Technical Support Document for the January 19, 2009 Lamar Exceptional Event

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

PM_{10} Standards

In July 1987, EPA promulgated National Ambient Air Quality Standards for Particulates with an aerodynamic diameter of 10 microns or less (PM_{10}). This is a size range that can affect the upper airways and can be inhaled into the alveolar regions of the lungs. The standard has one form, a 24-hour standard of 150 $\mu g/m^3$. The annual arithmetic mean standard of 50 $\mu g/m^3$ was revoked on October 17, 2006. The 24-hour standard is attained when the expected number of exceedances for each calendar year, averaged over three years, is less than or equal to one. The estimated number of exceedances is computed quarterly using available data and adjusting for missing sample days. A data recovery of 75 percent is needed for each calendar quarter to be considered a valid quarter of data. This standard was modified in by EPA in July 1997, but was subsequently nullified back to this form in May 1999.

Event Overview

Elevated 24-hour PM_{10} concentrations of 174 $\mu g/m^3$ at the Lamar Power Plant monitor (100 N. 2nd Avenue) and 173 $\mu g/m^3$ at the Lamar Municipal Building monitor (104 E. Parmenter Street) were recorded on 1/19/2009. The elevated levels at these sites coincided with dry soils across the region and strong north winds creating widespread blowing dust.

The Colorado Department of Public Health and Environment, 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 in Lamar and the exceedances of the National Ambient Air Quality Standard (NAAQS) for PM_{10} at Lamar on 1/19/2009 were caused by a natural event, specifically a regional dust storm. This event meets the criteria outlined by the final "Treatment of Data Influenced by Exceptional Events" Rule (72 FR 13560). This report and the analysis and data contained within it clearly show that this exceptional event passes the four required tests (a) through (d) under 40 CFR 50.14 (3)(iii). These tests are:

(a) The event satisfies the criteria set forth in 40 CFR 50.1(j) which requires that an exceptional event "affects air quality, is not reasonably controllable or preventable..." and that such events are "...natural event[s]".
(b) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area.
(c) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
(d) There would have been no exceedance or violation but for the event.

Attachment A contains a detailed analysis and climatology for blowing dust events at Lamar, Colorado. PM_{10} concentrations for both the Lamar Power Plant and Municipal Building sites for January of 2004 through March 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 PM_{10} 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 proves 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 PM_{10} 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 PM_{10} exceedances occur on less than 1% of the days in the record. *Attachment A 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.

Data and analyses in this report show that 30-day precipitation was generally 0.6 inches or lower in the source region for the dust, surface winds of 30 to 40 mph with gusts of 35 to 60 mph were widespread in the source area, the concentrations measured at both monitors exceeded the historical 99th percentile level for these sites, and conservative estimates of the contribution of the dust storm to measured PM_{10} generally exceed 80% of the total. But for the high winds over dry soils, these measured 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 (from Attachment A). The first is the Lamar PM_{10} Non-attainment Area (NAA) and Prowers County. *Blowing dust sources within the NAA and Prowers County have been reasonably controlled, as demonstrated by the PM_{10} 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. The third source area to the south and southwest of Colorado did not contribute to PM_{10} on January 19, 2009, because of the northerly winds during the event.

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 January 19, 2009, dust storm imagery and data show that large amounts of dust moved toward Lamar from a swath of eastern Colorado and portions of Wyoming and Nebraska. Aside from the soil conservation programs in effect, the dust from this region during this extreme high-wind, dry-soils event was not reasonably controllable.

2.0 Meteorological Analysis of the January 19, 2009, Blowing Dust Event

On Monday January 19, 2009, Lamar, Colorado, recorded exceedances of the twenty-four-hour PM_{10} standard with a concentration of 174 $\mu g/m^3$ at the Lamar Power Plant monitor and 173 $\mu g/m^3$ at the Lamar Municipal Building monitor. These exceedances can be seen in Figure 1, High PM_{10} Natural Event in Colorado, January 19, 2009. These exceedances were the consequence of strong northerly winds in combination with dry soil 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. The surface analysis for 12Z January 19 (5 AM MST January 19) presented in Figure 2 shows the 1048 millibar high pressure system covering the western U.S. and a series of low pressure systems and associated fronts over the eastern U.S. The surface analysis for 00Z January 20, 2009, (5 PM MST January 19) in Figure 3 shows that the low pressure systems over the eastern U.S. had moved further east and the tight pressure gradient had moved further to the east.

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 4 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 5 the 700 millibar analysis for 00Z January 20, 2009, (5 PM MST January 19) continued to show 40 to 50 knot winds over eastern Colorado and western Nebraska.

The January 20, 2009, 00Z (5 PM MST January 19) soundings at Denver and Goodland, Kansas, in Figures 6 and 7, respectively, show good vertical mixing to near 700 millibars. These two soundings bracket the area that experienced the strong gusty surface winds on January 19, 2009. Vertical mixing would have brought the strong winds in the 700-millibar speed maximum down to the surface. The combination of the mixing and the tight surface pressure gradient caused sustained 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. Sustained 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* and Attachment A). Figures 2 through 7 show that the conditions necessary for strong gusty winds were in place over the area of concern for the daytime hours of January 19, 2009.

Figures 8 and 9 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, sustained 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* and Attachment A).

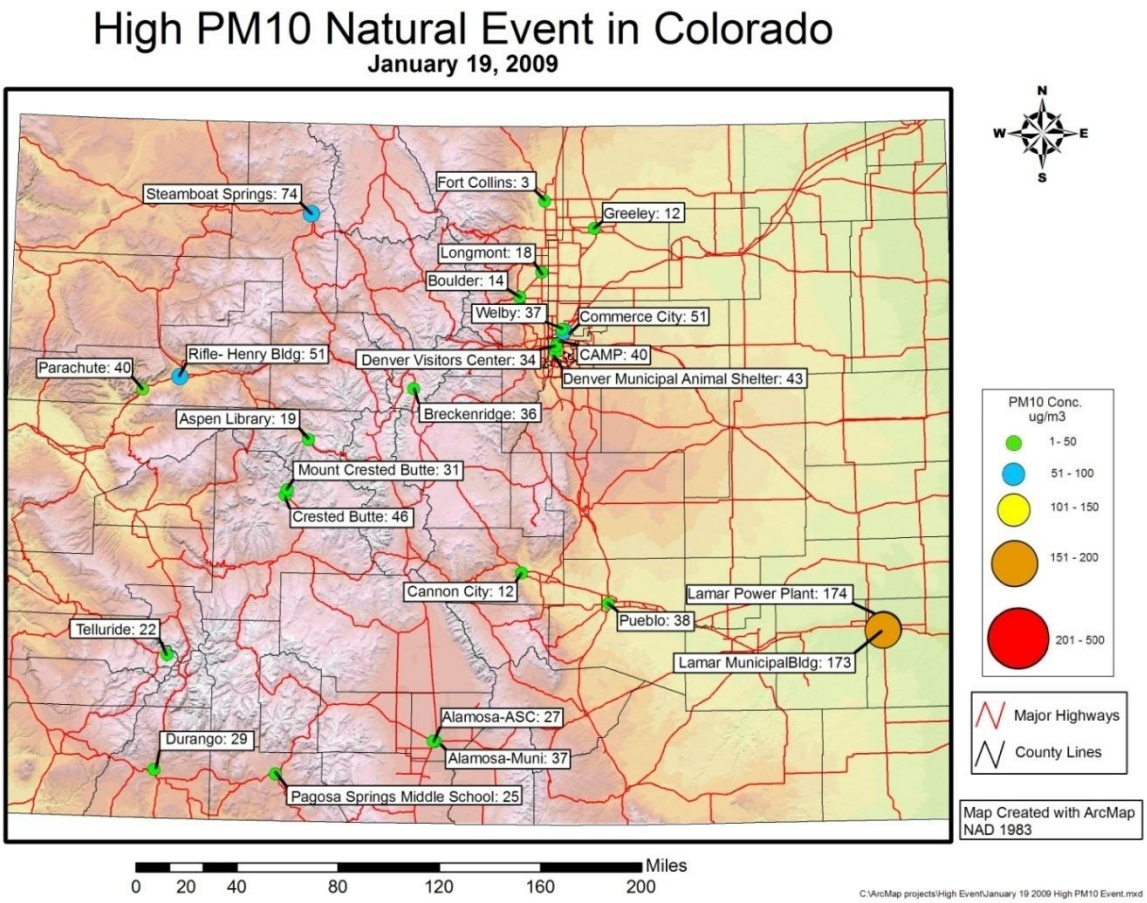


Figure 1. 24-hour PM_{10} readings for January 19, 2009.

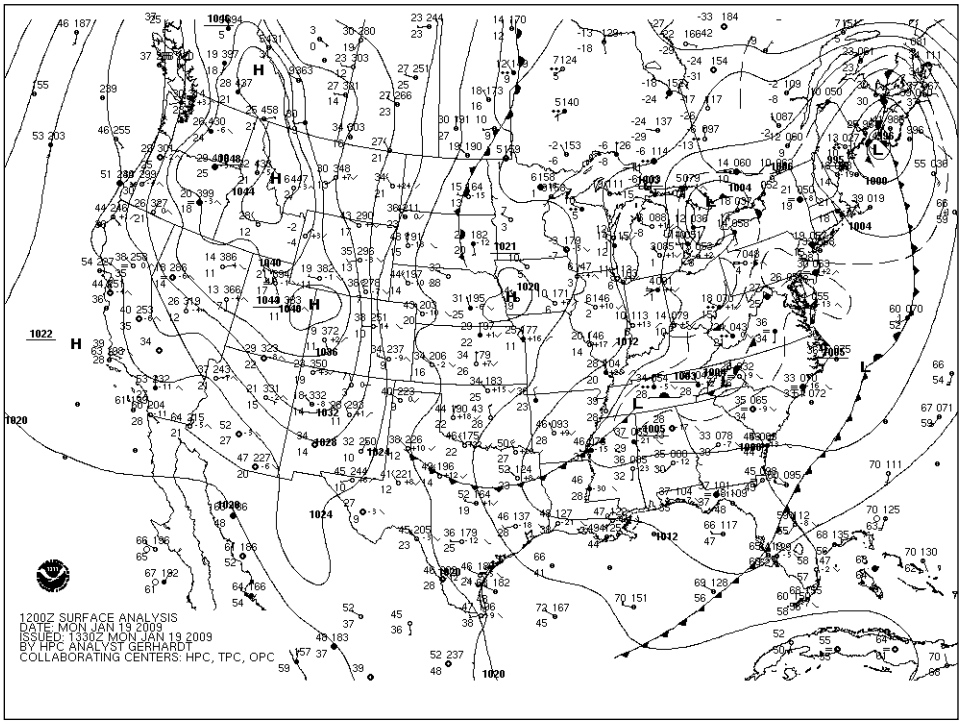


Figure 2. Surface analysis for 12Z January 19, 2009, or 5 AM MST January 19, 2009, (from National Weather Service fax maps: http://archive.atmos.colostate.edu/).

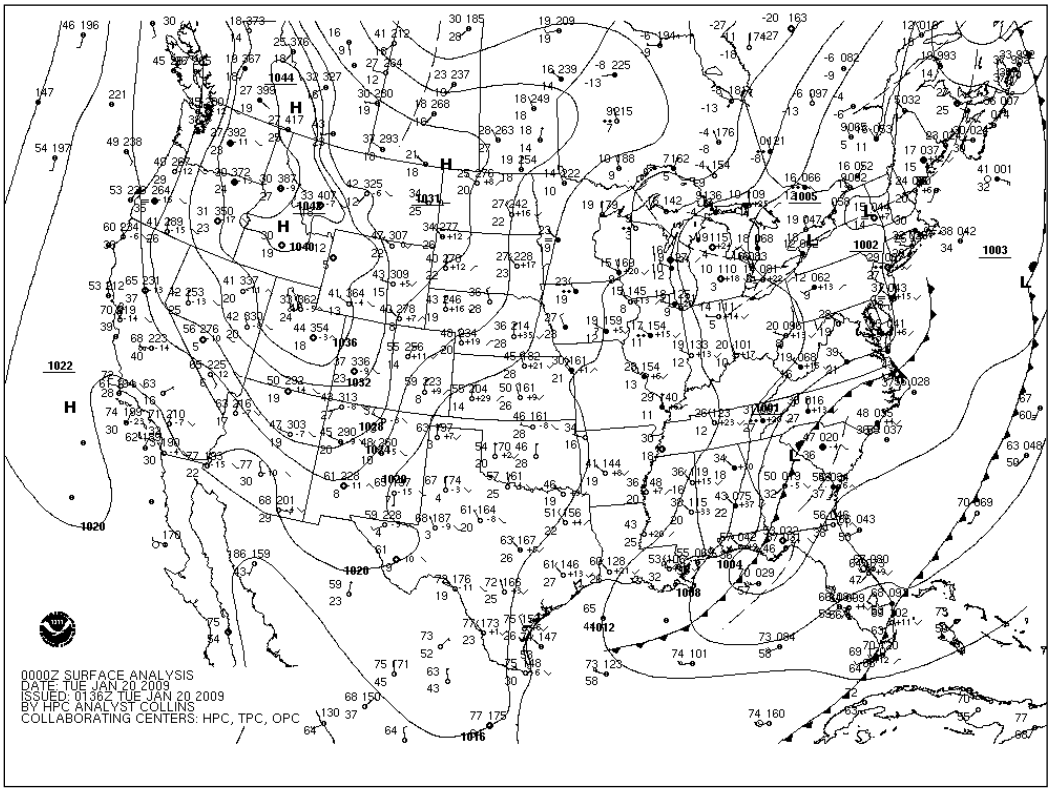


Figure 3. Surface analysis for 00Z January 20, 2009, or 5 PM MST January 19, 2009, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

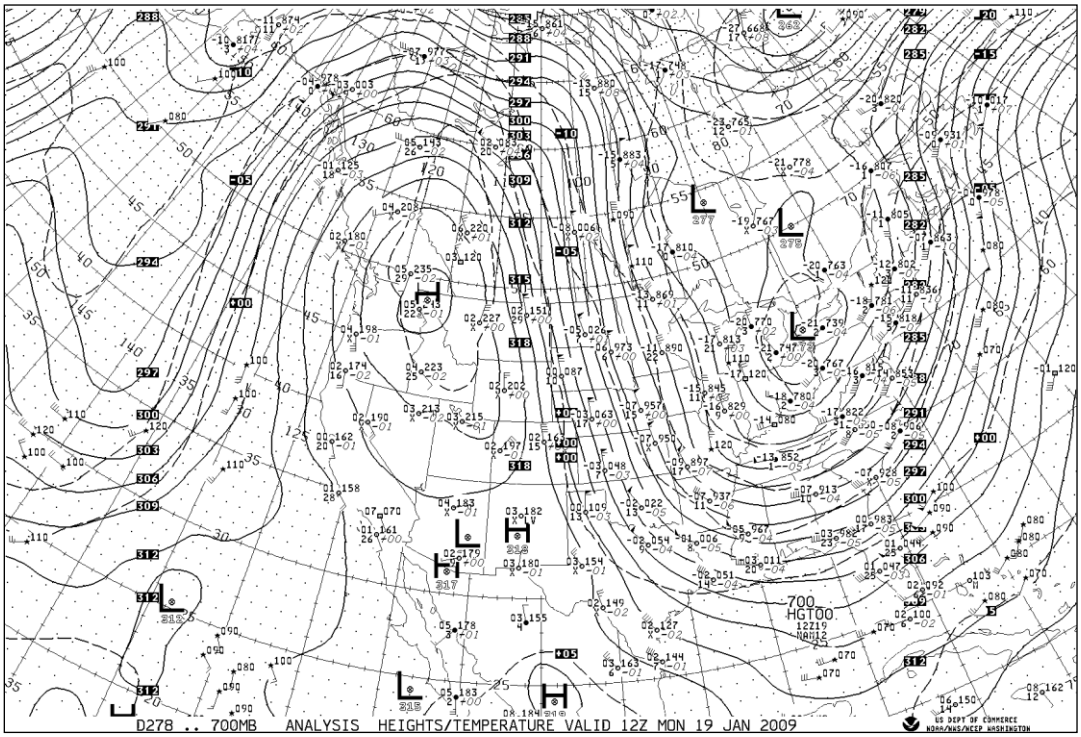


Figure 4. 700 millibar analysis for 12Z January 19, 2009, or 5 AM MST January 19, 2009, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

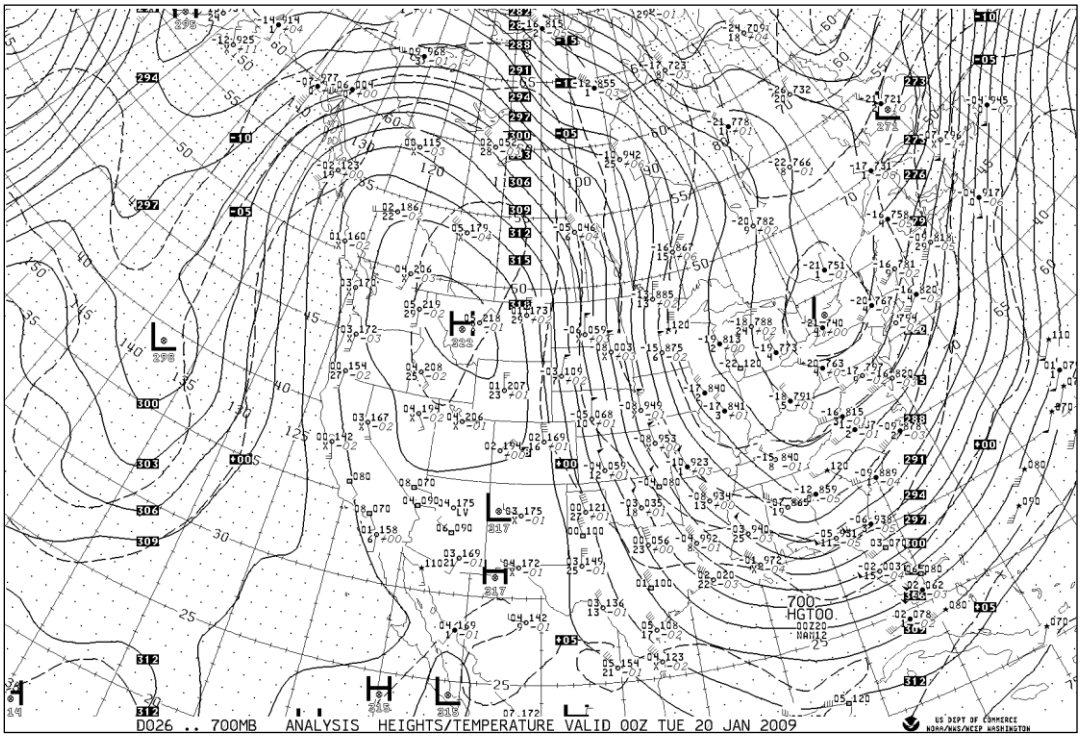


Figure 5. 700 millibar analysis for 00Z January 20, 2009, or 5 PM MST January 19, 2009, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

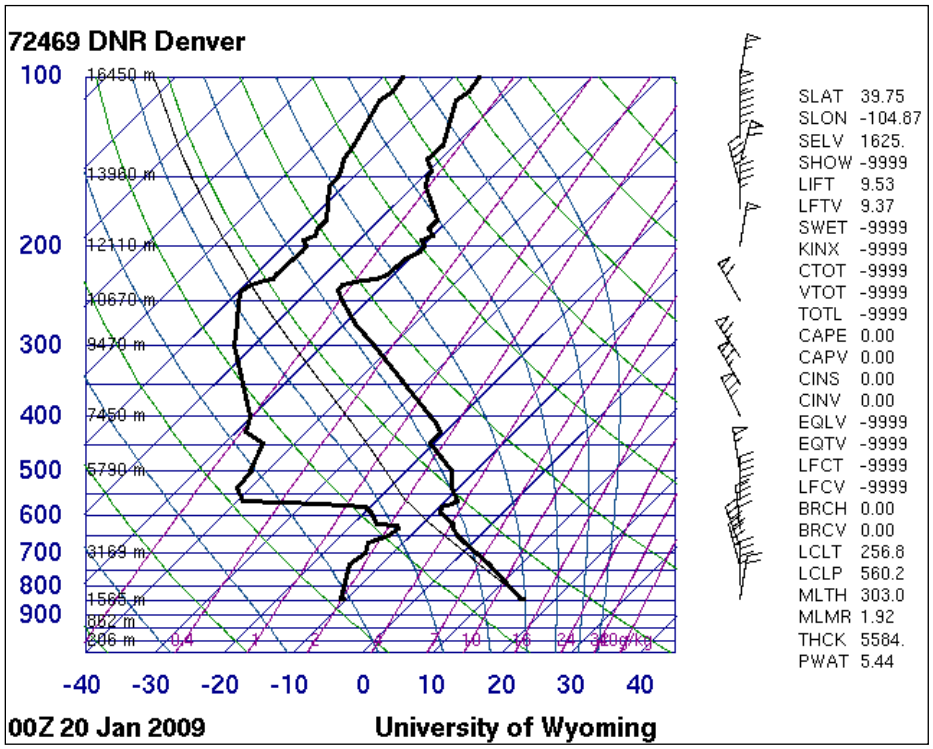


Figure 6. Denver sounding analysis for 00Z January 20, 2009, or 5 PM MST January 19, 2009, (from the University of Wyoming's archive of National Weather Service soundings: http://weather.uwyo.edu/upperair/sounding.html).

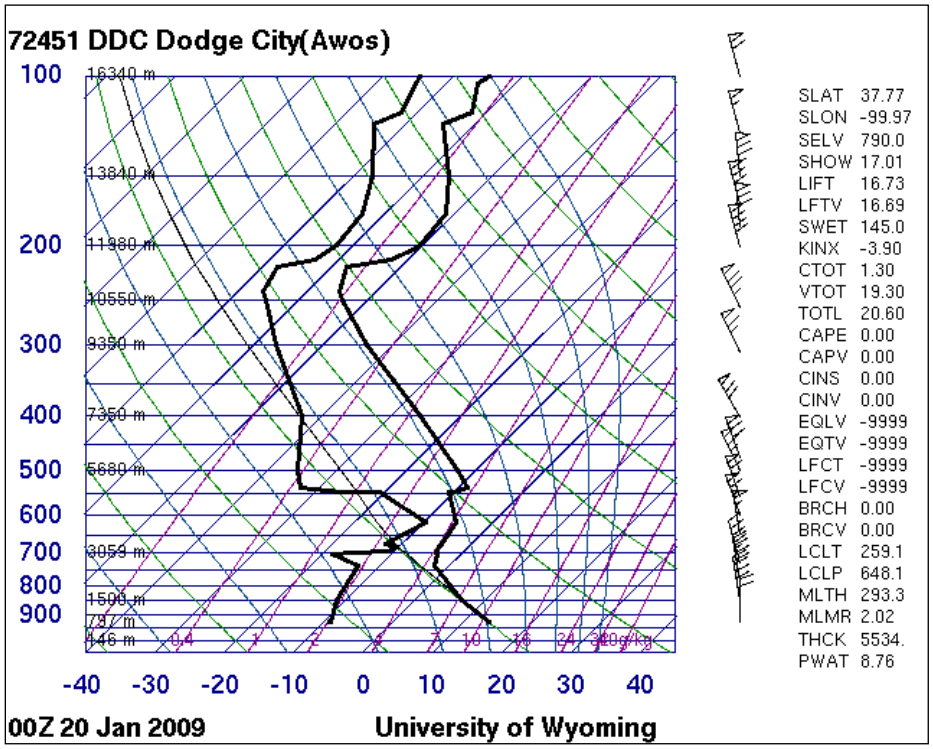


Figure 7. Dodge City sounding analysis for 00Z January 20, 2009, or 5 PM MST January 19, 2009, (from the University of Wyoming's archive of National Weather Service soundings: http://weather.uwyo.edu/upperair/sounding.html).

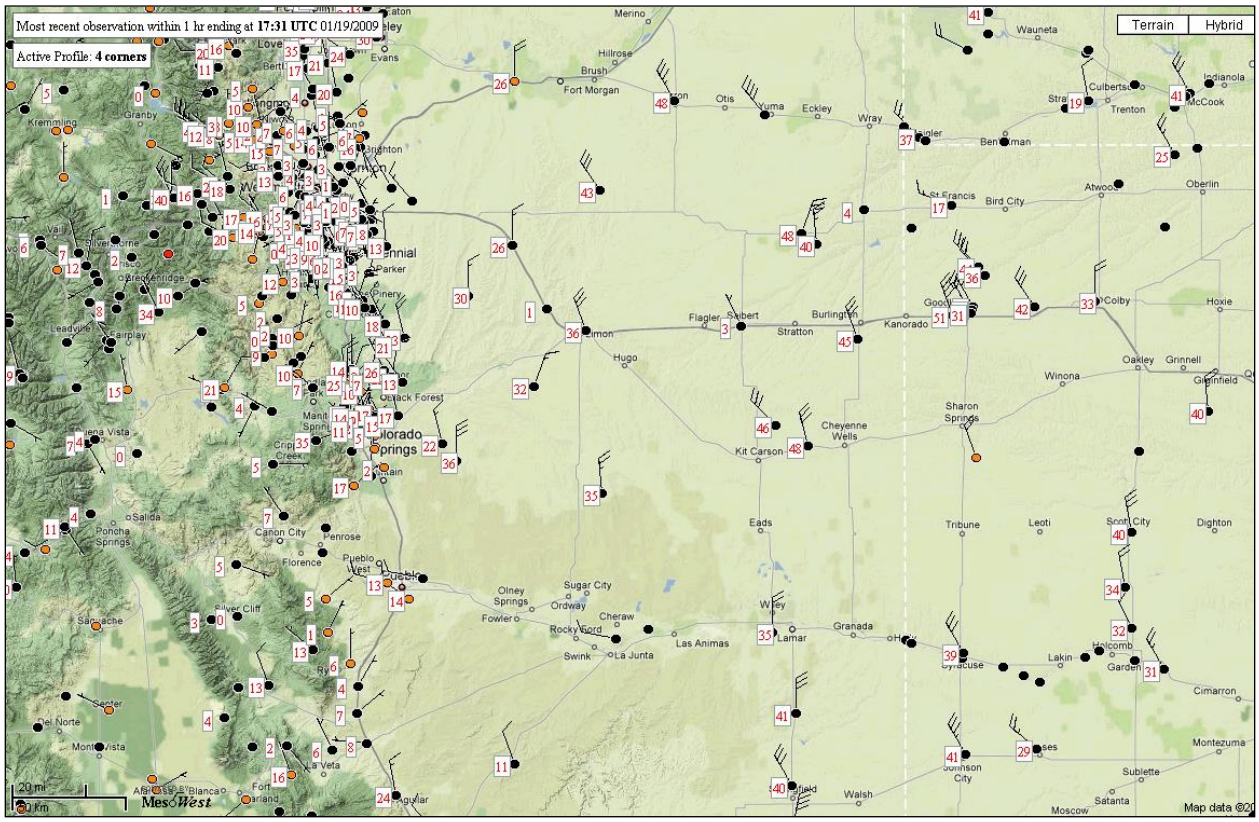


Figure 8. Wind directions and gust speeds in eastern Colorado and western Kansas 17:31 UTC January 19, 2009 (10:31 AM MST on January 19, 2009) (http://www.met.utah.edu/mesowest/).

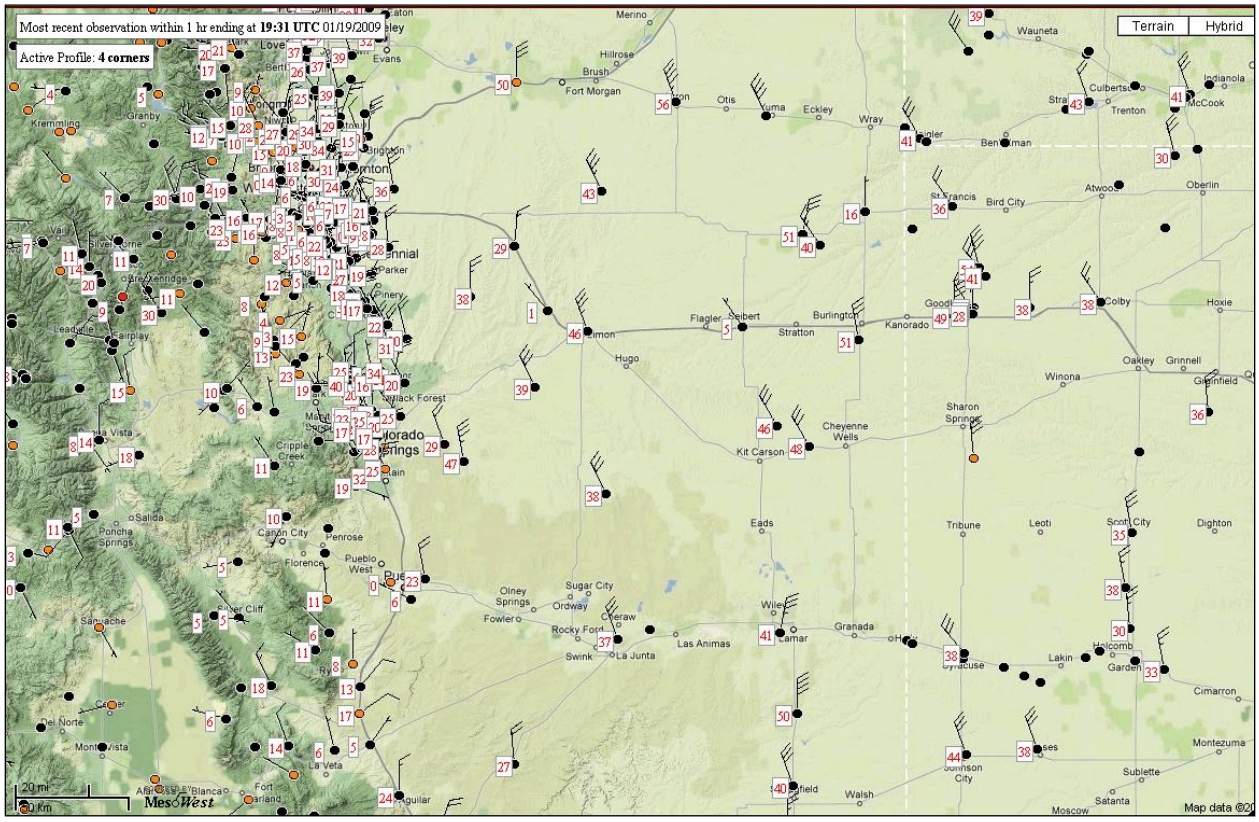


Figure 9. Wind directions and gust speeds in eastern Colorado and western Kansas 19:31 UTC January 19, 2009 (12:31 PM MST on January 19, 2009) (http://www.met.utah.edu/mesowest/).

