite image taken at approximately 1:50 AM MST (850Z) (Figure 29) shows plumes of dust originating in northern Mexico (the lighter shaded areas to the west of Interstate 10) and spreading to the east and northeast into southern New Mexico and western Texas. Note from Figure 30 that on November 5, 2011, eight air quality monitors in Juárez, Mexico, and El Paso, Texas, recorded twenty-four hour PM_{10} concentrations in the "Moderate" to "Unhealthy for Sensitive Groups" range (55-254 µg/ m^3), with one monitor (Boulevard Zaragoza) reporting a "Very Unhealthy" concentration of 393.5 µg/ m^3. Also recall that back trajectories from Figure 25 clearly suggest that some of the PM_{10} in the atmosphere over Lamar during the late morning and early afternoon of November 5, 2011, may have been transported from the dust suspended earlier in the day in northern Mexico, southern New Mexico and western Texas.

MODIS satellite imagery shows that southeast Colorado and points to the south and southwest of Colorado were source regions for blowing dust in Lamar on November 5, 2011. This is consistent with the climatology for many dust storms in Lamar as described in Appendix A at the end of this document.

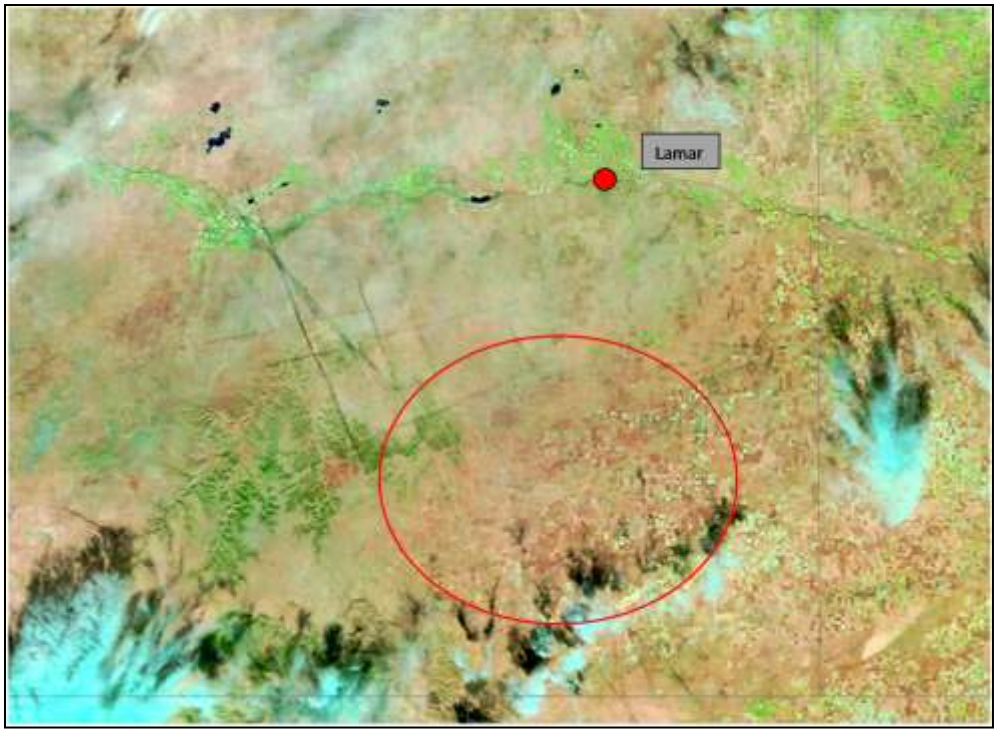


Figure 27: MODIS Terra false color satellite image of southeast Colorado at approximately 10:30 AM MST November 4, 2011.
(source: http://ge.ssec.wisc.edu/modis-today/index.php)

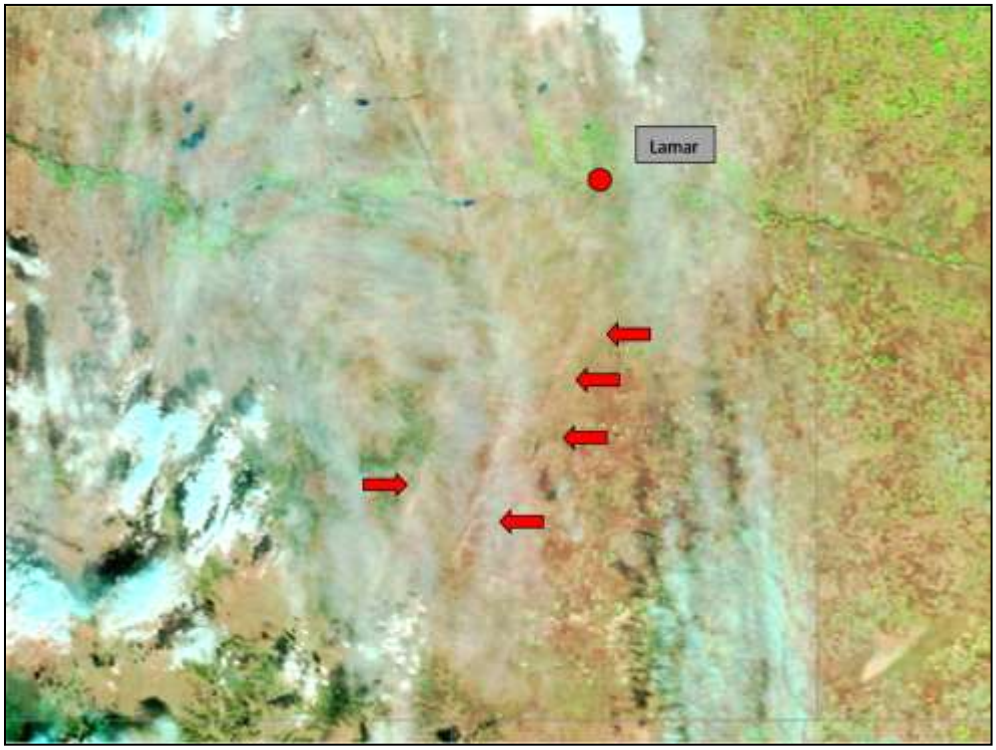


Figure 28: MODIS Terra false color satellite image of southeast Colorado at approximately 11:15 AM MST November 5, 2011.
(source: http://www.rap.ucar.edu/weather/satellite)

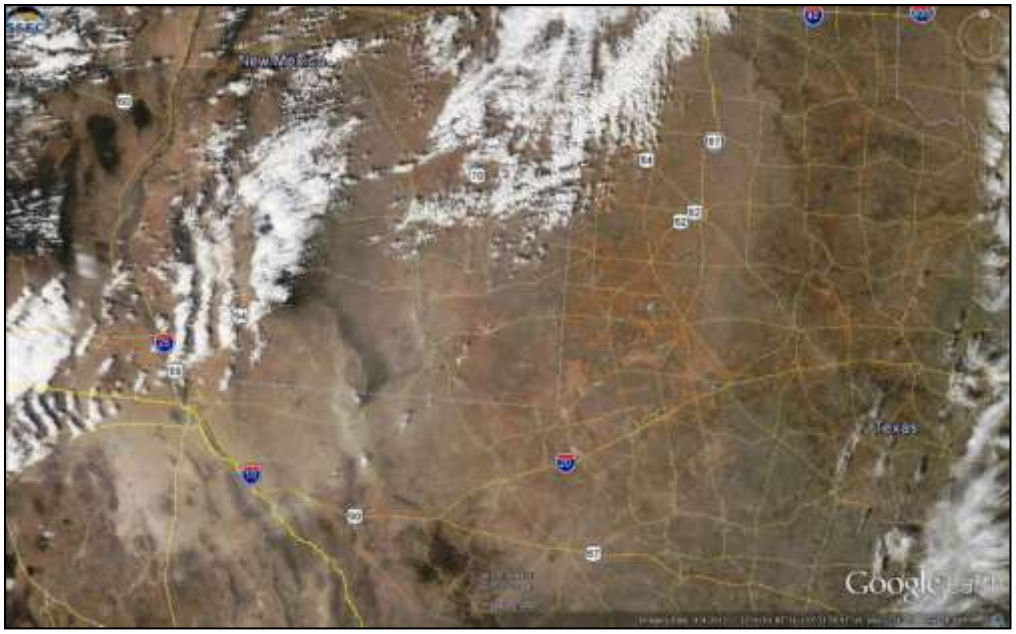


Figure 29: MODIS Aqua satellite image of the southwestern United States at approximately 1:50 AM MST (850Z) November 5, 2011.
(source: http://ge.ssec.wisc.edu/modis-today/index.php)

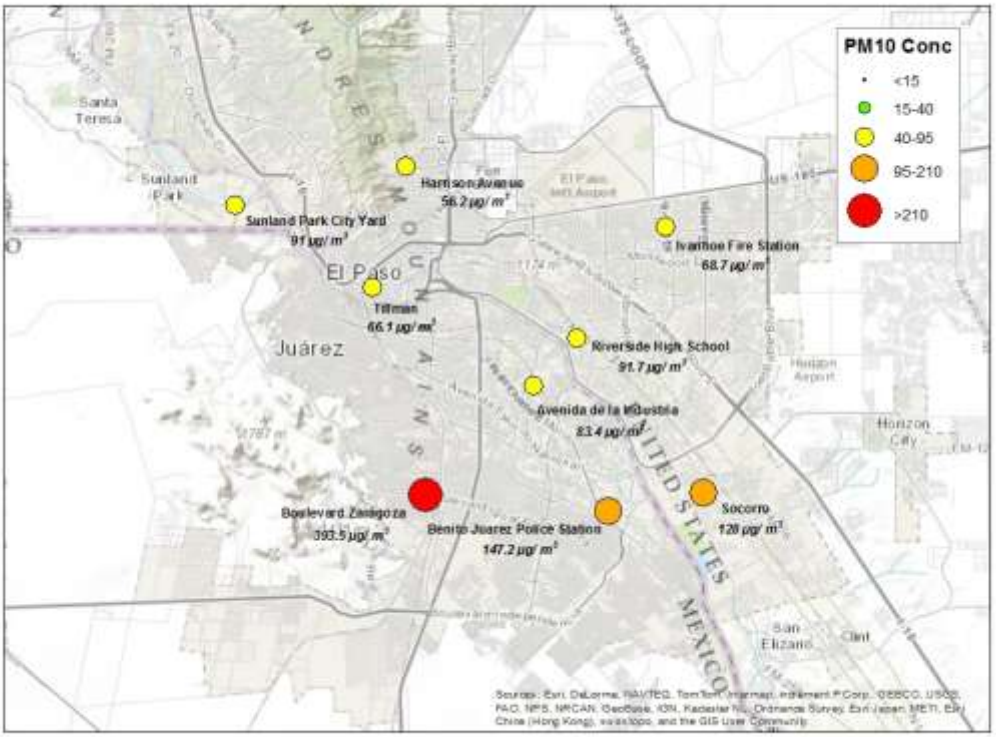


Figure 30: 24-hour PM_{10} concentrations in the El Paso, Texas/Juarez, Mexico, area for November 5, 2011.
(data source: http://webapps.datafed.net/datafed.aspx?dataset=AQS_D&parameter=pm10)

The Smoke Text Product from the National Oceanic and Atmospheric Administration (NOAA) Satellite Services Division - Descriptive Text Narrative for Smoke/Dust Observed in Satellite Imagery through 0100Z November 6 (6:00 PM MST November 5), 2011. (http://www.ssd.noaa.gov/PS/FIRE/DATA/SMOKE/2011/2011K060342.html) describes a blowing dust event in the southwestern United States. Although southeast Colorado is not mentioned in the narrative, the inclusion of many surrounding areas implies that a regional dust event took place:

> "Gusty winds along a cold front kicked up a rather extensive area of thin to moderate density blowing dust which extended from southern New Mexico/far western Texas (near and SE of El Paso)/northern Mexico to western Oklahoma and western Kansas."

NOAA scientists with expertise in the analysis of dust storms have indicated that a regional dust storm occurred in areas in close proximity to southeast Colorado and also in known source regions for Lamar blowing dust events on November 5, 2011.

Figure 31 shows the output for blowing dust from the Navy Aerosol Analysis and Prediction System (NAAPS) Global Aerosol Model for 11 AM (18Z) on November 5, 2011. The NAAPS system models blowing dust emissions and transport based on soil moisture content, soil erodibility factors and a variety of meteorological factors known to be conducive to blowing dust (for a description of NAAPS see: http://www.nrlmry.navy.mil/aerosol_web/Docs/globaer_model.html).

The forecast panel in the lower left of Figure 31 shows an area of highly elevated surface dust concentrations over much of New Mexico and southeast Colorado. This model output suggests that this drought-stricken region was a major source region for blowing dust on November 5, 2011, in Lamar.

Forecast products from the Navy Aerosol Analysis and Prediction System model provide evidence for a regional blowing dust event on November 5, 2011, suggesting that significant source regions for dust in Lamar were located in New Mexico and southeast Colorado.

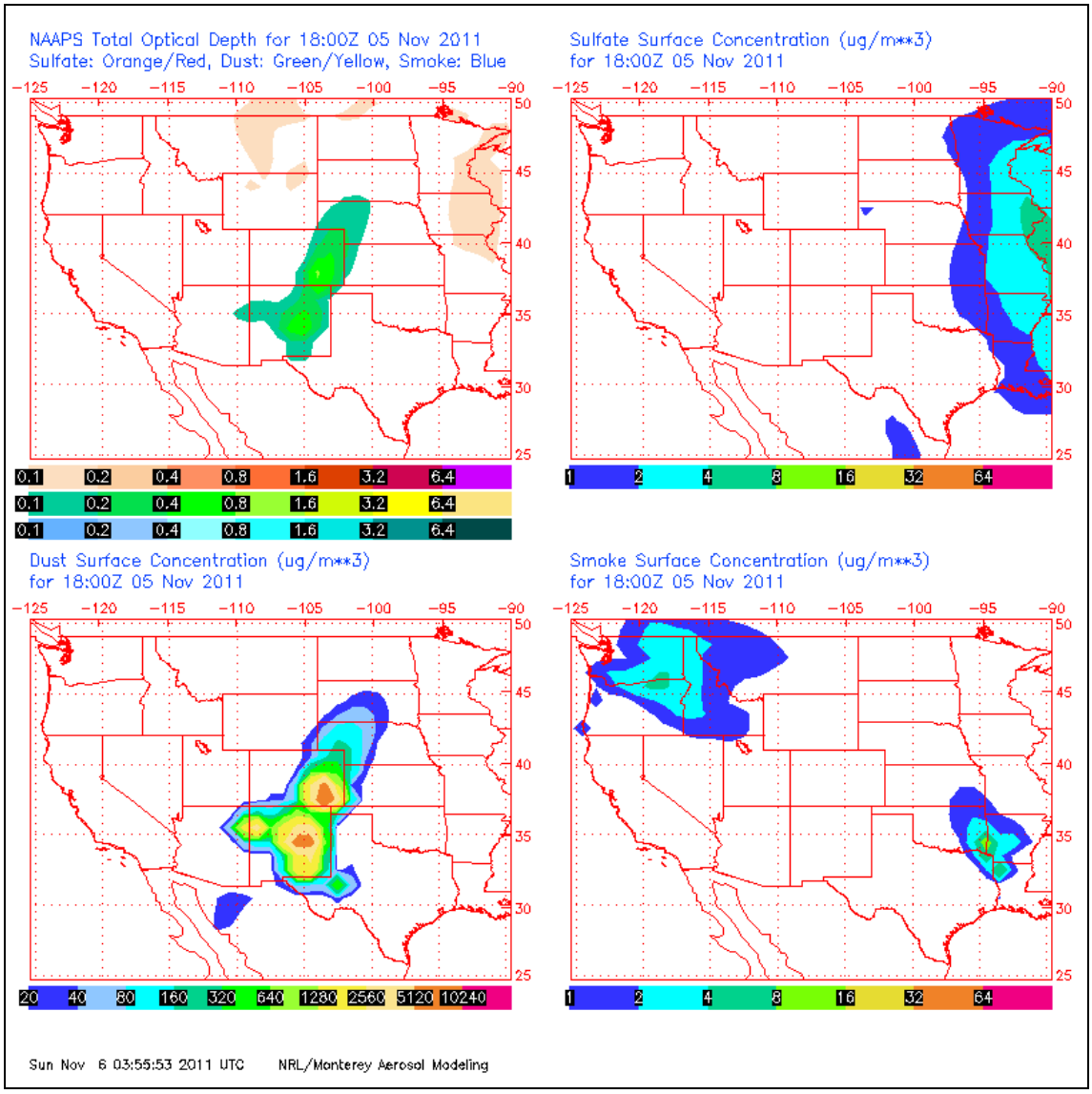
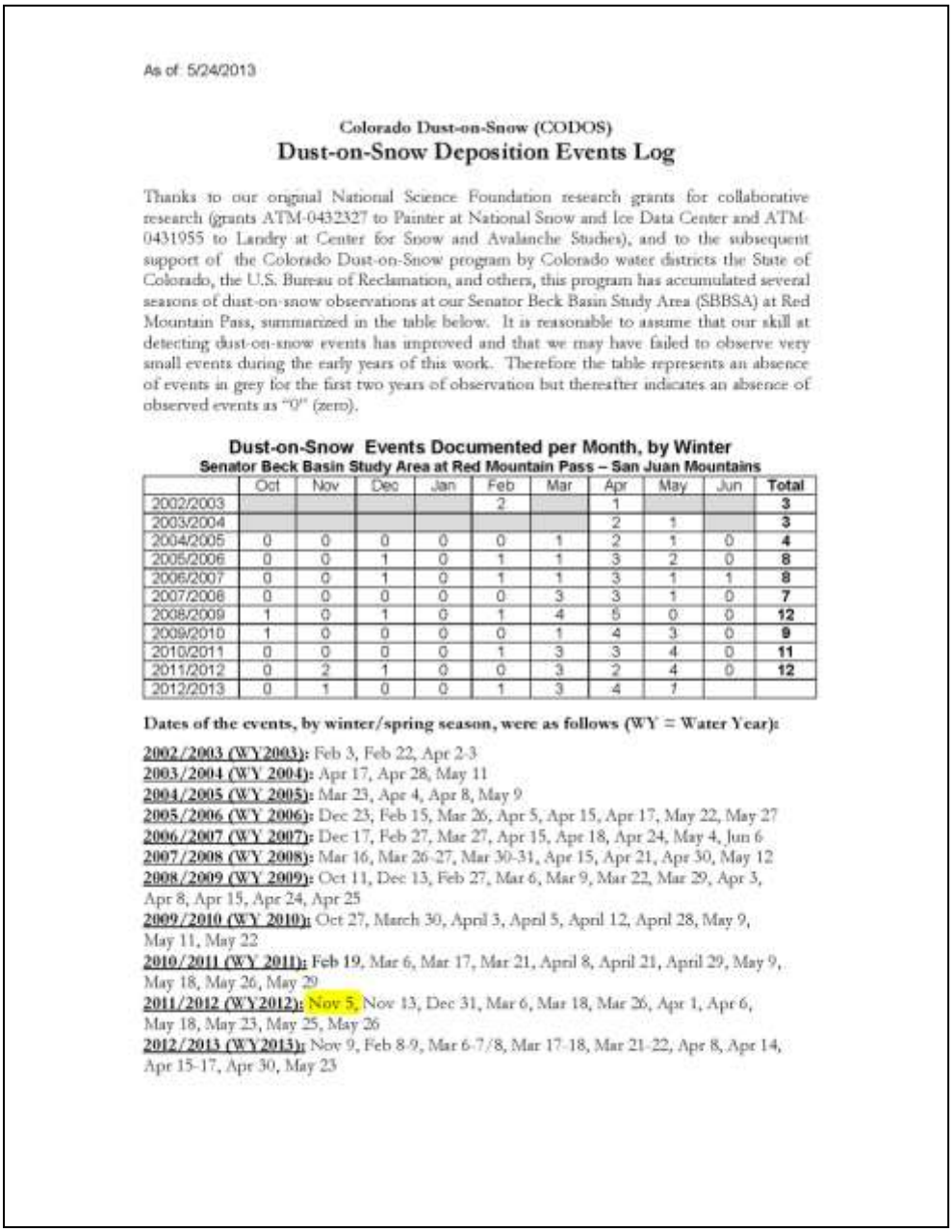


Figure 31: NAAPS forecasted dust concentrations for 11 AM MST November 5 (18Z November 5), 2011.
(source: http://www.nrlmry.navy.mil/aerosol-bin/aerosol/display_directory_all?DIR=/web/aerosol/public_html/globaer/ops_01/wus/)

The Center for Snow and Avalanche Studies has been studying the effects of wind-blown desert dust from Arizona, New Mexico and Utah on snowpack albedo and snowmelt in the San Juan Mountains of southwest Colorado for over 10 years. Figure 32 is the Center's log of events that are associated with deposits or layers of wind-blown dust on or within the snowpack at the Senator Beck Basin Study area at Red Mountain Pass. The Center for Snow and Avalanche Studies lists November 5, 2011 (highlighted in Figure 32), as a Dust-on-Snow event.

Although Red Mountain Pass is located a few hundred miles to the west of Lamar, this provides supporting evidence that a regional blowing dust event occurred in the southwestern United States on November 5, 2011.



As of 5/24/2013

Colorado Dust-on-Snow (CODOS)

Dust-on-Snow Deposition Events Log

Thanks to our original National Science Foundation research grants for collaborative research (grants ATM-0432327 to Painter at National Snow and Ice Data Center and ATM-0431955 to Landry at Center for Snow and Avalanche Studies), and to the subsequent support of the Colorado Dust-on-Snow program by Colorado water districts the State of Colorado, the U.S. Bureau of Reclamation, and others, this program has accumulated several seasons of dust-on-snow observations at our Senator Beck Basin Study Area (SBBSA) at Red Mountain Pass, summarized in the table below. It is reasonable to assume that our skill at detecting dust-on-snow events has improved and that we may have failed to observe very small events during the early years of this work. Therefore the table represents an absence of events in grey for the first two years of observation but thereafter indicates an absence of observed events as "0" (zero).

Dust-on-Snow Events Documented per Month, by Winter

Senator Beck Basin Study Area at Red Mountain Pass – San Juan Mountains

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
2002/2003					2		1			3
2003/2004							2	1		3
2004/2005	0	0	0	0	0	1	2	1	0	4
2005/2006	0	0	1	0	1	1	3	2	0	8
2006/2007	0	0	1	0	1	1	3	1	1	8
2007/2008	0	0	0	0	0	3	3	1	0	7
2008/2009	1	0	1	0	1	4	5	0	0	12
2009/2010	1	0	0	0	0	1	4	3	0	9
2010/2011	0	0	0	0	1	3	3	4	0	11
2011/2012	0	2	1	0	0	3	2	4	0	12
2012/2013	0	1	0	0	1	3	4	1		

Dates of the events, by winter/spring season, were as follows (WY = Water Year):

2002/2003 (WY2003): Feb 3, Feb 22, Apr 2-3
2003/2004 (WY 2004): Apr 17, Apr 28, May 11
2004/2005 (WY 2005): Mar 23, Apr 4, Apr 8, May 9
2005/2006 (WY 2006): Dec 23, Feb 15, Mar 26, Apr 5, Apr 15, Apr 17, May 22, May 27
2006/2007 (WY 2007): Dec 17, Feb 27, Mar 27, Apr 15, Apr 18, Apr 24, May 4, Jun 6
2007/2008 (WY 2008): Mar 16, Mar 26-27, Mar 30-31, Apr 15, Apr 21, Apr 30, May 12
2008/2009 (WY 2009): Oct 11, Dec 13, Feb 27, Mar 6, Mar 9, Mar 22, Mar 29, Apr 3, Apr 8, Apr 15, Apr 24, Apr 25
2009/2010 (WY 2010): Oct 27, March 30, April 3, April 5, April 12, April 28, May 9, May 11, May 22
2010/2011 (WY 2011): Feb 19, Mar 6, Mar 17, Mar 21, April 8, April 21, April 29, May 9, May 18, May 26, May 29
2011/2012 (WY2012): Nov 5, Nov 13, Dec 31, Mar 6, Mar 18, Mar 26, Apr 1, Apr 6, May 18, May 23, May 25, May 26
2012/2013 (WY2013): Nov 9, Feb 8-9, Mar 6-7/8, Mar 17-18, Mar 21-22, Apr 8, Apr 14, Apr 15-17, Apr 30, May 23

Figure 32: Dust-on-Snow Deposition Events Log at the Senator Beck Basin Study Area at Red Mountain Pass, Colorado.
(source: http://www.snowstudies.org/dust/SBBSA/summary_2013.html)

In a 1997 paper, "Factors controlling threshold friction velocity in semiarid and arid areas of the United States" (Marticorena et al., 1997), the authors characterized the erodibility of both disturbed and undisturbed desert soil types. The threshold friction velocity, which is described in detail in this paper, is a measure for conditions necessary for blowing dust and is higher for undisturbed soils and lower for disturbed soils.

Friction velocities have been calculated for 11 AM MST November 5, 2011, using the 12 km NAM (North American Mesoscale Model). These friction velocities are presented in Figure 33. According to Marticorena et al. (1997), even undisturbed desert soils normally resistant to wind erosion will be susceptible to emission of blowing dust when threshold friction velocities are greater than about 1.0 to 2.0 meters per second. In Figure 33, a wide area of southeast Colorado, southern and eastern New Mexico, western Texas and northern Mexico had friction velocities above 1.0 meters per second. This is the same area where 30-day precipitation totals were near or below 0.5 inches (Figure 20 and Figure 21) and which back trajectories from Figure 25 identify as a source region for air transported into Lamar. Note that blowing dust will typically only occur where friction velocities are high and soils are dry and not protected by vegetation, forest cover, boulders, rocks, etc. This is an accurate description of much of the terrain to the south and southwest of Lamar extending into northern Mexico. Therefore, it appears very likely that undisturbed soils in the desert and more arid regions of southeast Colorado and points to the south and southwest were a large contributor to the blowing dust that occurred in Lamar.

The elevated friction velocities shown in Figure 33, the data on soil moisture conditions presented elsewhere in this report and the prevalence of winds above blowing dust thresholds (all occurring in traditional source regions in southeast Colorado and areas to the south and southwest of Colorado) prove that this dust storm on November 5, 2011, was a natural event that was not reasonably controllable or preventable.

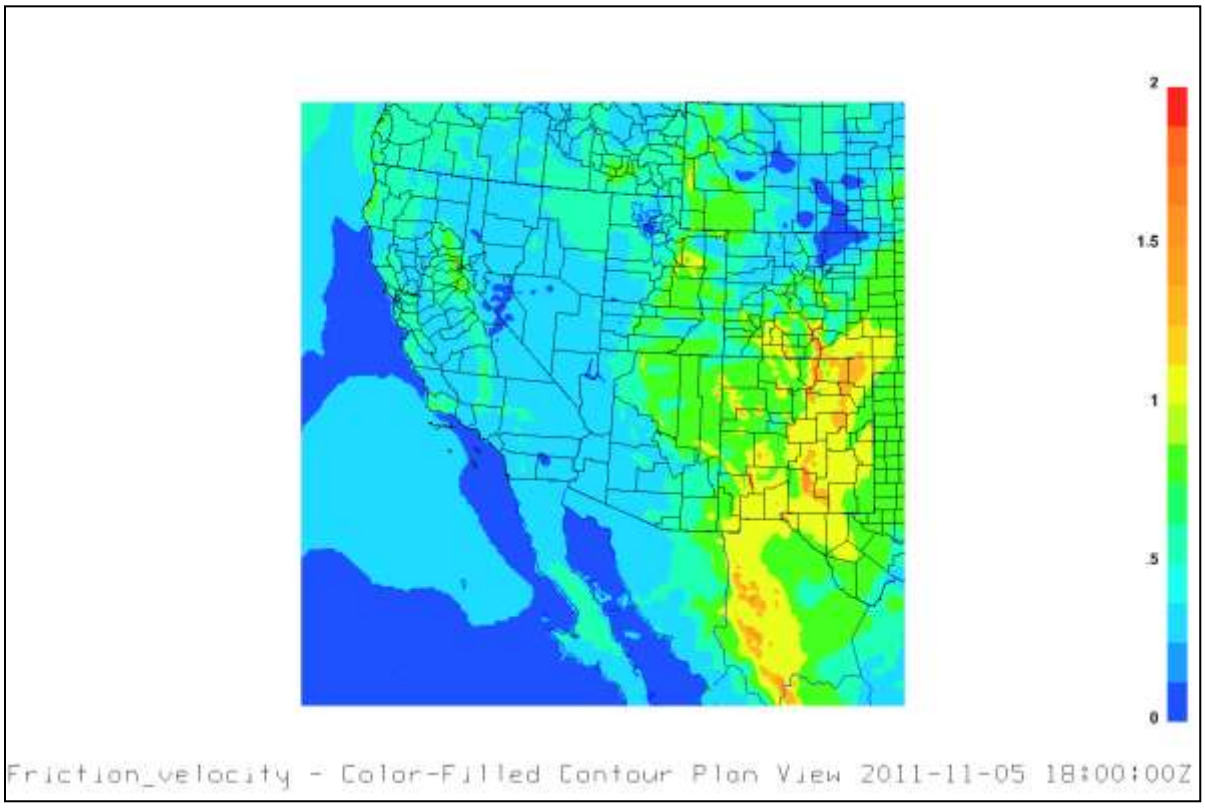


Figure 33: 12 km NAM friction velocities in meters/second at 11 AM MST November 5 (18Z November 5), 2011.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

3.0 Evidence-Ambient Air Monitoring Data and Statistics

On November 5 of 2011, an exceedance of the twenty-four hour PM_{10} standard occurred in Lamar, Colorado, at the Power Plant monitor with a concentration of 192 µg/ m^3. The PM_{10} exceedance in Lamar on November 5, 2011, would not have occurred if not for the following: (a) dry soil conditions over southeast Colorado, southern and eastern New Mexico, western Texas, and northern Mexico with 30-day precipitation totals below were near or below 0.5 inches (Figure 20 and Figure 21); (b) a combination of synoptic and mesoscale weather events; (In the synoptic scale, high winds were produced throughout much of the region by a vigorous cold front and surface low pressure system associated with an upper-level trough. Contributing at the smaller mesoscale were very strong outflow winds from collapsing thunderstorms.) (c) friction velocities over a wide area of southeast Colorado, southern and eastern New Mexico, western Texas and northern Mexico that were high enough to allow entrainment of dust from natural sources with subsequent transport of the dust to southeastern Colorado in strong winds.

For maps of the Colorado and southwestern PM_{10} monitoring sites and all valid PM_{10} concentrations on November 5, 2011, see Figure 1. Section 2 provides the meteorological evidence for this regional blowing dust event.

The APCD reviewed PM_{10} monitoring data in southeastern Colorado in the path of the dust storm (see Section 3.1). The PM_{10} concentrations at the Lamar Power Plant were compared using a time series plot for a number of days pre and post event. The time series graph (shown in Figure 34) clearly shows that the regional blowing dust storm adversely affected the air quality in Lamar on November 5, 2011. PM_{10} samples the day before and the day after the event were typical of samples at the affected site.

3.1 Historical Fluctuations of PM_{10} Concentrations in Lamar

This evaluation of PM_{10} monitoring data for sites affected by the November 05, 2011, event was made using valid samples from PM_{10} samplers in Lamar from 2006 through 2011. The overall data summary for the affected sites is presented in Table 15 (all data values are presented in µg/m^3):

Table 15: November 05 2011, Event Data Summary

Evaluation	*Lamar Power*	*Lamar Municipal*
11/05/13	**192**	122
Mean	27.2	20.7
Median	23	18
Mode	16	14
St. Dev.	20.1	13.3
Variance	403.3	175.6
Minimum	1	1
Maximum	367	176
Count	2181	2105

The spatial scope of this event, addressed elsewhere in this document, was broad and had an impact on PM_{10} concentrations at the only samplers in the path of the event. A snapshot summary of data from both Lamar sites is presented in Table 16, along with the approximate percentile value that data point represents for each site for their unique historical data sets, for the month of the event (every sample in any November), and for the year of the event. All percentile calculations presented in this section were made using the entire dataset, including known high wind events. There is no difference between the two

datasets (with and without high wind events) in regards to percentile calculations. Percentile calculations for all sites affected by the event are presented in Table 16. Only the sample in Lamar Power will be discussed in detail.

Table 16: November 05, 2011, Site Percentile

Evaluation	*Lamar Power*	*Lamar Municipal*
11/5/2011	**192**	**122**
Overall	99.9%	99.8%
All November	Max Value	Max Value
2011	Max Value	Max Value

The Lamar Power sample of 192 µg/m^3 is the highest concentration sample in 2011, the highest sample in any November and the fourth highest in the dataset. Additionally, the sample at Lamar Municipal of 122 µg/m^3 is exceptional within that datasets for any evaluation criteria. The overall magnitude and broad geographical extent of the event suggests that there was a common contribution to each sample from other than local sources.

The Lamar Power data set is further summarized by month. As with previous submittals these summaries the data presents no obvious 'season'; PM_{10} levels at any particular site in Colorado do not necessarily fluctuate by season. Of greater importance affecting day-to-day, typical PM_{10} concentrations are local sources, e.g. road sanding and sweeping, local burning from agriculture and residential heating, vehicle contributions via road dust, unpaved lots or roads, etc. While the historic monthly median values for the Lamar Power site can be higher during the winter and spring months there is little month-to-month variation. Additionally, some of the sites exhibit monthly medians over these periods (winter and early spring) that are generally lower than other months of the year. This time frame (winter and early spring) is that which is most likely to experience the regional meteorological and dry soil conditions necessary for this type of event and are discussed elsewhere in this document. Although the maximum values for these months (winter and early spring) are the highest in the data set the 'typical' data (i.e. day-to-day, reflective of local conditions) are similar or lower than the same 'typical' data for the rest of the year. The summary data for the month of November (all samples in any November from 2006 - 2011) and for 2011 for both Lamar sites are presented in Table 17.

Table 17: November 05, 2011, PM_{10} Evaluation by Month and Year

	Lamar Power		*Lamar Municipal*	
	November	2011	November	2011
Mean	31.3	27.5	21.4	21.3
Median	27	23	19	18
Mode	21	17	17	16
St. Dev.	20.7	20.3	13.8	15
Variance	428.2	411.7	190.7	226.4
Minimum	5	5	5	4
Maximum	192	192	122	122
Count	176	365	173	349

Lamar Power - 080990001

The PM_{10} sample on November 05, 2011, at Lamar Power of 192 µg/m^3 is the largest sample recorded among all November samples, is the maximum value for all 2011 data, and is the fourth largest sample value for the entire dataset. The three samples greater than the event sample are all associated with a high wind event. There are 2181 samples in this dataset. The sample of November 05, 2011, clearly exceeds the typical samples for this site.

Figure 34 through Figure 37 graphically characterize the Lamar Power PM_{10} data and demonstrate the extent to which the event sample is exceptional. The first, Figure 34, is a simple time series; both samples in this dataset (2006 – 2011) greater than 150 µg/m^3 are identified. Note the overwhelming number of samples occupying the lower end of the graph; an interested reader can count the number of samples greater than 100 µg/m^3. Of the 2181 samples in this data only slightly more than 1% are greater than 100 µg/m^3.

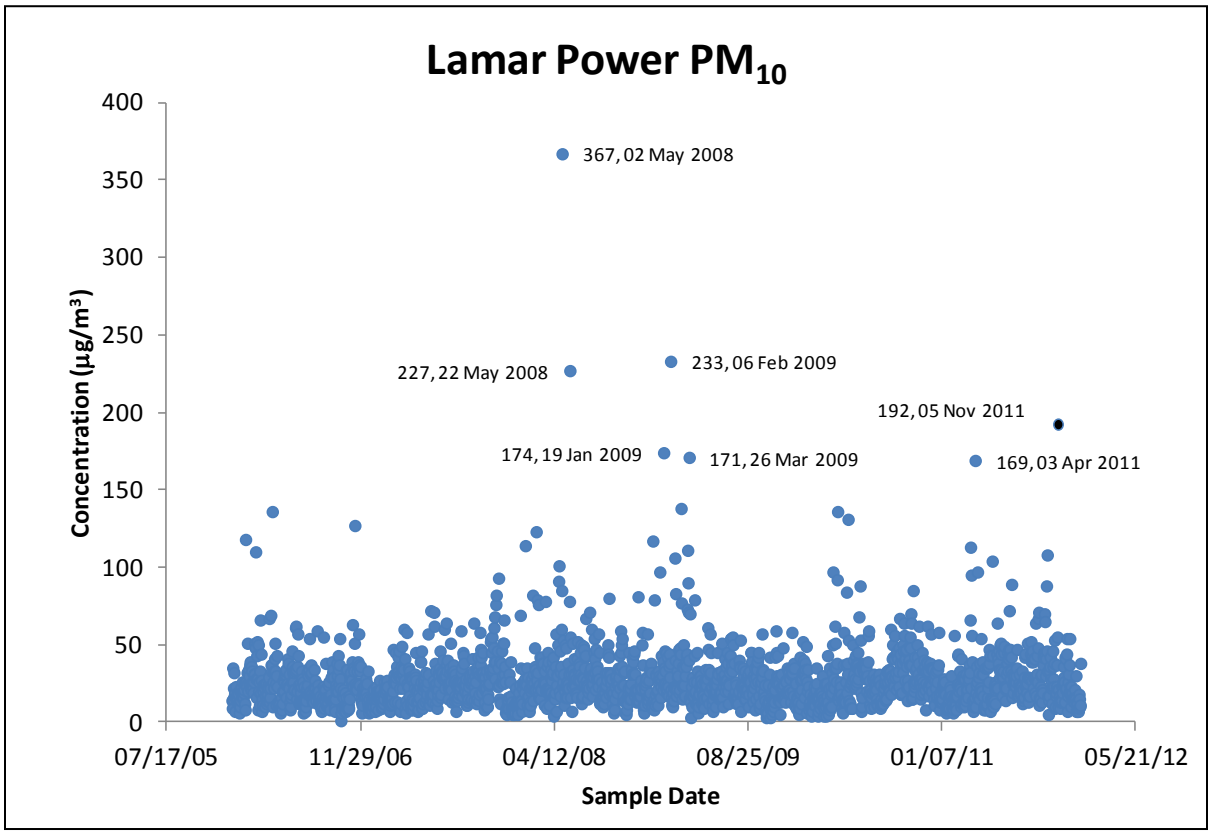


Figure 34: Lamar Power PM_{10} Time Series

The next chart, Figure 35, a simple histogram of the entire dataset, demonstrates the overwhelming weight of samples on the low end of the curve. This range of data can be considered typical, representing contributions from local sources. Nearly 75% of the samples in this data set are less than 20 µg/m^3. Clearly the sample of November 05, 2011, exceeds what is typical for this site.

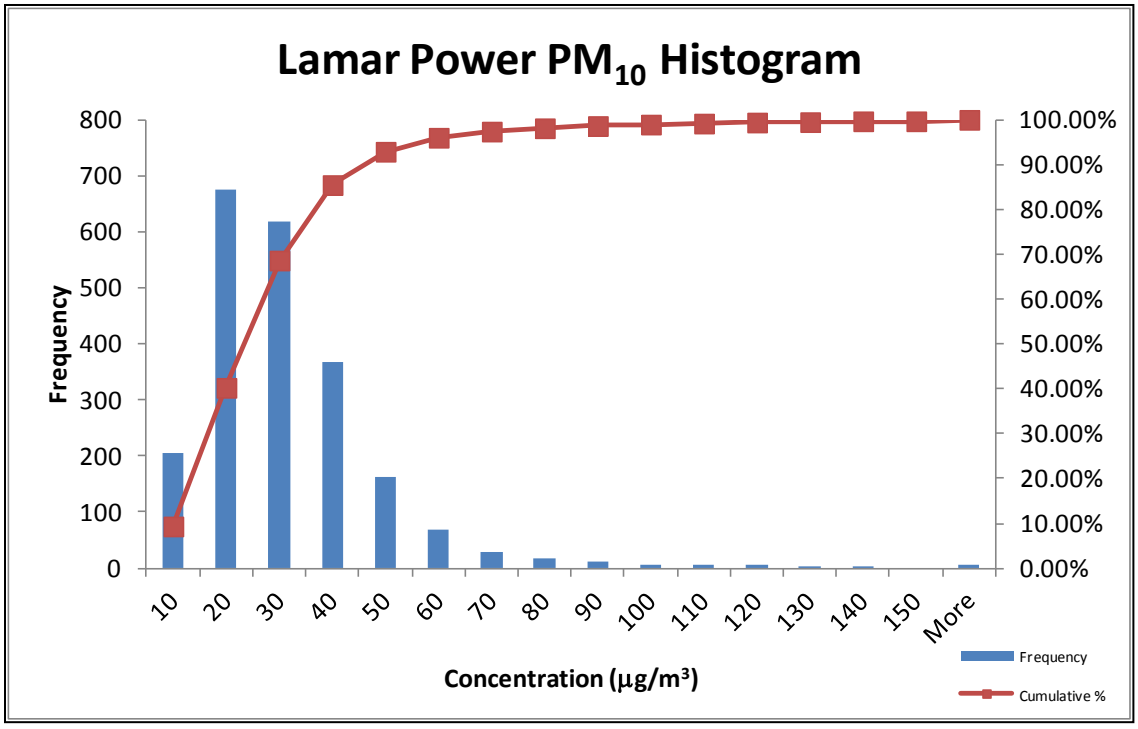


Figure 35: Lamar Power PM_{10} Histogram

The monthly box-whisker plot in Figure 36 highlights the consistency of the majority of data from month to month. Note the greater variability (wider inner-quartile range) and greater range of the data through the winter and early spring months that's accompanied by typically greater monthly maxima. Recall, this time period experiences a greater number of days with meteorological conditions similar to those experienced on November 05, 2011. Even in the highly variable months of winter and early spring over 90% of the samples are less than 50 µg/m^3. Although the relatively small number of high values affect the variability and central tendency (average) of the dataset they aren't representative of what is typical at the site.

