Technical Support Document
For the April 3, 2011,
Alamosa and Lamar Exceptional Event

Colorado Department
of Public Health
and Environment

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

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Executive Summary

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 On May 2, 2011, in an attempt to clarify this rule, EPA released draft guidance documents on the implementation of the EER to State, tribal and local air agencies for review.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

Due to the semi-arid nature of parts of the state, Colorado is highly susceptible to windblown dust events. These events are often captured by various air quality monitoring equipment throughout the state, sometimes resulting in exceedances or violations of the 24-hour PM_{10} NAAQS. This document contains detailed information about the large regional windblown dust event that occurred on April 3, 2011. The Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (APCD) has prepared this report for the U.S. Environmental Protection Agency (EPA) to demonstrate that the elevated PM_{10} concentrations were caused by a natural event.

On April 3 of 2011, a powerful spring storm system caused multiple exceedances of the twenty-four hour PM_{10} standard in southern Colorado. Exceedances were recorded at the Alamosa Municipal Building monitor with a concentration of 372 $\mu g/m^3$, the Adams State College (now Adams State University) monitor in Alamosa with a concentration of 295 $\mu g/m^3$, and the Lamar Power Plant monitor with a concentration of 169 $\mu g/m^3$. These high readings and other PM_{10} concentrations across Colorado are plotted on the map for April 3, 2011, in Figure 1.

On April 3, 2011, the twenty-four-hour PM_{10} samples at Lamar Power (169 $\mu g/m^3$), Alamosa Muni (372 $\mu g/m^3$), and Alamosa ASC (285 $\mu g/m^3$) all exceeded the 99th percentile value for any evaluation criteria and are the maximum values for all of April 2011 data. The statistical and meteorological data clearly shows that but for this high wind blowing dust event, Alamosa and Lamar would not have exceeded the 24-hour NAAQS on April 3, 2011. Since at least 2005, there has not been an exceedance that was not associated with high winds carrying PM_{10} dust from distant sources in these areas. This is evidence that the event was associated with a measured concentration in excess of normal historical fluctuations including background.

The exceedances were the consequence of high winds from an intensifying surface low pressure system and vigorous cold front. These surface features were associated with a strong upper-level trough that was moving across the western United States. The prefrontal surface winds were out of a west to southwesterly direction and moved over dry soils in Arizona, northwest New Mexico, southeast Utah and southern Colorado producing significant blowing dust. Behind the cold front the winds were northerly which moved over dry soils in eastern Colorado, consequently also producing significant amounts of blowing dust. This storm system transported PM_{10} dust into the southern and southeastern portions of Colorado.

EPA's June 2012 draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule states "the EPA

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

will accept a threshold of a sustained wind of 25 mph for areas in the west provided the agencies support this as the level at which they expect stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed…”. In addition, in both eastern and western Colorado it has been shown that wind speeds of 30 mph or greater and gusts of 40 mph or greater can cause blowing dust (see Appendix A – Grand Junction, Colorado, Blowing Dust Climatology and Appendix B - Lamar, Colorado, Blowing Dust Climatology at the end of this document). For this blowing dust event, it has been assumed that sustained winds of 30 mph and higher or wind gusts of 40 mph and higher can cause blowing dust in northeast Arizona, northwest New Mexico, southeast Utah and southern and eastern Colorado.

The Albuquerque, Flagstaff and Pueblo National Weather Service (NWS) forecast offices issue weather warnings and advisories for northeast Arizona, most of New Mexico and south-central and southeast Colorado. The weather warnings and advisories issued by these offices for April 3, 2011, pertaining to strong winds and blowing dust are presented in Appendix C. Additionally, the CDPHE issued a Blowing Dust Advisory on the morning of April 3 for southwestern, south-central and southeastern parts of Colorado, including both Alamosa and Lamar. This advisory can also be found in Appendix C. Warnings and advisories issued by the NWS and CDPHE show that strong winds and areas of blowing dust were expected and experienced across this region on April 3.

The blowing dust climatology for Grand Junction (Appendix A) and Lamar (Appendix B) indicates that the area can be susceptible to blowing dust when winds are high. Landform imagery shows that northeastern Arizona and southeastern Utah in particular have experienced a long-term pattern of wind erosion and blowing dust when winds have been southwesterly and blowing into Colorado. Forecast products from the Navy Aerosol Analysis and Prediction System model provide evidence for a widespread blowing dust event, suggesting that significant source regions for dust in Colorado were located in arid regions of Arizona, New Mexico and Colorado. NOAA HYSPLIT forward and backward trajectories provide clear supporting evidence that dust from arid regions of Arizona, northwest New Mexico and eastern Colorado caused the PM_{10} exceedances measured across portions of southern and southeastern Colorado on April 3, 2011.

The Drought Monitor report for the western United States as of March 29, 2011, (Figure 37) reveals that drought conditions in the Painted Desert of northeast Arizona were categorized as “Abnormally Dry” to “Moderate Drought” just a few days before the April 3, 2011, dust event. Severe drought conditions can also be observed in much of eastern Colorado, the likely source region for the dust transported into Lamar after the cold front passage. Soils in the Four Corners area of northeast Arizona, northwest New Mexico and southeast Utah along with the plains of eastern Colorado were dry enough to produce blowing dust when winds were above the thresholds for blowing dust.

The surface weather associated with the storm system of April 3, 2011, is presented in Figure 2 through Figure 5; the surface analyses for 11 PM MST April 2, and 5 AM, 11 AM and 5 PM MST April 3, respectively. The most significant surface feature in the western United States over this time period was a cold front that initially stretched from South Dakota to central California (Figure 2). This front drifted to the south and southeast across Colorado and was associated with a strong surface low pressure system. (Figure 3 through Figure 5). The synoptic weather conditions on April 3 (illustrated in Figure 3 through Figure 18) show that the conditions necessary for widespread strong gusty winds and transport of blowing dust were in place over the area of concern.

GASP satellite imagery shows that the desert regions of northeast Arizona and northwest New Mexico along with the arid plains of eastern Colorado were source regions for the blowing dust on April 3, 2011. This is consistent with the climatology for many dust storms in Colorado as described in the Grand Junction, Colorado, Blowing Dust Climatology report contained in Appendix A and the Lamar, Colorado, Blowing Dust Climatology in Appendix B, both found at the end of this document. The observations of winds above blowing dust thresholds and restricted visibilities in the areas of concern demonstrate that this is a natural event that cannot be reasonably controlled or prevented.

Friction velocities provide a measure of the near-surface meteorological conditions necessary to cause blowing dust. Frictional velocity values were at or above the blowing dust threshold across much of east-central and southeast Colorado on April 3, 2011. The elevated friction velocities shown in Figure 38 and Figure 39, the data on soil moisture conditions presented elsewhere in this report and the prevalence of winds above blowing dust thresholds (all occurring in traditional source regions in northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado) demonstrate that this dust storm was a natural event that was not reasonably controllable or preventable.

The PM_{10} exceedances in Alamosa and Lamar on April 3, 2011, would not have occurred if not for the following: (a) dry soil conditions over northeast Arizona, northwest New Mexico, southeast Utah, and eastern Colorado with 30-day precipitation totals below the threshold identified as a precondition for blowing dust in northeastern Arizona; (b) a surface low pressure system and vigorous cold front that were associated with a strong upper-level trough that caused strong prefrontal surface winds over the area of concern; and (c) friction velocities over regions of northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado that were high enough to allow entrainment of dust from natural sources with subsequent transport of the dust to southern Colorado in strong winds.

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

APCD is requesting concurrence on exclusion of the PM_{10} values from Alamosa-Adams State College (08-003-0001), Alamosa-Municipal Building (08-003-0003), and Lamar Power Plant (08-099-0001) on April 3, 2011.

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1.0 Exceptional Events Rule Requirements

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

1.1 Procedural Criteria

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

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

Public notification that event was occurring (40 CFR 50.14(c)(1)(i))
APCD issued Blowing Dust Advisories for southwestern, south-central and southeastern Colorado advising citizens of the potential for high wind/dust events on April 3, 2011. This area includes: Cortez, Durango, Pagosa Springs, Alamosa, Pueblo, Lamar, La Junta, and Springfield. The advisories that were issued on April 3, 2011 can be viewed at: http://www.colorado.gov/airquality/forecast_archive.aspx?seeddate=04%2f03%2f2011 and are included in Appendix C.

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

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

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

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

On April 3, 2011, three sample values greater than 150 $\mu g/m^3$ were taken at multiple sites across southern Colorado during the high wind event that occurred that day. These were the monitors located in Alamosa at Adams State College (SLAMS), Alamosa at the Municipal Building (SLAMS), and Lamar Power Plant monitor (SLAMS). All of these monitors are operated by APCD in partnership with local operators.

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

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

1.2 Documentation Requirements

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

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

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

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

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

2.0 Meteorological analysis of the April 3, 2011, blowing dust event and PM_{10} exceedance – Conceptual Model and Wind Statistics

On April 3, 2011, a powerful spring storm system caused multiple exceedances of the twenty-four hour PM_{10} standard in southern Colorado. Exceedances were recorded at the Alamosa Municipal Building monitor with a concentration of 372 µg/m^3, the Adams State College monitor in Alamosa with a concentration of 295 µg/m^3, and the Lamar Power Plant monitor with a concentration of 169 µg/m^3. These high readings and other PM_{10} concentrations across Colorado are plotted on the map for April 3, 2011, in Figure 1. The exceedances were the consequence of high winds from an intensifying surface low pressure system and vigorous cold front. These surface features were associated with a strong upper-level trough that was moving across the western United States. The prefrontal surface winds were out of a west to southwesterly direction and moved over dry soils in Arizona, northwest New Mexico, southeast Utah and southern Colorado producing significant blowing dust. Behind the cold front the winds were northerly which moved over dry soils in eastern Colorado, consequently also producing significant amounts of blowing dust.

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

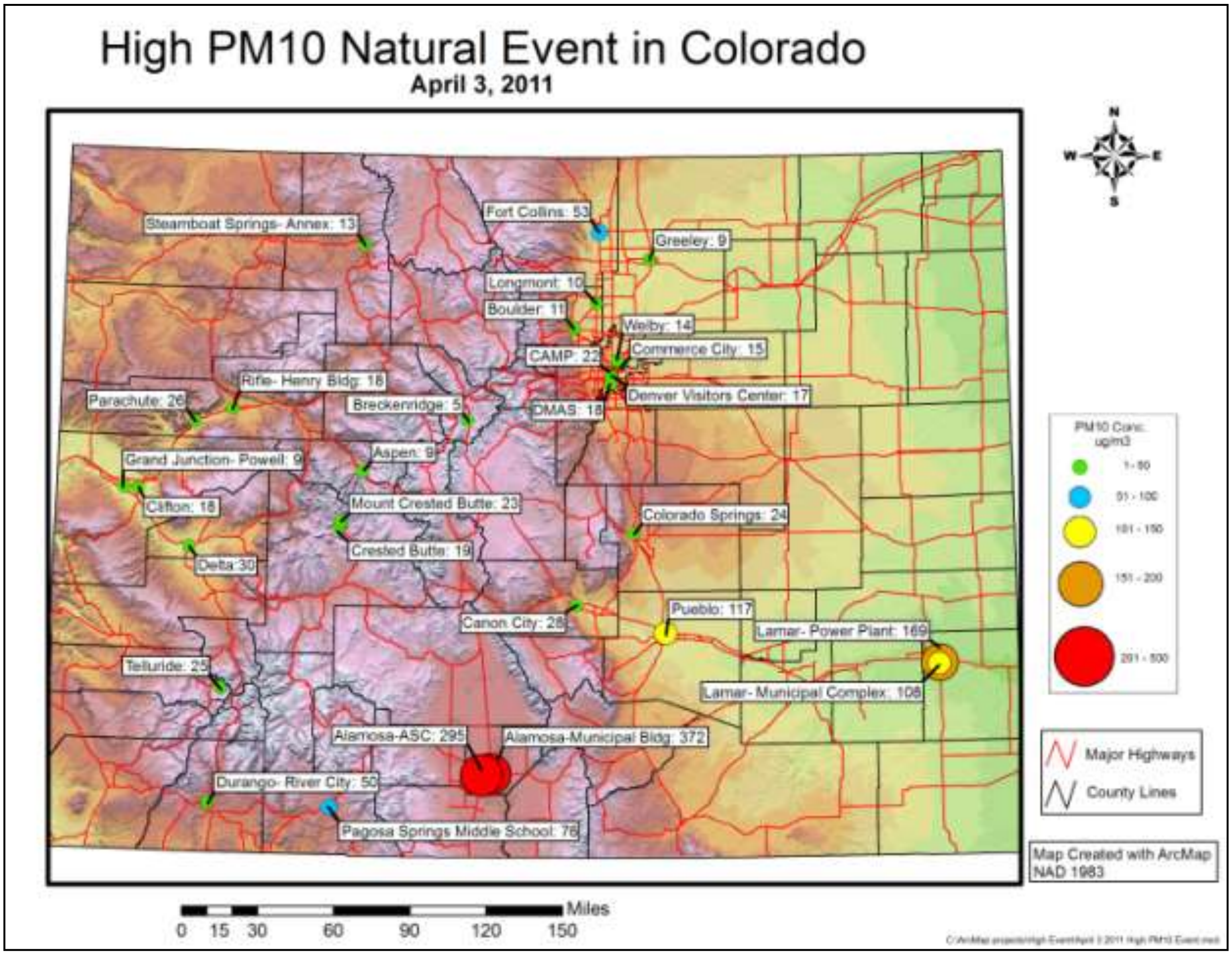


Figure 1: 24-hour PM_{10} concentrations for April 3, 2011.

The surface weather associated with the storm system of April 3, 2011, is presented in Figure 2 through Figure 5; the surface analyses for 11 PM MST April 2, and 5 AM, 11 AM and 5 PM MST April 3, 2011, respectively. The most significant surface feature in the western United States over this time period was a cold front that initially stretched from South Dakota to central California (Figure 2). This front drifted to the south and southeast across Colorado and was associated with a strong surface low pressure system. (Figure 3 through Figure 5).

The upper level trough with this storm system is shown in Figure 6 through Figure 9. Figure 6 and Figure 7 show the 700-mb height analysis maps for 5 PM MST April 2, and 5 AM MST April 3, 2011, respectively while Figure 8 and Figure 9 display the 500 mb height analysis maps for the same time period. The 700 mb level is roughly 3 kilometers above mean sea level (MSL) and the 500 mb level is generally located approximately 6 kilometers above MSL. These four charts show that a deep trough of low pressure was present in the upper levels of the atmosphere preceding and during the blowing dust event of April 3, 2011, and that it was moving over the western United States.

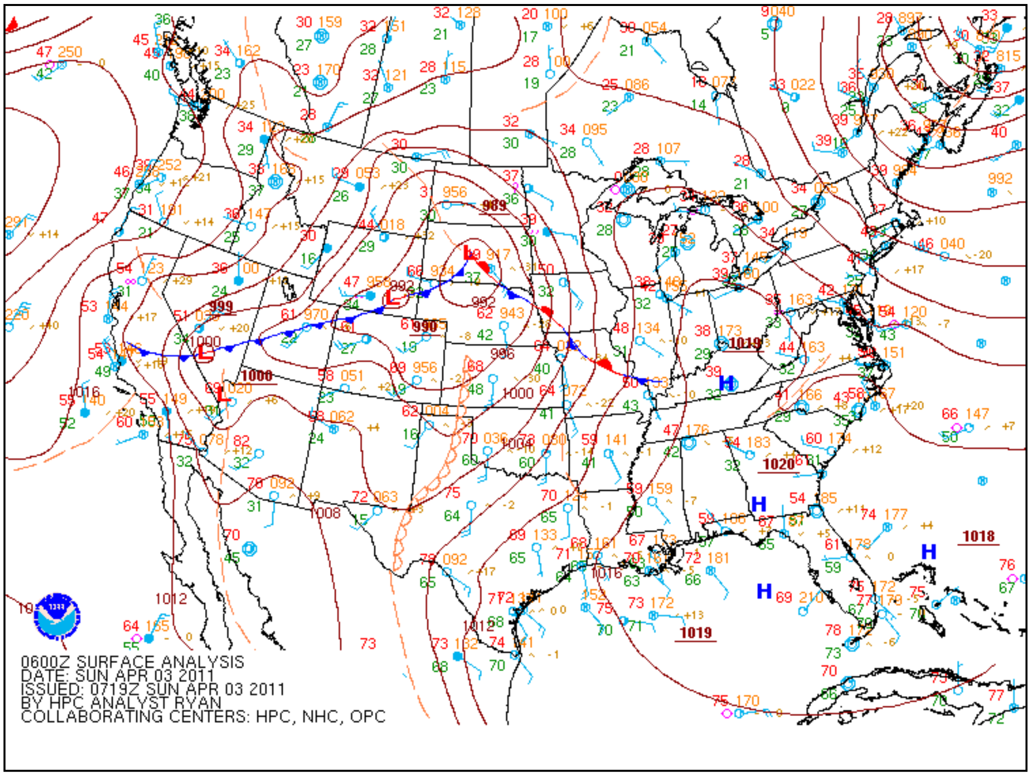


Figure 2: Surface Analysis for 06Z April 3, 2011, or 11 PM MST April 2, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

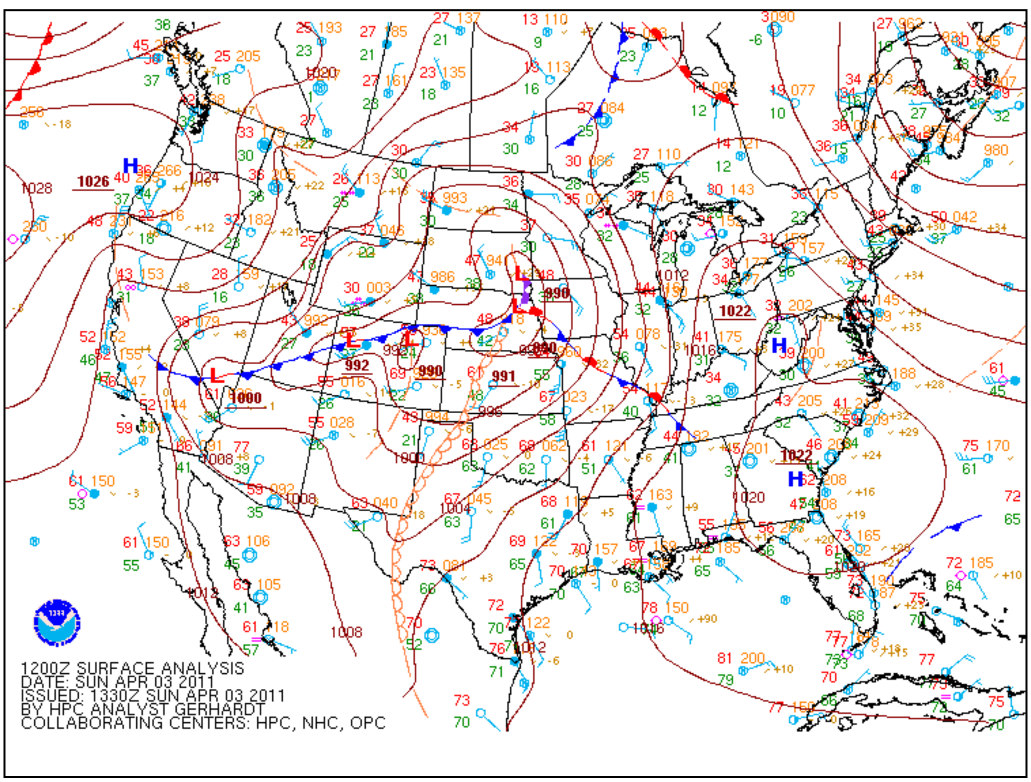


Figure 3: Surface Analysis for 12Z April 3, 2011, or 5 AM MST April 3, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

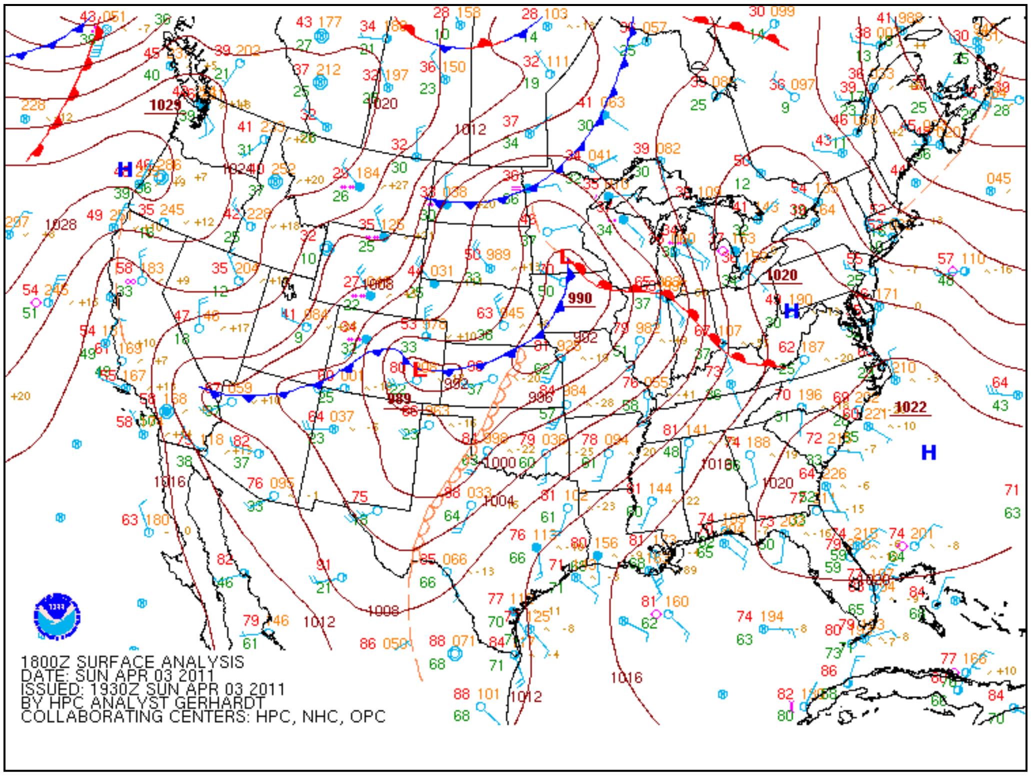


Figure 4: Surface Analysis for 18Z April 3, 2011, or 11 AM MST April 3, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

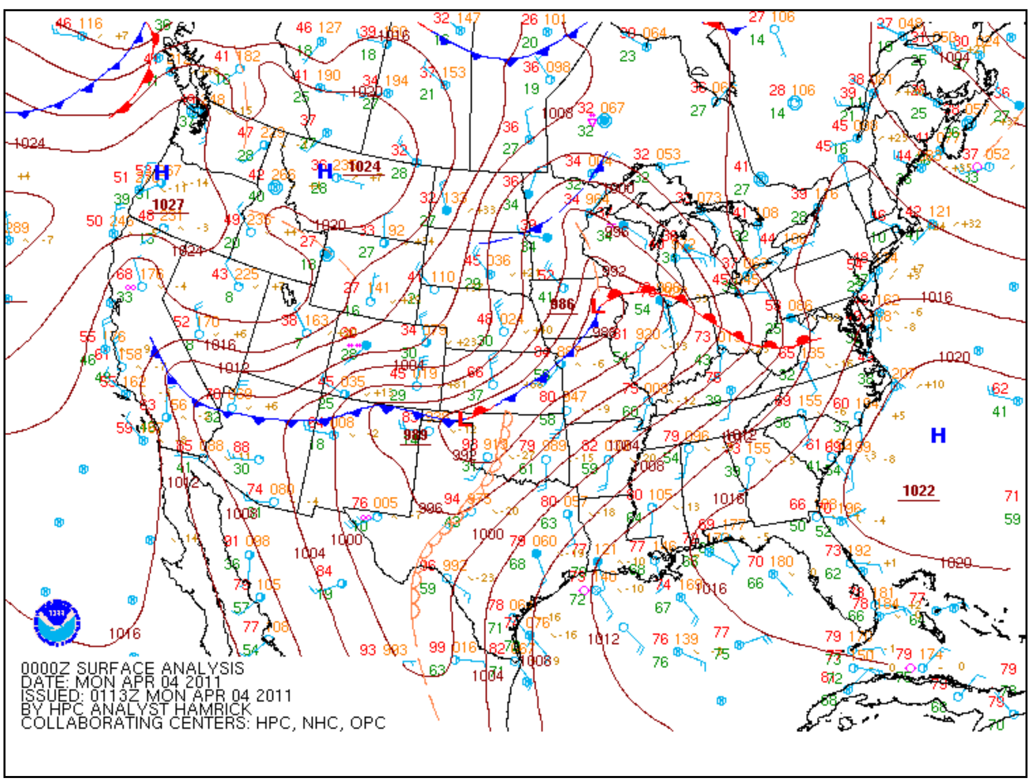


Figure 5: Surface Analysis for 00Z April 4, 2011, or 5 PM MST April 3, 2011. (source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

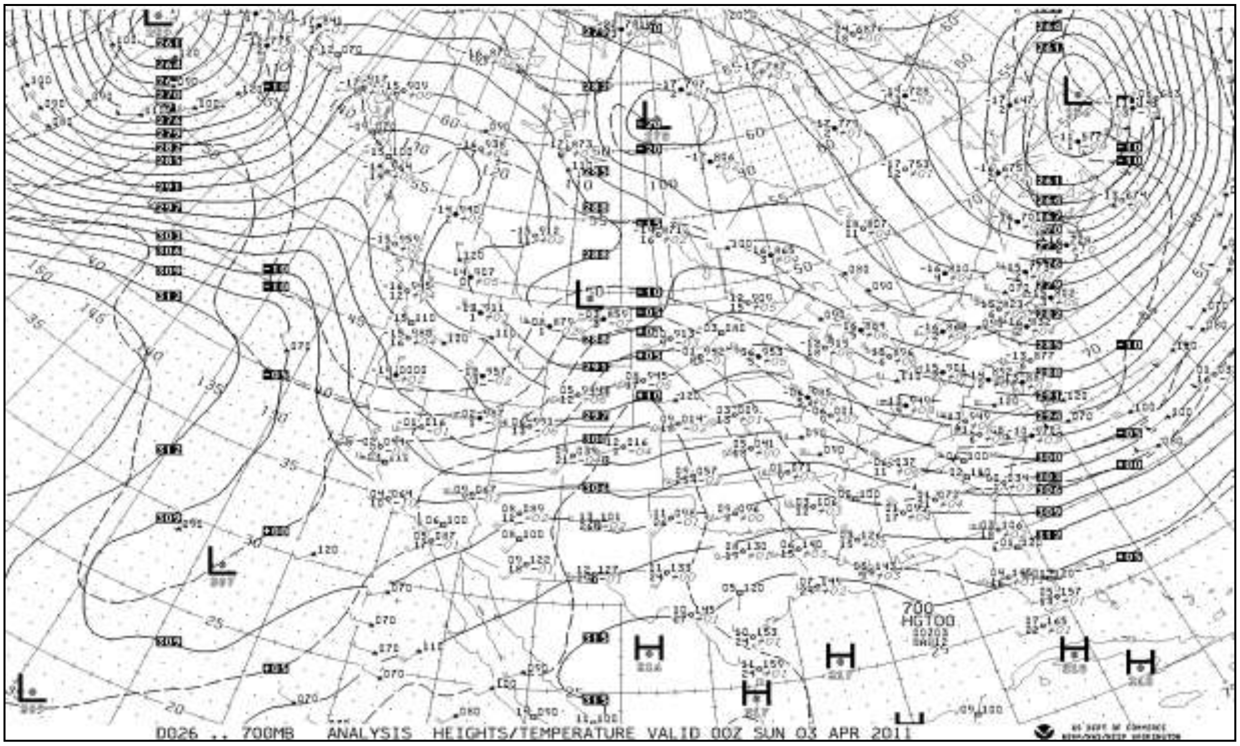


Figure 6: 700 mb (about 3 kilometers above mean sea level) analysis for 00Z April 3, 2011, or 5 PM MST April 2, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

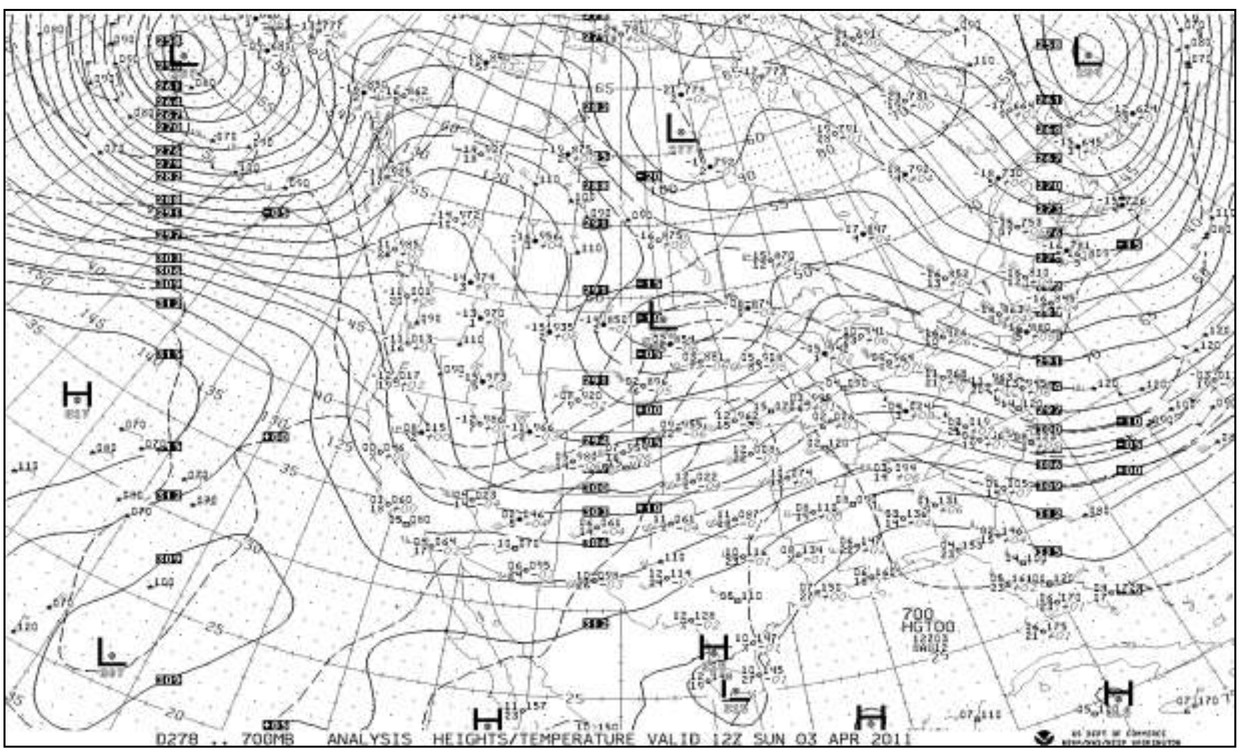


Figure 7: 700 mb (about 3 kilometers above mean sea level) analysis for 12Z April 3, 2011, or 5 AM MST April 3, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