Figure 10 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 11. Figure 11 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 12 shows that most of eastern Colorado had less than one inch of total precipitation in the three months of November 2008 through January 2009. Taken together, Figures 13 and 14 show that much of eastern and southeastern Colorado had less than 0.6 inches of precipitation from December 1 through January 31. This precipitation amount is an approximate threshold below which blowing dust exceedances at Lamar are more likely to occur (see Attachment A). Figure 15, shows that Powers County (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 1 through 4 show the National Weather Service observations for the eastern Colorado sites of Akron (about 140 miles north northwest of Lamar), Burlington (about 85 miles north northeast of Lamar), Limon (about 100 miles northwest of Lamar), and Lamar. National Weather Service fire weather watches and Red Flag warnings for the area for January 19 are also shown in Attachment C. The observations show that winds in excess of the thresholds identified for elevated PM10 in blowing dust (Attachment A and *Natural Events Action Plan for High Wind Events – Lamar, Colorado*) occurred across the area. The text of the watches and warnings show that high winds were expected. Sustained 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 in Figure 15. 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.*

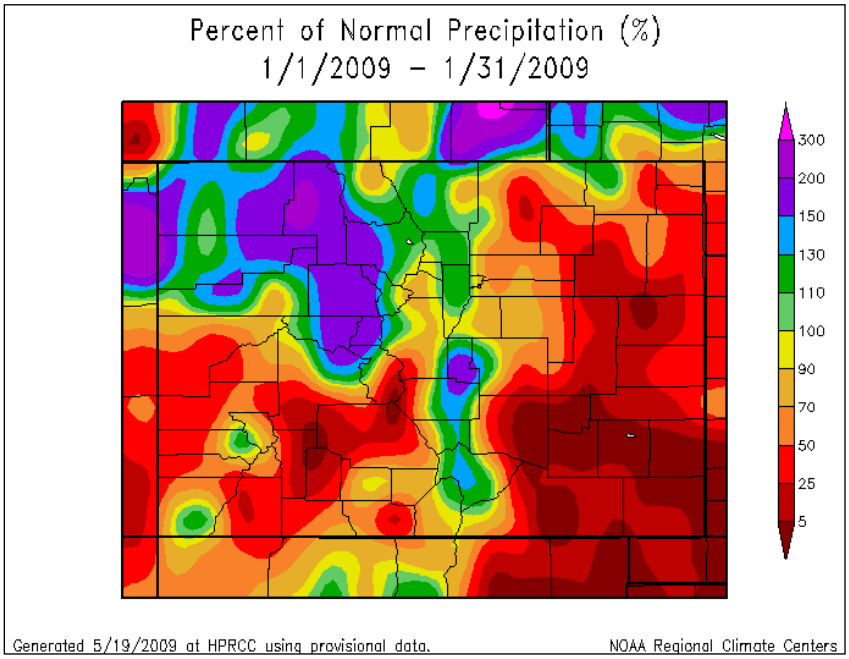


Figure 10. Percent of Normal Precipitation for January 2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_userdate&daterange=Jan&year=09).

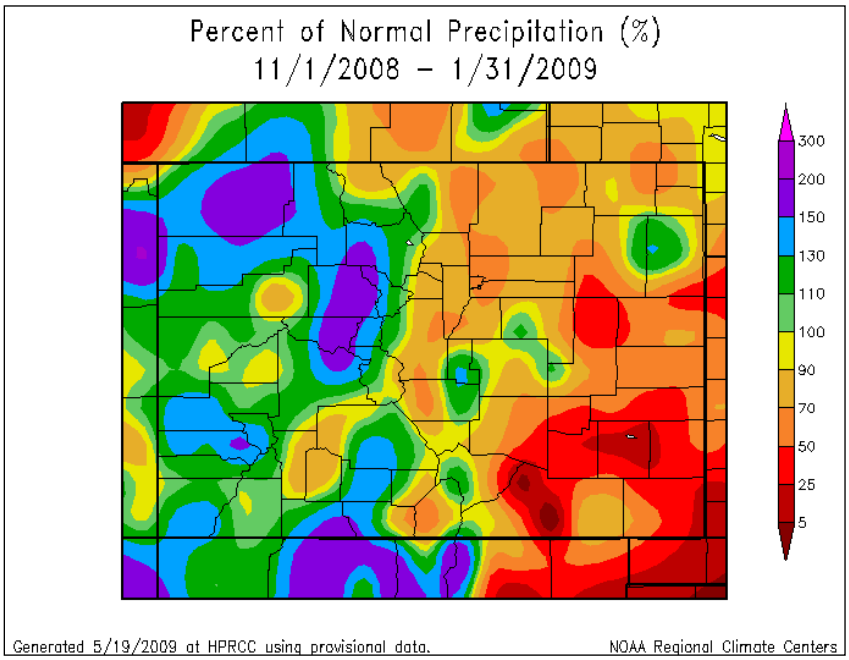


Figure 11. Percent of Normal Precipitation for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm).

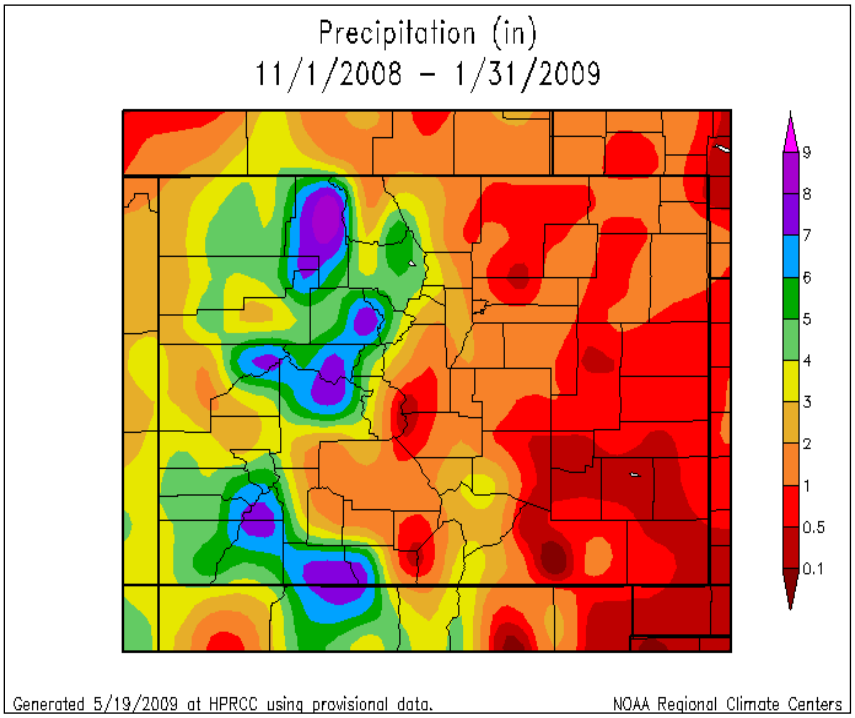


Figure 12. Precipitation in inches for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm).

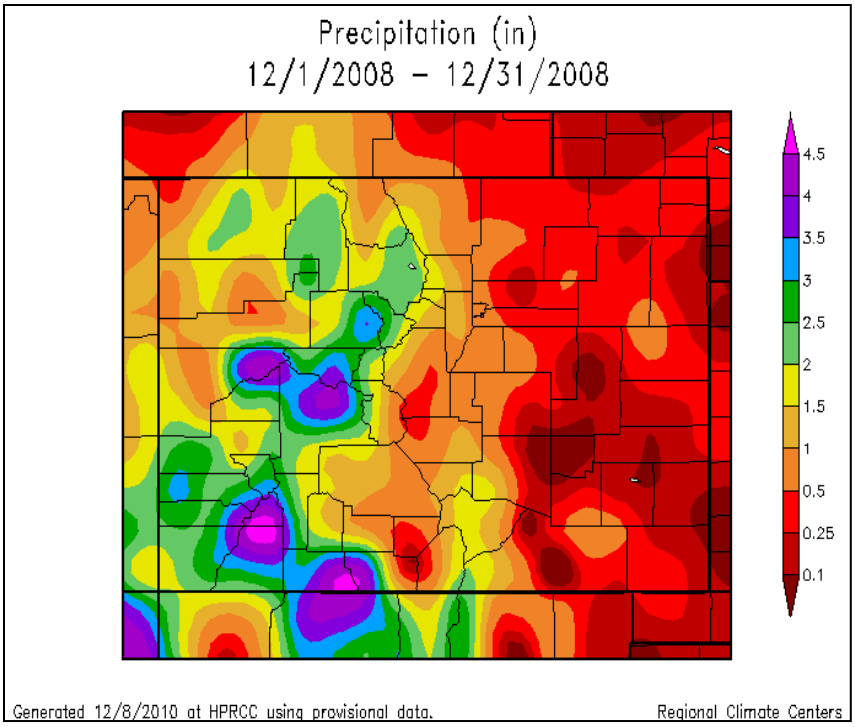


Figure 13. Precipitation in inches for 12/1/2008 – 12/31/2008, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm).

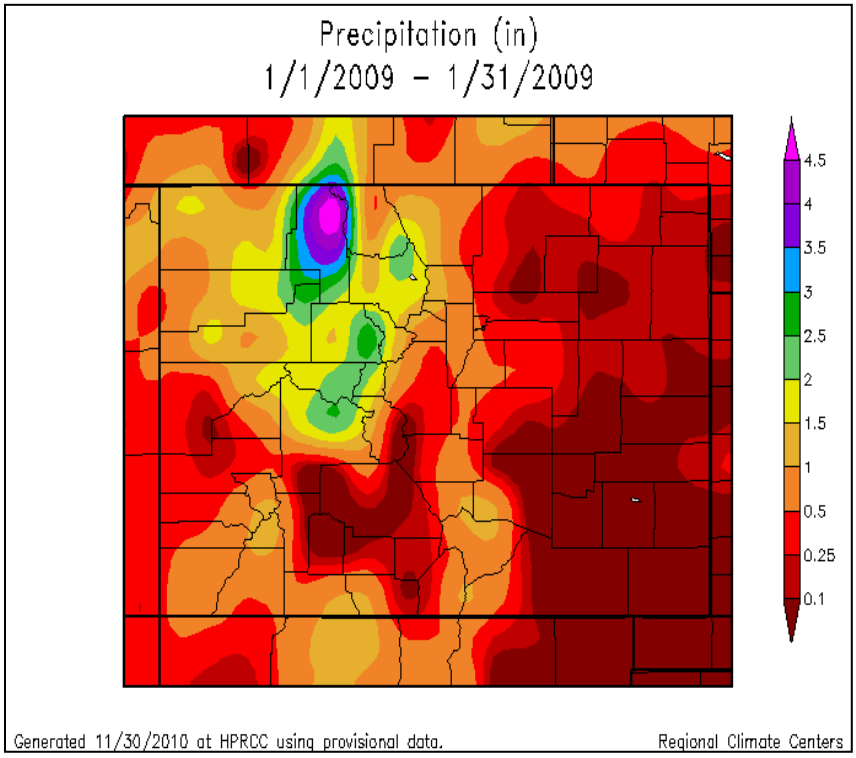


Figure 14. Precipitation in inches for 1/1/2009 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm).

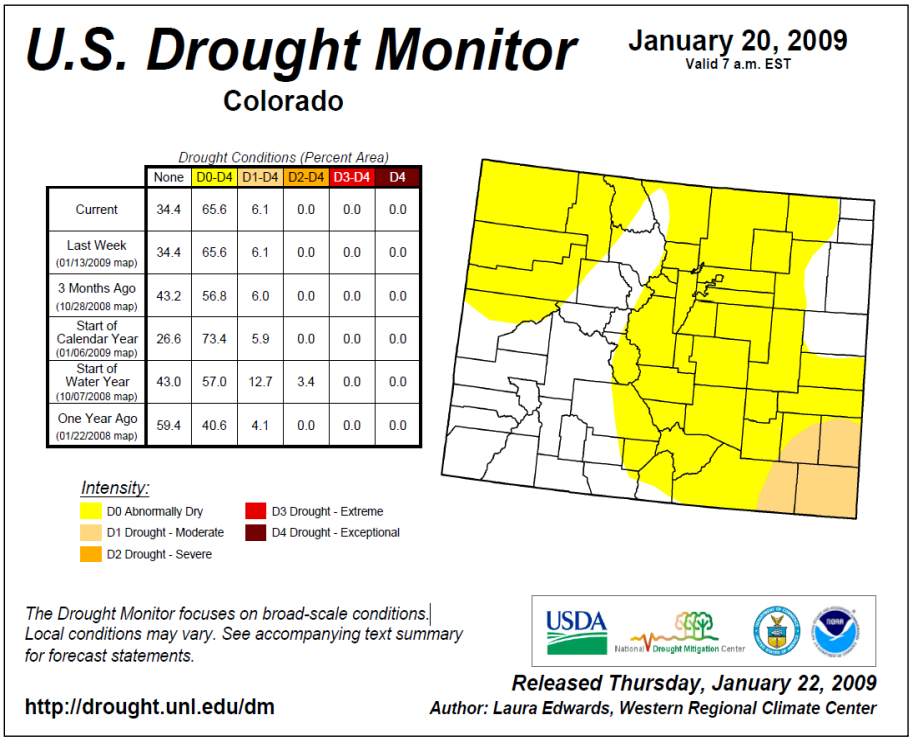


Figure 15. Drought status for Colorado on January 20, 2009 (source: the USDA, NOAA, and the National Drought Mitigation Center at: http://drought.unl.edu/dm/archive.html).

Table 1. Wind and weather observations for Akron, reported by the University of Utah MesoWest site for January 19, 2009 (http://www.met.utah.edu/mesowest/). 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 2. Wind and weather observations for Burlington, Colorado, reported by the University of Utah MesoWest site for January 19, 2009 (http://www.met.utah.edu/mesowest/). 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 3. Wind and weather observations for Limon, reported by the University of Utah MesoWest site for January 19, 2009 (http://www.met.utah.edu/mesowest/). Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

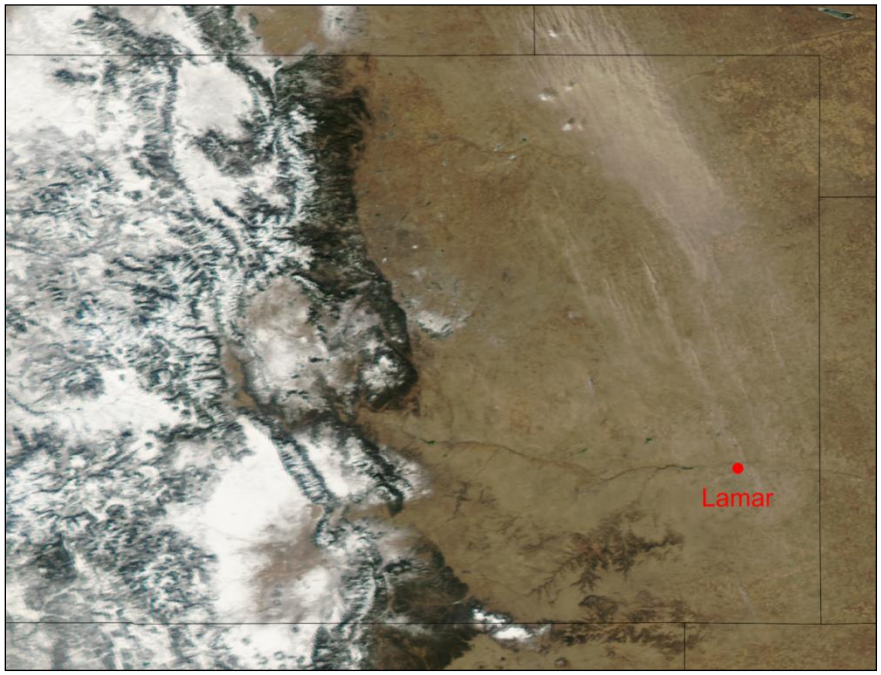
Time in MST January 19	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
23:55	36	32	14		340	clear	10
22:55	39.9	26	23	32	340	clear	10
21:55	39.9	26	20		330	clear	10
20:55	41	24	18		330	clear	10
19:55	44.1	20	24	36	340	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 4. Wind and weather observations for Lamar, Colorado, reported by the University of Utah MesoWest site for January 19, 2009 (http://www.met.utah.edu/mesowest/). Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

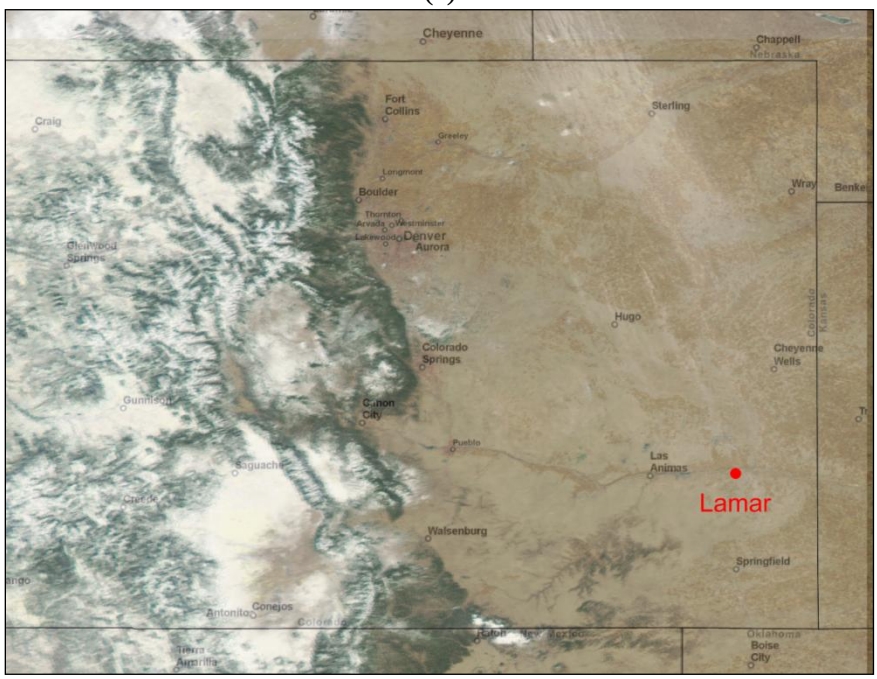
Time in MST January 19	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
23:53	30	48	7		340	clear	10
22:53	33.1	43	7		350	clear	10
21:53	37	37	7		20	clear	10
20:53	41	33	9		20	clear	9
19:53	43	30	10		10	clear	8
18:53	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 16 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 widespread over the next couple of hours. These figures show a clear causal relationship between a regional dust storm and the exceedance concentrations in Lamar. Figure 17 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. Again, this shows a clear causal relationship between the dust in the source region and Lamar PM10 concentrations. Figure 18 presents forecast dust PM_{10} concentrations from the Navy's NAAPS aerosol forecast model (http://www.nrlmry.navy.mil/aerosol/). The high concentrations of dust forecast for the area, the timing of dust cloud development, and the movement of dust from north to south are also consistent with the MODIS imagery, HYSPLIT output, and surface observations during the event.



(a)



(b)

Figure 16. (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).

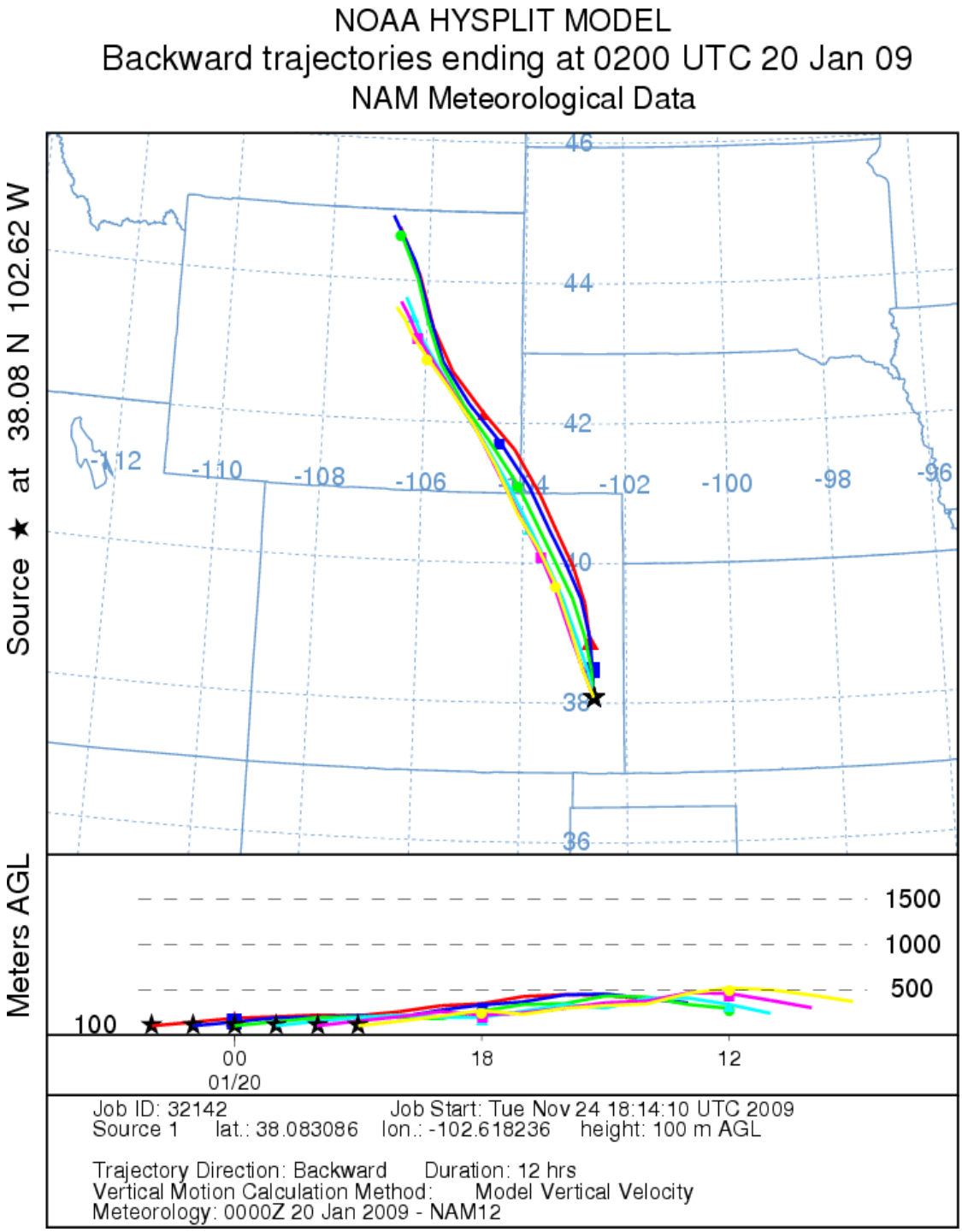


Figure 17. NOAA HYSPLIT 12-hour back trajectory plots for each hour during the windiest period on January 19, 2009. The HYSPLIT model run was based on data from the high-resolution 12-kilometer grid spacing NAM numerical weather model.

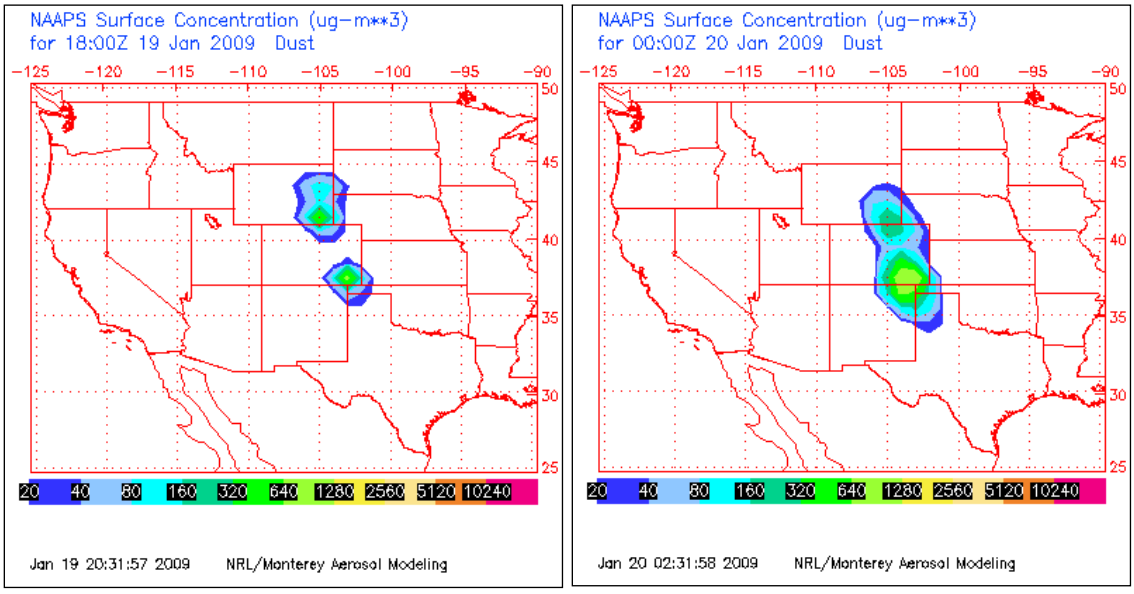


Figure 18. Forecast dust storm PM_{10} concentrations for 1100 MST (left) and 1800 MST (right) on January 19, 2009, from the archives of the U.S. Navy NAAPS global aerosol forecast model (http://www.nrlmry.navy.mil/aerosol/).

The NAAPS model output is based on actual soil moisture content, soil erodibility factors, and modeled meteorological factors conducive to blowing dust (for a description of NAAPS see: http://www.nrlmry.navy.mil/aerosol_web/Docs/globaer_model.html). Consequently, NAAPS forecast products provide an independent calculation of the potential for blowing dust and the spatial extent of blowing dust for this event. All of the products discussed here point to a widespread, regional-scale dust storm that originated in areas extending far beyond the PM_{10} nonattainment area boundaries for Lamar.

Attachment B contains the text of a satellite analysis of smoke, dust, and aerosols provided by satellite image analysis experts at the NOAA NESDIS Satellite and Information Service (http://www.ssd.noaa.gov/PS/FIRE/smoke.html). The smoke text product for smoke and dust observed in satellite imagery through 0030Z January 20, 2009, (1730 MST January 19, 2009) describes an area of blowing dust that originated in northeast Colorado and western Nebraska and moved southward over eastern Colorado. Note that this product is describing the blowing dust cloud eight hours after the winds across eastern Colorado had subsided below levels strong enough to cause additional blowing dust. Section 4.0 contains the text of Denver Post and 9NEWS articles describing the blowing dust that caused accidents along I-70 in eastern Colorado. These written accounts and the accompanying photographs of the dust storm and its impacts provide clear evidence that the event was regional in nature and originated well to the north of the Lamar nonattainment area.

The PM_{10} exceedances at Lamar on January 19, 2009, would not have occurred if not for the following: (a) dry soil conditions over eastern Colorado, southeastern Wyoming, and southwestern Nebraska; and (b) the tight surface pressure gradient and strong upper level winds mixing to the surface that lead to strong gusty surface winds over eastern Colorado, western Kansas, and western Nebraska. Clearly the PM_{10} exceedances at Lamar are due to an exceptional event associated with regional windstorm-caused emissions from erodible soil sources over a large area of eastern Colorado and western Nebraska, and these sources are not reasonably controllable during a significant regional windstorm under abnormally dry or moderate drought conditions.

3.0 Ambient Monitoring Data and Statistics

PM_{10} concentrations that exceeded the level of the NAAQS were monitored in Lamar, Colorado on Monday January 19, 2009. The recorded exceedances of the twenty-four-hour PM_{10} standard include concentrations of 174 µg/m3 at the Lamar Power Plant monitor and 173 µg/m3 at the Lamar Municipal Building monitor. Monitored PM_{10} levels before and after the January 19 episode were low with the exception of one moderate concentration at the Lamar Power Plant of 97 ug/m^3 on January 9th, as can be seen in Figure 19.