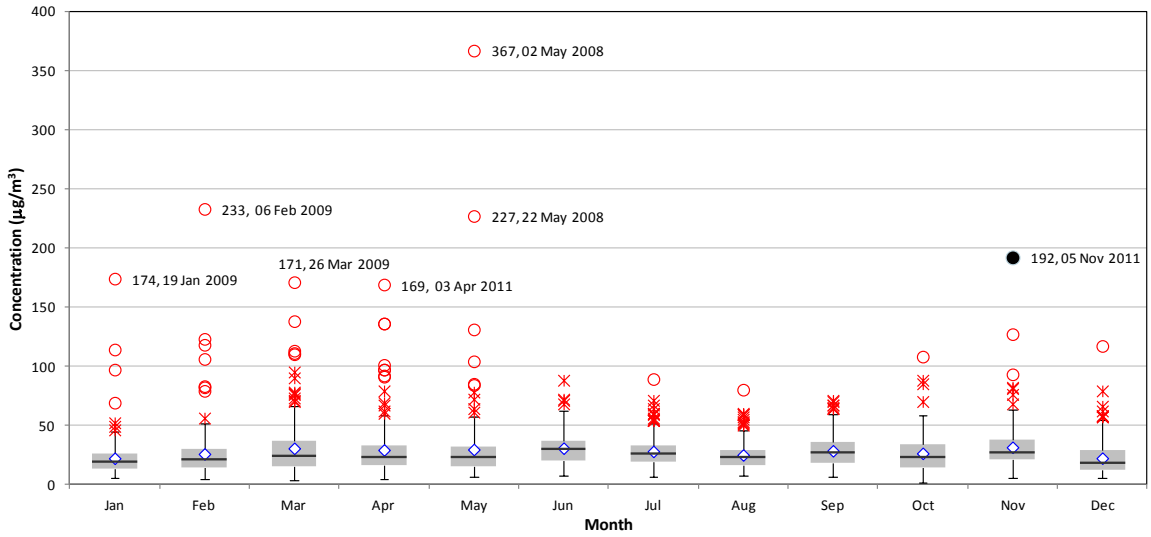


Figure 36: Lamar Power PM_{10} Box-Whisker Plot

The box-whisker plots graphically represent the overall distribution of each data set including the mean ( ), the inner quartile range (IQR, defined to be the distance between the 75th% and 25th%), the median (represented by the horizontal black line) and two types of outliers identifed in these plots: outliers greater than 75th% +1.5*IQR ( )and outliers greater than 75th% + 3*IQR ( ). The outliers that satisfy the last criteria and are greater than 150 µg/m^3 are labeled with sample value and sample date. Each of these outliers is associated with a known high-wind event similar to that of 05 April.

The presence of the extreme values distorts the graph, losing definition and distorting information presented across the range where the majority of data resides. The same plot graphed to 100 µg/m^3, which includes almost 99% of all the data, is presented in Figure 37.

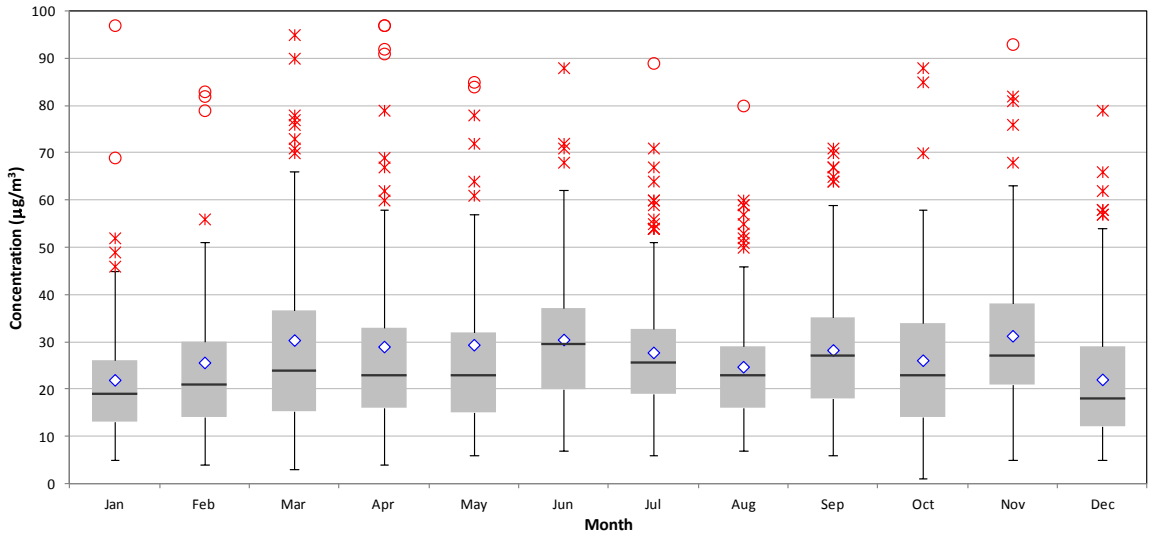


Figure 37: Lamar Power PM_{10} Box-Whisker Plot, Reduced Scale

Note the degree to which the data in November are skewed. The November mean (31.3 µg/m^3) is greater than the November median value (27 µg/m^3). This is due to the presence ofa handful of relatively large values. The typical November data is 'dirtier' than other months as measured by the median, but the degree is only a few □g/m^3. The sample of November 05, 2011, clearly exceeds the typical data at this site.

3.2 Wind Speed Correlations

Wind speeds around the region (Southeast Colorado, Western New Mexico) increased early in the morning November 05 and stayed elevated throughout most of the day, gusting to speeds in excess of 40 mph. The following charts display wind speed (mph) as a function of date from four widely dispersed stations throughout the region. Every one of these stations, despite being in completely disparate locations, exhibits similar behavior in regards to the sustained high winds on November 05, 2011.

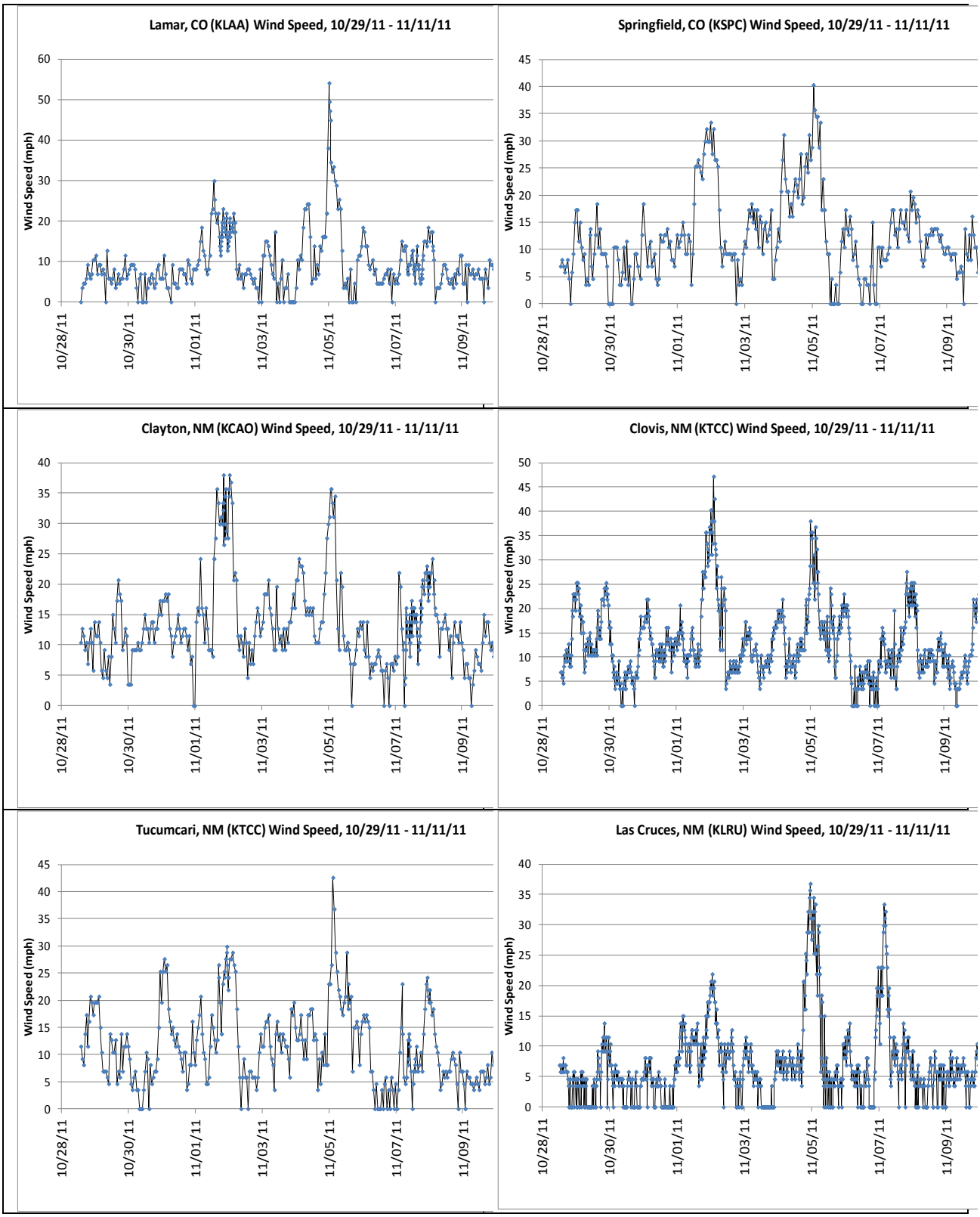


Figure 38: Wind Speed (mph) Various Stations, 04/08/2013 – 04/23/2013

Figure 39 plots PM_{10} concentrations from the Lamar sampling sites for the period for seven days prior to and following the samples of November 05, 2011.

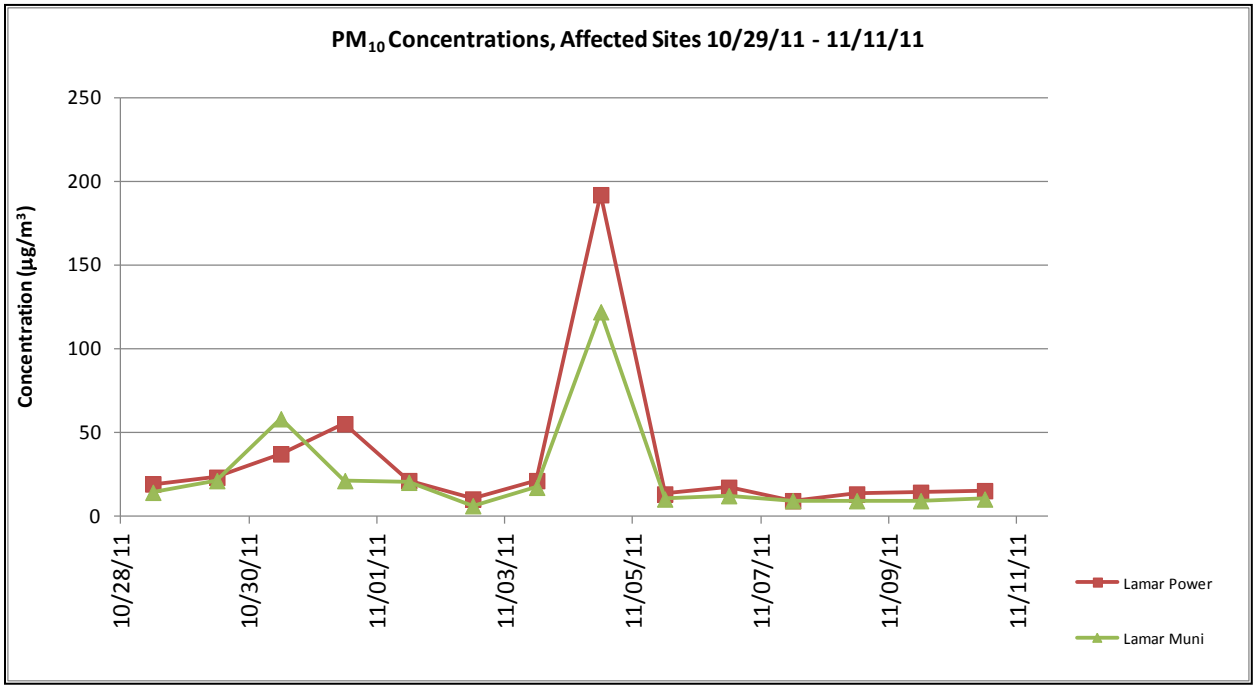


Figure 39: PM_{10} Concentrations, Affected Sites, 10/29/2011 – 11/11/2011

Figure 39 largely mimics the plots for wind speed, suggesting an association between the regional high winds and PM_{10} concentrations at Lamar sampling sites. Although both Lamar samples are not in excess of 150 µg/m^3 the elevated concentrations are clearly associated with the elevated wind speeds. Given the spatial dislocation of the sites (meteorological and PM_{10}) the relationship between the two data sets would suggest that the regional high winds had an effect on PM_{10} samples in Lamar on November 5, 2011.

3.3 Percentiles

Monthly percentile plots in Figure 40 demonstrate a high degree of association between monthly median values and relatively high monthly percentile values, e.g. the r^2 value between the Lamar Power PM_{10} site monthly 85th percentile value and the monthly median is 0.79. As the percentile value decreases (i.e. 85%, 75%, etc) the correlation between those values and the median increases sharply.

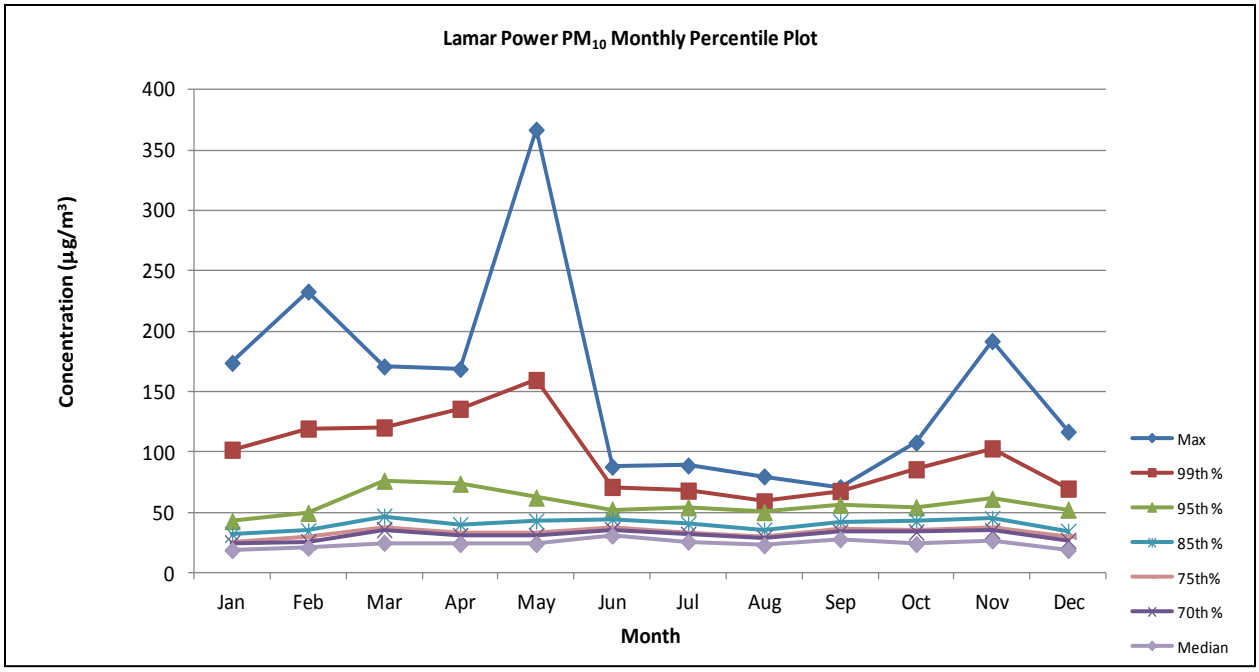


Figure 40: Lamar Power Monthly PM_{10} Percentile Plots

It is certainly the case that monthly median values are indicative of typical, day to day concentrations. Additionally, there is a range of samples that are a product of normal variation subject to typical, day to day local effects. This range may be restricted to percentile values that are well correlated with the median. For the data set of concern the percentile value that is reflective of typical, day to day variation is the 70th percentile value (r^2 = 0.87). Nearly all of the variation in the monthly 70th percentile values of this data set can be explained by the variation in monthly median. In contrast, a reasonable estimate of the contribution to the event from local sources for these data sets may be the monthly 85th percentile values (r2 = 0.80). The portion of the sample concentration remaining from these monthly percentile values would be the sample contribution due to the event. Table 18 identifies various percentile values that are representative of the maximum contribution due to local sources from Lamar selected from all November data. In Table 18, the range estimate in the 'Est. PM_{10} Contribution' column is derived using the difference between the actual sample value and the 85th percentile as the minimum (reasonable) event contribution estimate and the difference between the actual sample value and the 70th percentile as the maximum (conservative) event contribution estimate. The last column represents the range of estimated contribution to the November 05, 2011, Lamar sample from the high wind event.

Table 18: Estimated Maximum Event PM_{10} Contribution – Lamar Power

Site	Event Day Concentration (mg/m^3)	November Median (mg/m^3)	November Average (mg/m^3)	November 70th % (mg/m^3)	November 85th % (mg/m^3)	Est. Conc. Above Typical (mg/m^3)
Lamar Power	192	27	31.3	35	45	**147 - 157**

Since the local anthropogenic sources are well controlled in Lamar and the sustained surface wind speeds were well above 25 mph in the region, it follows that the dust was transported into the region on November 5, 2011. The size, extent, and origination of the blowing dust storm made the event not preventable and it could not be reasonably controlled. Statistical data clearly shows that but for this high wind blowing dust event, Lamar would not have exceeded the 24-hour NAAQS on November 5, 2011.

Clearly, there would have been no exceedance on November 5, 2011 at the Lamar Power Plant site but for the additional contribution to the PM_{10} samples provided by the event.

4.0 News and Credible Evidence

What a Windy Weekend

Russ Baldwin | Nov 11, 2011 | Comments 0

A lot of tumbleweeds got a chance to change their location in southeast Colorado this past Saturday, with wind gusts approaching 60 mph for a portion of the afternoon.

As usual, trash cans went rolling down the alleyways, some shingles went sailing from neighborhood roofs, a lot of autumn leaves were stripped from the trees earlier than expected and high school football and a college soccer game was played in less than favorable conditions. Dry dust was evident in some farmland areas, as the distant view of various landmarks were obscured off and on.

Strong winds tipped an 18 wheeler on its side a few miles west of Granada on Highway 50 Saturday afternoon, but there were no injuries reported at the time, although the local Haz-Mat Team, the Prowers County Sheriff's Deputies and Rural Fire Department responded, as did the Lamar Ambulance and Colorado State Patrol. The highway was briefly shut off to traffic while the accident was cleared.

Meanwhile up in the dusty skies, an Osprey aircraft didn't seem bothered by the winds one bit on Saturday, as the rototilt aircraft was using the Lamar Airport for various maneuvers. Airport staff said the combination plane/helicopter had been making practice landings and take-offs since Friday. Both the Marines and Air Force employ the vehicle, of which around 109 were manufactured, and some have seen service in the Far East. The plane, known as a VTOL type, for vertical take-off and landing, had no apparent problem holding steady in the southerly gales as it hovered several dozen feet above the runway. Because the engine nacelles on the wings tilt forward or straight up, the aircraft has no need for a lengthy runway in order to land or take off.

By Russ Baldwin
Photo and Video by Russ Baldwin

http://secolo-media.com/prowers/2011/11/11/what-a-windy-weekend/

CLASS A 8-MAN STATE FOOTBALL PLAYOFFS

Walsh, Springfield take aim at quarterfinals

Kevin Shaffer/Colorado Preps
Posted: 11/10/2011 08:26:29 AM MST

Walsh junior running back Terrell Stafford turned in a sterling performance as he rushed for 195 yards on 15 attempts and scored five touchdowns as the Eagles sailed to a 48-8 blowout victory over the Sanford Indians in first-round action of the Class A 8-man state playoffs on Saturday, Nov. 5. Walsh (9-1) will travel to face Norwood (9-1) in the state quarterfinals at 1 p.m. on Saturday, Nov. 12. (Pam Cogburn)

WALSH (9-1) AT NORWOOD (9-1)

For the second straight year, the Walsh Eagles and Norwood Mavericks meet in the Class A 8-man state quarterfinals.

And for the second time, Walsh will travel to Norwood where the Eagles will look to avenge a 42-28 loss to the Mavericks a year ago.

This year's rematch is expected to be as hard fought. Both teams suffered their lone loss to Hoehne. Walsh fell to the Farmers 43-6 in the season opener but has won nine straight since. Norwood came up short to the defending state champs 38-29 in Week 5.

Springfield quarterback Michael Crane eludes a Haxtun defender as he looks to pass during first-round action of the Class A 8-man state playoffs last Saturday, Nov. 5. On a windy and dusty day in Springfield, the Longhorns won 35-0 to advance to the state quarterfinals. The Longhorns (9-1) will entertain undefeated Dayspring Christian (10-0) on Saturday, Nov. 12 at 1 p.m. (Rob Dunlap)

Norwood has been nearly unstoppable since the loss to the Farmers. They've beaten Plateau Valley, Mancos, Dove Creek, Sierra Grande and Sangre De Cristo by a combined score of 262-14 and posted four shutouts. Even though that schedule has been light, the Mavericks have jumped to early 40 point leads and not allowed opponents to even believe they have a chance for the upset.

Complete statistics for Norwood were not available but main threats include senior running back Brandon Kennedy. He hopes to lead the Mavericks past Walsh and into the semifinals for a third straight year. Kennedy leads an offense averaging nearly 49 points a game and a defense surrendering only 8.6.

Walsh was most impressive this year with a 14-10 victory over rival Springfield to clinch the Arkansas Valley Conference championship in the regular season finale for both teams.

The Eagles held the Longhorns to only one touchdown but did allow 216 yards on the ground. They'll need as good or an even better performance on Saturday to avenge last year's playoff loss.

Walsh clipped Sanford 48-8 in the first-round behind junior running back Terrell Stafford who rushed for 195 yards on 15 attempts and scored five touchdowns on runs of 18, 26, 9, 3, and 74 yards.

Last week while Norwood dropped Sangre De Cristo 53-0.

The Mavericks as mentioned are gunning for a berth in the semifinals for a third straight year. They lost to Caliche, 41-0, in the semifinals last year and to Dayspring Christian in 2009. The Mavericks have never won a state title and last played for the championship in 1956.

Walsh won a state championship as recently as 2001 when they crushed Merino, 50-28, and that is also the last season they reached the semifinal round.
http://www.lamarledger.com/ci_19299173

Wind Storm Batters Southern Colorado

Damage Reported In Custer, Fremont, Las Animas Counties

KRDO.com Staff
POSTED: 03:39 AM MST Nov 13, 2011 UPDATED: 04:00 AM MST Nov 13, 2011
WESTCLIFFE, Colo. -
Powerful winds battered much of Southern Colorado over the weekend.

The worst of the storm hit overnight Saturday into Sunday.

KRDO viewers reported damage in Custer, Fremont, and Las Animas County.

Custer County Sheriff Fred Jobe tells KRDO NewsChannel 13 that two unofficial weather spotters who he deems reliable measured wind gusts of 115 mph and 125 mph respectively.

In Custer County, 75 power poles were snapped, some sheds and barns were destroyed, and there were even reports of trees crashing down onto homes.

Tree damage is reportedly widespread across the county.

Sheriff Job tells KRDO NewsChannel 13 that at one point, much of the county lost electricity.

Most Blackhills Energy customers have since had their power restored.

Some Sangre De Christo Electric Customers were still without power Sunday evening, including in the community of Rosita.

Sheriff Job says that Sangre De Christo customers who do not have electricity yet may not have their service restored for several days.

KRDO viewers also reported extensive damage in Stonewall, which is west of Trinidad in Las Animas County.

http://www.krdo.com/news/Wind-Storm-Batters-Southern-Colorado/-/417220/14817648/-/6twdy6z/-/index.html

Yes, it was windy!

- *November 6, 2011*
- **Tim**
- Skyview Weather

Strong winds occurred across the eastern plains of Colorado on Saturday, with the strongest winds in the southeastern areas of the state. Here are some of the wind gusts reported:

```
..TIME...   ...EVENT...      ...CITY LOCATION...     ...LAT.LON...
..DATE...   ....MAG....      ..COUNTY LOCATION..ST.. ...SOURCE....
            ..REMARKS..

0557 PM     NON-TSTM WND GST 1 WNW COLORADO CITY     37.95N 104.86W
11/05/2011  M64.00 MPH       PUEBLO             CO   MESONET

            COLORADO CITY RAWS SENSOR.

0530 PM     NON-TSTM WND GST 3 S AIR FORCE ACADEMY   38.94N 104.86W
11/05/2011  M62.00 MPH       EL PASO            CO   MESONET

0442 PM     NON-TSTM WND GST 3 ESE HOEHNE            37.26N 104.34W
11/05/2011  M69.00 MPH       LAS ANIMAS         CO   ASOS

            TRINIDAD ASOS

0435 PM     NON-TSTM WND GST 6 S COLORADO CITY       37.86N 104.85W
11/05/2011  M76.00 MPH       HUERFANO           CO   MESONET

0407 PM     NON-TSTM WND GST 9 NNW WALSENBURG        37.75N 104.84W
11/05/2011  M65.00 MPH       HUERFANO           CO   MESONET

0359 PM     NON-TSTM WND GST 4 SW CAMPO              37.06N 102.63W
11/05/2011  M68.00 MPH       BACA               CO   MESONET

            UTE CANYON RAWS

0214 PM     SNOW             1 SSE WOLF CREEK PASS   37.47N 106.79W
11/05/2011  M12.0 INCH       MINERAL            CO   PUBLIC

0153 PM     NON-TSTM WND GST 7 SSE SPRINGFIELD       37.31N 102.59W
11/05/2011  M58.00 MPH       BACA               CO   ASOS

0101 PM     NON-TSTM WND GST 25 S LAMAR              37.72N 102.62W
11/05/2011  M72.00 MPH       PROWERS            CO   MESONET
```

```
            GOBBLERS KNOB CDOT SENSOR

1236 PM     NON-TSTM WND GST 4 W LAMAR               38.07N 102.69W
11/05/2011  M68.00 MPH       PROWERS           CO    ASOS

1200 PM     NON-TSTM WND DMG 10 E LAMAR              38.08N 102.43W
11/05/2011                   PROWERS           CO    LAW ENFORCEMENT

            SEMI TRUCK BLOWN OFF HIGHWAY 50 AT MILE MARKER 447 AROUND
            NOON.

1143 AM     NON-TSTM WND GST 4 W LAMAR               38.07N 102.69W
11/05/2011  M63.00 MPH       PROWERS           CO    ASOS

1138 AM     NON-TSTM WND GST 5 NNE LA JUNTA          38.05N 103.51W
11/05/2011  M60.00 MPH       OTERO             CO    ASOS

1118 AM     NON-TSTM WND GST 3 WNW SWINK             38.03N 103.67W
11/05/2011  M60.00 MPH       OTERO             CO    TRAINED SPOTTER

1016 AM     NON-TSTM WND GST 12 NE TRINIDAD          37.29N 104.35W
11/05/2011  M60.00 MPH       LAS ANIMAS        CO    ASOS
```

Leave a Reply

http://www.skyviewweather.com/2011/11/06/yes-it-was-windy/

5.0 Not Reasonably Controllable or Preventable: Local Particulate Matter Control Measures

While it is likely that some dust was generated within the local communities as gusts from the regional dust storm passed through the area, the amount of dust generated locally was easily overwhelmed by, and largely unnoticeable as compared to the dust transported in from southern and eastern New Mexico, western Texas, and northern Mexico. The following sections will describe in detail the regulations and programs in place designed to control PM_{10} in Lamar. These sections will demonstrate that the event was not reasonably controllable, as laid out in Section 50.1(j) of Title 40 CFR 50, within the context of reasonable local particulate matter control measures. As shown from the meteorological and monitoring analyses (Sections 2 and 3), the source region for the associated dust that occurred during the November 5, 2011, event originated outside of the monitored areas, primarily from southern and eastern New Mexico, western Texas, and northern Mexico.

The APCD conducted thorough analyses and outreach with local governments to confirm that no unusual anthropogenic PM_{10}-producing activities occurred in Lamar and that despite reasonable control measures in place, high wind conditions overwhelmed all reasonably available controls. The following subsections describe in detail Best Available Control Measures (BACM), other reasonable control measures, applicable federal, state, and local regulations, appropriate land use management, and an in-depth analysis of potential areas of local soil disturbance for Lamar during the November 5, 2011, event. This information shall confirm that no unusual anthropogenic actions occurred in Lamar during this time.

Regulatory Measures- State
The APCDs regulations on PM_{10} emissions are summarized in Table 19.

Table 19: State Regulations Regulating Particulate Matter Emissions

Rule/Ordinance	Description
Colorado Department of Public Health and Environment Regulation 1- Emission Control For Particulate Matter, Smoke, Carbon Monoxide, And Sulfur Oxides	Applicable sections include but are not limited to: Everyone who manages a source or activity that is subject to controlling fugitive particulate emissions must employ such control measures and operating procedures through the use of all available practical methods which are technologically feasible and economically reasonable and which reduce, prevent and control emissions so as to facilitate the achievement of the maximum practical degree of air purity in every portion of the State. Section III.D.1.a) Anyone clearing or leveling of land greater than five acres in attainment areas or one acre in non-attainment areas from which fugitive particulate emissions will be emitted are required to use all available and practical methods which are technologically feasible and economically reasonable in order to minimize fugitive particulate

	emissions.(Section III.D.2.b) Control measures or operational procedures for fugitive particulate emissions to be employed may include planting vegetation cover, providing synthetic cover, watering, chemical stabilization, furrows, compacting, minimizing disturbed area in the winter, wind breaks and other methods or techniques approved by the APCD. (Section III.D.2.b) Any owner or operator responsible for the construction or maintenance of any existing or new unpaved roadway which has vehicle traffic exceeding 200 vehicles per day in the attainment/maintenance area and surrounding areas must stabilize the roadway in order to minimize fugitive dust emissions (Section III.D.2.a.(i))
Colorado Department of Public Health and Environment Regulation 3- Stationary Source Permitting and Air Pollutant Emission Notice Requirements	Construction Permit required if a land development project exceeds 25 acres and spans longer than 6 months in duration (Section II.D.1.j) All sources with uncontrolled actual PM_{10} emissions equal to or exceeding five (5) tons per year, must obtain a permit. The new source review provisions require all new and modified major stationary sources in non-attainment areas to apply emission control equipment that achieves the "lowest achievable emission rate" and to obtain emission offsets from other stationary sources of PM_{10}.
Colorado Department of Public Health and Environment Regulation 4- New Wood Stoves and the Use of Certain Woodburning Appliances During High Pollution Days	Regulates wood stoves, conventional fireplaces and woodburning on high pollution days. Prohibits the sale and installation a wood-burning stove in Colorado unless it has been tested, certified, and labeled for emission performance in accordance with criteria and procedures specified in the Federal Regulations and meets emission standards. (Section II) Section III regulates pellet stoves. Section IV regulates masonry heaters. Section VII limits the use of stoves on high pollution days.
Colorado Department of Public Health and Environment Regulation 6- Standards of Performance for New Stationary Sources	Implements federal standards of performance for new stationary sources including ones that have particulate matter emissions. (Section I)

Colorado Department of Public Health and Environment Regulation 9- Open Burning, Prescribed Fire, and Permitting	Prohibits open burning throughout the state unless a permit has been obtained from the appropriate air pollution control authority. In granting or denying any such permit, the authority will base its action on the potential contribution to air pollution in the area, climatic conditions on the day or days of such burning, and the authority's satisfaction that there is no practical alternate method for the disposal of the material to be burned. Among other permit conditions, the authority granting the permit may impose conditions on wind speed at the time of the burn to minimize smoke impacts on smoke-sensitive areas. (Section III)
Colorado Department of Public Health and Environment- Common Provisions Regulation	Applies to all emissions sources in Colorado When emissions generated from sources in Colorado cross the state boundary line, such emissions shall not cause the air quality standards of the receiving state to be exceeded, provided reciprocal action is taken by the receiving state. (Section II A)
Federal Motor Vehicle Emission Control Program	The federal motor vehicle emission control program has reduced PM_{10} emissions through a continuing process of requiring diesel engine manufacturers to produce new vehicles that meet tighter and tighter emission standards. As older, higher emitting diesel vehicles are replaced with newer vehicles; the PM_{10} emissions in areas will be reduced.

5.1 Lamar

Natural Events Action Plan (NEAP)

In response to exceedances of the PM_{10} NAAQS (two in 1995 and one in 1996), the APCD, in conjunction with the City of Lamar's Public Works Department, Parks and Recreation, and Prowers County Commissioners, the Natural Resources Conservation Services, the Burlington Northern Santa Fe Railroad, and other agencies developed a Natural Events Action Plan. That Plan was presented to EPA in 1998 and subsequently approved. Since 1998, it is this plan that has assisted the area in addressing blowing dust due to uncontrollable winds.

The most recently updated NEAP for High Wind Events in Lamar, Colorado was completed in 2003. The NEAP addresses public education programs, public notification and health advisory programs, and determines and implements Best Available Control Measures (BACM) for anthropogenic sources of windblown dust in the Lamar area. The City of Lamar, Prowers County, the APCD, and participating federal agencies worked diligently to identify contributing sources and to develop appropriate BACM as required by the Natural Events Policy.

Please refer to the Final NEAP for Lamar in Appendix C for more detail if needed.

Control Measures from the December 2012 Maintenance Plan

Control of Emissions from Stationary Sources
Although there are few stationary sources located in the Lamar attainment/maintenance area, the State's comprehensive permit rules listed in Table 19 will limit emissions from any new source that may, in the future, locate in the area.

The EPA approval of the original PM_{10} Maintenance Plan, effective on 11/25/05, reinstates the prevention of significant deterioration (PSD) permitting requirements in the Lamar Attainment/Maintenance area. The federal PSD requirements apply to new or modified major stationary sources which must utilize "best available control technology" (BACT).

Federal Motor Vehicle Emission Control Program (FMVECP)
The FMVECP has reduced PM_{10} emissions through a continuing process of requiring diesel engine manufacturers to produce new vehicles that meet tighter and tighter emission standards. As older, higher emitting diesel vehicles are replaced with newer vehicles through fleet turnover; tailpipe PM_{10} emissions in the Lamar area will be further reduced.

Voluntary and State-Only Measures
Additional activities in Lamar that result in the reduction of PM_{10} emissions include:

- The City of Lamar has historically cleaned their streets in town throughout the winter and spring using street sweepers. The frequency of this voluntary effort is determined by weather. As of October 2013, the Public Works Director informed APCD that the streets are swept on a weekly basis unless there is snow on the streets.
- The City of Lamar and immediately surrounding areas require that new developments have paved streets. As of October 2013, the City's Planning Commission is been working on making this an official city ordinance. In the past, it has been required despite the lack of official rule.

State Implementation Plan Measures
Any owner or operator responsible for the construction or maintenance of any existing or new unpaved roadway which has vehicle traffic exceeding 200 vehicles per day in the Lamar attainment/maintenance area and surrounding areas must stabilize the roadway in order to minimize fugitive dust emissions. These statewide requirements are defined in detail in the AQCC's Regulation No. 1 as listed in Table 19.]

City of Lamar

The City of Lamar has been very proactive in addressing potential PM10 sources within the Lamar area including the application of grass turf at baseball fields, implementing and enhancing a street sweeping program, and chip-seal paving of many unpaved roads. The City of Lamar - Public Works Department has implemented the following BACM controls within the area:

1. Wind Break
Beginning in the spring of 1997, a wind break of trees was planted north of the Power Plant monitoring site (080990001). The Russian Olive tree wind break is located approximately one half mile north of the Power Plant monitoring site and will block potential contributing blowing dust sources such as the Lamar Transfer Station and other unpaved equipment traffic areas to the north. The Russian Olive is a quick growing large shrub/small tree that thrives despite the semi-arid and windy climate of Lamar. As of October 2013, the Public Works Director states that most of the trees are still alive and in place. According to section 3.5.2.1 of EPA guidance entitled "Fugitive Dust Background Document and

Technical Information Document for Best Available Control Measures", dated September 1992, one-row of trees is considered an effective windbreak.

In addition to the plantation of tree wind breaks, a drip irrigation system has been installed to promote sustained tree growth. As of October 2013, the Public Works Director states that the drip system is still operational but due to the drought the City has been on strict water restrictions.

2. *Landfill Controls*

The East Lamar Landfill is located approximately six (6) miles east of the city limits. The landfill has a CDPHE Permit (#09PR1379) which specifies that visible emissions shall not exceed twenty percent (20%) opacity during normal operation of the source and that fugitive PM_{10} cannot exceed 5.77 tons per year. The permit also contains a Particulate Emissions Control Plan that states that:

- No off-property transport of visible emissions shall apply to on-site haul roads.
- There shall be no off-property transport of visible emissions from haul trucks.
- All unpaved roads and other disturbed surface areas on site shall be watered as often as needed to control fugitive particulate emissions.
- Surface area disturbed shall be minimized.
- Exposed land areas to be undisturbed for more than six months shall be revegetated.

According to section 3.5.1 of the "Operations and Closure Plan for the East Lamar Landfill", the Director of the Public Works Department and/or the landfill operator is required to do the following litter control measures under high wind conditions:

- Soil cover is required to be placed on the working face of the landfill daily during periods of wind in excess of 30 mph; and,

- The landfill must be closed down when sustained winds reach 35 mph or greater.

An on-site wind gauge monitors wind speed at the landfill. Operators have radios in their equipment connecting them with the main office so that when the decision to close the landfill is made, it can take place immediately. According to the Director of Public Works, landfill operators have been directed to close the landfill at their discretion. Because trash debris (paper) begins to lift and blow into the debris fences at wind speeds of 25 to 30 mph, the operator usually closes the landfill prior to wind speeds reaching 30 mph. The City of Lamar has agreed to make the closure of the Lamar landfill mandatory when wind speeds reach 30 mph, which reduces windblown dust from the landfill as earth moving activities are reduced or eliminated during periods of shut down. As of October 2013, the Public Works Director states that all of these practices are still enforced.

In addition, the placement of chain link fencing and various debris fences have been added to the previous litter entrapment cage. These additional fences better minimize the release of materials during high wind conditions. The Public Works Director states that this is a dynamic process; as the debris moves, the fences are moved too.

3. *Vegetative Cover/Sod*

The Lamar Recreation Department installed 100,000 square feet of turf sod at a recreational open space called Escondido Park in the early 2000s. Escondido Park is located in northwest Lamar at 11th and Logan Streets. A sprinkler system has also been installed by the Parks and Recreation Department. The sod provides a vegetative cover for the open area. This dense turf cover provides an effective control against windblown soil from the open area of the park.

In addition, the Lamar Public Works Department stabilizes the entrance road leading to and from Escondido Park with chemical soil stabilizer and chip-seal to reduce dirt tracked out onto city streets and minimize additional releases of PM_{10}. This is done on an as needed basis.

4. *Additional Public Works Projects*

The Public Works Department implemented the following projects to further reduce emissions of PM_{10}:

- The purchase of a TYMCO regenerative air street sweeper (May 2001) which is much more effective in reducing dust during street sweeping activities. The use of this sweeper allows for improved cleaning of the streets (e.g., sweeps the gutter and street);
- The fencing of an area around the City Shop at 103 North Second Street in 2011 to reduce vehicle traffic that may be responsible for lifting dust off of the dirt area between the railroad tracks and the Shop;
- The stabilization of a large dirt and mud hole in 2008on the north side of the City Shop by installing a curb and gutter that allows for better drainage. This project is credited with keeping mud from being tracked out into the street and becoming airborne by vehicular traffic;
- The ongoing commitment to search for other stabilization projects that benefit the community and improve area air quality, and;
- The relocation of the Municipal Tree Dump in the early 2000s (formerly located in the northeastern corner of the city) to approximately six miles east of the city (now housed at the Municipal Landfill). This relocation eliminates a major source of smoke from agricultural burns that may have previously affected the community.

Regulatory Measures - City

Lamar has an ordinance that requires that all off-street parking lots shall have a dust-free surface to control PM_{10} emissions (City of Lamar Charter and Code, ARTICLE XVII, Sec. 16-17-60).

Burlington-Northern/Santa Fe Rail Line

The rail line running east-west of the Lamar Power Plant monitoring site was deemed to be an important PM10 source during conditions of high winds and low precipitation. Ground disturbance from vehicle traffic, which damages vegetation and breaks-up the hard soil surfaces, resulted in re-entrainment of dust from traffic, high winds or passing trains. This area is problematic in the two block area immediately west of the Power Plant monitoring site as shown in Figure 42 as Site M. Control of this open area requires a close working agreement between the Burlington-Northern/Santa Fe Railroad Company (BNSF) and the City of Lamar Public Works Department. The purpose of this BACM is to reduce the amount of particulate matter susceptible to wind erosion under high wind conditions and general re-entrainment of dust in the ambient air as a result of local train traffic passing in close proximity of the PM_{10} monitor.

In September 1997, the City chemically stabilized exposed lands north of the rail line between Fourth and Second Street where there was evidence of vehicle traffic. All other lands on either side of the rail road tracks between Main Street (Fifth) and Second Street and extending westward have either natural, undisturbed ground cover or it is used for commercial/recreation purposes that do not allow for significant re-entrainment (BNSF is responsible for maintaining 50 feet of property on either side of the main track). Most of these lands are leased by the City. After September 1997, the City negotiated the lease of these lands. Once acquired, a long term plan, will be developed for these lands such as restricting vehicle access, permanently stabilizing lands with vegetation and gravel, increasing park and recreational use, and

using the lands for city maintenance and storage activities. As of October 2013, the Public Works Director stated that gravel has been periodically added to minimize blowing dust.

According to the Manager of Environmental Operations for BNSF, the railroad company owns the main rail line and 200 feet on either side of the track. Much of this property has been sold or leased under private contracts. At this time BNSF is responsible only for the main rail line and for 50 feet of property on either side of the main track. All property sold or under contract is not the responsibility of BNSF. As a result, BNSF has stabilized the railroad corridor 50 feet on either side of the main rail line.

In May 1997, BNSF placed chips (gravel) 50 feet on either side of the main track from Main Street to Second Street (three blocks) to control fugitive dust emissions from this section of the track. Graveling exposed surfaces not exposed to regular vehicle traffic is considered a permanent mitigation measure. Details of this arrangement can be found in the documentation under the 1998 SIP Maintenance Plan submittal.