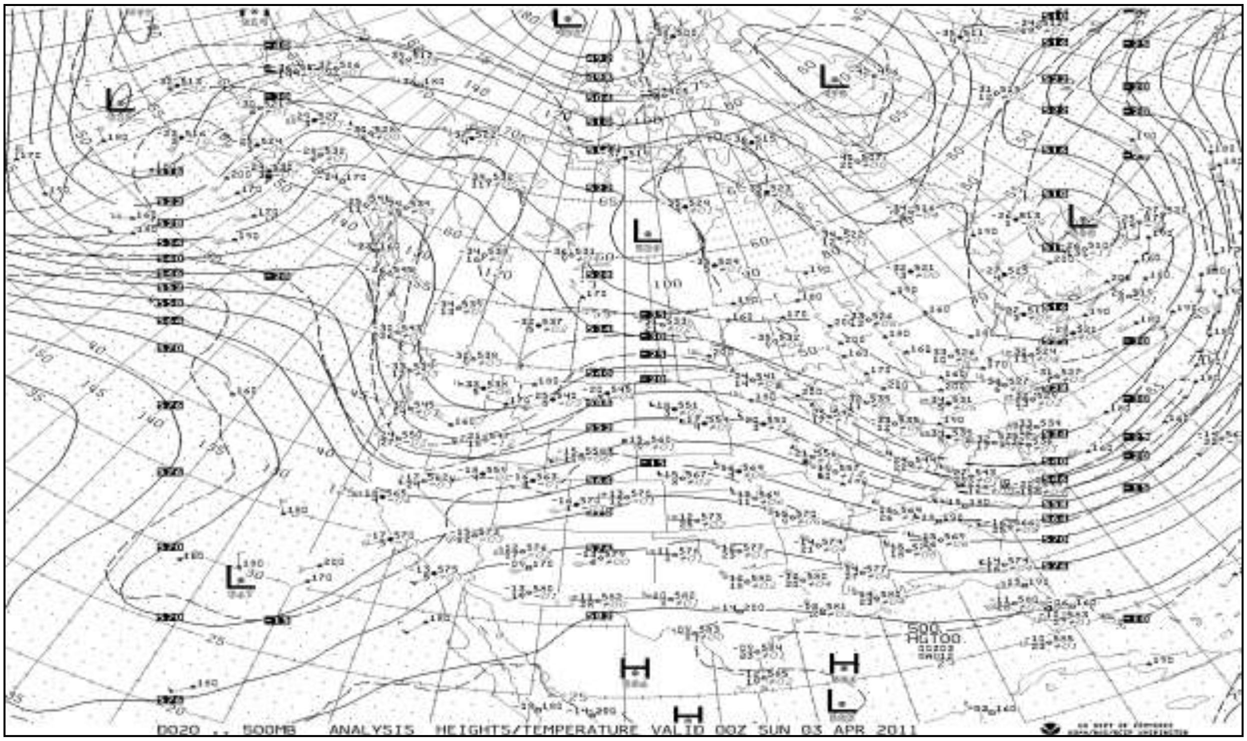


Figure 8: 500 mb (about 6 kilometers above mean sea level) analysis for 00Z April 3, 2011, or 5 PM MST April 2, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

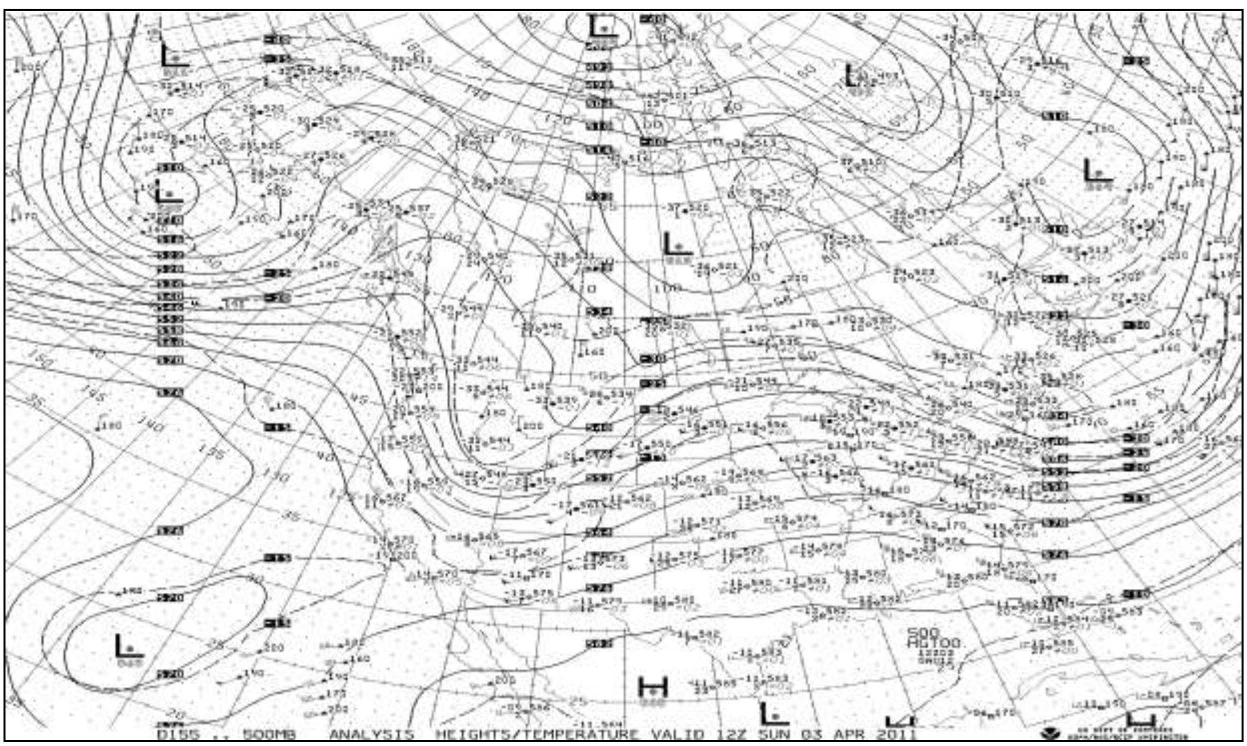


Figure 9: 500 mb (about 6 kilometers above mean sea level) analysis for 12Z April 3, 2011, or 5 AM MST April 3, 2011.
(source: http://nomads.ncdc.noaa.gov/ncep/NCEP)

Figure 10, Figure 11 and Figure 12 show the NARR (North American Regional Reanalysis) jet stream maximum winds rotating around the base of the 700 mb trough at 11 PM MST April 2, and 5 AM and 11 AM MST April 3, 2011, respectively. At the 700 mb level, peak winds stretched from southern Utah and northern Arizona eastward into Kansas, Oklahoma and the Texas Panhandle. This jet streak included an area of intense 30-50 knot winds located over the arid Four Corners region of Arizona, New Mexico, Colorado and Utah.

Figure 13 and Figure 14 show the 500 mb trough and corresponding wind speeds at 5 AM MST and 11 AM MST on April 3, 2011, respectively. It is evident that the 500 mb wind speed intensified dramatically during the morning hours in southern Colorado and northern New Mexico. Between 5 AM and 11 AM MST, the 500 mb wind along the Colorado/New Mexico state line increased from the 50 to 70 knot range (Figure 13) to the 70 to 90 knot range (Figure 14).

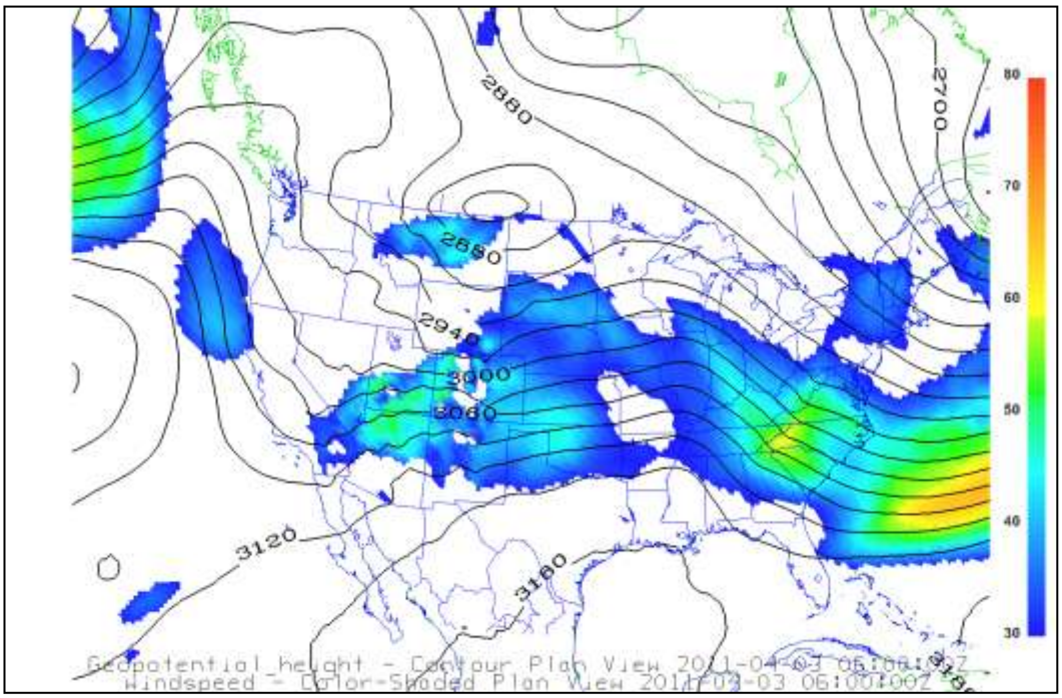


Figure 10: NARR 700 mb (about 3 kilometers above mean sea level) analysis for 06Z April 3, 2011, or 11 PM MST April 2, 2011, showing wind speeds in knots. Only speeds above 30 knots are plotted.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

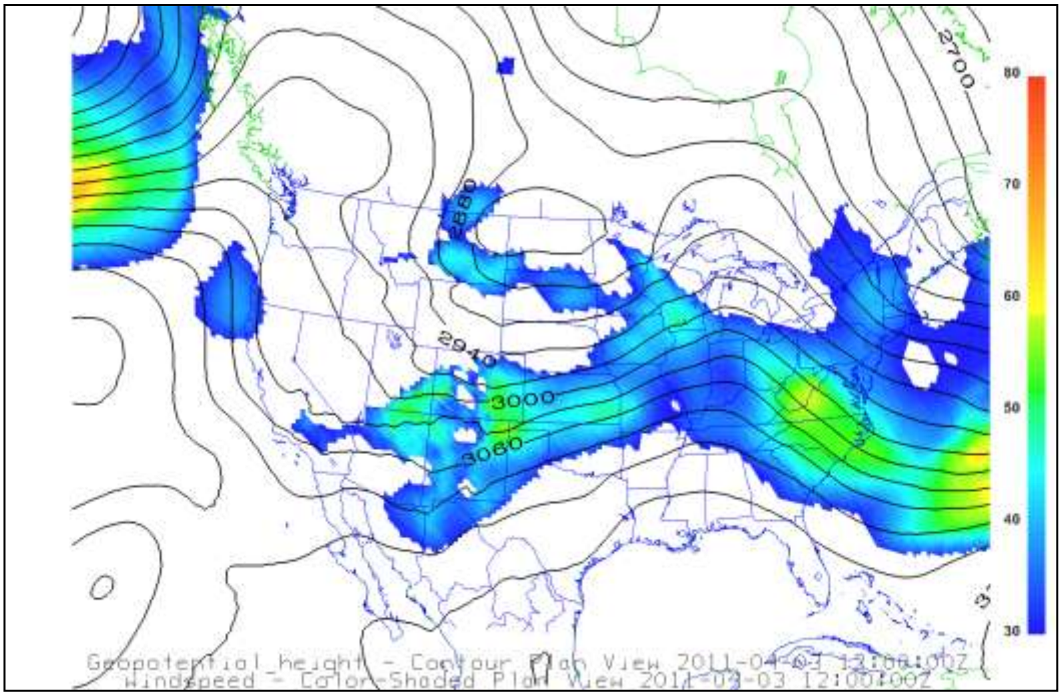


Figure 11: NARR 700 mb (about 3 kilometers above mean sea level) analysis for 12Z April 3, 2011, or 5 AM MST April 3, 2011, showing wind speeds in knots. Only speeds above 30 knots are plotted. (data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

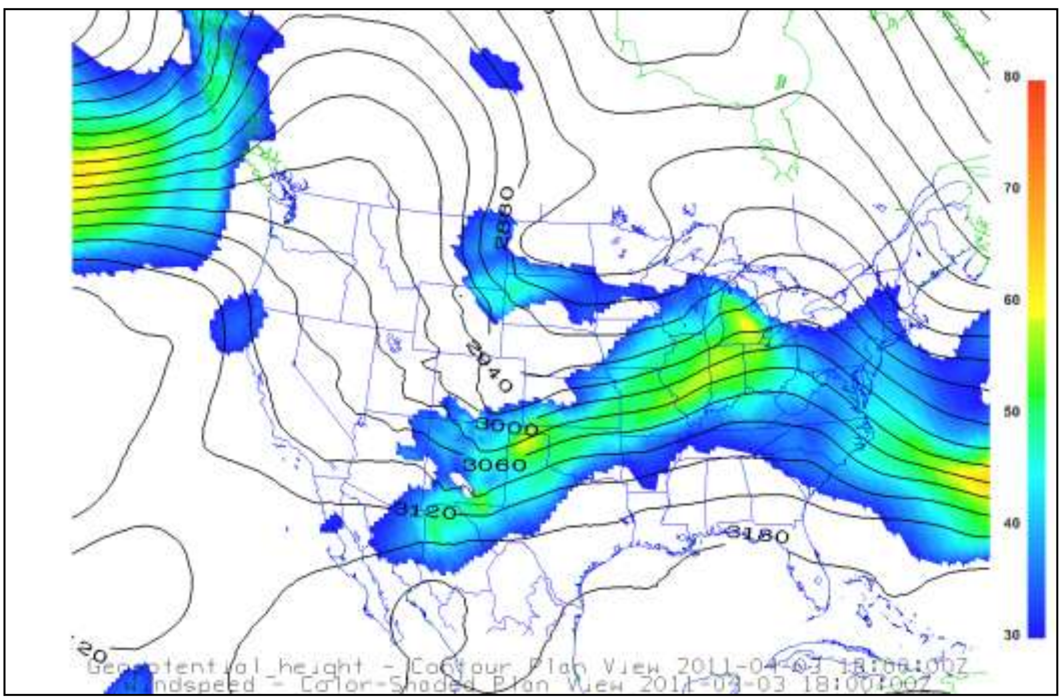


Figure 12: NARR 700 mb (about 3 kilometers above mean sea level) analysis for 18Z April 3, 2011, or 11 AM MST April 3, 2011, showing wind speeds in knots. Only speeds above 30 knots are plotted.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

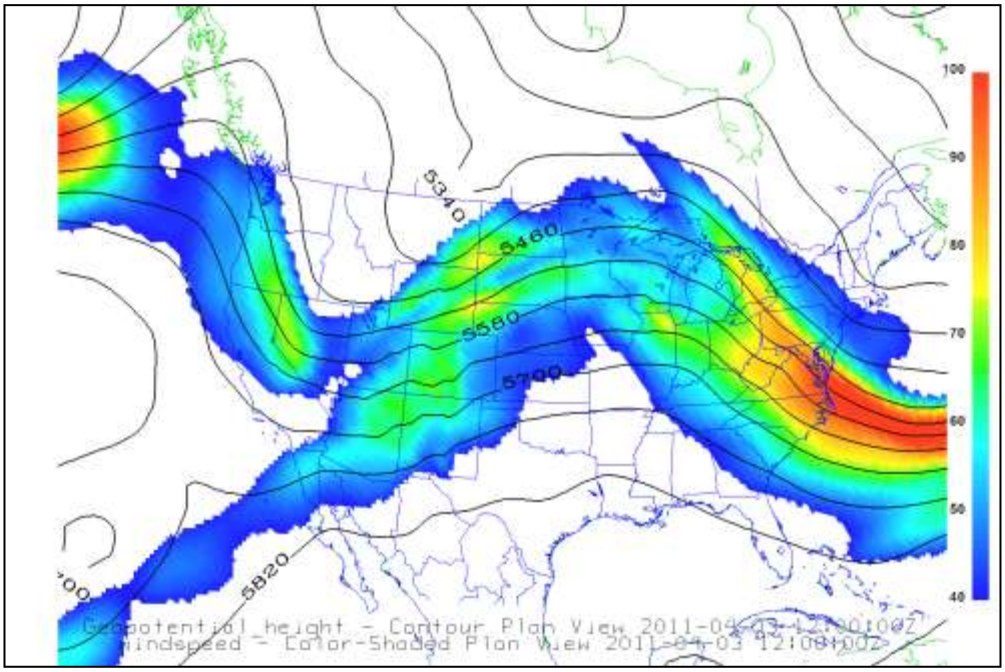


Figure 13: NARR 500 mb (about 6 kilometers above mean sea level) analysis for 12Z April 3, 2011, or 5 AM MST April 3, 2011, showing wind speeds in knots. Only speeds above 40 knots are plotted. (data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets).

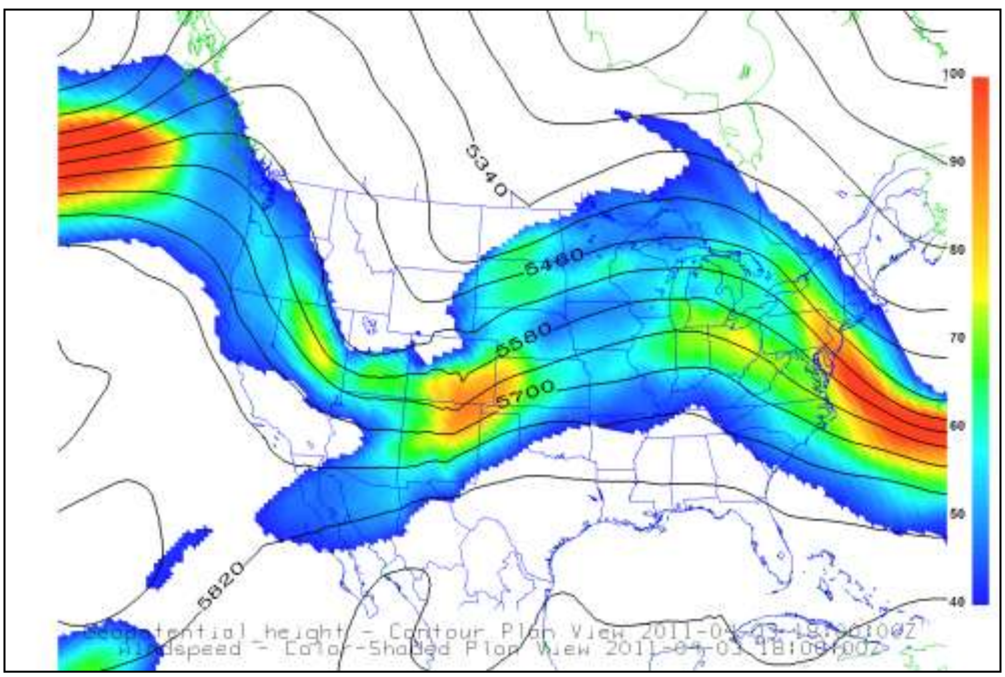


Figure 14: NARR 500 mb (about 6 kilometers above mean sea level) analysis for 18Z April 3, 2011, or 11 AM MST April 3, 2011, showing wind speeds in knots. Only speeds above 40 knots are plotted.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets).

The upper level trough (observed at 700 and 500 mb) affected winds near the surface in two ways. First, momentum associated with the strong winds aloft at the base of the trough was transferred to the surface because of deep vertical mixing in the area of the strong winds aloft. This appears to have been the mechanism for high surface winds <u>prior</u> to the passage of the cold front shown in Figure 2 through Figure 5.

Figure 15 through Figure 17 show the height of the top of the mixed layer in kilometers above MSL at 11 PM MST on April 2, and 5 AM and 11 AM MST on April 3, 2011, respectively. In Figure 15 and Figure 16, mixing of 3 to 6 kilometers above MSL is located over the Four Corners Region. Mixing to this degree would have been sufficient to transfer momentum to the surface from the zone of strong winds at 700 mb over the Four Corners region during the same time frame (Figure 10 and Figure 11). By 11 AM MST (Figure 17), mixing heights of 5 to 7 kilometers above MSL are located just to the south of Alamosa in south-central Colorado and north-central New Mexico. With this magnitude of mixing, it is conceivable that the very intense 500 mb winds located over the region shown in Figure 14 were transported down to the surface. Winds of this strength are not apparent at the 700 mb level at this time, and this may reflect a weakness in the model analysis for this level at this place and time.

The second mechanism that aided in producing high surface winds on April 3 was the surface low pressure system (Figure 2 through Figure 5) with tight pressure gradients. This was likely the key factor in dust production for eastern Colorado <u>after</u> the passage of the cold front. The tight pressure gradients are easily identified in Figure 18 where a bunching of isobars can be found in eastern Colorado just to the north of Lamar.

Strong winds aloft and deep mixing in advance of the cold front, with tight pressure gradients behind the cold front caused regional surface winds over 40 mph with gusts exceeding 50 mph for several hours. Winds of this strength can easily cause blowing dust if soils are dry. Recall that wind speeds of 30 mph or greater and/or gusts of 40 mph or higher have been shown to cause blowing dust in Colorado (*see Appendix A – Grand Junction, Colorado, Blowing Dust Climatology and Appendix B - Lamar, Colorado, Blowing Dust Climatology at the end of this document*). When blowing dust occurs with strong winds at the surface and aloft combined with deep mixing as was observed during the April 3, 2011, event, dust can be suspended for many hours and transported long distances. These conditions are the hallmarks of a regional dust transport event.

The synoptic weather conditions on April 3, 2011, (illustrated in Figure 3 through Figure 18) show that the conditions necessary for widespread strong gusty winds and transport of blowing dust were in place over the area of concern.

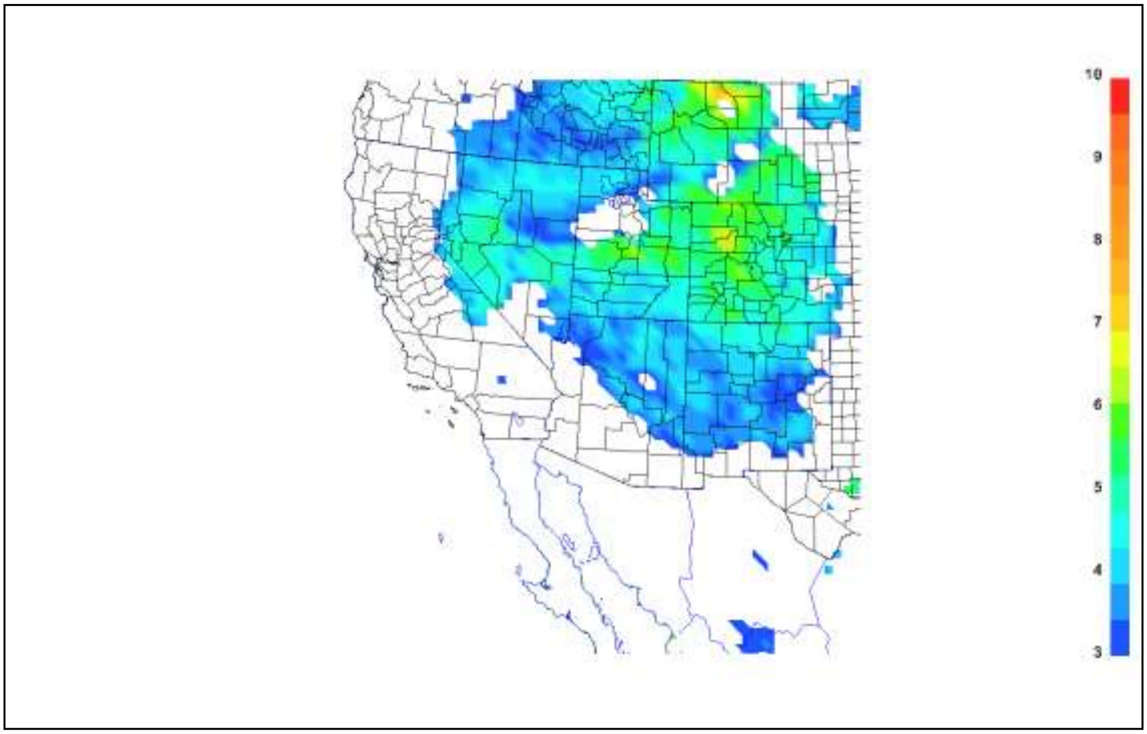


Figure 15: Height of the mixed layer in kilometers above mean sea level from the NARR at 06Z April 3, 2011, or 11 PM MST April 2, 2011. Only heights above 3 kilometers are plotted. (data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

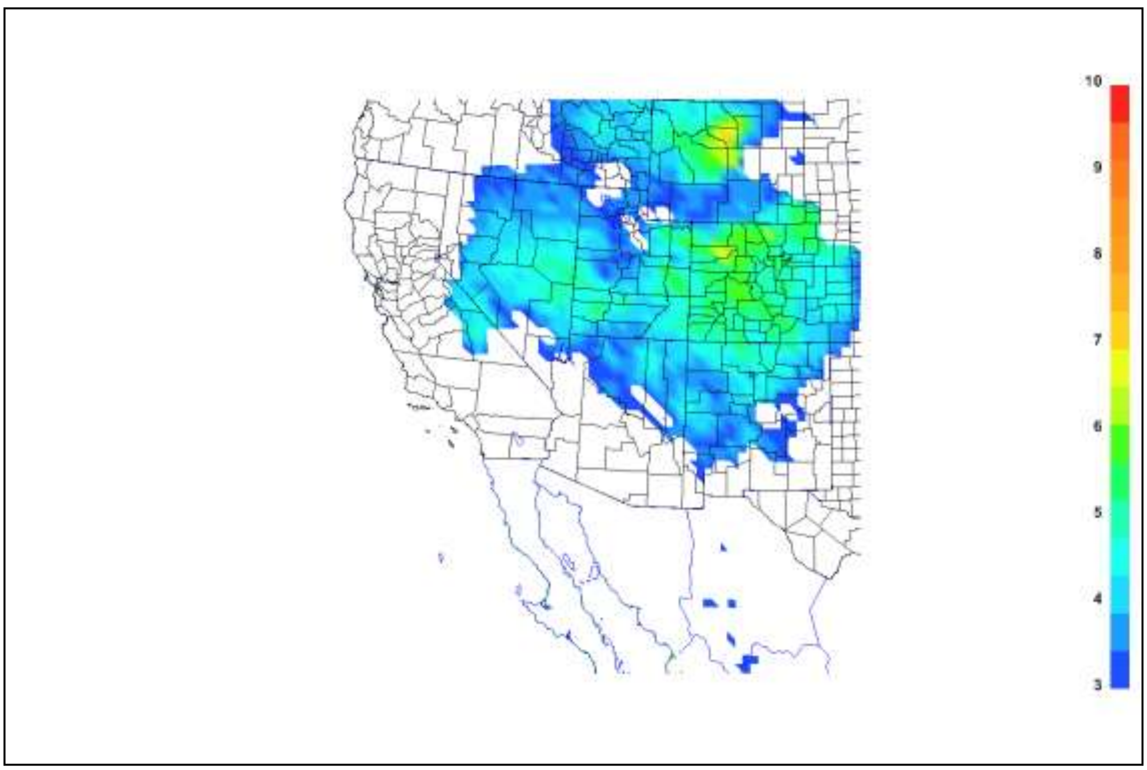


Figure 16: Height of the mixed layer in kilometers above mean sea level from the NARR at 12Z April 3, 2011, or 5 AM MST April 3, 2011. Only heights above 3 kilometers are plotted. (data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

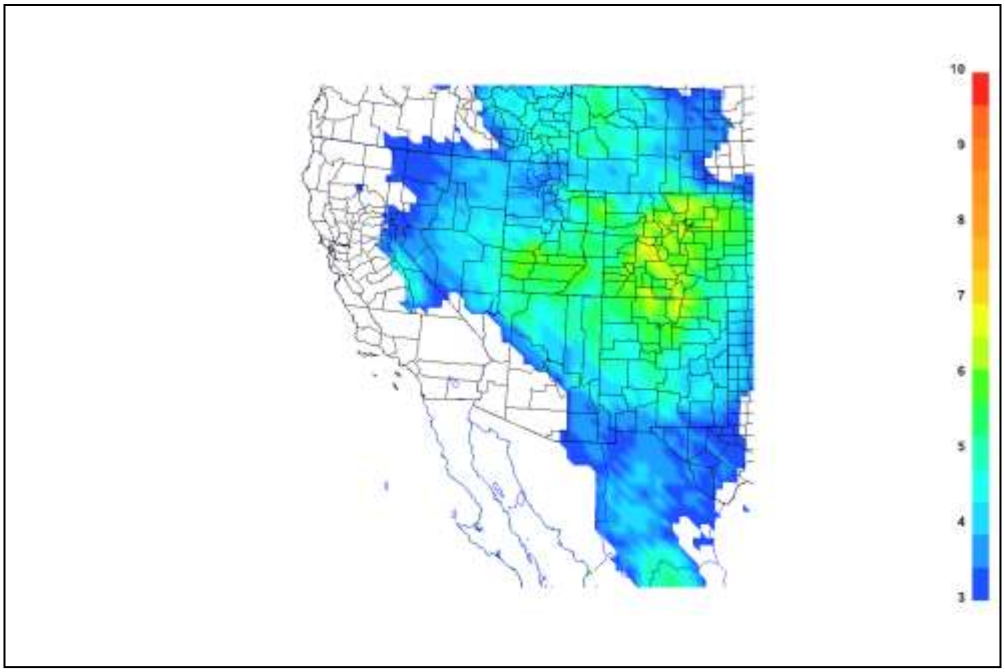


Figure 17: Height of the mixed layer in kilometers above mean sea level from the NARR at 18Z April 3, 2011, or 11 AM MST April 3, 2011. Only heights above 3 kilometers are plotted. (data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

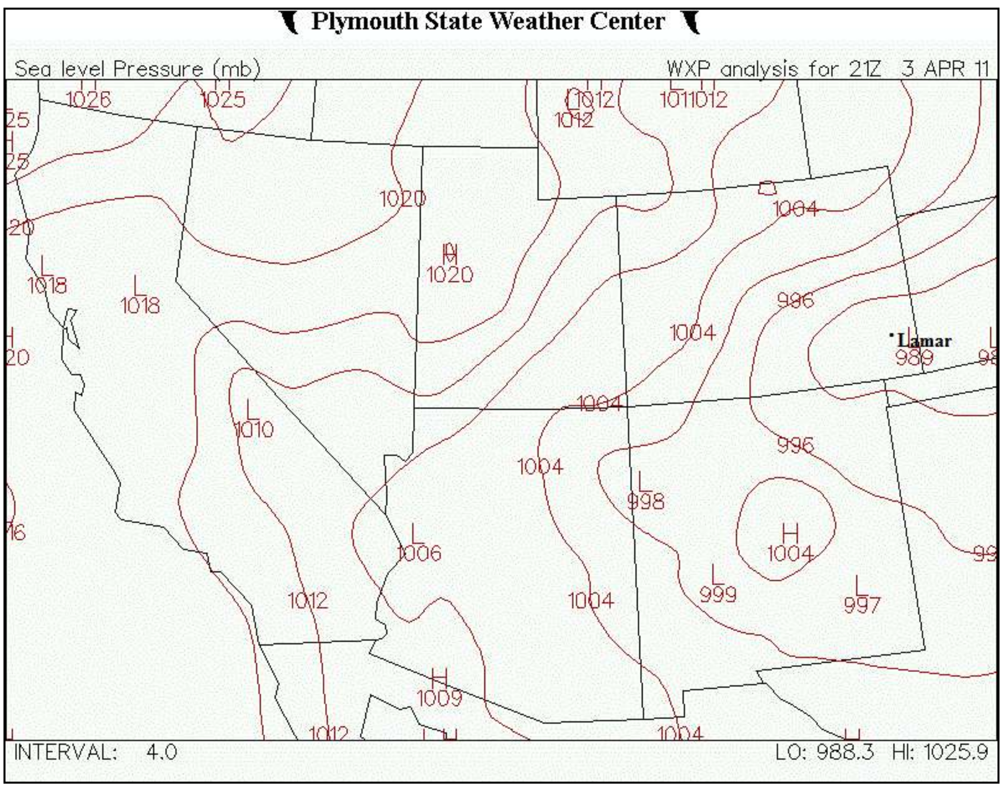


Figure 18: Sea level pressure analysis at 21Z April 3, 2011, or 2 PM MST April 3, 2011. (source: http://vortex.plymouth.edu/surface-u.html)

Figure 19 through Figure 23 present synoptic-scale weather maps centered over Denver, Colorado, which include individual surface weather observations for 4:43 AM, 10:43 AM, 1:43 PM, 2:43 PM and 3:43 PM MST April 3, 2011, respectively. These maps cover Colorado and the areas of Arizona, Utah, and New Mexico that were upwind of the portions of Colorado that experienced exceedances of the PM_{10} standard. These surface analyses illustrate that winds above 30 mph with gusts above 40 mph occurred in many areas both to the south and to the north of the cold front and surface low pressure complex shown in Figure 2 through Figure 5. On the map in Figure 19, the station plot for Alamosa, Colorado (ALS) at 4:43 AM MST shows a reduced visibility of 3 statute miles and is accompanied by the infinity sign (∞). The infinity sign is the weather symbol for haze. Haze is often reported during dust storms, and in dry and windy conditions haze typically refers to blowing dust (see the following link for the description of haze published by the National Oceanic and Atmospheric Administration (NOAA): http://www.crh.noaa.gov/lmk/?n=general_glossary).