The APCD reviewed PM_{10} monitoring data in Lamar and the surrounding area for the January 19, 2009 exceptional event. The PM_{10} concentrations in Lamar on January 19, 2009 were compared to the day before and the day after the regional dust storm. The days before and after the event were very low with typical concentrations for winter in Lamar (see Table 5 and the Historical Fluctuations of PM_{10} Concentrations in Lamar section). Unfortunately, there are no PM_{10} sampling sites in the area of the dust plume in eastern Colorado other than those in Lamar. The nearest site would be Pueblo, to the west, and it only recorded 38 µg/m^3 on January 19. All other Colorado sites recorded concentrations between 12 µg/m^3 and 74 µg/m^3 on January 19th.

Table 5. Lamar PM_{10} Concentrations Before and After Jan. 19, 2009 Regional Dust Storm.

Date	Lamar Power Plant	Lamar Municipal Bldg.
01/18/2009	21 µg/m^3	12 µg/m^3
01/19/2009	174 µg/m^3	173 µg/m^3
01/20/2009	25 µg/m^3	15 µg/m^3

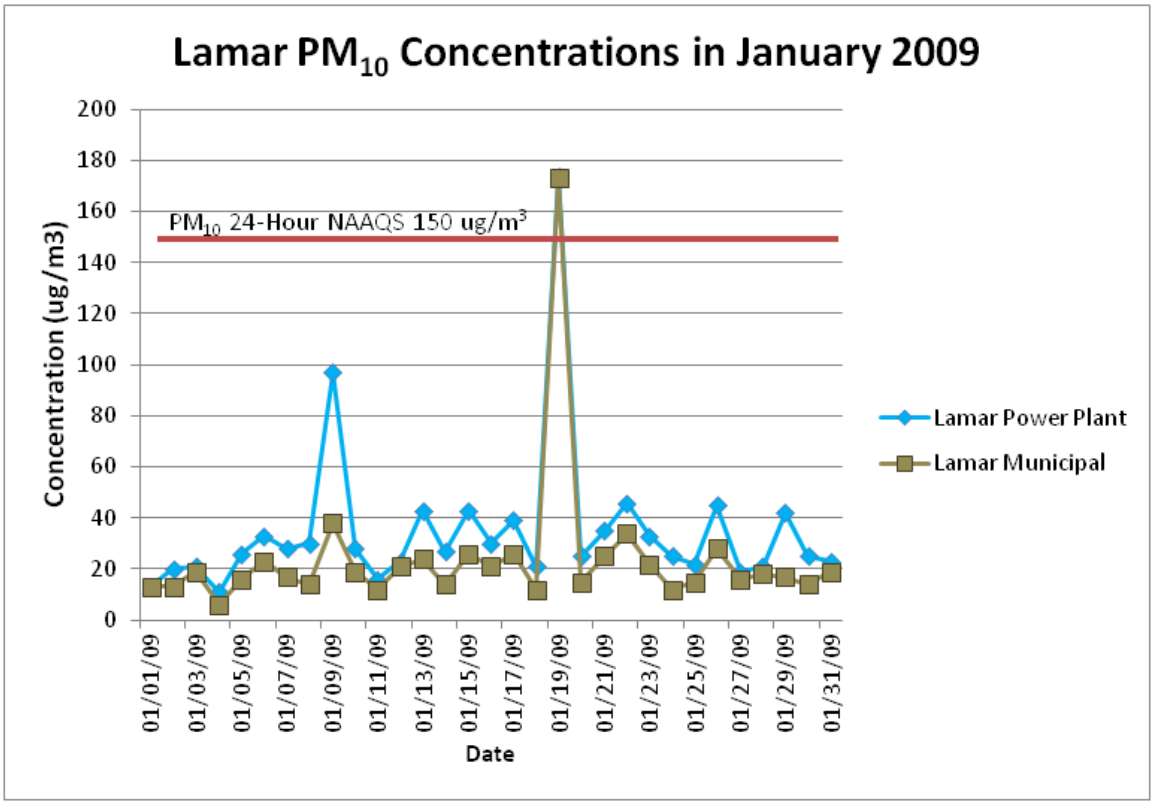


Figure 19. Lamar PM_{10} Concentrations in January 2009.

The PM_{10} data before and after the event and the data for the month of January demonstrate that this particular blowing dust event occurred only on January 19, and it caused PM_{10} concentrations that were much higher than normal for January 2009. In other words concentrations of 173 and 174 ug/m^3 were much higher than surrounding days. A full statistical analysis of the monitoring data and a "but for" test is presented in the Historical Fluctuations of PM_{10} Concentrations in Lamar section below.

Historical Fluctuations of PM_{10} Concentrations in Lamar

This historical fluctuation evaluation of PM_{10} monitoring data for Lamar was made using valid samples from both Lamar monitoring sites (AQS identification numbers 08-099-0001 and 08-099-0002 for the Lamar Power Plant and Lamar Municipal Building sites, respectively); both sites fell within the spatial extent of the event on January 19, 2009. It was decided to use only data from approved federal reference method (FRM) samplers. This restriction excluded data prior to 1988. Additionally, only years with complete data (>75% valid data capture per calendar quarter) were used, further restricting the data sets, yet retaining enough data to completely characterize each site. Both summaries are presented in Table 6.

Table 6. Lamar Historical PM_{10} Monitoring Data Summary

	Lamar Power Plant	**Lamar Municipal**
AQS ID	08-099-0001	08-099-0002
Date Range	1992 - 2010	1988 - 2010
01/19/2009 Conc.	174 ug/m^3	173 ug/m^3
1 Q (25^{th} %)	15 ug/m^3	13 ug/m^3
Median	23 ug/m^3	19 ug/m^3
3 Q (75^{th} %)	33 ug/m^3	27 ug/m^3
Count	5968	6597
Standard Deviation	19.9 ug/m^3	14.7 ug/m^3
Mean	27.1 ug/m^3	21.8 ug/m^3

Additionally, the data sets were summarized by month. These summaries (see Figures 21-22) present no obvious season. While the monthly median values for both sites vary slightly and are generally higher during summer months there is little difference in monthly median values for either site. The monthly maximum values for both sites through the winter and spring months stand in contrast to the slightly lower than normal monthly medians for this same interval. This time frame (winter and spring) is that which is most likely to experience the meteorological and dry conditions exhibited during this event and discussed elsewhere in this document. The lack of variability between monthly medians suggests that typical data exhibiting regular variation are those in the inter-quartile range (i.e. between the 75^{th} and 25^{th} percentile). If a conservative approach is taken then a monthly background value should be no higher than the historic monthly 75^{th} percentile value.

Lamar Power Plant

The PM_{10} sample on January 19, 2009, at Lamar Power of 174 µg/m^3 was 9.1 times the historical January median of 19 µg/m^3, 7.4 times the 2009 annual average of 23.4 µg/m^3, and 6.2 times January's historic 75^{th} percentile value of 28µg/m^3. This value is 7.4 sample standard deviations (s = 19.9 µg/m^3) beyond the sample mean (27.1 µg/m^3). Overall, this sample is the second highest sample in 2009, the second highest of any sample in any January, and exceeds the 99^{th} percentile sample value for this site for all samples. There are 5968 samples in this dataset. The sample of January 19, 2009, clearly exceeds the typical samples at this site.

The following three plots graphically characterize the Lamar Power PM_{10} data. The first plot, Figure 20, is the overall frequency histogram. The histogram is positively skewed as the density function exhibits a long right tail and the overall mean of 27.1µg/m^3 is equal to the 63rd percentile (i.e. the mean is greater than the median).

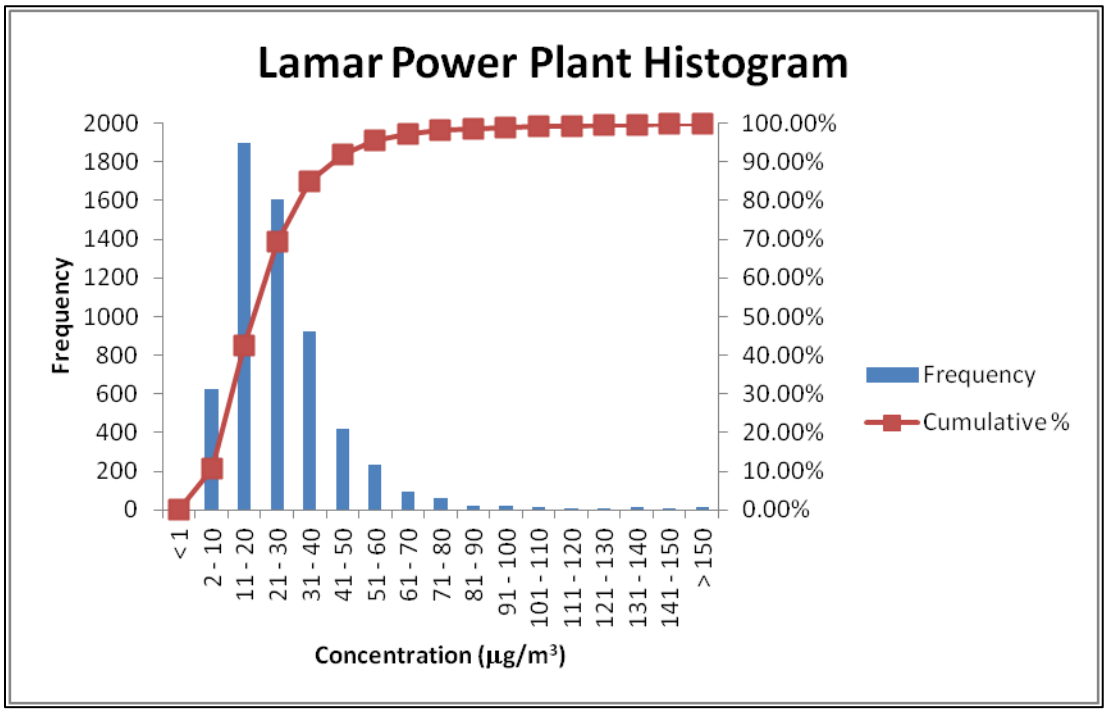


Figure 20. Lamar Power Plant PM_{10} Histogram, 1992 - 2010.

The monthly percentile plot, Figure 21, highlights the consistency of the majority of data from month to month. Note the slight decrease in the median monthly values through the early months that's accompanied by typically greater monthly maxima. This time period experiences a greater number of days with meteorological conditions similar to those experienced on January 19, 2009. Only one month (April) experienced a 99th percentile value greater than 135 µg/m^3 (the value is 136 g/m^3). Two months (April and May) have a 90th percentile value greater than 50 µg/m^3 (54 µg/m^3 and 50 µg/m^3, respectively). Of the 5968 of samples in this dataset there are only 13 greater than the sample of January 19, 2009.

The last plot, Figure 22, is the monthly Box Plot (with outliers) of the Lamar Power data. This box plot is included to demonstrate the narrow range of typical values (the inter-quartile range) for this site and to show the extent beyond the normal range the event value lies. Every sample in the box plot greater than 150 µg/m^3 is associated with a high wind event similar to this event.

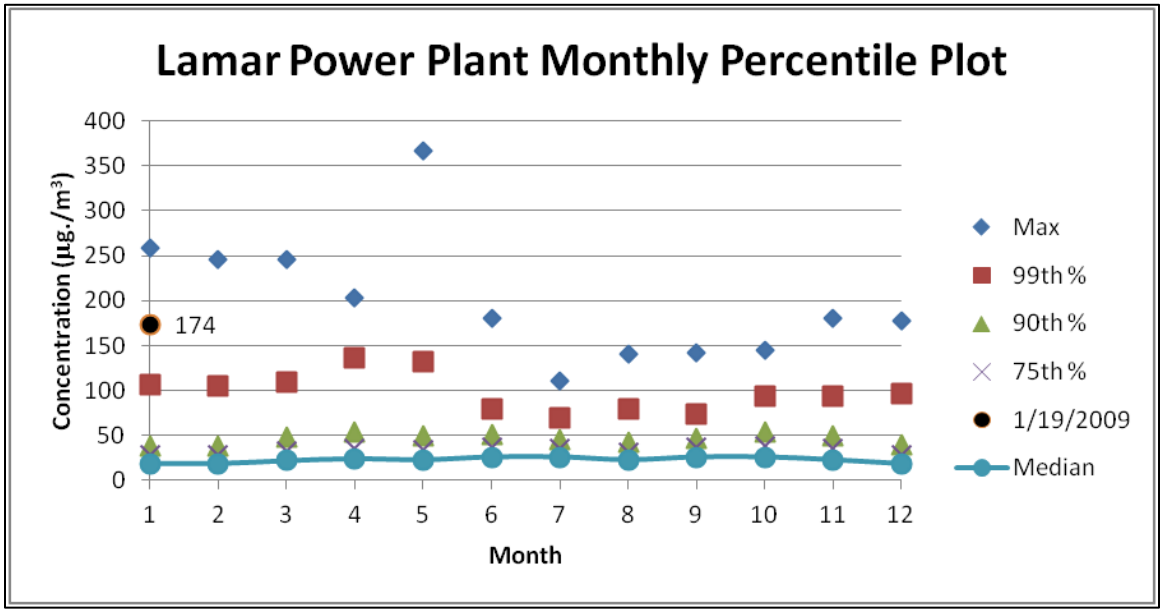


Figure 21. Lamar Power Plant PM_{10} Percentile Plot, 1992 - 2010.

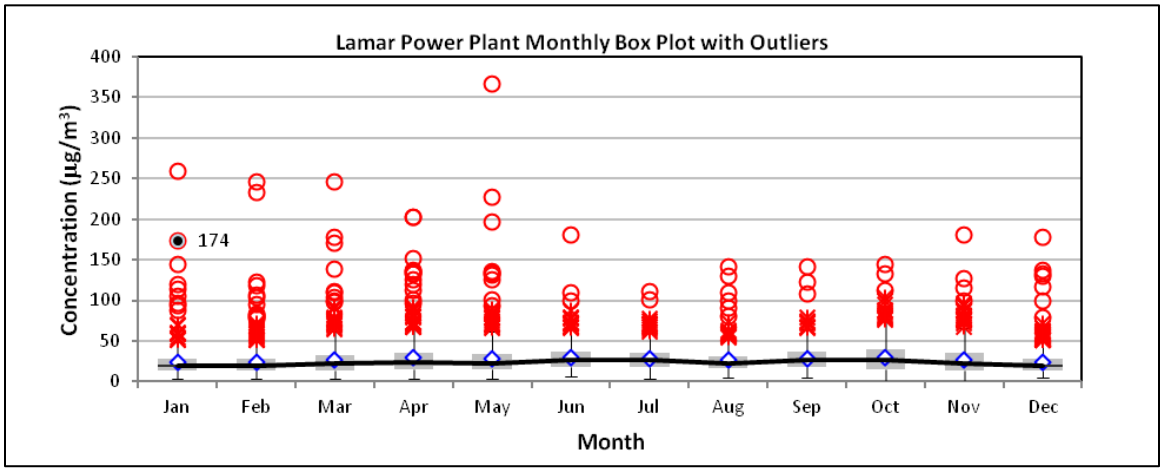


Figure 22. Lamar Power Plant PM_{10} Box Plot, 1992 - 2010.

No Exceedance But For the Event

An estimation of PM_{10} due to the event is presented here and in Table 7. Based on the entirety of data in the Historical Summary (including multiple high wind events), a conservative estimate of the 'typical' values in January would have been between 33 and 30 µg/m^3 and 24 and 31 µg/m^3 (corresponding to the 75th and 84th Percentile values) for Lamar Power and Lamar Municipal Building, respectively. Using these conservative values as 'typical' would indicate that the event provided an additional 135 – 141 µg/m^3 and 142 – 149 µg/m^3 for Lamar Power Plant and Lamar Municipal Building, respectively.

Table 7. Typical PM_{10} Values.

Site	Event Day Concentration ($\mu g/m^3$)	Jan. Median ($\mu g/m^3$)	Jan. Average ($\mu g/m^3$)	Jan. 75th % ($\mu g/m^3$)	Jan. 84th % ($\mu g/m^3$)	Est. Cont. Above Typical ($\mu g/m^3$)
Lamar Power Plant	174	24	27.1	33	39	135 - 141
Lamar Municipal Building	173	18	21.8	24	31	142 - 149

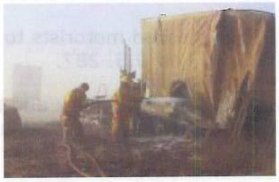
4.0 News Accounts and Credible Evidence

January 20, 2009

Dust-storm spawned pileup on I-70 kills two

By Howard Pankratz
The Denver Post
Posted: 01/19/2009 02:42:33 PM MST
Updated: 01/19/2009 09:43:18 PM MST

Blowing dust and brown-out conditions on Interstate 70 in eastern Colorado caused a massive traffic accident involving eight passenger cars and six tractor-trailer trucks, leaving two confirmed dead and multiple motorists with injuries, the Colorado State Patrol said this afternoon.



Firefighters extinguish remaining hot spots on a tractor-trailer rig that was involved in a multiple vehicle accident at I-70 Eastbound at mile marker 374. (Charles Hoffman, Eastern Colorado Plainsman)

Brian Jordan of the Colorado Transportation Management Center said I-70 between Limon and Burlington was closed because of the accident, blowing dust and brown-out conditions.

The eastbound lanes were opened about 5:20 p.m. and the westbound lanes opened at about 9:30 p.m.

Trooper David Hall, spokesman for the State Patrol, said it was "incredibly windy" and that there was so much dust in the air it created a "black wall" to the east of his location on I-70.

Hall said at 4:20 p.m. that the dust storm was so bad at the scene that he couldn't see his hand in front of his face and that the interior of his car was caked with dust.

A passenger vehicle sits amongst the wreckage of two tractor-trailer rigs following a multiple vehicle accident at I-70 Eastbound at mile marker 374. (Charles Hoffman, Eastern Colorado Plainsman)

He said there are jack-knifed tractor-trailers all over the interstate and that two cars were consumed by fire after they became wedged under one of the semis. That tractor-trailer also was destroyed.

Hall said one of the fatalities was in one of the burned cars, and the other fatality was in a pickup truck that crashed into a ditch.

All the vehicles were westbound. The accident occurred at about 1 p.m.

Hall said that there appeared to be a recently plowed field on one side of the highway. The wind literally picked up much of the dirt in the field and sent it blowing across the highway where the accident occurred, he added.

Hall described the scene as one of mass destruction — "mangled semis and cars."

He said a total of six people were transported from the scene, and some were to be airlifted to Denver.

Herman Schreivogel, chief executive of Lincoln Community Hospital, said ambulances transported five people from the accident to his hospital in Hugo.

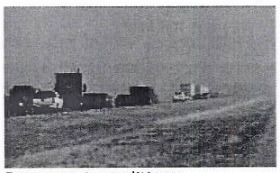
"They are not in too bad of shape," he said.

But Schreivogel said this afternoon that conditions outside were horrible, with the wind "blowing like hell" and visibility down to 10 feet at the accident scene.

The accident happened about 15 miles from Hugo, he said.

He said ambulance crews had to wash dust and dirt out of their eyes when they arrived.

Ester Chubbuck, who owns the Wonder Tower in Genoa — one of the oldest and most well-known attractions along I-70 in eastern Colorado — said visibility was very poor because of blowing dust. She said many eastbound trucks were backed up in Genoa because of the accident.



Brown-out conditions contributed to the fatal crash and closed Interstate 70 east of Limon. (Charles Hoffman, Eastern Colorado Plainsman)

Officials asked motorists to use alternate routes, including U.S. 385, U.S. 36 and U.S. 287.

In addition, Chubbuck and the Lincoln County Sheriff's Department said a large fire was threatening the town of Karval in the southern part of Lincoln County — the same county where the accident occurred.

A Sheriff's Department official said the fire was 15 miles long and 5 miles wide.

At the time of the accident, the National Weather Service had issued a "red flag warning" for Colorado's Eastern Plains, warning that critical fire weather conditions were either occurring or are imminent. The weather service said northwest winds of 20 to 35 mph were expected, with gusts reaching 50 mph.

9NEWS.com

2 killed after dust storm causes pileup on I-70

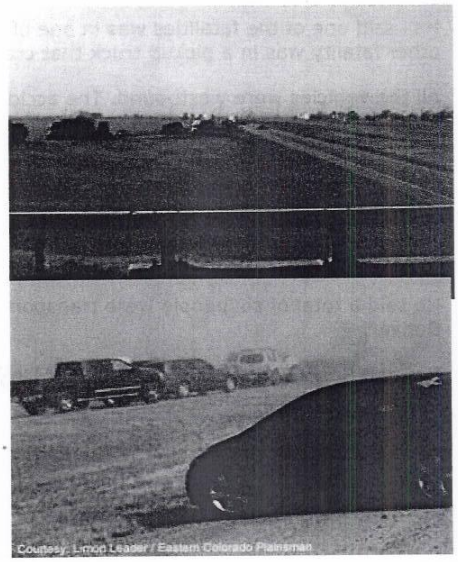
written by: Jeffrey Wolf updated by: Dan Boniface reported by: Anastasiya Bolton • Date last updated: 1/19/2009 11:34:20 PM

LIMON - Two people are dead after at least 13 different cars and trucks were involved in a pileup, forcing authorities to close an 80-mile stretch of Interstate 70 between Limon and Burlington on Monday afternoon.

The Colorado State Patrol says the accident happened around 1 p.m. at mile marker 374, about 15 miles east of Limon and near the town of Genoa, and involved eight passenger vehicles and five semi trucks.

State Patrol says there are two confirmed fatalities and at least five other injuries. Four of the injured were taken to Lincoln Community Hospital in Hugo and another victim was taken to the burn center at Anschutz Medical Center in Aurora.

Trooper David Hall with the Colorado State Patrol says one of the people who died was a man from Denver in a pickup truck who went into a ditch, but did not release his name. Hall says the other victim was in a heavily burned car that was sandwiched between two semi trucks. Hall says they haven't identified the burned victim.



The Colorado Department of Transportation describes the wind in the area as "extreme" and says there is blowing dust creating what they called "brownout" conditions.

The State Patrol called it a dust storm.

"It's an absolute 'brownout' with a dirt storm right now, unlike I've personally ever seen," said Hall. "When I first arrived on scene, I could barely see my hand in front of my face."

One of the troopers on scene told 9NEWS he couldn't see 5 to 10 yards in front of his car.

Four troopers were taken to Lincoln Community Hospital and treated for dust in their eyes, according to Hall.

"The visibility's so bad you can't see across the width of the interstate here," said Greg Vernie with The Limon Leader on Monday afternoon.

Vernie said he could see several trucks and cars involved in the accident from his office.

"You can see that most of the cars that were involved in the accident were hit from behind. They probably just drove into the cloud of dirt and then panicked, stopped and then people ran into them," he said.

"The wind is blowing through so bad it's like driving through fog. Pretty much can't see at all," said Lori Nunn, a driver on I-70 stopped by the pileup. "I can definitely see how it happened, with not being able to see where you're going."

"This very particular stretch of road right here, where this accident happened, there's a barren field that's got a layer of topsoil on it that's just blowing across the highway. I imagine when these vehicles got into it they stopped because of visibility and then it just racked up from there," Hall said.

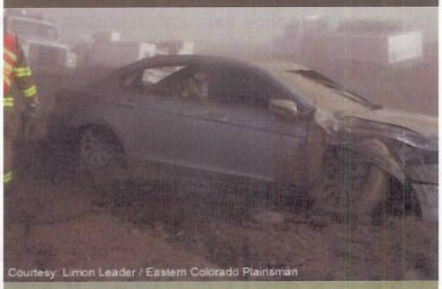
Vernie says the extreme winds started around 10 a.m.

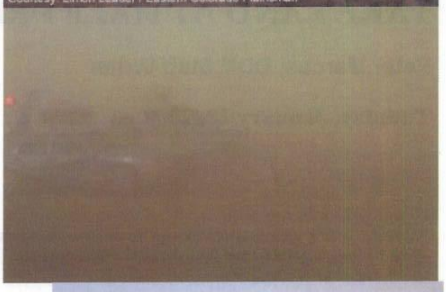
"Every fence and nook and cranny out here that will hold tumbleweeds are full of either tumbleweeds or trash that's blowing," he said.

9NEWS Meteorologist Marty Coniglio says winds were gusting on the Eastern Plains on Monday with gusts of 56 mph clocked in Limon, 53 mph in Akron and 52 mph in Sterling. On Sunday, winds were gusting up to 60 mph on the Eastern Plains.

I-70 was closed in both directions between Limon and Burlington because of the crashes. Eastbound I-70 reopened just after 5 p.m. and westbound reopened around 9:30 p.m. CDOT had said it didn't expect to reopen the highway until after midnight.

"You might expect blizzard conditions out here on I-70 in the middle of January, maybe not so much a complete 'brownout' dust storm," Hall said.





5.0 Local Dust Control

Best Available Control Measures (BACM) Implementation:

The City of Lamar and Prowers County have identified a number of contributing dust sources that have either implemented BACM controls or have phased-in BACM controls as economically and technically feasible. The following stakeholder agreements detail selected BACM for the Lamar area:

City of Lamar

The City of Lamar has been very proactive in addressing potential PM_{10} 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. 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 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 the plantation of tree wind breaks, a drip irrigation system has been installed to promote sustained tree growth.

2. *Landfill Shutdown*

The East Lamar Landfill is located approximately six (6) miles east of the city limits. 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.

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.

3. *Vegetative Cover/Sod*

The Lamar Recreation Department installed 100,000 square feet of turf 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 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 to reduce dirt track out onto city streets and minimize additional releases of PM_{10}.

4. *Additional Public Works Projects*

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

- The recent purchase of a TYMCO regenerative air street sweeper 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 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 Lamar Power Plant monitoring site was deemed to be an important PM_{10} 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 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) 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.

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 SIP Maintenance Plan submittal.

USDA: Natural Resources Conservation Service (NRCS)

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.[1] 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.

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

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.

Additional information about the CRP can be found in Attachment A.

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 PM_{10} 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:

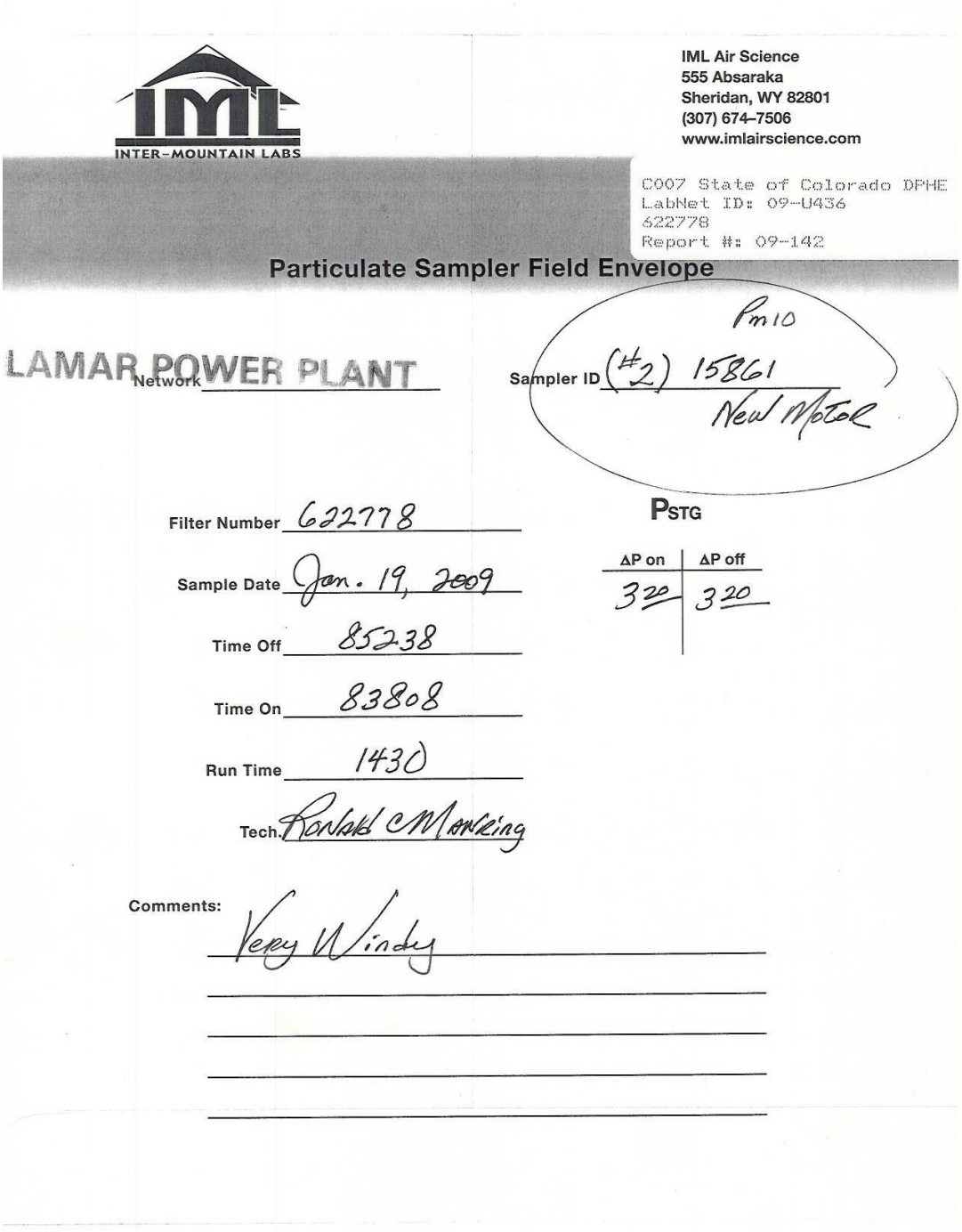
- Crop residue efforts that encourage no- or low-till practices. These have been deemed appropriate and useful in reducing blowing dust.
- Ongoing outreach efforts to educate area agricultural producers on soil management programs. These include one-on-one visitations and annual meetings with various 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 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.