Prowers County

Prowers County Land Use Plan:

Beginning in 1997, Prowers County with the assistance of local officials, environmental health officers and the general public began preparing a county land use plan. The Prowers County Land Use Plan is designed to have wide-reaching authority over the myriad of land use issues involving building (construction sites), siting, health, fire, environmental codes, and other social concerns associated with the City of Lamar and Prowers County. The county land use plan, entitled "*Guidelines and Regulations for Areas and Activities of State Interest – County of Prowers – State of Colorado*", was adopted on April 19, 2004 and amended on August 17, 2006. The plan incorporates provisions to minimize airborne dust including re-vegetation of disturbance areas associated with land development. The Prowers County Land Use Master Plan can be found on the County's website at: http://www.prowerscounty.net.

Regulations and ordinances of the Land Use Plan specific to reducing blowing dust and its impacts include:

- Additional regulations on development of fragile lands and vegetation to protect topsoil;
- Development of performance standards and best management practices to prevent soil erosion;
- Development of best management practices to reduce blowing sands and movement of area sand dunes across the county;
- Development of new special use permits to address the siting of animal feedlots and feed yards;
- Development of special use permits for other future stationary sources. The special use permits will also likely include the requirement for comprehensive fugitive dust control plans for both construction and operation of facilities;
- Consideration and review of enforcement capabilities through the area zoning ordinances, and;
- Planned public review and comment processes following the legal update of the draft County Land Use Plan.

Windblown Dust from Disturbed Soils

The City of Lamar is located in Prowers County in southeastern Colorado. Situated along the Arkansas River and near the Kansas border, Lamar serves as the largest city and the agricultural center for southeast Colorado. The area surrounding Lamar consists of gently rolling to nearly level uplands where the dominant slopes are less than 3 percent. The climate is generally mild and semiarid. Annual precipitation is about 15 inches. Summers are long and have hot days and cool nights. In winter and spring, windstorms

are common, especially in drier years. It is due to these high velocity dust storms and drought conditions that Lamar experiences most of the PM_{10} problems for the area. Figure 42 through Figure 49 illustrate potential areas of local soil disturbance that have been evaluated by the APCD for the Lamar Power Plant PM_{10} monitor (080990001).

Figure 41:Wind Direction relative to the Lamar Power Plant PM10 monitor for the November 5, 2011 event

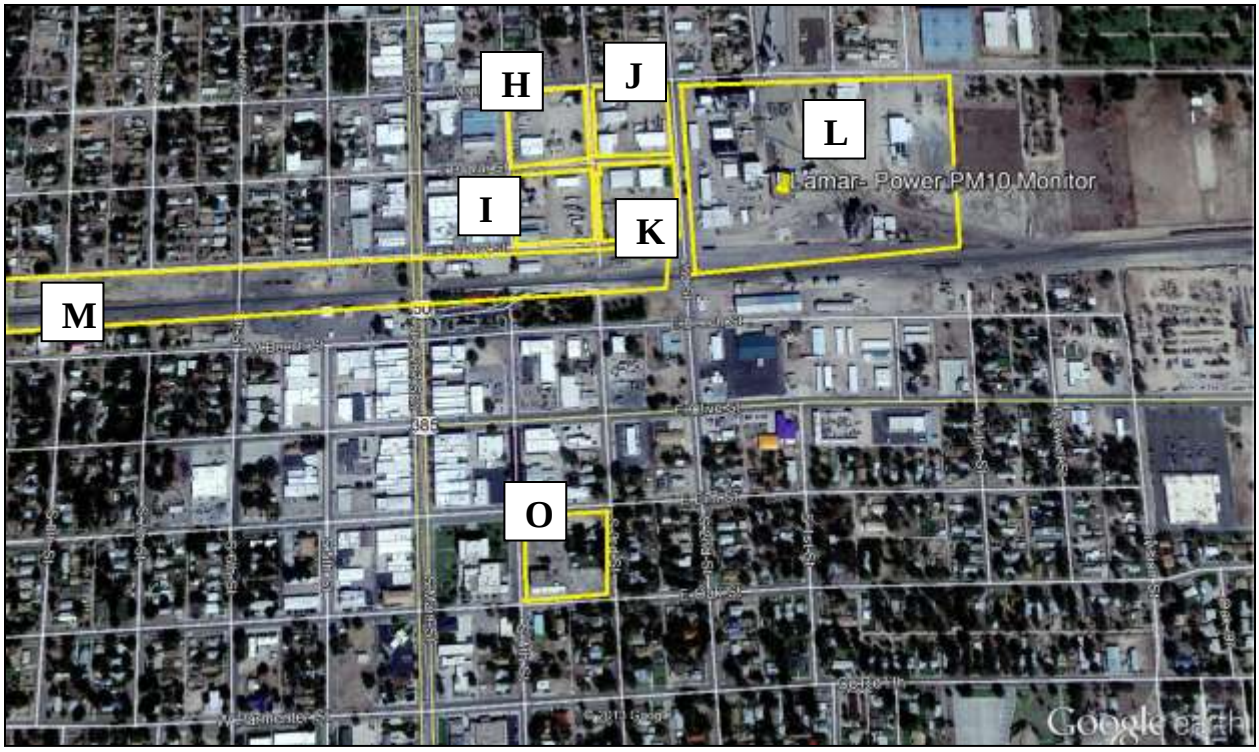


Figure 42: West of the Lamar Power Plant PM_{10} Monitor (Google Earth image 8-2013)

Site H in Figure 42 is west of the Lamar PM_{10} monitor at 200 N 4th St. This site is owned by "Heath & Son & Turpin Trucking", a company that repairs large trucks and shared with "HVH Transportation Inc", a freight service trucking company. This site consists of well maintained gravel. The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site I in Figure 42 is west of the Lamar PM_{10} monitor. The site is shared by a few businesses. All businesses have restricted access by fences surrounding the property. "Cowboy Corral Storage" at 102 North 4th St is one of the businesses on the lot. It has a very small gravel parking lot and is no longer in business according to the previous owner as of October 2013. The storage company has a small gravel parking lot with access being restricted by a security fence as shown in Figure 43. The lot is also shared with the "Prowers Area Transit" county bus garage. The bus garage is very small, only four bays. The garage has a concrete slab that runs to the asphalt road to avoid the busses driving on the gravel in order to mitigate fugitive dust. The gravel lot is watered on an as needed basis. The other business is an old feed supply company with grain storage as shown in Figure 44.The feed supply company is out of business and the grain elevators are not being utilized. The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Figure 43: Cowboy Corral Storage (Google Image 2012)

Figure 44: Feed Storage Company (Google Image 2012)

Site J in Figure 42 is west of the Lamar PM_{10} monitor at about 201 N 2nd Street. The gravel parking lot on site is owned by "Heath & Son & Turpin Trucking" and is shown in Figure 45. The lot is used to store trucks when not in use. This site consists of well maintained gravel. The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Figure 45: Heath & Son & Turpin Trucking Storage Lot (Google Image 2012)

Site K in Figure 42 is west of the Lamar PM_{10} monitor at about 103 North 2nd Street. It is the "Lamar Water Department". Also on site K is the "Lamar-Prowers County Volunteer Fire Department" at 300 E Poplar Street. Both sites have restricted access with security fences. The City of Lamar maintains their gravel lots by grating and watering them on an as needed basis. The APCD considers maintained gravel. limited access, grating, and watering to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site L in Figure 42 is the power plant that the Lamar PM_{10} monitor is located within at100 North 2nd Street. "Lamar Light and Power" historically operated a natural gas-fired boiler that produced steam for a 25 MW turbine/generator set. This boiler was constructed prior to 1972 and was grandfathered from construction permitting requirements. In the early 2000s, factors such as increasing costs of natural gas made the plant uneconomical to run. As a result, Lamar Light and Power purchased power and ran the natural gas-fired boiler very infrequently or not at all. In February 2006, APCD issued a permit for Lamar Light and Power to replace the existing natural gas-fired boiler with a coal-fired circulating fluidized bed (CFB) boiler rated at approximately 42 MW. The conversion prompted legal challenges from Lamar residents partnered and WildEarth Guardians, a New Mexico-based environmental group. Lamar Light and Power settled and agreed to shut down the coal-fired power plant. The power plant was shut down on November 11, 2011. The settlement also calls for the plant to stay offline until at least 2022, when the current agreement to supply electricity to Lamar and other communities expires.

"Lamar Light and Power" has an air quality permit (CDPHE # 05PR0027). The permit includes the following point and fugitive dust control measures:

- Limestone and ash handling, processing, and storage are controlled by high efficiency baghouses
- Water wash-down-systems are used for flushing down any accumulated dust on walkways, platforms, and other surfaces to prevent re-entrainment of the dust into the atmosphere.
- On-site haul roads are paved, and these surfaces are inspected at least once each day in which hauling activities occur, and cleaned as needed. Various cleaning methods are used depending on the extent of dust accumulations. These activities emit less than 1 ton per year of PM_{10} and are APEN Exempt.
- All transport vehicles containing substances that potentially generate fugitive particulate matter emissions (such as trucks containing limestone, inert material, or ash) are fully enclosed, or covered with a mechanical closing lid or a tight tarp-like cover at all times while on the facility grounds except during loading / unloading operations.
- Emissions from emergency coal stockpile are effectively controlled with a water dust suppression system.

Access to the power plant is restricted by security fences. The AOCD considers the enforceable conditions of the permit, including identified Best Available Control Technology (BACT) for limestone and ash handling, paving, wash-down systems, and enclosures, to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on November 5, 2011 did exceed the blowing dust thresholds of 30 mph or greater and gusts of 40 mph or greater at which the APCD expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 54 mph with wind gusts up to 68 mph).

Site M in Figure 42 is the Burlington Northern Santa Fe railroad that runs past the Lamar PM_{10} monitor to the south. On either side of the rail road tracks is gravel as shown in Figure 46. In May 1997, Burlington

Northern Santa Fe placed chips (gravel) 50 feet on either side of the main track from Main Street to Second Street (three blocks) to control fugitive dust emissions from this section of the track. Graveling exposed surfaces not exposed to regular vehicle traffic is considered a permanent mitigation measure. Also, all the train tracks are raised up on 3 inch diameter rock and tracks. Areas that are not used by the railroad are allowed to be naturally vegetated with Xeriscape. With regard to AQCC Regulation 1 requirements (Section III.D), the APCD considers gravel and 'Xeriscape' vegetation to be the appropriate available and practical method that is technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this type of source.

Figure 46: Railroad tracks with gravel on each side (Google Image 2012)

Site O in Figure 42 is southwest of the Lamar PM_{10} monitor. It is located at about 356 South 4th Street. Part of the property is owned by Century Link. Century Link has a storage lot for fleet vehicles that is well maintained gravel. Access to the storage lot is restricted by a fence as shown in Figure 47. A large part of site O is a free public gravel parking lot for the Prowers County Jail and the Prowers County Municipal Court as shown in Figure 48. The lot is maintained by the County. The parking lot is chip sealed and covered in crushed gravel. Site O, as shown in Figure 42, has reasonable dust control measures in place with regard to AQCC Regulation 1 requirements (Section III.D.1(a)). The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Figure 47: Site O - Century Link Fleet Storage Lot (Google Image 2012)

Figure 48: Site O - Parking lot for the Prowers County Jail and the Prowers County Municipal Court (Google Image 2012)

Figure 49: 5 miles West of Lamar - "Carder Inc"- 32625 County Rd 3.75 Lamar, CO (Google Earth 2012)

Site N in Figure 49 is "Carder Inc" at 32625 County Rd 3.75 (about 5 miles west of Lamar). Carder Inc mines this site, known as the Hard Scrabble Pit, for sand and gravel primarily for road construction. This site has a permit from CDPHE (#99PR0179F) and emits about 8 tons per year of PM_{10}. This is a wet mining operation so it produces minimal fugitive dust. The dust control measures that are part of the permit include watering the disturbed area as needed, revegetation within one year of disturbance, compacting of piles, mining moist materials, vehicles cannot exceed 10 mph on site at all times, and temporary roads are covered with gravel and watered as needed. The APCD considers the enforceable conditions of the permit, including identified continuous controls such as gravel roads with miles per hour restrictions, compaction, revegetation, watering, and extraction limitation, to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on November 5, 2011, did exceed the blowing dust thresholds of 30 mph

or greater and gusts of 40 mph or greater at which the APCD expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 54 mph with wind gusts up to 68 mph).

The APCD conducted thorough assessments to determine if the potential soil disturbances shown in Figure 42 through Figure 49 were present during the 2011 exceedances in Lamar. During the course of these assessments, the APCD discovered that these sites were either reasonably controlled or considered to be natural sources during the November 5, 2011 high wind event. Therefore, these sites were not significant contributors to fugitive dust in the Lamar area during the November 5, 2011, high wind event.

Colorado State University CO-OP Extension Office

While the following initiatives are not meant to be enforceable, the CSU Co-Op Extension Office has many efforts underway that further reduce blowing dust and its impacts. These include:

- Crop residue efforts that encourage no- or low-till practices. These have been deemed appropriate and useful in reducing blowing dust.
- Ongoing outreach efforts to educate area agricultural producers on soil management programs. These include one-on-one visitations and annual meetings with various corn and wheat programs to discuss crop management.
- Drought workshops to protect topsoil throughout the county.

USDA: Natural Resources Conservation Service (NRCS)

1. *Conservation Reserve Program*

Prowers County is a predominately agricultural area that is made up of 1,053,037acres of land area – 1,037,336 acres (or 92.7%) of which is land in farms.[2] For comparison, Baca County to the south is 78.4% land in farms, Bent County to the west is 88.9% land in farms, and Kiowa County to the north is 83.8% land in farms. It should be noted that cropland percentage in Bent County is lower than other Southeast Colorado counties at 21%. Figure 50 illustrates the counties of Southeast Colorado. Of the farm land acreage in Prowers County, cropland accounts for over half of the total (552,476 acres) and is approximately 53% of the total land in the county. Water, and often the lack of it, coupled with the frequent high winds experienced during late fall and early spring commonly destroy crops, encourage pests, and damage soil surfaces lending them susceptible to wind erosion, especially in recent drought years. Prowers County has been in a severe drought for almost three years, and entered an extreme drought in 2013. In 2011, most of Prowers County cropland acreage is farmed using dryland practices (versus irrigated) and consists of soils classified as highly-erodible-land (HEL) by the Department of Agriculture.

[2] 2007 Census of Agriculture. Vol. 1: Geographic Area Series, Part 6 Colorado State & County Data. U.S. Dept. Of Commerce: Bureau of Census.

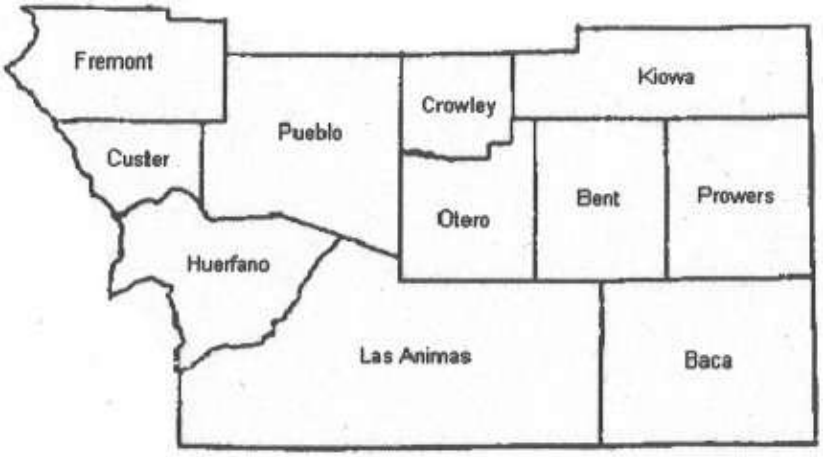


Figure 50: Southeast Colorado Counties

Recognizing the problems associated with erodible land and other environmental-sensitive cropland, the U.S. Department of Agriculture (USDA) included conservation provisions in the Farm Bill. This legislation created the Conservation Reserve Program (CRP) to address these concerns through conservation practices aimed at reducing soil erosion and improving water quality and wildlife habitat.

The CRP encourages farmers to enter into contracts with USDA to place erodible cropland and other environmentally-sensitive land into long-term conservation practices for 10-15 years. In exchange, landowners receive annual rental payments for the land and cost-share assistance for establishing those practices.

The CRP has been highly successful in Prowers County by placing approximately 156,195 acres of Prowers County cropland, or 27% of total cropland, under contract. Most of this land has been planted with a perennial grass cover to protect the soil and retain its moisture. Strong support of the program by Prowers County farmers continues as 38% of the counties HEL cropland has been offered for conservation practices. Prowers County employs NRCS practices at approximately 1.6 times the rate of the surrounding nine-county Southeast Colorado area (including Bent, Kiowa, Baca, Crowley, Otero, Las Animas, Cheyenne, Lincoln, and Prowers) as of 2011.

While the following initiatives are not meant to be enforceable, many efforts are underway that further reduce blowing dust and its impacts. These include:

- The CRP has moved to include all available area lands into area contracts. These contracts are good through 2007. Success of the CRP initiatives is measured through ongoing monitoring of the contracts to ensure ample grass coverage to minimize blowing dust.

- CRP sends out information several times per year through radio and the area newspaper to further reach farmers interested in topsoil protection.

- In response to the significant Colorado drought (2011-2013) the NRCS and FSA are working with multiple parties in extensive annual planning efforts to limit blowing dust and its impacts. These planning efforts change year to year depending on the severity of the drought.

2. *Limestone-Graveyard Creeks Watershed Project*

A watershed improvement project is currently underway in the Limestone-Graveyard Creeks Watershed. This project covers approximately 60,000 acres of land north of the Arkansas River between Hasty (Bent County) and Lamar. An estimated 44,500 acres of the watershed area are classified as priority land due to the highly erodible nature of the soil. Over 2,000 acres of agricultural cropland northwest of Lamar are included in this watershed project. As of 2013, NRCS informed the APCD that this project is approximately 99% complete.

Working with the NRCS, each farmer will create their own conservation plan with costs for improvements split equally between farmers and the federal government. The 15-year project will help reduce soil erosion and improve water quality and efficiency through conservation tillage practices and/or other conservation efforts. In short, the Limestone-Graveyard Creeks Watershed Project will help to reduce soil erosion and lower the impacts of blowing soils during future high wind events.

More recently (since the 1998 NEAP submittal), the Watershed project has been evaluated and is seen as an ongoing successful program as most eligible acres are signed up.

3. *New Initiatives*

While the following initiatives are not meant to be enforceable, the Natural Resources Conservation Service has many efforts underway that further reduce blowing dust and its impacts. These include:

- A comprehensive rangeland management program;
- Tree planting program;
- Drip irrigation purchase program, and;
- A multi-party drought response planning effort coordinated through the State of Colorado Governor's office.
- In 2013, NRCS also tried a proactive approach to drought management by offering producers incentives to mitigate erosion hazard areas before they became an erosion problem.

These are but a few of the efforts at the local, county, and regional level underway to reduce emissions of PM_{10} and limit impacts.

6.0 Summary and Conclusions

APCD is requesting concurrence on exclusion of the PM_{10} value from the Lamar Power Plant (08-099-0001) on November 5, 2011.

An elevated 24-hour PM_{10} concentration was recorded in Lamar on November 5, 2011. The PM_{10} sample at Lamar Power (192 $\mu g/m^3$) exceeded the 99th percentile value (shown in

Table 16) for any evaluation criteria and is the maximum value for all 2011 data. The statistical and meteorological data clearly shows that but for this high wind blowing dust event, Lamar would not have exceeded the 24-hour NAAQS on November 5, 2011. Since at least 2005, there has not been an exceedance that was not associated with high winds carrying PM_{10} dust from distant sources in Lamar. This is evidence that the event was associated with a measured concentration in excess of normal historical fluctuations including background.

The PM_{10} exceedance in Lamar on November 5, 2011, would not have occurred if not for the following: (a) dry soil conditions over southeast Colorado, southern and eastern New Mexico, western Texas, and northern Mexico with 30-day precipitation totals below were near or below 0.5 inches (Figure 20 and Figure 21); (b) a combination of synoptic and mesoscale weather events; (In the synoptic scale, high winds were produced throughout much of the region by a vigorous cold front and surface low pressure system associated with an upper-level trough. Contributing at the smaller mesoscale were very strong outflow winds from collapsing thunderstorms.) (c) friction velocities over a wide area of southeast Colorado, southern and eastern New Mexico, western Texas and northern Mexico that were high enough to allow entrainment of dust from natural sources with subsequent transport of the dust to southeastern Colorado in strong winds.

Surface weather maps show evidence of blowing dust and winds above the threshold speeds for blowing dust on November 5. The combination of synoptic and mesoscale weather events which generated very intense surface winds in Lamar to reach sustained speeds of 54 mph with gusts to 68 mph. Winds of this strength can easily cause blowing dust if soils are dry. Recall that wind speeds of 30 mph or greater and/or gusts of 40 mph or higher have been shown to cause blowing dust in southeast Colorado (see Appendix A). Specifically, these high values were the consequence of high winds that were produced throughout much of the region displayed in Figure 1 by a vigorous cold front and surface low pressure system associated with an upper-level trough. The surface winds were predominantly out of a south to southwesterly direction and moved over dry soils that stretched from southeast Colorado southward into northern Mexico caused significant blowing dust across southeast Colorado, southern and eastern New Mexico, western Texas, and northern Mexico. These PM_{10} exceedances were due to an exceptional event associated with regional windstorm-caused emissions from erodible soil sources over southern and eastern New Mexico, western Texas, and northern Mexico. These sources are not reasonably controllable during a significant windstorm under abnormally dry or exceptional drought conditions.

The blowing dust climatology for Lamar (Appendix A) indicates that the Lamar area can be susceptible to blowing dust when winds are high. Landform imagery shows that northeastern Arizona and southeastern Utah in particular have experienced a long-term pattern of wind erosion and blowing dust when winds have been southwesterly and blowing into Colorado. Forecast products from the Navy Aerosol Analysis and Prediction System model provide evidence for a regional blowing dust event, suggesting that significant source regions for dust in Lamar were located in New Mexico and southeast Colorado. NOAA HYSPLIT forward and backward trajectories provide clear supporting evidence that dust from arid regions of southeast Colorado along with other areas further to the south and southwest which were experiencing extreme to exceptional drought conditions caused or contributed to the PM10 exceedances

measured in Lamar on November 5. Soils in southeast Colorado and areas upwind to the south and southwest were dry enough to produce blowing dust when winds were above the thresholds for blowing dust.

Both wind speeds and soil moisture in southeast Colorado and areas upwind to the south and southwest were conducive to the generation of significant blowing dust. Multiple sources of data for the event in question and analyses of past dust storms in this area prove that this was a natural event and, more specifically, a significant natural dust storm originating in southern and eastern New Mexico, western Texas, and northern Mexico. But for the dust storm on November 5, 2011, this exceedance would not have occurred.

Friction velocities provide a measure of the near-surface meteorological conditions necessary to cause blowing dust. Friction velocities across a wide area of southeast Colorado, southern and eastern New Mexico, western Texas and northern Mexico were above 1.0 meters per second on November 5, 2011. Even undisturbed desert soils normally resistant to wind erosion will be susceptible to blowing dust when friction velocities are greater than about 1.0 to 2.0 meters per second. Note that blowing dust will typically only occur where these values are high and the soils are dry and not protected by vegetation, forest cover, boulders, rocks, etc. This is an accurate description of much of the terrain to the south and southwest of Lamar extending into northern Mexico. The elevated friction velocities shown in Figure 33, the data on soil moisture conditions presented elsewhere in this report, and the prevalence of winds above blowing dust thresholds (all occurring in traditional source regions in southeast Colorado and areas to the south and southwest of Colorado) prove that this dust storm was a natural event that was not reasonably controllable or preventable.

MODIS satellite imagery shows that southeast Colorado and points to the south and southwest of Colorado were source regions for blowing dust in Lamar on November 5. This is consistent with the climatology for many dust storms in Lamar as described in Appendix A at the end of this document. The observations of winds above blowing dust thresholds and restricted visibilities in the areas of concern demonstrate that this is a natural event that cannot be reasonably controlled or prevented.

As demonstrated in Section 3 and particularly in

Table 16, the PM_{10} exceedance in Lamar on November 5, 2011, would not have occurred “but for” the large regional dust storm on November 5, 2011.

7.0 References

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Appendix A - Lamar, Colorado, Blowing Dust Climatology March 10, 2010

Introduction – Executive Summary

PM10 concentrations for both the Lamar Power Plant and Municipal Building sites for January of 2004 through February of 2009 have been analyzed and compared with meteorological data for the period. The analyses included an evaluation of climate and land use characteristics; cluster analysis of PM10 concentrations, 30-day total precipitation, and daily maximum 5-second wind gust speeds; NOAA HYSPLIT back trajectories for high-wind, blowing dust events; and an assessment of satellite imagery. *Cluster analysis shows that without wind gusts above 40 mph and dry soils caused by 30-day precipitation totals of 0.6 inches or less, the exceedances of the PM10 standard measured during the period would not have occurred*. The conditions for blowing dust are consistent with earlier analyses completed by the Colorado Department of Public Health and Environment (1998) which indicate that significant dust storms only occur when soils are sufficiently dry and hourly average wind speeds are at or above 30 miles per hour or wind gust speeds are at or above 40 miles per hour. The high-wind events occur on less than 15% of the days in the period. The PM10 exceedances occur on less than 1% of the days in the record. *This document provides a detailed weight of evidence analysis for dust transport into and within Colorado and demonstrates that "but for" the exceptional high winds over dry soils these exceedances would not have occurred*.

Trajectory analyses and land use patterns point to three likely source areas that may contribute to blowing dust during blowing-dust events. The first is the Lamar PM10 Non-attainment Area (NAA) and Prowers County. *Blowing dust sources within the NAA and Prowers County have been reasonably controlled for particulate matter, as demonstrated by the PM10 State Implementation Plan (SIP) and Maintenance Plan for the area.* In addition, the Power Plant monitor, which is responsible for most of the exceedances, is inappropriately sited and does not represent ambient air exposure. The second likely source area is lands in eastern Colorado outside of Prowers County and the NAA. Small grain (wheat-fallow-sorghum) farmlands are a likely source for dust in late fall through spring. The Natural Resources Conservation Service (NRCS) has provided reasonable controls for these sources during the period of record and has alternative programs for erosion control as lands under contract with the Conservation Reserve Program (CRP) are released from contracts (in the five-year period beginning in late 2009.) The third source area includes lands in Arizona and New Mexico. Natural sources in these states may include deserts, barren lands, and playas; and anthropogenic sources may include agricultural lands. Control of these sources is beyond the purview of the State of Colorado. Existing and planned programs operated by the NRCS and the states may already reasonably control agricultural sources within these states.

Regional Precipitation

Lamar, Colorado, is located in a part of the country that is largely arid to semi-arid. Arid to semi-arid soils make much of the region susceptible to blowing dust. Figures A-1

through A-3 show the annual average precipitation for Colorado, Arizona, and New Mexico, respectively. Lamar is located in the Arkansas River Valley of southeastern Colorado where the annual precipitation is typically 10 to 20 inches. Large areas of Arizona, which can be upwind of Lamar during blowing dust events, receive between 5 and 15 inches of precipitation each year. Much of New Mexico, which is also frequently upwind of Lamar during blowing dust events, also receives only 5 to 15 inches per year. Figure A-4 shows the 1971-2000 monthly normal precipitation amounts for Lamar, Colorado, from the National Climatic Data Center. The annual average for this time period is 15.82 inches. The wettest months are May through August. The driest months are October, November, December, January, February, and March. These months receive an average of only 0.64 inches per month. The annual monthly average precipitation is 1.32 inches.

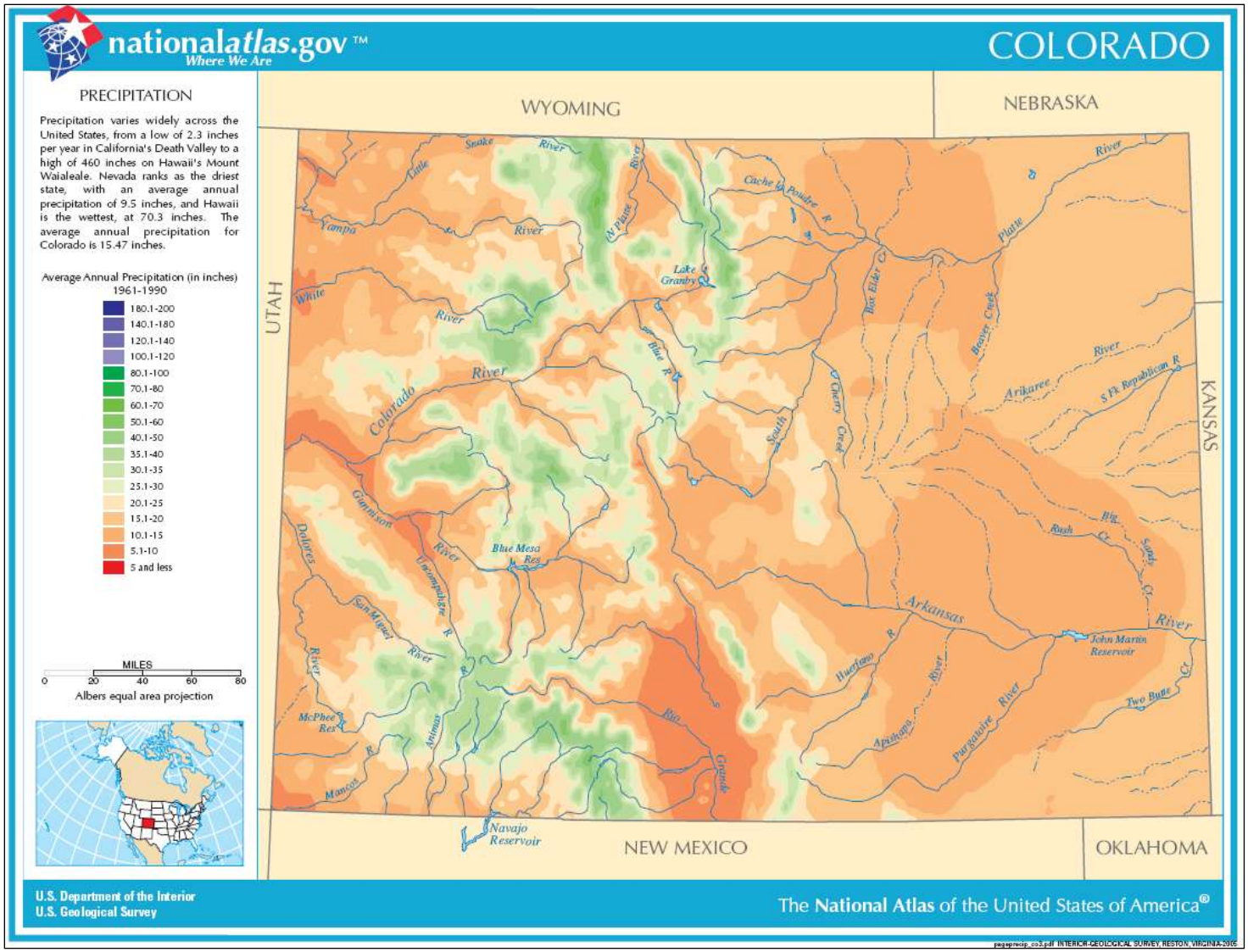


Figure A-1. Average annual precipitation in Colorado based on 1961-1990 normals.

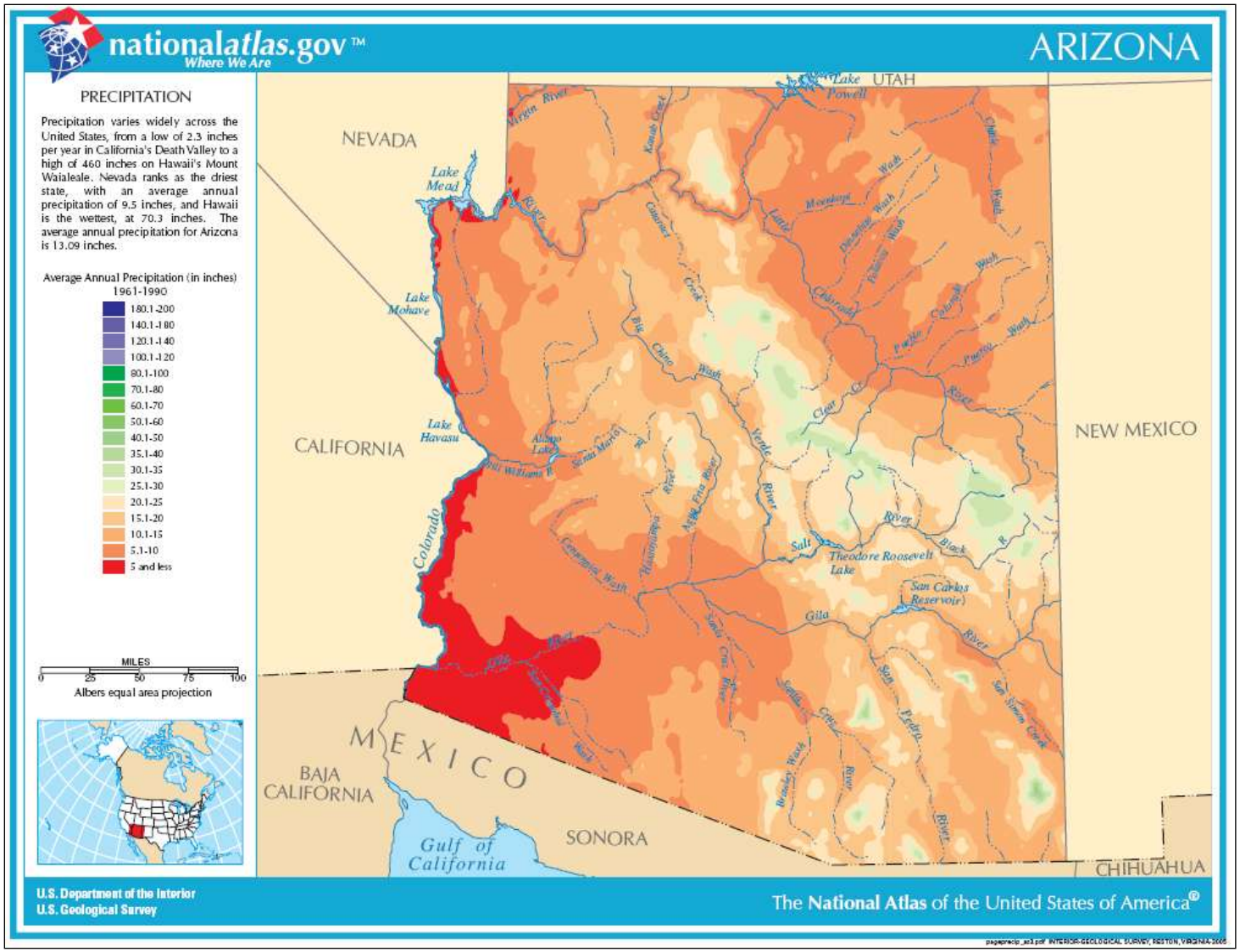


Figure A-2. Average annual precipitation in Arizona based on 1961-1990 normals.

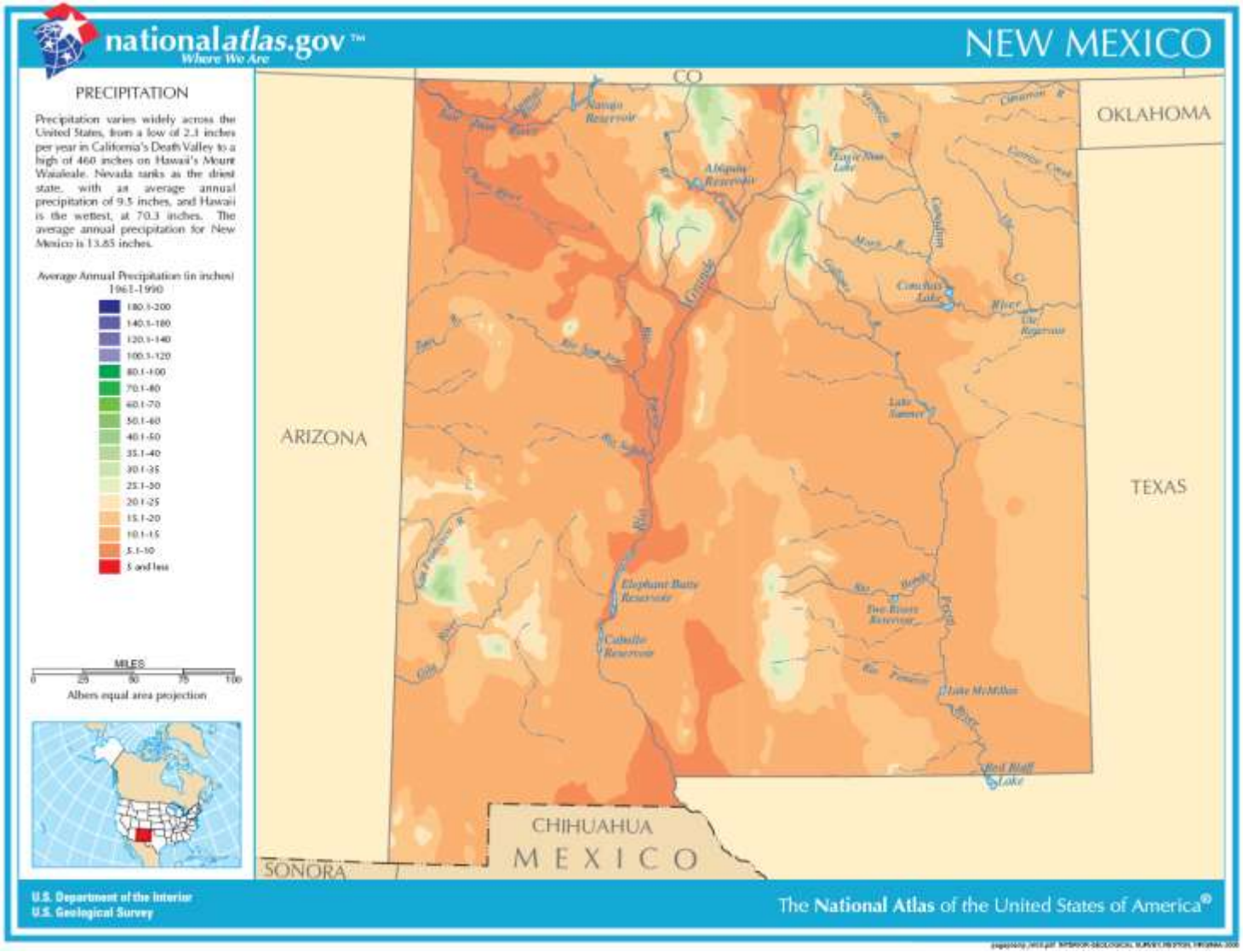


Figure A-3. Average annual precipitation in New Mexico based on 1961-1990 normals.

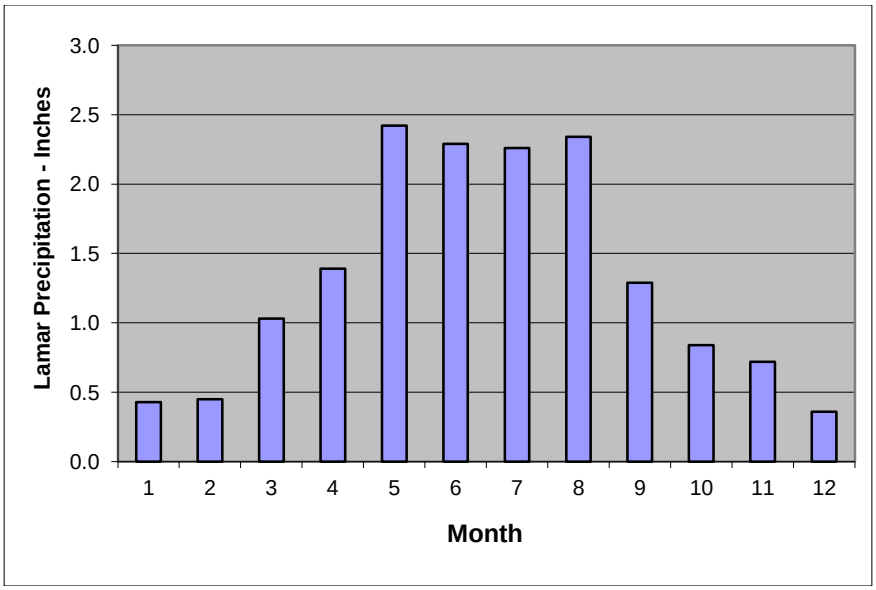


Figure A-4. 1971-2000 monthly normal precipitation in Lamar, Colorado.

Cluster Analysis

K-means cluster analysis has been applied to Lamar Power and Municipal Building PM10 concentrations, Lamar 30-day total precipitation for each PM10 monitoring day, and Lamar daily maximum wind gust speeds for each monitoring day (a readily available wind variable with good predictive power.) K-means cluster analysis is a statistical method for identifying clusters or groupings of values for many variables. For environmental variables, these clusters often represent distinct processes, conditions, or events. In this case, cluster analysis differentiates PM10 concentrations associated with strong winds, low soil moistures, and blowing dust by providing mean values for these 4 variables for 5 distinct categories of PM10 events. The period of record considered was from January 2004 through February 2009. The Lamar Airport weather station was used to represent Lamar conditions. Initial screening of a variety of multi-day precipitation averages demonstrated that the 30-day total precipitation values appear to be a better metric for blowing dust conditions than shorter-term totals.

The results of the cluster analysis are presented in Table A-1 below. Cluster 1 represents high soil moisture conditions, moderate gust speeds, and low PM10 concentrations. Cluster 2 represents low to moderate soil moisture, low PM10, and moderate gust speeds. Cluster 3 represents low to moderate soil moisture, high gusts, and low to moderate PM10. Cluster 4 represents low soil moisture, low gusts, and low PM10. Finally, Cluster 5 represents high PM10, high gusts, and low soil moisture. Cluster numbers, Lamar Power PM10 concentrations, and Lamar daily maximum gust speeds are plotted in Figure A-5. Similar results for the Lamar Municipal Building site are presented in Figure A-6. The data in Figures A-5 and A-6 clearly show that the highest PM10 concentrations tend to occur in Cluster 5 with gusts above 40 mph. Seven exceedances in this period occurred on days with peak gusts above 45 mph.

Figures A-7 and A-8 show the Lamar Power and Municipal Building PM10 concentrations versus Lamar 30-day precipitation totals, respectively, by cluster. The blowing dust group, Cluster 5, is generally associated with 30-day precipitation totals of less than 1.00 inches at Lamar. Concentrations of 150 ug/m3 or higher occurred when the 30-day precipitation was 0.6 inches or lower. Strong winds and low soil moisture content can lead to blowing dust in Colorado and adjoining states. If it were not for high winds and low soil moisture content, these exceedances would not have occurred.