A second period of dust occurred later that morning and continued into the afternoon as a cold front approached the region. At 10:43 AM MST (Figure 20), the station observation for Farmington, NM (FMN) approximately 20 miles south of the Colorado state line in northwestern New Mexico shows a dollar sign ($). The dollar sign is the weather symbol for dust or sand raised by wind at the time of the observation. Three hours later at 1:43 PM MST (Figure 21) directly downwind from Farmington, haze was again reported at Alamosa (ALS) with visibility significantly reduced to just 0.75 statute miles. Additionally, blowing dust and haze were beginning to shift further east into southeast Colorado with La Junta (LHX) reporting haze and visibility of 5 statute miles with winds from the west-southwest.

By 2:43 PM MST (Figure 22), the cold front was moving through southeast Colorado. As the wind shifted to the north with the frontal passage, La Junta (LHX) recorded an observation of haze and visibility of 4 statute miles. Meanwhile just to the east of La Junta in Lamar (LAA), haze with a visibility of only 1 statute mile was observed at 3:43 PM MST (Figure 23). Additional surface weather maps not included here show that haze and blowing dust were reported in other parts of Arizona, New Mexico and Colorado on April 3.

Surface weather maps show evidence of widespread blowing dust and winds above the threshold speeds for blowing dust on April 3, 2011.

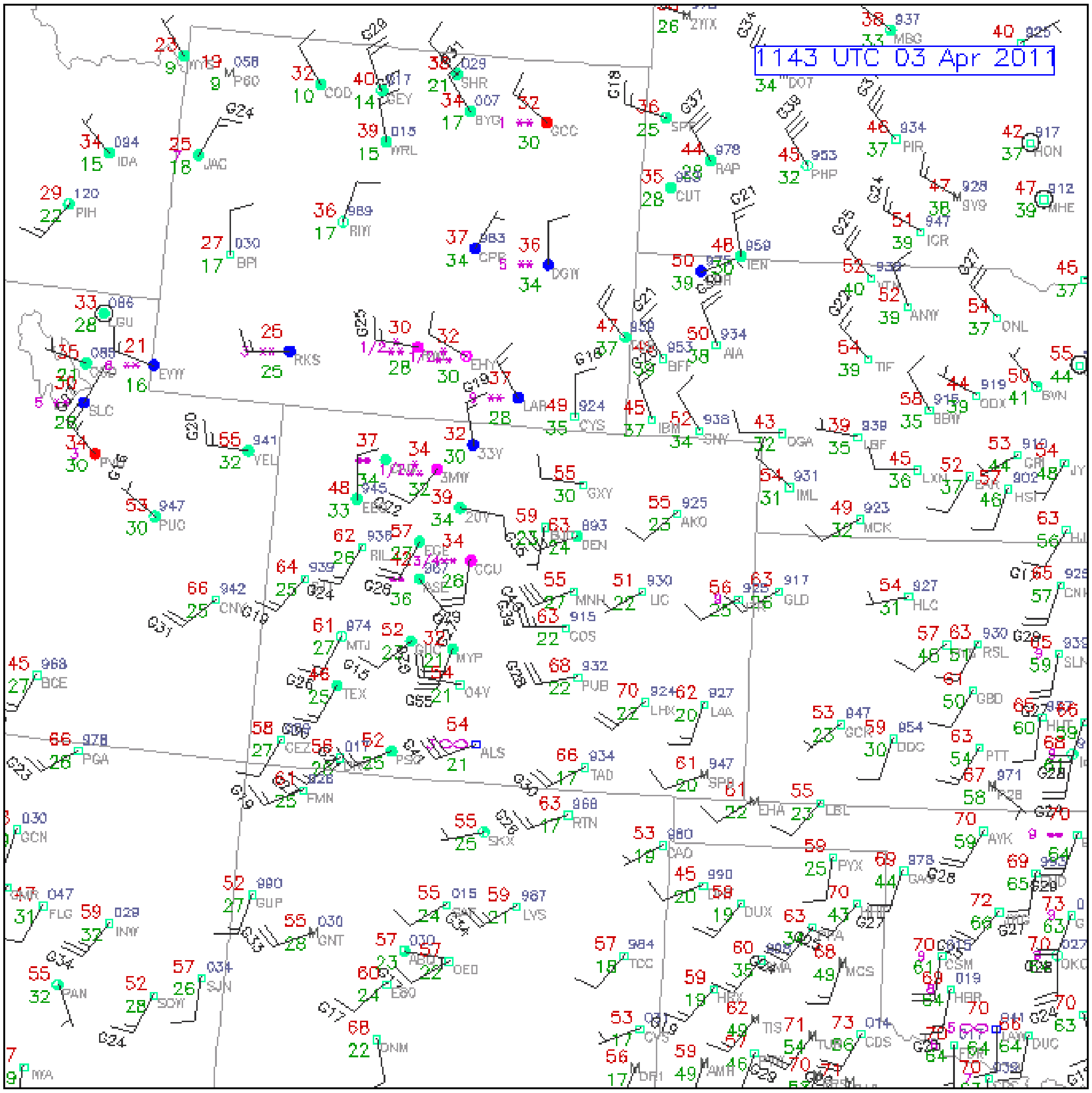


Figure 19: NCAR RAP Real-Time Weather Data website DEN sector surface analysis for 1143Z April 3, 2011, or 4:43 AM MST April 3, 2011.
(source: http://www.rap.ucar.edu/weather/)

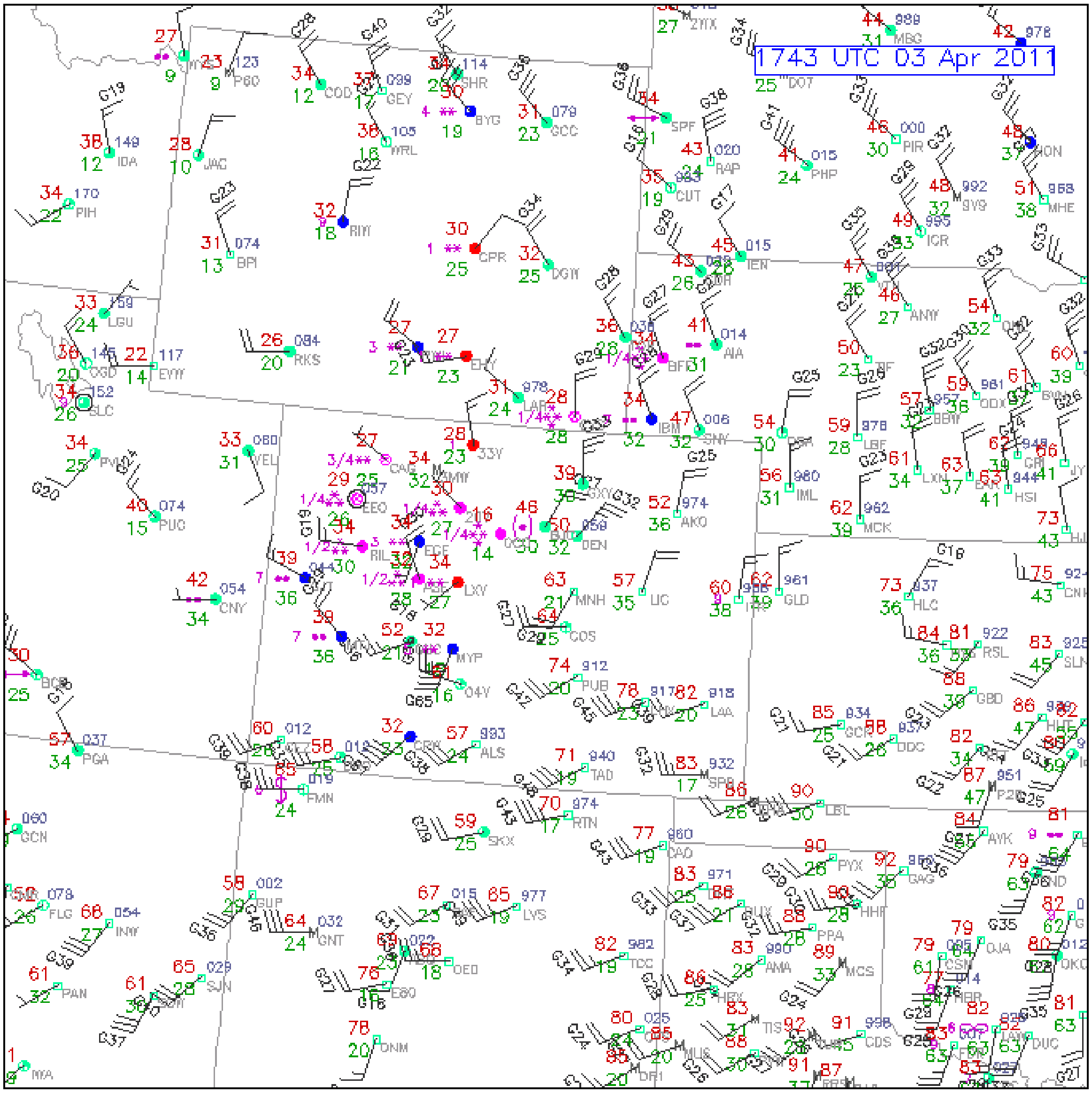


Figure 20: NCAR RAP Real-Time Weather Data website DEN sector surface analysis for 1743Z April 3, 2011, or 10:43 AM MST April 3, 2011.
(source: http://www.rap.ucar.edu/weather/)

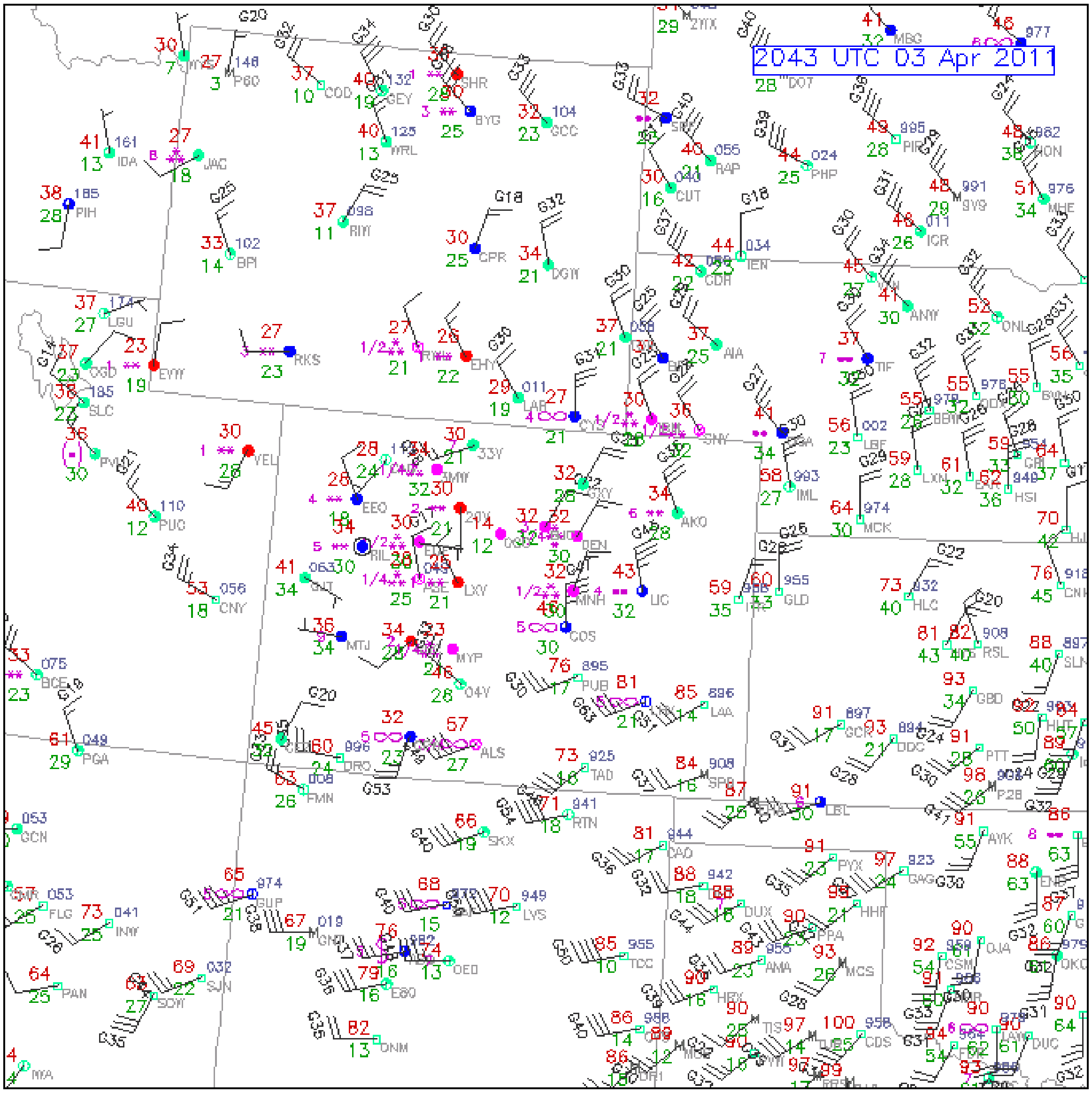


Figure 21: NCAR RAP Real-Time Weather Data website DEN sector surface analysis for 2043Z April 3, 2011, or 1:43 PM MST April 3, 2011.
(source: http://www.rap.ucar.edu/weather/)

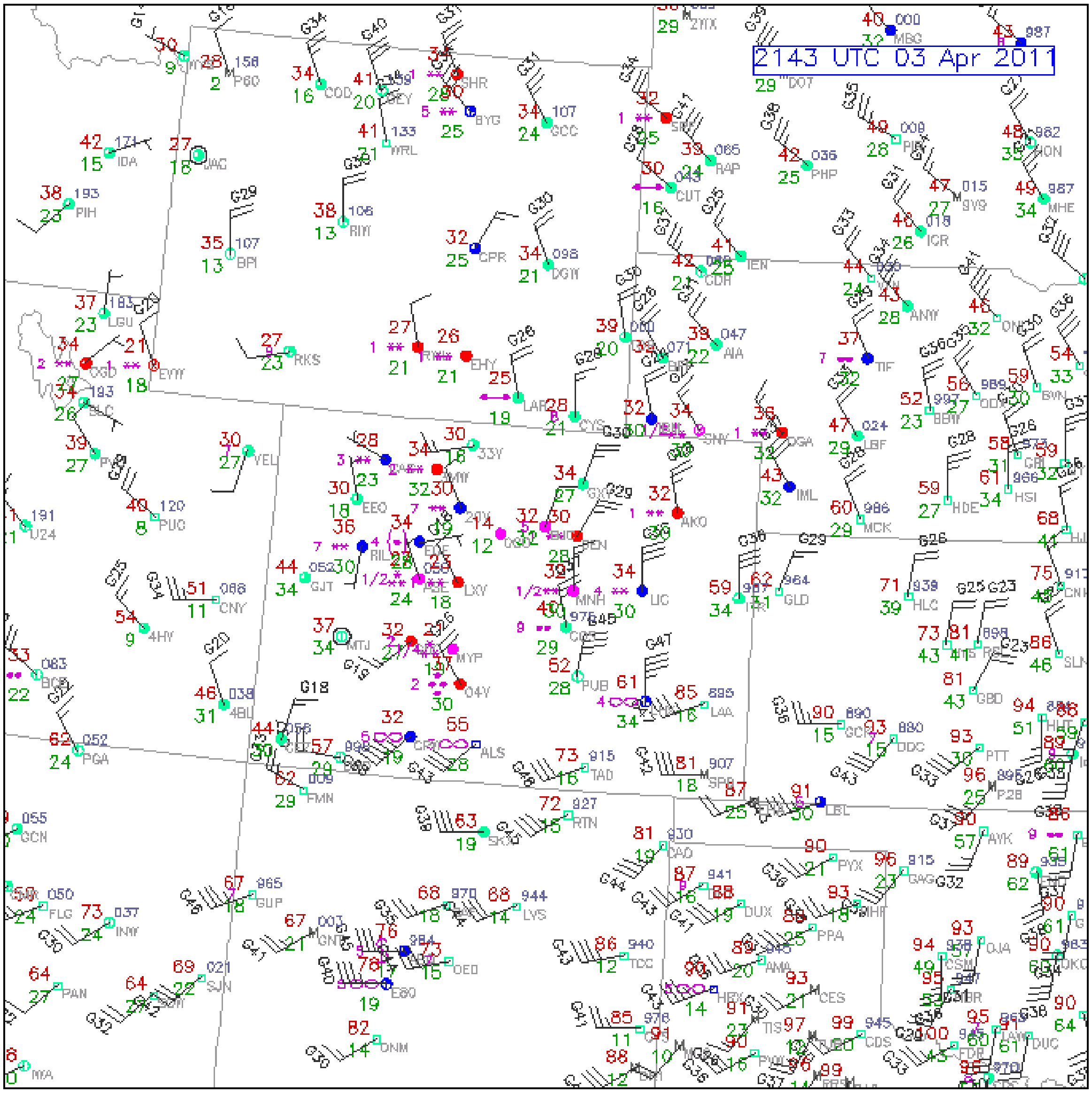


Figure 22: NCAR RAP Real-Time Weather Data website DEN sector surface analysis for 2143Z April 3, 2011, or 2:43 PM MST April 3, 2011.
(source: http://www.rap.ucar.edu/weather/)

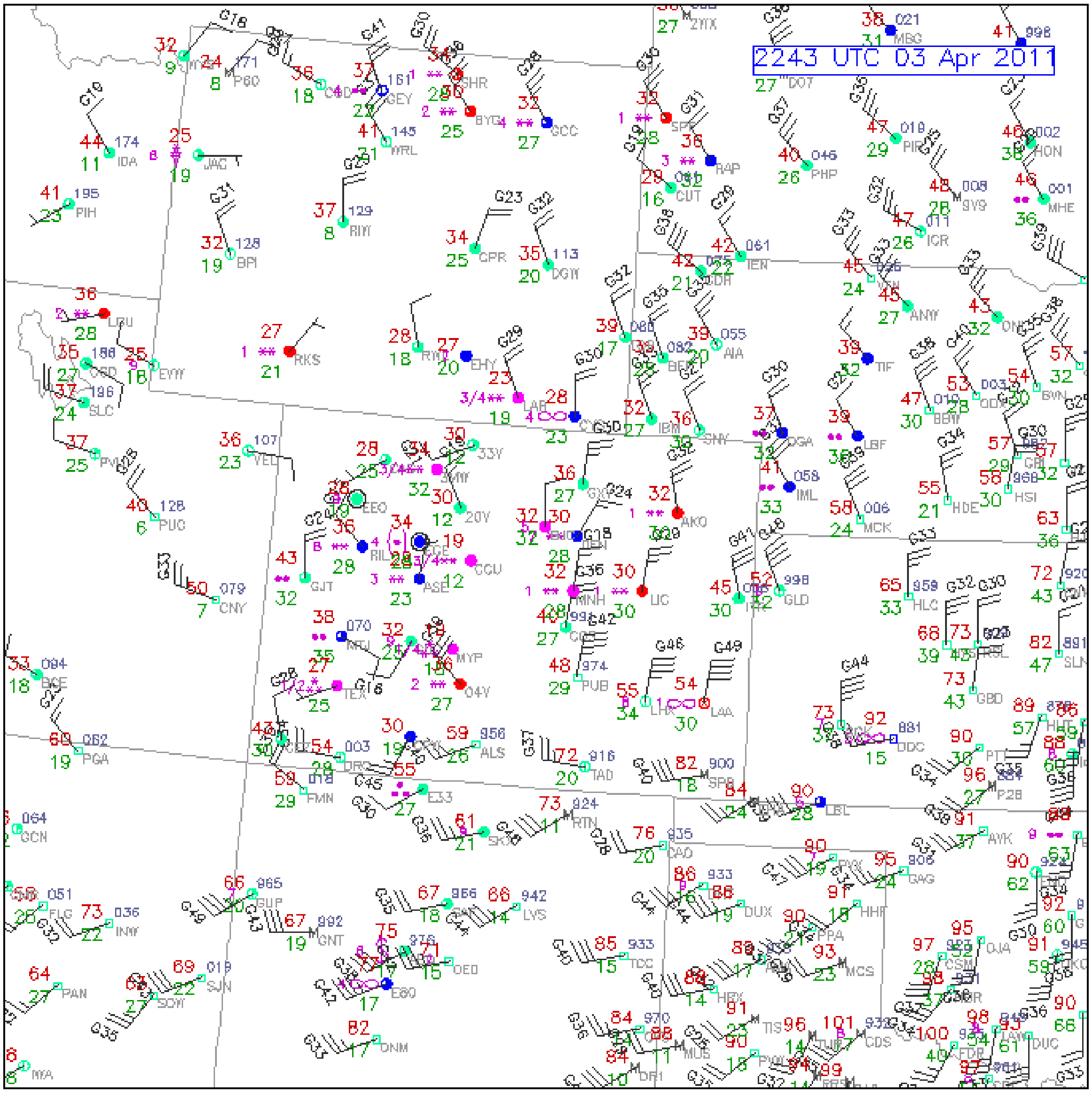


Figure 23: NCAR RAP Real-Time Weather Data website DEN sector analysis for 2243 April 3, 2011, or 3:43 PM MST April 3, 2011.
(source: http://www.rap.ucar.edu/weather/)

To expand on the data from these synoptic maps, hourly surface weather observations were gathered from several reporting stations located in Colorado, New Mexico and Arizona for April 3, 2011. Figure 24 provides a reference map containing the locations of all the stations utilized for this analysis. The two locations which recorded PM_{10} exceedances (Alamosa and Lamar, CO) are denoted in bold and caps.

Table 1 and Table 2 list observations for the PM_{10} exceedance locations of Alamosa and Lamar. Observations that are climatologically consistent with blowing dust conditions are highlighted in yellow. Table 3 through Table 14 contain the surface observations from sites that are in close vicinity to Alamosa or Lamar, or are in or near areas in eastern Colorado, northeast Arizona and northwest New Mexico that are known source regions for blowing dust (*see Appendix A – Grand Junction, Colorado, Blowing Dust Climatology and Appendix B - Lamar, Colorado, Blowing Dust Climatology at the end of this document*). At these locations sustained wind speeds were as high as 51 mph with wind gusts up to 70 mph. Both of these values are well above the blowing dust thresholds already identified.

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

Observations of sustained wind speeds and gust speeds above the blowing dust thresholds and reduced visibilities on April 3, 2011, at weather stations in northeast Arizona, northwest New Mexico and southern and eastern parts of Colorado show that a regional dust storm event occurred under south to southwesterly flow prior to a cold front passage, and under northerly flow at Lamar after a cold front passage. The observations contribute to the body of evidence that shows that a regional dust storm caused the PM_{10} exceedances at the monitoring sites in question.

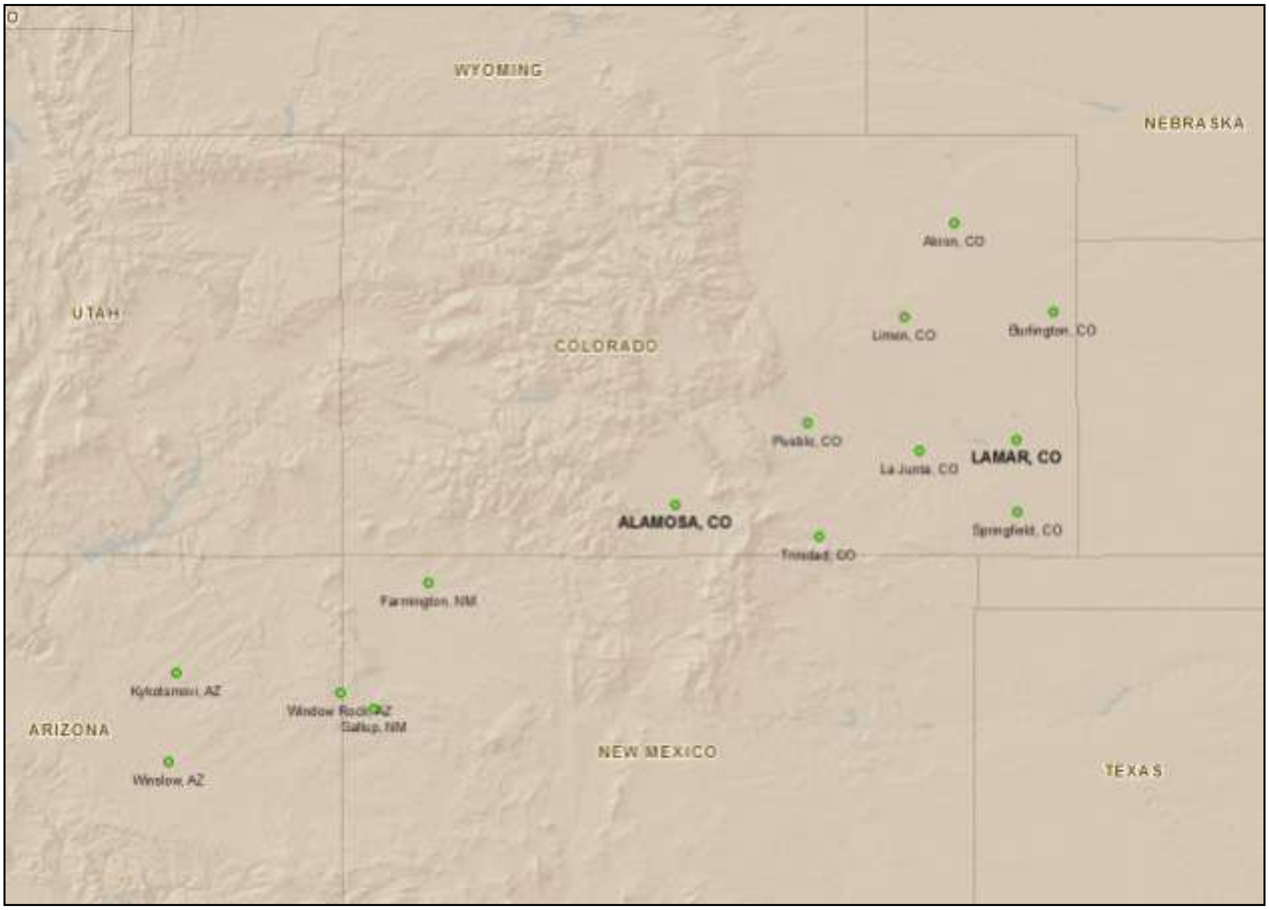


Figure 24: Weather observation stations for April 3, 2011, meteorological analysis.