6.0 Laboratory and Field Data



INTER-MOUNTAIN LABS

IML Air Science
555 Absaraka
Sheridan, WY 82801
(307) 674-7506
www.imlairscience.com

C007 State of Colorado DPHE
LabNet ID: 09-U436
622778
Report #: 09-142

Particulate Sampler Field Envelope

PM10

Network LAMAR POWER PLANT

Sampler ID (#2) 15861
New Motor

Filter Number 622778

Sample Date Jan. 19, 2009

Time Off 85238

Time On 83808

Run Time 1430

Tech. Ronald C Manning

PSTG

ΔP on	ΔP off
320	320

Comments: Very Windy

INTER-MOUNTAIN LABS

IML Air Science
555 Absaraka
Sheridan, WY 82801
(307) 674-7506
www.imlairscience.com

C007 State of Colorado DPHE
LabNet ID: 09-U437
622403
Report #: 09-142

Particulate Sampler Field Envelope

AMAR MUNICIPAL COMPLEX

Network _____ Sampler ID PM10-1-1999

Filter Number 622403

Sample Date 1-20-09 1/19/09

Time Off 52194

Time On 50764

Run Time 1430

Tech. _____

PSTG

ΔP on	ΔP off
2.90	3.10

Comments:

7.0 Summary and Conclusions.

The APCD has clearly shown in this analysis that the exceedance concentrations in Lamar on January 19, 2009 were caused by a regional dust storm that brought dust in from the source areas located north of Lamar in eastern Colorado, western Kansas and western Nebraska. A clear causal relationship was established in Section 2, Meteorological Analysis of the January 19, 2009, Blowing Dust Event. Satellite images show the blowing dust from the source areas, soil moisture analyses, a back trajectory analysis and other weather data clearly substantiate the direction of transport high wind speeds, and preconditions necessary for a regional dust storm. Section 3, Ambient Monitoring Data and Statistics, demonstrated that the concentrations on January 19, 2009 of 174 $\mu g/m^3$ at the Lamar Power Plant site and 173 $\mu g/m^3$ at the Municipal Building site were well in excess of normal historical fluctuations, including background concentrations. In fact, using conservative values as "typical", these concentrations showed that the event provided an additional 135 – 141 $\mu g/m^3$ and 142 – 149 $\mu g/m^3$ for Lamar Power and Lamar Municipal Building monitors, respectively. The meteorological and monitoring data sections demonstrate that the exceptional event affected the air quality on January 19, 2009, and "but for" this regional blowing dust storm Lamar would not have exceeded the NAAQS.

In addition, Attachment A contains a detailed analysis and climatology for blowing dust events at Lamar, Colorado. PM_{10} concentrations for both the Lamar Power Plant and Municipal Building sites for January of 2004 through March 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 PM_{10} 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 proves 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 PM_{10} 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 PM_{10} exceedances occur on less than 1% of the days in the record. *Attachment A 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*.

Data and analyses in this report show that 30-day precipitation was generally 0.6 inches or lower in the source region for the dust, surface winds of 30 to 40 mph with gusts of 35 to 60 mph were widespread in the source area, the concentrations measured at both monitors exceeded the historical 99^{th} percentile level for these sites, and conservative estimates of the contribution of the dust storm to measured PM_{10} generally exceed 80% of the total. But for the high winds over dry soils, these measured 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 (from Attachment A). The first is the Lamar PM_{10} Non-attainment Area (NAA) and Prowers County. *Blowing dust sources within the NAA and Prowers County have been reasonably controlled, as demonstrated by the PM_{10} 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. The third source area to the south and southwest of Colorado did not contribute to PM10 on January 19, 2009, because of the northerly winds during the event.

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 January 19, 2009, dust storm imagery and data show that large amounts of dust moved toward Lamar from a swath of eastern Colorado and portions of Wyoming and Nebraska. Aside from the soil conservation programs in effect, the dust from this region during this extreme high-wind, dry-soils event was not reasonably controllable.

8.0 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. *PM_{10} 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*.

U.S. Environmental Protection Agency, September 1992. *Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, EPA-450/2-92-004*.

U.S. National Archives and Records Administration, July 2010. *Code of Federal Regulations, Title 40, Part 58*.

Attachment A
Lamar, Colorado,
Blowing Dust Climatology

March 10, 2010

Technical Services Program
Air Pollution Control Division
Colorado Department of Public Health & Environment

Introduction – Executive Summary

PM_{10} 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 PM_{10} 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 PM_{10} 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 PM_{10} 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 PM_{10} 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 PM_{10} 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.

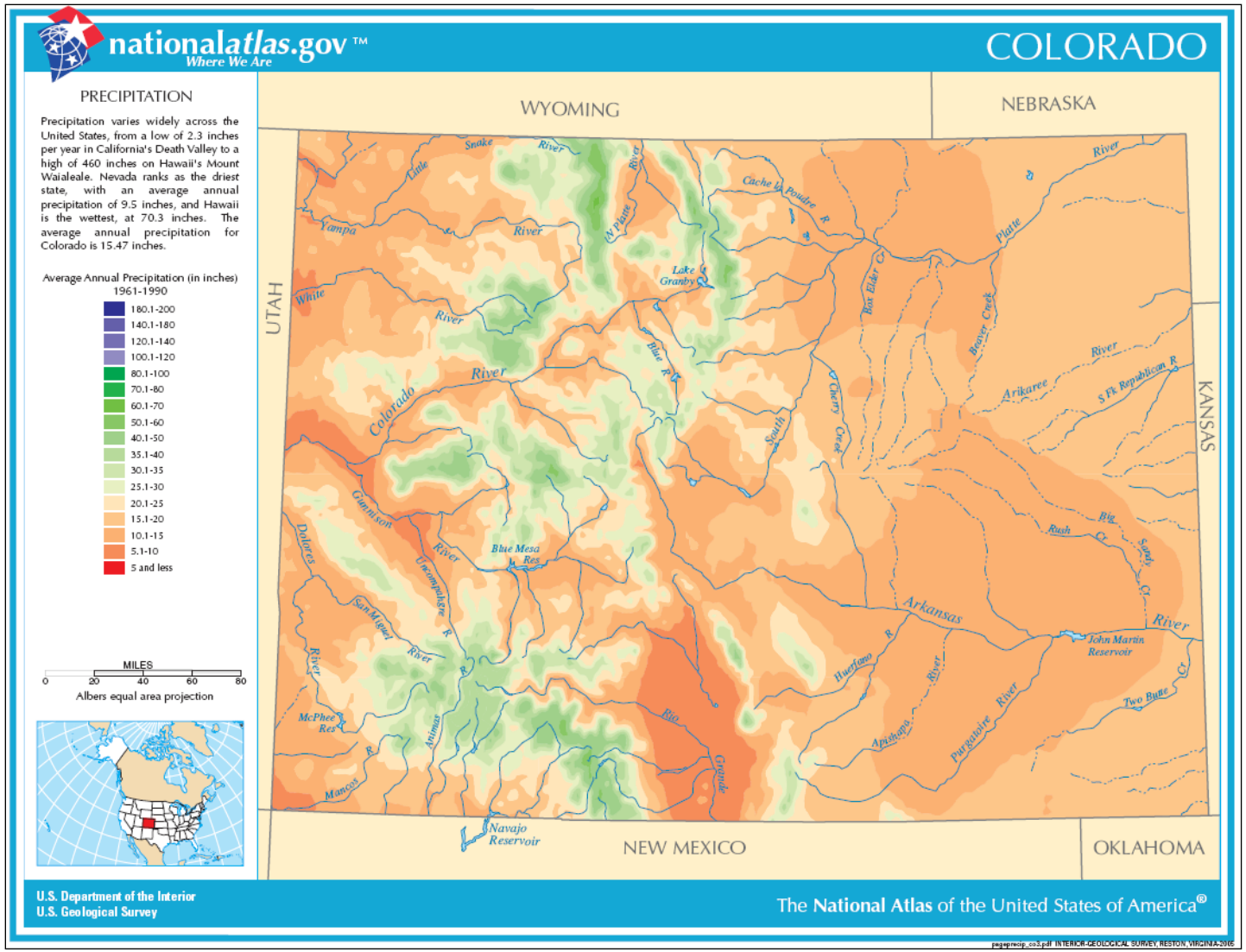


Figure A-1. Average annual precipitation in Colorado based on 1961-1990 normals.

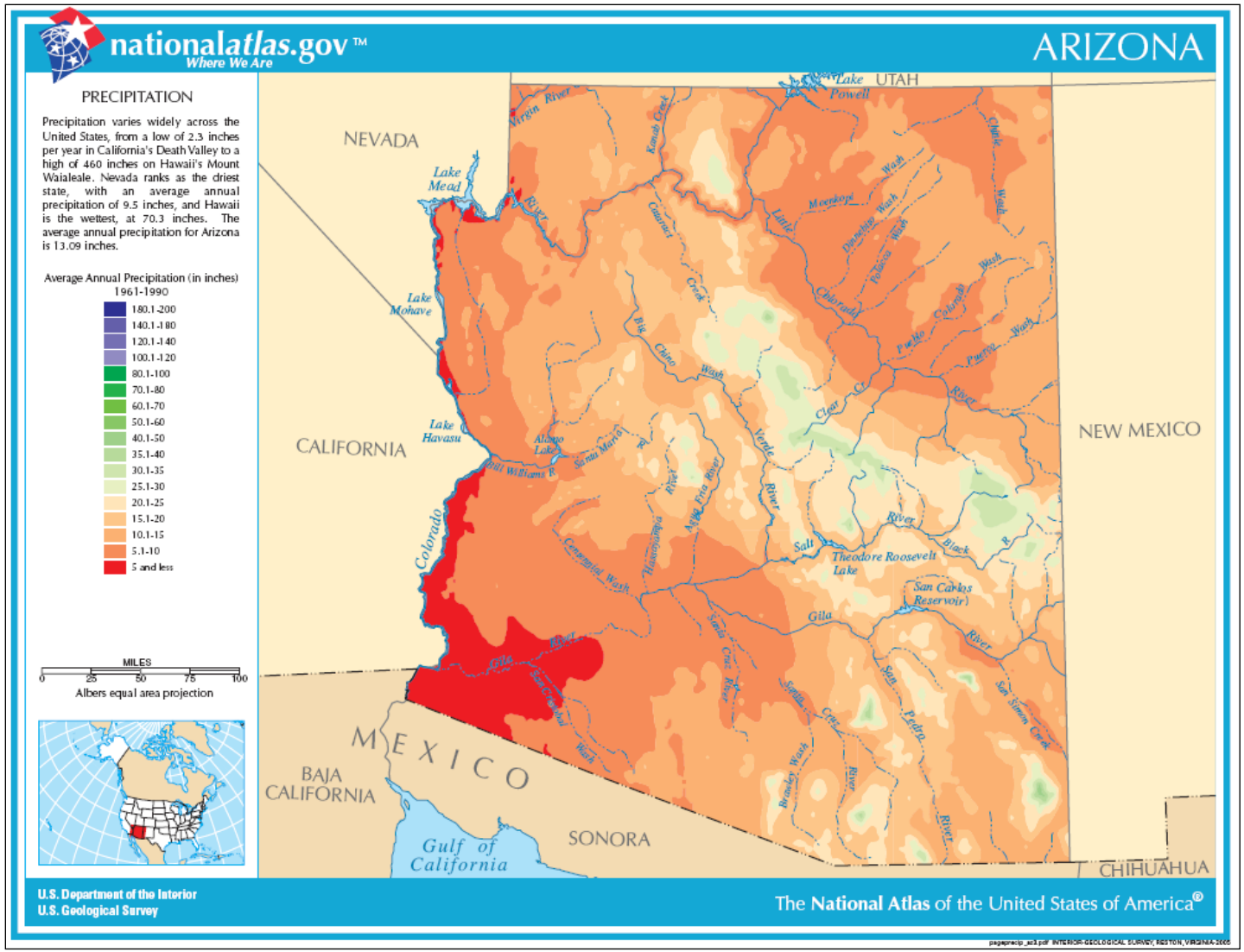


Figure A-2. Average annual precipitation in Arizona based on 1961-1990 normals.

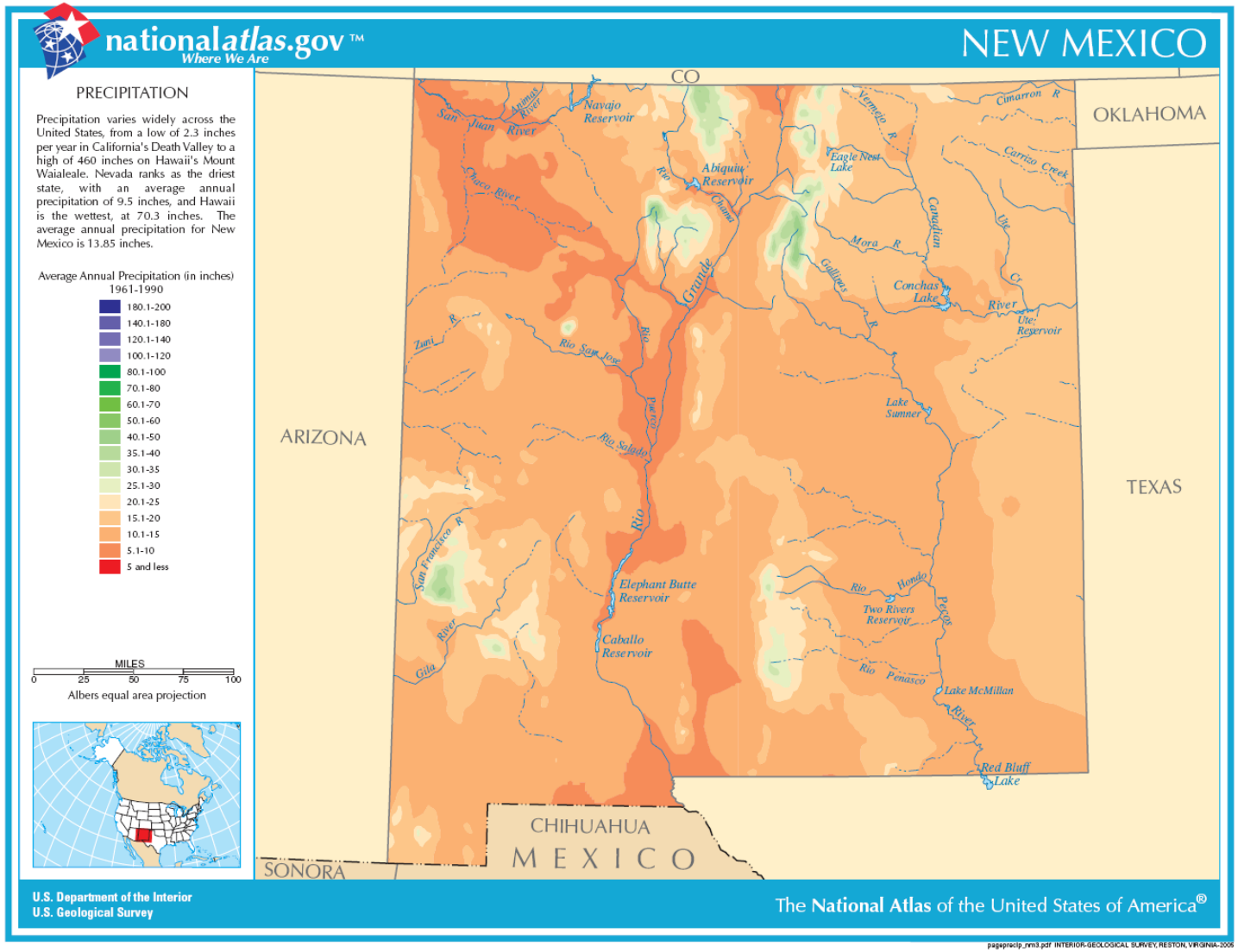


Figure A-3. Average annual precipitation in New Mexico based on 1961-1990 normals.

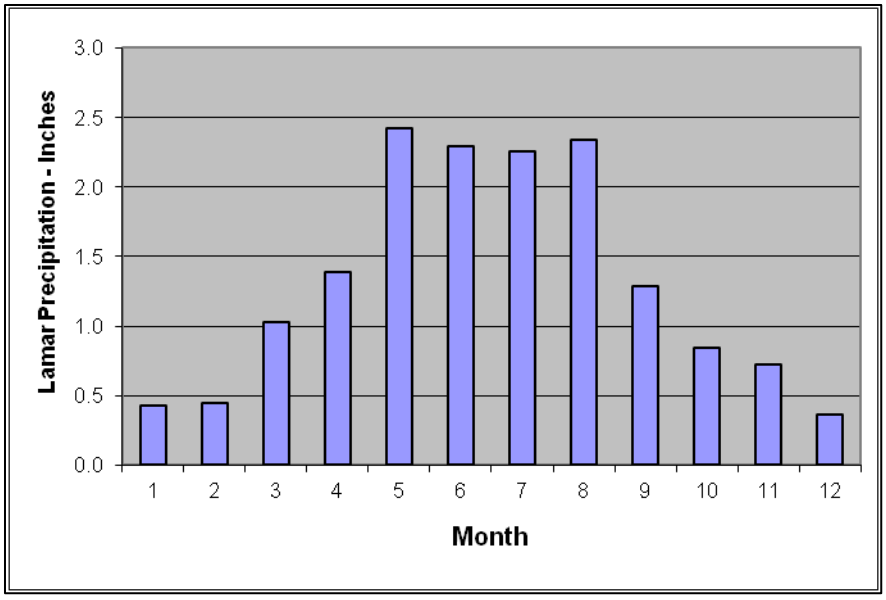


Figure A-4. 1971-2000 monthly normal precipitation in Lamar, Colorado.

Cluster Analysis

K-means cluster analysis has been applied to Lamar Power and Municipal Building PM_{10} concentrations, Lamar 30-day total precipitation for each PM_{10} 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 PM_{10} concentrations associated with strong winds, low soil moistures, and blowing dust by providing mean values for these 4 variables for 5 distinct categories of PM_{10} 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 PM_{10} concentrations. Cluster 2 represents low to moderate soil moisture, low PM_{10}, and moderate gust speeds. Cluster 3 represents low to moderate soil moisture, high gusts, and low to moderate PM_{10}. Cluster 4 represents low soil moisture, low gusts, and low PM_{10}. Finally, Cluster 5 represents high PM_{10}, high gusts, and low soil moisture. Cluster numbers, Lamar Power PM_{10} 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 PM_{10} 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 PM_{10} 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 $\mu g/m^3$ 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 PM_{10} 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 PM_{10} in $\mu g/m^3$	22.6	22.6	53.2	19.6	154.9
Lamar Municipal PM_{10} in $\mu g/m^3$	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

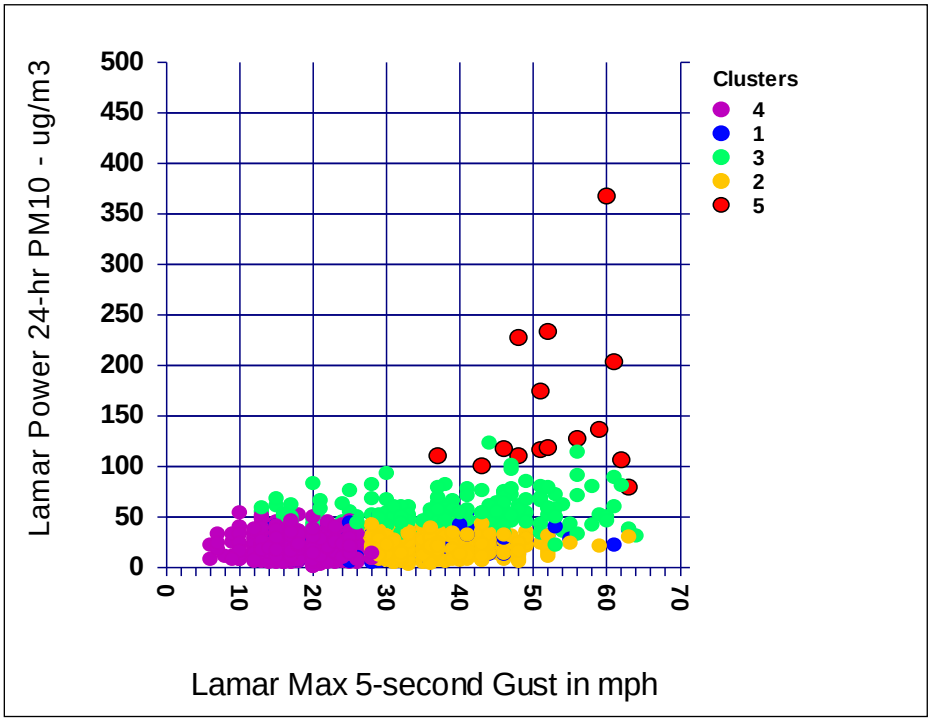


Figure A-5. Lamar Power 24-hour PM_{10} concentrations versus Lamar gust speed by cluster.

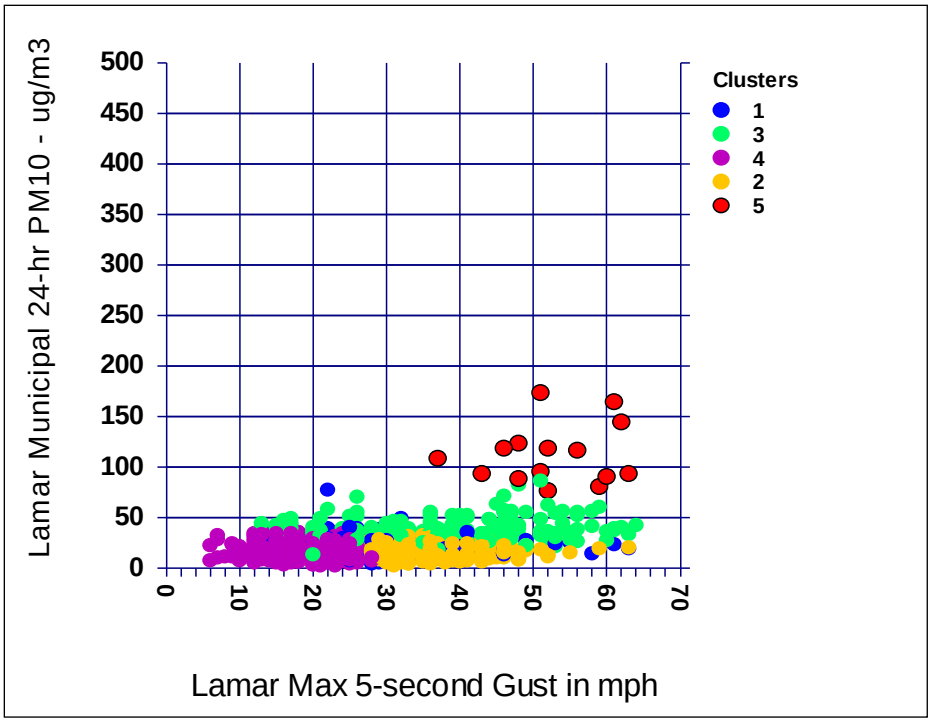


Figure A-6. Lamar Municipal Building 24-hour PM_{10} concentrations versus Lamar gust speed by cluster.

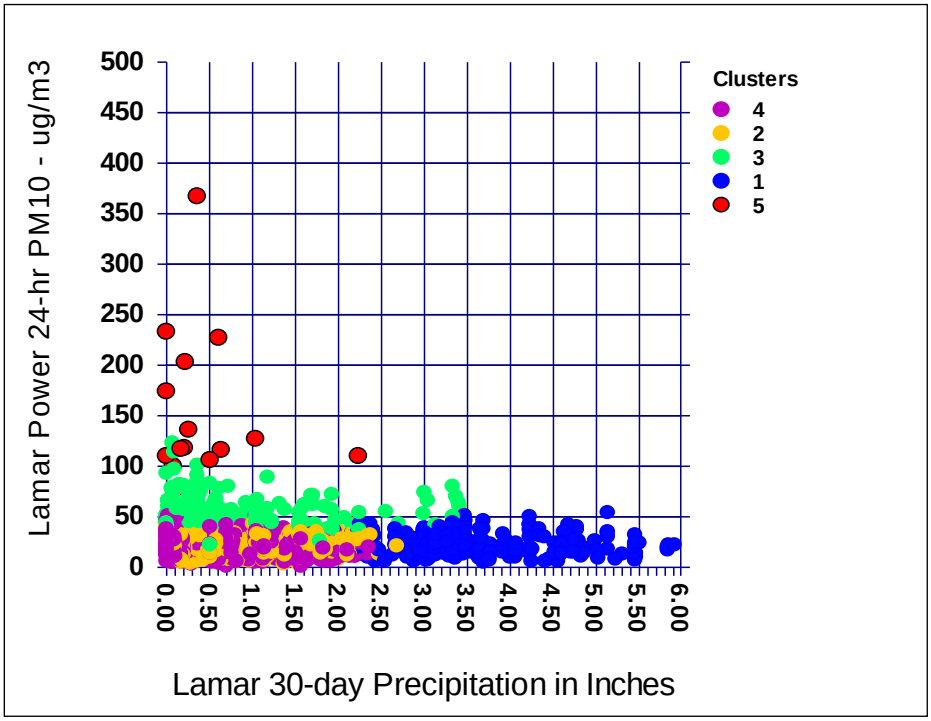


Figure A-7. Lamar Power 24-hour PM_{10} concentrations versus Lamar 30-day total precipitation by cluster.

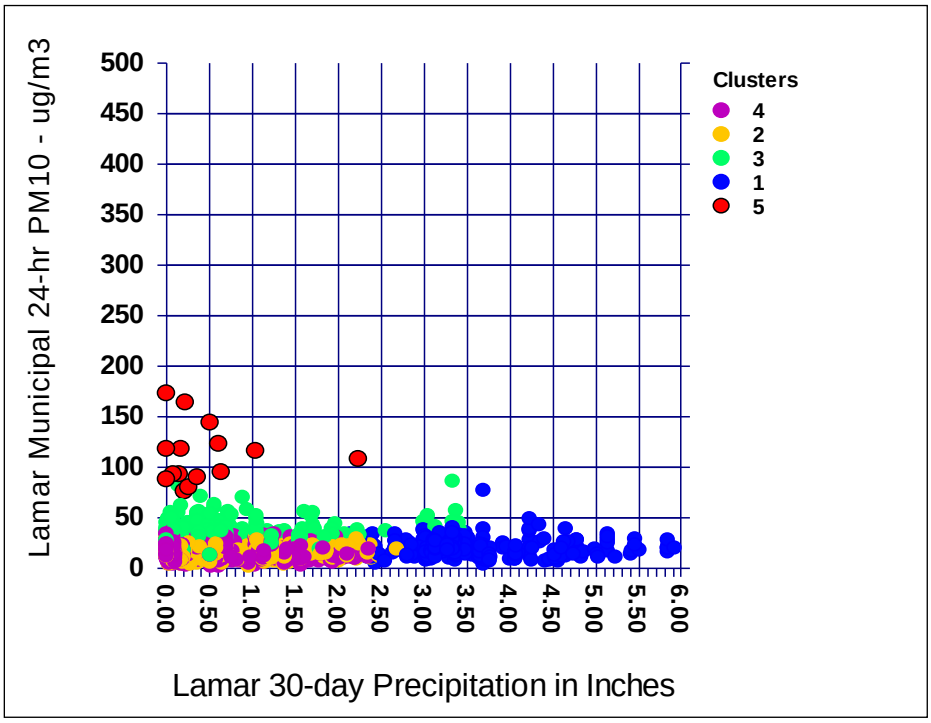


Figure A-8. Lamar Municipal Building 24-hour PM_{10} concentrations versus Lamar 30-day total precipitation by cluster.

High Wind and PM_{10} 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 PM_{10} 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.

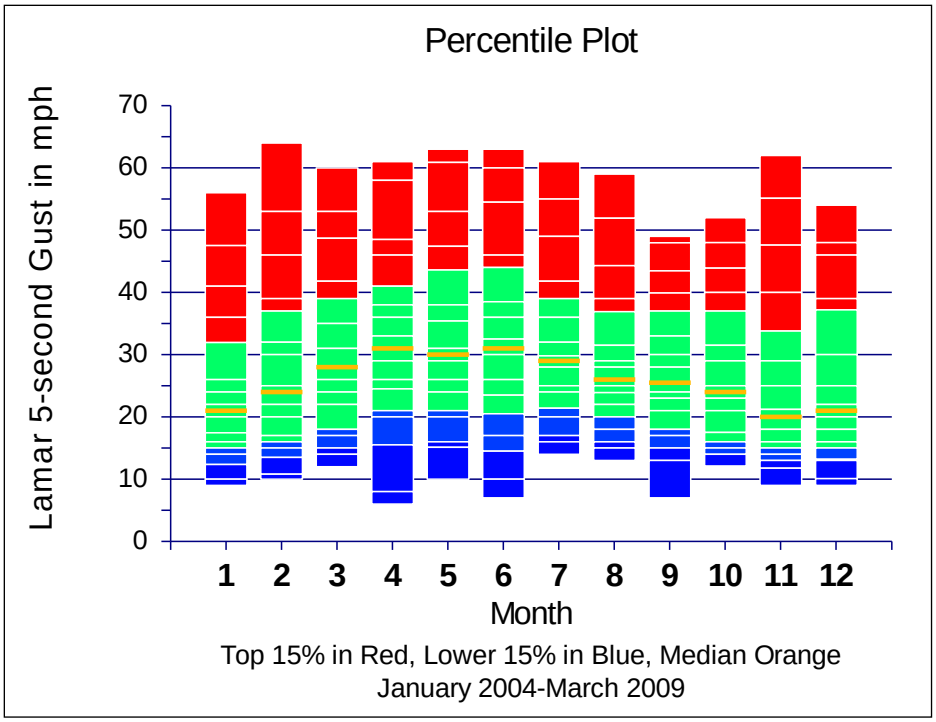


Figure A-9. Percentile plot of Lamar daily maximum 5-second gust speed in miles per hour showing that gusts of 40 mph or greater generally occur within the top 15 percentile speeds for each month of the year.