Table A-1. K-means cluster analysis means for Lamar PM10 and meteorological variables.

Cluster Variables	Cluster 1 Means	Cluster 2 Means	Cluster 3 Means	Cluster 4 Means	Cluster 5 Means
Lamar 5-second Gust in mph	27.4	34.7	38.9	19.5	52.6
Lamar Power PM10 in ug/m3	22.6	22.6	53.2	19.6	154.9
Lamar Municipal PM10 in ug/m3	20.6	18.0	38.5	16.4	111.9
Lamar 30-day Precipitation in Inches	3.68	0.75	0.85	0.64	0.43
Count	295	552	183	799	15

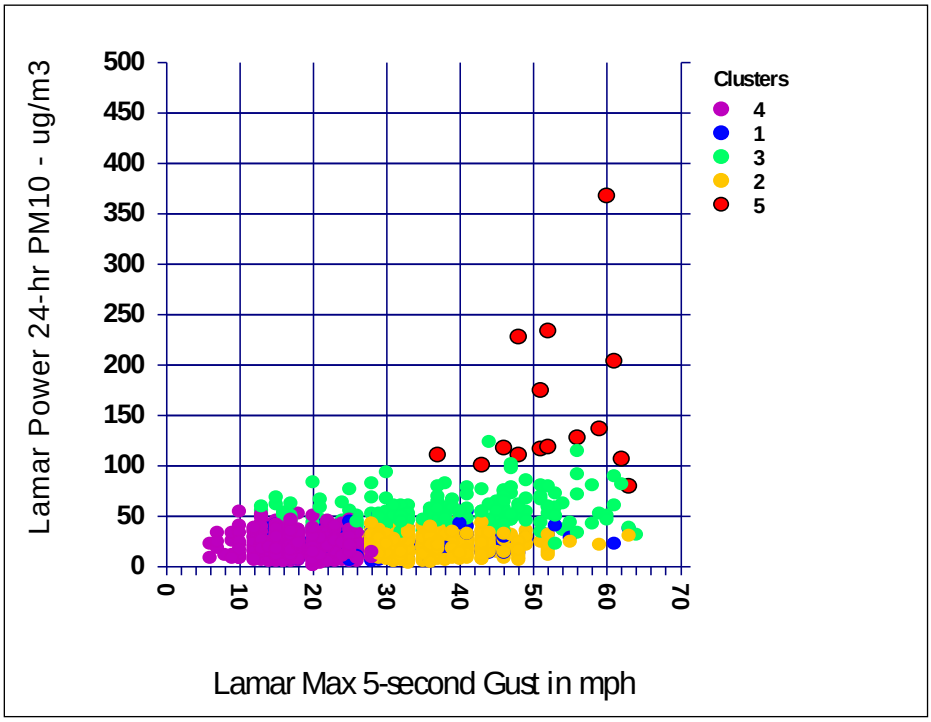


Figure A-5. Lamar Power 24-hour PM10 concentrations versus Lamar gust speed by cluster.

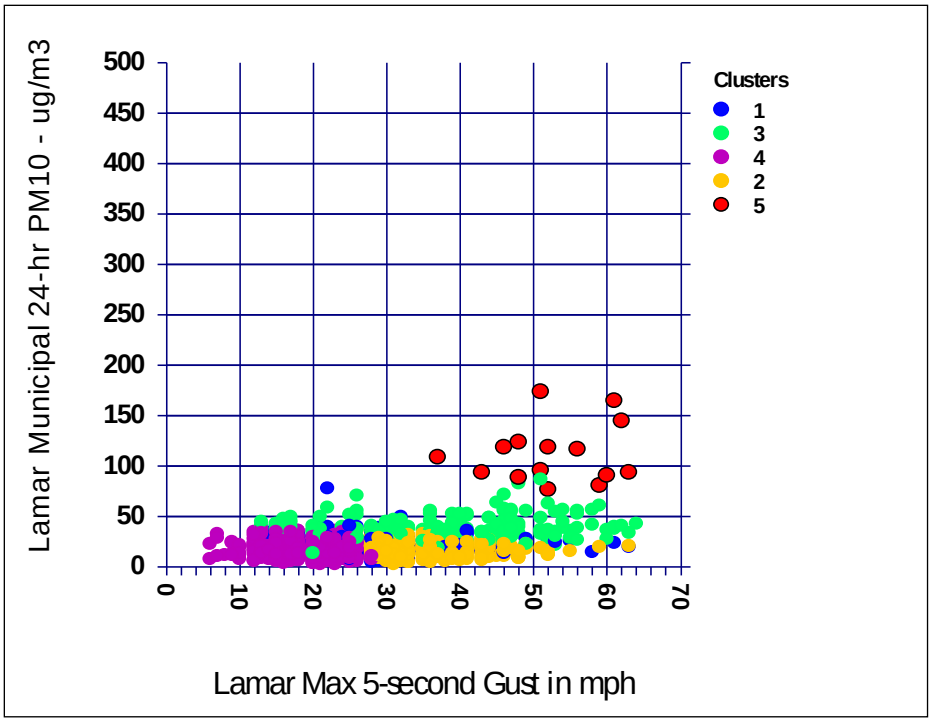


Figure A-6. Lamar Municipal Building 24-hour PM10 concentrations versus Lamar gust speed by cluster.

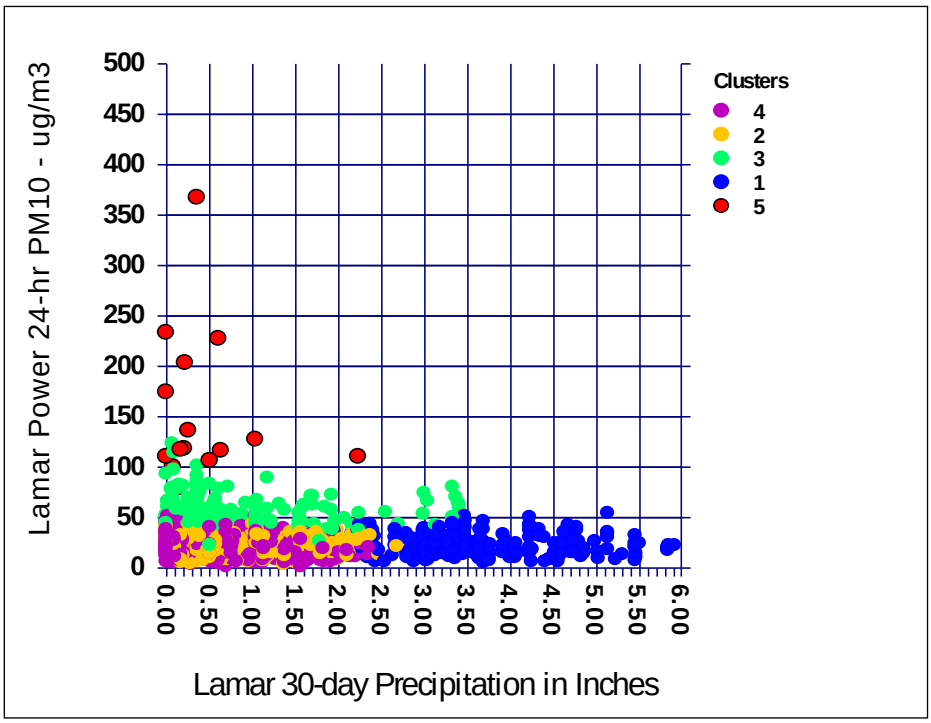


Figure A-7. Lamar Power 24-hour PM10 concentrations versus Lamar 30-day total precipitation by cluster.

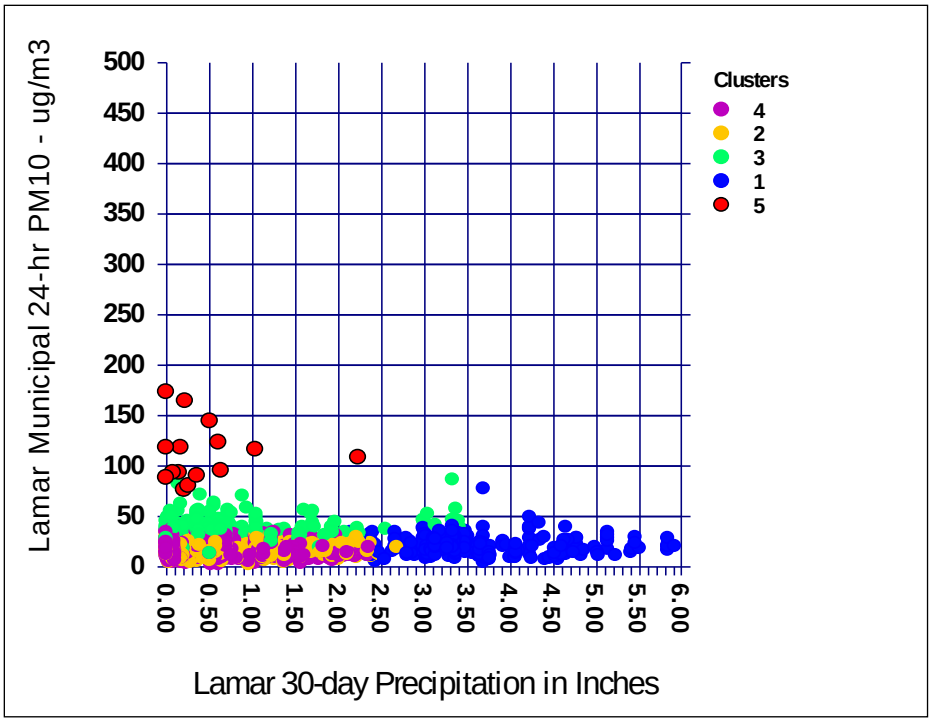


Figure A-8. Lamar Municipal Building 24-hour PM10 concentrations versus Lamar 30-day total precipitation by cluster.

High Wind and PM10 Exceedance Climatology for Lamar

Figure A-9 presents monthly percentiles for Lamar wind gust speeds for January 2004 through March 2009. Wind gusts generally considered to be high enough for significant blowing dusts (40 mph or higher) are within the upper 15 percent during most months of the year and in the upper 20 percent during April May and June. Figure A-10 shows an annual average histogram for Lamar wind gusts. Gusts of 40 mph or higher occur 12 percent of the time. Gusts of 41 mph or higher occur 10% of the time, and the 95 percentile gust is 47 mph. Consequently, these high wind events can be viewed as exceptional rather than normal. Cluster analysis also shows that the blowing dust events represent less than 1% of the 1844 PM10 sample days considered (sample days must have had measurements at both sites to be considered in the cluster analysis.)

Gusts above 40 can occur any month of the year, but are most likely in March, April, May, June and July. Figure A-4 shows that at Lamar May, June, and July are the wettest months and March and April are among the drier months of the year. It is in drier years, therefore, that blowing dust may be most prevalent during the late spring and early summer months. January and February are typically very dry, and might be expected to have a significant proportion of blowing dust events. Figure A-11 and A-12 show that the main blowing dust season at Lamar can be considered to run from January through May, based on data from January 2004 through February of 2009.

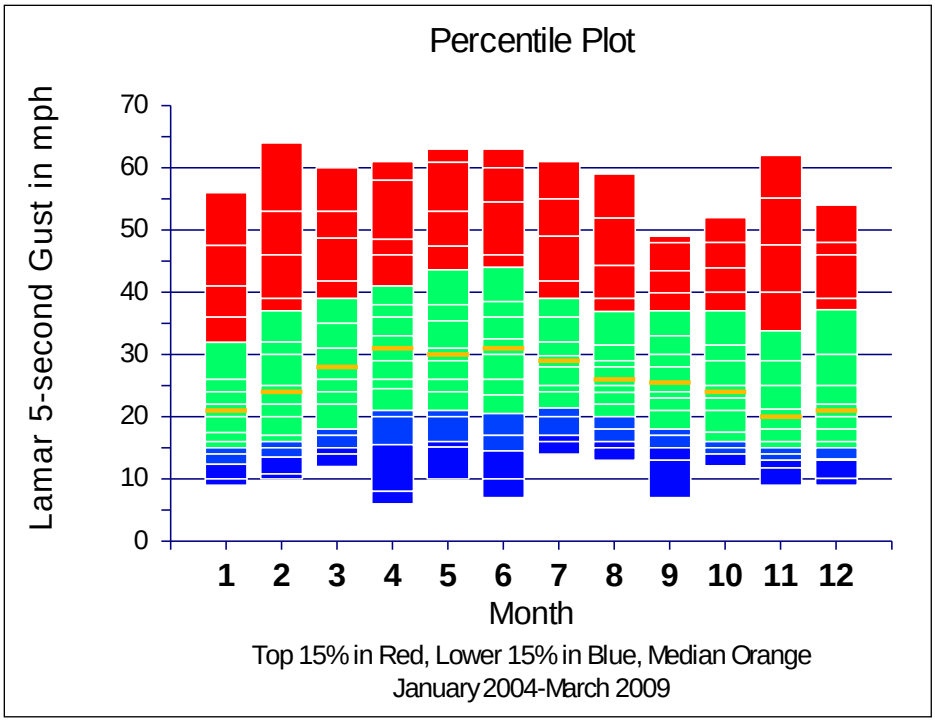


Figure A-9. Percentile plot of Lamar daily maximum 5-second gust speed in miles per hour showing that gusts of 40 mph or greater generally occur within the top 15 percentile speeds for each month of the year.

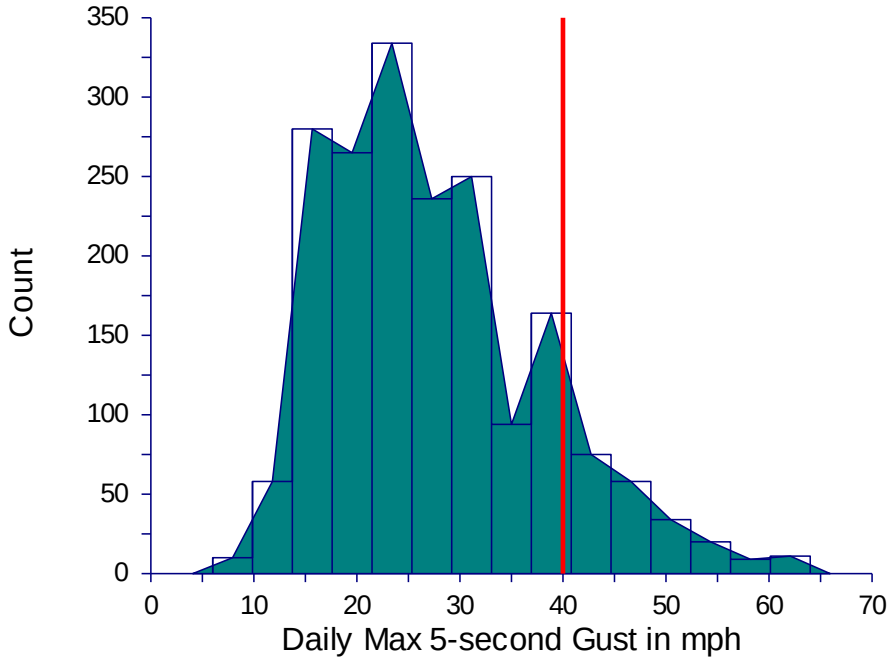


Figure A-10. Histogram of daily maximum 5-second wind gusts at Lamar based on January 2004 – March 2009. The red line at gusts of 40 mph represents the 88 percentile value.

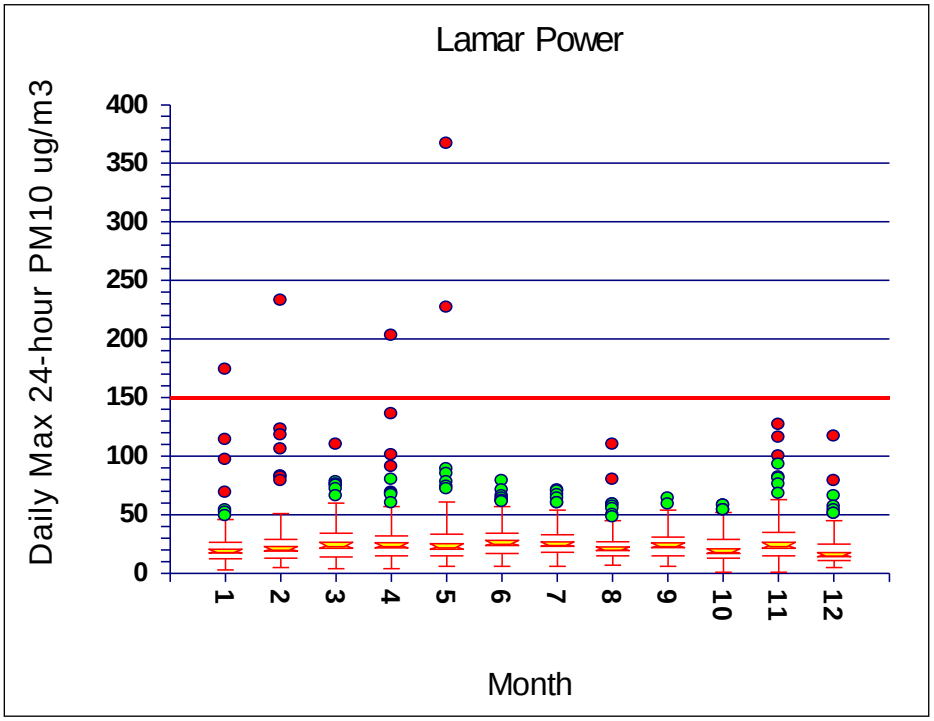


Figure A-11. Box plot of daily maximum Lamar Power 24-hour PM10 concentrations in ug/m3 by month for January 2004 through February 2009.

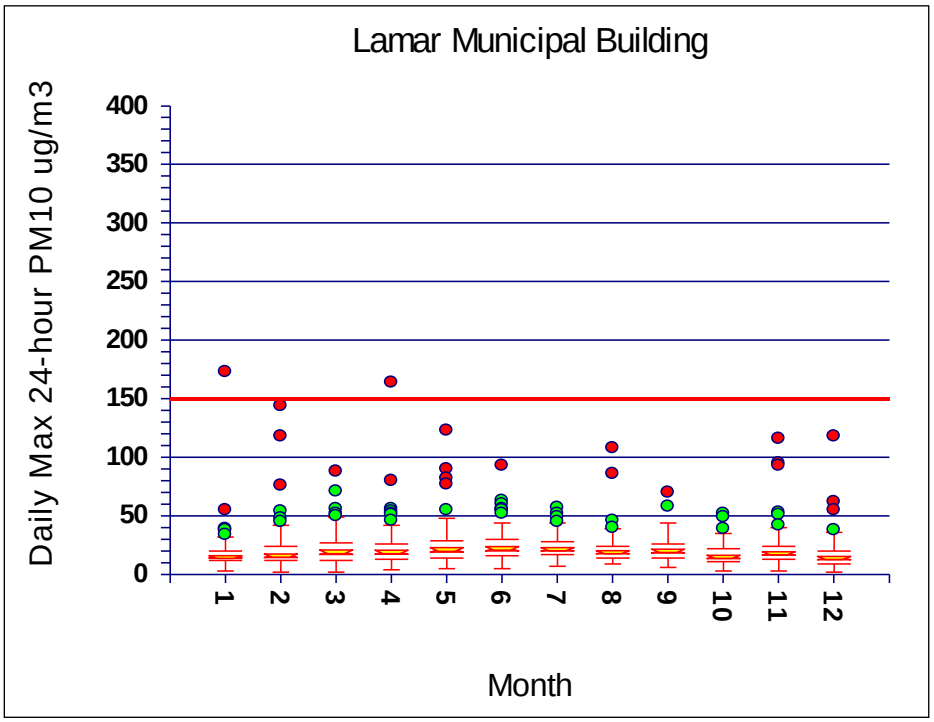


Figure A-12. Box plot of daily maximum Lamar Municipal Building 24-hour PM10 concentrations in ug/m3 by month for January 2004 through February 2009.

Back Trajectory Analyses and Source Regions

NOAA HYSPLIT 36-hour back trajectories were calculated for Lamar for the eight 24-hour periods from 2004 through early 2009 with strong regional winds, dry soils, and either the Power Plant or Municipal Building PM10 concentrations in excess of 125 ug/m3. Each of these events was classified as a Cluster 5 blowing dust event in the cluster analysis previously discussed. Trajectories were modeled every 4 hours for each day. The 6 back trajectories for each day were calculated for an arrival height of 500 meters using EDAS40 data and model vertical velocities (see: http://www.arl.noaa.gov/HYSPLIT.php). The eight days used in the analysis and the monitor concentrations measured on these days are presented in Table A-2.

The specific back trajectories for the periods with haze and/or elevated gusts at Lamar on these high-concentration days are shown in Figure A-13. Transport for the highest concentrations generally falls into one of two categories. In one category, transport originates from the north-northwest through north and covers parts of northeastern and eastern Colorado. In the second, transport is from the west-southwest, southwest, or south and originates in southern Colorado, New Mexico, or Arizona.

Table A-2. Lamar Power Plant and Municipal Building monitor days with concentrations for at least one site in excess of 125 ug/m3 and blowing dust conditions (from 2004 through early 2009).

Year	Month	Day	Lamar Power 24-hour PM10 concentration in ug/m3	Lamar Municipal 24-hour PM10 concentration in ug/m3
2008	5	2	367	90
2009	2	6	233	118
2008	5	22	227	123
2005	4	5	203	164
2009	1	19	174	173
2006	4	15	136	80
2006	11	14	127	116
2009	2	17	106	144

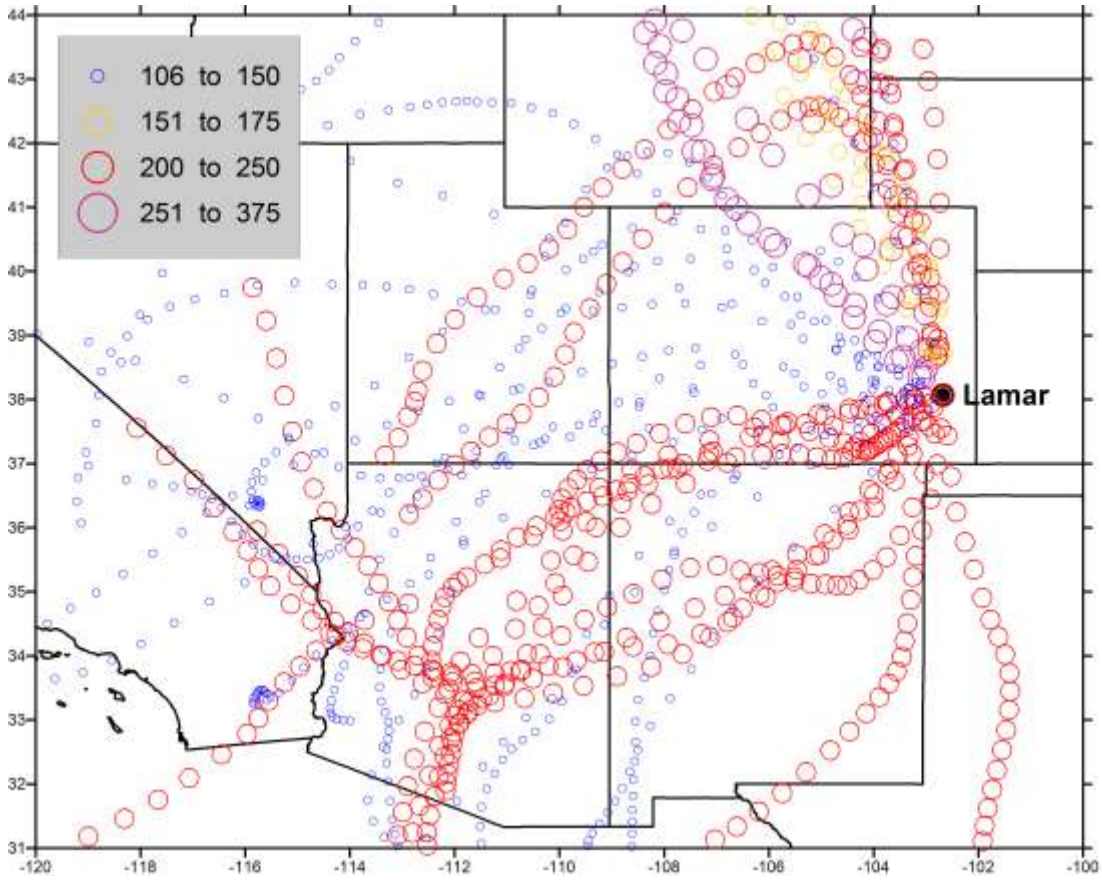


Figure A-13. NOAA HYSPLIT 36-hour back trajectories for Lamar for the periods with haze and/or elevated gusts at Lamar on the eight Cluster 5 high-concentration days shown in Table A-2. Trajectory points are sized and color-coded to reflect 24-hour PM10 concentrations at the Power Plant in ug/m3.

An analysis of the annual frequency of dust storms (Orgill and Sehmel, 1976) in the western half of the U.S. suggests that large areas of eastern Colorado, western Kansas, Texas, New Mexico and Arizona are source regions for blowing dust (see Figure A-14). The back trajectories in Figure A-13 cross these source areas and suggest that dust from upwind states can contribute to PM10 concentrations at Lamar during regional high-wind events.

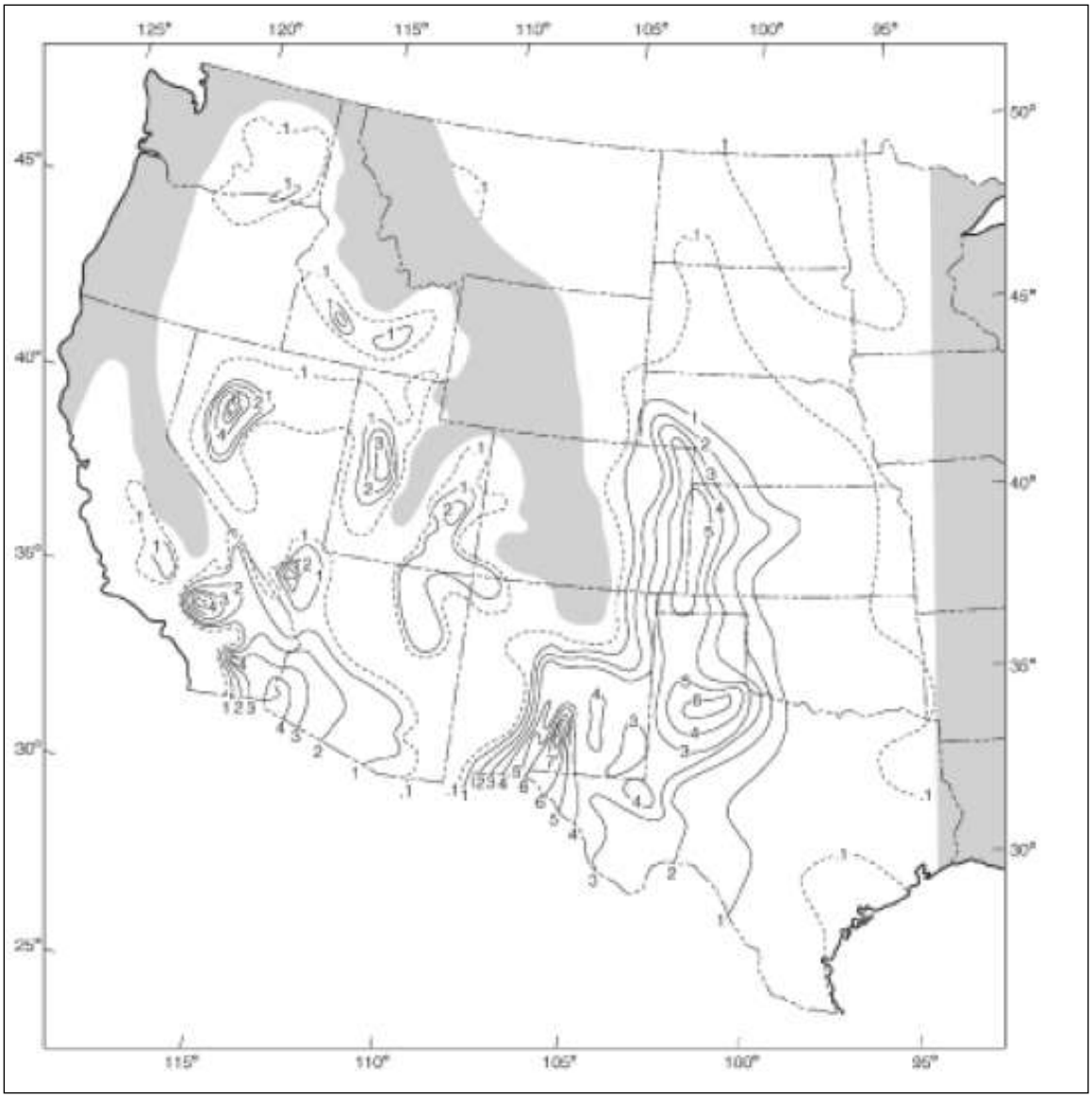


Figure A-14. Number of dust storms per year from: Orgill, M.M., Sehmel, G.A., 1976. Frequency and diurnal variation of dust storms in the contiguous USA. *Atmospheric Environment 10*, 813‑825.

Dust Transport Example 1

A blowing dust exceedance at Lamar on May 22, 2008, provides an example of a regional high-wind, blowing-dust event with transport from New Mexico into southeastern Colorado.

On Thursday May 22, 2008, Lamar Colorado recorded an exceedance of the twenty-four-hour PM10 standard with a concentration of 227 ug/m3 at the Lamar Power Plant. A twenty-four-hour PM10 concentration of 123 ug/m3 was measured at the Lamar Municipal Building on May 22. An intense surface low-pressure system was centered over Southeast Colorado with a strong upper level cut-off low over the Great Basin. The central pressure of the low-pressure system ranged from 985 to 987 mb while over

southeast Colorado. The central pressure of the storm is significant since storms of about 1000 mb or lower were identified as a typical precondition for blowing dust in eastern Colorado when soils are dry (see reference for the *Natural Events Action Plan for High Wind Events – Lamar, Colorado* at the end of this attachment).

Sustained winds and gusts in eastern and southeastern Colorado exceeded blowing dust criteria. Many sites showed wind speeds in excess of 30 miles per hour (mph) and gusts in excess of 40 mph. Winds at Lamar were above the blowing dust thresholds for several hours on May 22, and gusts were as high as 58 mph.

Figure A-15 shows that abnormally dry to moderate drought conditions prevailed in eastern and southeastern Colorado on May 6, 2008. Figure A-16 shows that there was a significant soil moisture deficit in southeastern Colorado in April of 2008; and this deficit spread southward into Texas, southwestern Kansas, Oklahoma, and New Mexico.

This same storm system caused significant blowing dust in New Mexico and points south on May 21. A NOAA Operational Significant Event Imagery (OSEI) satellite product in Figure A-17 shows blowing dust plumes identified by NOAA scientists in the southwestern U.S. and northern Mexico. Figures A-18 and A-19 provide additional satellite evidence for large-scale blowing dust in New Mexico on May 21. NOAA 24-hour HYSPLIT back trajectories for a several-hour period at Lamar on May 22 (the windiest period in southeast Colorado - each hour from 11 AM MST to 6 PM MST) in Figure A-20 show that the air mass over Lamar on May 22 had its origins in New Mexico and Texas on May 21. Figures A-21 and A-22 show the relationships between these back trajectories and PM10 exceedances and blowing dust on the previous day. (Available satellite imagery for Colorado does not show any obvious blowing dust on either May 21 or May 22, 2008.) Twenty-four hour PM10 concentrations in southern New Mexico ranged from near 200 ug/m3 to just over 1000 ug/m3 on May 21. Back trajectories clearly suggest that some of the PM10 in the atmosphere over Lamar on May 22 had been transported from the dust storm stricken areas of New Mexico on May 21.

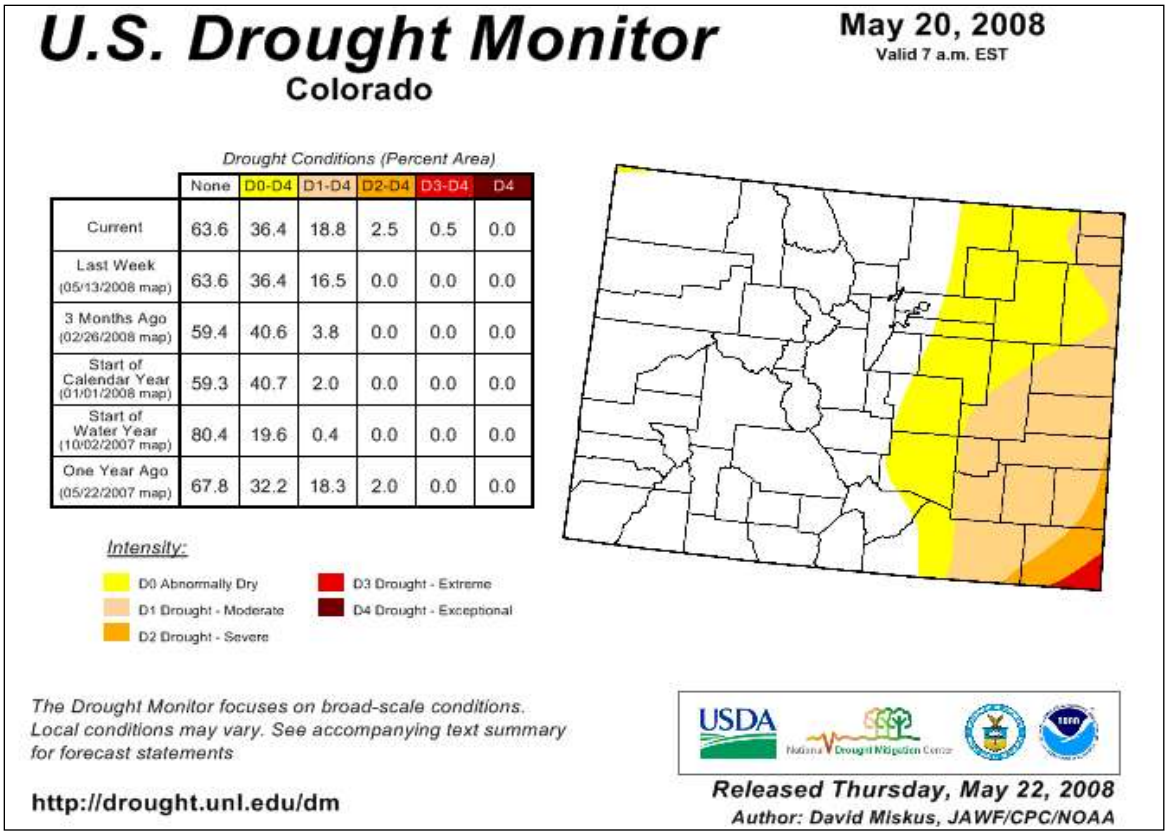


Figure A-15. Drought status for the Colorado on May 20, 2008 (source: the USDA, NOAA, and the National Drought Mitigation Center at: http://drought.unl.edu/dm/archive.html).

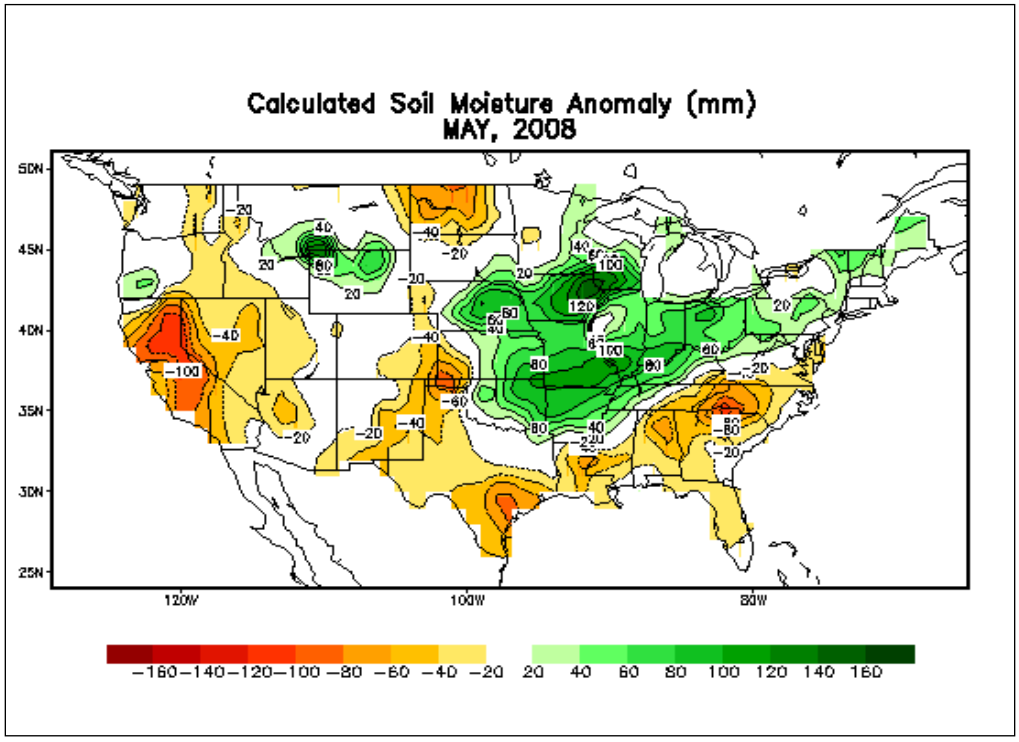


Figure A-16. Calculated Soil Moisture Anomaly (mm) May 2008 (http://www.ncdc.noaa.gov/img/climate/research/2008/may/cpc-soil-moist-anom-200806.gif).

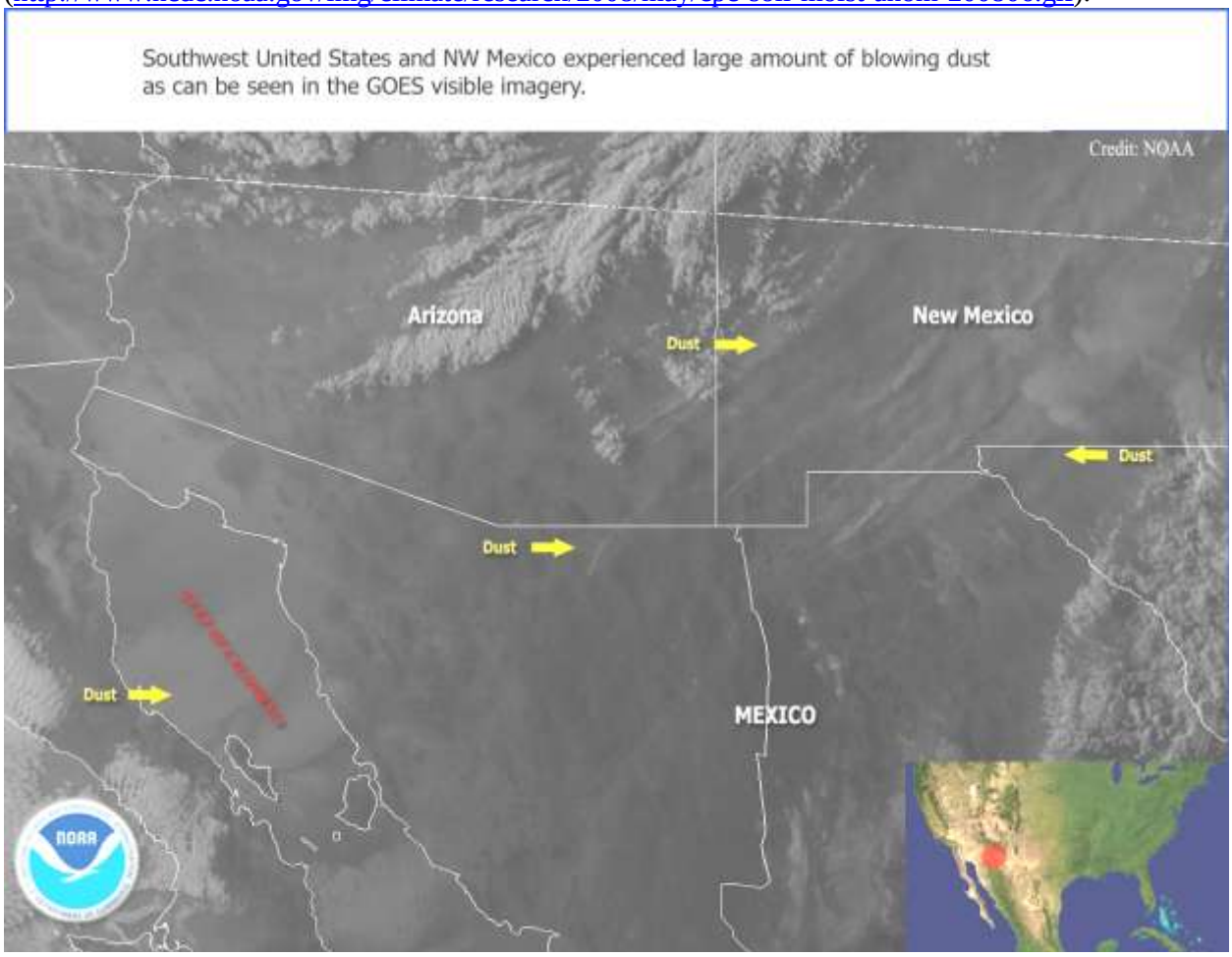


Figure A-17. Plumes of blowing dust are visible across southern Arizona, New Mexico, northern New Mexico, and the Gulf of California in this NASA MODIS satellite image for 6:45 PM MDT on May 21, 2008. (source: http://www.osei.noaa.gov/Events/Dust/US_Southwest/2008/DSTusmx142_G12.jpg)

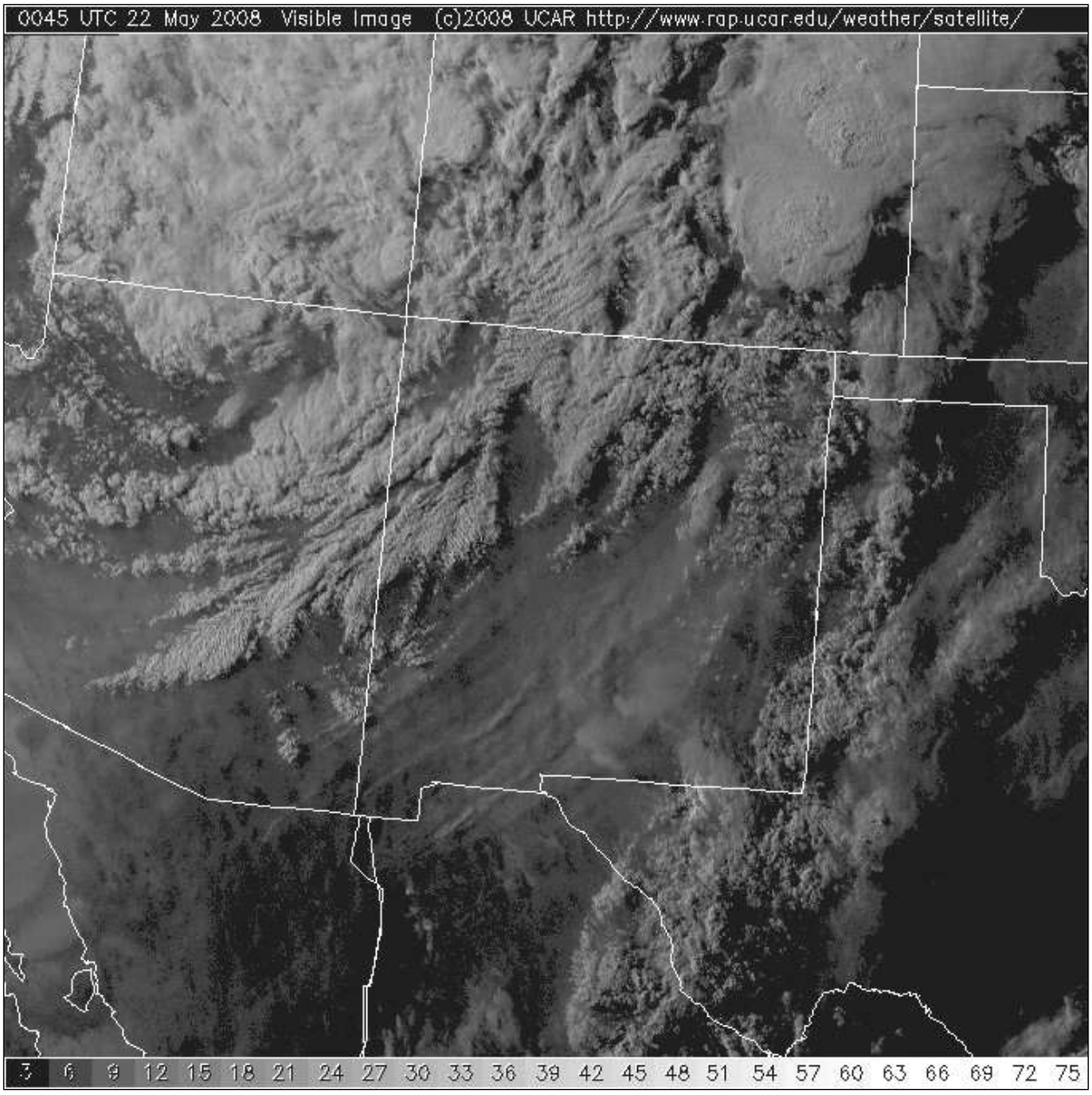


Figure A-18. Visible satellite image of the southwestern U.S. for 6:45 PM MDT on May 21, 2008, showing pronounced southwest to northeast trending plumes of blowing dust in New Mexico.