Table 1: Weather observations for Alamosa, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
1:52	55	26	9	18	210		10
2:18	54	28	10	16	240		9
2:52	52	28	7				10
3:52	54	27	40	53	250	haze	2
3:59	54	28	35	53	240	haze	1.75
4:02	54	28	35	47	250	haze	3
4:52	52	35	27	39	270		10
5:52	50	37	16		230		10
6:52	52	35	18	25	240		10
7:52	52	36	27	37	230		10
8:52	58	26	30	40	250		10
9:52	57	28	32	44	240		10
10:52	55	29	29	45	250	haze	2.5
11:35	52	40	46	67	250	lt rain	1.5
11:39	48	46	39	67	260	lt rain	0.75
11:52	49	50	51	70	240	lt rain	2.5
11:57	52	40	48	70	240	lt rain	0.25
12:09	54	38	43	59	220	haze	0.5
12:16	55	35	33	58	220	haze	1
12:19	57	33	36	50	230	haze	2
12:26	57	33	39	51	240	haze	3
12:34	61	25	39	53	240	haze	2
12:38	61	25	46	59	240	haze	1
12:41	59	27	48	62	240	haze	0.5
12:52	58	30	45	56	230	lt rain	0.5
13:01	57	28				haze	0.5
13:17	59	29	37	53	240	haze	1.5
13:22	59	27	37	48	240	haze	3
13:30	59	29	44	53	250	haze	1.25
13:33	57	31	45	56	250	haze	0.75
13:42	55	38	31	60	240	haze	1.25
13:48	57	36	37	48	240	haze	3
13:52	56	37	39	48	230	haze	6
14:02	57	33	51	61	240	haze	1.75
14:13	55	35	37	50	230	haze	3
14:52	59	29	30	46	250		10

Table 2: Weather observations for Lamar, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	54	24	13		200		10
1:53	55	24	12		200		10
2:53	67	16	15		210		10
3:53	62	20	17		200		10
4:53	69	15	25	31	230		10
5:53	69	15	21		240		10
6:53	74	14	22	31	260		10
7:53	76	14	36	45	240		10
8:53	80	12	32	46	250		10
9:53	82	10	25	45	250		10
10:53	85	7	38	47	270		10
11:53	85	7	37	48	250		10
12:53	85	7	37	59	240		10
13:53	85	8	41	54	250		10
15:35	55	41	41	55	10	haze	1.25
15:40	54	41	44	56	10	haze	1
15:50	54	41	35	54	360	haze	1.25
15:53	54	41	41	54	360	haze	1.25
16:00	54	41	37	53	10	haze	1.5
16:03	54	41	39	51	10	haze	2
16:05	54	41	32	51	10	haze	3
16:17	52	43	41	52	10	haze	3
16:25	52	43	33	52	10	haze	2.5
16:40	48	46	35	46	360	haze	3
16:53	47	48	40	48	360	haze	4
17:53	41	62	35	47	360	haze	5
18:53	38	67	27	38	360		
19:53	37	72	17	38	360		10
20:53	37	64	24	39	350	lt snow	7
21:53	36	67	13		10	lt snow	9
22:53	39	48	16		350		10
23:53	38	50	16	21	320		

Table 3: Weather observations for Akron, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	62	19	12		220		10
1:53	60	21	13		210		10
2:53	59	23	15		210		10
3:53	55	29	12		230		10
4:53	53	32	12		250		10
5:53	52	38	15		10		10
6:53	49	63	27	32	10		10
7:53	49	66	24	29	360		10
8:53	48	66	25	33	10		10
9:53	52	54	25	29	10		10
10:53	53	46	28	35	350		10
11:53	47	56	30	38	350		10
12:16	43	61	30	43	340		10
12:31	39	70	30	41	350		10
12:53	38	70	31	38	340		10
13:43	34	80	28	40	350	lt snow; fog	3
13:53	33	88	25	36	340	lt snow; fog	1.25
14:53	33	92	29	35	350	lt snow; fog	1.75
15:53	32	92	25	31	350	lt snow; fog	4
16:53	34	85	22	28	340		10
17:53	33	72	28	33	350		10
18:53	32	66	22	30	350		10
19:53	30	69	17		350		10
20:53	30	69	16		340		10
21:53	30	66	20	25	330		10
22:53	30	71	25	31	340		10
23:03	30	69	23	30	340		10
23:53	28	75	22	28	340		10

Table 4: Weather observations for Burlington, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	53	32	12		230		10
1:53	59	27	15		240		10
2:53	57	29	12		240		9
3:53	56	30	12		240		9
4:53	61	24	14		240		8
5:53	56	31	12		240		7
6:53	62	28	9		250		8
7:53	64	27	13		20		8
8:53	63	34	16		20		10
9:53	60	44	16		10		9
10:53	59	47	16		30		10
11:53	62	38	22	30	10		10
12:53	59	41	20	30	20		10
13:53	59	39	32	41	360		10
14:53	45	56	32	47	350		10
15:53	38	70	29	41	360		10
16:20	36	87	24	37	350		9
16:30	34	93	23	33	350	lt snow; fog	1.75
16:42	34	93	23	30	340	lt snow; fog	2
16:53	33	96	22	31	360	lt snow; fog	1
17:01	34	86	22	31	350	mod snow; fog	0.5
20:53	34	72	20	31	350		10
21:53	33	75	20	24	340		10
22:53	33	69	20	29	340		10
23:53	32	69	22	33	340		10

Table 5: Weather observations for La Junta, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	65	17	8		220		10
1:53	67	16	9		200		10
2:53	71	16	25		240		10
3:53	70	16	24		230		10
4:53	69	17	25	31	250		10
5:53	65	20	16		230		10
6:53	69	20	25	31	250		10
7:53	75	15	28	40	260		10
8:53	77	14	37	47	270		10
9:53	78	13	38	52	250		10
10:53	80	12	37	50	250		10
11:53	81	11	43	59	250		10
12:53	81	11	39	51	250		10
13:31	81	11	41	73	250	haze	5
13:53	80	12	44	55	260		10
14:29	63	34	41	55	350	haze	2.5
14:35	61	36	40	54	360	haze	4
14:53	58	40	44	53	10		10
15:00	55	44	40	53	10		8
15:53	51	46	44	52	360		10
16:53	45	53	40	52	360		10
17:53	41	60	39	45	360		10
18:53	36	75	31	43	10		10
19:48	36	80	13	21	20	lt snow	3
19:53	34	85	15	21	10	lt snow; fog	2
19:59	34	86	15	23	360	lt snow; fog	1.5
20:12	34	86	23		20	lt snow; fog	1
20:18	34	86	20	27	10	lt snow; fog	0.75
20:41	32	93	30	37	10	mod snow; fog	0.5
20:53	32	92	23	33	10	fog	0.5

Table 6: Weather observations for Limon, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:55	59	22	10		200		10
1:55	47	34	6		140		10
2:55	54	28	7		230		10
3:55	51	32	7		240		10
4:55	49	33	6		20		10
5:55	44	40					10
6:55	51	36					10
7:55	65	20	5		200		10
8:55	61	33	27	33	30		10
9:55	57	44	23		20		10
10:55	59	44	24	30	10		10
11:55	56	49	23	31	20		10
12:55	49	50	37	46	350		10
13:51	36	80	36	48	350	lt snow; fog	2.5
13:55	35	88	35	44	360	lt snow; fog	3
14:22	36	93	28	43	10	unknown prcp	10
14:40	34	86	36	41	360	lt snow; fog	4
14:55	33	88	27	38	360		8
15:06	32	86	27	36	360	lt snow; fog	2.5
15:12	30	100	27	36	360	lt snow; fog	0.75
15:21	30	100	27	37	10	mod snow; ice fog	0.5
15:35	30	100	27	33	360	lt snow; fog	1
15:39	30	100	27	33	10	lt snow; fog	1.25
15:55	31	92	27	36	10	lt snow; fog	1.5
16:06	30	93	28	37	360	mod snow; ice fog	0.5

Table 7: Weather observations for Pueblo, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	72	12	13		230		10
1:53	72	13	13	20	230		10
2:32	72	14	32	44	260		10
2:53	70	15	20	32	260		10
3:53	68	17	23	32	260		10
4:53	67	18	18	27	270		10
5:53	67	17	17	32	260		8
6:13	68	17	31	40	260	haze	4
6:46	68	17	38	52	260		7
6:53	68	17	37	56	250		8
7:53	70	16	30	46	240		10
8:53	73	15	35	53	250		10
9:53	74	13	29	48	240		10
10:53	76	12	35	47	230		10
11:53	77	10	28	44	220		10
12:53	76	11	27	35	250		10
13:53	75	15	17	37	250		10
14:17	52	40	43	52	10		10
14:53	48	47	38	48	10		10
15:53	46	49	33	45	10		10
16:53	39	70	36	47	360	lt rain	10
17:53	35	85	36	52	10		10
18:37	36	69	35	52	10	lt snow	7
18:50	34	80	35	44	20	lt snow	1.75
18:53	33	81	33	44	10	lt snow	1.25
19:11	34	80	29	40	20	lt snow; fog	1.75
19:29	34	80	21	33	30	lt snow	2.5
19:39	34	80	21	33	20	lt snow	3
19:43	34	80	30	38	20	lt snow	1.75
19:53	33	81	18	36	20	lt snow	1.5
20:04	34	80	25	37	30	lt snow	2
20:18	36	69	24	36	30	lt snow	4
20:46	36	69	20	27	30		10
20:53	35	69	18	27	40		10

Table 8: Weather observations for Springfield, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:56	57	20	9		260		
1:56	58	22	16		240		
2:56	62	19	13		250		
3:56	61	20	13		250		
4:56	57	23	8		260		
5:56	52	28	12		260		
6:56	63	21	10		250		
7:56	75	13	20	28	270		
8:56	77	12	18	32	270		
9:56	83	9	29	37	270		
10:56	84	7	28	41	260		
11:56	83	7	25	38	270		
12:56	84	8	23	43	250		
13:56	81	9	32	48	270		
14:56	82	9	32	46	260		
15:56	81	8	24	38	270		
16:11	64	30	38	56	30		
16:56	54	41	41	48	20		
17:56	47	49	35	46	10		
18:56	41	62	25	41	20		
19:56	38	67	29	41	10		
20:56	35	69	30	39	20		
21:56	32	85	27	31	10		
22:56	31	92	23	32	360		
23:56	31	85	30	44	10		

Table 9: Weather observations for Trinidad, Colorado on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:54	60	19	6		200		10
1:54	64	16	7				10
2:54	65	14	13	21	290		10
3:54	66	15	24	35	240		10
4:54	65	18	31	45	250		10
5:54	65	19	46	56	250		10
6:54	65	20	30	46	250		10
7:54	67	17	35	51	250		10
8:54	69	15	47	56	250		10
9:54	71	14	41	55	240		10
10:54	71	12	50	60	250		10
11:54	72	12	40	53	250		10
12:54	73	11	39	55	230		10
13:54	73	11	37	55	250		10
14:54	72	14	29	43	280		10
15:54	70	17	35	46	260		10
16:47	52	43	29	40	20		10
16:54	48	49	31	47	20		10
17:01	46	53	35	41	20		10
17:54	42	57	15	24	30		10
18:19	39	65	16		40		10
18:54	38	70	12		30	lt snow	10

Table 10: Weather observations for Kykotsmovi (Hopi), Arizona on April 3, 2011. (source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:13	58	32	21	27	197		
1:13	57	31	15	26	191		
2:13	53	36	9	19	207		
3:13	49	40	5	11	233		
4:13	51	42	8	12	204		
5:13	44	45	5	12	308		
6:13	51	49	8	10	193		
7:13	58	36	22	33	226		
8:13	62	26	26	38	232		
9:13	65	20	27	37	248		
10:13	66	19	28	42	258		
11:13	66	19	30	43	271		
12:13	67	18	27	44	255		
13:13	69	17	29	42	265		
14:13	67	15	28	41	279		
15:13	67	18	27	41	281		
16:13	59	24	19	40	332		
17:13	54	23	22	34	347		
18:13	49	23	23	35	353		
19:13	45	23	26	39	352		
20:13	43	22	24	38	349		
21:13	40	21	19	37	7		
22:13	36	24	19	28	25		
23:13	33	22	7	11	18		

Table 11: Weather observations for Window Rock, Arizona on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	56	34	20	28	220		10
1:53	53	38	14	25	220		10
2:53	52	39	17	23	220		10
3:53	51	41	15	25	220		10
4:53	50	42	18	30	220		10
5:53	50	42	21	39	220		10
6:53	50	44	15	23	220		10
7:53	51	44	18	30	220		10
8:53	54	41	23	33	230		10
9:53	56	37	29	40	240		10
10:53	60	28	35	45	250		10
11:53	61	24	29	43	260		10
12:53	64	20	28	46	250		10
13:53	65	18	38	48	240		10
14:53	64	19	30	40	270		10
15:53	58	26	23	50	280		10
16:53	58	28	28	37	250		10
17:53	49	50	20	28	350		10
18:53	41	62	8		360		10
19:53	43	43	9	16	350		10
20:53	39	30	12	21	360		10
21:53	35	28	13	23	350		10
22:53	32	27	10	21	340		10
23:53	30	21	12		360		10

Table 12: Weather observations for Winslow, Arizona on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:56	60	29	8		150		10
1:56	59	33	18	27	210		10
2:56	59	36	29	39	220		10
3:56	58	37	33	40	220		10
4:56	57	40	28	39	220		10
5:56	57	40	25	37	220		10
6:56	60	36	30	44	210		10
7:56	65	29	41	56	210		10
8:56	68	21	33	45	220		10
9:56	71	14	32	43	250		10
10:56	71	16	32	48	230		10
11:56	73	17	17	30	240		10
12:56	73	16	24	35	240		10
13:56	73	15	25	37	250		10
14:56	71	16	32	44	250		10
15:56	70	18	33	44	260		10
16:56	67	18	28	39	260		10
17:56	63	20	25	32	250		10
18:56	61	27	23	31	320		10
19:56	53	21	21	28	350		10
20:56	49	22	20	28	320		10
21:56	45	24	15		310		10
22:56	42	25	9		290		10
23:56	37	29	7		300		10

Table 13: Weather observations for Farmington, New Mexico on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	64	21	22		240		10
1:53	64	22	18	29	250		10
2:53	63	23	18	24	250		10
3:53	61	25	15	22	250		10
4:53	61	24	18	30	230		10
5:53	59	27	23	31	230		10
6:53	59	28	21	35	220		10
7:53	59	31	24	35	220		10
8:53	65	25	25	36	240		8
9:24	64	22	30	46	260	haze	2
9:41	66	21	31	43	270	haze	5
9:53	65	21	29	44	270	haze; blowing dust	6
10:53	67	18	37	50	270	haze	6
11:53	65	18	28	41	250		7
12:53	63	24	27	38	300		10
13:53	62	28	28	38	300		10
14:53	59	32	25	40	310		10
15:53	57	33	30	40	310		10
16:53	45	63	21	37	310		9
17:02	45	57	23	35	310		10
17:53	46	42	14	22	290		10
18:53	45	31	15	27	320		10
19:53	43	18	18	29	310		10
20:53	40	19	24	35	320		10
21:53	37	18	27	33	320		10
22:53	36	22	22	32	310		10
23:53	34	27	17	26	300		10

Table 14: Weather observations for Gallup, New Mexico on April 3, 2011.
(source: http://www.met.utah.edu/mesowest/)

Time MST April 3	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
0:53	55	34	13		210		10
1:53	54	35	13		210		10
2:53	53	38	14	22	220		10
3:53	52	38	16		200		10
4:53	51	38	16		210		10
5:53	50	40	14		220		10
6:53	52	41	25	32	210		10
7:53	54	40	23	37	230		10
8:53	56	37	33	41	230		10
9:53	58	33	30	41	220		10
10:53	61	28	28	39	240		10
11:53	65	20	40	50	250		10
12:53	65	18	43	59	250		5
13:53	67	15	43	53	250		7
14:53	66	17	39	56	240		7
15:53	63	19	35	50	250		9
16:53	60	23	28	39	270		10
17:53	54	38	20	40	240		10
18:18	52	47	16	45	340		10
18:26	50	54	13	23	340		10
18:53	46	63	21	28	330		10
19:53	44	55	7		290		10
20:53	43	38	9		330		10
21:53	40	26	15	21	350		10
22:53	37	26	13	17	330		10
23:53	33	21	12	18	350		10

The Albuquerque, Flagstaff and Pueblo National Weather Service (NWS) forecast offices issue weather warnings and advisories for northeast Arizona, most of New Mexico and south-central and southeast Colorado. The weather warnings and advisories issued by these offices for April 3, 2011, pertaining to strong winds and blowing dust are presented in Appendix C. Additionally, the Colorado Department of Public Health and Environment (CDPHE) issued a Blowing Dust Advisory on the morning of April 3 for southwestern, south-central and southeastern parts of Colorado, including both Alamosa and Lamar. This advisory can also be found in Appendix C. ***Warnings and advisories issued by the NWS and CDPHE show that strong winds and areas of blowing dust were expected and experienced across this region on April 3, 2011.***

Figure 25 shows the NOAA HYSPLIT 18-hour forward matrix trajectories (Draxler and Rolph, 2012) for northeast Arizona and northwest New Mexico starting at 11 PM MST April 2, 2011 (see the following link for more information on HYSPLIT from the NOAA Air Resources Laboratory: http://ready.arl.noaa.gov/HYSPLIT.php). This analysis clearly shows the transport of air from these areas into southern Colorado on April 3. HYSPLIT 14-hour back trajectories for 1 PM MST April 3, 2011, in Alamosa and Lamar are presented in Figure 26 and Figure 27 respectively. These figures also visibly illustrate that Arizona and northwest New Mexico were source regions for air transported into Colorado on April 3 prior to a cold front passage. Additionally, Figure 28 shows the HYSPLIT 4-hour back trajectory for 5 PM MST April 3 in Lamar. The importance of this image is to display the source regions of the dust transported into Lamar both before and after the cold front passage.

NOAA HYSPLIT forward and backward trajectories provide clear supporting evidence that dust from arid regions of Arizona, northwest New Mexico and eastern Colorado caused the PM_{10} exceedances measured across portions of southern Colorado on April 3, 2011.

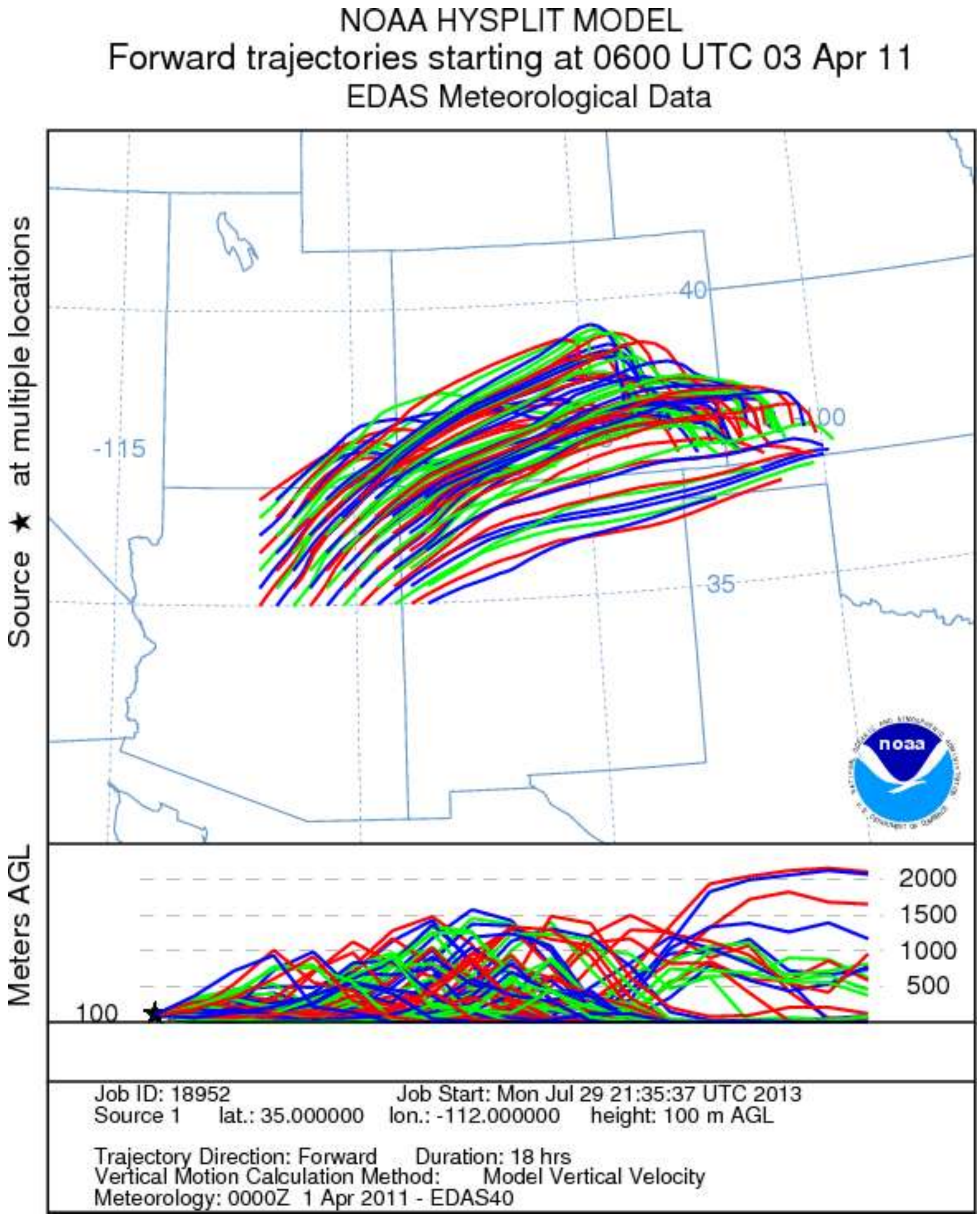


Figure 25: NOAA HYSPLIT 18-hour forward trajectories for northeast Arizona and northwest New Mexico for 11 PM MST April 2 (06Z April 3), 2011, to 5 PM MST April 3, 2011. (source: http://ready.arl.noaa.gov/HYSPLIT.php)

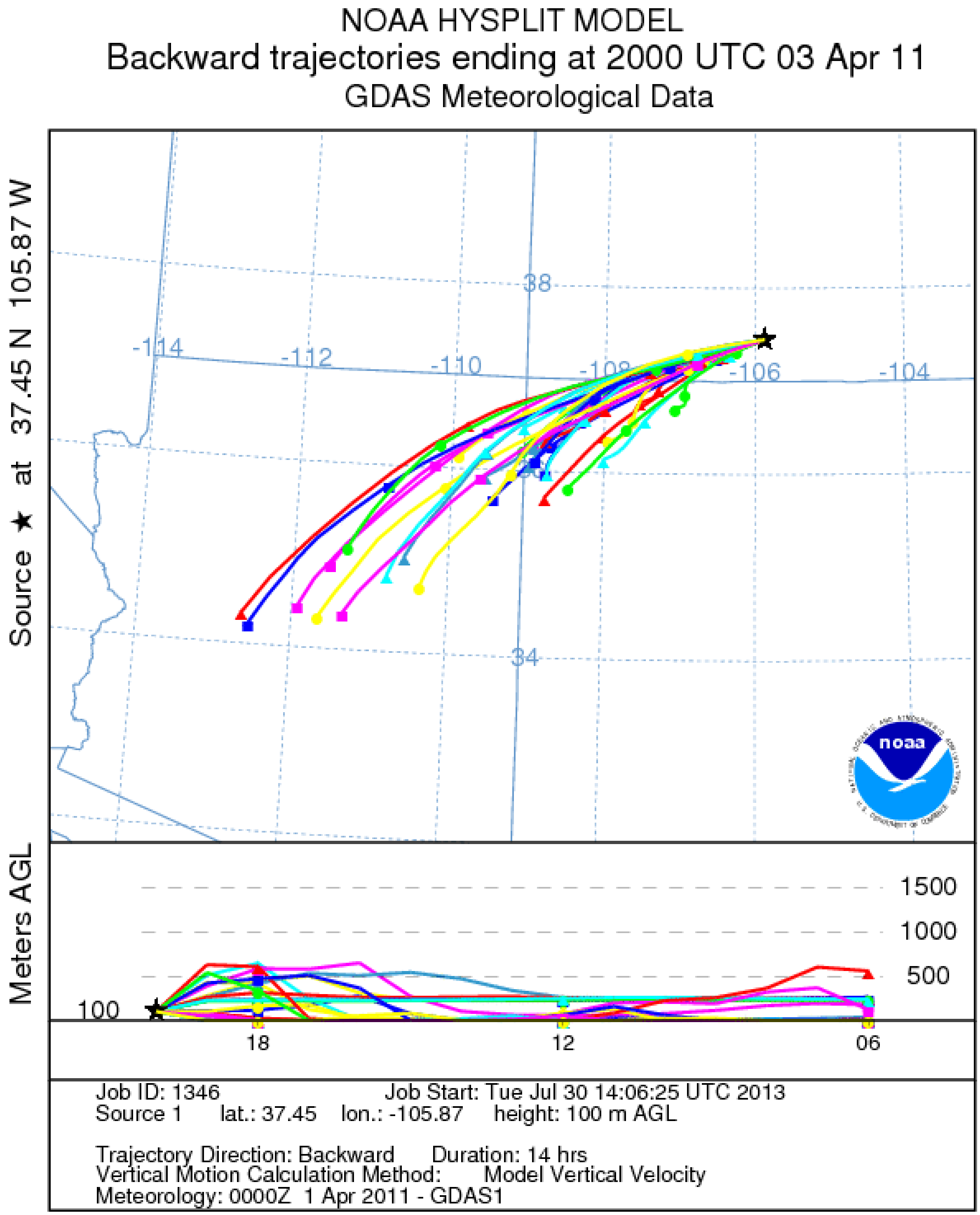


Figure 26: NOAA HYSPLIT 14-hour back trajectories for Alamosa, CO for each hour from 11 PM MST April 2, 2011, to 1 PM MST April 3 (20Z April 3), 2011. (source: http://ready.arl.noaa.gov/HYSPLIT.php)

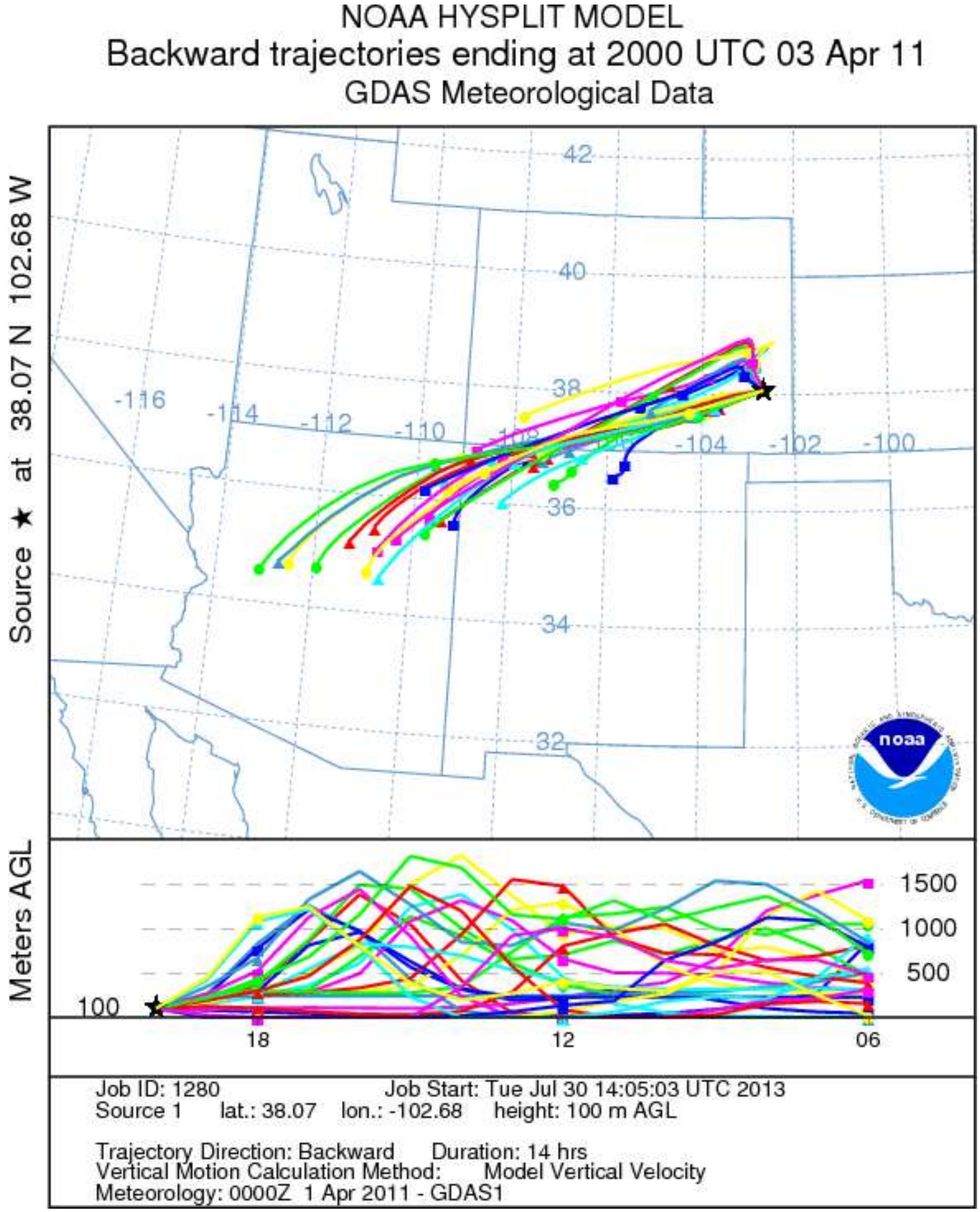


Figure 27: NOAA HYSPLIT 14-hour back trajectories for Lamar, CO for each hour from 11 PM MST April 2, 2011, to 1 PM MST April 3 (20Z April 3), 2011.
(source: http://ready.arl.noaa.gov/HYSPLIT.php)

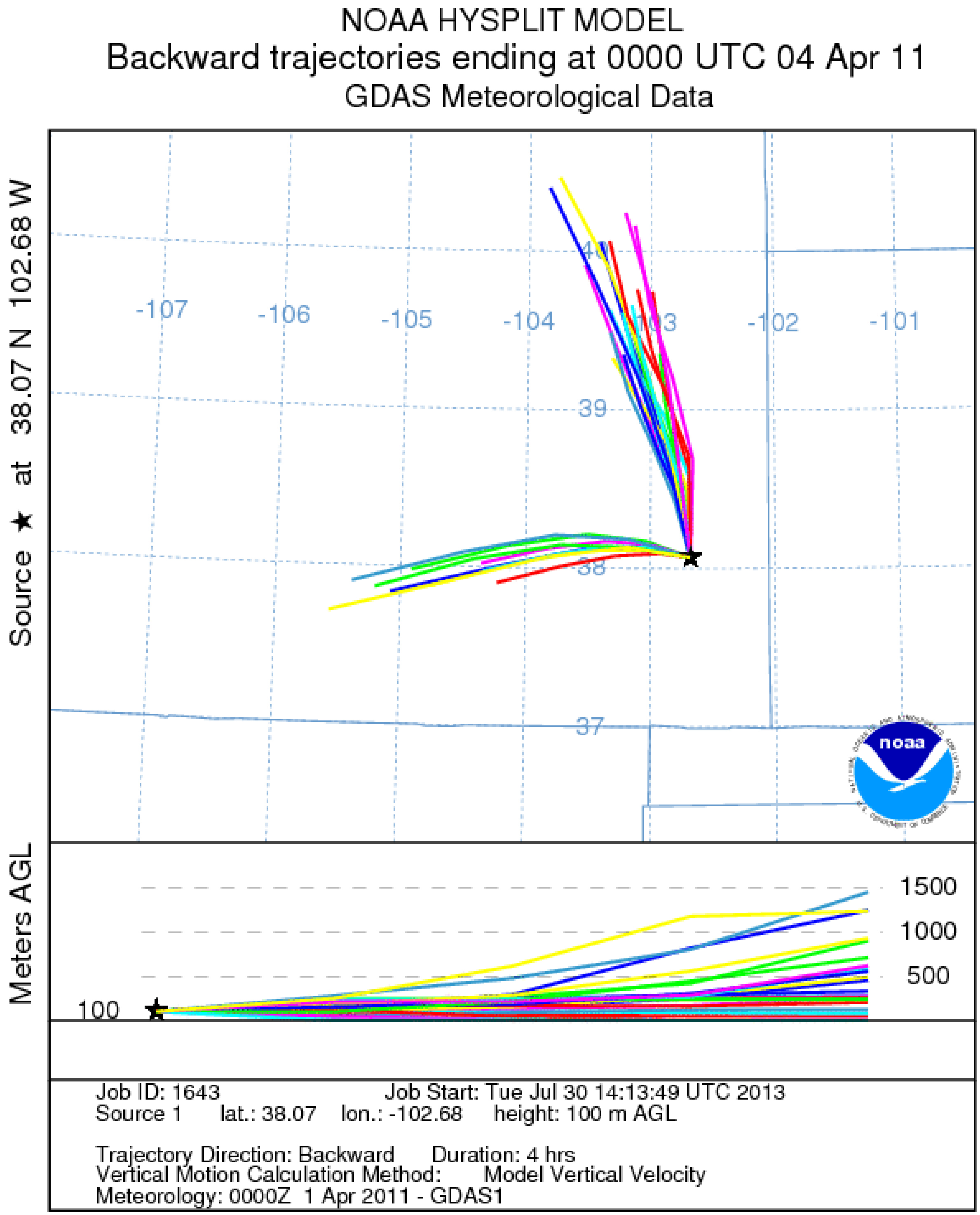


Figure 28: NOAA HYSPLIT 4-hour back trajectories for Lamar, CO for each hour from 1 PM MST April 3, 2011, to 5 PM MST April 3 (00Z April 4), 2011.
(source: http://ready.arl.noaa.gov/HYSPLIT.php)

Figure 29 shows the output for blowing dust from the Navy Aerosol Analysis and Prediction System (NAAPS) Global Aerosol Model for 5 PM April 3 (00Z April 4), 2011. The NAAPS system models blowing dust emissions and transport based on soil moisture content, soil erodibility factors and a variety of meteorological factors known to be conducive to blowing dust (for a description of NAAPS see: http://www.nrlmry.navy.mil/aerosol_web/Docs/globaer_model.html).