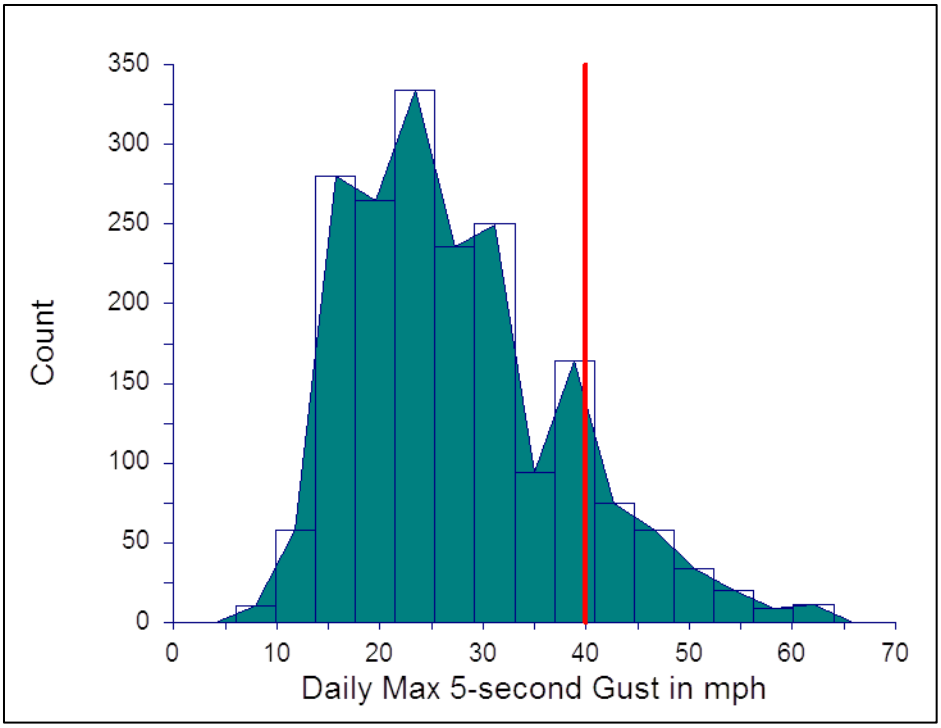


Figure A-10. Histogram of daily maximum 5-second wind gusts at Lamar based on January 2004 – March 2009. The red line at gusts of 40 mph represents the 88 percentile value.

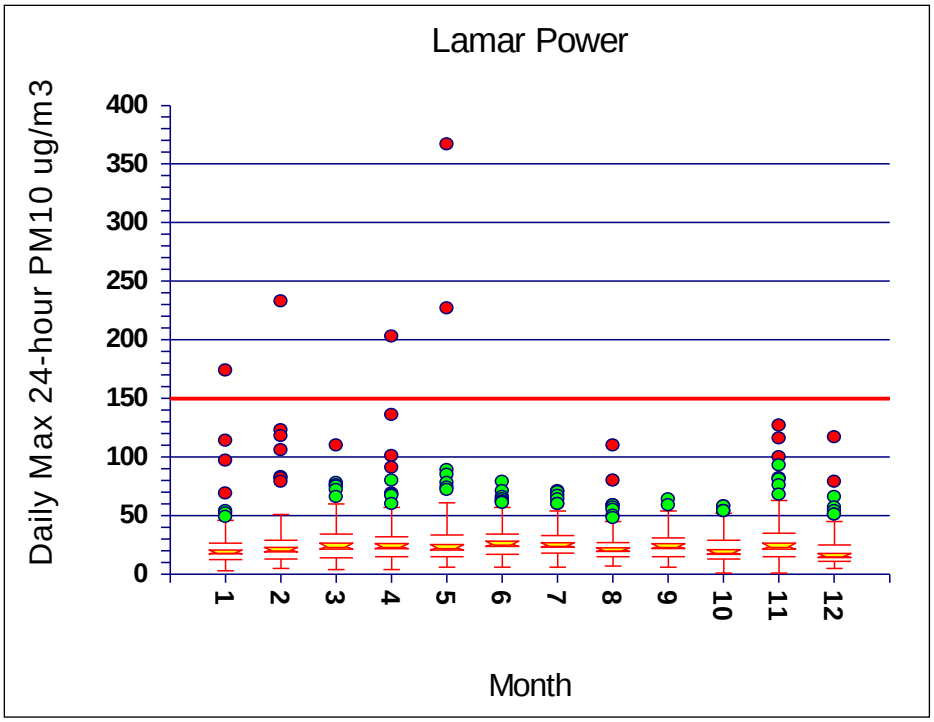


Figure A-11. Box plot of daily maximum Lamar Power 24-hour PM_{10} concentrations in $\mu g/m^3$ by month for January 2004 through February 2009.

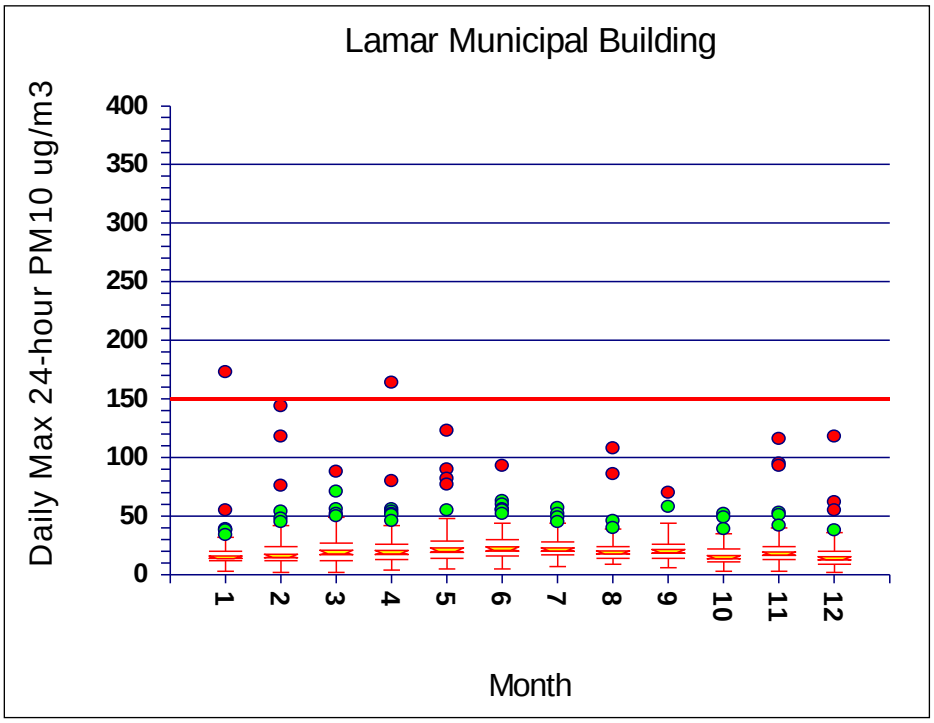


Figure A-12. Box plot of daily maximum Lamar Municipal Building 24-hour PM_{10} concentrations in $\mu g/m^3$ by month for January 2004 through February 2009.

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 PM_{10} concentrations in excess of 125 µg/m^3. 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 µg/m^3 and blowing dust conditions (from 2004 through early 2009).

Year	Month	Day	Lamar Power 24-hour PM_{10} concentration in µg/m^3	Lamar Municipal 24-hour PM_{10} concentration in µg/m^3
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

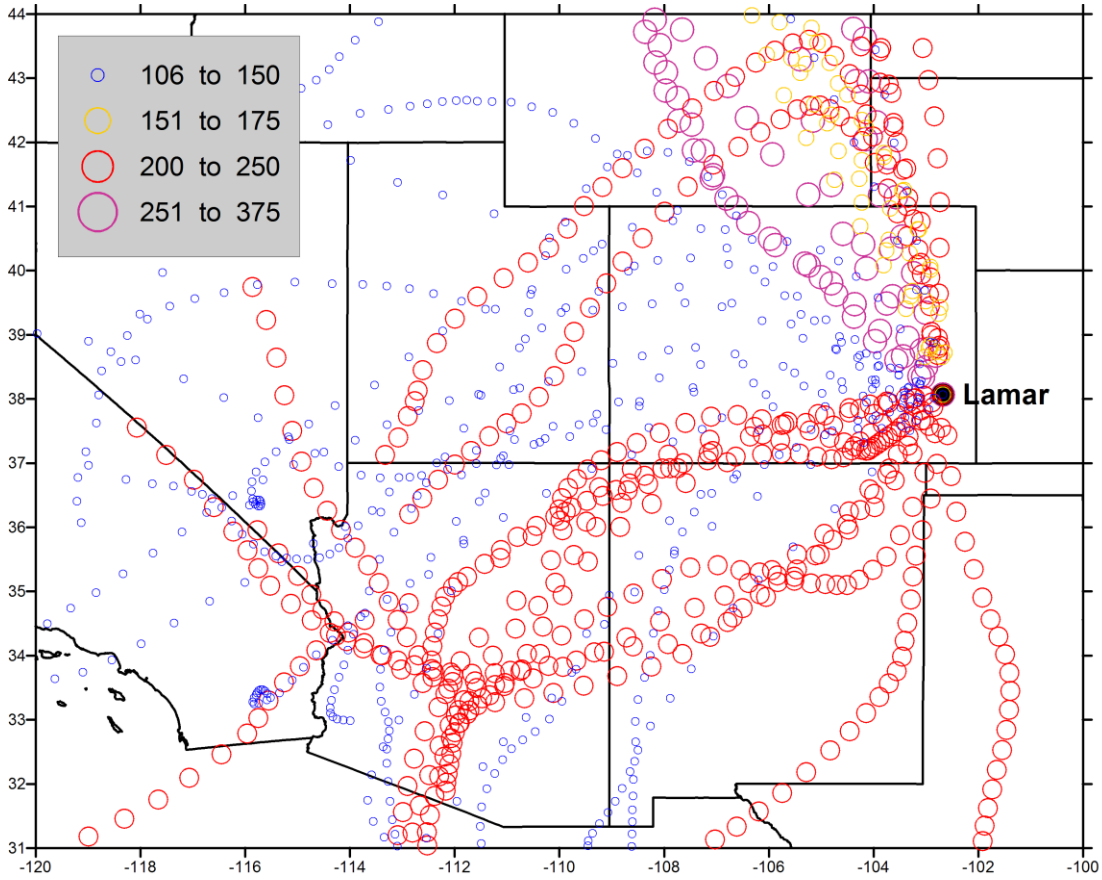


Figure A-13. NOAA HYSPLIT 36-hour back trajectories for Lamar for the periods with haze and/or elevated gusts at Lamar on the eight Cluster 5 high-concentration days shown in Table A-2. Trajectory points are sized and color-coded to reflect 24-hour PM_{10} concentrations at the Power Plant in $\mu g/m^3$.

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 PM_{10} concentrations at Lamar during regional high-wind events.

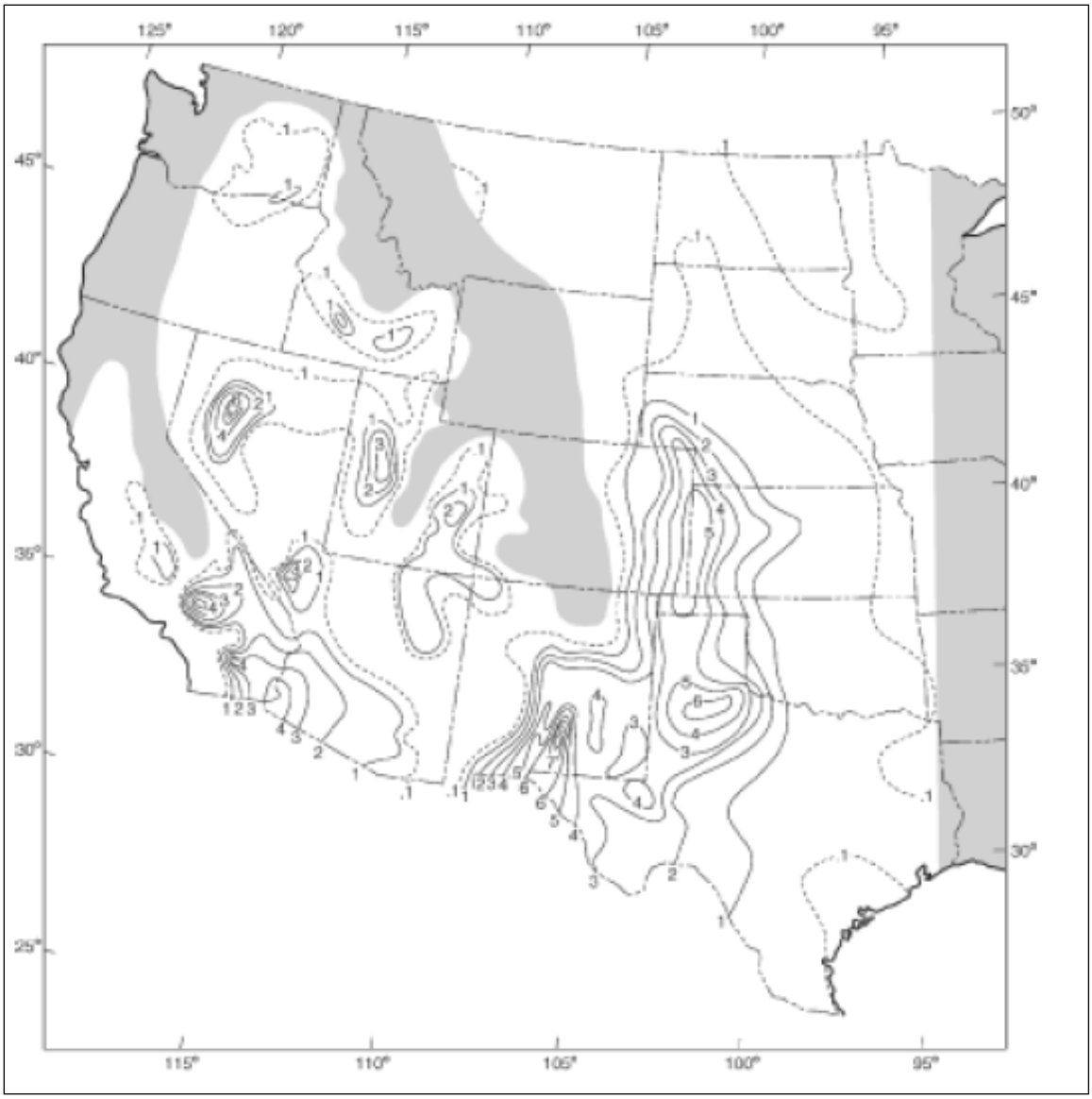


Figure A-14. Number of dust storms per year from: Orgill, M.M., Sehmel, G.A., 1976. Frequency and diurnal variation of dust storms in the contiguous USA. **Atmospheric Environment 10**, 813−825.

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 PM_{10} standard with a concentration of 227 $\mu g/m^3$ at the Lamar Power Plant. A twenty-four-hour PM_{10} concentration of 123 $\mu g/m^3$ 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 PM_{10} 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 PM_{10} concentrations in southern New Mexico ranged from near 200 $\mu g/m^3$ to just over 1000 / $\mu g/m^3$ on May 21. Back trajectories clearly suggest that some of the PM_{10} in the atmosphere over Lamar on May 22 had been transported from the dust storm stricken areas of New Mexico on May 21.

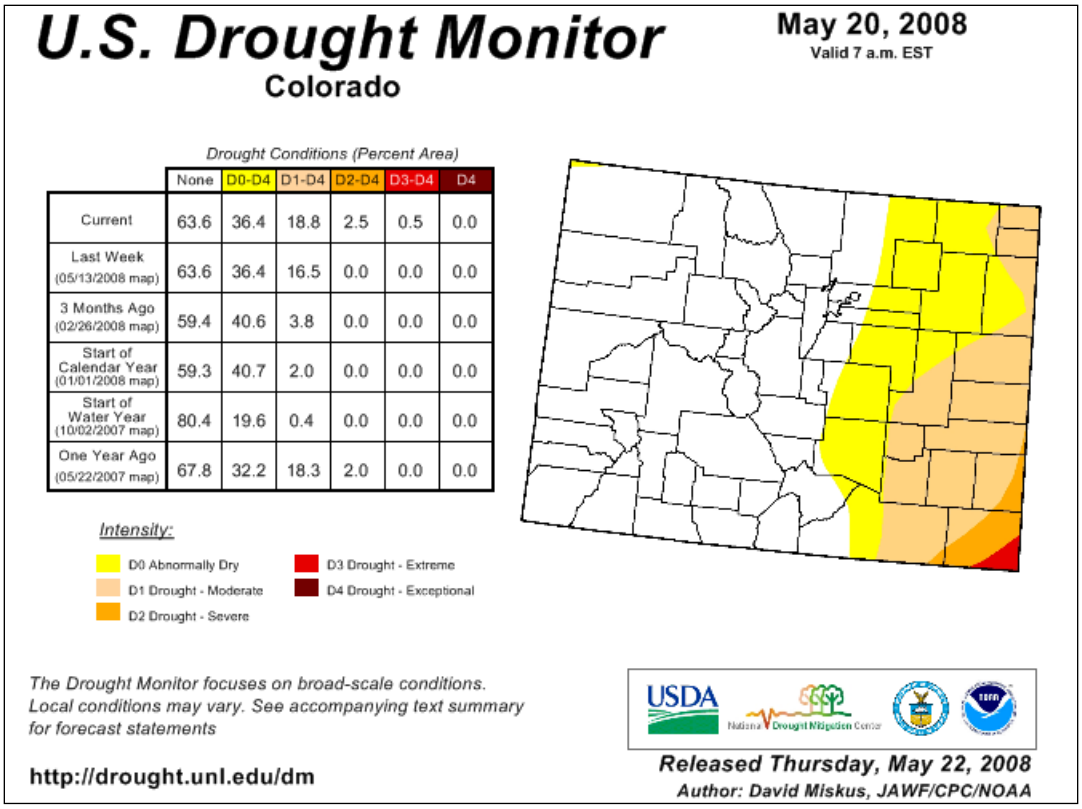


Figure A-15. Drought status for the Colorado on May 20, 2008 (source: the USDA, NOAA, and the National Drought Mitigation Center at: http://drought.unl.edu/dm/archive.html).

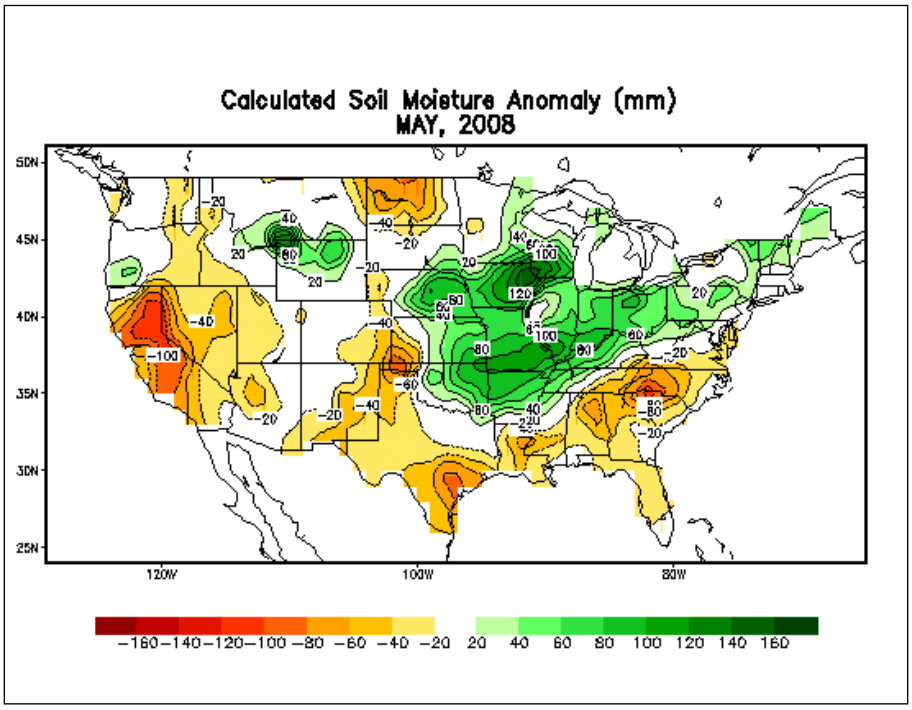


Figure A-16. Calculated Soil Moisture Anomaly (mm) May 2008 (http://www.ncdc.noaa.gov/img/climate/research/2008/may/cpc-soil-moist-anom-200806.gif).

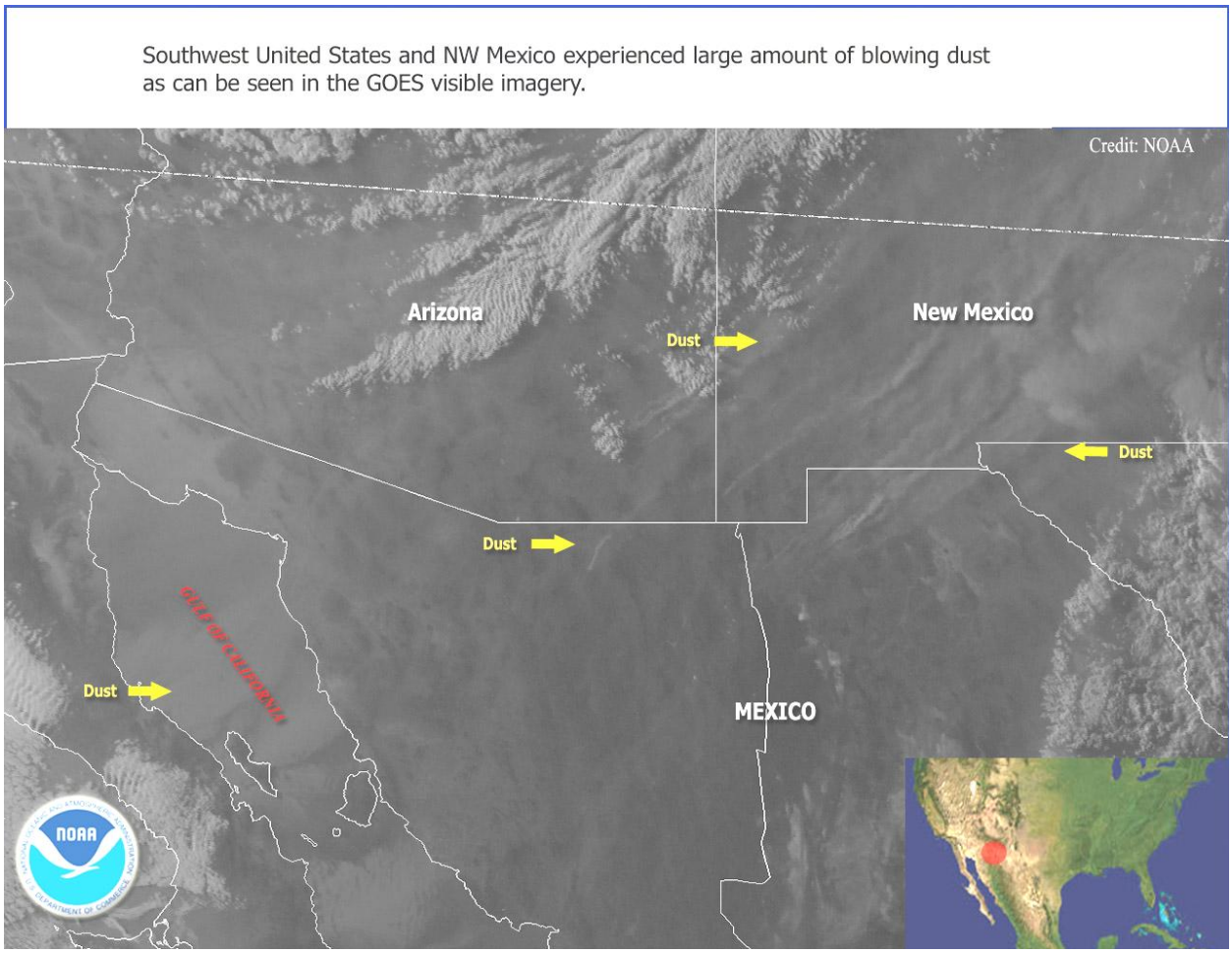


Figure A-17. Plumes of blowing dust are visible across southern Arizona, New Mexico, northern New Mexico, and the Gulf of California in this NASA MODIS satellite image for 6:45 PM MDT on May 21, 2008. (source: http://www.osei.noaa.gov/Events/Dust/US_Southwest/2008/DSTusmx142_G12.jpg)

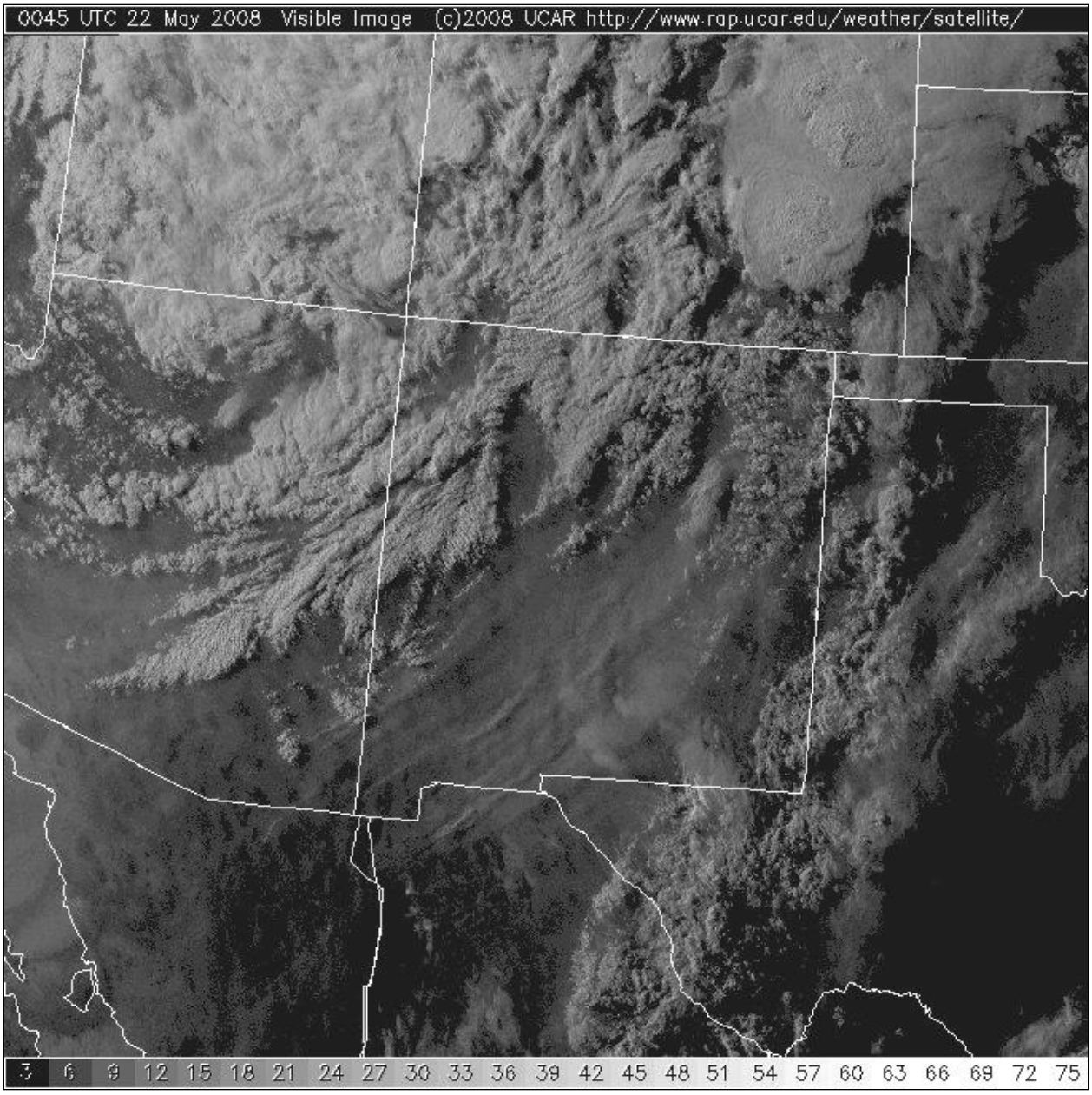


Figure A-18. Visible satellite image of the southwestern U.S. for 6:45 PM MDT on May 21, 2008, showing pronounced southwest to northeast trending plumes of blowing dust in New Mexico.