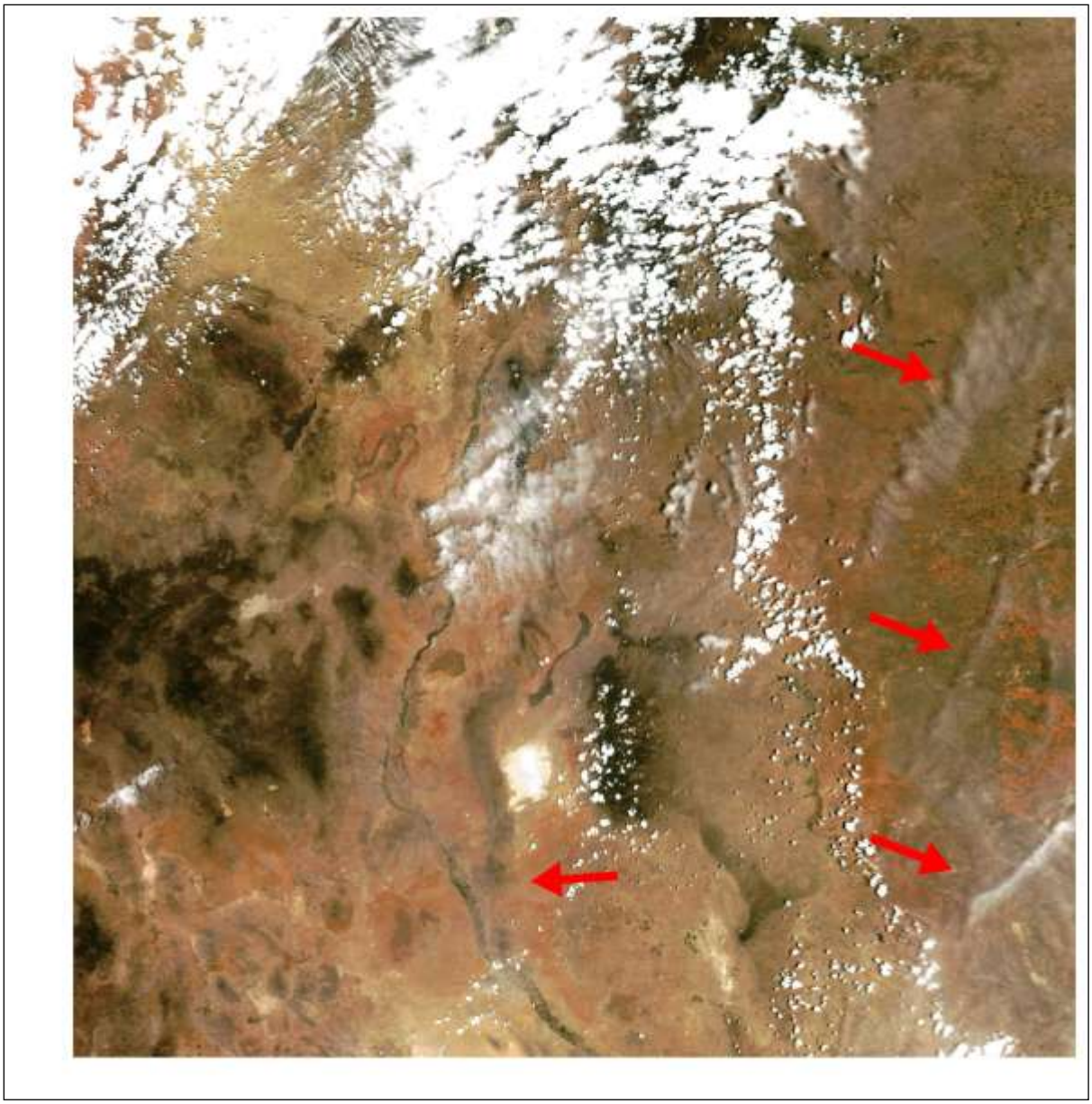


Figure A-19. Visible satellite image of New Mexico at 1:40 PM MST, May 21, 2008. Plumes and areas of blowing dust are marked with an arrow (http://activefiremaps.fs.fed.us/imagery.php?op=fire&passID=51054&month=5&year=2008).

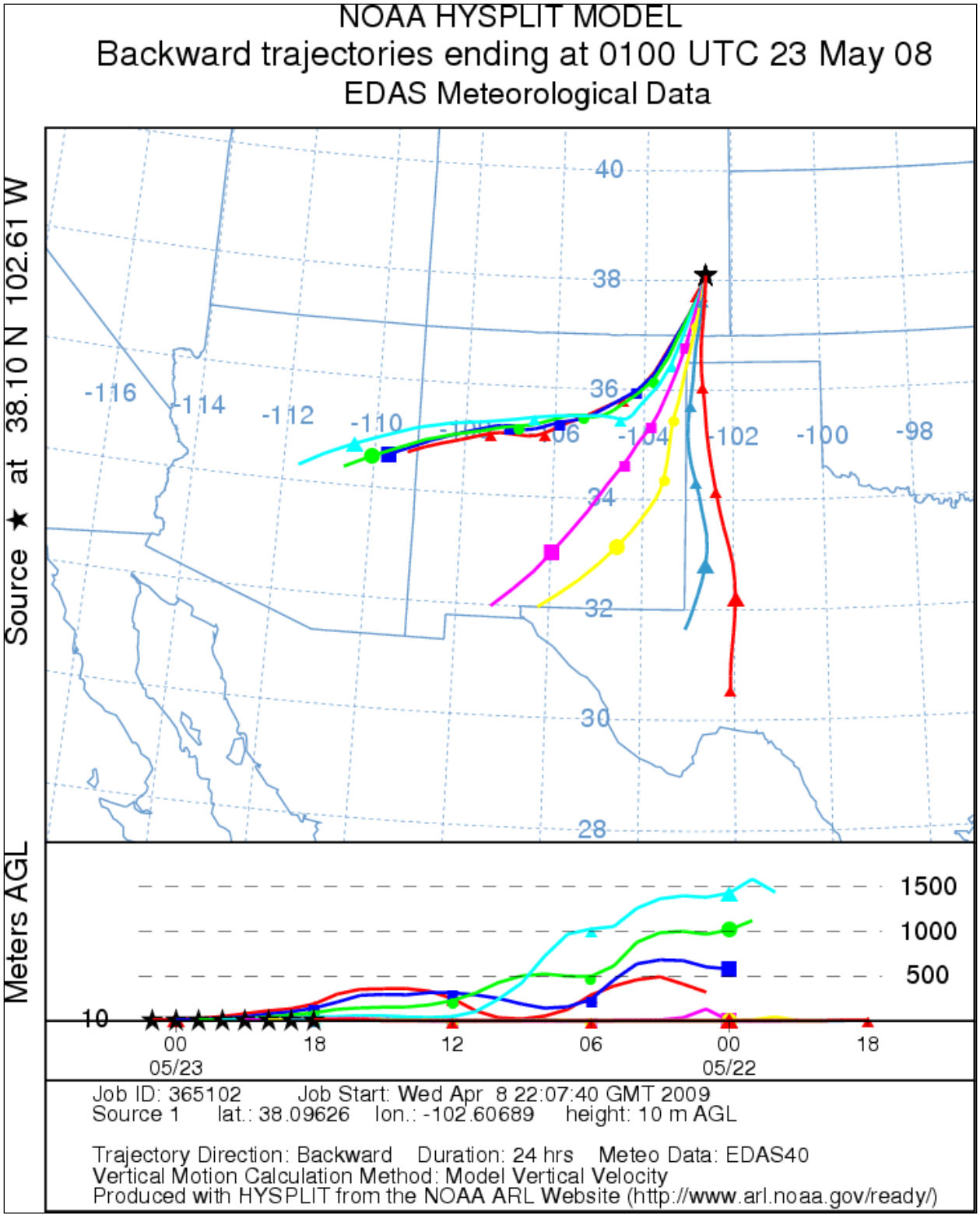


Figure A-20. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado for each hour from 11 AM MST to 6 PM MST on May 22, 2008.

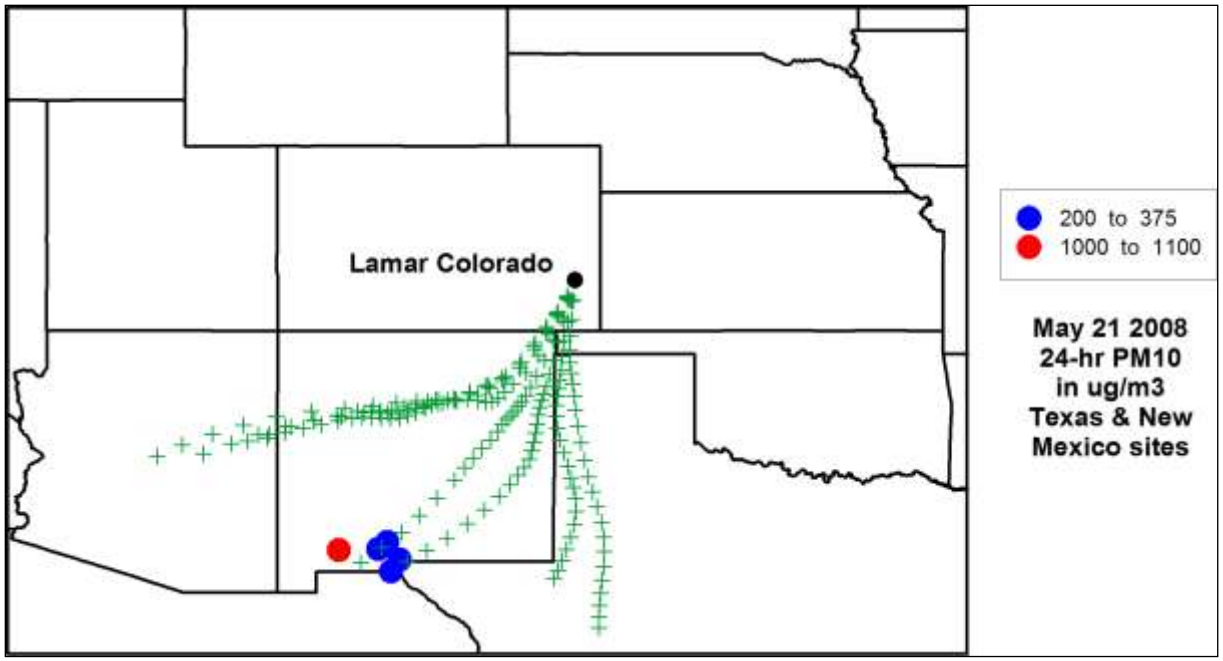


Figure A-21. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado from Figure A-20 and May 21 PM10 exceedance concentrations in southern New Mexico and Texas.

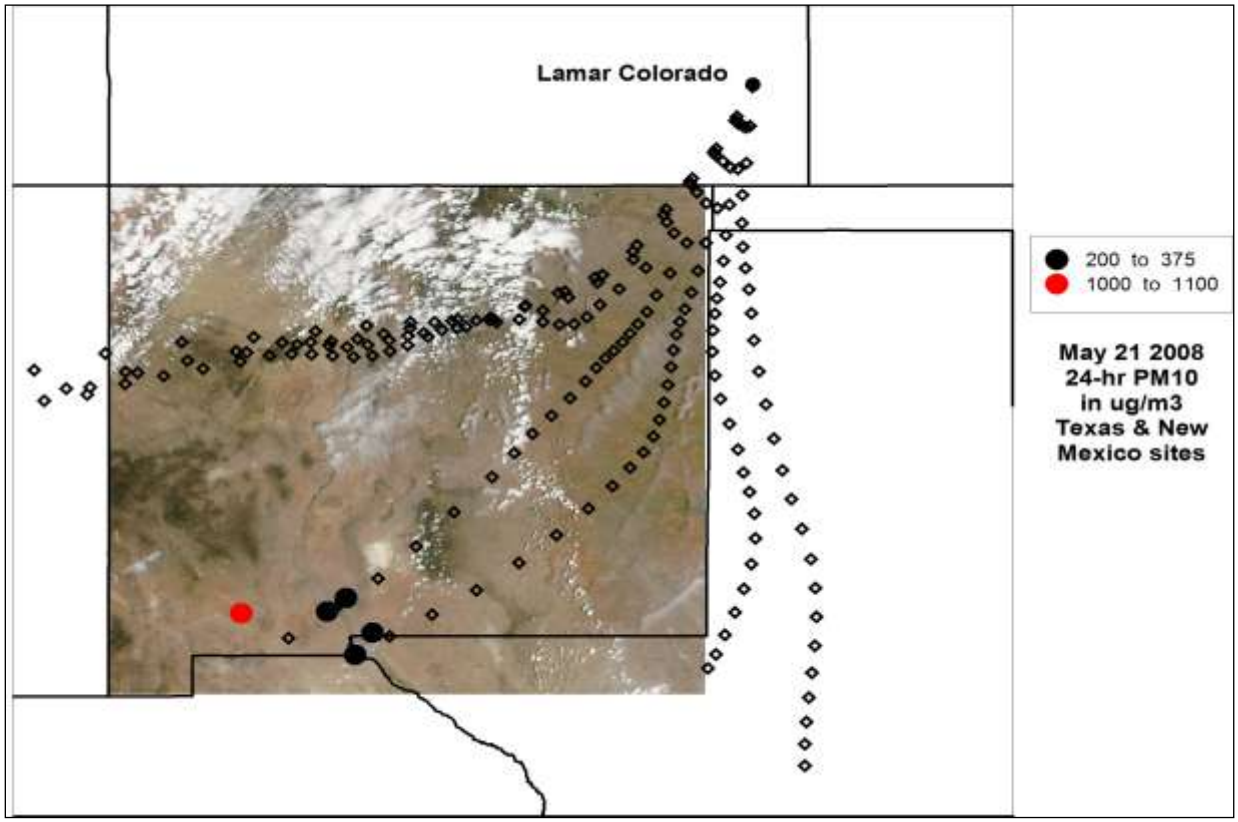


Figure A-22. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado from Figure A-20, May 21 PM10 exceedance concentrations in southern New Mexico and Texas, and May 21 visible satellite image from Figure A-19.

Dust Transport Example 2

A blowing dust exceedance at Lamar on January 19, 2009, provides an example of a regional high-wind, blowing-dust event with transport from eastern and northeastern Colorado and southwestern Nebraska into southeastern Colorado. On Monday January 19, 2009, Lamar, Colorado, recorded exceedances of the twenty-four-hour PM10 standard with a concentration of 174 ug/m3 at the Lamar Power Plant monitor and 173 ug/m3 at the Lamar Municipal Building monitor. These exceedances were the consequence of strong northerly winds in combination with dry conditions, which caused significant blowing dust across the plains of eastern Colorado, western Kansas, and western Nebraska. The winds were partly the result of a strong pressure gradient between a 1048 millibar high pressure system over the western U.S. and a complex series of low pressure systems over the eastern U.S.

These surface features were associated with a high amplitude upper level trough centered over the Ohio Valley and an upper level ridge centered over northern Idaho. Figure A-23 shows the 700 millibar analysis for 12Z January 19 (5 AM MST January 19). The 700-millibar level is at approximately 10,000 feet above sea level. There was a wind speed maximum of 60 to 70 knots at this level that stretched from the Texas Panhandle to western South Dakota including eastern Colorado and western Nebraska. Once the morning inversion had dissipated the momentum associated with the 700-millibar wind speed maximum mixed down to the surface intensifying the winds induced by the surface pressure gradient. In Figure A-24 the 700 millibar analysis for 00Z January 20, 2009, (5 PM MST January 19) continues to show 40 to 50 knot winds over eastern Colorado and western Nebraska.

The combination of the mixing and the tight surface pressure gradient caused surface winds of 30 to 40 mph with gusts of 35 to 60 mph. Winds of this strength will cause blowing dust if soils are dry. Wind speeds of 30 mph or greater and gusts of 40 mph or higher have been shown to cause blowing dust in eastern Colorado (see reference for the *Natural Events Action Plan for High Wind Events – Lamar, Colorado* at the end of this attachment). The conditions necessary for strong gusty winds were in place over the area of concern for the daytime hours of January 19, 2009.

Figures A-25 and A-26 show surface maps for eastern Colorado and western Kansas for some of the hours with the strongest vertical mixing of the atmosphere. They show wind speeds across the region of 20 to 40 mph and wind gusts of 25 to 51 mph. Once again, wind speeds and gust speeds exceeded thresholds that have been shown to cause blowing dust in eastern Colorado (see reference for the *Natural Events Action Plan for High Wind Events – Lamar, Colorado* at the end of this attachment).

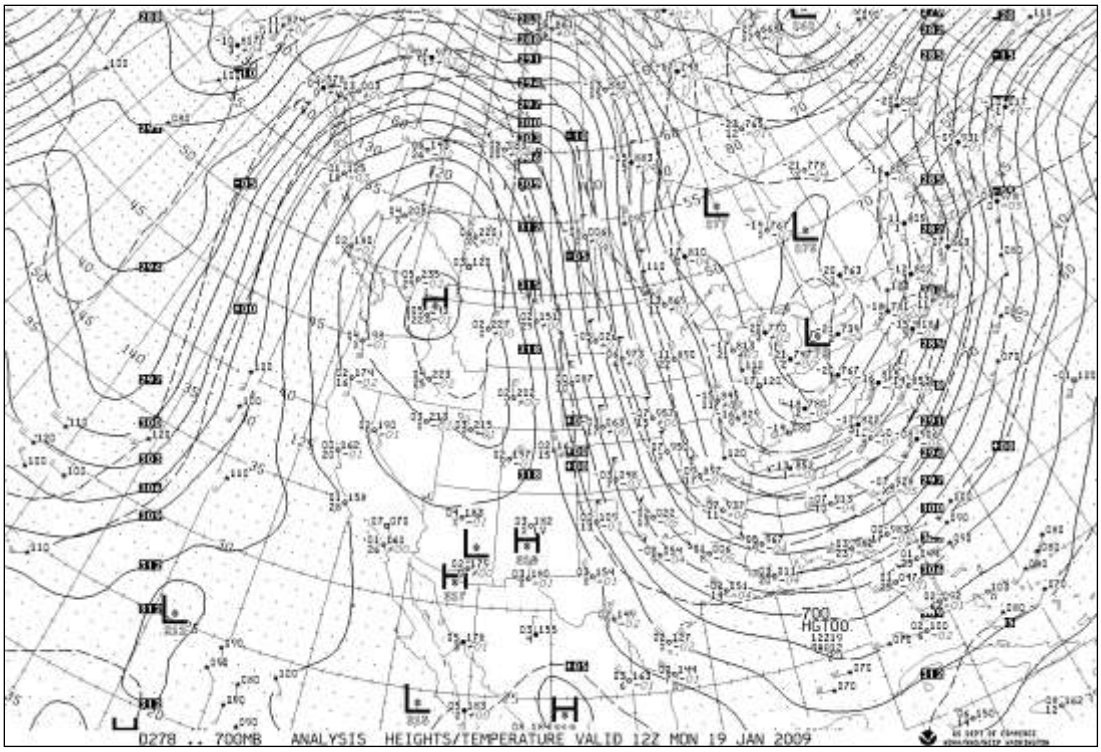


Figure A-23. 700 millibar analysis for 12Z January 19, 2009, or *5 AM MST January 19, 2009*, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

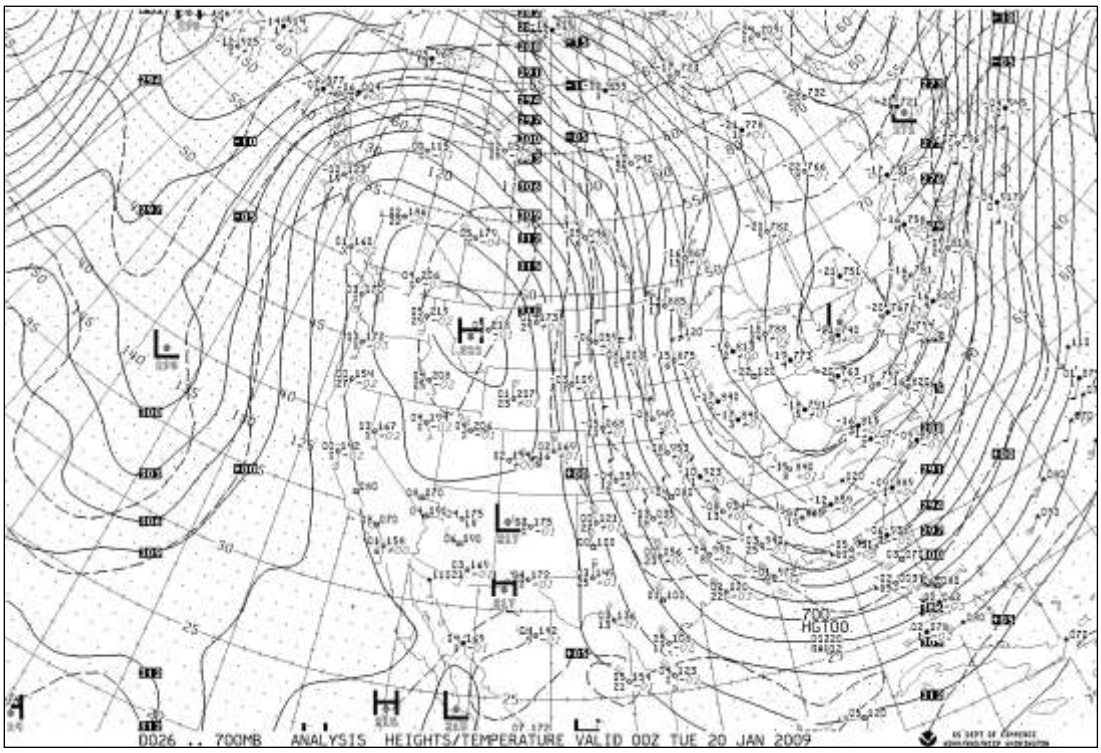


Figure A-24. 700 millibar analysis for 00Z January 20, 2009, or *5 PM MST January 19, 2009*, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

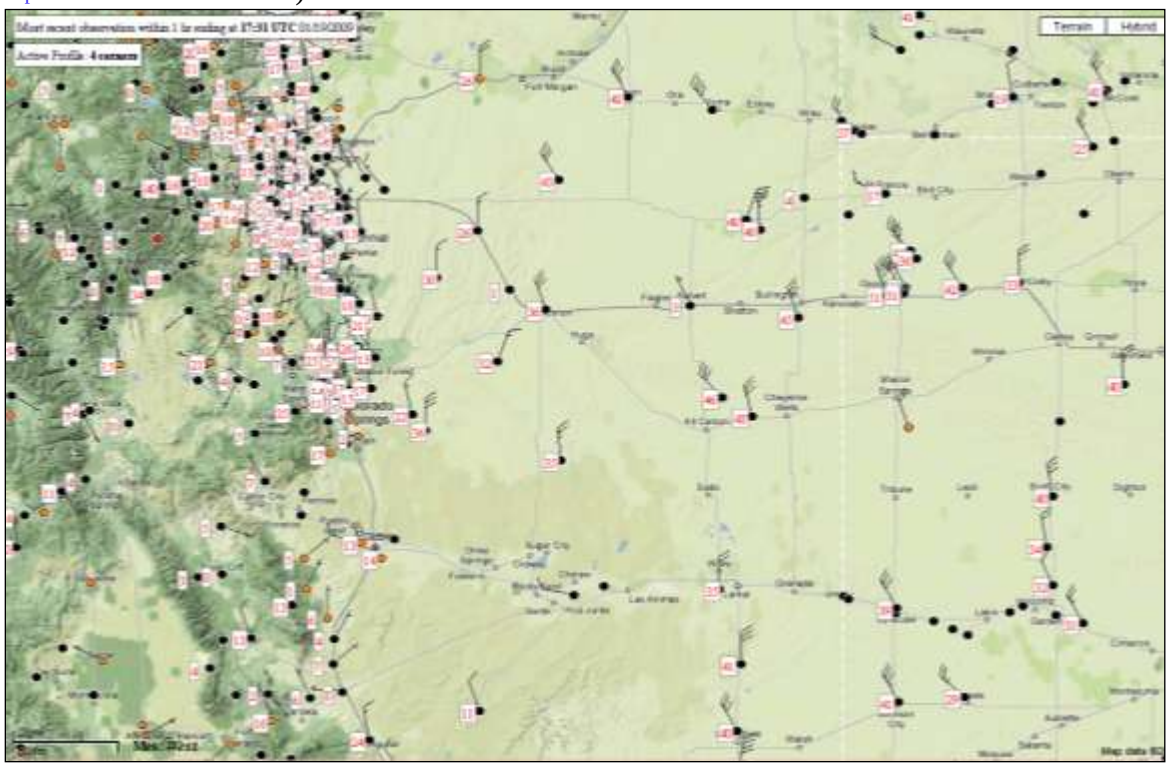


Figure A-25. Wind directions and gust speeds in mph in eastern Colorado and western Kansas 17:31 UTC January 19, 2009 (10:31 AM MST on January 19, 2009). (http://mesowest.utah.edu/index.html)

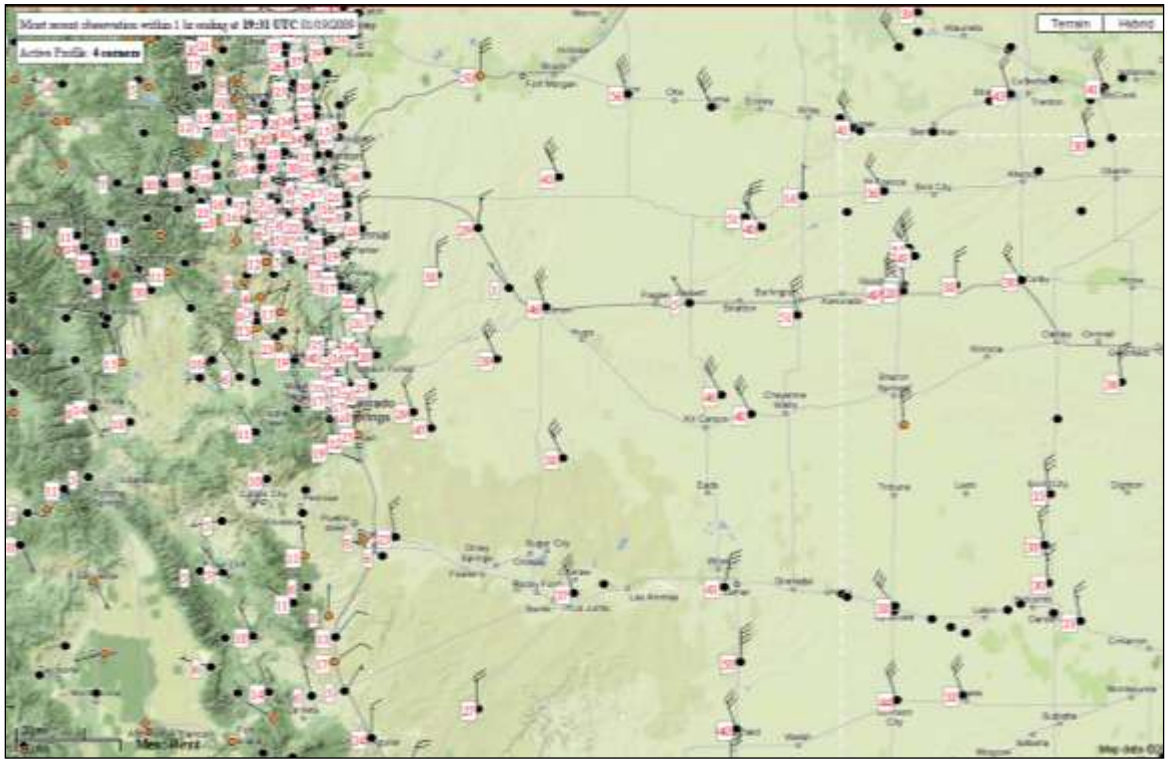


Figure A-26. Wind directions and gust speeds in mph in eastern Colorado and western Kansas 19:31 UTC January 19, 2009 (12:31 PM MST on January 19, 2009). (http://mesowest.utah.edu/index.html) Figure A-27 shows the percent of normal precipitation for Colorado during January 2009. Most of eastern Colorado had less than 50 percent of normal precipitation. This lack of precipitation was not limited to January. The region had been abnormally dry since November of 2008 as shown in Figure A-28. Figure A-28 indicates that most of eastern Colorado had below normal precipitation, and the area around Lamar had less than 50 percent of normal precipitation from November 2008 through January 2009. Figure A-29 shows that most of eastern Colorado had less than one inch of total precipitation in the three months of November 2008 through January 2009. Figure A-30, shows that Prowers County, Colorado (the county Lamar is in), was classified as having moderate drought conditions on January 20 and most of eastern Colorado had abnormally dry conditions.

Tables A-3 through A-6 show the National Weather Service observations for the eastern Colorado sites of Akron, Burlington, Limon, and Lamar. Winds of 30 mph or greater, wind gusts of 40 mph or greater, reduced visibility, and the weather type of "haze" are highlighted in yellow. Note that Burlington is the only town not located in an area classified as having Moderate Drought or Abnormally Dry conditions. Burlington only had three hours of reduced visibility. This is the fewest hours of reduced visibility of the four stations. Lamar had the greatest number with nine hours of reduced visibility. Lamar reported four hours with haze and six hours with reduced visibility after the winds had died down to values below the thresholds needed to cause blowing dust. *The only explanation for the haze and reduced visibility after the winds had subsided would be dust that was transported into the Lamar area from areas far upwind.*

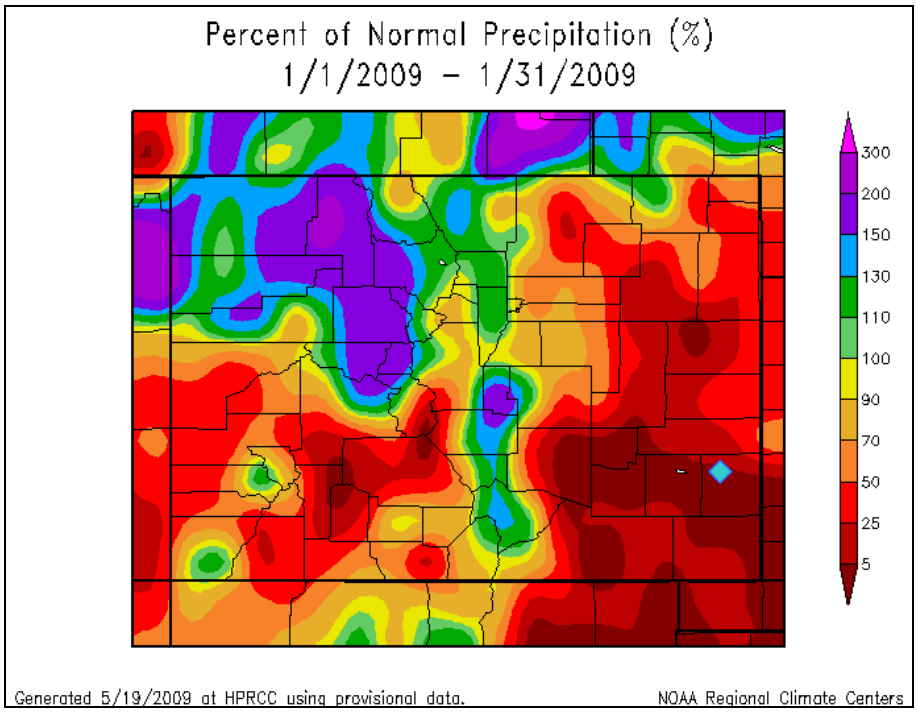


Figure A-27. Percent of Normal Precipitation for January 2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_userdate&daterange=Jan&year=09). Blue diamond shows the approximate location of Lamar.

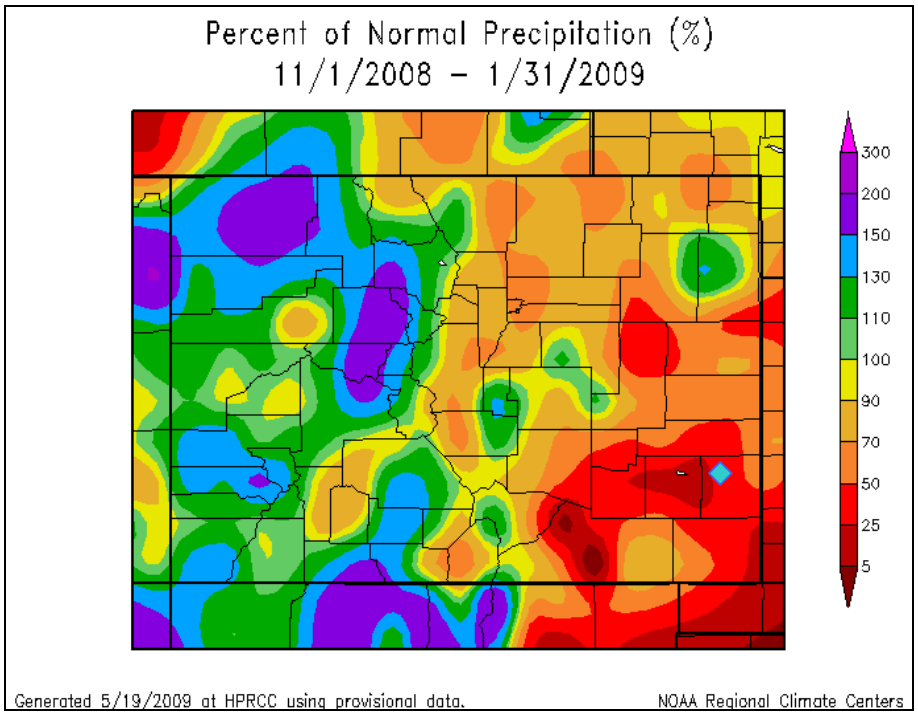


Figure A-28. Percent of Normal Precipitation for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm). Blue diamond shows the approximate location of Lamar.

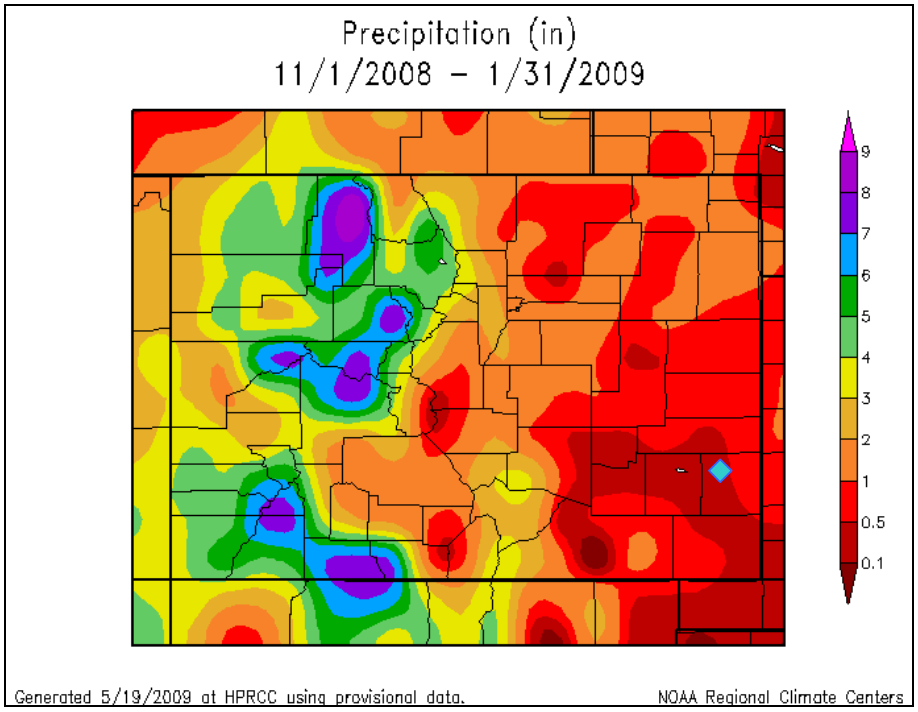


Figure A-29. Precipitation in inches for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm). Blue diamond shows the approximate location of Lamar.

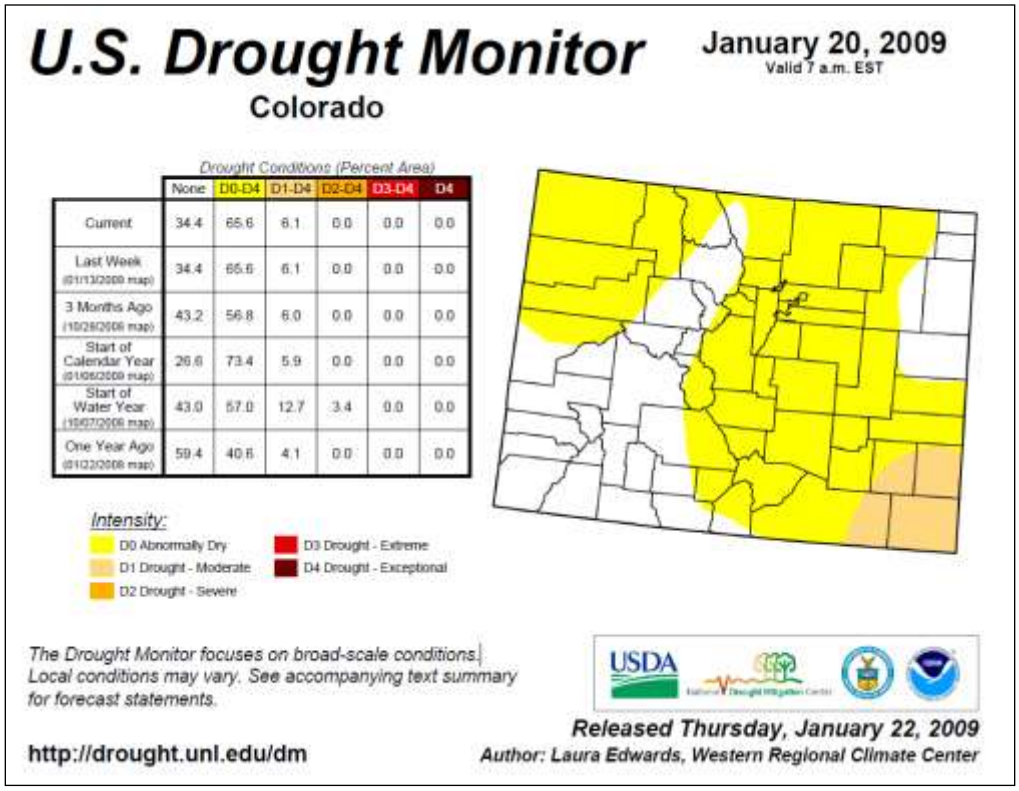


Figure A-30. Drought status for the Colorado on January 20, 2009 (source: the USDA, NOAA, and the National Drought Mitigation Center at: http://drought.unl.edu/dm/archive.html).