The forecast panel in the lower left of Figure 29 shows an area of highly elevated surface dust concentrations over much of New Mexico, northeast Arizona and eastern Colorado. This model output suggests that the Four Corners area of northeast Arizona and northwest New Mexico along with the high plains of eastern Colorado were major source regions for blowing dust on April 3, 2011.

Forecast products from the Navy Aerosol Analysis and Prediction System model provide evidence for a widespread blowing dust event on April 3, 2011, suggesting that significant source regions for dust in Colorado were located in arid regions of Arizona, New Mexico and Colorado.

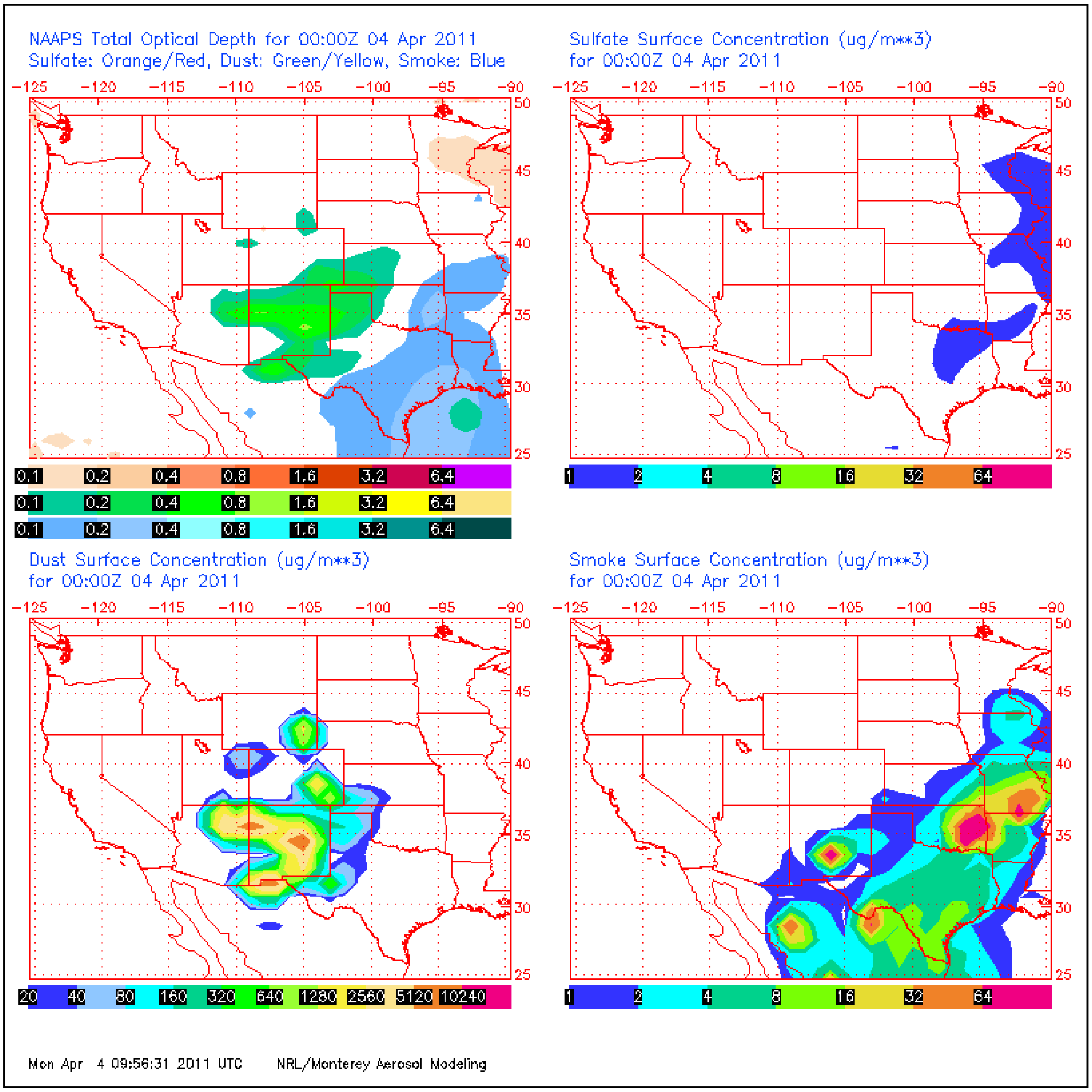


Figure 29: NAAPS forecasted dust concentrations for 5 PM MST April 3 (00Z April 4), 2011. (source: http://www.nrlmry.navy.mil/aerosol-bin/aerosol/display_directory_all?DIR=/web/aerosol/public_html/globaer/ops_01/wus/)

Figure 30 shows the GASP (GOES Aerosol Smoke Product) West Aerosol Optical Depth image at 8:30 AM MST April 3, 2011. Aerosol Optical Depth (AOD) is a measure of the degree to which aerosols prevent the transmission of light (see the following link for additional information on GASP: http://www.star.nesdis.noaa.gov/smcd/emb/aerosols/products_geo.php). In Figure 30 cloud cover has interfered with the AOD calculations and prevented the derivation of values in much of south-central and southwest Colorado, including the San Luis Valley where Alamosa is located. However, moderate to high-moderate AOD values of 0.4 - 0.7 can be found in northeast Arizona and northwest New Mexico. This corresponds in both location and time to observations of deteriorating visibility, haze and blowing dust in Farmington, New Mexico, between 7:53 and 9:53 AM MST (Table 13). Blowing dust in the Painted Desert of northeast Arizona remained visible on GASP AOD imagery through mid to late morning (Figure 31).

Figure 31, Figure 32 and Figure 33 show the GASP images for 10:15 AM MST, 2:15 PM MST and 2:45 PM MST April 3, respectively. By this period of time, dust had increased over southeast Colorado with elevated AOD values found throughout the region. Concurrently, observations in La Junta, Colorado, of poor visibility and haze commenced at 1:31 PM MST and persisted through 3:00 PM MST (Table 5).

Lamar also reported reduced visibility and haze between 3:35 PM and 5:53 PM MST, but it appears that most of this dust originated north of Lamar as the wind direction during this time period was out of a northerly direction (Table 2). This correlates well with the GASP imagery displayed in Figure 32, Figure 33 and Figure 34. On Figure 32, a thin band of elevated AOD values can be found across central Nebraska. Thirty minutes later in Figure 33, that band spread to the southwest and expanded in coverage across east-central Colorado. Concluding with Figure 34 at 3:45 PM MST, highly elevated AOD values of 0.6 - 1.0 had pushed southward towards Lamar. These high AOD values in the Lamar area coincide with observations of haze and visibility of only 1 – 1¼ statute miles in Lamar between 3:40 PM and 3:50 PM MST (Table 2).

GASP satellite imagery shows that the desert regions of northeast Arizona and northwest New Mexico along with the arid plains of eastern Colorado were source regions for the blowing dust on April 3, 2011. This is consistent with the climatology for many dust storms in Colorado as described in the Grand Junction, Colorado, Blowing Dust Climatology report contained in Appendix A and the Lamar, Colorado, Blowing Dust Climatology in Appendix B, both found at the end of this document.

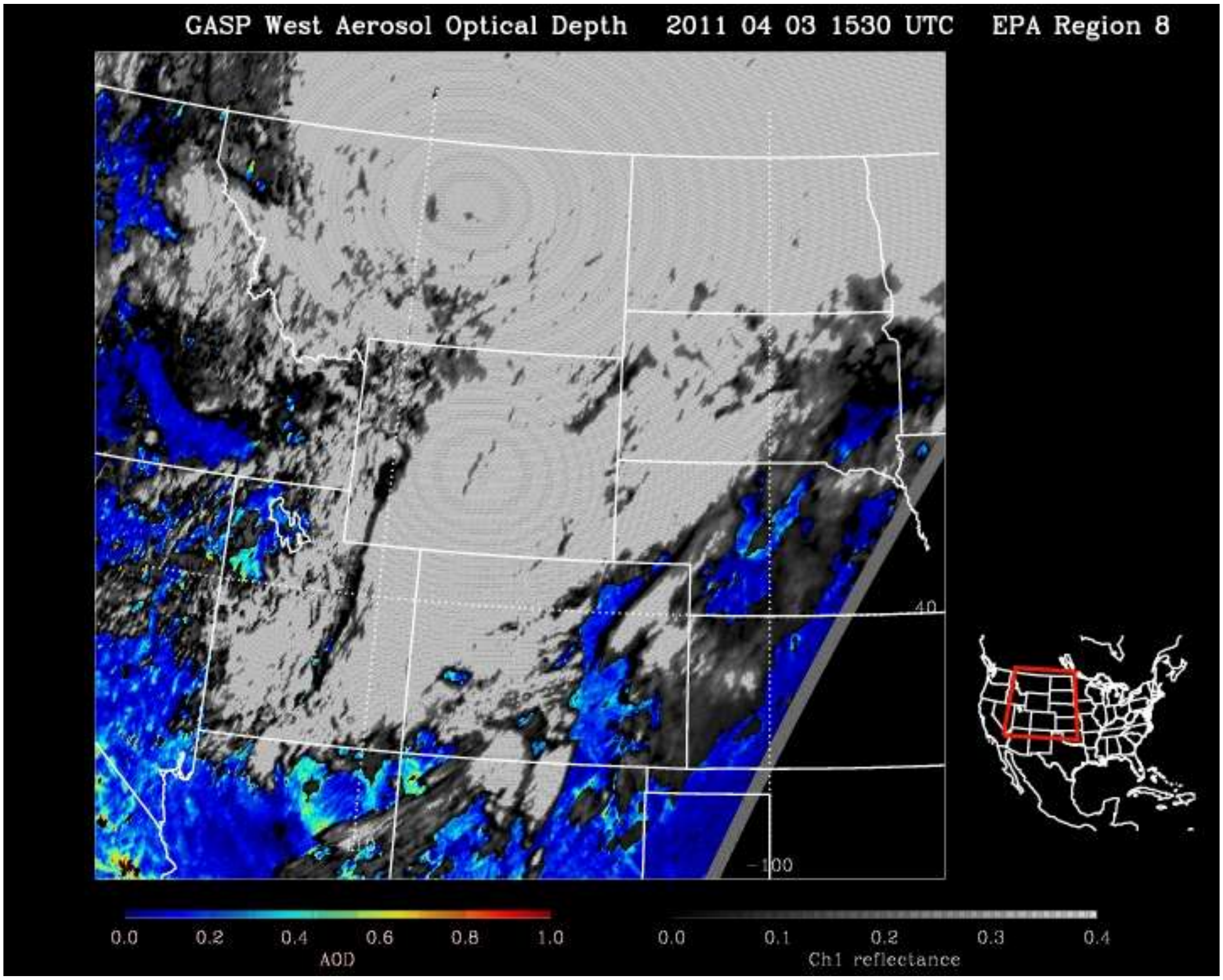


Figure 30: GASP West Aerosol Optical Depth image, EPA Region 8 at 8:30 AM MST April 3 (1530Z April 3), 2011.
(source: http://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php?product_id=2)

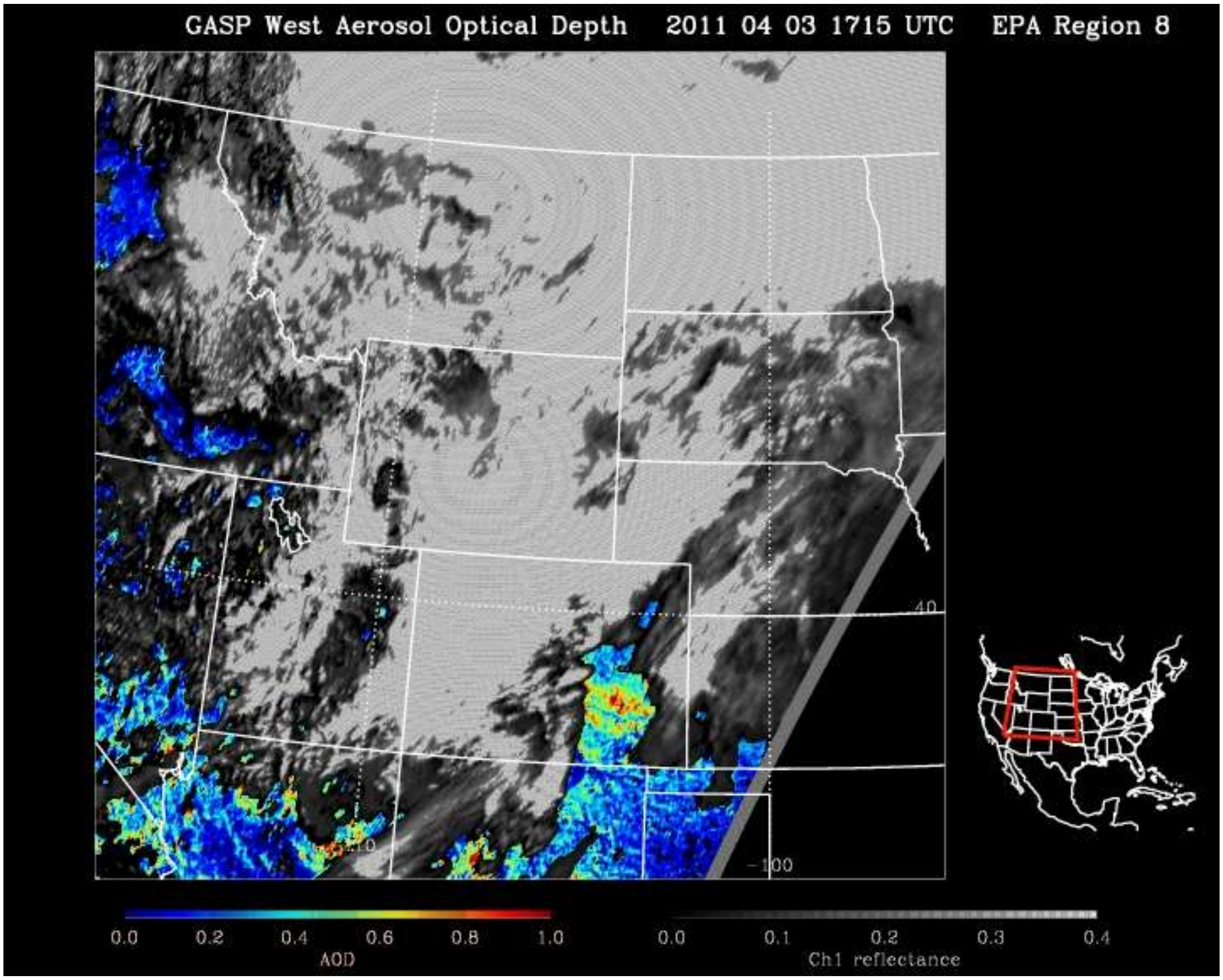


Figure 31: GASP West Aerosol Optical Depth image, EPA Region 8 at 10:15 AM MST April 3 (1715Z April 3), 2011.
(source: http://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php?product_id=2)

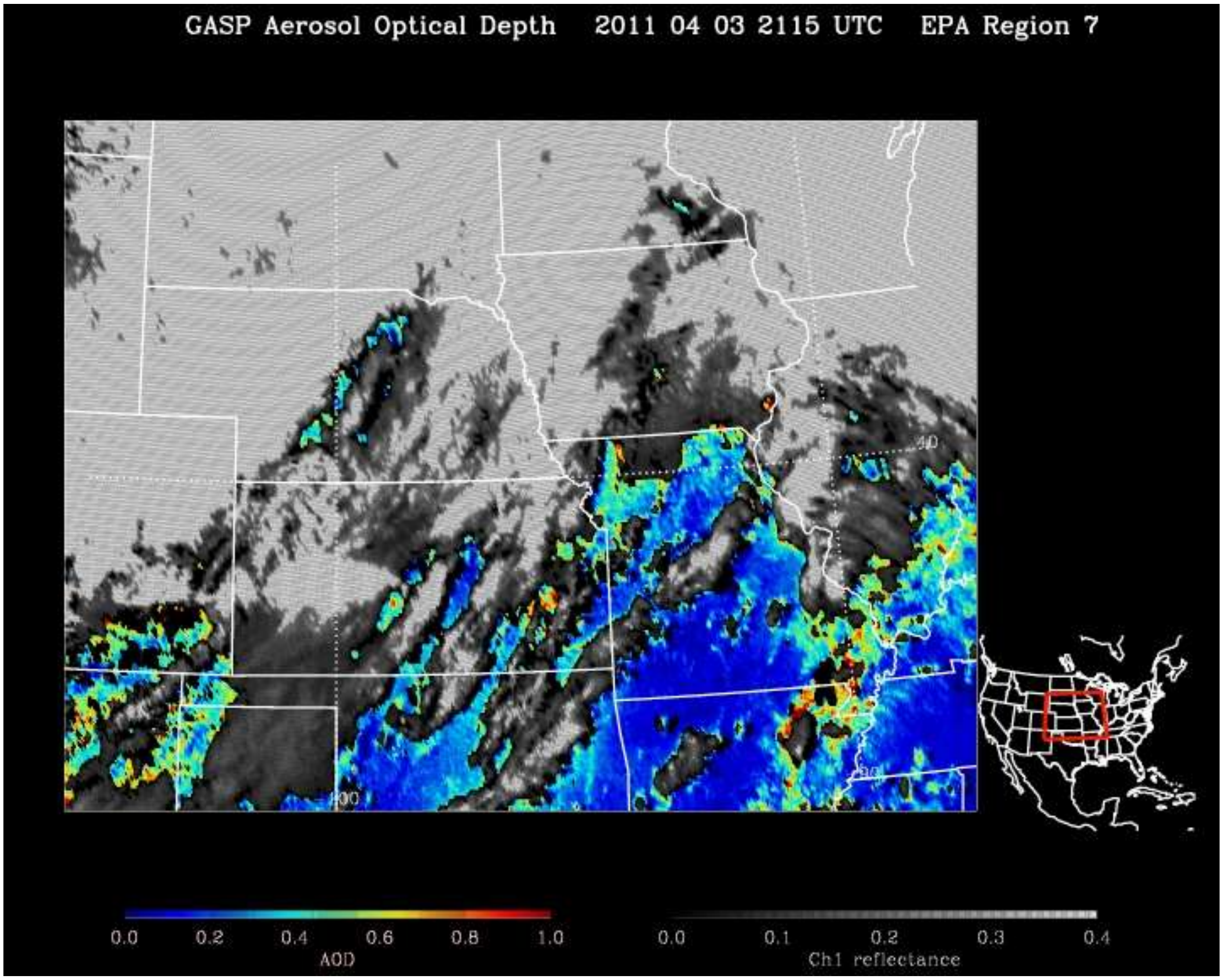


Figure 32: GASP West Aerosol Optical Depth image, EPA Region 7 at 2:15 PM MST April 3 (2115Z April 3), 2011.
(source: http://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php?product_id=2)

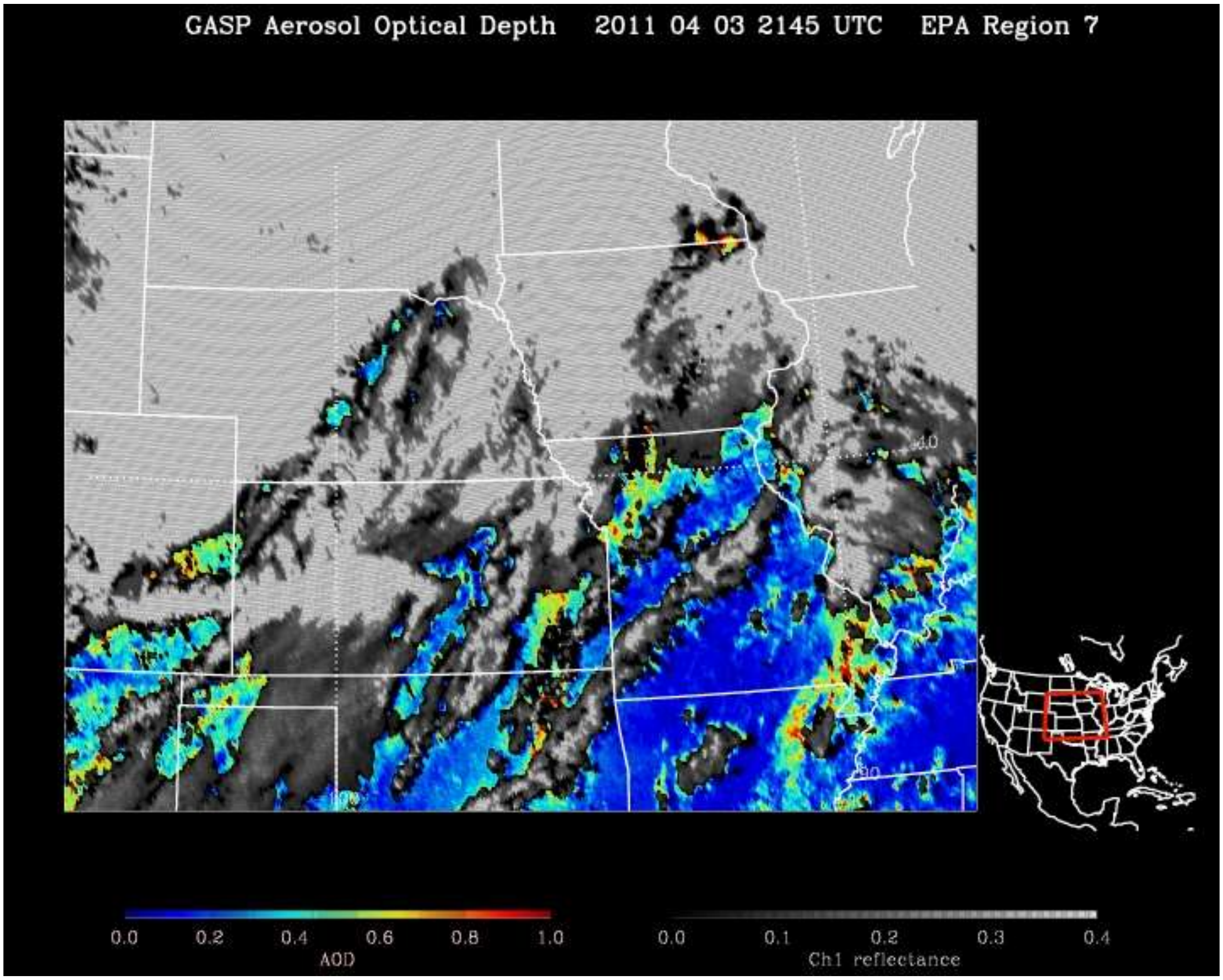


Figure 33: GASP West Aerosol Optical Depth image, EPA Region 7 at 2:45 PM MST April 3 (2145Z April 3), 2011.
(source: http://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php?product_id=2)

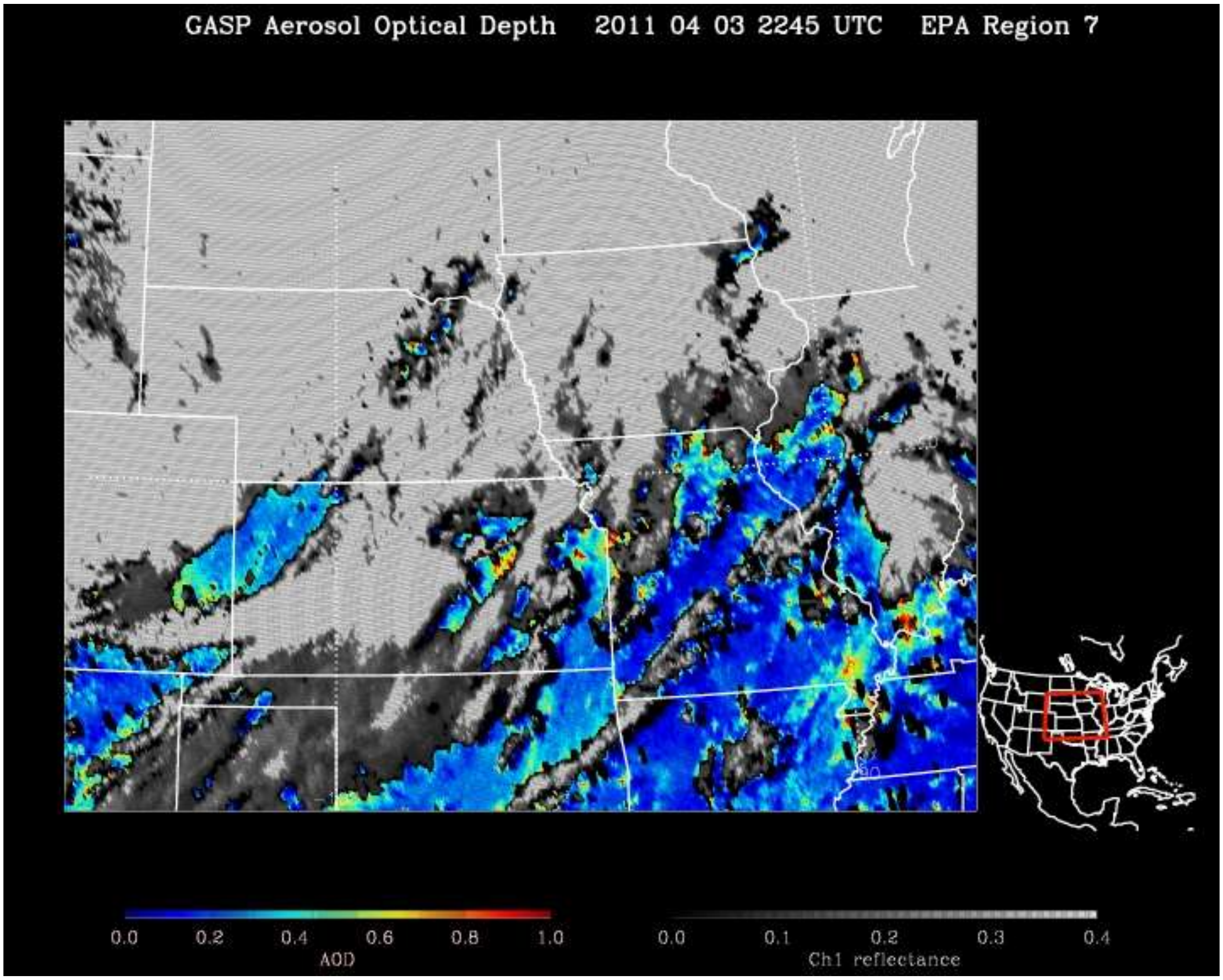


Figure 34: GASP West Aerosol Optical Depth image, EPA Region 7 at 3:45 PM MST April 3 (2245Z April 3), 2011.
(source: http://www.star.nesdis.noaa.gov/smcd/spb/aq/index.php?product_id=2)

The Smoke Text Product from the National Oceanic and Atmospheric Administration (NOAA) Satellite Services Division - Descriptive Text Narrative for Smoke/Dust Observed in Satellite Imagery through 0245Z April 4, 2011 (7:45 PM MST April 3, 2011) (http://www.ssd.noaa.gov/PS/FIRE/DATA/SMOKE/2011/2011D040319.html) describes dust moving southward through eastern Colorado following the passage of a cold front on April 3:

> "A few areas of blowing dust could be seen in these [*sic*] region in this evening's satellite imagery. The first could be seen across the Panhandle region of Texas moving eastward/southeastward along the dryline in that region. **The second area could be seen moving southward through parts of far eastern Colorado and into western Kansas where high winds have picked up after the passage of a cold front this evening.**"

NOAA scientists with expertise in the analysis of dust storms have indicated that a regional dust storm occurred in eastern Colorado on April 3, 2011.

Figure 35 shows the total precipitation in inches for a portion of the southwestern United States for March 2011. It shows that most of northeast Arizona, northwest New Mexico and southeast Utah received less than 0.4 inches of precipitation during March 2011. Additionally, it should be noted that little to no precipitation was reported in this region during the first few days of April 2011 as evidenced in Figure 36. Recall that this area has been identified as the source region for the blowing dust that occurred prior to the cold front passage of April 3, 2011. Combining the data from Figure 35 and Figure 36, we can extrapolate that most of northeast Arizona, northwest New Mexico and southeast Utah received less than 0.5 inches of precipitation during the March 1-April 3 time frame. This is an approximate precipitation threshold below which blowing dust can occur in the Painted Desert area when winds are above the blowing dust thresholds. This precipitation threshold is reported in Appendix A which shows that blowing dust can occur in northeastern Arizona source regions when soils are dry (typically less than 0.5 inches in a 30-day period at Hopi, Arizona) and winds are strong.

After the cold front passage on April 3, 2011, the source region for dust shifted to eastern Colorado. As stated earlier in this report, the majority of the dust that impacted Lamar appears to have originated in eastern Colorado and was transported on northerly winds. Referring again to Figure 35 and Figure 36, precipitation amounts of 0.5 inches or less were widespread across eastern Colorado. According to Appendix B, this is also the approximate precipitation threshold below which blowing dust exceedances in Lamar are more likely to occur when combined with high winds.

Furthermore, the Drought Monitor report for the western United States as of 5:00 AM MST March 29, 2011, (Figure 37) reveals that drought conditions in the Painted Desert of northeast Arizona were categorized as "Abnormally Dry" to "Moderate Drought" just a few days before the April 3, 3011, dust event. Severe drought conditions can also be observed in much of eastern Colorado, the likely source region for the dust transported into Lamar after the cold front passage.

Soils in the Four Corners area of northeast Arizona, northwest New Mexico and southeast Utah along with the plains of eastern Colorado were dry enough to produce blowing dust when winds were above the thresholds for blowing dust on April 3, 2011.