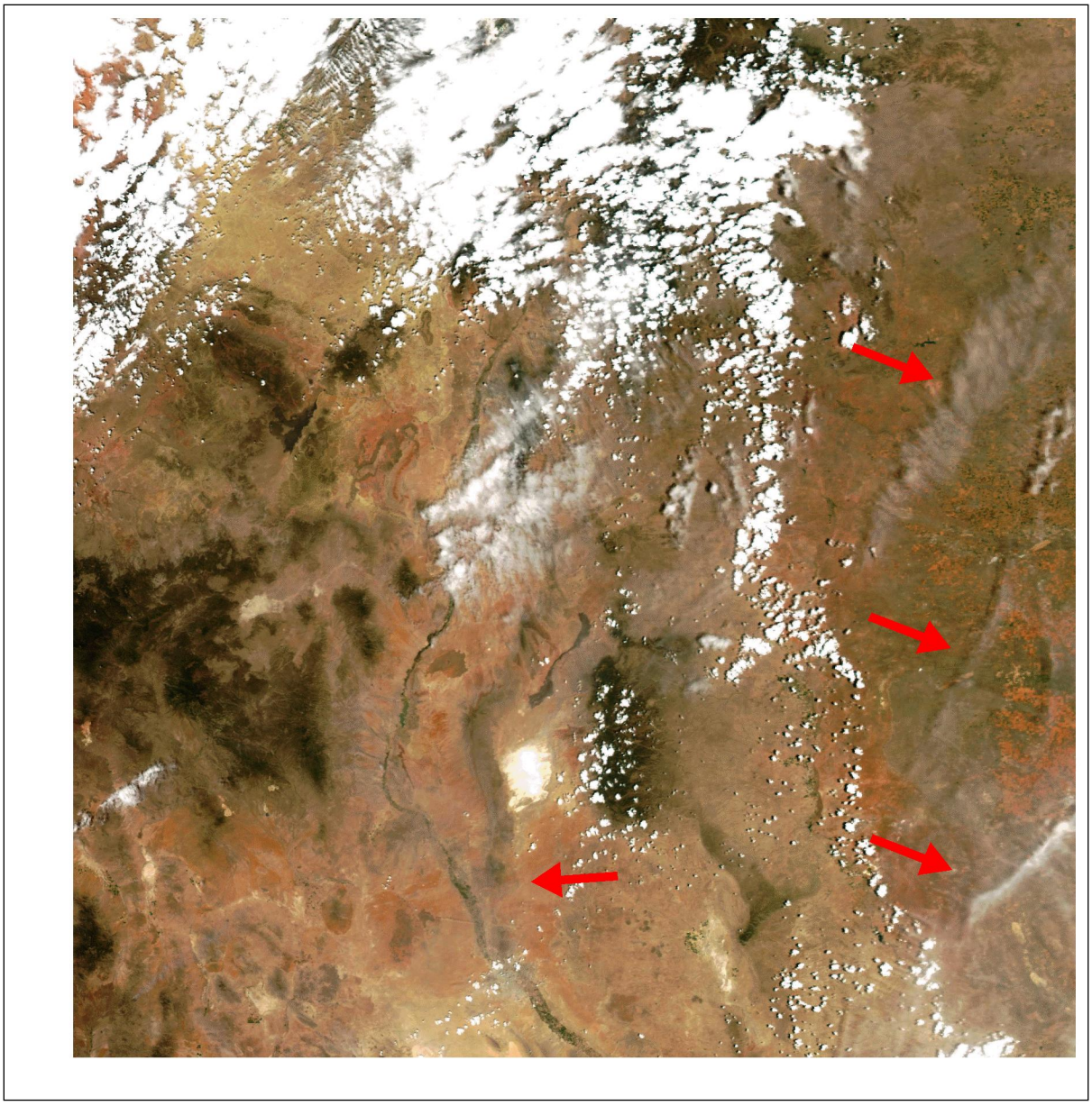


Figure A-19. Visible satellite image of New Mexico at 1:40 PM MST, May 21, 2008. Plumes and areas of blowing dust are marked with an arrow (http://activefiremaps.fs.fed.us/imagery.php?op=fire&passID=51054&month=5&year=2008).

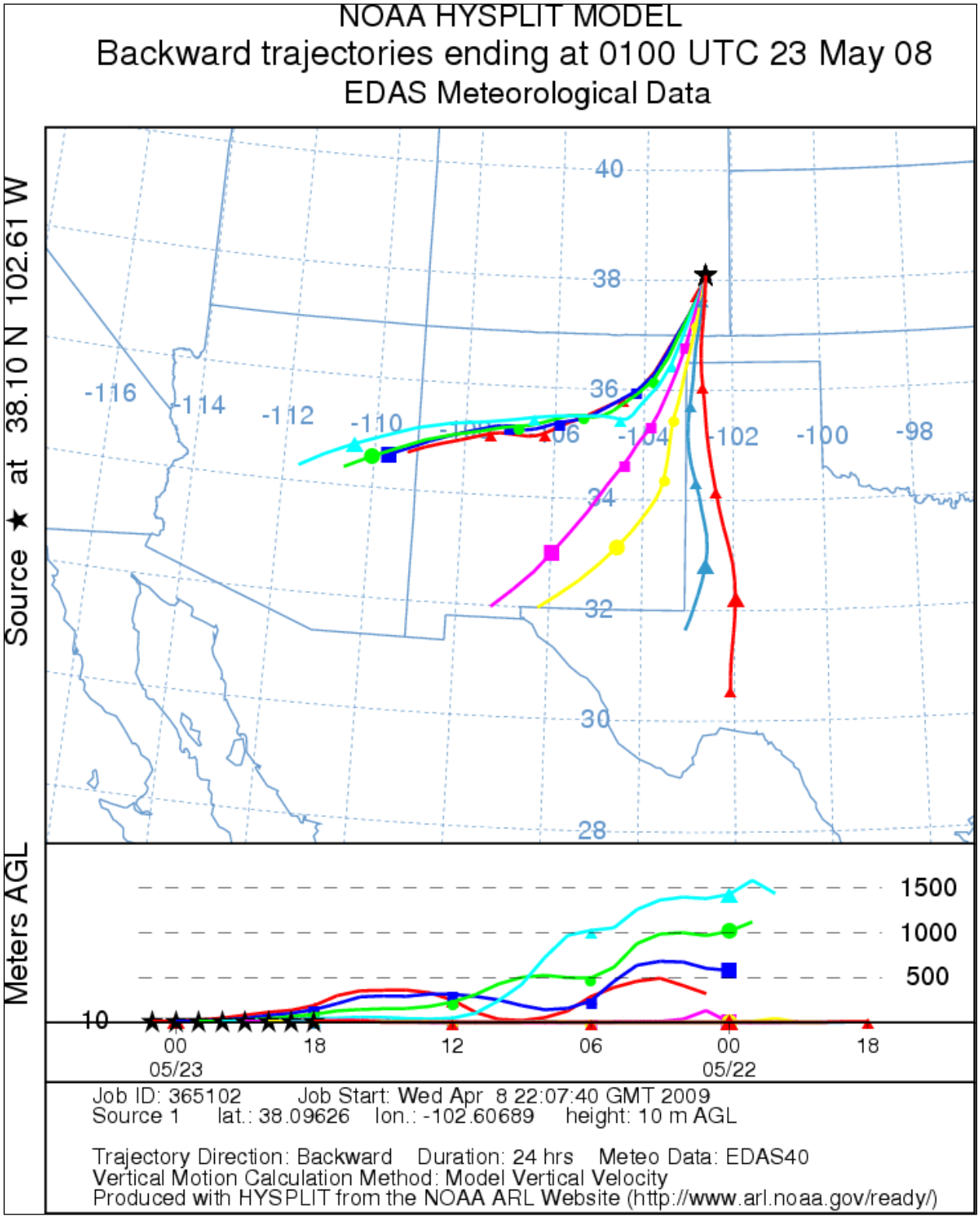


Figure A-20. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado for each hour from 11 AM MST to 6 PM MST on May 22, 2008.

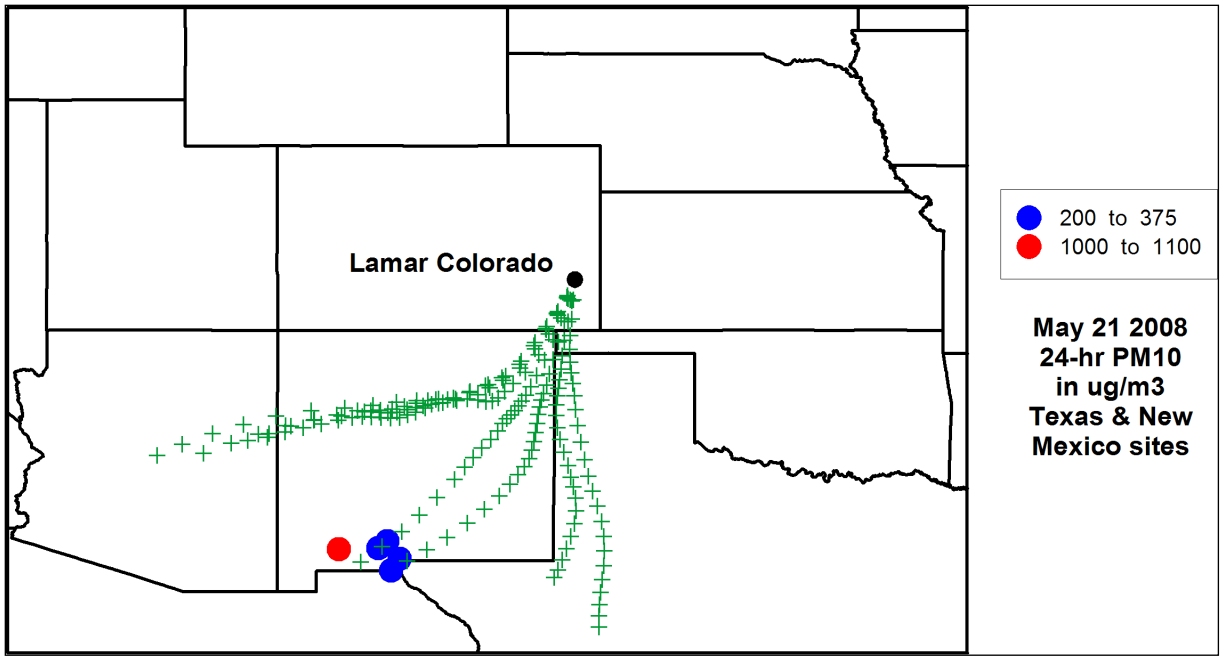


Figure A-21. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado from Figure A-20 and May 21 PM_{10} exceedance concentrations in southern New Mexico and Texas.

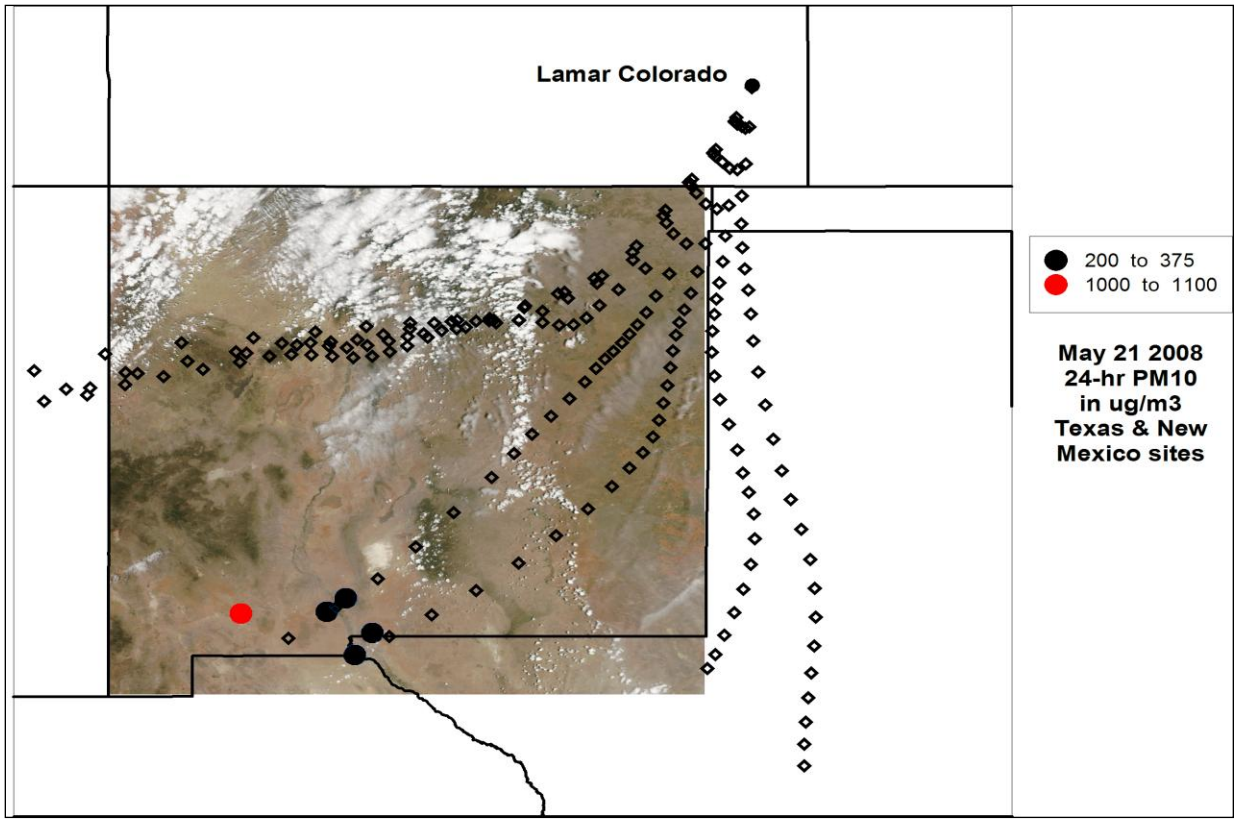


Figure A-22. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado from Figure A-20, May 21 PM_{10} exceedance concentrations in southern New Mexico and Texas, and May 21 visible satellite image from Figure A-19.

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 PM_{10} standard with a concentration of 174 $\mu g/m^3$ at the Lamar Power Plant monitor and 173 $\mu g/m^3$ 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*). 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*).

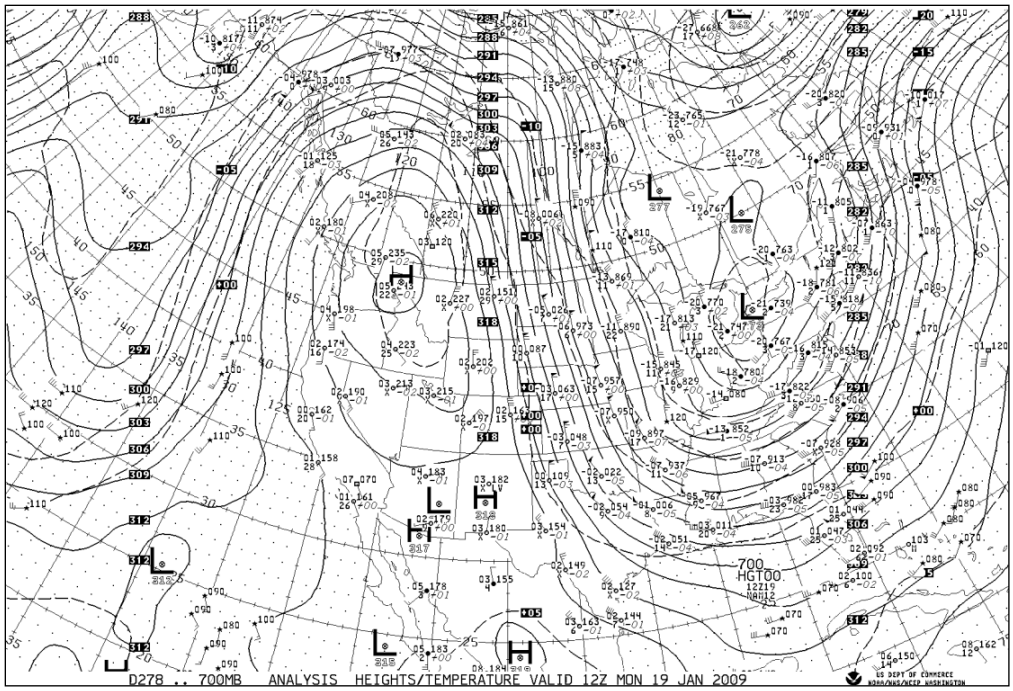


Figure A-23. 700 millibar analysis for 12Z January 19, 2009, or *5 AM MST January 19, 2009*, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

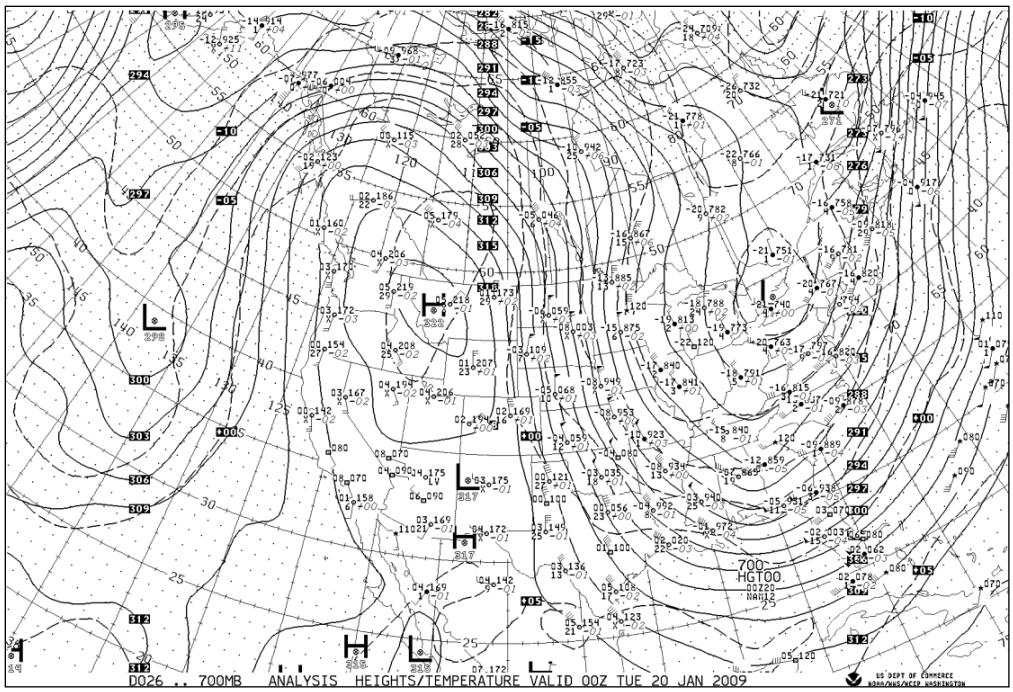


Figure A-24. 700 millibar analysis for 00Z January 20, 2009, or *5 PM MST January 19, 2009*, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

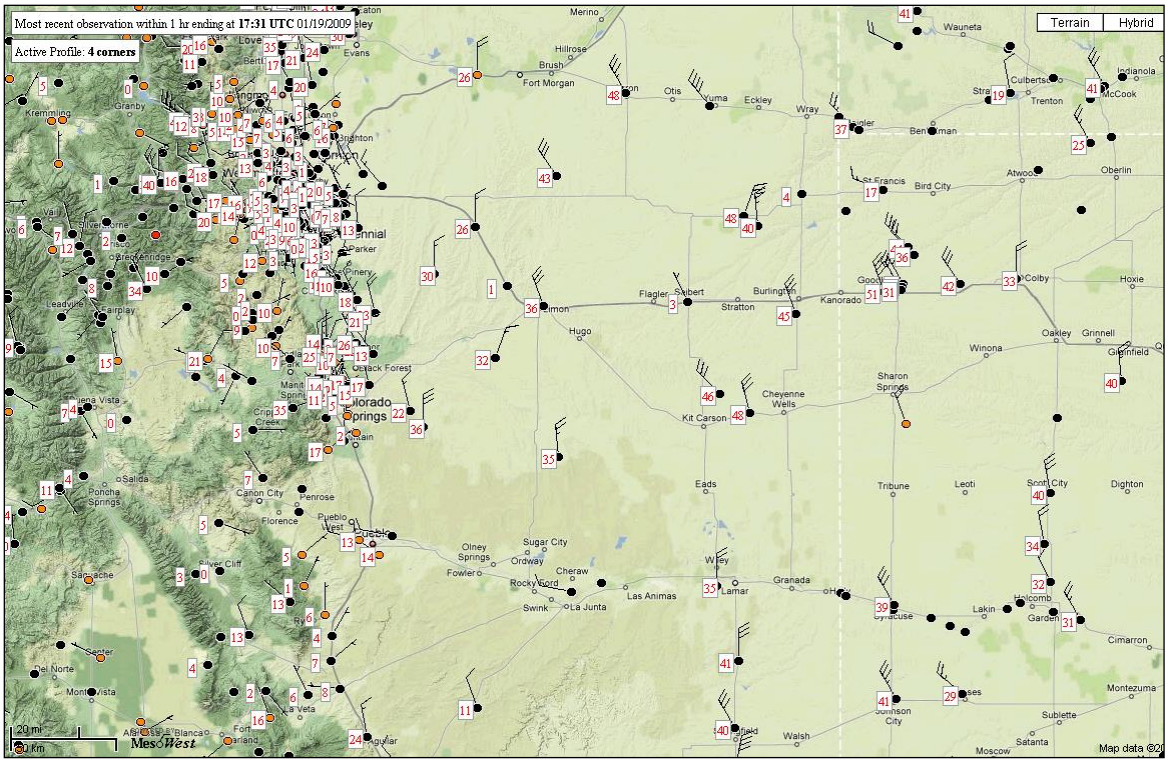


Figure A-25. Wind directions and gust speeds in mph in eastern Colorado and western Kansas 17:31 UTC January 19, 2009 (10:31 AM MST on January 19, 2009). (http://mesowest.utah.edu/index.html)

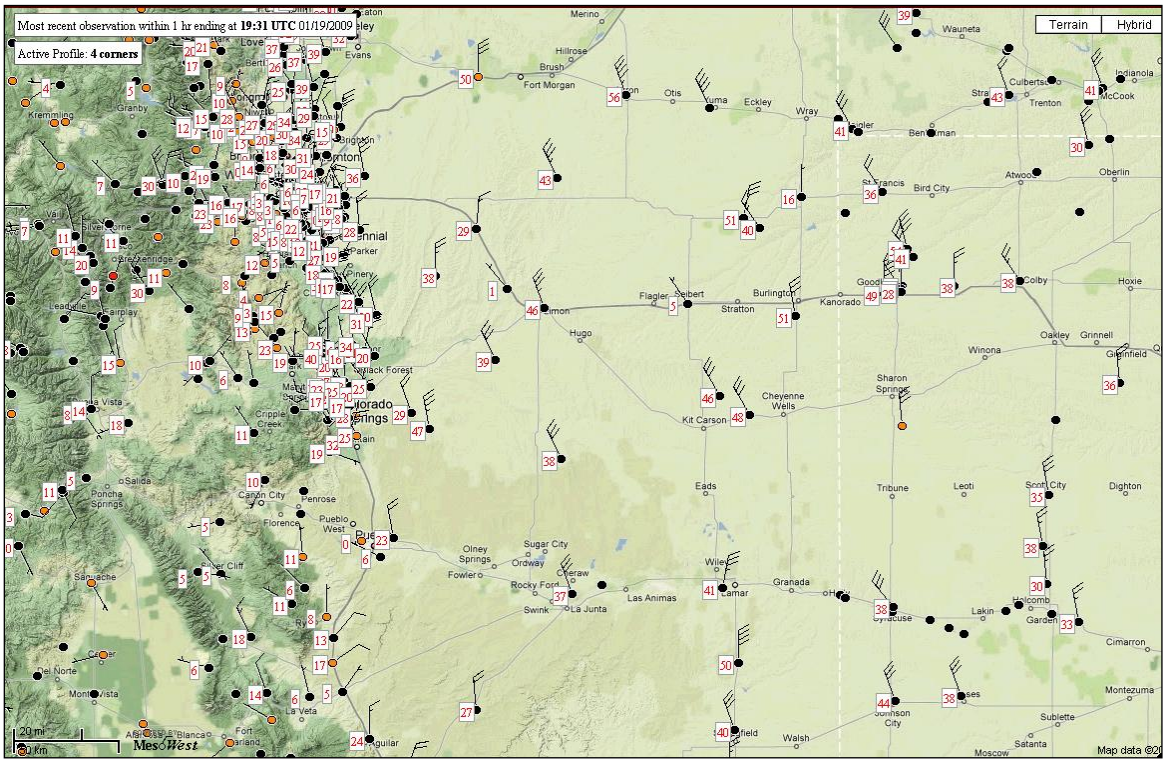


Figure A-26. Wind directions and gust speeds in mph in eastern Colorado and western Kansas 19:31 UTC January 19, 2009 (12:31 PM MST on January 19, 2009). (http://mesowest.utah.edu/index.html)

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.*

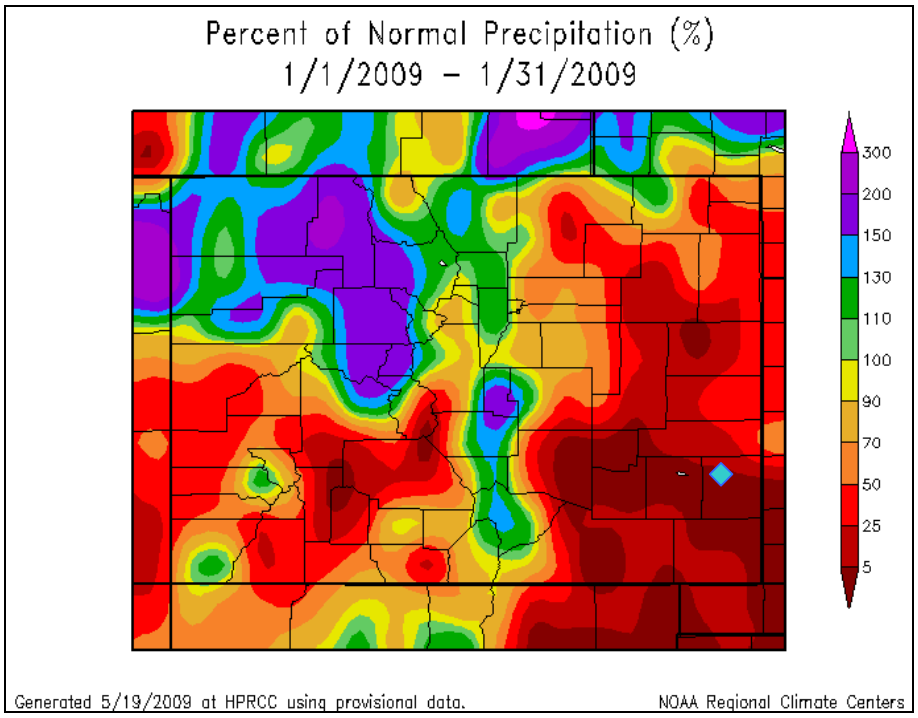


Figure A-27. Percent of Normal Precipitation for January 2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_userdate&daterange=Jan&year=09). Blue diamond shows the approximate location of Lamar.

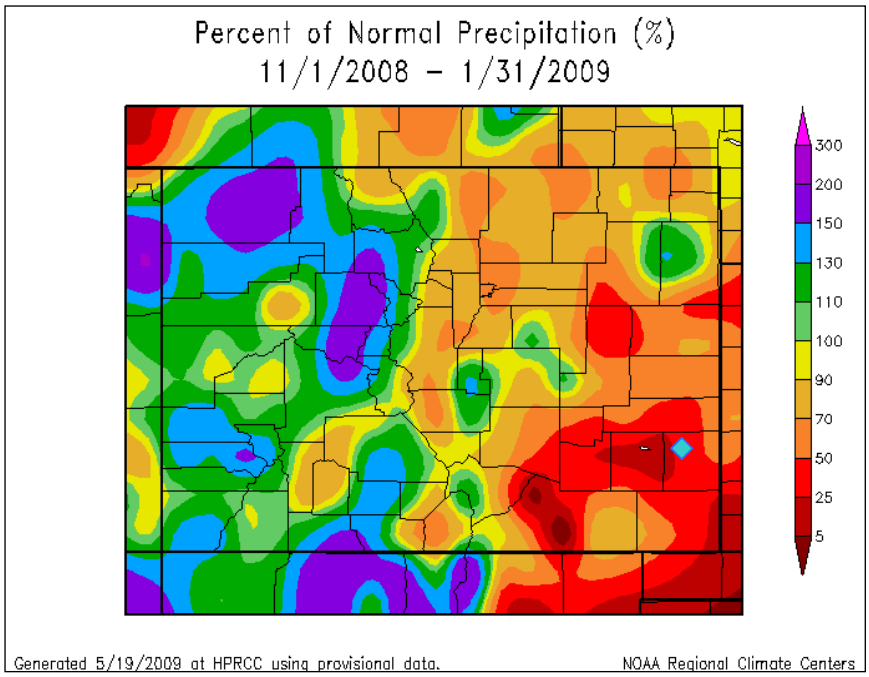


Figure A-28. Percent of Normal Precipitation for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm). Blue diamond shows the approximate location of Lamar.