Table A-3. Wind and weather observations for Akron, Colorado, reported by the University of Utah MesoWest site (http://mesowest.utah.edu/index.html) for January 19, 2009. Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

Time in MST January 19	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
23:53	33.1	38	15		300	clear	10
22:53	33.1	41	12		310	clear	10
21:53	33.1	45	12		320	clear	10
20:53	30.9	49	10		340	clear	10
19:53	37	40	13		340	clear	10
18:53	44.1	31	21		340	clear	10
17:53	46.9	29	25	35	340	clear	10
16:53	50	25	23	31	350	clear	10
16:30	51.8	24	28	36	340	partly cloudy	10
15:53	54	20	32	44	340	mostly cloudy	7
15:24	55.4	18	37	47	340	haze	6
14:53	55.9	18	33	43	350	haze	4
14:05	57.2	14	36	47	350	haze	3
13:53	57	13	38	48	350	haze	2.5
13:29	57.2	12	30	44	340	haze	3
13:18	57.2	11	38	53	340	haze	2.5
12:53	57.9	11	35	49	330	haze	3
12:41	57.2	11	41	52	340	haze	3
12:23	57.2	10	43	56	340	haze	2
12:15	57.2	10	48	56	330	haze	3
11:53	57.9	10	41	54	340	haze	2.5
11:38	57.2	10	38	53	340	haze	4
10:53	57	10	37	48	330	clear	10
9:53	54	13	37	48	330	clear	10
8:53	50	18	29	39	320	clear	10
7:53	44.1	24	21	30	300	clear	10
6:53	42.1	27	17	25	300	clear	10
5:53	42.1	29	20		310	clear	10
4:53	39.9	31	14	22	290	clear	10
3:53	43	27	20	26	290	clear	10
2:53	43	29	21	28	300	clear	10
1:53	43	30	21		300	clear	10
0:53	45	28	24	32	300	clear	10

Table A-4. Wind and weather observations for Burlington, Colorado, reported by the University of Utah MesoWest site (http://mesowest.utah.edu/index.html) for January 19, 2009. Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

Time in MST January 19	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
23:53	30	58	12		330	clear	10
22:53	33.1	53	12		330	clear	10
21:53	34	49	10		330	clear	10
20:53	37	44	15		350	clear	10
19:53	39	39	12		360	clear	10
18:53	42.1	33	16		360	clear	10
17:53	45	28	17		10	clear	10
16:53	50	21	20	26	10	clear	10
15:53	55.9	16	23	32	360	clear	10
14:53	59	15	32	46	350	clear	10
13:53	61	14	36	49	350	clear	7
12:53	61	10	36	51	350	haze	6
11:53	60.1	10	31	51	350	clear	9
10:53	57.9	11	33	47	350	clear	10
9:53	55.9	13	30	45	340	clear	10
8:53	52	17	28	37	340	clear	10
7:53	48.9	19	30	41	330	clear	10
6:53	46.9	24	25	33	330	clear	10
5:53	46.9	24	21	32	330	clear	10
4:53	48	25	30	39	330	clear	10
3:53	46.9	26	26	37	330	clear	10
2:53	46.9	27	29	41	330	clear	10
1:53	48	26	30	43	320	clear	10
0:53	48	27	30	43	330	clear	10

Table A-5. Wind and weather observations for Limon, Colorado, reported by the University of Utah MesoWest site (http://mesowest.utah.edu/index.html) for January 19, 2009. Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

Time in MST January 19	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
23:55	36	32	14		340	clear	10
22:55	39.9	26	23	32	340	clear	10
21:55	39.9	26	20		330	clear	10
20:55	41	24	18		330	clear	10
19:55	44.1	20	24	36	340	clear	10
18:55	45	22	23	33	340	clear	10
17:55	45	24	13	24	350	clear	10
16:55	50	20	23	33	350	clear	10
15:55	55	17	30	48	350	clear	8
14:55	57	13	33	48	340	clear	7
14:30	57.2	11	35	52	340	haze	5
14:23	57.2	11	38	52	340	haze	2.5
13:55	57.9	11	44	54	340	haze	4
13:44	57.2	10	43	56	340	haze	5
13:33	57.2	10	39	49	340	haze	4
13:19	57.2	10	37	56	340	haze	2.5
13:06	59	9	41	56	340	haze	3
12:55	59	10	43	55	340	clear	10
11:55	57.9	9	37	46	340	clear	10
10:55	57	10	33	48	340	clear	10
9:55	53.1	14	29	36	340	clear	10
8:55	46	21	28	33	330	clear	10
7:55	37	35	12		340	clear	10
6:55	33.1	41	12		290	clear	10
5:55	33.1	43	13		290	clear	10
4:55	37.9	34	16		330	clear	10
3:55	41	30	21		340	clear	10
2:55	42.1	27	22	28	340	clear	10
1:55	44.1	25	21	31	340	clear	10
0:55	45	26	26	33	340	clear	10

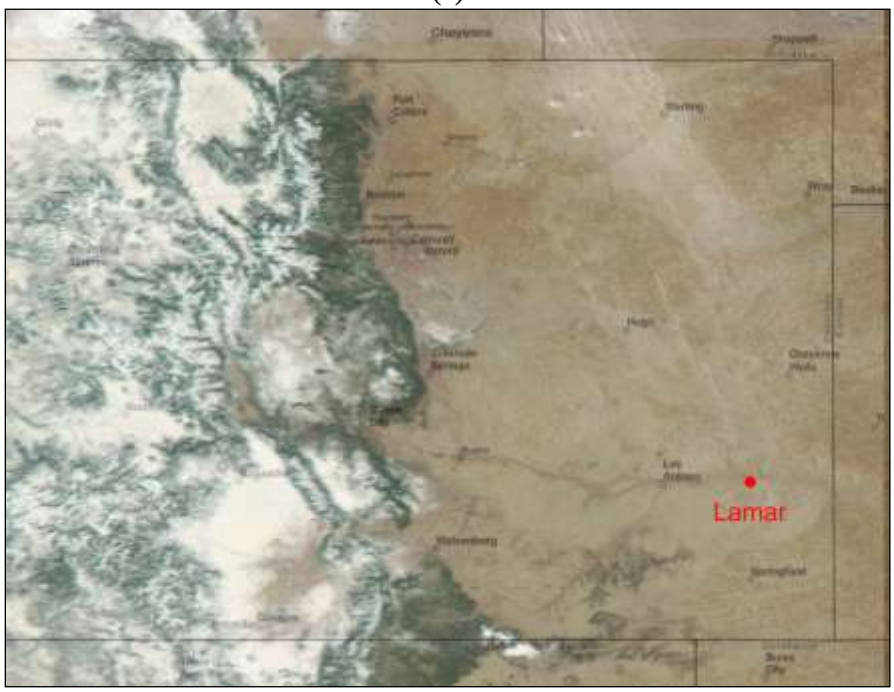
Table A-6. Wind and weather observations for Lamar, Colorado, reported by the University of Utah MesoWest site (http://mesowest.utah.edu/index.html) for January 19, 2009. Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

Time in MST January 19	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
23:53	30	48	7		340	clear	10
22:53	33.1	43	7		350	clear	10
21:53	37	37	7		20	clear	10
20:53	41	33	9		20	clear	9
19:53	43	30	10		10	clear	8
18:53	48.9	23	10		10	haze	6
18:41	48.2	23	8		10	haze	6
17:53	55	18	15		20	haze	5
16:53	57.9	14	13	22	30	haze	4
16:40	60.8	12	16	28	20	haze	4
15:53	62.1	13	26	37	20	haze	4
14:53	64.9	9	30	38	10	clear	7
13:53	66.9	7	35	45	20	haze	6
12:53	66.9	6	32	40	20	clear	10
11:53	66.9	6	36	41	10	clear	9
10:53	64	9	23	31	350	clear	10
9:53	57.9	12	22	35	360	clear	10
8:53	54	16	22	29	330	clear	10
7:53	43	27	14		320	clear	10
6:53	37	35	9		290	clear	10
5:53	37.9	34	10		320	clear	10
4:53	39.9	31	10		320	clear	10
3:53	39.9	31	13		300	clear	10
2:53	41	31	14		300	clear	10
1:53	42.1	30	13		300	clear	10
0:53	42.1	29	13		310	mostly clear	10

Figure A-31 presents two versions of the NASA MODIS true color satellite picture of Colorado at 19:27Z January 19, 2009 (12:27 MST January 19, 2009) (from the USFS site at http://activefiremaps.fs.fed.us/imagery.php?op=fire&fireID=co-000). A large area of blowing dust in north-to-south lines can be seen over northeastern Colorado with smaller areas across the rest of eastern Colorado. This picture was taken near the beginning of the blowing dust episode. The blowing dust would become more wide spread over the next couple of hours. Figure A-32 contains back trajectory plots for Lamar during the peak period of winds and reduced visibilities. These back trajectories are from the NOAA HYSPLIT model using high-resolution NAM12 meteorological input data (http://ready.arl.noaa.gov/HYSPLIT.php). The back trajectory paths in

Colorado, Wyoming, and Nebraska are completely consistent with the observed dust plumes in the MODIS imagery.

(a)



(b)

Figure A-31. (a) MODIS satellite picture of Colorado at 19:27Z January 19, 2009 (12:27 MST January 19, 2009) and (b) the same image with town and city labels. (http://activefiremaps.fs.fed.us/resources/2009019/co-000/crefl2_A2009019192756-2009019193607_250m_co-000_143.jpg).

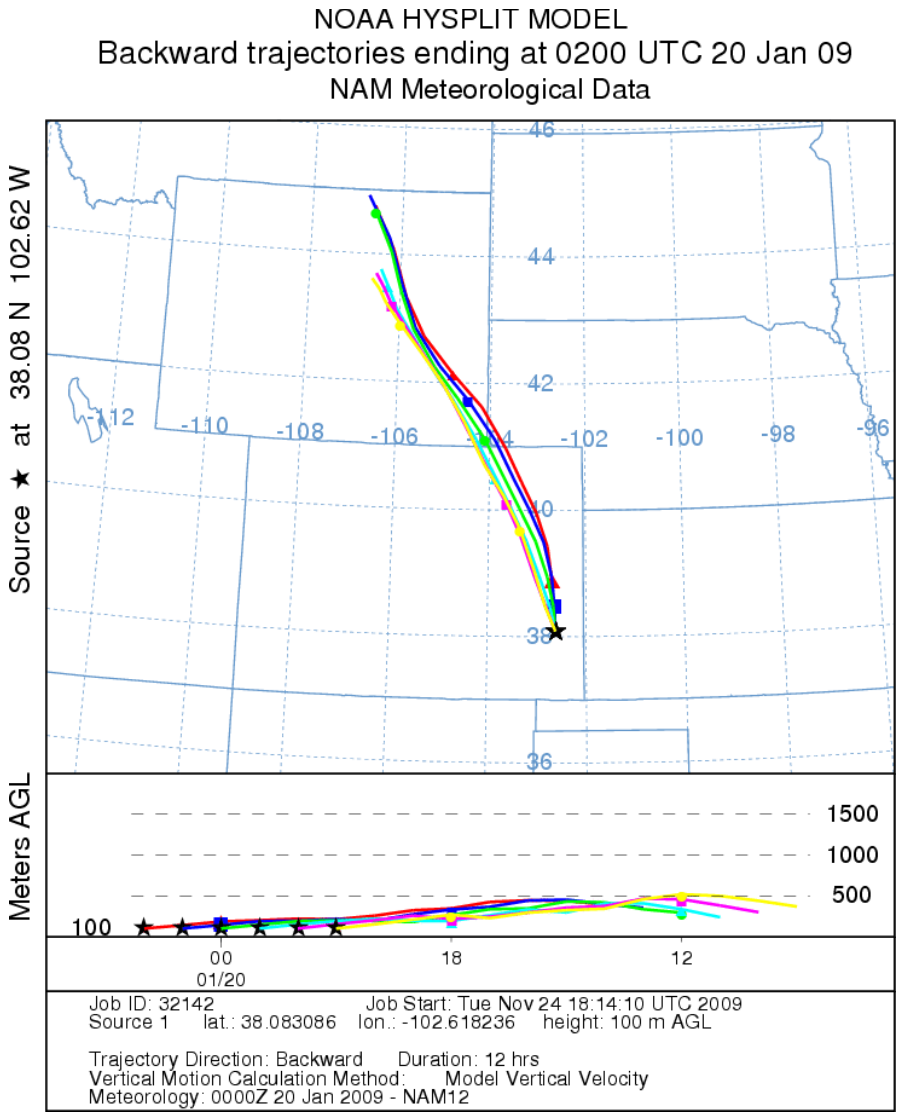


Figure A-32. NOAA HYSPLIT 12-hour back trajectory plots for each hour during the windiest period on January 19, 2009. The HYSPLIT model run was based on data from the high-resolution 12-kilometer grid spacing NAM numerical weather model.

Landform Signs of Blowing Dust

Surface geologic features in some areas of eastern Colorado reflect the effects of wind-blown dust caused by passing, intense low pressure systems and their associated cold fronts (see Figure A-33). Eolian or wind-blown soil deposits can be seen in this aerial image of the area immediately to the west and south of Kit Carson, Colorado, which is about 50 miles north of Lamar. These north-northwest to south-southeast trending lines are caused by strong northerly to north-northwesterly winds. The Air Pollution Control Division does not know whether these features were created in the centuries immediately after the last Ice Age, the Dust Bowl years, during recent events, or in some combination of these; but the structures point to wind patterns that have been a consistent part of the climate of eastern Colorado for thousands of years. This part of Colorado has been subject to dust storms since the end of the last Ice Age.

Figure A-33. Eolian or wind-blown soil structures in the area immediately to the west and south of Kit Carson, Colorado, which is about 50 miles north of Lamar.

Source Areas and Emissions Controls

What are the likely sources for blowing dust measured during exceedance events at these two PM10 monitoring sites in Lamar? Three categories are considered here. The first category includes local sources within the Lamar PM10 Non-attainment area (NAA), which is shown along with land use categories in Figures A-34 through A-36. The land use categories within the NAA include low and high-density residential, grasslands, and the commercial, industrial, and transportation category.

The Lamar Redesignation Request and Maintenance Plan (Colorado Department of Public Health and Environment, 2001) and the Revised Natural Events Action Plan (Colorado Department of Public Health and Environment et al., 2003) indicate that many BACM measures have been applied to reduce fugitive dust. Roads within the NAA are largely paved. According to the EPA (Federal Register: October 25, 2005 (Volume 70, Number 205, Rules and Regulations, Page 61563-61567), there were four monitoring stations in the Lamar area in 2004:

"…two of which have been monitoring PM_{10} since the mid-1970s and the other two started monitoring this year for a special study that was at the request of the Prowers Local Health Department to monitor potential impacts from nearby feed lots. The two special purpose monitors (SPM) operated for 6 months (March to September, 2004) on an every 6th day schedule. Both monitors recorded lower values than the permanent PM_{10} monitors that run on an every day schedule. The highest 24-hour value recorded was 69 ug/m3 at the Red Barn station, well below the 24-hour 150 g/m3 PM_{10} standard."

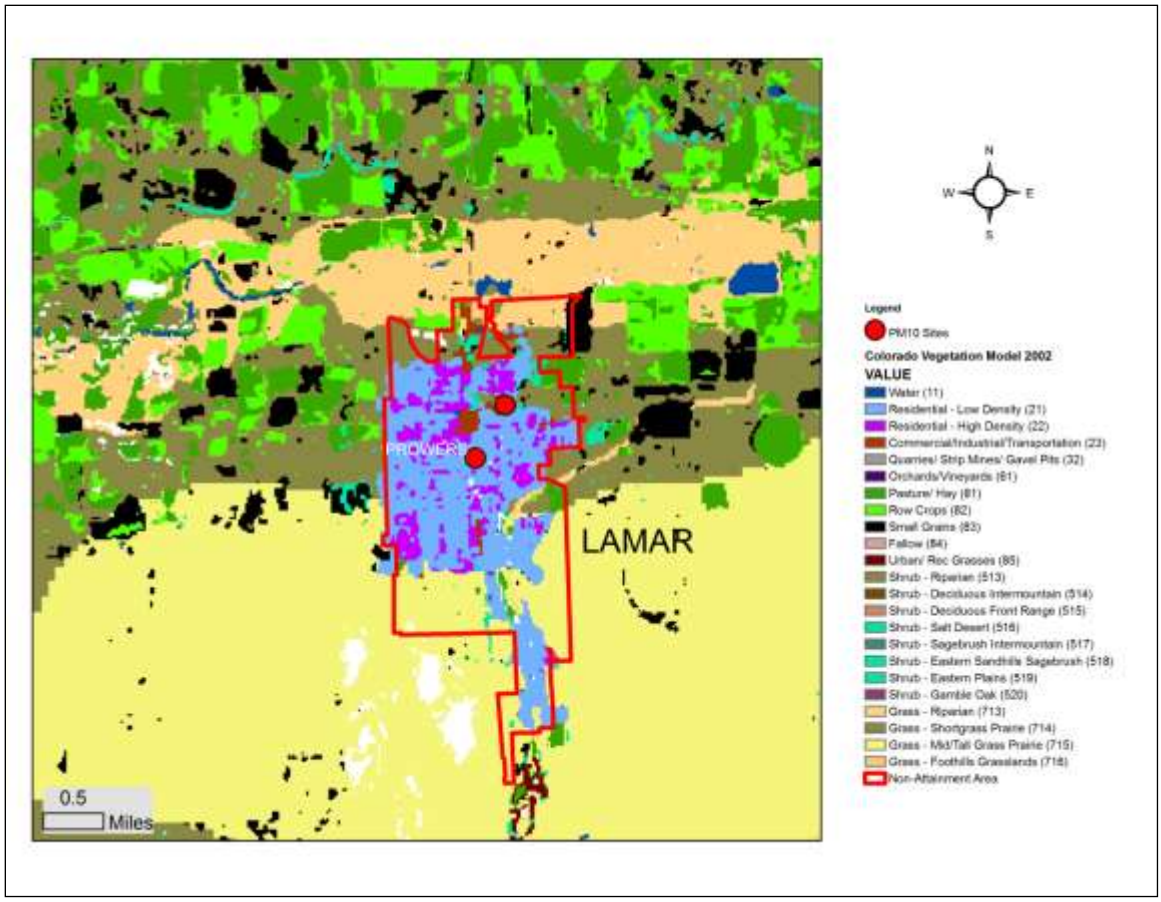


Figure A-34. The Lamar PM10 Non-attainment Area (outlined in red) and vegetative cover and land use categories.

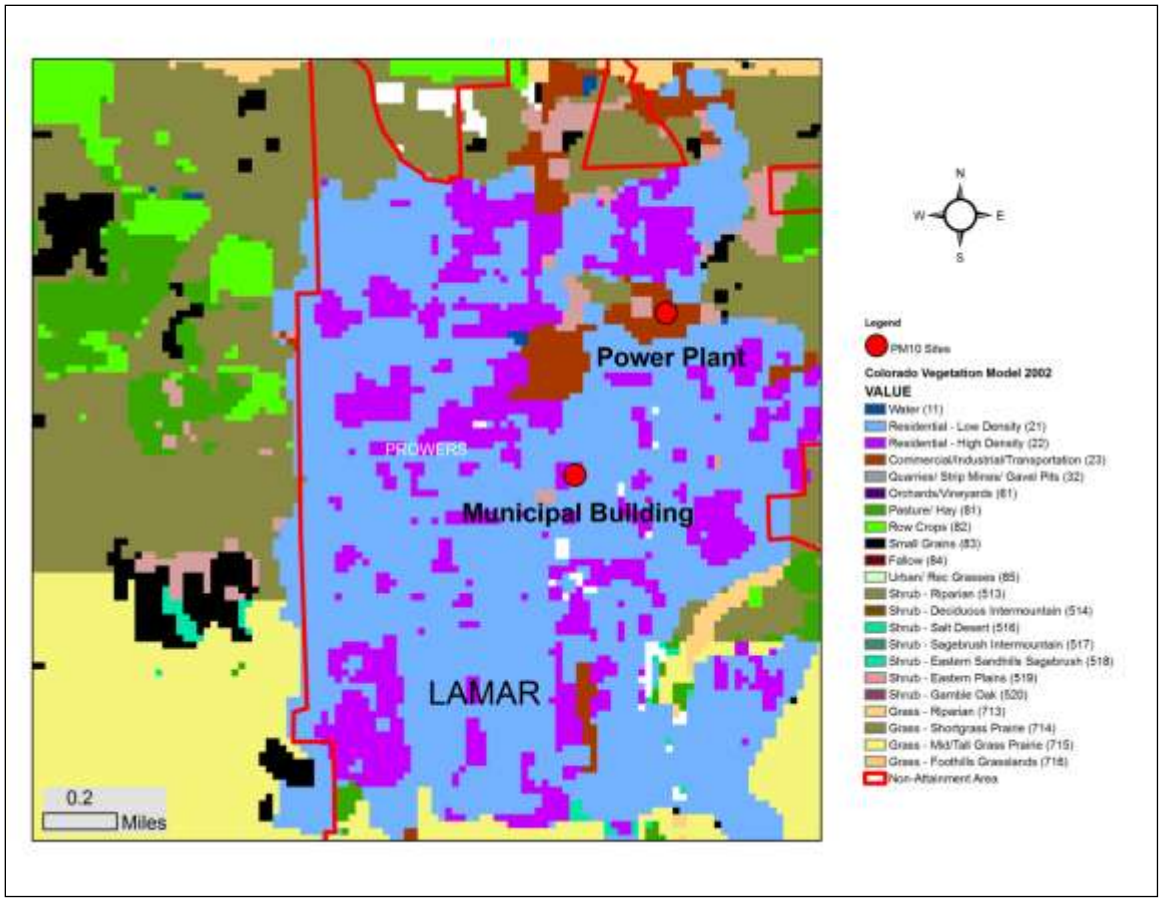


Figure A-35. The Lamar PM10 Non-attainment Area (outlined in red), locations of the Lamar PM10 monitors, and vegetative cover and land use categories.

Figure A-36. Aerial view of the Lamar PM10 monitoring sites.

There are no extensive areas of significant fugitive dust sources within the NAA (see Colorado Department of Public Health and Environment, 2001, for emission inventories). Reasonable control measures have been implemented by the Lamar PM10 SIP for both the NAA and Prowers County. Sources for wind blown dust within the NAA area are likely dwarfed by natural and agricultural sources outside of the NAA.

It is possible, however, that dust sources within the Power Plant property fenceline affect concentrations at the Power Plant monitor. Figures A35 and A-36 show that this monitor is within the Power Plant facility and potentially subject to fugitive emissions from this industrial facility, including those from unpaved and exposed soils and gravels. Because this monitor is on top of a building within plant property and not in a public area, it can be exposed to higher concentrations of facility emissions and does not represent ambient air public exposure offsite. Figure A-37 shows the relationship between Lamar Power Plant and Lamar Municipal Building PM10 concentrations for January 2004 through February 2009. Concentrations at the Power Plant are, on average, 23% higher than those at the Municipal Building. The 95 percentile values for the Power Plant and Municipal Buildings are 53 ug/m3 and 39 ug/m3, respectively.

The second category of blowing dust sources considered here are natural and agricultural sources in eastern Colorado. Dryland farming is the dominant farming type in southeastern Colorado and occurs on areas with highly erodible soils. The wheat-sorghum-fallow system is common in much of eastern and southeastern Colorado. The wheat-sorghum-fallow system is generally a planting of wheat, followed by a planting of sorghum and then a period with the land left fallow to allow the soil to recover. According to the Colorado State Extension publication 0.5160 (http://www.ext.colostate.edu/pubs/crops/00516.html), “soils under no-till production systems

store more water than soils on conventional stubble mulch systems and allow conversion to more intense crop rotations." Sorghum is a plant suited for dry arid climates with a very extensive root system that holds soil in place as well as helping soil stay moist. Lands in these crop systems are shown in several of the land use maps presented below as small grain croplands (in black). Croplands in this system are typically left fallow for as much as 14 months to allow natural soil water content a chance to recover between crops. If sufficient no-till or low tillage practices are not followed, these lands can be significant sources for blowing dust during the fall, winter, and spring of the year, and they may also be significant sources of dust even with reasonable agricultural controls applied.

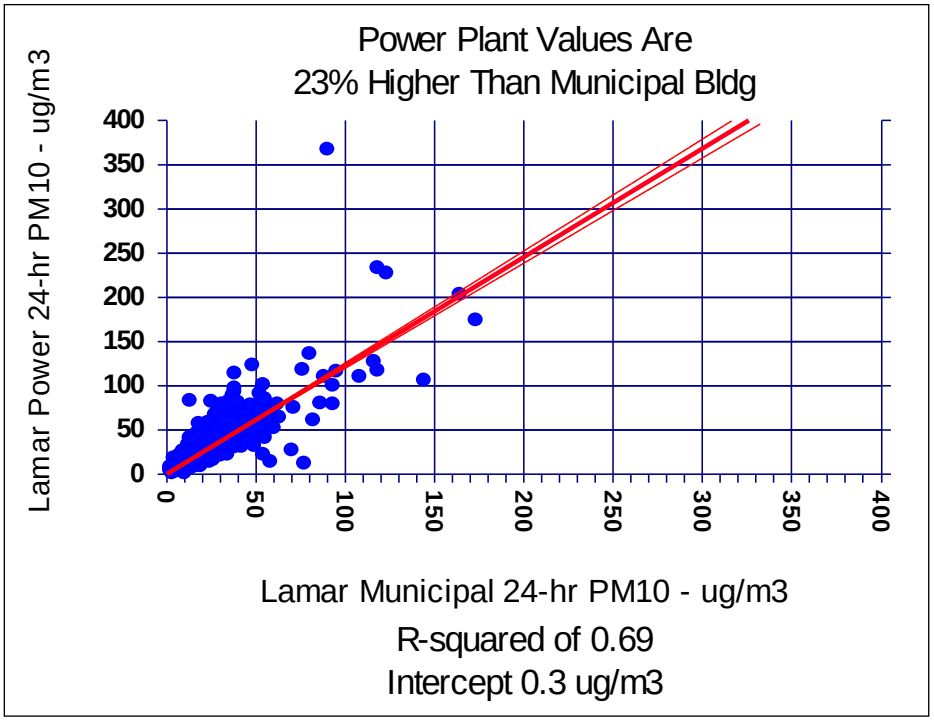


Figure A-37. Linear regression between Lamar Power Plant and Municipal Building PM10 concentrations for January 2004 through February of 2009. (The slope is 1.23.)

On April 18, 2004, a major dust storm occurred in eastern Colorado and Western Kansas (see the satellite image in Figure A-38). This system did not lead to extreme blowing dust in Lamar. The Lamar Power Plant and Municipal Building concentrations on April 18, 2004, were 80 ug/m3 and 56 ug/m3, respectively. This storm, however, demonstrates the role of small grain fallow rotation farming on blowing dust in eastern Colorado. Figure A-39 shows the land use categories in the counties near Lamar, and Figure A-40 shows the satellite image superimposed on the land use map. It's clear from this last image that the area of intensive small grain and fallow cropland in Lincoln and Kiowa Counties is a source for large plumes of blowing dust moving to the northeast during this phase of the storm. Although somewhat limited within the immediate Lamar area, these small grain and fallow cropland areas are common in all of the counties in the region.

The Natural Resources Conservation Service (NRCS) is the federal agency responsible for promoting soil conservation practices on agricultural lands. The NRCS administers the Conservation Reserve Program (CRP). CRP has entered into contracts with farmers in the High Plains states to keep marginal agricultural lands, which are vulnerable to erosion, in grassland and natural vegetative cover.

Figure A-38. Satellite image of a dust storm north of Lamar on April 18, 2004. (Source: http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=13048)

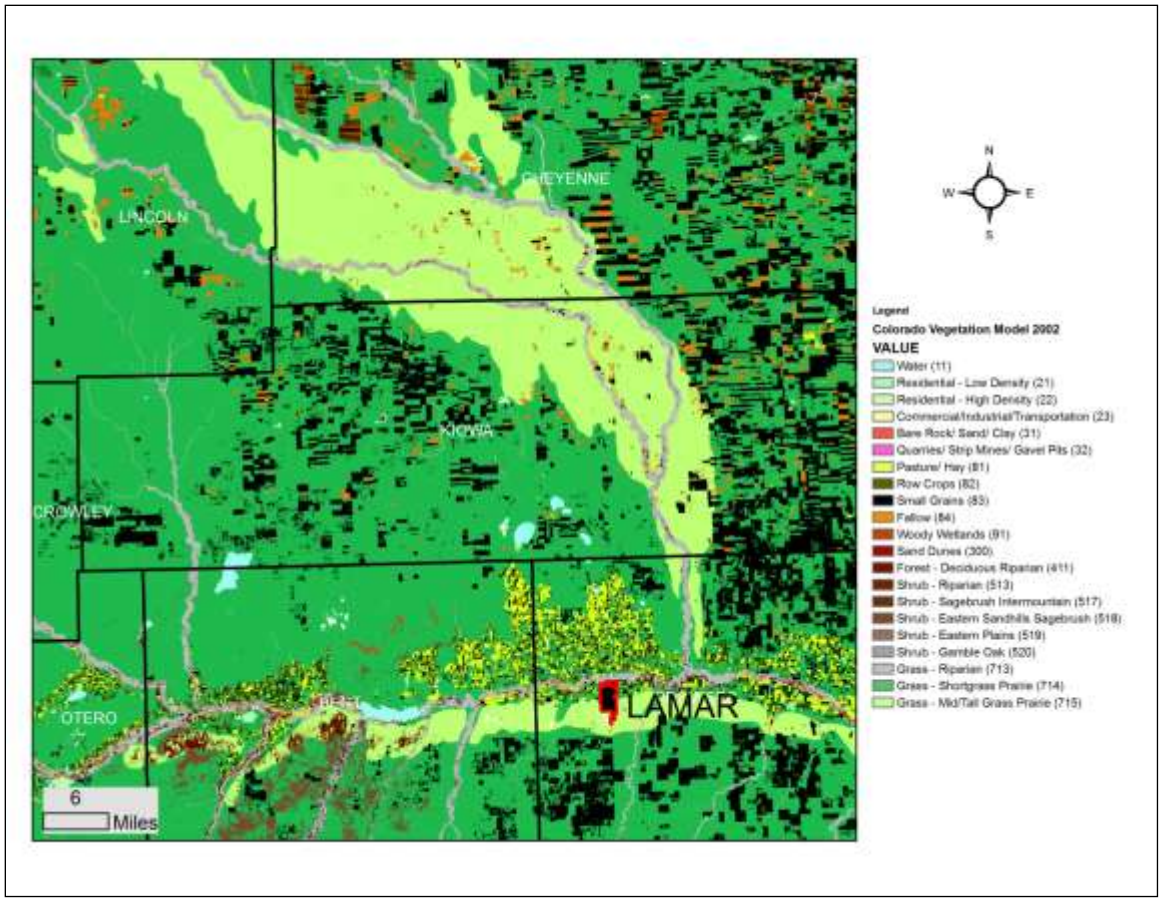


Figure A-39. Vegetative cover and land use categories in the vicinity of Lamar, Colorado.

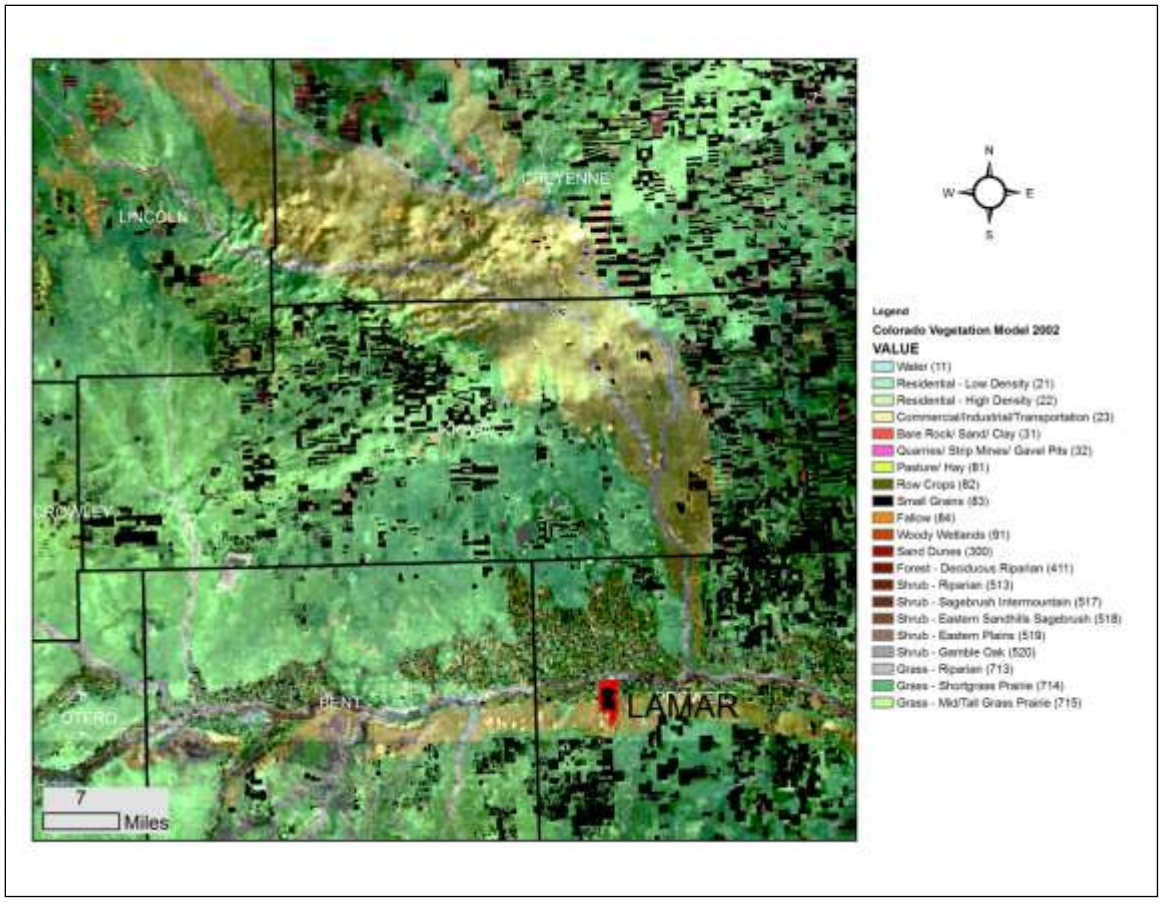


Figure A-40. Vegetative cover and land use categories in the vicinity of Lamar, Colorado, superimposed with the satellite image from Figure A-38 for April 18, 2004.

This NRCS program and others are cited in the Revised Lamar Natural Events Action Plan (Colorado Department of Public Health and Environment et al., 2003). More specifically, the plan indicates that:

"recognizing the problems associated with erodible land and other environmental-sensitive cropland, the U.S. Department of Agriculture (USDA) included conservation provisions in the Farm Bill. This legislation created the Conservation Reserve Program (CRP) to address these concerns through conservation practices aimed at reducing soil erosion and improving water quality and wildlife habitat."

"The CRP encourages farmers to enter into contracts with USDA to place erodible cropland and other environmentally-sensitive land into long-term conservation practices for 10-15 years. In exchange, landowners receive annual rental payments for the land and cost-share assistance for establishing those practices."

"The CRP has been highly successful in Prowers County by placing approximately 146,000 acres of Prowers County cropland, or 28% of total cropland, under contract. Most of this land has been planted with a perennial grass cover to protect the soil and retain its moisture. Strong support of the program by Prowers County farmers continues as 38% of the counties HEL cropland has been offered for conservation practices."

"While the following initiatives are not meant to be enforceable, many efforts are underway that further reduce blowing dust and its impacts. These include:

- The CRP has moved to include all available area lands into area contracts. These contracts are good through 2007. Success of the CRP initiatives is measured through ongoing monitoring of the contracts to ensure ample grass coverage to minimize blowing dust.

- CRP sends out information several times per year through radio and the area newspaper to further reach farmers interested in topsoil protection.

- In response to the significant Colorado drought the CRP is working with multiple parties in extensive annual planning efforts to limit blowing dust and its impacts. These planning efforts change year to year depending on the severity of the drought."

These programs were in effect during the period addressed in the analysis in this attachment (2004-2009). The NRCS in Colorado has also worked through the CRP and other programs to bring erosion control practices to croplands throughout eastern Colorado. Beginning in September of 2009, however, 743,238 acres of the 2,412,238 acres of Colorado land under the CRP were to become eligible to come out of the CRP in the subsequent five-year period. Much of this land is in eastern and southeastern Colorado. Land released from the CRP has the potential to increase the amount of lands contributing to blowing dust in eastern Colorado. The NRCS, however, has identified a variety of alternatives and options to promote soil conservation on the lands that will be released from CRP contracts (http://www.co.nrcs.usda.gov/programs/CRP/crp.html).

These include conservation easements, enrollment in the Continuous CRP (a subset of CRP), transition to grazing land, and managing land for wildlife. Returning the land to cropland is also an option, and the NRCS is encouraging conservation tillage for these lands. The Colorado office of the NRCS has a form letter that will be sent to those whose contracts will be expiring. It includes the following:

> "Over the next five years, approximately two million acres of land contracted under the Conservation Reserve Program (CRP) will expire in Colorado. A significant portion of <<***COUNTY NAME***>> County land enrolled in CRP either expired last September, or will be expiring within the next few years."
>
> "The current crop prices are causing many landowners to consider farming their CRP land by returning it to crop production. However, there are some valuable information and alternatives that must be considered prior to making this major decision…"
>
> "While some fields may return to cropland, many acres of CRP are environmentally sensitive and not suited to annual crop production. By making the decision to return CRP land to cropland you will impact the local economy, landscape, and environment. It is important for you to consider several factors before deciding what to do when your CRP contract expires: soil productivity and limitations, past yields, commodity prices, production, conversion or renovation costs, and other required investments."
>
> "There are several options available to landowners who have expiring CRP contracts. These options include: re-enrolling eligible acres into Continuous CRP, returning land to

a cropland rotation, utilizing and enhancing forage as pasture or hayland, or managing the expired CRP for wildlife."

"It is important for you to develop an NRCS approved conservation plan, particularly when considering converting expired CRP acres to cropland. It requires proper planning and good management. NRCS conservation plans provide an inventory and complete assessment of a landowner's resources, as well as recommendations for improving those resources, which if implemented can positively impact your bottom line."

According to the NRCS (see brochure at: http://www.co.nrcs.usda.gov/programs/CRP/CCRP_1.pdf):

"The Continuous CRP program (CCRP), a subset of the Conservation Reserve Program, offers year round enrollment and increased incentives to keep these small sensitive areas in permanent cover.

Practice Incentive Payment (PIP) - This is an additional incentive of 40% of eligible practice establishment costs.

Signing Incentive Payment (SIP) - This is a one time incentive payment for signing the Continuous CRP contract.

Rental Incentive Payment—This is an additional incentive payment equal to the shown percentage of the CRP rental rate. All of the above incentives are in addition to the regular CRP rental payment. For more information on CCRP, contact your local USDA Service Center."

Details on the incentive payments for various categories of land use conservation practices can be found in the brochure link above. Additional information on NRCS post-CRP programs is presented in Figures A-41 through A-44 below.

Conclusions and Summary

PM10 concentrations for both the Lamar Power Plant and Municipal Building sites for January of 2004 through February of 2009 have been analyzed and compared with meteorological data for the period. The analyses included an evaluation of climate and land use characteristics; cluster analysis of PM10 concentrations, 30-day total precipitation, and daily maximum 5-second gust speeds; NOAA HYSPLIT back trajectories for high-wind, blowing dust events; and an assessment of satellite imagery. *Cluster analysis shows that without wind gusts above 40 mph and dry soils caused by 30-day precipitation totals of 0.6 inches or less, the exceedances of the PM10 standard measured during the period would not have occurred*. The high-wind events occur on less than 15% of the days in the period. The PM10 exceedances occur on less than 1% of the days in the record. *This document provides a detailed weight of evidence analysis for dust transport into and within Colorado and demonstrates that but for the exceptional high winds over dry soils these exceedances would not have occurred*.

Trajectory analyses and land use patterns point to three likely source areas that may contribute to blowing dust during blowing dust events. The first is the Lamar PM10 Non-attainment Area (NAA) and Prowers County. *Blowing dust sources within the NAA and Prowers County have been reasonably controlled, as demonstrated by the PM10 State Implementation Plan (SIP) and*

Maintenance Plan for the area. In addition, the Power Plant monitor, which is responsible for most of the exceedances, is inappropriately sited and does not represent ambient exposure. The second likely source area is lands in eastern Colorado outside of Prowers County and the NAA.

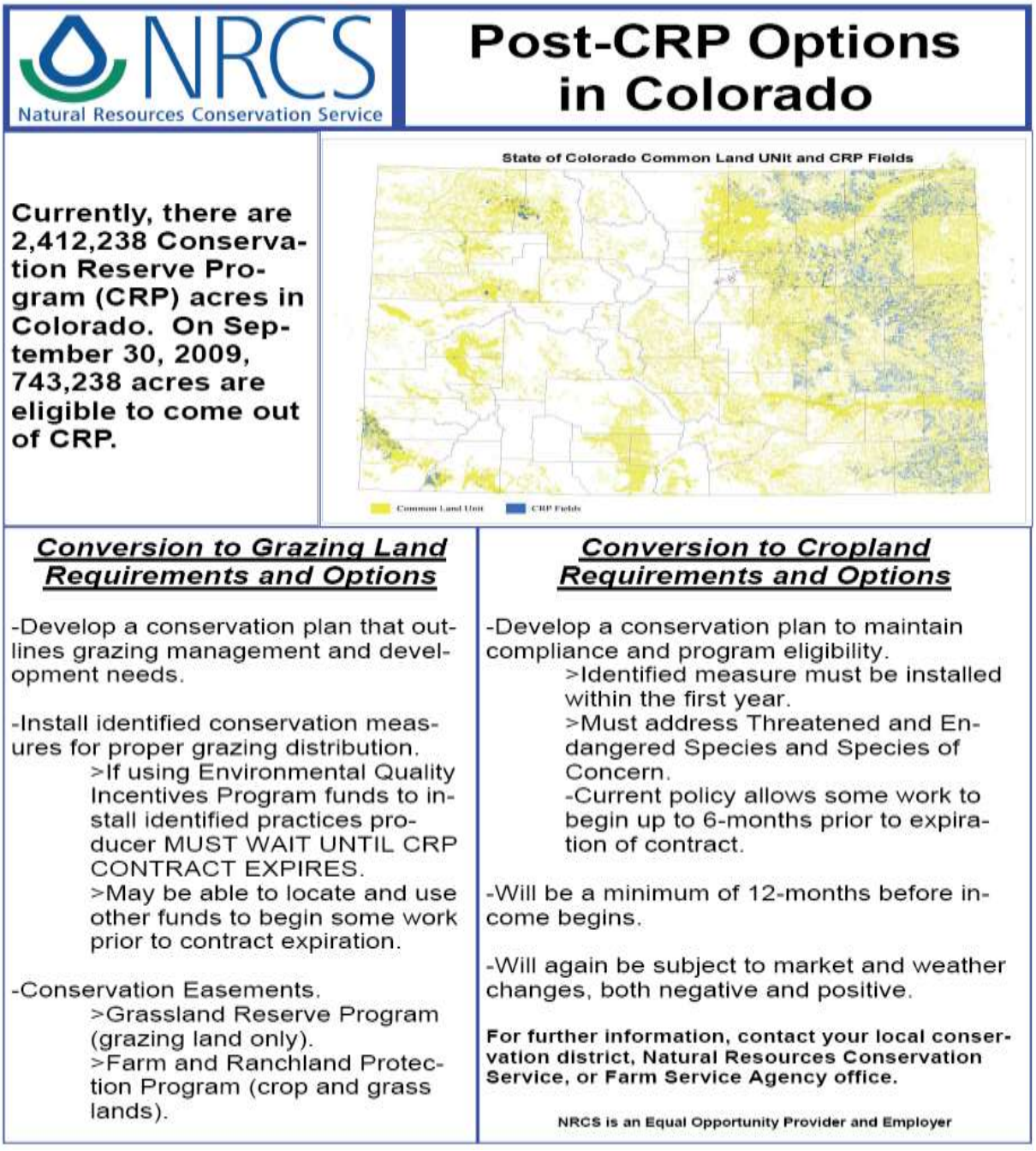


Figure A-41. Colorado NRCS overview of Post-CRP options in Colorado.