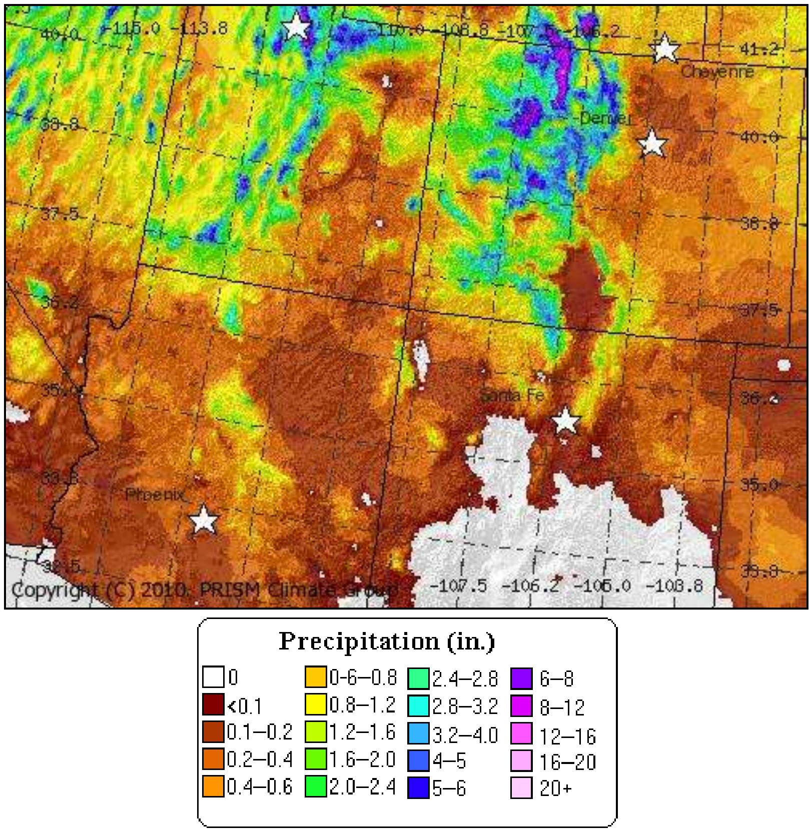


Figure 35: Total precipitation in inches for March 2011.
(source: http://prismmap.nacse.org/nn/index.phtml)

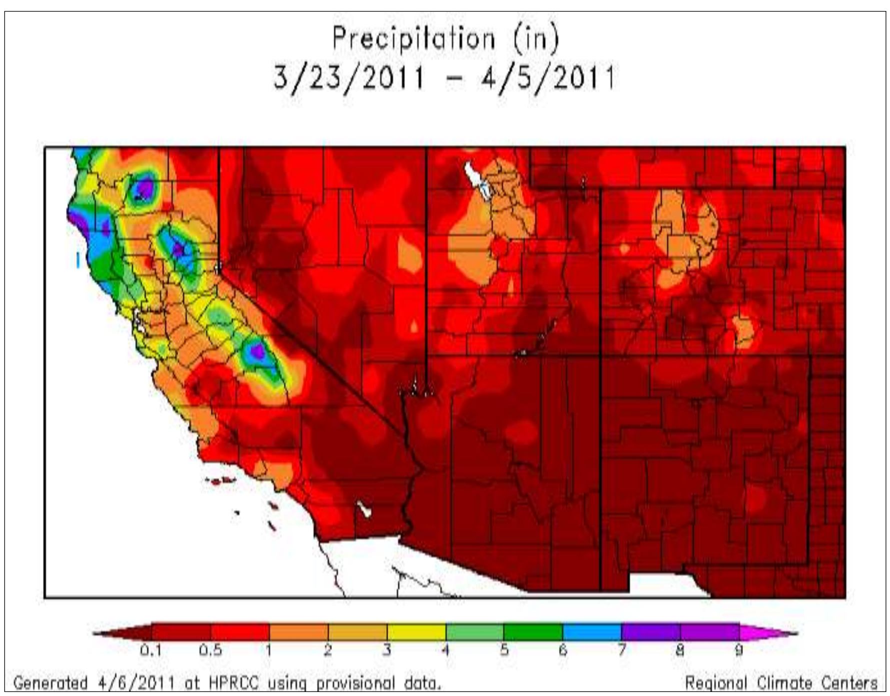


Figure 36: Total precipitation in inches for March 23-April 5, 2011.
(source:
http://www.hprcc.unl.edu/maps/current/index.php?action=update_region&region=WRCC)

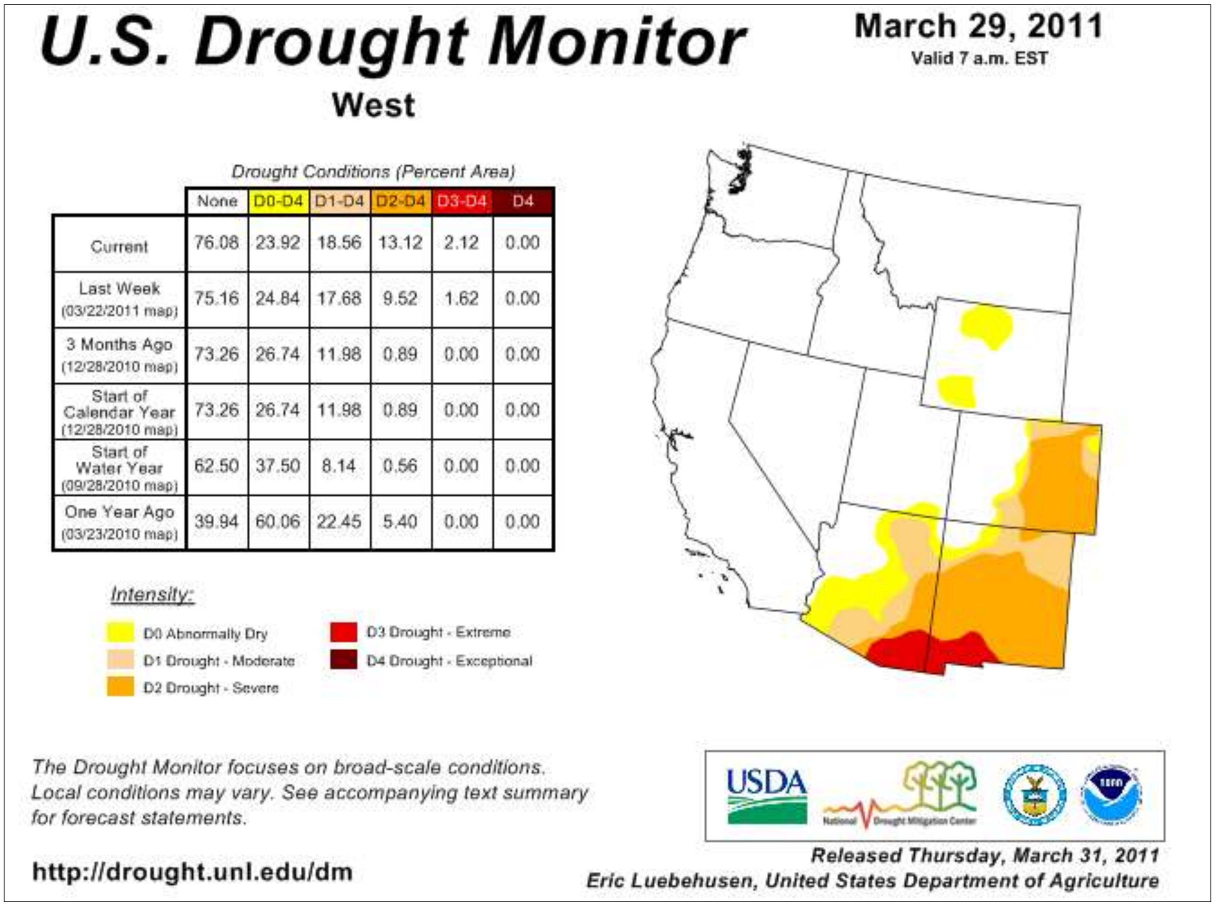


Figure 37: Drought conditions for the western United States at 5:00 AM MST March 29, 2011. (source: http://droughtmonitor.unl.edu/archive.html)

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

Friction velocities have been calculated for 11 AM MST and 5 PM MST April 3, 2011, using the 12 km NAM (North American Mesoscale Model). These friction velocities are presented in Figure 38 and Figure 39, respectively. According to Marticorena et al. (1997), even undisturbed desert soils normally resistant to wind erosion will be susceptible to emission of blowing dust when threshold friction velocities are greater than about 1.0 to 2.0 meters per second. These figures show that a wide area of northern Arizona, northwest New Mexico, southeast Utah and southern and eastern Colorado had friction velocities above 1.0 meters per second during the late morning and afternoon hours of April 3.

During the late morning of April 3, 2011, high friction velocity values were present in northwest New Mexico and within the Little Colorado River Valley and Painted Desert region of northeast Arizona (Figure 38). This is the same area where GASP imagery shows elevated AOD values corresponding to blowing dust (Figure 30 and Figure 31) and also where 30-day precipitation totals were near or below 0.5 inches (Figure 35 and Figure 36). Figure 38 also shows that frictional velocities were high enough for dust from undisturbed soils in parts of southern Colorado, including western sections of the arid San Luis Valley upwind of Alamosa.

Furthermore, frictional velocity values were at or above the blowing dust threshold across much of east-central and southeast Colorado (Figure 38 and Figure 39). This is consistent with the conclusion that the dust which impacted Lamar after the cold front passage was a natural event. Note that blowing dust will typically only occur where friction velocities are high and the soils are dry and not protected by vegetation, forest cover, boulders, rocks, etc. This is why blowing dust occurred in the desert and more arid sections of northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado on April 3.

The elevated friction velocities shown in Figure 38 and Figure 39, the data on soil moisture conditions presented elsewhere in this report and the prevalence of winds above blowing dust thresholds (all occurring in traditional source regions in northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado demonstrate that this dust storm on April 3, 2001, was a natural event covering a large geographic area that was not reasonably controllable or preventable.

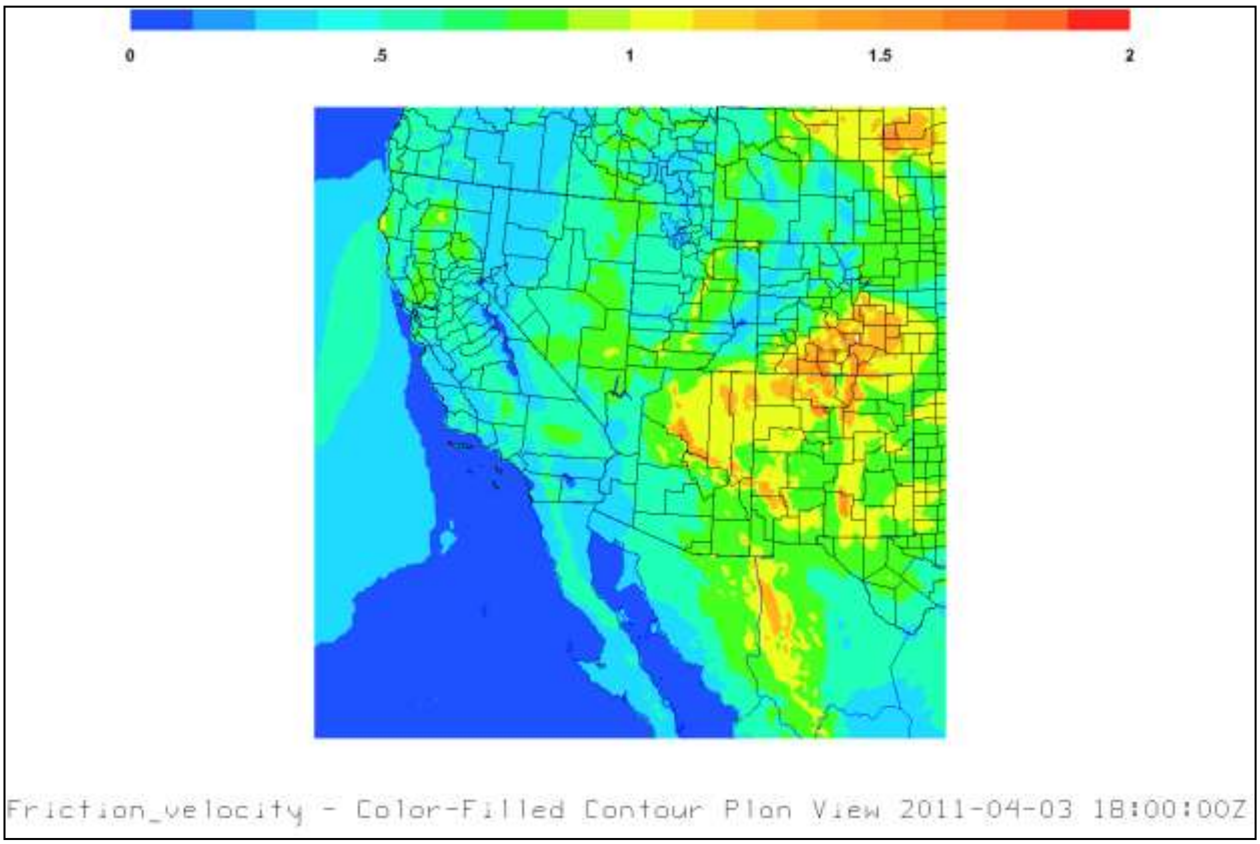


Figure 38: 12km NAM friction velocities in meters/second at 11 AM MST April 3 (18Z April 3), 2011.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

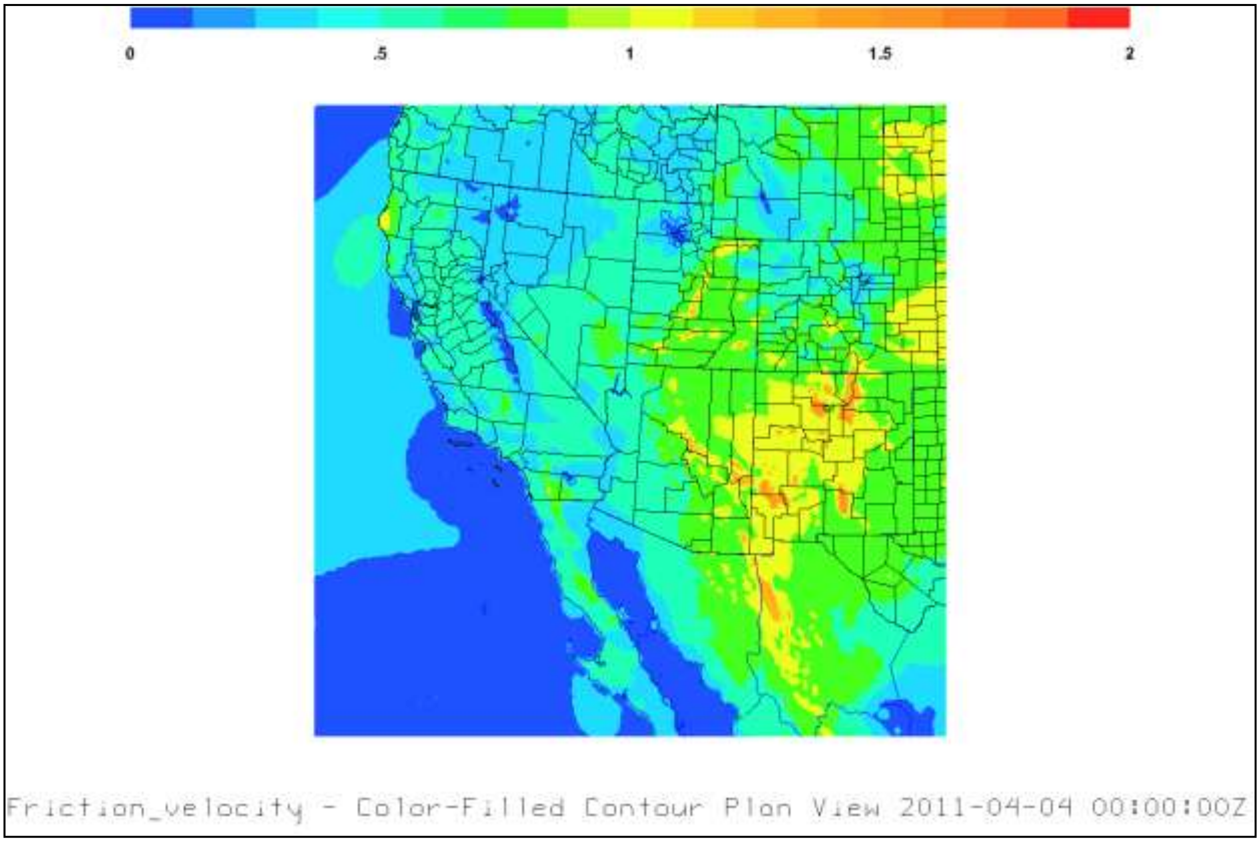


Figure 39: 12km NAM friction velocities in meters/second at 5 PM MST April 3 (00Z April 4), 2011.
(data source: http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets)

3.0 Evidence-Ambient Air Monitoring Data and Statistics

PM_{10} concentrations that exceeded the level of the twenty-four-hour PM_{10} NAAQS were monitored across a broad geographical area of Colorado on April 3, 2011. During this interval PM_{10} sample values greater than 150 $\mu g/m^3$ were taken at multiple sites across southwestern Colorado. Samples in excess of 150 $\mu g/m^3$ were recorded at Alamosa - Adams State College (Alamosa ASC, 298 $\mu g/m^3$), Alamosa Municipal (Alamosa Muni, 392 $\mu g/m^3$), and Lamar Power Plant (Lamar, 169 $\mu g/m^3$). Additionally, exceptionally high samples (greater than the 90^{th} percentile for the site) were recorded at the PM_{10} monitors at Lamar Municipal (108 $\mu g/m^3$), Pagosa Springs (76 $\mu g/m^3$), Pueblo (117 $\mu g/m^3$), and Durango (50 $\mu g/m^3$). The PM_{10} exceedances in Alamosa and Lamar on April 3, 2011, would not have occurred if not for the following: (a) dry soil conditions over northeast Arizona, northwest New Mexico, southeast Utah, and eastern Colorado with 30-day precipitation totals below the threshold identified as a precondition for blowing dust in northeastern Arizona; (b) a surface low pressure system and vigorous cold front that were associated with a strong upper-level trough that caused strong prefrontal surface winds over the area of concern; and (c) friction velocities over regions of northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado that were high enough to allow entrainment of dust from natural sources with subsequent transport of the dust to southern Colorado in strong winds. This weather system adversely affected the air quality in much of southeastern Colorado.

For maps of the Colorado PM_{10} monitoring sites and all valid PM_{10} concentrations on April 3, 2011, see Figure 1. Section 2 provides the meteorological evidence for the spatial extent of this regional blowing dust event.

The APCD reviewed PM_{10} monitoring data in southeastern Colorado in the path of the dust storm (see Section 3.1). The PM_{10} concentrations at affected sites were compared using time series plots for a number of days pre and post event. The time series graphs (shown in Figure 40, Figure 44, and Figure 48) clearly show that the regional blowing dust storm adversely affected the air quality in Alamosa and Lamar on April 3, 2011. PM_{10} samples the day before and the day after the event were typical of samples at each affected site.

3.1 Historical Fluctuations of PM_{10} Concentrations in Alamosa and Lamar

This evaluation of PM_{10} monitoring data for sites affected by the April 3, 2011, event was made using valid samples from PM_{10} samplers in Alamosa and Lamar from 2006 through 2011. APCD has been monitoring PM_{10} concentrations in these areas since 1985. Data in this analysis for sites affected by the event are from January 2006 through the end of 2011, with one exception; monitoring began at Pueblo, Fountain Magnate School in June 2009. The overall data summary for the affected sites is presented in Table 15 (all data values are presented in $\mu g/m^3$):

Table 15: April 3, 2011, Event Data Summary

Evaluation	*Alamosa ASC*	*Alamosa Muni*	*Pagosa Springs*	*Durango*	*Lamar Power*	*Lamar Muni*	*Pueblo*
4/3/2011	**295**	**372**	76	50	**169**	108	117
Mean	22.3	28.6	22.6	20.6	27.2	20.8	18.7
Median	18	23.5	20	17	23	18	18
Mode	14	19	16	16	16	14	21
St. Dev.	25.2	28.4	17.5	19.8	20.1	13.3	10.7
Variance	633.1	807.7	304.5	392.7	403.3	175.6	114.2
Minimum	1	1	2	3	1	1	4
Maximum	473	635	349	320	367	176	117
Count	1904	1824	2075	698	2181	2105	270

As Table 15 demonstrates, the spatial scope of this event, addressed elsewhere in this document, was broad and had an impact on PM_{10} concentrations at multiple sites covering an extensive geographical area. Since this event will affect attainment status of Alamosa and Lamar only, these data sets will be discussed in detail. A snapshot summary of data from all those sites affected by the event is presented in Table 16, along with the approximate percentile value that data point represents for each site for their unique historical data sets, for the month of the event (every sample in any April), and for the year of the event. All percentile calculations presented in this section were made using the entire dataset, including known high wind events. There is no difference between the two datasets (with and without high wind events) in regards to percentile calculations. Percentile calculations for all sites affected by the event are presented in Table 16. Only those sites for which samples concentrations were in excess of 150 $\mu g/m^3$ will be discussed in detail.

Table 16: April 3 2011 Site Percentile (All Affected Sites)

Evaluation	*Alamosa ASC*	*Alamosa Muni*	*Pagosa Springs*	*Durango*	*Lamar Power*	*Lamar Muni*	*Pueblo*
4/3/2011	**295**	**372**	**76**	**50**	**169**	**108**	**117**
Overall	99.8%	99.9%	97.4%	92.4%	99.5%	99.6%	Max Value
All April	Max Value	Max Value	95.8%	88.1%	Max Value	Max Value	Max Value
2011	*99.7%*	*99.7%*	*99.4%*	*99.2%*	*99.7%*	*99.4%*	*Max Value*

Of those samples in excess of 150 μg/m^3 all three are the maximum value for any sample taken in April. The samples at Alamosa ASC, Alamosa Muni and Lamar Power on April 3, 2011, exceeded the 99th% value of any evaluation criteria. The overall magnitude and broad geographical extent of affected sites suggests that there was a common contribution to each sample from other than local sources.

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

Table 17: April 3, 2011 PM_{10} Evaluation by Month and Year

	Alamosa ASC		***Alamosa Muni***		***Lamar Power***	
	April	2011	April	2011	April	2011
Mean	27.7	25.5	36.4	37.9	29.0	27.5
Median	18	20	24	30	23	23
Mode	11	17	15	20	16	17
St. Dev.	38.6	31.6	45.2	44.1	23.5	20.3
Variance	1491.3	999.7	2047.2	1947.6	551.9	411.7
Minimum	1	5	3	7	4	5
Maximum	295	440	372	635	169	192
Count	166	327	160	303	178	365

Alamosa ASC – 080030001

The PM_{10} sample on April 3, 2011 at Alamosa ASC of 285 μg/m^3 is the largest sample recorded among all April samples, exceeds the 99^{th} percentile value for all 2011 data, and is greater than the 99^{th} percentile value (97 μg/m^3) for the entire dataset. Overall, this sample is the sixth largest sample in the entire data set and the second largest sample in 2011. The five samples greater than the event sample are all associated with high wind events. There are 2214 samples in this dataset. The sample of April 3, 2011, clearly exceeds the typical samples for this site.

Figure 40 through Figure 43 graphically characterize the Alamosa ASC PM_{10} data. The first, Figure 40, is a simple time series; every sample in this dataset (2006 – 2011) greater than 150 μg/m^3 is identified. Note the overwhelming number of samples occupying the lower end of the graph; an interested reader can count the number of samples greater than 100 μg/m^3. Of the 1904 samples in this data set less than 1% is greater than 100 μg/m^3.

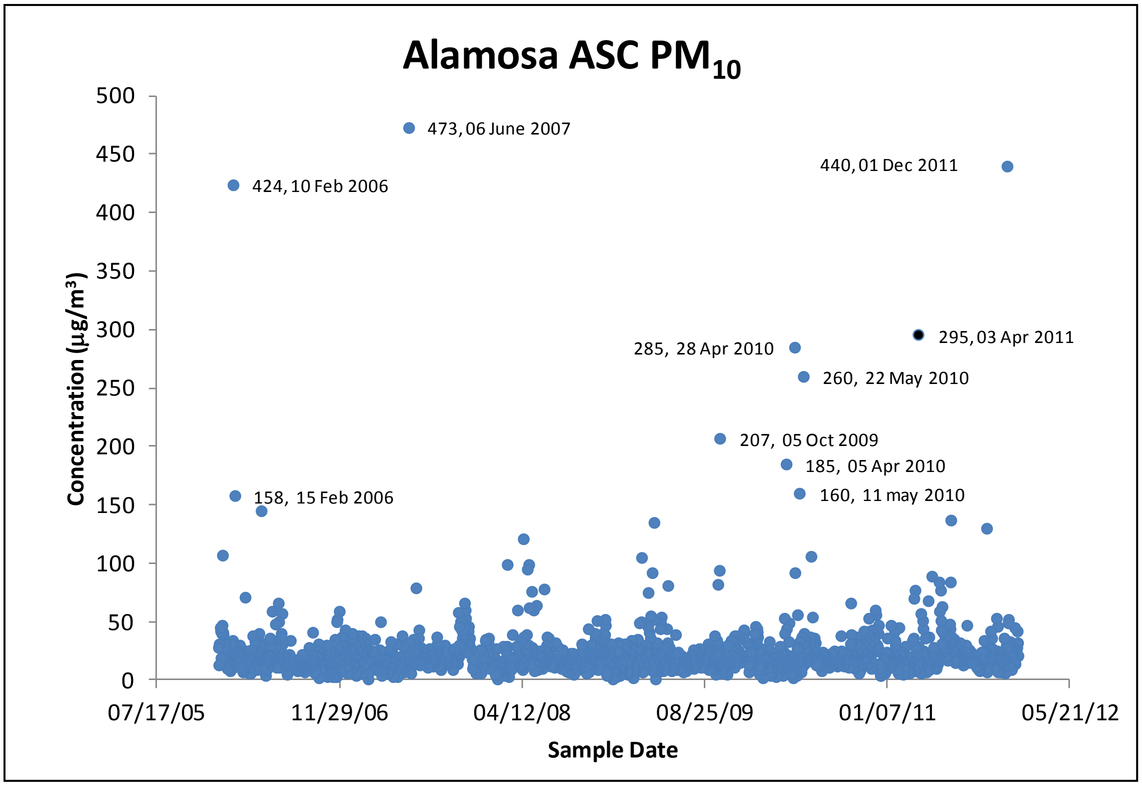


Figure 40: Alamosa Adams State College PM_{10} Time Series

Figure 41 is a simple histogram, demonstrating the overwhelming weight of samples on the low end of the curve. This range of data can be considered typical, representing contributions from local sources. Over 60% of the samples in this data set are less than 20 µg/m^3. Even in the highly variable month of winter and early spring over 90% of the samples are less than 50 µg/m^3. Clearly the sample of April 3, 2011, exceeds what is typical for this site.

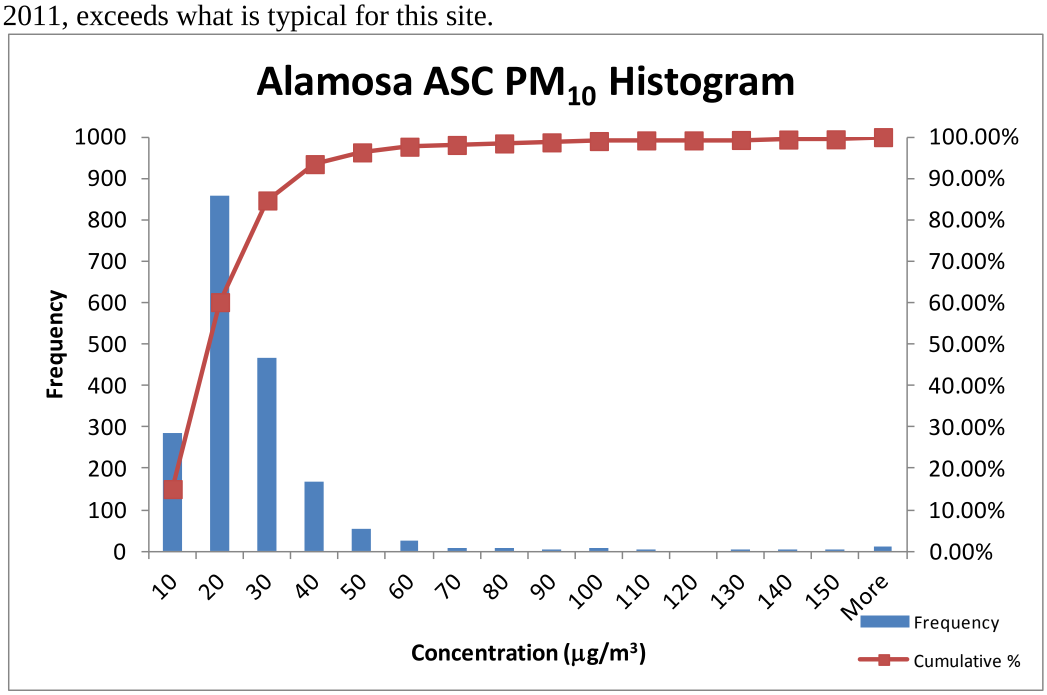


Figure 41: Alamosa Adams State College PM_{10} Histogram

The monthly box-whisker plot shown in Figure 42 highlights the consistency of the majority of data from month to month. Note the greater variability (wider inner-quartile range) and greater range of the data through the winter and early spring months that's accompanied by typically greater monthly maxima. Recall, this time period experiences a greater number of days with meteorological conditions similar to those experienced on April 3, 2011. Although these high values affect the variability and central tendency (average) of the dataset they aren not representative of what is typical at the site.

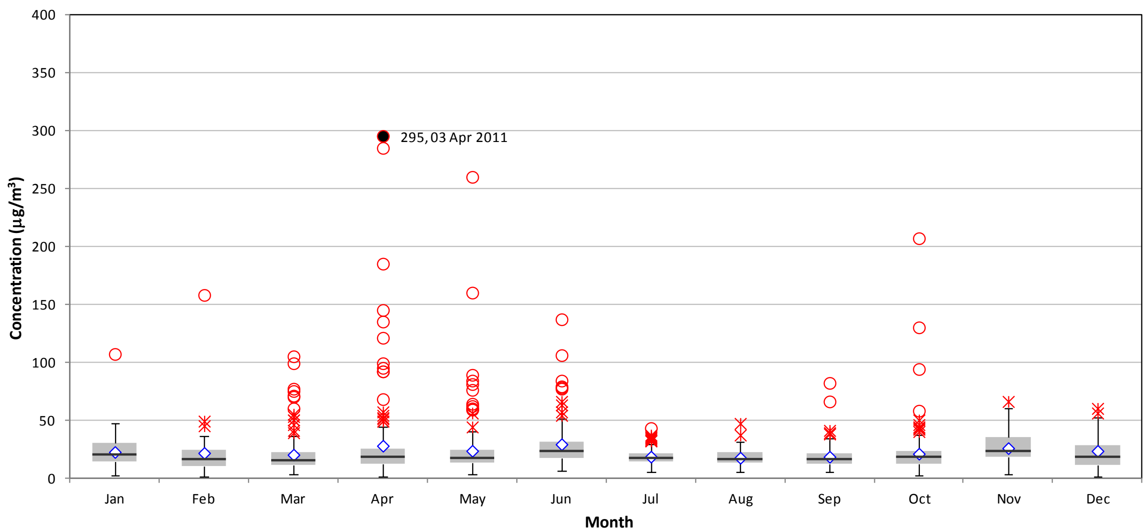


Figure 42: Alamosa Adams State College PM_{10} Box-Whisker Plot

Box-whisker plots graphically represent the overall distribution of each data set including the mean ( ), the inner quartile range (IQR, defined to be the distance between the 75th% and 25th%), the median (represented by the horizontal black line) and two types of outliers identifed in these plots: outliers greater than 75th% +1.5*IQR ( )and outliers greater than 75th% + 3*IQR ( ). The outliers that satisfy the last criteria and are greater than 150 µg/m^3 are labeled with sample value and sample date. Each of these outliers is associated with a known high-wind event similar to that of April 3, 2011.