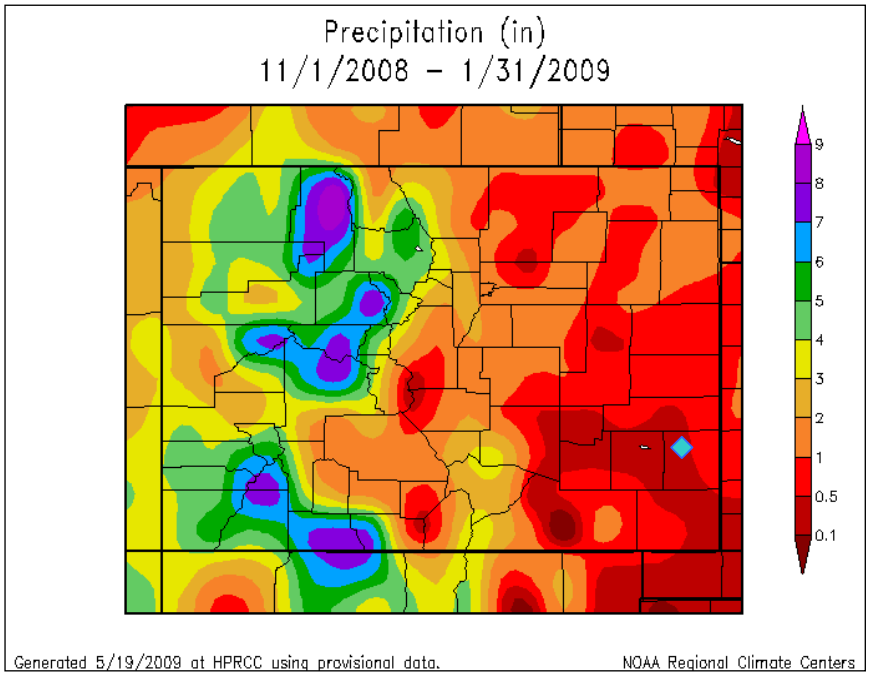


Figure A-29. Precipitation in inches for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm). Blue diamond shows the approximate location of Lamar.

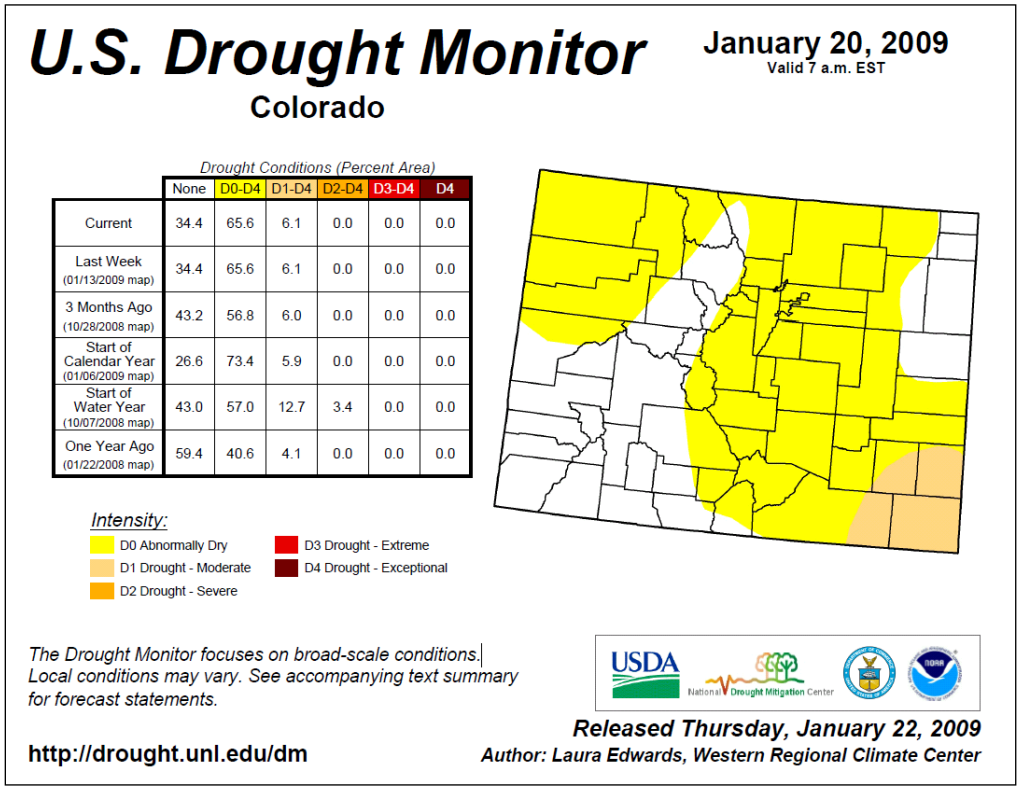


Figure A-30. Drought status for the Colorado on January 20, 2009 (source: the USDA, NOAA, and the National Drought Mitigation Center at: http://drought.unl.edu/dm/archive.html).

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

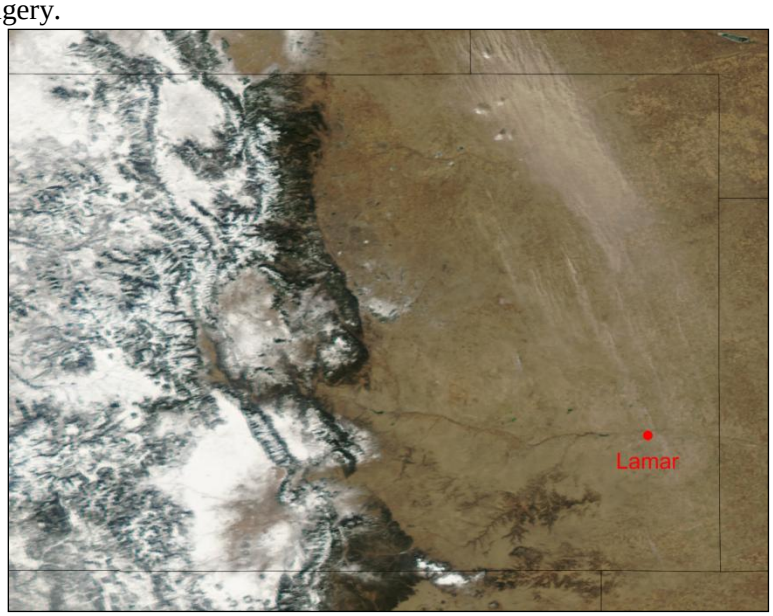
Table A-5. Wind and weather observations for Limon, Colorado, reported by the University of Utah MesoWest site (http://mesowest.utah.edu/index.html) for January 19, 2009. Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

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

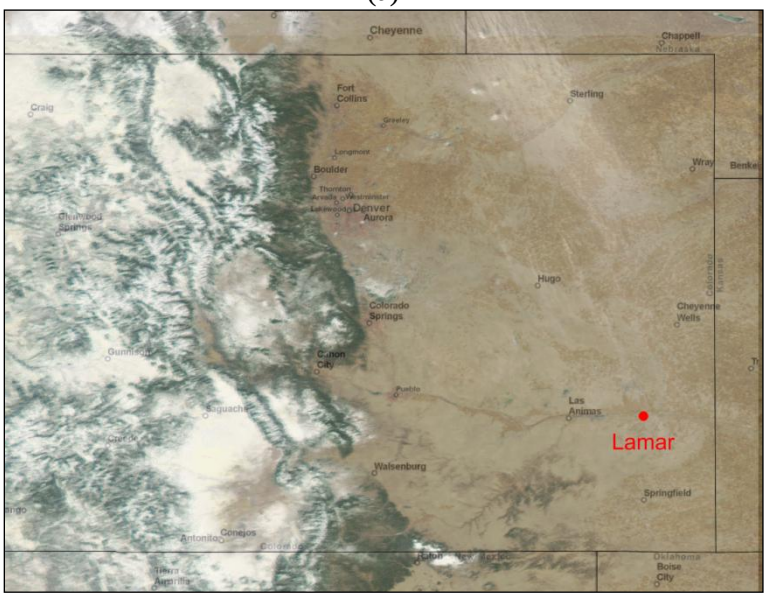
Table A-6. Wind and weather observations for Lamar, Colorado, reported by the University of Utah MesoWest site (http://mesowest.utah.edu/index.html) for January 19, 2009. Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

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).

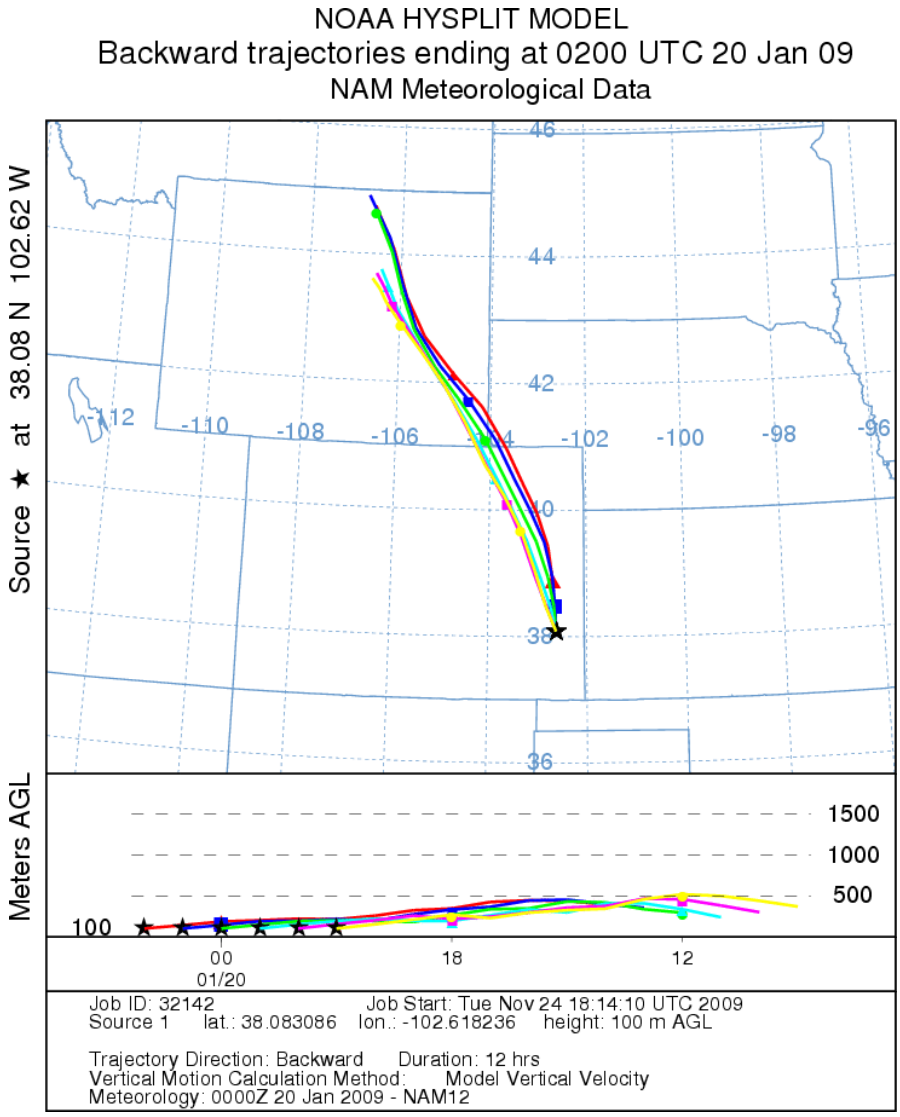


Figure A-32. NOAA HYSPLIT 12-hour back trajectory plots for each hour during the windiest period on January 19, 2009. The HYSPLIT model run was based on data from the high-resolution 12-kilometer grid spacing NAM numerical weather model.

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 PM_{10} monitoring sites in Lamar? Three categories are considered here. The first category includes local sources within the Lamar PM_{10} Attainment/Maintenance Plan area, which is shown along with land use categories in Figures A-34 through A-36. The land use categories within the Attainment/Maintenance Plan area 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 "Best Available Control Measures" have been applied to reduce fugitive dust. Roads within the Attainment/Maintenance Plan area 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 $\mu g/m^3$ at the Red Barn station, well below the 24-hour 150 $\mu g/m^3$ PM_{10} standard."

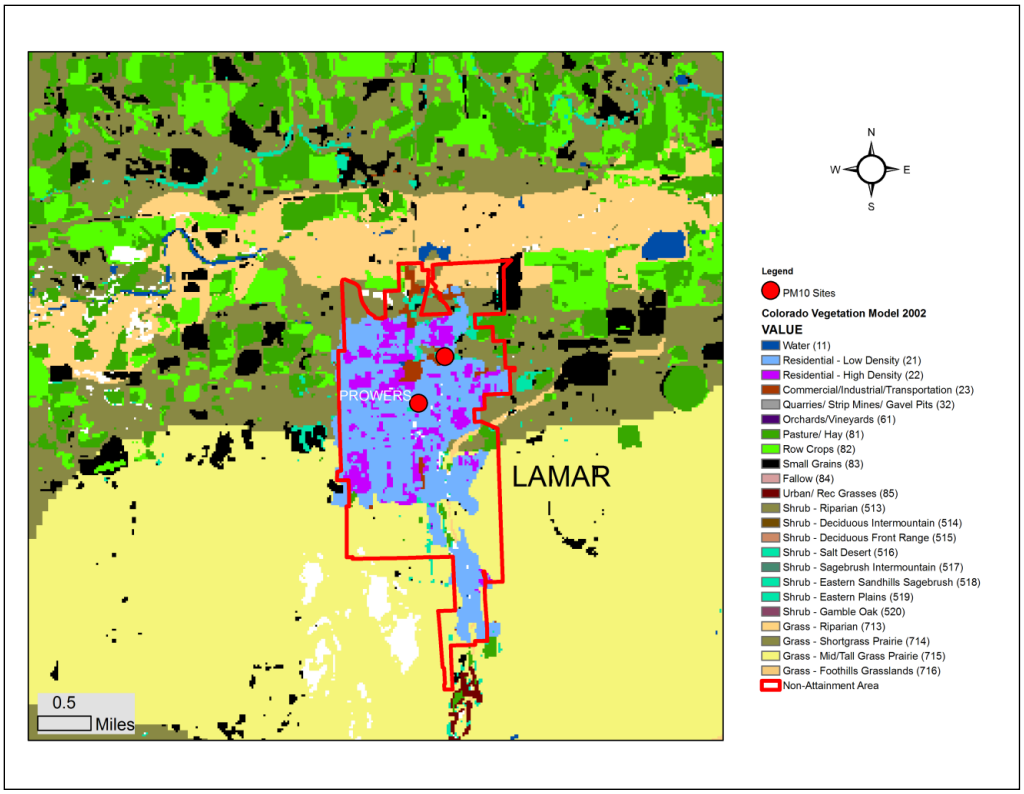


Figure A-34. The Lamar PM_{10} Attainment/Maintenance Plan Area (outlined in red) and vegetative cover and land use categories.

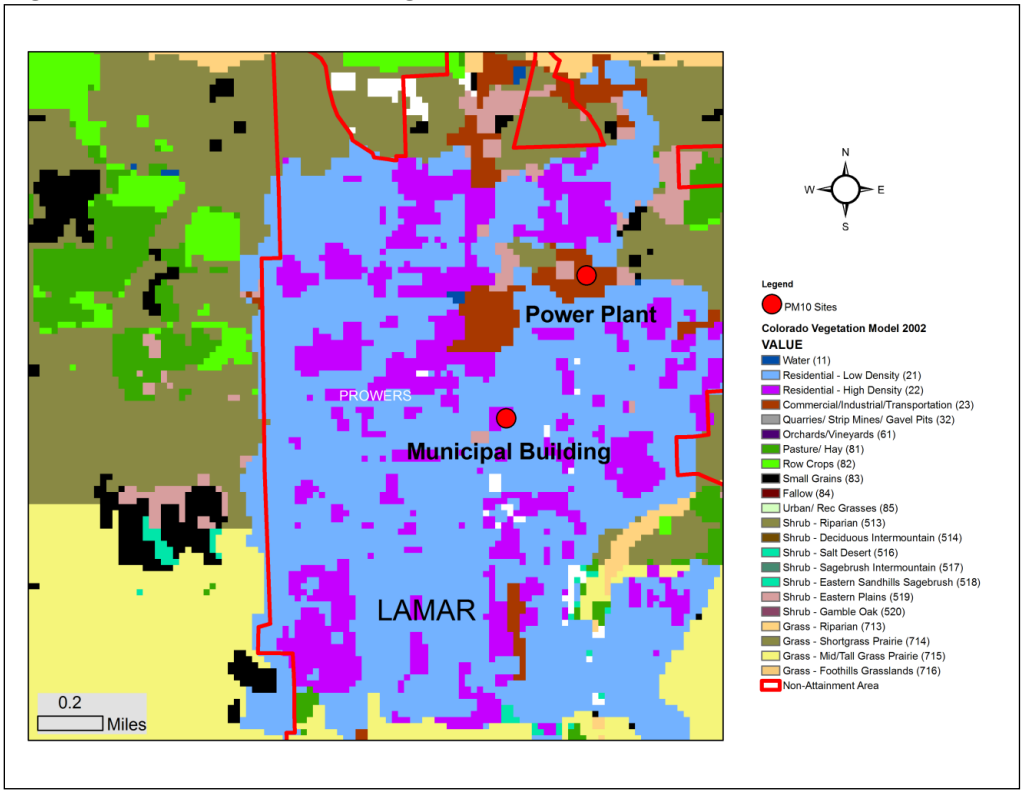


Figure A-35. The Lamar PM_{10} Attainment/Maintenance Plan Area (outlined in red), locations of the Lamar PM_{10} monitors, and vegetative cover and land use categories.

Figure A-36. Aerial view of the Lamar PM_{10} monitoring sites.

There are no extensive areas of significant fugitive dust sources within the Attainment/Maintenance Plan area (see Colorado Department of Public Health and Environment, 2001, for emission inventories). Reasonable control measures have been implemented by the Lamar PM_{10} SIP for both the Attainment/Maintenance Plan area and Prowers County. Sources for wind blown dust within the Attainment/Maintenance Plan area area are likely dwarfed by natural and agricultural sources outside of the Attainment/Maintenance Plan area.

It is possible, however, that dust sources within the Power Plant property fence line 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 PM_{10} 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 $\mu g/m^3$ and 39 $\mu g/m^3$, 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.

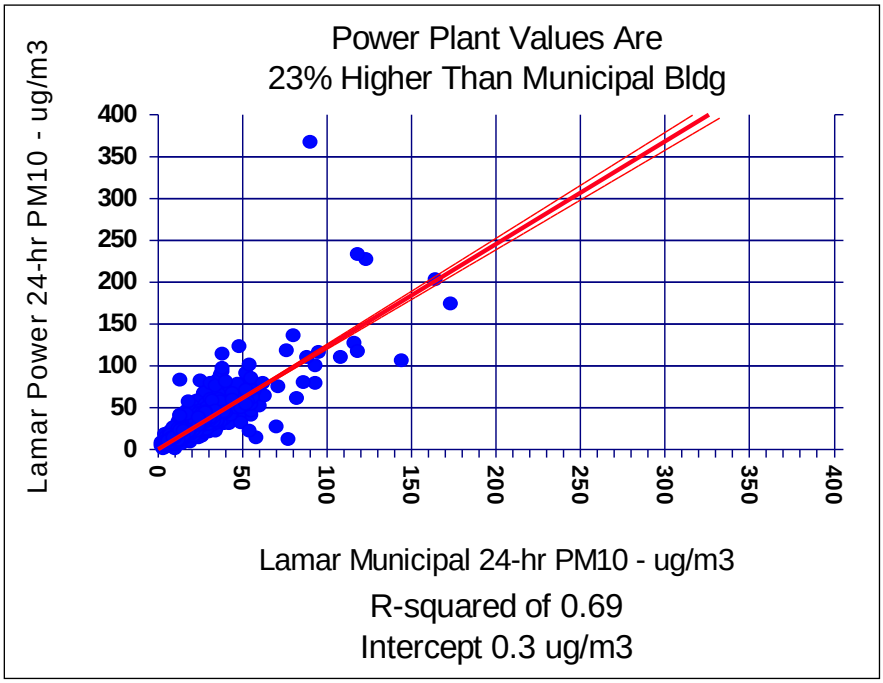


Figure A-37. Linear regression between Lamar Power Plant and Municipal Building PM_{10} concentrations for January 2004 through February of 2009. (The slope is 1.23.)

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 µg/m^3 and 56 µg/m^3, 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)

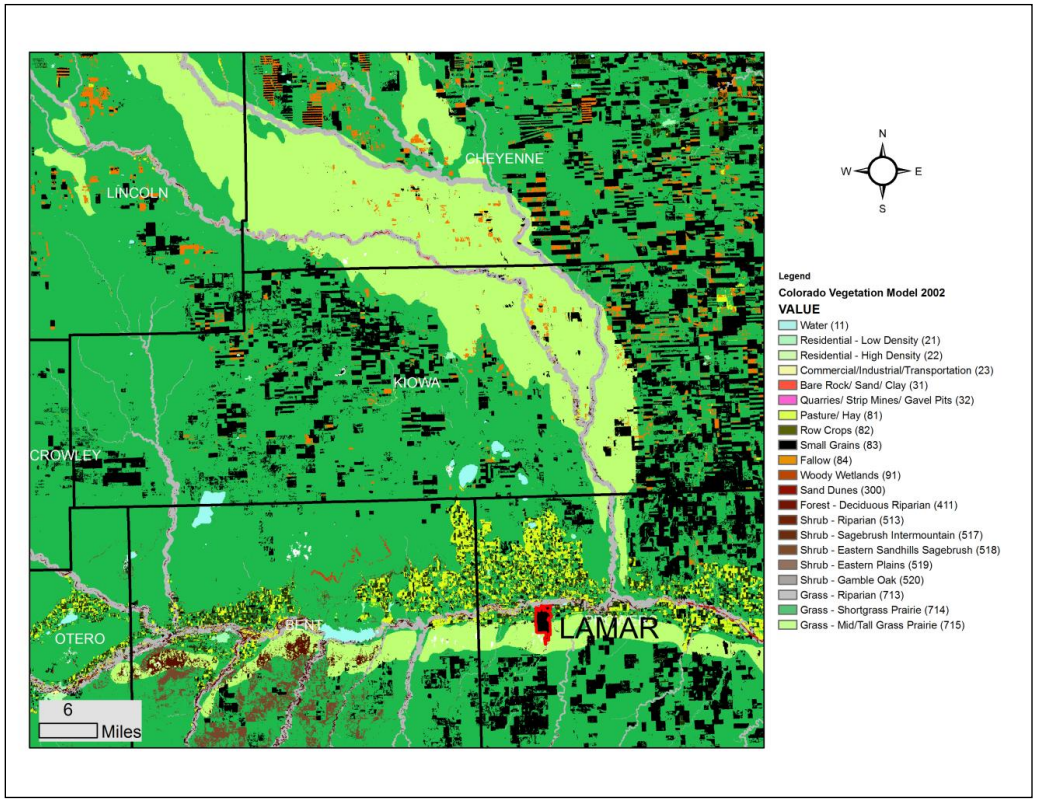


Figure A-39. Vegetative cover and land use categories in the vicinity of Lamar, Colorado.

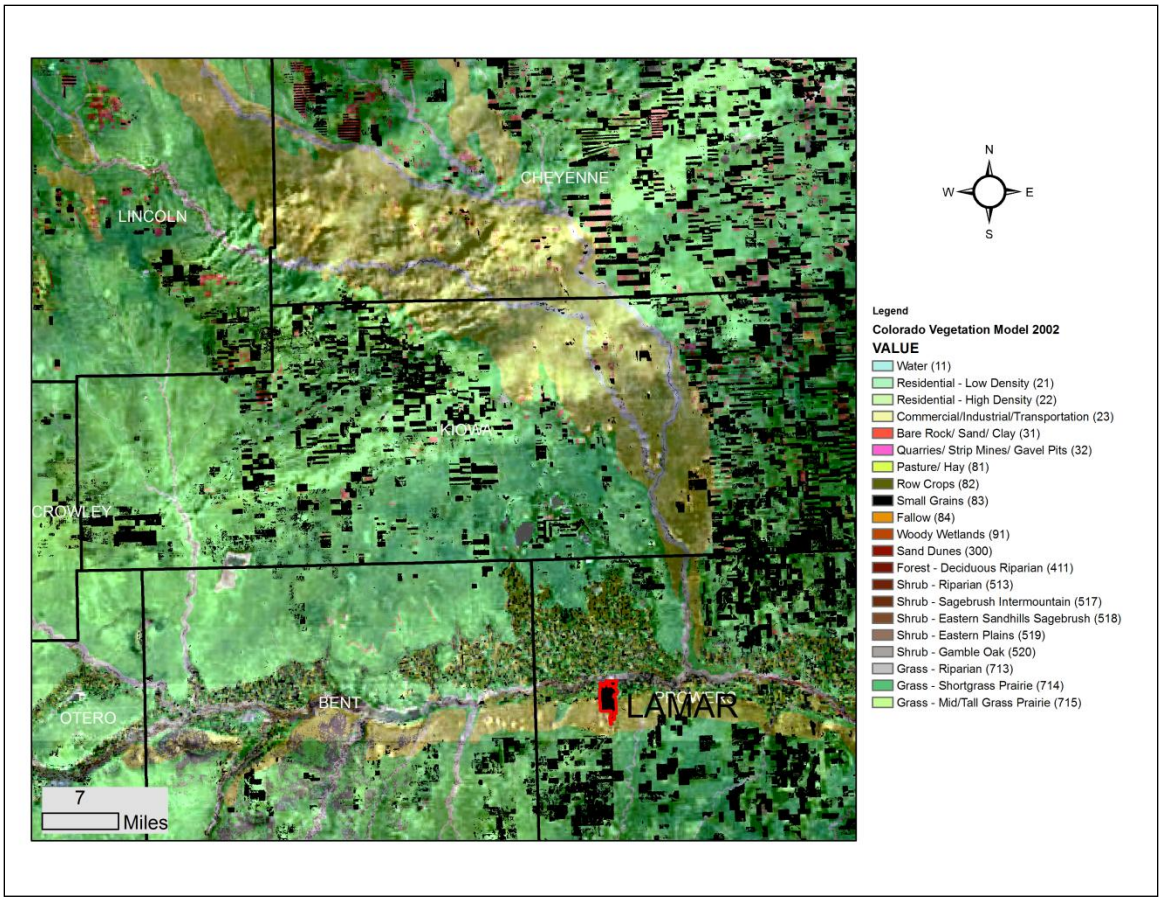


Figure A-40. Vegetative cover and land use categories in the vicinity of Lamar, Colorado, superimposed with the satellite image from Figure A-38 for April 18, 2004.

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

PM_{10} 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 PM_{10} 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 PM_{10} 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 PM_{10} 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 PM_{10} Attainment/Maintenance Plan area and Prowers County. *Blowing dust sources within the NAA and Prowers County have been reasonably controlled, as demonstrated by the PM_{10} 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 Attainment/Maintenance Plan area.

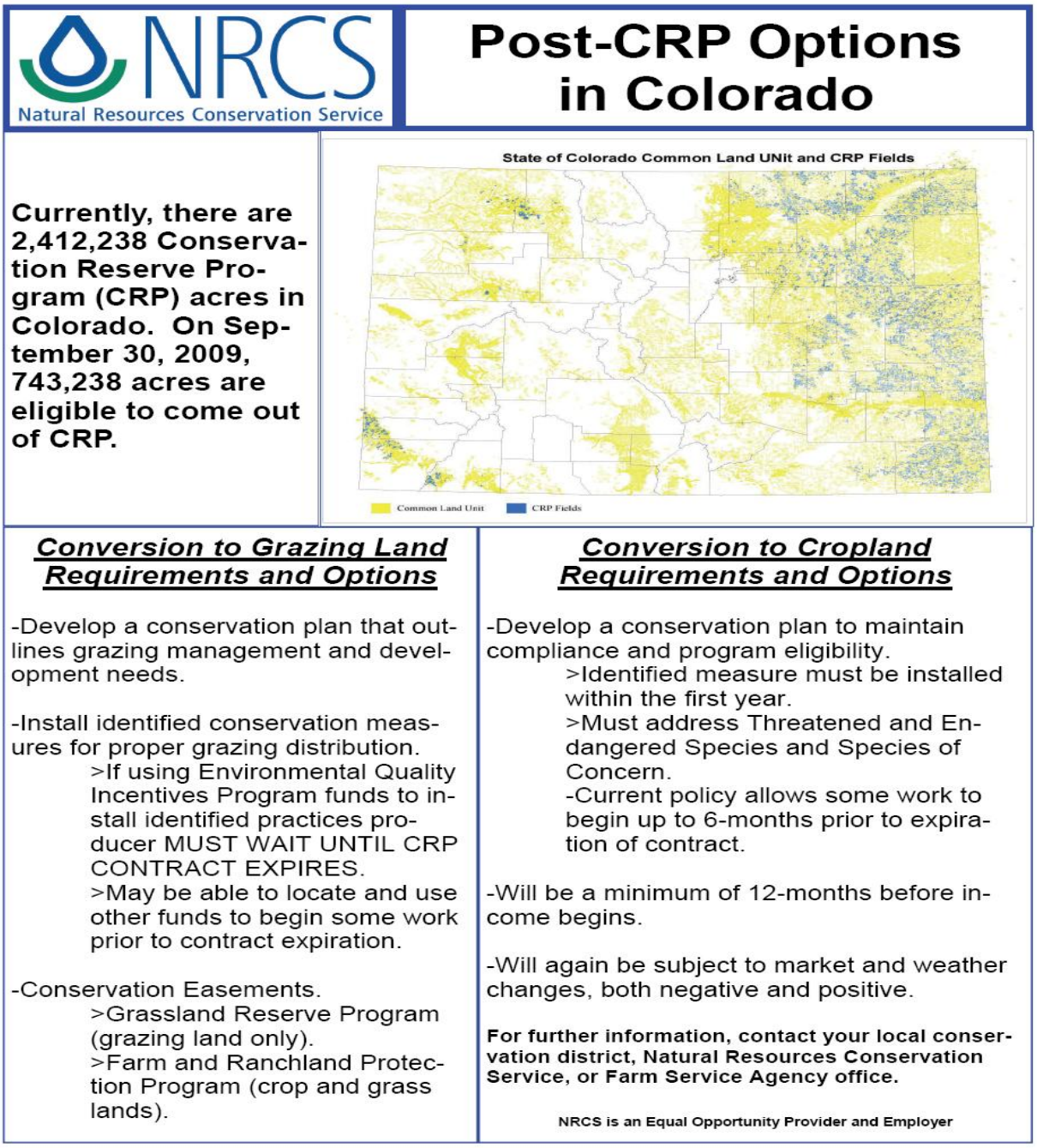


Figure A-41. Colorado NRCS overview of Post-CRP options in Colorado.