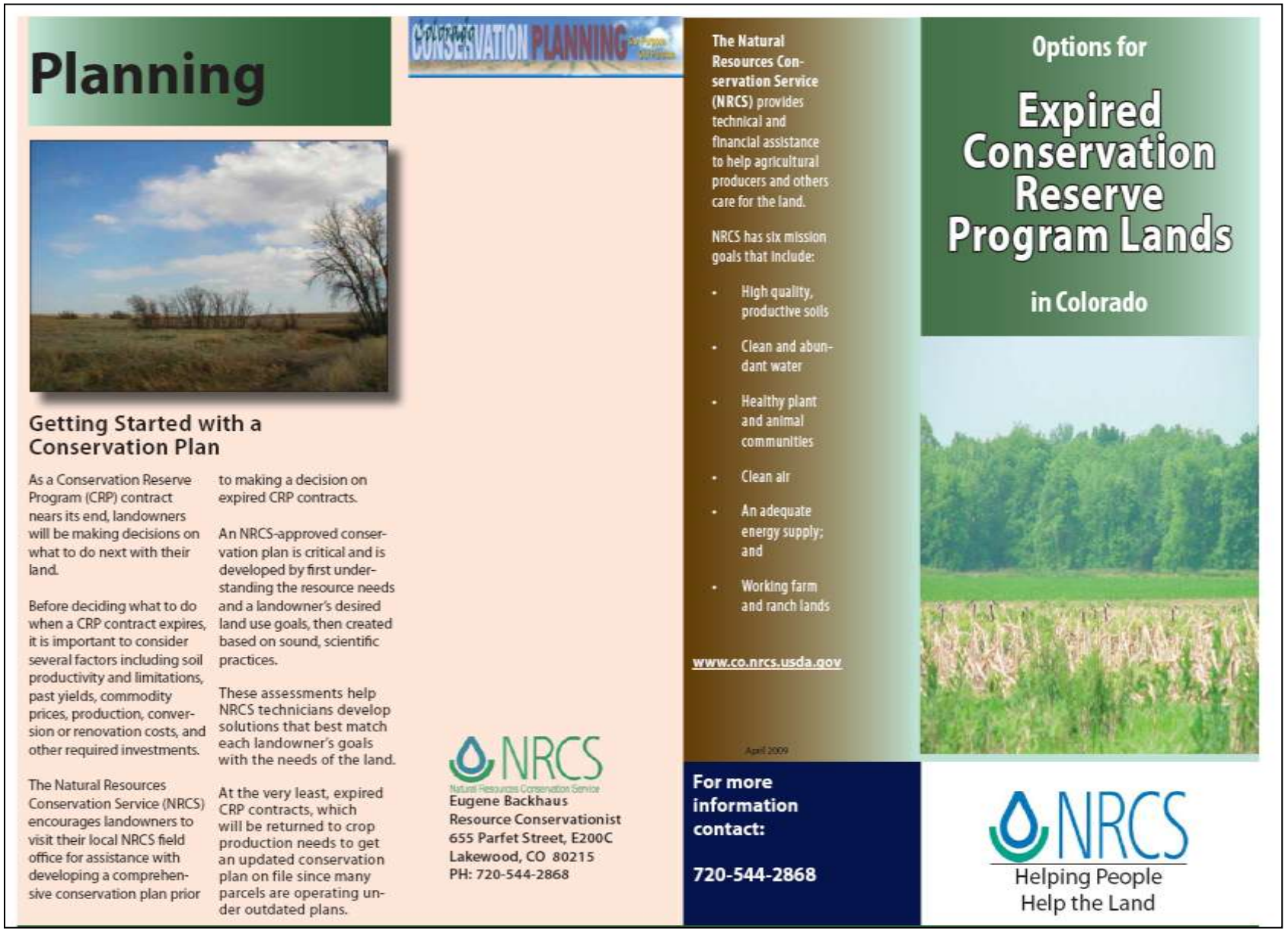


Figure A-42. NRCS brochure on Post-CRP options, page 1.

Overview

The Conservation Reserve Program (CRP) protects millions of acres of American topsoil from erosion and is designed to safeguard the Nation's natural resources.

Acreage enrolled in the CRP is planted to resource-conserving vegetative covers, making the program a major contributor to increased wildlife populations in many parts of the country.

Over two million acres of Colorado's grasslands are currently listed within the CRP with contracts expiring through 2013.

Due to changes in the 2008 Farm Bill, agricultural producers having these grasslands may find little opportunity to re-enroll their land in the CRP.

According to the Colorado Deparment of Agriculture, if a large portion of expiring CRP acres go back into cropland, Colorado will lose many of its important conservation benefits accrued over the lifetime of the contracts that established these grasslands including reduced soil erosion and improved wildlife habitat.

However, if some of the expiring CRP lands are kept in grass and managed for other uses, many of the conservation benefits realized during the CRP contracts could be maintained or enhanced.

Options

Options for Expiring Conservation Reserve Program Lands

Conversion to Grazing Land

REQUIREMENTS AND OPTIONS

- Develop a conservation plan that outlines grazing management and development needs
- Install identified conservation measures for proper grazing distribution
- If using Environmental Quality Incentives Program funds to install identified practices, producer **MUST WAIT UNTIL CRP CONTRACT EXPIRES**
- May be able to locate and use other funds to begin some work prior to contract expiration
- Conservation Easements
- Grassland Reserve Program (grazing land only)
- Farm and Ranchland Protection Program (crop and grass lands)

Conversion to Cropland

REQUIREMENTS AND OPTIONS

- Develop a conservation plan to maintain compliance and program eligibility
- Identified measure must be installed within the first year
- Must address Threatened and Endandered Species and Species of Concern
- Current policy allows some work to begin up to five months prior to expiration of contract
- Will be at least until July 2010 before income begins
- Will again be subject to market and weather changes, both negative and positive.

Enrollment in Continuous CRP

- **SAFE** - The new State acres for wildlife Enhancement (SAFE) program focuses on high priority wildlife habitat areas, and aims to retain desirable cover to halt the decline of numerous at-risk species.
- **CREP** - the Conservation Reserve Enhancement Program helps protect environmentally sensitive land, decrease erosion, and restore wildlife habitat.
- **High priority conservation practices** - an opportunity to re-enroll a portion of expired land into Continuous CRP and focuses on environmentally sensitive land.

Conservation Reserve Program - encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers.

NRCS Programs that Can Help:

- Environmental Quality Incentives Program (EQIP)
- Continuous Conservation Reserve Program (CCRP)
- Grassland Reserve Program (GRP)
- Farm and Ranchland Protection Program (FRPP)

Figure A-43. NRCS brochure on Post-CRP options, page 2.

USDA NRCS

United States Department of Agriculture
Natural Resources Conservation Service

Expiring CRP Options—Transition to Grazingland

USDA Natural Resources Conservation Service — Colorado March 2009

Between the years 2009 and 2013, approximately 2 million acres of CRP contracts will expire in Colorado. This mass contract expiration has the potential to impact soil erosion, wildlife habitat, water quality, farm incomes and rural economies. However, the USDA Natural Resources Conservation Service provides technical assistance and financial incentives to producers and landowners as they chose to transition these lands to other uses.

Incentives for Grazing Management

Through its Environmental Quality Incentives Program, the NRCS offers technical and financial assistance for producers with expiring CRP who want to transition that land management into a grazing management system. The NRCS can provide financial assistance for installing necessary infrastructure such as fences, livestock pipeline and tanks. The NRCS also provides management incentive payments for grazing management, weed control and wildlife habitat management.

Potential Payments for CRP transition to Grazingland

Practice	Example Incentive Payment (Tentative costs calculated for Northeast Colorado)
382-Fence	$0.85/Foot
516-Pipeline	$1.35/foot
614-Watering Facililty	$0.60—$1.35/gallon
528-Grazing Management	$10/acre
595-Pest Management	$10/acre
645-Upland Wildlife Habitat Management	$10—$15/acre

NRCS Technical Assistance

NRCS Field Office staff, Range Conservationists and Wildlife Biologists are available to offer technical advice on implementing or expanding a grazing system onto CRP ground.

For More Information

To learn more about these incentives, or for other options for expiring CRP, contact your local NRCS Field Office. Log on to www.nrcs.usda.gov to find your nearest office.

Figure A-44. NRCS information on expiring CRP options – transition to grazingland.

Small grain (wheat-fallow-sorghum) farmlands in eastern Colorado are a likely source for dust in late fall through spring. The Natural Resources Conservation Service (NRCS) has provided reasonable controls for these sources during the period of record and has alternative programs for erosion control as lands under contract with the Conservation Reserve Program (CRP) are released from contracts (in the five-year period beginning in late 2009.) The third source area includes lands in Arizona and New Mexico. Natural sources in these states may include barren lands and playas, and anthropogenic sources may include agricultural lands. Control of these sources is beyond the purview of the State of Colorado. Agricultural sources within these states may already be reasonably controlled by existing and planned programs operated by the NRCS and the states.

References:

Colorado Department of Public Health and Environment, City of Lamar, Prowers County Commissioners, April 1998. *Natural Events Action Plan for High Wind Events – Lamar, Colorado*.

Colorado Department of Public Health and Environment, Air Pollution Control Division, November 2001. *PM10 Redesignation Request and Maintenance Plan for the Lamar Area*, adopted by the Colorado Air Quality Control Commission.

Colorado Department of Public Health and Environment, Air Pollution Control Division, City Of Lamar, and Prowers County Commissioners, 2003. *Revised (2003) Natural Events Action Plan for High Wind Events Lamar, Colorado*.

Croissant, R.L., G.A. Peterson and D.G. Westfall, 2008, *Dry Land Cropping Systems*, Colorado State Extension publication 0.516 (http://www.ext.colostate.edu/pubs/crops/00516.html).

Orgill, M.M., Sehmel, G.A., 1976. Frequency and diurnal variation of dust storms in the contiguous USA. *Atmospheric Environment 10*, 813‑825.

Appendix B - Weather Warnings, Advisories, Short-Term Forecasts and Local Storm and Roads Reports for November 5, 2011

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456
WWUS75 KABQ 051053
NPWABQ

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
453 AM MDT SAT NOV 5 2011

...STRONG TO VERY STRONG WINDS TODAY PROGRESSING FROM WEST TO EAST OVER
MUCH OF NORTHERN AND CENTRAL NEW MEXICO...

.AN UPPER LEVEL STORM AND ASSOCIATED COLD FRONT WILL CROSS OVER
THE STATE TODAY. STRONG SOUTHWEST WINDS WITH SOME GUSTS TO 55 MPH
WILL AFFECT THE WEST THIS MORNING AND THEN SPREAD EAST ACROSS THE
CENTRAL MOUNTAIN CHAIN AND EASTERN PLAINS. THE STRONGEST WINDS
WILL LIKELY OCCUR ALONG THE CENTRAL MOUNTAIN CHAIN AND THE
ADJACENT HIGHLANDS AND NORTHEAST PLAINS WHERE DAMAGING WIND GUSTS
WILL BE POSSIBLE LATER THIS MORNING. STRONG WINDS WILL ALSO SPREAD
EAST INTO THE PLAINS BEFORE DIMINISHING DURING THE MID TO LATE
AFTERNOON. AREAS OF BLOWING DUST WILL ALSO REDUCE VISIBILITIES TO
BELOW THREE MILES AT TIMES IN DUST PRONE LOCATIONS.

NMZ512-514-515-521-523-524-526>530-539-540-052200-
/O.CON.KABQ.HW.W.0014.000000T0000Z-111105T2200Z/
WEST SLOPES SANGRE DE CRISTO MOUNTAINS-
SOUTHERN SANGRE DE CRISTO MOUNTAINS ABOVE 9500 FEET-
EAST SLOPES SANGRE DE CRISTO MOUNTAINS-SANDIA/MANZANO MOUNTAINS-
CENTRAL HIGHLANDS-SOUTH CENTRAL HIGHLANDS-SOUTH CENTRAL MOUNTAINS-
RATON RIDGE/JOHNSON MESA-FAR NORTHEAST HIGHLANDS-
NORTHEAST HIGHLANDS-UNION COUNTY-EASTERN LINCOLN COUNTY-
SOUTHWEST CHAVES COUNTY-
453 AM MDT SAT NOV 5 2011

...HIGH WIND WARNING REMAINS IN EFFECT UNTIL 4 PM MDT THIS
AFTERNOON...

A HIGH WIND WARNING REMAINS IN EFFECT UNTIL 4 PM MDT THIS
AFTERNOON.

* LOCATION...UNION COUNTY...RATON RIDGE AND JOHNSON MESA
  INCLUDING RATON PASS...SUGARITE CANYON STATE PARK AND FOLSOM.

* WINDS...SOUTHWEST 30 TO 40 MPH WITH GUSTS BETWEEN 55 AND 65
  MPH.

* TIMING...STRONGEST WINDS EXPECTED BETWEEN 9 AM AND 2 PM THEN
  SLOWLY DIMINISHING THEREAFTER.

* VISIBILITY...MAY OCCASIONALLY BE REDUCED TO BELOW 3 MILES IN
  BLOWING DUST.