The presence of the extreme values distorts the graph, losing definition and distorting information presented across the range where the majority of data resides. The same plot graphed to 100 µg/m^3, which includes almost 99% of all the data, is presented in Figure 43. This expanded plot demonstrates that November is the month where contributions from local sources are the highest of the year; November is the month with the highest median value, the broadest inter-quartile range and a monthly median value only slightly less than the monthly average.

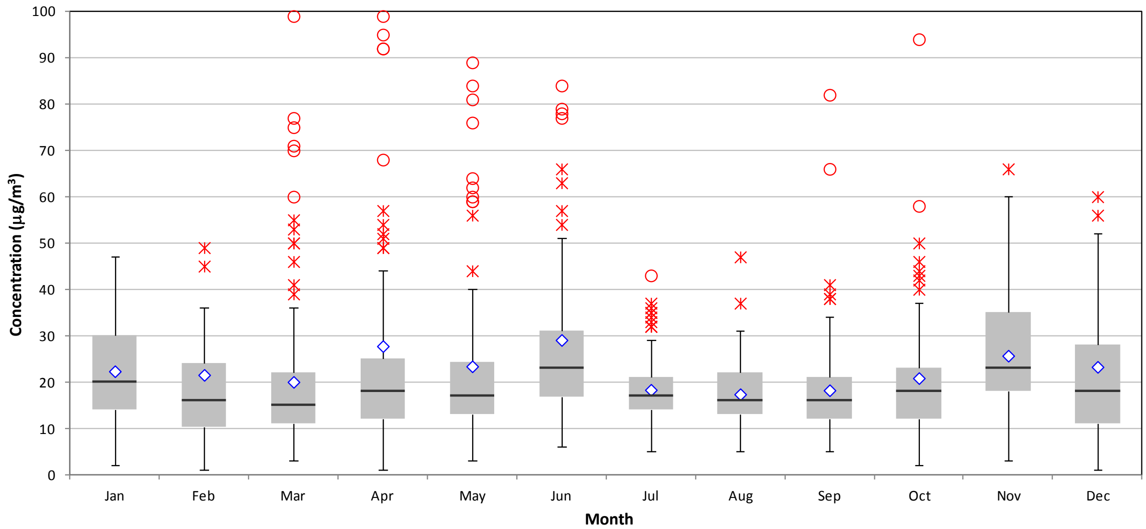


Figure 43: Alamosa Adams State College PM_{10} Box-Whisker Plot, Reduced Scale

Note the degree to which the data in the months of winter and spring, including April, is skewed. The April mean (27.7 µg/m^3) is greater than the April 75th percentile value (25 µg/m^3). This is due to the presence of a handful of extreme values and can create the perception that those months experiencing these high wind events are somehow 'dirtier' than other months of the year. This data exposes that perception as flawed as the typical data is similar to every other month of the year. The sample of April 3, 2011, clearly exceeds the typical data at this site.

Alamosa Municipal – 080030003

The PM_{10} sample on April 3, 2011, at Alamosa Muni of 372 µg/m^3 exceeds the 99th percentile value for all evaluation criteria and is the largest sample recorded in any April. Overall, this sample is the third largest sample in the entire data set and the second largest sample in 2011. The two samples greater than the event sample are both associated with high wind events. There are 1823 samples in this dataset. The sample of April 3, 2011, clearly exceeds the typical samples for this site.

Figure 44 through Figure 47 graphically characterize the Alamosa Muni PM_{10} data. The first is a simple time series. The sample of April 3, 2011, is identified. Note the overwhelming number of samples occupying the lower end of the graph; an interested reader can count the number of samples greater than 100 µg/m^3. Of the 1823 samples in this data set less than 1% are greater than 80 µg/m^3.

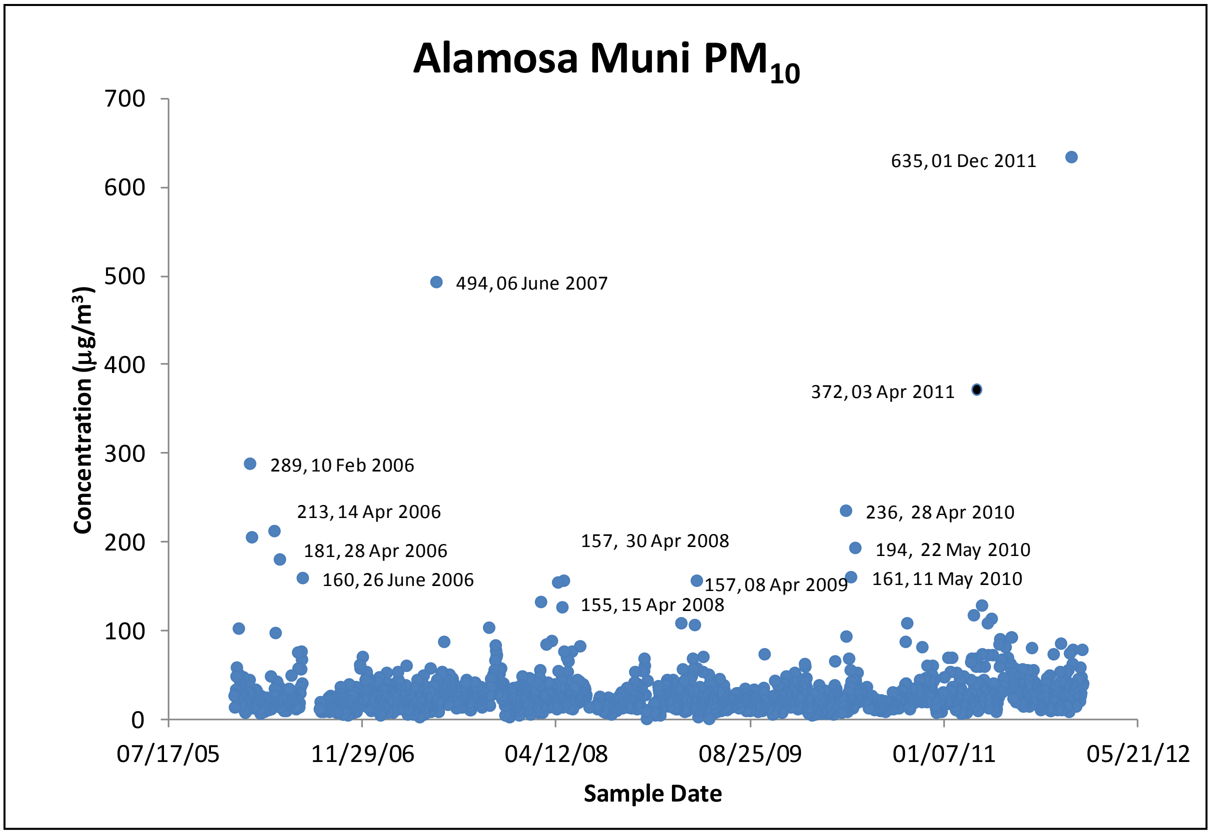


Figure 44: Alamosa Municipal PM_{10} Time Series

Figure 45, is a simple histogram, demonstrating the overwhelming weight of samples on the low end of the curve. Over 80% of the samples in this data set are less than 30 $\mu g/m^3$. Even in the highly variable months subject to similar conditions typified by this event over 90% of the samples are less than 40 $\mu g/m^3$. Clearly, the sample on April 3, 2011, exceeds what is typical for this site.

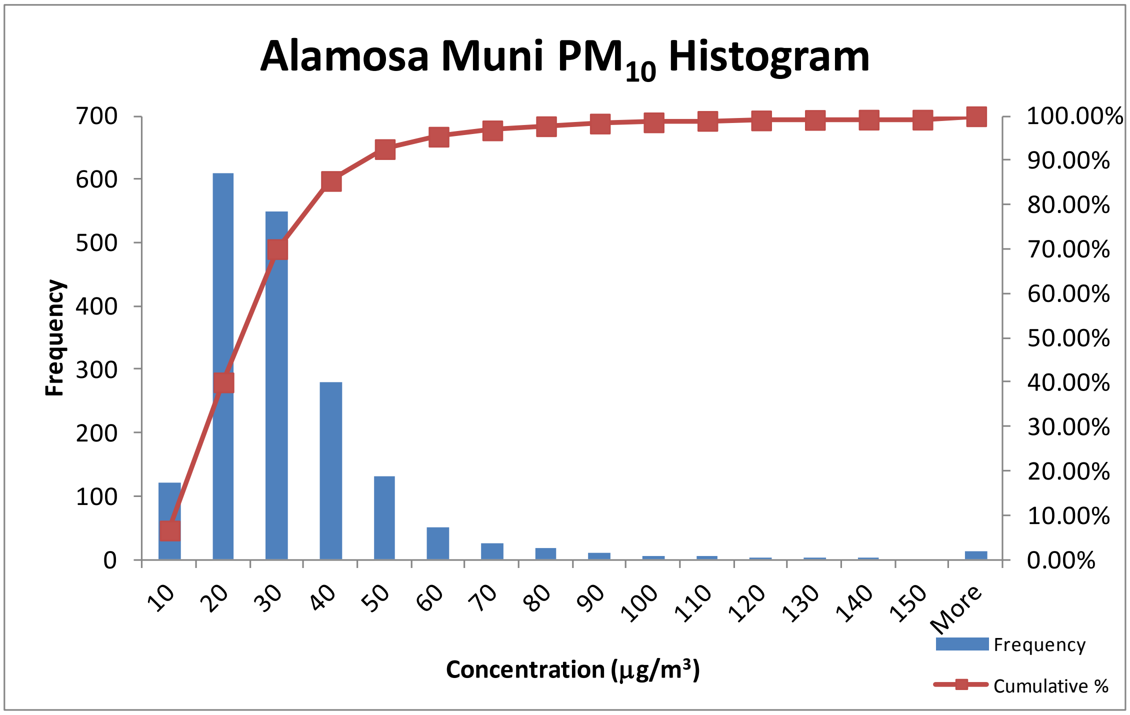


Figure 45: Alamosa Municipal PM_{10} Histogram

The monthly box-whisker plot in Figure 46 highlights the consistency of the majority of data from month to month. Note the greater variability (wider inner-quartile range) and greater range of the data through the winter and early spring months that's accompanied by typically greater monthly maxima. Recall, this time period experiences a greater number of days with meteorological conditions similar to those experienced on April 3, 2011. Although these high values affect the variability and central tendency (average) of the dataset they are not representative of what is typical at the site.

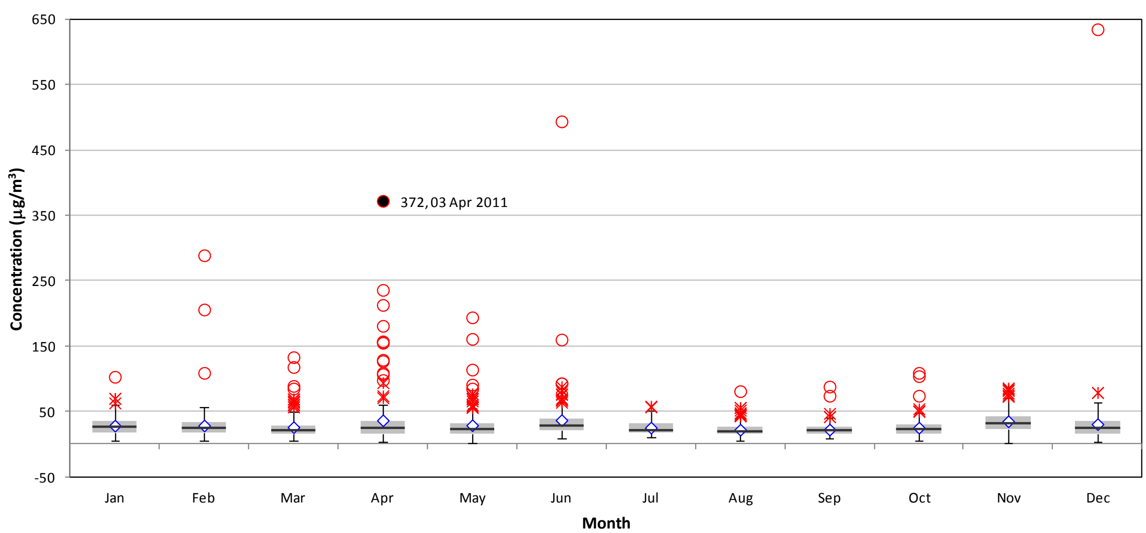


Figure 46: Alamosa Municipal PM_{10} Box-Whisker Plot

The presence of the extreme values distorts the graph, losing definition and distorting information presented across the range where the majority of data resides. The same plot graphed to 100 μg/m^3, which includes almost 99% of all the data, is presented in Figure 47. As with Figure 43, this expanded plot demonstrates that November is the month where contributions from local sources are the highest of the year; November is the month with the highest median value, the broadest inter-quartile range and a monthly median value only slightly less than the monthly average.

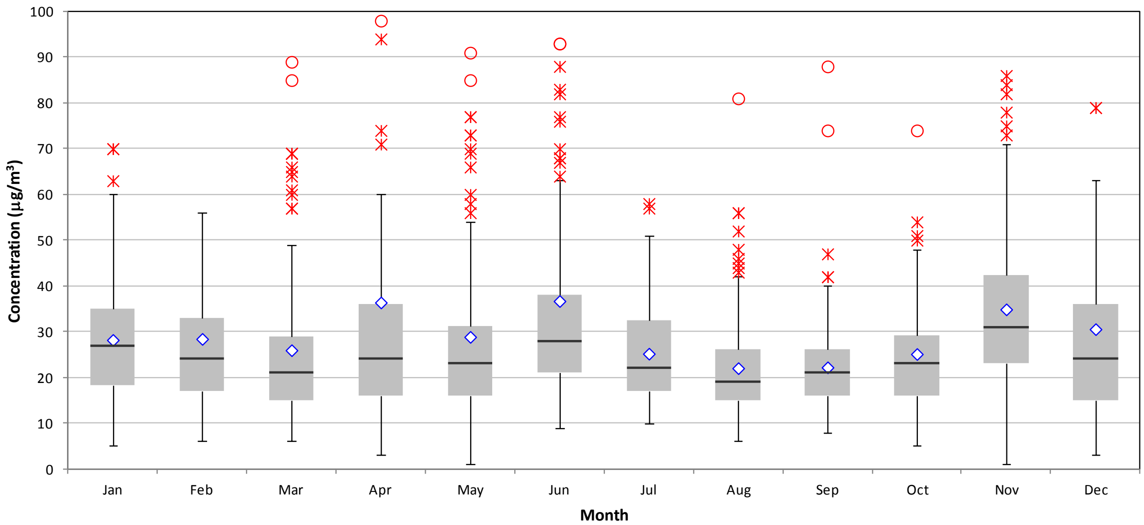


Figure 47: Alamosa Municipal PM_{10} Box-Whisker Plot, Reduced Scale

Note the degree to which the data from the months of winter/spring, including April, is skewed. The April mean (36.4 μg/m^3) is slightly larger than the 75th percentile value (36 μg/m^3). This is due to the presence of a handful of extreme values and can create the perception that those months experiencing these high wind events are somehow 'dirtier' than other months of the year. This data exposes that perception as flawed as the typical data is similar to every other month of the year. The sample of April 3, 2011, clearly exceeds the typical data at this site.

Lamar Power - 080030001

The PM_{10} sample on April 3, 2011, at Lamar Power of 169 μg/m^3, exceeds the 99th percentile value for any evaluation criteria and is the maximum value of all April data. There are 2181 samples in this dataset. The sample of April 3, 2011, clearly exceeds the typical samples for this site.

Figure 48 through Figure 51 graphically characterize the Lamar Power PM_{10} data. The first, Figure 48, is a simple time series. The sample of April 3, 2011, has been identified. Note the overwhelming numbers of samples occupying the lower end of the graph; of the 2181 samples in this data set less than 1% are greater than 110 μg/m^3.

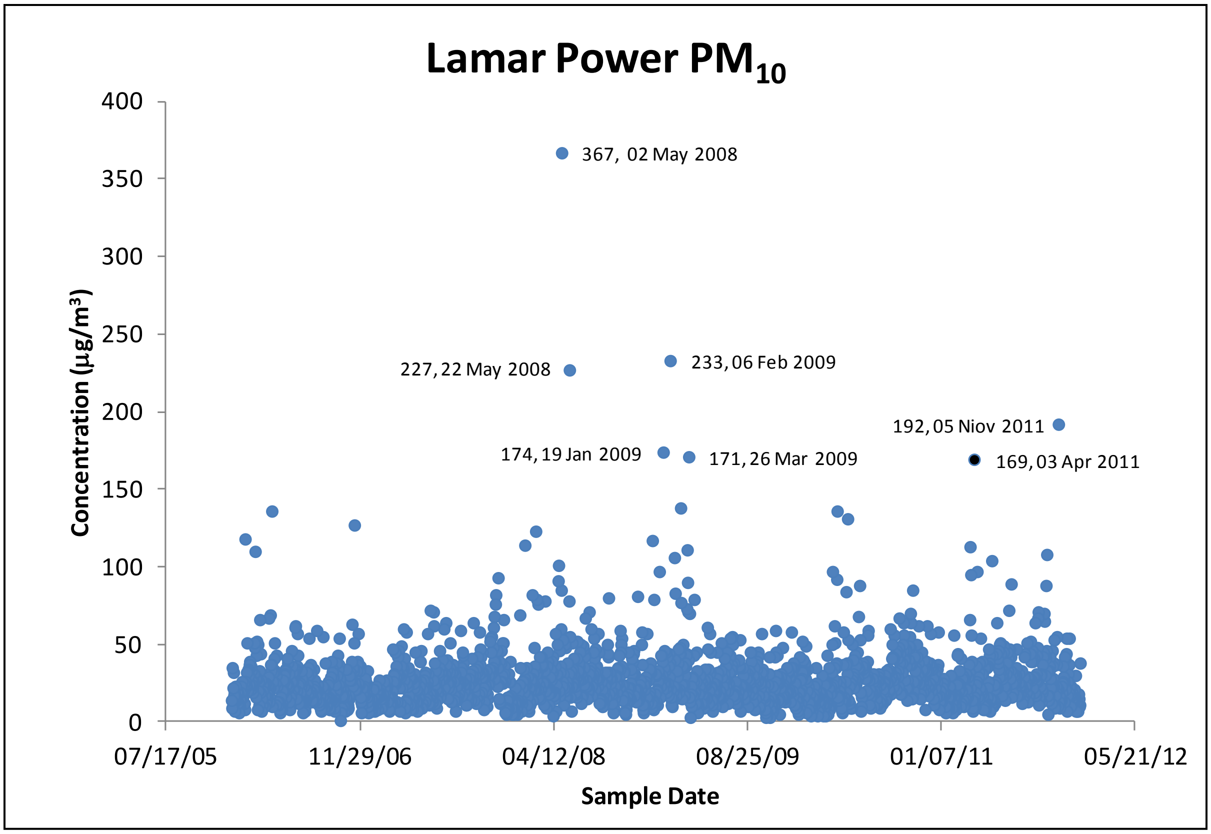


Figure 48: Lamar Power PM_{10} Time Series

Figure 49, is a simple histogram, demonstrating the overwhelming weight of samples on the low end of the curve. Over 50% of the samples in this data set are less than 23 μg/m^3. Even in the highly volatile month of April, 95% of the samples are less than 50 μg/m^3. Clearly the sample on April 3, 2011, exceeds what is typical for this site.

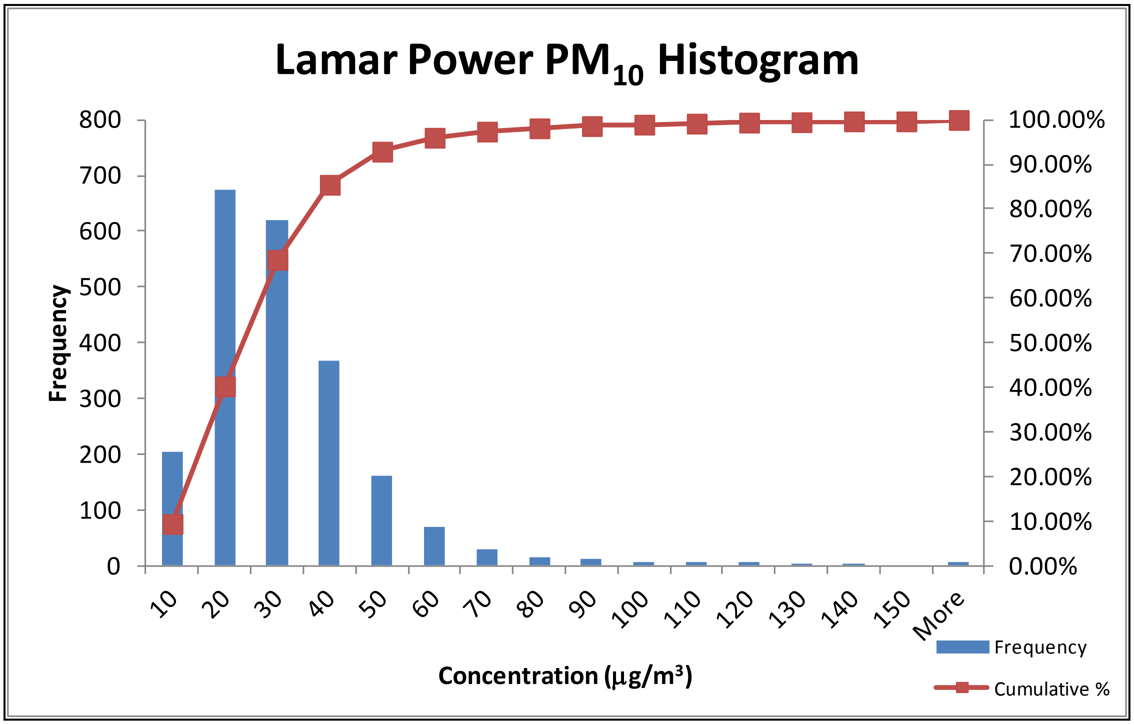


Figure 49: Lamar Power PM_{10} Histogram

The monthly box-whisker plot in Figure 50 highlights the consistency of the majority of data from month to month. Note the greater variability (wider inner-quartile range) and greater range of the data through the winter and early spring months that's accompanied by typically greater monthly maxima. Recall, this time period experiences a greater number of days with meteorological conditions similar to those experienced on April 3, 2011. Although these high values affect the variability and central tendency of the dataset they are not representative of what is typical at the site.

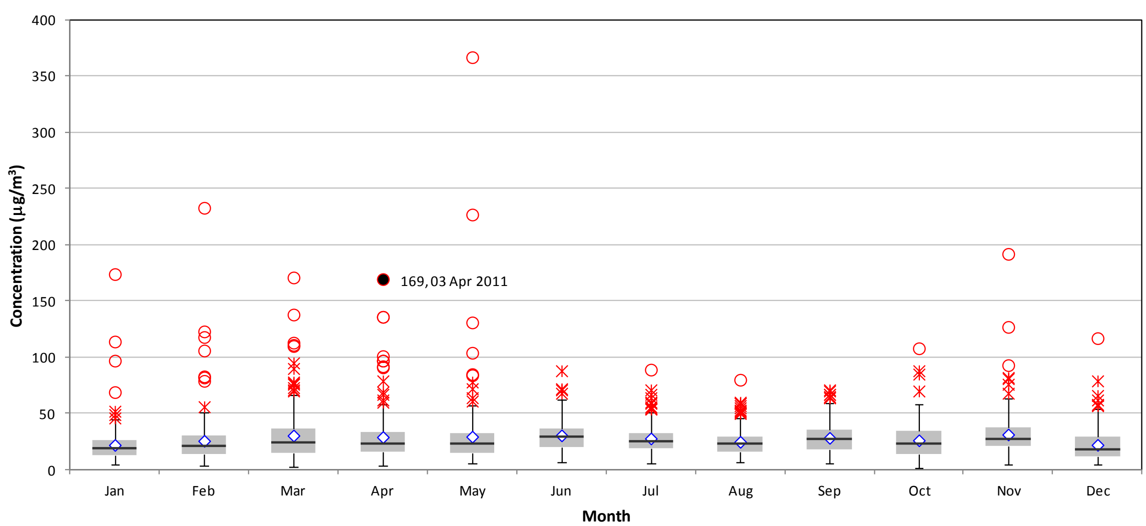


Figure 50: Lamar Power PM_{10} Box-Whisker Plot

As with the previous box-whisper plots the event sample is identified by concentration and date. Each of the samples greater than 150 μg/m^3 is associated with a known high-wind event similar to that of April 3, 2011. The presence of these extreme values distorts the graph, losing definition and distorting information presented across the range where the majority of data resides. The same plot graphed to 100 μg/m^3, which includes almost 99% of all the data, is presented in Figure 51.

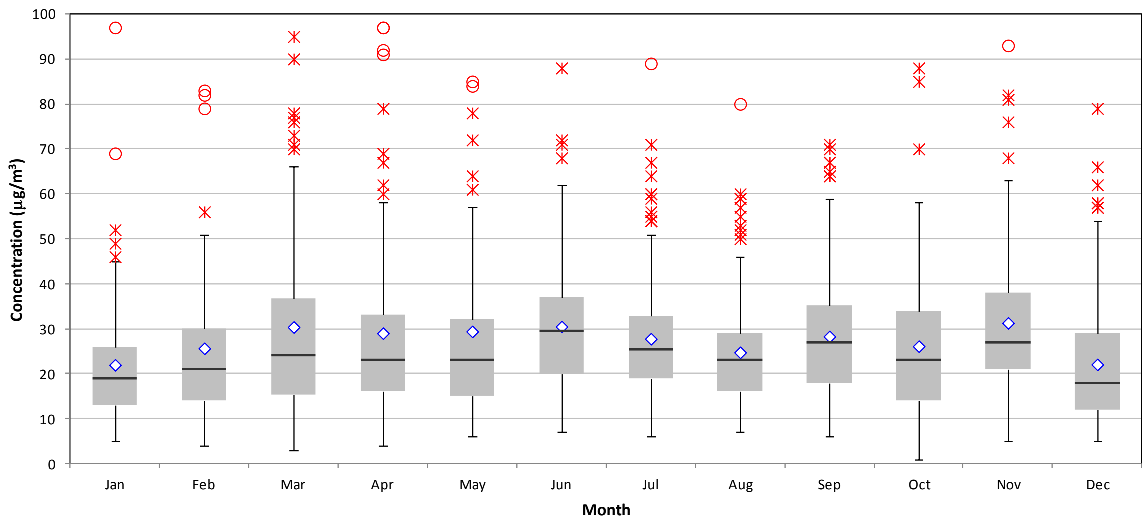
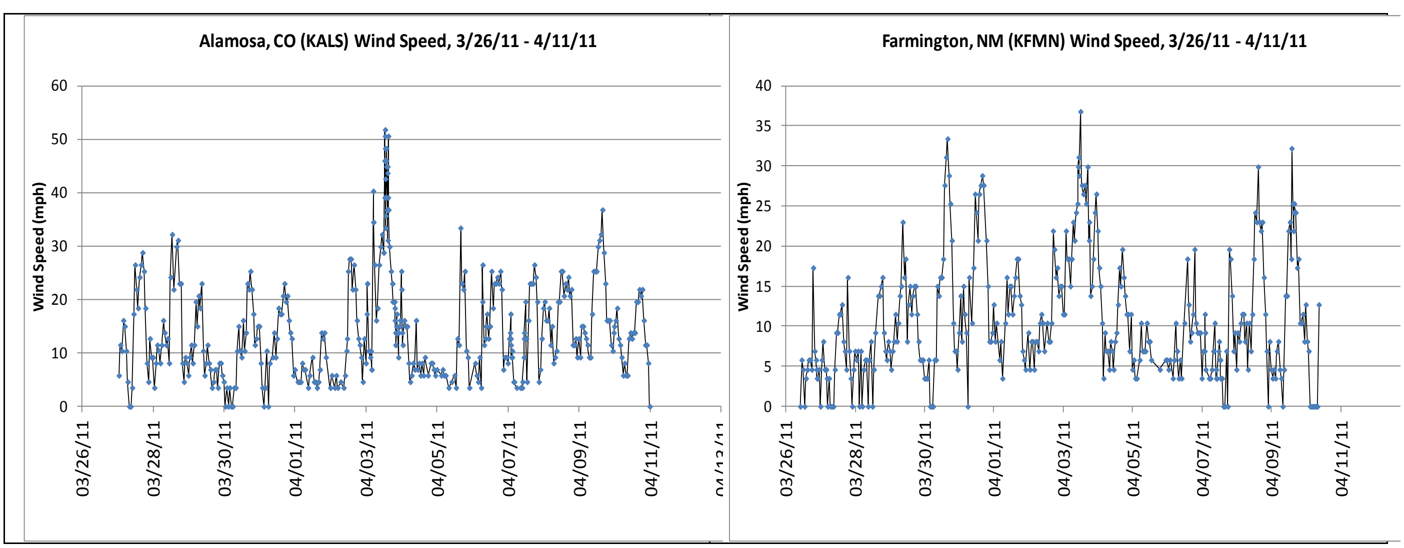


Figure 51: Lamar Power PM_{10} Box-Whisker Plot, Reduced Scale

3.2 Wind Speed Correlations

Wind speeds around the region (Southwest Colorado, Northeast Arizona, Northwest New Mexico) increased early in the morning April 3 and stayed elevated through early morning of April 4, gusting to speeds in excess of 50 mph. Figure 52 displays wind speed (mph) as a function of date from four widely dispersed stations throughout the region. Every one of these stations, despite being in completely disparate locations, exhibits nearly the same behavior in regards to the sustained high winds from April 3, 2011.