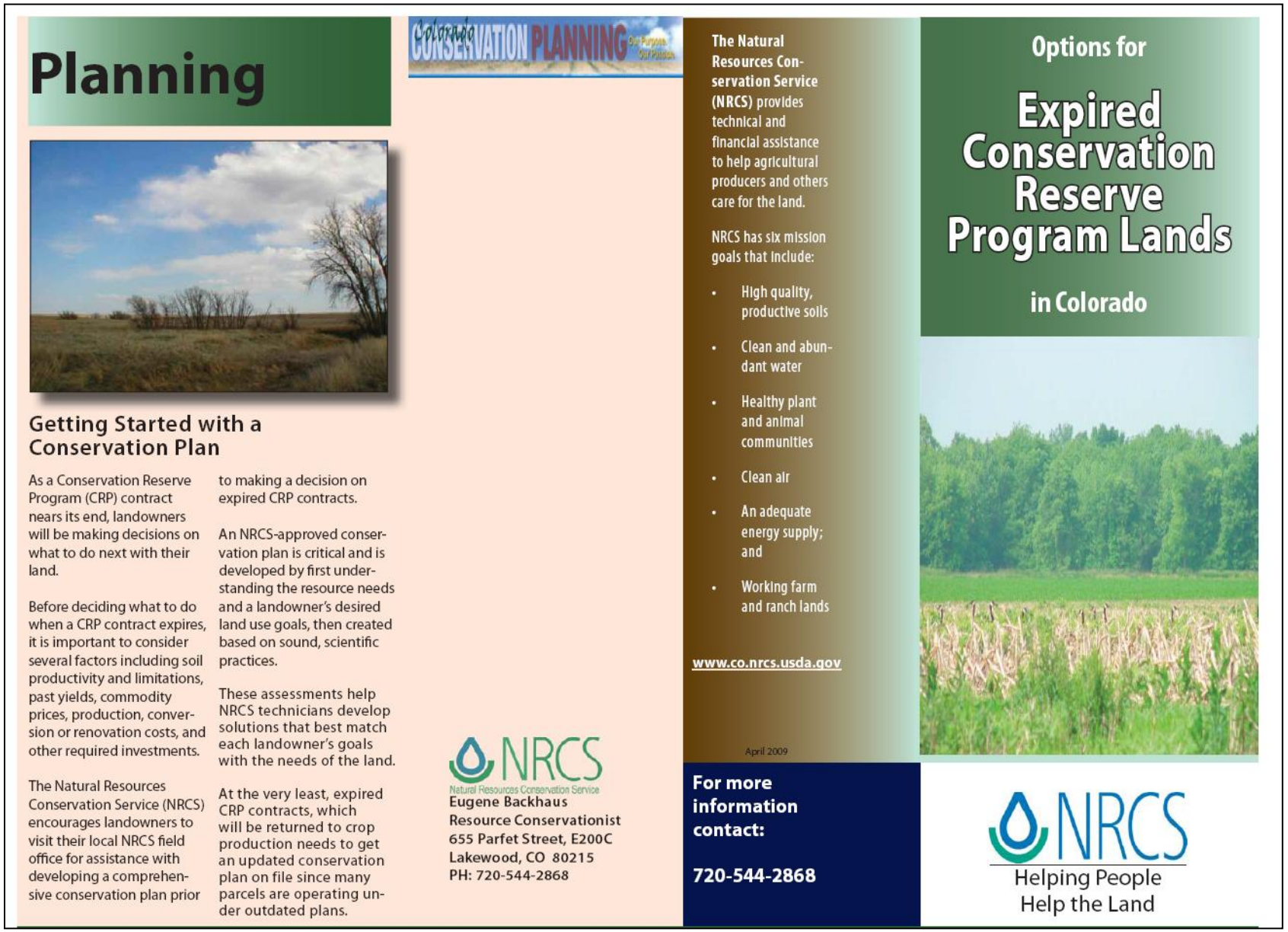


Figure A-42. NRCS brochure on Post-CRP options, page 1.

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 grazing land.

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. *PM_{10} 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.

Attachment B - Satellite Discussion for January 19, 2009

* Monday, January 19, 2009 *

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY THROUGH 0030Z JANUARY 20, 2009 (Smoke Text Product - Satellite Services Division)

Colorado:
Blowing dust earlier this afternoon along the border of Colorado and far western Nebraska advanced south into the eastern region of the state.

Gulf Coast/Texas Coastline:
Blowing dust over the Gulf of Mexico earlier today was observed moving to the south and east, following a cold front. Also in Kleberg County, a heavy smoke plume was observed advancing to the southeast at a quick pace over the Gulf of Mexico. The plume extended 350km from the source. Lastly, several light smoke plumes along the Texas coastline were observed moving to the southeast over the Gulf as well. Most of these lighter plumes extended out at least 50-100km from their sources.

Florida:
In Brevard County, a light smoke plume was seen moving to the northeast and extended 150km out, moving over the Atlantic Ocean.

Attachment C - Fire Weather Watches and Red Flag Warnings January 19, 2009

NWS SRRS PRODUCTS FOR:
2009011900 to 2009012007

WWUS85 KBOU 191721
RFWBOU
RED FLAG WARNING
NATIONAL WEATHER SERVICE DENVER CO
1021 AM MST MON JAN 19 2009
...A RED FLAG WARNING FOR STRONG GUSTY WINDS...LOW HUMIDITIES AND
DRY FUELS HAS BEEN ISSUED UNTIL 5 PM MST TODAY FOR THE PLAINS OF
NORTHEAST COLORADO...INCLUDING FIRE WEATHER ZONES 238 AND 242
THROUGH 251...
.STRONG NORTHERLY WINDS AND LOW HUMIDITIES OVER THE PLAINS OF
NORTHEAST COLORADO WILL BE PERSISTENT THROUGH THIS AFTERNOON. IN
COORDINATION WITH THE AREA LAND MANAGEMENT AGENCIES...FUELS ARE A
CONCERN OVER THESE AREAS. WINDS SHOULD DECREASE AFTER 5 PM THIS
EVENING.
COZ238-242>251-200000-
/O.NEW.KBOU.FW.W.0001.090119T1721Z-090120T0000Z/
LARIMER COUNTY BELOW 6000 FEET/NORTHWEST WELD COUNTY-
NORTHEAST WELD COUNTY-CENTRAL AND SOUTH WELD COUNTY-MORGAN COUNTY-
CENTRAL AND EAST ADAMS AND ARAPAHOE COUNTIES-
NORTH AND NORTHEAST ELBERT COUNTY BELOW 6000 FEET/NORTH LINCOLN
COUNTY-
SOUTHEAST ELBERT COUNTY BELOW 6000 FEET/SOUTH LINCOLN COUNTY-
LOGAN COUNTY-WASHINGTON COUNTY-SEDGWICK COUNTY-PHILLIPS COUNTY-
INCLUDING...FORT COLLINS...HEREFORD...LOVELAND...NUNN...
WEST PAWNEE GRASSLANDS...BRIGGSDALE...EAST PAWNEE GRASSLANDS...
GROVER...PAWNEE BUTTES...RAYMER...STONEHAM...EATON...
FORT LUPTON...GREELEY...ROGGEN...BRUSH...FORT MORGAN...GOODRICH...
WIGGINS...BENNETT...BYERS...DEER TRAIL...LEADER...AGATE...HUGO...
LIMON...MATHESON...FORDER...KARVAL...KUTCH...PUNKIN CENTER...
CROOK...MERINO...STERLING...PEETZ...AKRON...COPE...LAST CHANCE...
OTIS...JULESBURG...OVID...SEDGWICK...AMHERST...HAXTUN...HOLYOKE
1021 AM MST MON JAN 19 2009
...RED FLAG WARNING IN EFFECT UNTIL 5 PM MST THIS AFTERNOON
FOR STRONG WINDS AND LOW HUMIDITIES...
THE NATIONAL WEATHER SERVICE IN DENVER HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT UNTIL 5 PM MST THIS AFTERNOON.
NORTH TO NORTHWEST WINDS OF 20 TO 35 MPH WITH GUSTS REACHING 50
MPH WILL SPREAD ACROSS MUCH OF THE PLAINS OF NORTHEAST COLORADO.
RELATIVE HUMIDITIES ARE EXPECTED TO DROP BELOW 15 PERCENT ALONG
WITH DRY FUELS. THE GUSTY WINDS WILL CONTINUE THROUGH THIS
AFTERNOON THEN DECREASE AROUND 5 PM WITH RELATIVE HUMIDITIES
RECOVERING SHORTLY AFTER.
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING OR IMMINENT. PLEASE ADVISE THE APPROPRIATE
OFFICIALS AND FIRE CREWS IN THE FIELD OF THIS RED FLAG WARNING.
$$

WWUS85 KBOU 191721
RFWBOU
RED FLAG WARNING
NATIONAL WEATHER SERVICE DENVER CO
1021 AM MST MON JAN 19 2009
...A RED FLAG WARNING FOR STRONG GUSTY WINDS...LOW HUMIDITIES AND
DRY FUELS HAS BEEN ISSUED UNTIL 5 PM MST TODAY FOR THE PLAINS OF
NORTHEAST COLORADO...INCLUDING FIRE WEATHER ZONES 238 AND 242

THROUGH 251...
.STRONG NORTHERLY WINDS AND LOW HUMIDITIES OVER THE PLAINS OF
NORTHEAST COLORADO WILL BE PERSISTENT THROUGH THIS AFTERNOON. IN
COORDINATION WITH THE AREA LAND MANAGEMENT AGENCIES...FUELS ARE A
CONCERN OVER THESE AREAS. WINDS SHOULD DECREASE AFTER 5 PM THIS
EVENING.
COZ238-242>251-200000-
/O.NEW.KBOU.FW.W.0001.090119T1721Z-090120T0000Z/
LARIMER COUNTY BELOW 6000 FEET/NORTHWEST WELD COUNTY-
NORTHEAST WELD COUNTY-CENTRAL AND SOUTH WELD COUNTY-MORGAN COUNTY-
CENTRAL AND EAST ADAMS AND ARAPAHOE COUNTIES-
NORTH AND NORTHEAST ELBERT COUNTY BELOW 6000 FEET/NORTH LINCOLN
COUNTY-
SOUTHEAST ELBERT COUNTY BELOW 6000 FEET/SOUTH LINCOLN COUNTY-
LOGAN COUNTY-WASHINGTON COUNTY-SEDGWICK COUNTY-PHILLIPS COUNTY-
INCLUDING...FORT COLLINS...HEREFORD...LOVELAND...NUNN...
WEST PAWNEE GRASSLANDS...BRIGGSDALE...EAST PAWNEE GRASSLANDS...
GROVER...PAWNEE BUTTES...RAYMER...STONEHAM...EATON...
FORT LUPTON...GREELEY...ROGGEN...BRUSH...FORT MORGAN...GOODRICH...
WIGGINS...BENNETT...BYERS...DEER TRAIL...LEADER...AGATE...HUGO...
LIMON...MATHESON...FORDER...KARVAL...KUTCH...PUNKIN CENTER...
CROOK...MERINO...STERLING...PEETZ...AKRON...COPE...LAST CHANCE...
OTIS...JULESBURG...OVID...SEDGWICK...AMHERST...HAXTUN...HOLYOKE
1021 AM MST MON JAN 19 2009
...RED FLAG WARNING IN EFFECT UNTIL 5 PM MST THIS AFTERNOON
FOR STRONG WINDS AND LOW HUMIDITIES...
THE NATIONAL WEATHER SERVICE IN DENVER HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT UNTIL 5 PM MST THIS AFTERNOON.
NORTH TO NORTHWEST WINDS OF 20 TO 35 MPH WITH GUSTS REACHING 50
MPH WILL SPREAD ACROSS MUCH OF THE PLAINS OF NORTHEAST COLORADO.
RELATIVE HUMIDITIES ARE EXPECTED TO DROP BELOW 15 PERCENT ALONG
WITH DRY FUELS. THE GUSTY WINDS WILL CONTINUE THROUGH THIS
AFTERNOON THEN DECREASE AROUND 5 PM WITH RELATIVE HUMIDITIES
RECOVERING SHORTLY AFTER.
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING OR IMMINENT. PLEASE ADVISE THE APPROPRIATE
OFFICIALS AND FIRE CREWS IN THE FIELD OF THIS RED FLAG WARNING.
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NWS SRRS PRODUCTS FOR:
2009011900 to 2009012007

WWUS85 KPUB 190000
RFWPUB
URGENT - FIRE WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
500 PM MST SUN JAN 18 2009
...A FIRE WEATHER WATCH IS IN EFFECT FOR LOW HUMIDITIES AND
STRONG GUSTY WINDS FROM 11 AM TO 5 PM MST MONDAY FOR FIRE WEATHER
ZONES 226 THROUGH 237. THIS INCLUDES ALL OF THE SOUTHEAST COLORADO
PLAINS FROM THE I-25 CORRIDOR EASTWARD TO THE KANSAS BORDER...
.A FIRE WEATHER WATCH HAS BEEN ISSUED FOR FIRE WEATHER ZONES 226
THROUGH 237 FROM 11 AM TO 5 PM MST MONDAY. THIS WATCH INCLUDES ALL
OF THE SOUTHEAST COLORADO PLAINS FROM THE I-25 CORRIDOR...EASTWARD
TO THE KANSAS BORDER. THE FIRE WEATHER WATCH IS IN EFFECT FOR
STRONG GUSTY WINDS AND LOW HUMIDITIES.

COZ234>237-191600-
/O.EXP.KPUB.FW.W.0001.000000T0000Z-090119T0000Z/
/O.CON.KPUB.FW.A.0001.090119T1800Z-090120T0000Z/
KIOWA COUNTY-BENT COUNTY-PROWERS COUNTY-BACA COUNTY-
500 PM MST SUN JAN 18 2009
...FIRE WEATHER WATCH REMAINS IN EFFECT FROM MONDAY MORNING
THROUGH MONDAY AFTERNOON...
...RED FLAG WARNING WILL EXPIRE AT 5 PM MST THIS AFTERNOON...
THE RED FLAG WARNING WILL EXPIRE AT 5 PM MST THIS AFTERNOON. A
FIRE WEATHER WATCH REMAINS IN EFFECT FROM MONDAY MORNING THROUGH
MONDAY AFTERNOON.
ON MONDAY WEST TO NORTHWEST WINDS 15 TO 30 MPH WITH GUSTS OF 35
TO 45 MPH ARE EXPECTED TO DEVELOP...WITH HUMIDITIES DROPPING TO
BETWEEN 5 TO 15 PERCENT. THESE CONDITIONS WILL COMBINE WITH DRY FUELS
TO PRODUCE THE POTENTIAL FOR RED FLAG CONDITIONS ACROSS THE FAR
EASTERN COLORADO PLAINS ON MONDAY.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A FIRE WEATHER WATCH MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE FORECAST TO OCCUR. LISTEN FOR LATER FORECASTS AND POSSIBLE
RED FLAG WARNINGS.
&&
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COZ226>233-191600-
/O.CON.KPUB.FW.A.0001.090119T1800Z-090120T0000Z/
NORTHERN EL PASO COUNTY-SOUTHERN EL PASO COUNTY-PUEBLO COUNTY-
HUERFANO COUNTY-WESTERN LAS ANIMAS COUNTY-CROWLEY COUNTY-
OTERO COUNTY-EASTERN LAS ANIMAS COUNTY-
500 PM MST SUN JAN 18 2009
...FIRE WEATHER WATCH REMAINS IN EFFECT FROM MONDAY MORNING
THROUGH MONDAY AFTERNOON...
A FIRE WEATHER WATCH REMAINS IN EFFECT FROM MONDAY MORNING
THROUGH MONDAY AFTERNOON.
WEST TO NORTHWEST WINDS 15 TO 30 MPH WITH GUSTS OF 35 TO 45 MPH
AND HUMIDITIES OF 5 TO 15 PERCENT WILL COMBINE WITH DRY FUELS TO
PRODUCE THE POTENTIAL FOR RED FLAG CONDITIONS ACROSS THE EASTERN
COLORADO PLAINS MONDAY AFTERNOON.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A FIRE WEATHER WATCH MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE FORECAST TO OCCUR. LISTEN FOR LATER FORECASTS AND POSSIBLE
RED FLAG WARNINGS.
&&
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WWUS85 KPUB 191108
RFWPUB
URGENT - FIRE WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
408 AM MST MON JAN 19 2009
...A RED FLAG WARNING FOR STRONG GUSTY WINDS...LOW HUMIDITIES AND
DRY FUELS HAS BEEN ISSUED FROM 11 AM TO 5 PM MST TODAY...FOR FIRE
WEATHER ZONES 226 THROUGH 228...AND 231 THROUGH 237...WHICH
INCLUDES EL PASO...PUEBLO...CROWLEY...OTERO...KIOWA...BENT...
PROWERS...BACA AND EASTERN LAS ANIMAS COUNTIES...
.THE NATIONAL WEATHER SERVICE IN PUEBLO...IN COORDINATION WITH
AREA LAND MANAGEMENT AGENCIES...HAS ISSUED A RED FLAG WARNING FROM
11 AM TO 5 PM TODAY FOR MUCH OF THE SOUTHEAST PLAINS. STRONG
GUSTY NORTH WINDS AND LOW HUMIDITIES ARE EXPECTED TO SPREAD ACROSS
THE SOUTHEAST PLAINS AGAIN THIS AFTERNOON...WITH RED FLAG
CONDITIONS SPREADING AS FAR WEST AS THE NORTHERN I-25 CORRIDOR

ACROSS EL PASO AND PUEBLO COUNTIES.
COZ229-230-191215-
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COZ226>228-231>237-200000-
/O.UPG.KPUB.FW.A.0001.090119T1800Z-090120T0000Z/
/O.NEW.KPUB.FW.W.0002.090119T1800Z-090120T0000Z/
NORTHERN EL PASO COUNTY-SOUTHERN EL PASO COUNTY-PUEBLO COUNTY-
CROWLEY COUNTY-OTERO COUNTY-EASTERN LAS ANIMAS COUNTY-
KIOWA COUNTY-BENT COUNTY-PROWERS COUNTY-BACA COUNTY-
408 AM MST MON JAN 19 2009
...RED FLAG WARNING IN EFFECT FROM 11 AM THIS MORNING TO 5 PM MST
THIS AFTERNOON...
THE NATIONAL WEATHER SERVICE IN PUEBLO HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT FROM 11 AM THIS MORNING TO 5 PM MST
THIS AFTERNOON. THE FIRE WEATHER WATCH IS NO LONGER IN EFFECT.
GUSTY NORTH TO NORTHWEST WINDS OF 15 TO 30 MPH WITH GUSTS UP TO 40
MPH WILL SPREAD ACROSS MUCH OF THE SOUTHEAST PLAINS THIS
AFTERNOON. COMBINED WITH HUMIDITIES BELOW 15 PERCENT...AND DRY
FUELS...CONDITIONS FAVORABLE FOR EXTREME FIRE BEHAVIOR WILL DEVELOP
THIS
AFTERNOON.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND WARM TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL.
&&
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WWUS85 KPUB 191108
RFWPUB
URGENT - FIRE WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
408 AM MST MON JAN 19 2009
...A RED FLAG WARNING FOR STRONG GUSTY WINDS...LOW HUMIDITIES AND
DRY FUELS HAS BEEN ISSUED FROM 11 AM TO 5 PM MST TODAY...FOR FIRE
WEATHER ZONES 226 THROUGH 228...AND 231 THROUGH 237...WHICH
INCLUDES EL PASO...PUEBLO...CROWLEY...OTERO...KIOWA...BENT...
PROWERS...BACA AND EASTERN LAS ANIMAS COUNTIES...
.THE NATIONAL WEATHER SERVICE IN PUEBLO...IN COORDINATION WITH
AREA LAND MANAGEMENT AGENCIES...HAS ISSUED A RED FLAG WARNING FROM
11 AM TO 5 PM TODAY FOR MUCH OF THE SOUTHEAST PLAINS. STRONG
GUSTY NORTH WINDS AND LOW HUMIDITIES ARE EXPECTED TO SPREAD ACROSS
THE SOUTHEAST PLAINS AGAIN THIS AFTERNOON...WITH RED FLAG
CONDITIONS SPREADING AS FAR WEST AS THE NORTHERN I-25 CORRIDOR
ACROSS EL PASO AND PUEBLO COUNTIES.
COZ226>228-231>237-200000-
/O.UPG.KPUB.FW.A.0001.090119T1800Z-090120T0000Z/
/O.NEW.KPUB.FW.W.0002.090119T1800Z-090120T0000Z/
NORTHERN EL PASO COUNTY-SOUTHERN EL PASO COUNTY-PUEBLO COUNTY-
CROWLEY COUNTY-OTERO COUNTY-EASTERN LAS ANIMAS COUNTY-
KIOWA COUNTY-BENT COUNTY-PROWERS COUNTY-BACA COUNTY-
408 AM MST MON JAN 19 2009
...RED FLAG WARNING IN EFFECT FROM 11 AM THIS MORNING TO 5 PM MST
THIS AFTERNOON...
THE NATIONAL WEATHER SERVICE IN PUEBLO HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT FROM 11 AM THIS MORNING TO 5 PM MST
THIS AFTERNOON. THE FIRE WEATHER WATCH IS NO LONGER IN EFFECT.
GUSTY NORTH TO NORTHWEST WINDS OF 15 TO 30 MPH WITH GUSTS UP TO 40

MPH WILL SPREAD ACROSS MUCH OF THE SOUTHEAST PLAINS THIS
AFTERNOON. COMBINED WITH HUMIDITIES BELOW 15 PERCENT...AND DRY
FUELS...CONDITIONS FAVORABLE FOR EXTREME FIRE BEHAVIOR WILL DEVELOP
THIS
AFTERNOON.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND WARM TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL.
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WWUS85 KPUB 192221
RFWPUB
URGENT - FIRE WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
321 PM MST MON JAN 19 2009
...A RED FLAG WARNING FOR STRONG GUSTY WINDS...LOW HUMIDITIES AND
DRY FUELS HAS BEEN EXPANDED TO INCLUDE FIRE WEATHER ZONES 229 AND
230 AND HAS BEEN EXTENDED UNTIL 6 PM MST. THIS WARNING NOW COVERS
ALL OF THE SOUTHEAST COLORADO PLAINS FROM THE EAST SLOPES OF THE
MOUNTAINS OUT TO THE KANSAS BORDER...
.THE NATIONAL WEATHER SERVICE IN PUEBLO...IN COORDINATION WITH
AREA LAND MANAGEMENT AGENCIES...HAS ISSUED A RED FLAG WARNING
IN EFFECT UNTIL 6 PM MST FOR ALL OF THE SOUTHEAST COLORADO PLAINS
FROM THE EAST SLOPES OF THE MOUNTAINS OUT TO THE KANSAS BORDER. STRONG
GUSTY NORTH WINDS AND LOW HUMIDITIES ARE EXPECTED TO CONTINUE
THROUGH EARLY THIS EVENING ACROSS THE SOUTHEAST COLORADO PLAINS.
COZ229-230-200100-
/O.EXB.KPUB.FW.W.0002.000000T0000Z-090120T0100Z/
HUERFANO COUNTY-WESTERN LAS ANIMAS COUNTY-
321 PM MST MON JAN 19 2009
...RED FLAG WARNING IN EFFECT UNTIL 6 PM MST THIS EVENING...
THE NATIONAL WEATHER SERVICE IN PUEBLO HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT UNTIL 6 PM MST THIS EVENING.
NORTHERLY WINDS OF 15 TO 30 MPH COMBINED WITH HUMIDITIES BELOW 15
PERCENT AND DRY FUELS WILL CREATE CONDITIONS FAVORABLE FOR EXTREME
FIRE BEHAVIOR THIS EVENING.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND WARM TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL.
&&
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COZ226>228-231>237-200100-
/O.EXT.KPUB.FW.W.0002.000000T0000Z-090120T0100Z/
NORTHERN EL PASO COUNTY-SOUTHERN EL PASO COUNTY-PUEBLO COUNTY-
CROWLEY COUNTY-OTERO COUNTY-EASTERN LAS ANIMAS COUNTY-
KIOWA COUNTY-BENT COUNTY-PROWERS COUNTY-BACA COUNTY-
321 PM MST MON JAN 19 2009
...RED FLAG WARNING NOW IN EFFECT UNTIL 6 PM MST THIS EVENING...
THE RED FLAG WARNING IS NOW IN EFFECT UNTIL 6 PM MST THIS
EVENING.
NORTHERLY WINDS OF 15 TO 30 MPH WITH GUSTS TO 50 MPH WILL COMBINE
WITH HUMIDITIES BELOW 15 PERCENT AND DRY FUELS TO CREATE
CONDITIONS FAVORABLE FOR EXTREME FIRE BEHAVIOR THIS EVENING.
PRECAUTIONARY/PREPAREDNESS ACTIONS...

A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND WARM TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL.
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WWUS85 KPUB 192221
RFWPUB
URGENT - FIRE WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
321 PM MST MON JAN 19 2009
...A RED FLAG WARNING FOR STRONG GUSTY WINDS...LOW HUMIDITIES AND
DRY FUELS HAS BEEN EXPANDED TO INCLUDE FIRE WEATHER ZONES 229 AND
230 AND HAS BEEN EXTENDED UNTIL 6 PM MST. THIS WARNING NOW COVERS
ALL OF THE SOUTHEAST COLORADO PLAINS FROM THE EAST SLOPES OF THE
MOUNTAINS OUT TO THE KANSAS BORDER...
.THE NATIONAL WEATHER SERVICE IN PUEBLO...IN COORDINATION WITH
AREA LAND MANAGEMENT AGENCIES...HAS ISSUED A RED FLAG WARNING
IN EFFECT UNTIL 6 PM MST FOR ALL OF THE SOUTHEAST COLORADO PLAINS
FROM THE EAST SLOPES OF THE MOUNTAINS OUT TO THE KANSAS BORDER. STRONG
GUSTY NORTH WINDS AND LOW HUMIDITIES ARE EXPECTED TO CONTINUE
THROUGH EARLY THIS EVENING ACROSS THE SOUTHEAST COLORADO PLAINS.
COZ229-230-200100-
/O.EXB.KPUB.FW.W.0002.000000T0000Z-090120T0100Z/
HUERFANO COUNTY-WESTERN LAS ANIMAS COUNTY-
321 PM MST MON JAN 19 2009
...RED FLAG WARNING IN EFFECT UNTIL 6 PM MST THIS EVENING...
THE NATIONAL WEATHER SERVICE IN PUEBLO HAS ISSUED A RED FLAG
WARNING...WHICH IS IN EFFECT UNTIL 6 PM MST THIS EVENING.
NORTHERLY WINDS OF 15 TO 30 MPH COMBINED WITH HUMIDITIES BELOW 15
PERCENT AND DRY FUELS WILL CREATE CONDITIONS FAVORABLE FOR EXTREME
FIRE BEHAVIOR THIS EVENING.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND WARM TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL.
&&
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COZ226>228-231>237-200100-
/O.EXT.KPUB.FW.W.0002.000000T0000Z-090120T0100Z/
NORTHERN EL PASO COUNTY-SOUTHERN EL PASO COUNTY-PUEBLO COUNTY-
CROWLEY COUNTY-OTERO COUNTY-EASTERN LAS ANIMAS COUNTY-
KIOWA COUNTY-BENT COUNTY-PROWERS COUNTY-BACA COUNTY-
321 PM MST MON JAN 19 2009
...RED FLAG WARNING NOW IN EFFECT UNTIL 6 PM MST THIS EVENING...
THE RED FLAG WARNING IS NOW IN EFFECT UNTIL 6 PM MST THIS
EVENING.
NORTHERLY WINDS OF 15 TO 30 MPH WITH GUSTS TO 50 MPH WILL COMBINE
WITH HUMIDITIES BELOW 15 PERCENT AND DRY FUELS TO CREATE
CONDITIONS FAVORABLE FOR EXTREME FIRE BEHAVIOR THIS EVENING.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE EITHER OCCURRING NOW...OR WILL SHORTLY. A COMBINATION OF
STRONG WINDS...LOW RELATIVE HUMIDITY...AND WARM TEMPERATURES WILL
CREATE EXPLOSIVE FIRE GROWTH POTENTIAL.
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LW