* LOCAL IMPACTS...STRONG CROSS WINDS WILL LIKELY DEVELOP ALONG
```

NORTHWEST TO SOUTHEAST ORIENTED ROADWAYS INCLUDING HIGHWAY 64
AND 87 FROM RATON TO CLAYTON.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

REMEMBER...A HIGH WIND WARNING MEANS DAMAGING WINDS ARE IMMINENT
OR HIGHLY LIKELY. SUSTAINED WIND SPEEDS OF AT LEAST 40 MPH OR
GUSTS OF 58 MPH OR MORE CAN LEAD TO PROPERTY DAMAGE.

&&

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NMZ506>508-052200-
/O.CON.KABQ.WI.Y.0052.000000T0000Z-111105T2200Z/
WEST CENTRAL MOUNTAINS-WEST CENTRAL HIGHLANDS-SOUTHWEST MOUNTAINS-
453 AM MDT SAT NOV 5 2011

...WIND ADVISORY REMAINS IN EFFECT UNTIL 4 PM MDT THIS
AFTERNOON...

A WIND ADVISORY REMAINS IN EFFECT UNTIL 4 PM MDT THIS AFTERNOON.

* LOCATION...WEST CENTRAL MOUNTAINS...WEST CENTRAL HIGHLANDS AND
SOUTHWEST MOUNTAINS.

* WINDS...SOUTHWEST 25 TO 35 MPH WITH GUSTS BETWEEN 45 TO 55 MPH.

* TIMING...THE STRONGEST WINDS WILL OCCUR BETWEEN 5 AM AND 10 AM.
WINDS WILL GRADUALLY LIGHTEN THEREAFTER.

* VISIBILITY...BRIEFLY REDUCED TO BELOW 3 MILES IN BLOWING DUST
ALONG THE COLD FRONT AND PRIOR TO RAIN OR SNOW SHOWERS.

* LOCAL IMPACTS...STRONG CROSS WINDS WILL DEVELOP ALONG
NORTHWEST TO SOUTHEAST FACING ROADWAYS INCLUDING INTERSTATE 40
FROM THE ARIZONA STATE LINE TO THE RIO PUERCO.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

MOTORISTS SHOULD EXERCISE CAUTION WHILE TRAVELLING. SUDDEN GUSTS
OF WIND MAY CAUSE YOU TO LOSE CONTROL OF YOUR VEHICLE. EXTRA
ATTENTION SHOULD BE GIVEN TO CROSS WINDS.

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NMZ513-516>518-522-525-531>538-052200-
/O.CON.KABQ.WI.Y.0052.111105T1200Z-111105T2200Z/
NORTHERN SANGRE DE CRISTO MOUNTAINS ABOVE 9500 FEET/RED RIVER-
UPPER RIO GRANDE VALLEY-LOWER CHAMA RIVER VALLEY-
SANTA FE METRO AREA-ESTANCIA VALLEY-UPPER TULAROSA VALLEY-
HARDING COUNTY-EASTERN SAN MIGUEL COUNTY-GUADALUPE COUNTY-
QUAY COUNTY-CURRY COUNTY-ROOSEVELT COUNTY-DE BACA COUNTY-
CHAVES COUNTY PLAINS-
453 AM MDT SAT NOV 5 2011

...WIND ADVISORY REMAINS IN EFFECT UNTIL 4 PM MDT THIS
AFTERNOON...

A WIND ADVISORY REMAINS IN EFFECT UNTIL 4 PM MDT THIS AFTERNOON.

* LOCATION...NORTHERN SANGRE DE CRISTO MOUNTAINS...UPPER RIO
  GRANDE VALLEY...UPPER AND LOWER CHAMA RIVER VALLEY...UPPER
  TULAROSA VALLEY...AND THE EASTERN PLAINS.

* WINDS...SOUTHWEST INCREASING TO 25 TO 35 MPH WITH GUSTS
  BETWEEN 40 TO 50 MPH.

* TIMING...THE STRONGEST WINDS WILL OCCUR BETWEEN 6 AM AND 2 PM
  ALONG AND WEST OF THE RIO GRANDE VALLEY...AND BETWEEN 9 AM AND
  4 PM IN THE EASTERN PLAINS.

* VISIBILITY...OCCASIONALLY REDUCED TO BELOW 3 MILES IN BLOWING
  DUST ACROSS THE EASTERN PLAINS.

* LOCAL IMPACTS...STRONG CROSS WINDS WILL LIKELY DEVELOP OVER
  NORTHWEST TO SOUTHEAST FACING ROADWAYS...INCLUDING INTERSTATE
  40 FROM CLINES CORNERS TO THE TEXAS BORDER.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

MOTORISTS SHOULD EXERCISE CAUTION WHILE TRAVELLING. SUDDEN GUSTS
OF WIND MAY CAUSE YOU TO LOSE CONTROL OF YOUR VEHICLE. EXTRA
ATTENTION SHOULD BE GIVEN TO CROSS WINDS.

&&

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50

297
FPUS75 KABQ 051746
NOWABQ

SHORT TERM FORECAST
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
1146 AM MDT SAT NOV 5 2011

NMZ530>538-052000-
CHAVES COUNTY PLAINS-CURRY COUNTY-DE BACA COUNTY-
EASTERN SAN MIGUEL COUNTY-GUADALUPE COUNTY-HARDING COUNTY-
QUAY COUNTY-ROOSEVELT COUNTY-UNION COUNTY-
INCLUDING THE CITIES OF...CLAYTON...CLOVIS...CONCHAS...FORT SUMNER...
PORTALES...ROSWELL...ROY...SANTA ROSA...TUCUMCARI
1146 AM MDT SAT NOV 5 2011

.NOW...
A BAND OF PRECIPITATION ORIENTED ALONG A STRONG COLD FRONT FROM
RATON...TO JUST EAST OF SANTA ROSA...TO ROSWELL...WILL CONTINUE TO
QUICKLY MOVE EAST ACROSS THE PLAINS EARLY THIS AFTERNOON. THOUGH SOME
LIGHT RAIN WILL BE OBSERVED...THE MAIN CONCERN WITH THIS FRONT WILL
BE VERY STRONG WIND GUSTS. WIND GUSTS BETWEEN 50 AND 60 MPH ARE

LIKELY ALONG AND JUST BEHIND THE FRONT. THESE STRONG WINDS WILL
IMPACT CLAYTON...TUCUMCARI...CLOVIS...PORTALES AND ROSWELL BY 2 PM.

$$

34

234
WWUS74 KLUB 051825 CCA
NPWLUB

URGENT - WEATHER MESSAGE...CORRECTED
NATIONAL WEATHER SERVICE LUBBOCK TX
121 PM CDT SAT NOV 5 2011

TXZ021>024-027>030-033>035-039>041-060000-
/O.COR.KLUB.WI.Y.0027.000000T0000Z-111106T0000Z/
PARMER-CASTRO-SWISHER-BRISCOE-BAILEY-LAMB-HALE-FLOYD-COCHRAN-
HOCKLEY-LUBBOCK-YOAKUM-TERRY-LYNN-
INCLUDING THE CITIES OF...FRIONA...BOVINA...DIMMITT...HART...
TULIA...SILVERTON...QUITAQUE...MULESHOE...LITTLEFIELD...OLTON...
PLAINVIEW...FLOYDADA...LOCKNEY...MORTON...LEVELLAND...LUBBOCK...
SLATON...WOLFFORTH...PLAINS...DENVER CITY...BROWNFIELD...TAHOKA...
ODONNELL
121 PM CDT SAT NOV 5 2011

...WIND ADVISORY NOW IN EFFECT UNTIL 7 PM CDT THIS EVENING...

THE WIND ADVISORY IS NOW IN EFFECT UNTIL 7 PM CDT THIS EVENING.

* TIMING: THE STRONGEST WINDS WILL OCCUR THROUGH THE MIDDLE AND
  LATE AFTERNOON HOURS BEFORE SLOWLY DIMINISHING THIS EVENING.

* WINDS: SOUTHWESTERLY WINDS OF 25 TO 35 MPH WITH GUSTS IN EXCESS
  OF 50 MPH WILL OCCUR ACROSS MUCH OF THE CAPROCK.

* IMPACTS: DRIVING MAY BECOME DIFFICULT...PARTICULARLY ON
  NORTHWEST TO SOUTHEAST ORIENTED ROADS. IN ADDITION...THE STRONG
  WINDS WILL CREATE AREAS OF BLOWING DUST THAT WILL REDUCE
  VISIBILITIES...ESPECIALLY NEAR OPEN FIELD AND CONSTRUCTION SITES.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A WIND ADVISORY MEANS THAT SUSTAINED WINDS OF 30 MPH ARE EXPECTED.
WINDS THIS STRONG CAN MAKE DRIVING DIFFICULT...ESPECIALLY FOR HIGH
PROFILE VEHICLES. USE EXTRA CAUTION.

&&

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709
WWUS75 KPUB 051037
NPWPUB

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
437 AM MDT SAT NOV 5 2011

COZ084>089-093>099-051645-
/O.CON.KPUB.HW.W.0009.111105T1500Z-111106T0000Z/
NORTHERN EL PASO COUNTY/MONUMENT RIDGE/RAMPART RANGE BELOW
7500 FT-
COLORADO SPRINGS VICINITY/SOUTHERN EL PASO COUNTY/RAMPART RANGE
BELOW 7400 FT-PUEBLO AND VICINITY/PUEBLO COUNTY BELOW 6300 FT-
WALSENBURG VICINITY/UPPER HUERFANO RIVER BASIN BELOW 7500 FT-
TRINIDAD VICINITY/WESTERN LAS ANIMAS COUNTY BELOW 7500 FT-
CROWLEY COUNTY-LA JUNTA VICINITY/OTERO COUNTY-
EASTERN LAS ANIMAS COUNTY-WESTERN KIOWA COUNTY-
EASTERN KIOWA COUNTY-LAS ANIMAS VICINITY/BENT COUNTY-
LAMAR VICINITY/PROWERS COUNTY-SPRINGFIELD VICINITY/BACA COUNTY-
INCLUDING...BLACK FOREST...AIR FORCE ACADEMY...COLORADO SPRINGS...
PUEBLO...WALSENBURG...TRINIDAD...ORDWAY...OLNEY SPRINGS...
LA JUNTA...ROCKY FORD...BRANSON...KIM...EADS...SHERIDAN LAKE...
LAS ANIMAS...LAMAR...SPRINGFIELD...WALSH
437 AM MDT SAT NOV 5 2011

...HIGH WIND WARNING REMAINS IN EFFECT FROM 9 AM THIS MORNING TO
6 PM MDT THIS EVENING...

A HIGH WIND WARNING REMAINS IN EFFECT FROM 9 AM THIS MORNING TO
6 PM MDT THIS EVENING.

* LOCATION...THE EASTERN PLAINS OF SOUTHEAST COLORADO.

* CAUSE AND TIMING...A STRONG PACIFIC COLD FRONT WILL CROSS THE
  REGION LATE TOMORROW MORNING AND AFTERNOON.

* WIND...SOUTHWEST TO WEST WINDS 30 TO 40 MPH WITH GUSTS TO 65
  MPH. WINDS WILL BE STRONGEST DURING THE AFTERNOON.

* IMPACT...STRONG CROSS WINDS WILL OCCUR ON SATURDAY...
  ESPECIALLY ALONG NORTH SOUTH ORIENTED ROADWAYS SUCH AS I-25.
  THESE STRONG WINDS CAN CAUSE DAMAGE TO STRUCTURES...AND
  BLOWING DUST WILL RESTRICT VISIBILITIES AT TIMES.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

HIGH WINDS CAPABLE OF CAUSING POWER OUTAGES AND PROPERTY DAMAGE
ARE EXPECTED.

THESE WINDS CAN CAUSE LIGHTWEIGHT OBJECTS TO BECOME DANGEROUS
AIRBORNE PROJECTILES. HIGH PROFILE VEHICLES AND VEHICLES PULLING
TRAILERS CAN BE FLIPPED BY CROSSWINDS. BLOWING DUST CAN QUICKLY
REDUCE VISIBILITY TO NEAR ZERO...RESULTING IN HAZARDOUS DRIVING
CONDITIONS AND ACCIDENTS INVOLVING MOTORISTS TAKEN BY SURPRISE.
BLOWING DUST OR SAND CAN ALSO BE A HEALTH HAZARD FOR THOSE WITH
RESPIRATORY PROBLEMS. SECURE LIGHTWEIGHT OBJECTS. AVOID TRAVELING

ON ROADS WITH CROSSWINDS.

$$

109
NWUS55 KPUB 060239
LSRPUB

PRELIMINARY LOCAL STORM REPORT...SUMMARY
NATIONAL WEATHER SERVICE PUEBLO CO
838 PM MDT SAT NOV 05 2011

..TIME... ..DATE...	...EVENT... ....MAG.... ..REMARKS..	...CITY LOCATION... ..COUNTY LOCATION..ST..	...LAT.LON... ...SOURCE....
0557 PM 11/05/2011	NON-TSTM WND GST M64.00 MPH	1 WNW COLORADO CITY PUEBLO CO	37.95N 104.86W MESONET
	COLORADO CITY RAWS SENSOR.		
0530 PM 11/05/2011	NON-TSTM WND GST M62.00 MPH	3 S AIR FORCE ACADEMY EL PASO CO	38.94N 104.86W MESONET
0442 PM 11/05/2011	NON-TSTM WND GST M69.00 MPH	3 ESE HOEHNE LAS ANIMAS CO	37.26N 104.34W ASOS
	TRINIDAD ASOS		
0435 PM 11/05/2011	NON-TSTM WND GST M76.00 MPH	6 S COLORADO CITY HUERFANO CO	37.86N 104.85W MESONET
0407 PM 11/05/2011	NON-TSTM WND GST M65.00 MPH	9 NNW WALSENBURG HUERFANO CO	37.75N 104.84W MESONET
0359 PM 11/05/2011	NON-TSTM WND GST M68.00 MPH	4 SW CAMPO BACA CO	37.06N 102.63W MESONET
	UTE CANYON RAWS		
0214 PM 11/05/2011	SNOW M12.0 INCH	1 SSE WOLF CREEK PASS MINERAL CO	37.47N 106.79W PUBLIC
0153 PM 11/05/2011	NON-TSTM WND GST M58.00 MPH	7 SSE SPRINGFIELD BACA CO	37.31N 102.59W ASOS
0101 PM 11/05/2011	NON-TSTM WND GST M72.00 MPH	25 S LAMAR PROWERS CO	37.72N 102.62W MESONET
	GOBBLERS KNOB CDOT SENSOR		
1236 PM 11/05/2011	NON-TSTM WND GST M68.00 MPH	4 W LAMAR PROWERS CO	38.07N 102.69W ASOS
1200 PM 11/05/2011	NON-TSTM WND DMG	10 E LAMAR PROWERS CO	38.08N 102.43W LAW ENFORCEMENT

SEMI TRUCK BLOWN OFF HIGHWAY 50 AT MILE MARKER 447 AROUND NOON.

1143 AM NON-TSTM WND GST 4 W LAMAR 38.07N 102.69W
11/05/2011 M63.00 MPH PROWERS CO ASOS

1138 AM NON-TSTM WND GST 5 NNE LA JUNTA 38.05N 103.51W
11/05/2011 M60.00 MPH OTERO CO ASOS

1118 AM NON-TSTM WND GST 3 WNW SWINK 38.03N 103.67W
11/05/2011 M60.00 MPH OTERO CO TRAINED SPOTTER

1016 AM NON-TSTM WND GST 12 NE TRINIDAD 37.29N 104.35W
11/05/2011 M60.00 MPH LAS ANIMAS CO ASOS

&&

SXUS45 KBOU 051900
STOCO
COLORADO ROAD REPORTS
NATIONAL WEATHER SERVICE DENVER CO
100 PM MDT SAT NOV 5 2011

COLORADO DEPARTMENT OF TRANSPORTATION ROAD CONDITIONS REPORT
STATEWIDE ROAD CONDITIONS DIAL 511
OUTSIDE OF COLORADO CALL 303-639-1111
http://www.cotrip.org

****
HIGHWAYS NOT LISTED ARE REPORTED DRY
****

I-70 DENVER-UTAH INCLUDING BERTHOUD AND LOVELAND PASSES

HIGHWAY	CITY/AREA	CONDITIONS
I-70	Utah-Grand Junction	Wet, Scattered Showers
I-70	Grand Junction-Palisade-Rifle	Wet, Scattered Showers
I-70	Rifle -Glenwood Springs	Wet, Scattered Showers
I-70	Glenwood Springs-Eagle	Wet, Scattered Showers
	Bike Path closed from Shoshone Power Plant to Hanging Lake rest area. No estimated reopen.	

I-70 DENVER-KANSAS

HIGHWAY	CITY/AREA	CONDITIONS
I-70	Airpark Rd-Bennett	Dry, High Wind
I-70	Bennett-Limon	Dry, High Wind
I-70	Limon-Genoa-Seibert	Dry, High Wind
I-70	Seibert-Stratton-Burlington-Kans	Dry, High Wind

I-25 WYOMING-NEW MEXICO

HIGHWAY	CITY/AREA	CONDITIONS
I-25	New Mexico/Raton Pass-Walsenburg	High Wind, Scattered Show
I-25	Walsenburg-Pueblo	Dry, High Wind
I-25	Lincoln Ave-CO 7	Dry, High Wind

FRONT RANGE HIGHWAYS-DENVER, BOULDER AND SURROUNDING AREAS
All roads reported dry.

NORTHEAST

HIGHWAY	CITY/AREA	CONDITIONS
US 6	Sterling-Holyoke	Dry, High Wind
US 385	Burlington-Wray	Dry, High Wind
CO 71	Limon-Brush	Dry, High Wind

SOUTHEAST

HIGHWAY	CITY/AREA	CONDITIONS
US 24	Colorado Springs-Limon	Dry, High Wind
US 40	Kit Carson-Cheyenne Wells	Dry, High Wind
US 50	Pueblo-LaJunta	Dry, High Wind
US 50	LaJunta-Lamar	Dry, High Wind
US 50	Lamar-Kansas Border	Dry, High Wind
	Closed due to rolled semi trailer. No estimated time of re-opening.	
US 287	Springfield-Lamar	Dry, High Wind
US 385	Cheyenne Wells-Burlington	Dry, High Wind
CO 12	La Veta-Trinidad	High Wind, Snow, Snow Pac

SOUTHWEST

HIGHWAY	CITY/AREA	CONDITIONS
US 24	Leadville-Tennessee Pass	Wet
US 50	Grand Junction-Delta	Rain, Wet
US 50	Delta-Montrose	Rain, Wet
US 50	Montrose-Cerro Summit-Blue Mesa-	Snow, Wet
US 50	Monarch Pass	Snow, Icy Spots, Snow Pac
US 160	Mancos Hill-Hesperus	Snow, Wet
US 160	Durango-Bayfield-Pagosa Spgs	Snow, Wet, Slushy
US 160	Wolf Creek Pass	Snow, Slushy, Icy Spots
	Chains required for all commercial vehicles including buses and vans with 16+ capacity.	
US 160	Del Norte-Alamosa	High Wind, Snow, Snow Pac
US 160	La Veta Pass-Walsenburg	Icy, High Wind, Wet, Slus
US 285	Antero Jct-Fairplay-Jefferson (S	Wet
US 491	Cortez-Pleasant View-Dove Creek-	Wet
US 550	Bondad Hill-Durango	Snow, Wet
US 550	Durango-Ski Area	Snow, Wet, Slushy
US 550	Coal Bank Pass	Snow, Icy Spots, Snow Pac
	Chains all commercial vehicles	
US 550	Molas Pass	Snow, Icy Spots, Snow Pac
	Chains all commercial vehicles	
US 550	Silverton-Red Mountain Pass	Snow, Icy Spots, Snow Pac
	Chains required for all commercial vehicles including buses and vans with 16+ capacity.	
US 550	Ouray-Ridgway	Snow, Wet
CO 9	Fairplay-US 50	Wet
CO 9	Hoosier Pass-Frisco	Icy Spots
CO 17	Cumbres-La Manga passes	Snow, Wet, Icy Spots
CO 62	Dallas Divide	Snow, Wet, Slushy
CO 65	Grand Mesa	Snow, Wet
CO 82	Basalt-Glenwood Springs	Rain, Wet
CO 82	Aspen-Basalt	Rain, Wet
CO 91	Fremont Pass	Snow, Icy Spots
CO 114	Cochetopa/North passes	Wet
CO 133	McClure Pass	Icy, Snow, Wet, Slushy
CO 135	Crested Butte	Snow, Wet
CO 141	Dove Creek-Slick Rock-Naturita	Rain, Wet
CO 141	Unaweep Canyon	Rain, Wet
CO 145	Cortez-Rico	Snow, Wet, Slushy
CO 145	Lizard Head Pass	Snow, Slushy, Icy Spots
	Chains required for all commercial vehicles.	
CO 145	Telluride/Keystone	Snow, Slushy, Icy Spots
CO 149	CO 149 Creede	Snow, Wet
CO 149	Spring Creek-Slumgullion	Snow, Wet
CO 149	Lake City	Snow, Wet

NORTHWEST

HIGHWAY	CITY/AREA	CONDITIONS
US 40	Dinosaur-Elk Springs-Maybell	Snow, Wet
US 40	Craig-Hayden-Milner	Snow, Wet
US 40	Steamboat Springs	Scattered Showers, Wet
US 40	Rabbit Ears Pass	Snow, Wet
US 40	Kremmling-Granby	Scattered Showers, Wet
US 40	Granby-Winter Park	Scattered Showers, Wet
CO 9	Silverthorne-Kremmling	Scattered Showers, Wet
CO 13	Rio Blanco Hill/Nine Mile Hill	Snow, Wet
CO 13	Meeker-Craig-Wyoming	Snow, Wet
CO 64	Rangely	Snow, Wet
CO 131	Wolcott-Steamboat Springs	Scattered Showers, Wet
CO 134	Gore Pass	Snow, Wet
CO 139	Douglas Pass	Snow, Slushy, Icy Spots

SEASONAL

HIGHWAY	CITY/AREA	CONDITIONS
US 34	Trail Ridge Road	No Data
	Closed for the season.	
CO 5	Mt. Evans	No Data
	Closed for the season.	
CO 82	Independence Pass	No Data
	Closed for the season.	
FR209	FR 209	No Data
	Open. Historically closes last week of October. Closure date determined by severity of weather.	
CR381	Guanella Pass	No Data
	Clear Creek County Road open from I-70 Georgetown to US 285 Grant. Information call 303-679-2422	
GCR 12	GCR 12 Kebler Pass	No Data
	Open. Historically closes late November. Closure date determined by severity of weather.	
COS 1	Pikes Peak Hwy.	No Data

Appendix C - Final Natural Events Action Plan For High Wind Events, Lamar, Colorado

REVISED (2003)

NATURAL EVENTS ACTION PLAN FOR

HIGH WIND EVENTS LAMAR, COLORADO

Prepared by:

Colorado Department of Public Health and Environment

AIR POLLUTION CONTROL DIVISION
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and

CITY OF LAMAR PROWERS COUNTY

COMMISSIONERS

I. EXECUTIVE SUMMARY

Over the past eight years, the monitors located at the Municipal Power Plant and Municipal Building in Lamar, Colorado experienced exceedances of the 24-hour National Ambient Air Quality Standard (NAAQS) for PM10 (particulate matter having a nominal aerodynamic diameter equal to or less than 10 microns).[1] Each of these exceedances was associated with unusually high winds and blowing dust in the Lamar area.

Recognizing that certain uncontrollable natural events, such as high winds, wildfires, and volcanic/seismic activity can have on the NAAQS, the Environmental Protection Agency (EPA) issued a Natural Events Policy (NEP) on May 30, 1996. The NEP sets forth procedures through the development of a Natural Events Action Plan (NEAP) for protecting public health in areas where the PM10 standard may be violated due to these uncontrollable natural events. The guiding principles of the policy are:

- Federal, State, and local air quality agencies must protect public health;
- The public must be informed whenever air quality is unhealthy;
- All valid ambient air quality data should be submitted to the EPA Aerometric Information Retrieval System (AIRS) and made available for public access;
- Reasonable measures safeguarding public health must be taken regardless of the source of PM10 emissions; and,
- Emission controls should be applied to sources that contribute to exceedances of the PM10 NAAQS when those controls will result in fewer violations of the standards.

In response to Lamar's three exceedances of the PM10 NAAQS (two in 1995 and one in 1996), the Colorado Department of Public Health and Environment's Air Pollution Control Division (Division), in conjunction with the City of Lamar's Public Works Department, Parks and Recreation, and Prowers County Commissioners, the Natural Resources Conservation Services, the Burlington Northern Santa Fe Railroad, and other agencies developed a Natural Events Action Plan. That Plan was presented to EPA in 1998 and subsequently approved. Since 1998 it is this plan that has assisted the area in addressing blowing dust due to uncontrollable winds.

As required by the Natural Events Policy, the NEAP must be updated no less than every five years. This plan is that required update.

Both this plan and the original NEAP provide analysis and documentation of the exceedances as attributable to uncontrollable natural events due to unusually high winds. In addition, the NEAP is designed to protect public health, educate the public about high wind events and blowing dust; mitigate health impacts on the community during future events; and, identify and implement Best Available Control Measures (BACM) for anthropogenic sources of windblown dust. These issues are also addressed in this revised NEAP.

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II. INTRODUCTION

The City of Lamar is located in Prowers County in southeastern Colorado (see map, page 2). Situated along the Arkansas River and near the Kansas border, Lamar serves as the largest city and the agricultural center for southeast Colorado. The area surrounding Lamar consists of gently rolling to nearly level uplands where the dominant slopes are less than 3 percent.[2] The climate is generally mild and semiarid. Annual precipitation is about 15 inches. Summers are long and have hot days and cool nights. In winter and spring, windstorms are common, especially in drier years including year 2002, one of the driest periods in over 350 years. It is due to these high velocity dust storms and drought conditions that Lamar experiences most of the PM10 problems for the area.

For dates beginning in 1995 to the present, both the Lamar Power Plant and Municipal Complex recorded exceedances of the primary, 24-hour NAAQS for PM10. The PM10 concentrations were recorded on these days - as were unusually high wind speeds and no precipitation. Details can be found in the table below.

Lamar Area PM10 Exceedances

Date	Site	PM10 Concentration*	Natural Event?
March 22, 1995	Power Plant	178 $\mu g/m^3$	Yes
November 26, 1995	Power Plant	180 $\mu g/m^3$	Yes
January 17, 1996	Power Plant	259 $\mu g/m^3$	Yes
April 8, 1999	Power Plant	203 $\mu g/m^3$	Yes
December 17, 2000	Power Plant	178 $\mu g/m^3$	Yes
February 9, 2002	Power Plant	246 $\mu g/m^3$	Yes
March 7, 2002	Power Plant	246 $\mu g/m^3$	Yes
May 21, 2002	Power Plant	196 $\mu g/m^3$	Under EPA consideration
May 21, 2002	Municipal Complex	183 $\mu g/m^3$	Under EPA consideration
June 20, 2002	Power Plant	181 $\mu g/m^3$	Under EPA consideration
June 20, 2002	Municipal Complex	162 $\mu g/m^3$	Under EPA consideration

* Recorded exceedances of the primary, 24-hour NAAQS for PM10

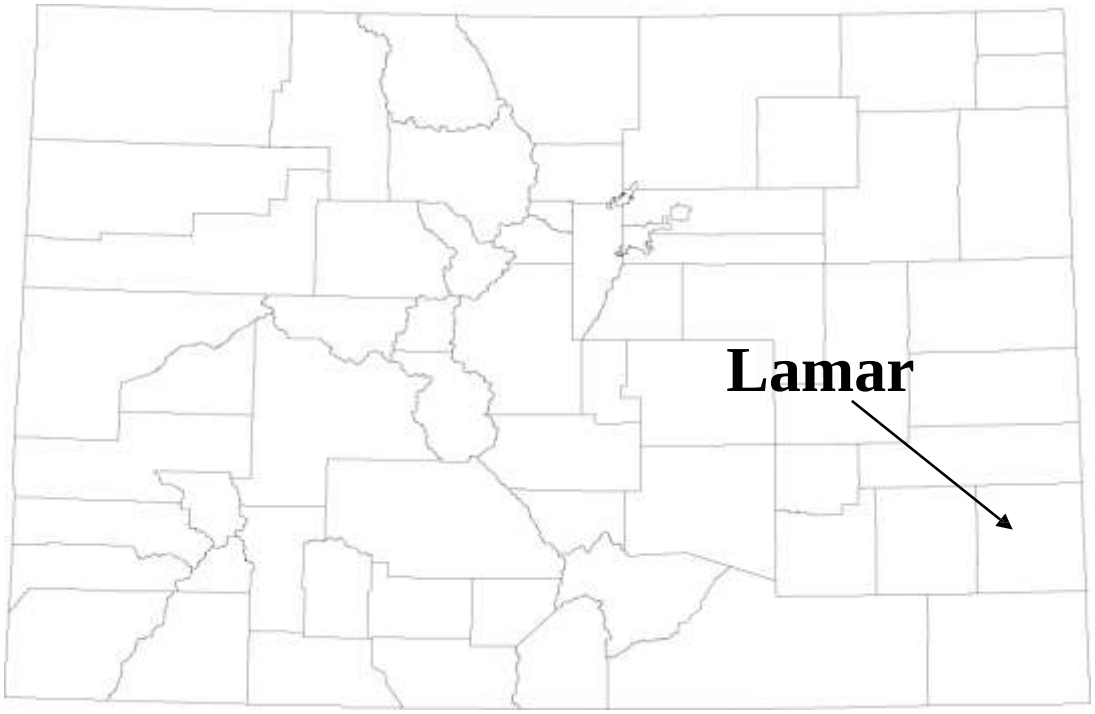
The circumstances surrounding the Lamar exceedances have provided adequate reason for the Division, in consultation with the City of Lamar and Prowers County, to believe the blowing dust due to high wind events have caused exceedances of the NAAQS that otherwise would not have occurred.

As required by the NEP, each of the exceedances has been flagged by the Division's Technical Services Program in the AIRS system. The flags appear after the recorded values in AIRS with the descriptor code "A" for high winds. All supporting documentation of the high wind events has been submitted to EPA Region VIII and has been made available to the residents of Lamar for review and/or comment. According to EPA guidance the type and amount of documentation provided for each event should be sufficient to demonstrate that the natural event occurred, and that it impacted a particular monitoring site in such a way as to cause the PM10 concentrations measured.[3]

Recognizing the need to protect public health in areas where PM10 exceeds the NAAQS due to natural events such as the unusually high winds, a Natural Events Action Plan has been developed for the Lamar area based on the NEP guidance. This plan outlines specific procedures to be taken in response to wind blown events. In short, the purpose of the plan is to:

- Educate the public about the problem;
- Mitigate health impacts on exposed populations during future events; and
- Identify and implement Best Available Control Measures (BACM) for anthropogenic sources of windblown dust.

Plan Area



A. Background

High winds are common to the southeast region of Colorado. Under some conditions, these winds are strong enough to lift particulate matter into the air and cause elevated levels of PM10 above the Federal and State standards. Due to observed problems in Lamar with dirt, dust, and particulate, area monitoring of total suspended particle pollution was instituted at the Power Plant site in 1975. In June 1985, monitoring for PM10 began. A new site, the Municipal Complex, was selected in August, 1986. This site was considered to better meet the maximum siting criteria and more adequately reflect worse case population exposure. The Power Plant site was re-established in February 1992 and has since operated along with the Municipal Complex site on an everyday sampling schedule.

Lamar's monitoring history shows that the annual PM10 standard of 50 $\mu g/m^3$ averaged over an annual period has never been exceeded. The Lamar area has however experienced exceedances of the 24-hour PM10 standard of 150 $\mu g/m^3$ since 1985. The associated weather conditions on each of the exceedance days conform to a repeated pattern of regional high winds and blowing dust. In each case an intense, fast-moving, surface low-pressure system tracked through eastern Colorado. Typically these systems had surface lows that were not collocated with a closed upper low or nearly closed upper level trough. This distinction is important because the collocated or vertically "coupled" systems usually bring significant up slope snow or rain to the region. The intensity of the lows associated with the PM10 exceedances is evident in the average central pressure of 990 mb (corrected to sea level). This value is typical of a deep, well-organized
system. Such well-organized systems usually generate high winds in the vicinity of the low center.[4]

The past exceedances of the PM10 NAAQS classified Lamar as a moderate nonattainment area for PM10. In response to this designation, Lamar with the assistance of the State prepared the Lamar PM10 Non-Attainment Plan and the Redesignation Request and Maintenance Plan. The Lamar PM10 Maintenance Plan was submitted to EPA in 2002 and is currently awaiting EPA approval (see Appendix for copy of the Maintenance Plan). According to EPA's Natural Events Policy, states may request that a moderate nonattainment area not be reclassified as serious if it can be demonstrated that the area would attain the standards by the statutory attainment date but for emissions caused by natural events. The NEP applies only to emissions caused by natural events that have occurred since January 1, 1994.[5] Thus, only those high wind events beginning with the March 22, 1995 event can be addressed by this NEAP. As indicated throughout this document, the revision here demonstrates commitment to the "every 5-year" requirement as indicated by the NEP.

B. The Natural Events Policy

1. Background

On May 30, 1996, EPA issued the Natural Events Policy in a memorandum from Mary D. Nichols, Assistant Administrator for Air and Radiation. In this memorandum EPA announced its new policy for protecting public health when the PM10 NAAQS are violated due to natural events. Under this policy three categories of natural events are identified as affecting the PM10 NAAQS: (1) volcanic and seismic activity; (2) wildland fires; and, (3) high wind events. Only high wind events will be addressed in this NEAP. Based on EPA's natural events policy high winds are defined as uncontrollable natural events under the following conditions: (1) the dust originated from nonanthropogenic sources; or, (2) the dust originated from anthropogenic sources controlled with best available control measures (BACM). Furthermore, the conditions that create high wind events vary from area to area with soil type, precipitation, and the speed of wind gusts.[6]

Prior to EPA guidance on PM10 exceedances due to natural events, the Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events and Appendix K to 40 CFR, Part 50, were issued by EPA to address situations where natural sources strongly influence an area's air quality. Similar to EPA's natural events policy, Appendix K provides, in part, that measured exceedances of the PM10 NAAQS may be discounted from decisions regarding nonattainment area status if the data are shown to be influenced by uncontrollable events caused by natural sources of particulate matter. Then in 1990, the Clean Air Act Amendments added section 188(f) that provides EPA with discretionary statutory authority to waive either a specific attainment date or certain planning requirements for serious PM10 nonattainment areas that are significantly impacted by nonanthropogenic sources.

According to EPA's Natural Events Policy the section 188(f) waiver provision, Appendix K, and the Exceptional Events Guidance are to be considered revised by the requirements of the May 30, 1996 NEP. Additional justification of the revisions can be found in the Appendix of EPA's natural events policy.

2. Content

In order for exceedances of the NAAQS to be considered as due to a natural event, a Natural Events Action Plan must be developed to address future events. The following is a summary of the specific EPA guidance regarding development of a NEAP.[7]

1) Analysis and documentation of the event should show a clear causal relationship between the measured exceedance and the natural event. The type and amount of documentation

provided should be sufficient to demonstrate that the natural event occurred, and that it impacted a particular monitoring site in such a way as to cause the PM10 concentrations measured.

2) Establish education programs. Such programs may be designed to educate the public about the short-term and long-term harmful effects that high concentrations of PM10 could have on their health and inform them that: (a) certain types of natural events affect the air quality of the area periodically, (b) a natural event is imminent, and (c) specific actions are being taken to minimize the health impacts of events.

3) Minimize public exposure to high concentrations of PM10 through a public notification and health advisory program. Programs to minimize public exposure should (a) identify the people most at risk, (b) notify the at-risk population that a natural event is imminent or currently taking place (c) suggest actions to be taken by the public to minimize their exposure to high concentrations of PM10, and (d) suggest precautions to take if exposure cannot be avoided.

4) Abate or minimize appropriate contributing controllable sources of PM10. Programs to minimize PM10 emissions for high winds may include: the application of BACM to any sources of soil that have been disturbed by anthropogenic activities. The BACM application criteria require analysis of the technological and economic feasibility of individual control measures on a case-by-case basis. The NEAP should include analyses of BACM for contributing sources. If BACM are not defined for the anthropogenic sources in question, step 5 listed below is required.

5) Identify, study, and implement practical mitigating measures as necessary. The NEAP may include commitments to conduct pilot tests of new emission reduction techniques. For example, it may be desirable to test the feasibility and effectiveness of new strategies for minimizing sources of windblown dust through pilot programs. The plan must include a timely schedule for conducting such studies and implementing measures that are technologically and economically feasible.

6) Periodically reevaluate: (a) the conditions causing violations of a PM10 NAAQS in the area, (b) the status of implementation of the NEAP, and (c) the adequacy of the actions being implemented. The State should reevaluate the NEAP for an area every 5 years at a minimum and make appropriate changes to the plan. Again, this revision directly reflects Element #6 as required under the Natural Events Policy.

7) The NEAP should be developed by the State in conjunction with the stakeholders affected by the plan.

8) The NEAP should be made available for public review and comment and may, but is not required, to be adopted as a revision to the State Implementation Plan (SIP) if current SIP rules are not revised.

9) The NEAP should be submitted to the EPA for review and comment.

The following text describes the Lamar NEAP and its conformance with the EPA guidance on natural events.

III. NATURAL EVENTS ACTION PLAN

Element 1: Documentation & Analysis

On October 11, 1996 the Division submitted documentation to EPA Region VIII in support of the three most recent exceedances of the PM10 NAAQS in Lamar due to natural events. The documentation contained monitoring data, meteorological data, PM10 filter analysis and receptor model results, maps of the area, news accounts of the events and other miscellaneous supporting material.

The supporting documentation, however, was deemed to be incomplete by EPA Region VIII in a letter dated December 19, 1996. A request for additional information was made by EPA. This request was fulfilled through the submission of supplemental documentation on February 28, 1997. The supplemental documentation contained additional meteorological analyses on wind speed, wind direction, and precipitation data. Identification of potential anthropogenic and nonathropogenic sources in relation to the two Lamar PM10 monitor sites was also provided.

A further request from EPA for historical documentation on meteorological conditions and associated high/low PM10 values under a low/high wind speed conditions was made on March 13, 1997. The Addendum to the supplemental supporting documentation was submitted to EPA on May 7, 1997. All three documentation submittals were included in Appendix A of 1998 NEAP.

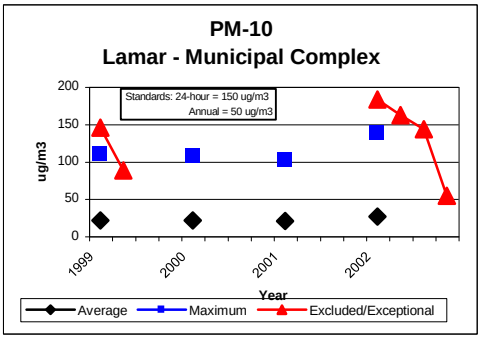
Taken together, the supporting documentation establishes a clear, casual relationship between the measured exceedances and the natural events as required by the NEP. On the days of Lamar's PM10 exceedances, unusually high winds and/or wind gusts were experienced over a prolonged period of time. On March 22, 1995 seven consecutive hours of 21-32 mph wind speeds blew from the west. The maximum hourly average wind speed was 32 mph with a maximum wind gust recorded at 62.2 mph. The November 26, 1995 exceedance experienced

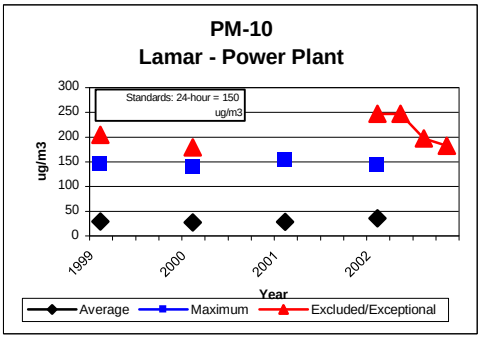
an hourly wind speed average of 31.1 mph and six consecutive hours of winds blowing from the west at 24 -
31.1 mph. On January 17, 1996, eleven consecutive hours of strong north winds blew from between 21-28 mph. The strongest wind gust recorded that day was 41.5 mph. No precipitation was measured either on the exceedance days, or up to seven days prior to the high wind events. At the time of the November 26, 1995 exceedance, a lack of precipitation was evident for as many days as 52 prior to the exceedance.

According to the Natural Events Policy, "the conditions that create high wind events vary from area to area with soil type, precipitation and the speed of wind gusts." Thus, states are to determine the conditions that define high winds in an area. Making a precise determination, however, is a complex task that requires detailed information on soil moisture, daily wind speeds, temperature, and a number of other variables that are not readily available at this time. Until such research and/or guidance is available, the Division will use the definition of high winds included in the *Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events* for the Lamar area. According to this guidance, high winds are defined as: "An hourly wind speed of greater than or equal to 30 mph or gusts equal to or greater than 40 mph, with no precipitation or only a trace of precipitation." In all three high wind events, hourly wind speeds and/or wind gust data coupled with low precipitation levels meets this high wind definition.

For events more recent, that is, since the submittal and EPA concurrence of the 1995- 1998 high wind events, full technical descriptions for each event have been submitted to EPA. Naturally occurring blowing dust due to high wind events in Lamar meet the same strict definitions and guidelines as those events documented in the 1998 NEAP. The graphs below highlight exceedances recorded in recent years compared to the NAAQS at both the Lamar Power Plant and Municipal Complex. Data are also represented on page 1.

Lamar Area Exceedances at Both Municipal Complex and Power Plant





This section, alongside technical documentation provided previously, fulfills the requirement of Element #1 as described on page 4.

Element 2: Public Education Programs

The purpose of this program is to inform and educate the public about the problem. The Division has worked closely with the City of Lamar, Prowers County Commissioners, local media, and interested community groups to educate the public about the problems associated with elevated levels of PM10 in the Lamar area. Over the years numerous meetings have taken place with the City and County governments to discuss these issues and to develop a plan to address future high wind events in Lamar. Elements of the program include: informing the public when air quality in the area is unhealthy; explaining what the public can expect when high wind events occur; what steps will be taken to control dust emissions during future high wind events; and, how to minimize their exposure to high concentrations of PM10 during high wind conditions. The public notification and education programs have included but are not limited to:

- An informational and health-related brochure has been and will continue to be distributed by the local governments, the Prowers County Health Nurses, the Prowers County conservation and agricultural extension agencies to sensitive populations (elderly and local school districts) as well as the general public. Distribution of the *Blowing Dust Health Advisory Brochure* began in January 1998 (see Appendix). Additional activities/commitments of this revised (2003) NEAP include: the development of a Spanish language brochure for the non- English speaking community.

- Media press releases for both the print and local radio are conducted as needed to continually raise public awareness. Additional activities/commitments of this revised (2003) NEAP include: Division and area staff have participated in several radio interviews to further raise public awareness to air quality issues and advise local residents of opportunities to participate in the development of local air quality plans. Also, community radio polling has been completed to better identify local mitigation opportunities/considerations.

- Numerous public meetings have also been conducted. Additional activities/commitments of this revised (2003) NEAP include: 1) To gauge community understanding of air quality issues, a local focus group was convened. Through this focus group, an air quality survey was developed to further gauge community awareness and willingness to address other air quality issues. A copy of the survey is included in the Appendix, and; 2) Division staff have participated in local events (e.g., County Fair) to pass out high wind/blowing dust

literature and answer questions related to the NEAP and local control strategies to minimize PM10 exposure.

- Also, blowing dust watches and health advisories have been and will continue to be issued by Lamar's Southeast Land and Environment office (local health department) during the high wind season. Thirteen (13) advisories have been issued since the last revision. Additional activities and commitments of this revised (2003) NEAP include: the adequacy and accuracy of the blowing dust watches and health advisories have been verified and quality assured on several occasions to ensure minimization of the public's exposure.

- An Air Quality Task Force has been established in the community over the past year. Members of the task force include local health department personnel, staff from city and county, the business community, a public health nurse representative, and the Division itself. The charge before the task force is to identify any unresolved air quality issues, ensure area exceedances are minimized, and work to ensure the community is aware of ongoing air quality issues and efforts to minimize impacts. This is a new commitment/activity that was not part of the 1998 NEAP and demonstrates additional efforts by the local agencies and the Division to improve area air quality.

- Several meetings have also been held to review the requirements of and local involvement in the NEAP and its 2003 revision. Other meetings will be convened as deemed necessary by the Division and/or the local stakeholders.

- Finally, through recommendation from the air quality task force, an independent study is being conducted to better understand any impacts from an area feedlot. Results should be available in 2003/2004 for additional community address. This too is a new activity that was not part of the 1998 NEAP.

This section fulfills the requirement of Element #2 as described on page 5.

Element 3: <u>Blowing Dust Health Advisory and Notification Program</u>

The Blowing Dust Health Advisory Program will notify the public as to the possibility that a high wind event is imminent or currently taking place, and will include an advisory suggesting what actions can be taken to minimize exposure to high concentrations of particulate matter.

Advisories will be issued by the Lamar area Environmental Health Southeastern offices with forecasting assistance provided by the Division and the National Weather Service. The forecasting methodology - approved as part of the 1998 NEAP submittal and agreed to all

parties listed elsewhere in this NEAP -alongside the public brochure and the forecasting and health advisory protocols are included in the appendix.

In addition, high winds are currently being documented to determine if the Division can better address these issues. Included in this analysis is a rudimentary review of the high wind data to identify patterns of events and possible solutions to minimize public exposure. Given the drought conditions affecting the Lamar area over the past several years, no consistent pattern (outside of extremely dry conditions and lack of rainfall) has been noted. Nonetheless, the Division is committed to continually investigating this issue and improving the advisory as possible. This is a new activity that was not part of the 1998 NEAP and demonstrates additional efforts by the Division.

This section fulfills the requirement of Element 3 as described on page 5.

Element 4: Determination and Implementation of BACM

1. BACM Determination

According to the NEP, BACM must be implemented for anthropogenic sources contributing to NAAQS exceedances in moderate PM10 nonattainment areas. BACM for PM10 are defined in 59 F.R. 42010, August 16, 1994 as techniques that achieve the maximum degree of emissions reduction from a source as determined on a case-by-case basis considering technological and economic feasibility.

Through a series of meetings beginning in 1997 between the Division and Lamar officials representing the City of Lamar, Prowers County Commissioners, local farmers, a county health specialist, the local media, the Natural Resources Conservation Service, the county extension office, and concerned citizens, issues were discussed surrounding the NEAP and its efforts. Specifically covered were issues of the meteorological data, monitoring data, potential contributing sources to the high wind events, and potential candidate BACM. The community meetings, coupled with the analyses of the supporting documentation, identified two distinct set of circumstances that lead to Lamar's high wind exceedances of the PM10 NAAQS:

- High concentrations of PM_{10} caused by a mixture of anthropogenic and nonanthropogenic sources coming largely from outside the nonattainment area under high wind conditions - from about the 270 degree to 360 degree wind directions (west, northwest, and north directions); and,

- Prolonged climatic conditions of low precipitation over an extended period of time that

act to dry area soils making them more susceptible to airborne activity under high wind conditions.

The meetings also identified potential BACM candidates including the Burlington Northern Santa Fe rail line, agricultural lands, other open areas, limited construction activity (which has been since completed), the city landfill, and area gravel pit. Specific documentation for these candidate BACM can be found in the 1998 NEAP.

BACM Options Considered

To determine the most appropriate and viable control measures for the community, both a review of the area emission inventory and consideration of all BACM was undertaken. Note that numerous other BACM options have been considered for the revised NEAP that were not part of the original (1998) NEAP.

Based on the contributing source analysis and in review with community stakeholders, the following BACM options were considered as possible PM10 control measures for the community:

a) Street Sweeping Activities- Community Street sweeping programs have demonstrated effectiveness in other communities. Such activities were considered as a local control measure. Expanding the current street sweeping program and purchasing additional, more effective equipment were also reviewed.

b) Construction/Demolition Activity – local ordinances to control emissions from construction and demolition sites have been implemented in other parts of the state with good success. Also, several work practice could be applied to reduce emissions from the site including watering, a track out policy, and an area land use plan. Based on the contributing source analysis, this option was discussed with the City of Lamar and Prowers County officials as part of the 1998 NEAP as well.

c) Wind Erosion of Open Areas – several practices were reviewed regarding the wind erosion of open areas, including both local and regional efforts. Recommendations under consideration included sodding of local parks, tree breaks planted at the area transfer station, gravel/chips along railroad corridor, and chemical stabilization applied by the city along the railroad corridor in a two-block area. Based on the contributing source analysis, this option was discussed with the City of Lamar and Prowers County officials as part of the 1998 NEAP as well.

d) Control of Stationary Source Emissions- as identified elsewhere in this NEAP, a review of stationary sources and their relative contribution to overall PM concentrations was completed.

It was determined that few PM10 sources exist in the area, appearing to contribute a very small amount of particulate matter to the overall inventory.

e) Road Stabilization- In a effort to better understand the effects of road stabilization, several options were reviewed including the use of chemical stabilizers and water as a stabilizing measure.

Also, periodic assessments to determine if traffic levels on unpaved roads surpass Colorado Regulation No. 1 limits were considered. If daily traffic counts exceed 200 trips per day on unpaved roads, state regulations apply that reduce PM10 emissions from those roads. Specifically, periodic assessments of traffic levels on unpaved roads within the city limits and within one mile of the city limits were considered. State regulation calls for a road traffic count and dust control plan for roads that exceed the 200 trips threshold.

In addition, Lamar currently suggests that drivers maintain their vehicles at a slow speed on unpaved roads and other dirt surfaces to reduce dust emissions. This information is disseminated throughout the community.

f) Woodburning Curtailment Programs- the possibility of instituting a citywide curtailment program was reviewed and considered. This has been a consideration for the community and includes discouraging wood burning on high wind days.

g) Open Burning- The usefulness of imposing and maintaining an open burning curtailment program during high wind events was reviewed. Current state air pollution control laws and regulations provide some guidance on the effort.

h) Avoidance of Dust Producing Equipment- The effectiveness of avoiding the use of dust producing equipment has also been considered. Currently Lamar discourages the use of dust- producing equipment (e.g., leaf blowers) in an effort to reduce PM10 emissions and does so through public education and outreach efforts.

i) Reducing or Postponing Tilling and Plowing or Other Agricultural Practices that Contribute to PM10 Emissions- It is well recognized that dust-producing activities such as tilling, plowing, and other agricultural practices increase the amount of PM10 released. As such, these control measures were discussed as part of the effort to reduce PM10 impacts on Lamar. Review of existing and potentially future control practices were considered at the local, regional, state, and federal (e.g., Natural Resources Conservation Service) level.

j) Wind Break- Various trees are found throughout Lamar. However, the placement of one

row of barrier trees (e.g., Russian Olives) would block potential contributing sources. The Russian Olive is a quick growing large shrub/small tree will do well given the windy climate of Lamar. According to section 3.5.2.1 of EPA guidance entitled Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, dated September 1992, one-row of trees is considered an effective windbreak.

k) Vegetative Cover/Sod- Efforts elsewhere in the State have demonstrated the usefulness of using a vegetative cover at sites where dust is known to blow. Efforts to use this control measure were reviewed for applicability and effectiveness.

l) Railroad Corridor - Two categories of surface treatments were considered to control fugitive dust emissions lifted from the 400'-wide railroad corridor under dry, high wind conditions. This option was fully explored in the 1998 NEAP and details of this option can be found there.

Lamar Stationary Sources Emission Inventory

To ensure that significant changes in PM10 emissions from local stationary sources are not a significant contributing factor to area exceedances, an emission inventory was prepared and reviewed. The following table demonstrates their limited impacts on the total emission inventory. Note how this relatively minor value compares to the approximately 12,700 pounds per day emission inventory prepared as part of the area's Maintenance Plan (circa 2000 inventory). That is, the stationary source emission inventory accounts for less than 2% of the total PM10 emission inventory. For more information regarding the Maintenance Plan and its inventory, please see the PM10 Redesignation Request and Maintenance Plan for the Lamar Area. A copy of the Plan is available in the Appendix.

Current Lamar PM10 Emission Inventory (circa 2003)

Source	Emissions in lbs/day (also 1998 emissions)
Carder *	4.1 (1170.6)
Utility Board of Lamar	17.5 (44.9)
SE Colorado Co-Op	0.3 (0.5)
Valco	1.5 (1.7)
Neoplan	0.9 (4.2)
Fiberglass Component	0.0 (0.3)
All Rite	28.0 (28.2)
Hog Slat	15.3 (15.3)
City of Lamar	0.0 (4.9)
Lamar Community College	0.1 (1.2)

Ranch Manufacturing *	0.9 (0.0)
National Swine Builders*	35.6 (0.0)
Colorado Mills, LLC *	67.4 (0.0)
Total	**171.6 (1271.8)**

* Emissions include "Potential to Emit," not necessarily actual emissions, for 1998.
Sources with zero emissions in 1998 not part of the inventory then or doing business under a different name (emissions not available at the time of this documentation, though anticipated as "low")

BACM Options Discounted

Several BACM options were discounted from consideration based on the meteorological analysis, on site inspection and discussion with area residents and local government officials. A complete discussion of these previous efforts can be found in the 1998 NEAP.

For this revised Plan however, the community is committed to meet BACM in all instances, where feasible. For example, meetings with local officials coupled with the use of an area focus group indicated that the ongoing regional drought significantly impacts the amount of water available as a control measure (e.g., watering of area roads to reduce PM10). With that, water restrictions (and related economic impacts of the drought) will likely dictate the utility of this control measure.

BACM Implementation

Refer to the stakeholder agreements for details on the selected BACM.

III. STAKEHOLDER AGREEMENTS

The City of Lamar and Prowers County have been working hard to identify contributing sources and to develop BACM for those sources as required by NEP. The following descriptions include BACM that has either already been put into place or will be phased in as economically and technically feasible.

City of Lamar

The City of Lamar has been very active in addressing potential PM10 sources within the Lamar area through efforts such as sodding baseball fields, implementing and enhancing a street sweeping program, and chip-seal paving of many unpaved roads. In addition to these type of

control measures already taken by the City, the Public Works Department implemented the following BACM within the area:

1. *Wind Break*

Beginning in the Spring of 1997, a wind break of trees was planted north of the Power Plant monitoring site. The Russian Olive tree wind break is located approximately one half mile north of the Power Plant monitoring site and will block potential contributing sources such as the Lamar Transfer Station and other unpaved equipment traffic areas to the north. The Russian Olive is a quick growing large shrub/small tree will do well given the semi-arid and windy climate of Lamar. According to section 3.5.2.1 of EPA guidance entitled Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, dated September 1992, one-row of trees is considered an effective windbreak.

In addition to this commitment, more recent efforts include: the installation of a drip irrigation system to irrigate these tree groves.

2. *Landfill Shutdown*

The East Lamar Landfill is located approximately six (6) miles east of the city limit. According to section 3.5.1 of the "Operations and Closure Plan for the East Lamar Landfill", the Director of the Public Works Department and/or the landfill operator is required to do the following litter control measures under high wind conditions:

- Soil cover is required to be placed on the working face of the landfill daily during periods of wind in excess of 30 mph; and,

- The landfill must be closed down when sustained winds reach 35 mph or greater.

An on-site wind gauge is used to monitor wind speeds at the landfill. Operators have radios in their equipment connecting them with the main office so that when the decision to close the landfill is made, it can take place immediately. According to the previous Director of Public Works, landfill operators have been directed to close the landfill at their discretion. Because paper begins to lift and blow into the debris fences at wind speeds of 25 to 30 mph, the operator usually closes the landfill prior to wind speeds reaching 30 mph. The City of Lamar has agreed to make the closure of the Lamar landfill mandatory when wind speeds reach 30 mph. This also reduces wind blown dust from the landfill as earth moving activities are reduced or eliminated during periods of shut down.

In addition to this commitment, more recent efforts include: the placement of chain link fencing and various debris fences in place of the previous litter entrapment cage. This effort is to better minimize the release of materials during high wind conditions.

3. *Vegetative Cover/Sod*

The Lamar Recreation Department installed 100,000 square feet of sod at a recreational open space called Escondido Park. Escondido Park is located in northwest Lamar at 11th and Logan Streets. A sprinkler system has also been installed by the Parks and Recreation Department. The sod provides a vegetative cover for the open area. This dense, complete cover provides an effective control against wind blown soil from the open area of the park.

In addition to the commitment above, more recent efforts include: the commitment by the Lamar Public Works Department to stabilize the entrance road leading to and from Escondido Park to reduce track out onto city streets and minimize additional releases of PM10.

4. *Additional Public Works Projects*

In addition to the PM10 control efforts of the original NEAP, new Public Works projects to further reduce emissions of PM10 include:

- The recent purchase of a TYMCO regenerative air street sweeper which is much more effective in reducing dust during street sweeping activities. Use of this sweeper allows for improved cleaning of the streets (e.g., sweeps the gutter and street);
- The fencing of an area around the City Shop to reduce vehicle traffic that may be responsible for lifting dust off of the dirt area between the railroad tracks and the Shop;
- The stabilization of a large dirt and mud hole on the north side of the City Shop. This project is credited with keeping mud from being tracked out into the street and becoming airborne by vehicular traffic;
- The ongoing commitment to search for other stabilization projects that benefit the community and improve area air quality, and;
- The relocation of the Municipal Tree Dump (formerly located in the northeastern corner of the city) to approximately six miles east of the city (now housed at the Municipal Landfill). This relocation eliminates a major source of smoke from agricultural burns that may have previously affected the community.

Burlington-Northern/Santa Fe Rail Line

The rail line running east-west of the Power Plant monitoring site was deemed to be an important PM10 source during conditions of high winds and low precipitation. Vehicle traffic which damages vegetation and break up the hard soil surfaces, highwinds, and passing trains re-entrains the dust into the air. This area is particularly problematic in the two block area immediately west of the Power Plant monitoring site. Control of this open area requires a close working agreement between the Burlington-Northern/Santa Fe Railroad Company (BNSF), the Division, and the City of Lamar Public Works Department. The purpose of this BACM is to reduce the amount of particulate matter susceptible to wind erosion under high wind conditions and general re- entrainment of dust in the ambient air as a result of local train traffic passing in close proximity of the PM10 monitor.

In September 1997, the City chemically stabilized exposed lands north of the rail line between Fourth and Second Street where there was evidence of vehicle traffic. All other lands on either side of the rail road tracks between Main Street (Fifth) and Second Street and extending westward have either natural, undisturbed ground cover or it is used for commercial/recreation purposes that do not allow for significant re-entrainment (BNSF is responsible for maintaining 50 feet of property on either side of the main track). Most of these lands are leased by the City. After September 1997 the City negotiated the lease of these lands. Once acquired, a long term plan, will be developed for these lands such as restricting vehicle access, permanently stabilizing lands with vegetation and gravel, increasing park and recreational use, and using the lands for city maintenance and storage activities.

According to John Meldrum, Manager of Environmental Operations for BNSF, the railroad company owns the main rail line and 200 feet on either side of the track. Much of this property has been sold or leased under private contracts. At this time BNSF is responsible only for the main rail line and for 50 feet of property on either side of the main track. All property sold or under contract is not the responsibility of BNSF. As a result, BNSF has stabilized the railroad corridor 50 feet on either side of the main rail line.

In May 1997, Burlington Northern Santa Fe placed chips (gravel) 50 feet on either side of the main track from Main Street to Second Street (three blocks) to control fugitive dust emissions from this section of the track. Graveling exposed surfaces not exposed to regular vehicle traffic is considered a permanent mitigation measure. Details of this arrangement can be found in the documentation under the 1998 submittal.

USDA: NATURAL RESOURCES CONSERVATION SERVICE

1. *Conservation Reserve Program*

Prowers County is a predominately agricultural area that is made up of over one million acres of land area - 882,165 acres (or 84.6%) of which is land in farms.[8] Of the farm land acreage, cropland accounts for over half of the total (467,650 acres). Water, and often the lack of it, coupled with the frequent high winds experienced during late fall and early spring can destroy crops, encourage pests, and damage soil surfaces lending them susceptible to wind erosion. Most of Prowers County cropland acreage is farmed using dryland practices (versus irrigated) and consists of soils classified as highly-erodible-land (HEL) by the Department of Agriculture.

Recognizing the problems associated with erodible land and other environmental-sensitive cropland, the U.S. Department of Agriculture (USDA) included conservation provisions in the Farm Bill. This legislation created the Conservation Reserve Program (CRP) to address these concerns through conservation practices aimed at reducing soil erosion and improving water quality and wildlife habitat.

The CRP encourages farmers to enter into contracts with USDA to place erodible cropland and other environmentally-sensitive land into long-term conservation practices for 10-15 years. In exchange, landowners receive annual rental payments for the land and cost-share assistance for establishing those practices.

The CRP has been highly successful in Prowers County by placing approximately 146,000 acres of Prowers County cropland, or 28% of total cropland, under contract. Most of this land has been planted with a perennial grass cover to protect the soil and retain its moisture. Strong support of the program by Prowers County farmers continues as 38% of the counties HEL cropland has been offered for conservation practices.

While the following initiatives are not meant to be enforceable, many efforts are underway that further reduce blowing dust and its impacts. These include:

- The CRP has moved to include all available area lands into area contracts. These contracts are good through 2007. Success of the CRP initiatives is measured through ongoing monitoring of the contracts to ensure ample grass coverage to minimize blowing dust.

- CRP sends out information several times per year through radio and the area newspaper to further reach farmers interested in topsoil protection.

- In response to the significant Colorado drought the CRP is working with multiple parties in extensive annual planning efforts to limit blowing dust and its impacts. These planning efforts change year to year depending on the severity of the drought.

2. *Limestone-Graveyard Creeks Watershed Project*

A watershed improvement project is currently underway in the Limestone-Graveyard Creeks Watershed. This project covers approximately 60,000 acres of land north of the Arkansas River between Hasty (Bent County) and Lamar. An estimated 44,500 acres of the watershed area are classified as priority land due to the highly erodible nature of the soil. Over 2,000 acres of agricultural cropland northwest of Lamar are included in this watershed project.

Working with the NRCS, each farmer will create their own conservation plan with costs for improvements split equally between farmers and the federal government. The 15-year project will help reduce soil erosion and improve water quality and efficiency through conservation tillage practices and/or other conservation efforts. In short, the Limestone-Graveyard Creeks Watershed Project will help to reduce soil erosion and lower the impacts of blowing soils during future high wind events.

More recently (since the 1998 NEAP submittal), the Watershed project has been evaluated and is seen as an ongoing successful program as most eligible acres are signed up.

3. *New Initiatives*

While the following initiatives are not meant to be enforceable, the Natural Resources Conservation Service has many efforts underway that further reduce blowing dust and its impacts. These include:

- A comprehensive rangeland management program;
- Tree planting program;
- Drip irrigation purchase program, and;
- A multi-party drought response planning effort coordinated through the State of Colorado Governor's office.

These are but a few of the efforts at the local, county, and regional level underway to reduce emissions of PM10 and limit impacts.

COLORADO STATE UNIVERSITY CO-OP EXTENSION OFFICE

While the following initiatives are not meant to be enforceable, the CSU Co-Op Extension Office has many efforts underway that further reduce blowing dust and its impacts. These include:

- Crop residue efforts that encourage no- or low-till practices. These have been deemed appropriate and useful in reducing blowing dust.
- Ongoing outreach efforts to educate area agricultural producers on soil management programs. These include one-on-one visitations and annual meetings with various corn and wheat programs to discuss crop management.
- Drought workshops to protect topsoil throughout the county.

PROWERS COUNTY

Prowers County Land Use Plan

Beginning in 1997, Prowers County with the assistance of local officials, environmental health officers, the general public, etc. began preparing a County Land Use Plan. The Prowers County Land Use Plan is designed to have wide-reaching impacts on the City of Lamar and Prowers County for a myriad of land use issues involving building (construction sites), siting, health, fire, environmental codes, and other social concerns. The early work on the Land Use Plan was seen as a diverse set of administrative, code, and enforcement activities brought together into one process.

While the Plan has undergone extensive draft and local consideration since that time, the Plan was never fully implemented. This was due to the community's interest in identifying the most appropriate approach for holistically addressing County issues.

More recently (since the 1998 submittal), the Prowers County Land Use Plan has undergone significant review and re-draft (as part of the County's broader Comprehensive 2003 Plan). In short, the original County sub-division regulations and zoning ordinances are being legally reviewed and enhanced to address community needs. Regulations and ordinances of the Land Use Plan specific to reducing blowing dust and its impacts include:

- Additional regulations on development of fragile lands and vegetation to protect topsoil;
- Development of performance standards and best management practices to prevent soil erosion;

- Development of best management practices to reduce blowing sands and movement of area sand dunes across the county;
- Development of new special use permits to address the siting of animal feedlots and feed yards;
- Development of special use permits for other future stationary sources. The special use permits will also likely include the requirement for comprehensive fugitive dust control plans for both construction and operation of facilities;
- Consideration and review of enforcement capabilities through the area zoning ordinances, and;
- Planned public review and comment processes following the legal update of the draft County Land Use Plan.

The draft strategies described above are at the county level and are informational only. The descriptions are meant only to capture the regional considerations being made to address blowing dust and its impacts. The County's Comprehensive Plan should be available by October 31, 2003. The Division commits to sending this final land use plan to EPA Region 8 as an addendum to this NEAP upon completion.

This section fulfills the requirement of Elements #4 as described on page 5.

PUBLIC REVIEW AND PERIODIC EVALUATION

This section describes the public process used to develop this NEAP and the commitment made to periodically evaluate the plan.

Stakeholder Involvement

The EPA's NEAP development guidance states that the NEAP should be developed by the State in conjunction with the stakeholders affected by the Plan. The Division worked with stakeholders mentioned throughout this document. Numerous meetings and telephone conversations occurred with stakeholders, and the final agreement here reflects strategies offered as part of the NEAP.

Public Review

The Division made this documentation available for, and presented the NEAP to, the public to ensure ample public review and comment. Examples of these efforts, beginning with the earliest community involvement, include:

- "Air Quality Documentation in Support of High Wind Events in Lamar available for Public Review/Comment at the Lamar Public Library…" February 1997
- Briefing of the Prowers County Board of Commissioners, February 1997
- "Media Advisory" notifying the public of upcoming Lamar City Council meeting to discuss the NEAP, January 1998
- Briefing the Lamar City Council, January 1998
- Dissemination of the "Blowing Dust Health Advisory Brochure - Lamar Area" through the Southeast Land and Environment offices, January 1998 through the present
- Briefing of the Colorado Air Quality Control Commission, February 1998
- "Lamar Area Air Quality Natural Events Action Plan to be Available for Public Review" at the Lamar Public Library and Lamar City Complex - February 6 through March 6, 1998" this notice was published in the Lamar Daily News on February 6, 1998
- Briefing of the Lamar City Council on the PM10 Maintenance Plan, including a discussion of the Maintenance Plan's relationship to attainment status and the use of other air quality tools (e.g., Lamar NEAP), August 2000
- "Media Advisory" notifying the public of an upcoming Lamar area meeting to discuss air quality issues. This notice ("Lamar Air Quality Topic of Public Meeting Tonight") was published in the Lamar Daily News, August 29, 2000
- Local meeting with public to discuss air quality issues in the Lamar area including the planned PM10 Maintenance Plan, the area Natural Events Action Plan, and other initiatives to reduce blowing dust and its impacts on the public, August 2000
- Briefing of the Prowers County Board of Commissioners on the PM10 Maintenance Plan including a discussion of the Maintenance Plan's relationship to attainment status and the use of other air quality tools (e.g., Lamar NEAP), August 2000

- Briefing of the Lamar City Council on the Update to the Draft PM10 Maintenance Plan and its relationship to attainment status and the use of other air quality tools (e.g., Lamar NEAP), February 2001

- Briefing of the Lamar City Council on the Update to the Final PM10 Maintenance Plan and its relationship to attainment status and the use of other air quality tools (e.g., Lamar NEAP), August 2001

- Briefing of the Colorado Air Quality Control Commission, May 2002

- Briefing of the Lamar Air Quality Task Force, May 2002

- Briefing of the Colorado Air Quality Control Commission, January 2003

- Public Notice, "Revised (2003) Natural Events Action Plan for Lamar, Colorado" Available for Public Review and Comment at the Lamar Public Library, April 2003

- Briefing the Lamar City Council, April 2003

Periodic Evaluation

EPA's Natural Events Policy guidance requires the state to periodically reevaluate: 1) the conditions causing violations of the PM10 NAAQS in the area, 2) the status of implementation of the NEAP, and 3) the adequacy of the actions being implemented. The State has reevaluated the NEAP for Lamar at the five-year mark and has made appropriate changes to the plan here within. The plan presented here represents the first 5-year revision to the original NEAP dated April 1998.

Evaluation of the effectiveness of the NEAP included several key strategies to ensure protection of public health and a robust plan. Strategies included: review of Natural Events Policy in specific relation to the Lamar community, review of the effectiveness/appropriateness of ongoing control strategies, consideration of new/additional control options, review of meteorological and climatological conditions leading to blowing dust, review of local and regional PM10 monitoring data, discussions with other States (e.g., South Dakota, Washington) and Federal (US EPA) personnel regarding NEAP updates and protocols, use of community surveys, establishment of a area air quality task force, review of the established emission inventory and identification of any new emission sources, review of the blowing dust advisory protocol and notification records, public/stakeholder meetings and community outreach/education efforts, initiation of special studies to better understand possible impacts from certain sources (e.g., feedlots), etc.

The Division commits to continually review the effectiveness of the Lamar Natural Events Action Plan and improve the effort, where feasible.

Submittal to EPA

The original NEAP was submitted to EPA in April 1998. This revised NEAP is submitted according to the Natural Events Policy five-year revision schedule.

This section fulfills the requirement of Elements #6, 7, 8, and 9 as described on page 5.

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1. Natural Events Policy (NEP). EPA, May 30, 1996, p. 1.

2. Soil Survey: Prowers County Colorado. USDA, Soil Conservation Service. April 1966, p. 140.

3. NEP. p. 8.

4. Colorado State PM10 Natural Events Report: Technical Support Document. Colorado Department of Public Health and Environment, Air Pollution Control Division, Technical Services Program. October 6, 1996. p. 14.

5. NEP. p. 9.

6. NEP. p. 5.

7. NEP. p. 5.

8. 1987 Census of Agriculture. Vol. 1: Geographic Area Series, Part 6 Colorado State & County Data. U.S. Dept. Of Commerce: Bureau of Census.