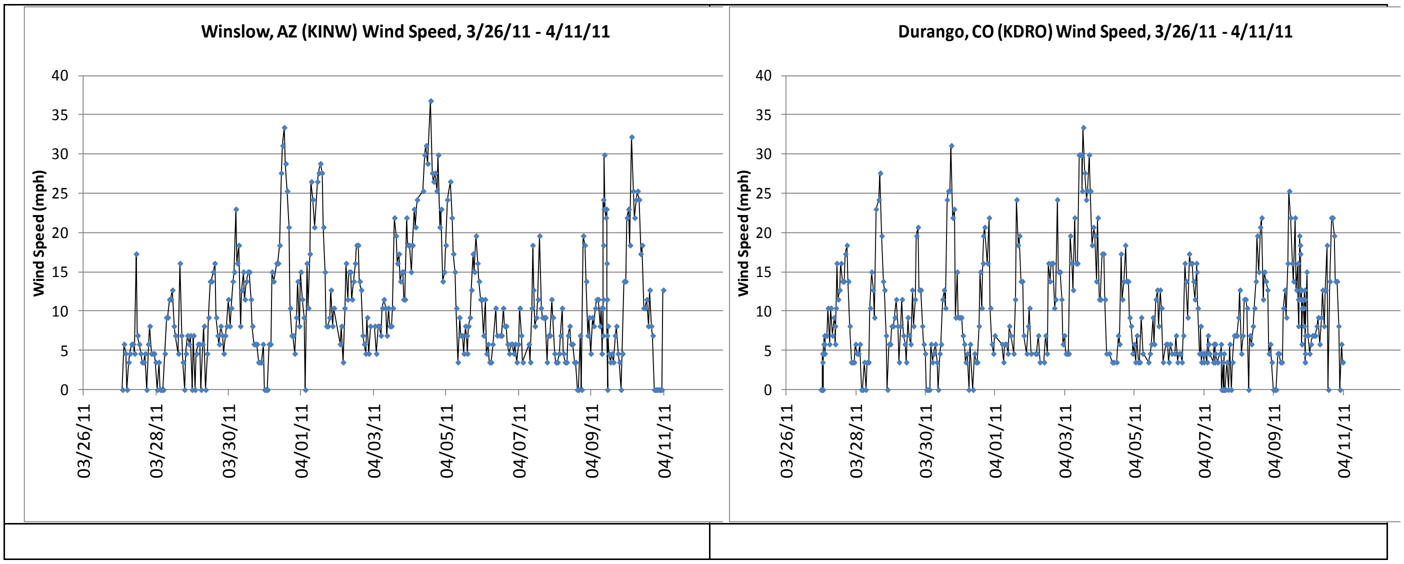


Figure 52: Wind Speed (mph) Various Stations, 03/26/2011 – 04/11/2011

Figure 53 plots PM_{10} concentrations from the affected sites in Colorado for the period for seven days prior to and following the samples of April 3, 2011.

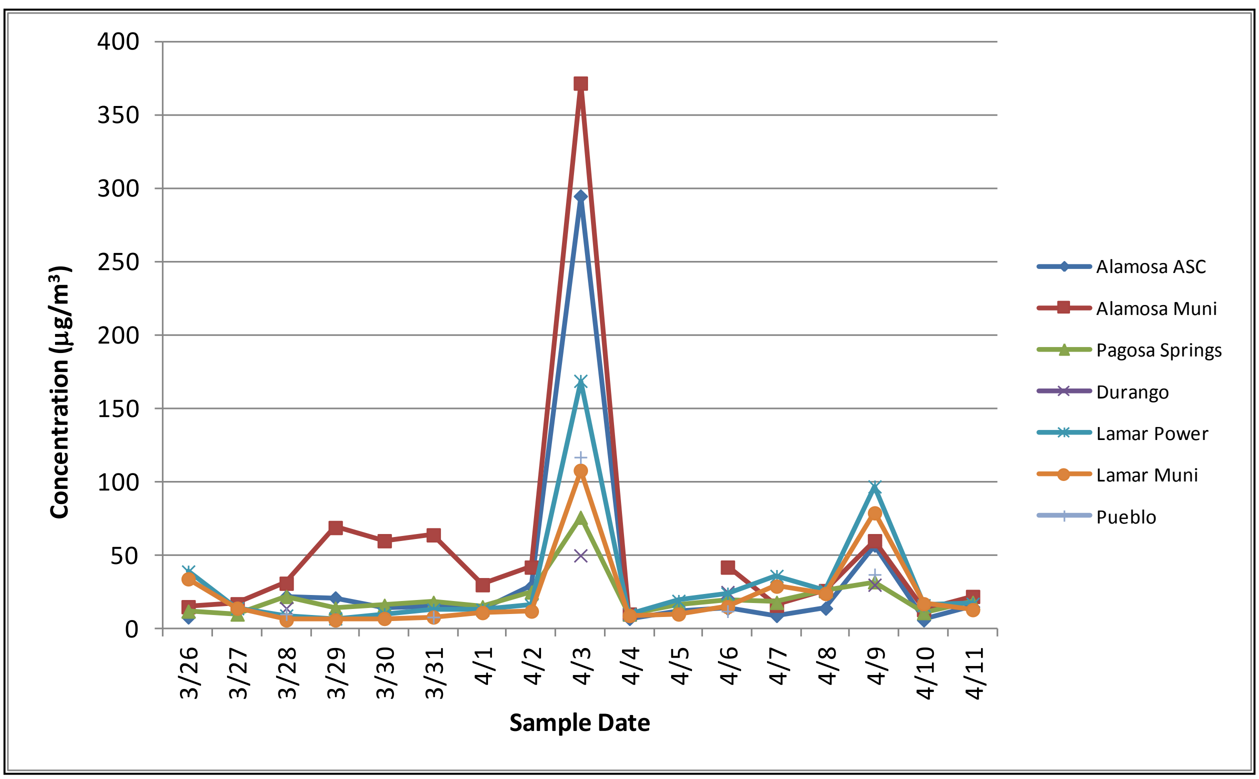


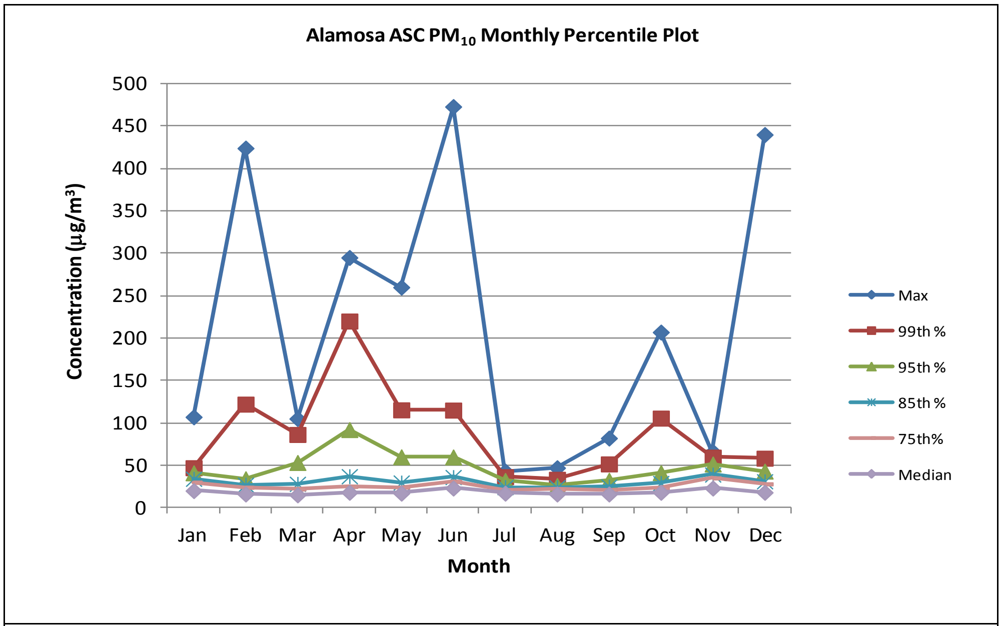
Figure 53: PM_{10} Concentrations, Affected Sites, 03/26/2011 – 04/11/2011

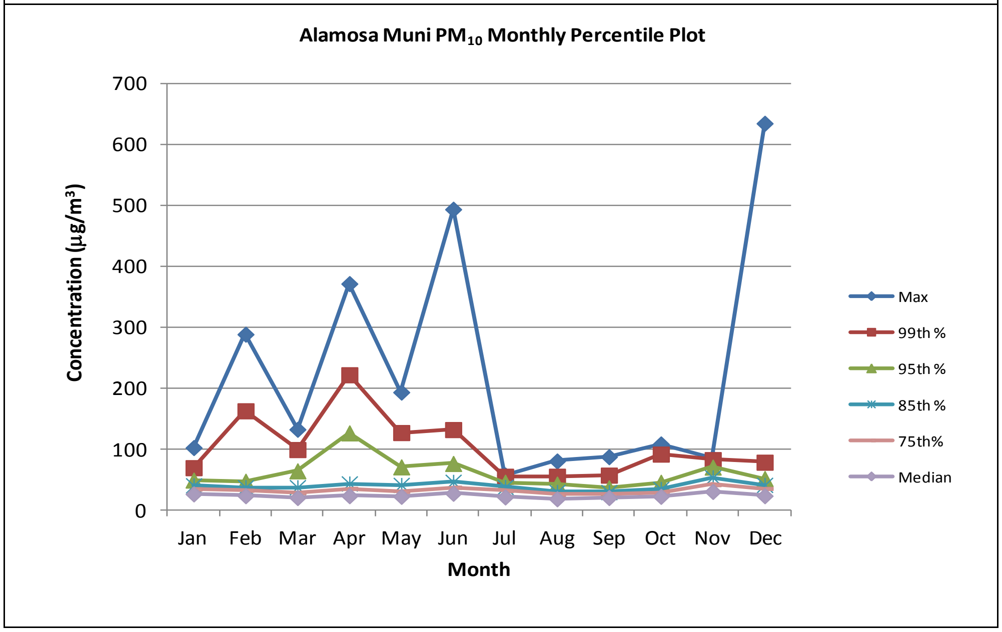
Figure 53 mimics the plots for wind speed, suggesting an association between the regional high winds and PM_{10} concentrations at the affected sites. Although not every sample from April 3, 2011, is in excess of

150 elevated µg/m^3, the elevated concentrations are clearly associated with the elevated wind speeds. Given the spatial dislocation of the sites (meteorological and PM_{10}) the relationship between the two data sets would suggest that the regional high winds had an effect on PM_{10} samples across a broad spatial region in Colorado.

3.3 Percentiles

Monthly percentile plots in Figure 54 demonstrate a high degree of association between monthly median values and relatively high monthly percentile values, e.g. the r^2 value between the Alamosa ASC monthly 90th percentile value and the Alamosa ASC monthly median is 0.699. The same values for Alamosa Muni and Pagosa Springs are 0.751 and 0.827, respectively. As the percentile value decreases (i.e. 85%, 75%, etc) the correlation between those values and the median increases sharply. The monthly percentile plots for each site are presented here (the black line is the 85th percentile):





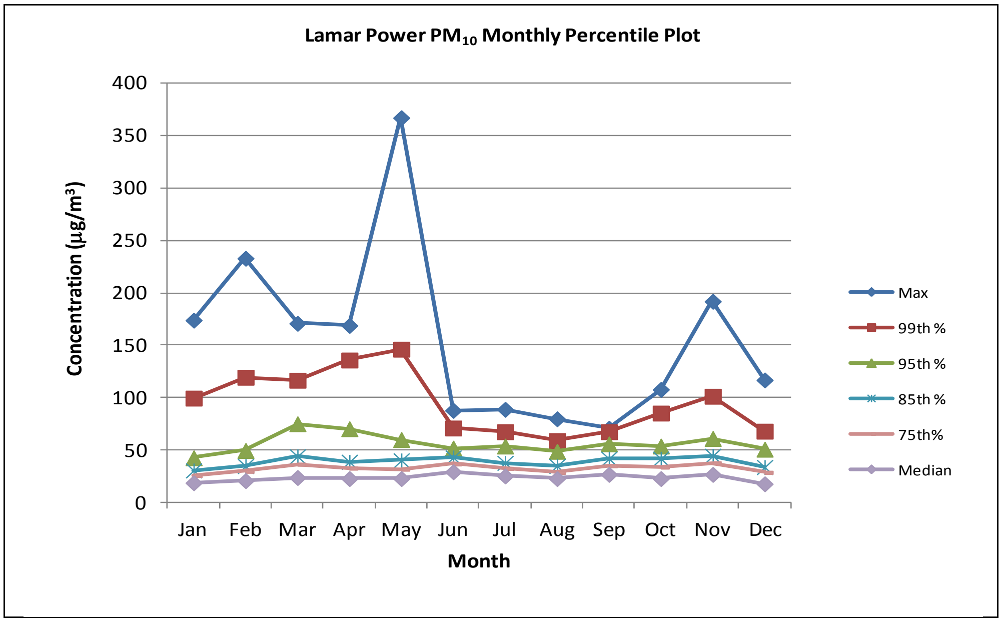


Figure 54: Monthly PM_{10} Percentile Plots

It is certainly the case that monthly median values are indicative of typical, day to day concentrations. Additionally, there is a range of samples that are a product of normal variation subject to typical, day to day local effects. This range may be restricted to percentile values that are well correlated with the median. For the data sets of concern (Alamosa ASC, Alamosa Muni, and Lamar Power) a conservative estimate of the percentile value that is reflective of typical, day to day variation is the 75th percentile value. Nearly all of the variation in the monthly 75th percentile values of these three data sets can be explained by the variation in monthly medians; for these three sites the correlation between the median and monthly 75th percentile values vary from an $r^2 = 0.85$ (Lamar Power) to an $r^2 = 0.95$ (Alamosa Muni). A reasonable estimate of the contribution to the event from local sources for these data sets may be the monthly 85th percentile values; for these three sites the correlation between the median and the monthly 85th percentile values vary from an $r^2 = 0.78$ (Lamar Power) to an $r^2 = 0.88$ (Alamosa Muni). The portion of the sample concentration remaining from these monthly percentile values would be the sample contribution due to the event.

Table 18 identifies various percentile values that are representative of the maximum contribution due to local sources for each site from all April data. In Table 18 the range estimate in the 'Est. PM_{10} Contribution' column is derived using the difference between the actual sample value and the 85th percentile as the minimum (reasonable) event contribution estimate and the difference between the actual sample value and the 75th percentile as the maximum (conservative) event contribution estimate. This column represents the range of estimated contribution to the April 3, 2011, sample at the sites listed in the table from the high wind event.

Table 18: Estimated Maximum Event PM_{10} Contribution - Alamosa ASC, Alamosa Muni, Lamar Power

Site	Event Day Concentration (µg/m^3)	April Median (µg/m^3)	April Average (µg/m^3)	April 75th % (µg/m^3)	April 85th % (µg/m^3)	Est. Conc. Above Typical (µg/m^3)
Alamosa ASC	298	18	27.7	25	37	**261 - 273**
Alamosa Muni	372	24	36.4	36	44	**328 - 336**
Lamar Power	169	23	29.0	33	39	**130 - 136**

Since the local anthropogenic sources are well controlled in Alamosa and Lamar and the sustained surface wind speeds were well above 25 mph in the region of the dust storm, it follows that the dust was transported into the region on April 3, 2011. The size, extent, and origination of the blowing dust storm made the event not preventable and it could not be reasonably controlled. Statistical data clearly shows that but for this high wind blowing dust event, Alamosa and Lamar would not have exceeded the 24-hour NAAQS on April 3, 2011.

Clearly, there would have been no exceedance on April 3, 2011, but for the additional contribution to the PM_{10} samples provided by the event.

4.0 News and Credible Evidence

Blowing dust pictures for Alamosa on 4/3/2011

Cabinet/Exceptional Events x

Reddy - CDPHE, Patrick <patrick.reddy@state.co.us> Jul 19 Reply

to Scott, me

Are attached. The time in UTC or "Z" is a part of each image file name. These are from the Airport.

--

Patrick J. Reddy

Senior Air Quality Meteorologist

Modeling, Meteorology, and Emissions Inventory Unit

Technical Services Program

Air Pollution Control Division

Colorado Department of Public Health and Environment

APCD-TS-B1

4300 Cherry Creek Drive South

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303-692-3239| patrick.reddy@state.co.us

2011 0403 1853

2011 0403 1935

2011 0403 1937

2011 0403 1939

2011 0403 2005

2011 0403 1941

2011 0403 2029

Great Sand Dunes National Park Visit

April 4, 2011 By Kristen Belschner 1 Comment

Last week the Sandhill Cranes migration brought Walking Mountains outdoor enthusiasts to the San Luis Valley near Alamosa, Colorado. On this trip we witnessed several amazing feats of nature. One of these was the dunes at Great Sand Dunes National Park. Rising up to 750 feet above the valley floor, the sight of the dunes tucked up against the Sangre de Cristos is almost surreal.

Although there is no clear date researchers believe the dunes could be up to 440,000 years old. They are unique in that they've changed very little in at least the last 130 years (for which we have photographic comparisons). Geologists believe that the valley was once covered by a lake many thousands of years ago. The lakes eventually receded with climate changes leaving a significant sand sheet on the valley floor. Over time, predominant southwest winds moved the sand up against a low curve in the Sangre de Cristo Range. Storm winds blow the opposite direction creating the vertical nature of these dunes (the highest in the US). These opposing wind directions balance each other out over time. The main dune field is moist beneath the thin layer of dry surface sand which also lends to the stability of this system. In windstorms, the top few inches of sand blows around, and the moist sand remains largely in place.

The day we visited the dunes the winds were blowing up to 35 mph. We persevered and set out for a tour with Ranger Libbie against all odds. Although sandblasted and wind whipped, we thoroughly enjoyed our foray onto the dunes. Libbie's backpack seemed to be a never-ending void filled with educational exhibits and tools. Harard Peak provided a beautiful backdrop as we learned about local vegetation, animal life, geology and more. The geology was particularly interesting – we saw samples of fulgarite which are the resulting formations from lighting hitting the sand, a demonstration about magnetite – the magnetic bits of iron oxide in black sand, and we learned about epidote – the beautiful green colored local rocks found throughout the park. Libbie even packed in samples of insects that live on the dunes and a kangaroo rat which had seen some better days. We also witnessed remnants of a large wildfire that ravaged parts of the park a few years prior. Caked ash remains part of the seasonally dry riverbed in Medano Creek.

We trekked out and back a few miles and then headed on to the park's visitor center. All in all it was a fantastic day and a super learning experience. **If you've never visited this area of Colorado, consider taking a trip. It's only 3-4 hours from Denver and well worth the spectacular sights.**

Click on the photos below and then once again from the resulting page to see larger versions.

  

  

http://vailnaturenews.com/2011/04/04/great-sand-dunes-national-park-visit/

COMMUNITY COLLABORATIVE RAIN, HAIL & SNOW NETWORK

"Because every drop counts"

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- Multiple Day Reports
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Station Fields: ☐ **Station Number** ☐ **Station Name**

Location: USA | Colorado | AM - Alamosa

Date Range:

Start Date: 4/3/2011 **End Date:** 4/4/2011

Search

Searched: Stations in Alamosa, Colorado. Report date between 4/3/2011 and 4/4/2011.

Showing 4 Records.

Date ▲	Station Number	Station Name	Total Precip in.	Comments	
4/4/2011	CO-AM-10	Great Sand Dunes 7.0 SSW	0.33	4F clear, calm. Snow yesterday very welcome.!	View
4/4/2011	CO-AM-21	Alamosa 1.2 NE	0.05	dab wind all day.blew shingles off roofs all around town.power was off for awhile that afternoon	View
4/3/2011	CO-AM-10	Great Sand Dunes 7.0 SSW	0.00	36F high clouds WINDY	View
4/3/2011	CO-AM-11	Alamosa 6.9 NW	0.00	25 days without measurable precipitation	View

COMMUNITY COLLABORATIVE RAIN, HAIL & SNOW NETWORK

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- Station Snow Summary
- Rainy Days Report
- Total Precip Summary
- List Stations

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- Optics
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Station Fields: ☐ **Station Number** ☐ **Station Name**

Location: USA | Colorado | LA - Las Animas

Date Range:

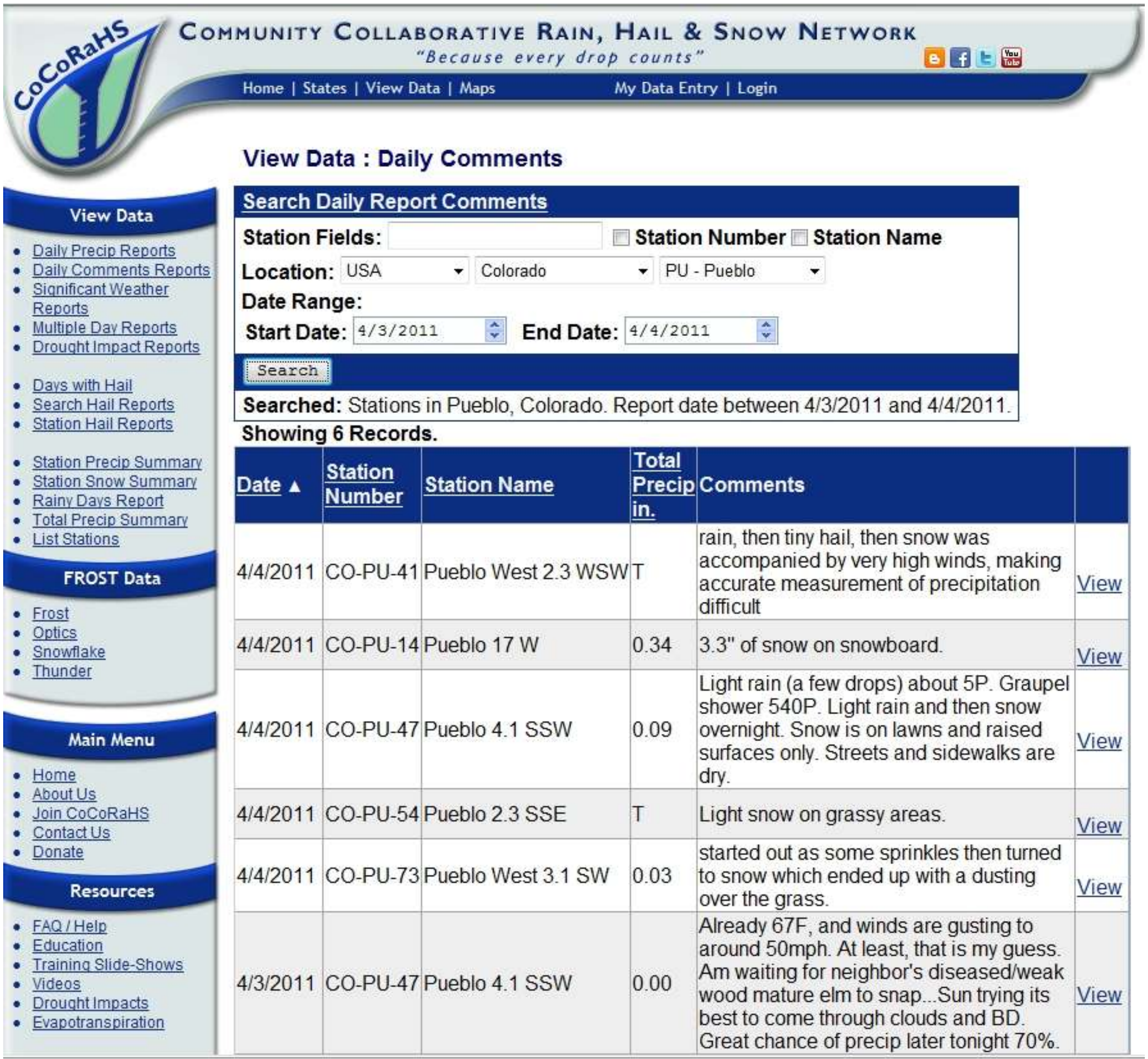
Start Date: 4/3/2011 **End Date:** 4/4/2011

Search

Searched: Stations in Las Animas, Colorado. Report date between 4/3/2011 and 4/4/2011.

Showing 3 Records.

Date ▲	Station Number	Station Name	Total Precip in.	Comments	
4/4/2011	CO-LA-48	Trinidad 1.9 ENE	0.39	There was a lot of melting on the ground even though the snow was mostly overnight. I observed a few snowflakes before the 7:00 observation time, but none at 7:00.	View
4/4/2011	CO-LA-13	Boncarbo 1.5 WSW	0.46	There was crusty ice under the gauge when I did the melted value so there might be a little more in that area that was unavailable to measure.	View
4/3/2011	CO-LA-13	Boncarbo 1.5 WSW	0.00	Very Very Windy -- AGAIN !!!	View



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COMMUNITY COLLABORATIVE RAIN, HAIL & SNOW NETWORK

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Date Range:

Start Date: 4/3/2011 **End Date:** 4/4/2011

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Searched: Stations in Pueblo, Colorado. Report date between 4/3/2011 and 4/4/2011.

Showing 6 Records.

Date ▲	Station Number	Station Name	Total Precip in.	Comments	
4/4/2011	CO-PU-41	Pueblo West 2.3 WSW	T	rain, then tiny hail, then snow was accompanied by very high winds, making accurate measurement of precipitation difficult	View
4/4/2011	CO-PU-14	Pueblo 17 W	0.34	3.3" of snow on snowboard.	View
4/4/2011	CO-PU-47	Pueblo 4.1 SSW	0.09	Light rain (a few drops) about 5P. Graupel shower 540P. Light rain and then snow overnight. Snow is on lawns and raised surfaces only. Streets and sidewalks are dry.	View
4/4/2011	CO-PU-54	Pueblo 2.3 SSE	T	Light snow on grassy areas.	View
4/4/2011	CO-PU-73	Pueblo West 3.1 SW	0.03	started out as some sprinkles then turned to snow which ended up with a dusting over the grass.	View
4/3/2011	CO-PU-47	Pueblo 4.1 SSW	0.00	Already 67F, and winds are gusting to around 50mph. At least, that is my guess. Am waiting for neighbor's diseased/weak wood mature elm to snap...Sun trying its best to come through clouds and BD. Great chance of precip later tonight 70%.	View

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

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

The APCD conducted thorough analyses and outreach with local governments to confirm that no unusual anthropogenic PM_{10}-producing activities occurred in these areas and that despite reasonable control measures in place, high wind conditions overwhelmed all reasonably available controls. The following subsections describe in detail Best Available Control Measures (BACM), other reasonable control measures, applicable federal, state, and local regulations, appropriate land use management, and an in-depth analysis of potential areas of local soil disturbance for each affected community during the April 3, 2011, event. This information shall confirm that no unusual anthropogenic actions occurred in the local areas of Alamosa and Lamar during this time.

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

Table 19: State Regulations Regulating Particulate Matter Emissions

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

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

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

5.1 Alamosa

Natural Events Action Plan (NEAP)

The Final NEAP for High Wind Events in Alamosa, Colorado was completed in May 2003. The NEAP addresses public education programs, public notification and health advisory programs, and determines and implements Best Available Control Measures (BACM) for anthropogenic sources in the Alamosa area. The APCD followed up with the City and County of Alamosa in January 2007 and in the spring of 2013 on whether the NEAP mitigation measures and commitments were satisfied, the results of which are detailed below. The City of Alamosa, Alamosa County, the APCD, and participating federal agencies worked diligently to identify contributing sources and to develop appropriate BACM as required by the Natural Events Policy.

Regulatory Measures - City and County

The APCD, the City of Alamosa, and Alamosa County are responsible for implementing regulatory measures to control emissions from agricultural sources, stationary sources, fugitive dust sources, and open burning within Alamosa. Alamosa's ordinances of PM_{10} emissions are summarized in Table 20.

Table 20: Rules and Ordinances Regulating Particulate Matter Emissions in Alamosa

Rule/Ordinance	Description
City of Alamosa Code of Ordinances Article VII of Section 21-140 (5)	Addresses dust control for home occupations
City of Alamosa Code of Ordinances Article V Sec. 17-87(3))	Requires all new roads and alleys to be paved
City of Alamosa Code of Ordinances (Article VI Sec. 21-119(g)(3)).	New large commercial/retail establishments must install underground automatic irrigation systems for all landscaped areas
Alamosa County Land Use and Development Code (1.4.2)	Agriculture an important part of the economy and adds intrinsic value to life in Alamosa County. Agriculture, as a business, brings dust and other inconveniences. To maintain this way of life, Alamosa County intends to protect agricultural operators from unnecessary, intrusive litigation. Therefore, no inconvenience shall be considered a nuisance so long as it occurs as a part of non-negligent and legal agricultural practice, as stated in C.R.S. 35-3.5-101, 102 and 103.
Alamosa County Land Use and Development Code (3.5.2(A)(8))	For Feed lot, animal waste treatment, or animal waste collection facilities fugitive dust shall be confined on the property
Alamosa County Land Use and Development Code (3.5.6(D)(2))	For a proposed oil and gas well installation, any interior transportation network shall be paved, or the company shall undertake appropriate dust abatement measures
Alamosa County Land Use and Development Code (3.5.7(G))	All roads, driveways, parking lots and loading and unloading areas within 500 feet of any lot line shall be graded and paved with an approved concrete or asphalt/concrete surface as to limit adjoining lots and public roads the nuisance caused by wind-borne dust.
Alamosa County Land Use and Development Code (4.2.3(C)(2))	Where off-street facilities are provided for parking or any other vehicular use area, they shall be surfaced with asphalt bituminous, concrete or other dustless material approved by the administrator and shall be maintained in a smooth, well-graded condition.

City of Alamosa's Control Measures

The City of Alamosa has been active in addressing potential PM_{10} sources within the Alamosa area through various efforts. Some of these efforts, plus other potential future measures, include the adoption of local ordinances to reduce PM_{10}. Copies of current ordinances and any related commitments are included in the NEAP in Appendix D. According to the City's Public Works Director, as of 2013, the City is planning on adding additional dust control best management practices to the International Building Codes that are adopted by the city in the next update. The best management practices will include requiring a Dust Control Plan for any site that is issued a clearing permit for any site over 2 acres. The City is also currently (as of 2013) working on revising part of their landscaping ordinances to require mulch in areas that are not vegetated or covered by rock to help mitigate fugitive particulate emissions. These efforts have been stalled in the past due to employee turnover at City Manager's Office.

Street Sweeping
The City of Alamosa sweeps on an every 4-week schedule or as needed, as determined by local officials on a case by case situation (e.g., following each snowstorm and/or where sand was applied). Sweeping occurs on every single City street with an emphasis on the downtown corridor where public exposure is expected to be greatest. As of spring 2013, street sweeping in the downtown corridor currently takes place twice per week according to the City's Public Works Director.

According to the City's Public Works Director, the city (as of 2013) owns an Elgin Pelican (mobile mechanical sweeper) and a Tymko 600 (brush-assisted head) street sweeper. As of June 2013, the City will also own a new Elgin Broom Badger street sweeper at which time the Tymko 600 will be sent in for a re-build. The new Elgin Broom Badger street sweeper can be used in the winter months when the Tymko cannot due to freezing of the water delivery system.

Unpaved Roads within the City
The City of Alamosa (as of 2008) requires all new roads and alleys to be paved according to the Municipal Code (Article V Sec. 17-87(3)) and some existing unpaved roads are being treated with dust suppressants until all underground utilities are installed. No new development is allowed until paving is complete unless a performance bond is in place.

According to the City's Public Works Director, as of 2013, less than 3% of City roads are unpaved; most of these unpaved roads are legacy annexations. One of these unpaved roads is scheduled for paving this year (2013). The remaining unpaved roads are all low traffic (less than 100 ADT) and the City continues to seek funding sources for paving these streets.

Sod/Vegetative Cover Projects in the City of Alamosa
As of 2008, the City of Alamosa placed vegetative cover in all city parks and has installed irrigation systems to maintain the cover. As of 2013, the City has been emphasizing more low-water use landscaping with shrubs, mulch, etc. including both organic and rock. All turf areas do have irrigation systems which utilize drip systems for specimen plantings.

Alamosa County's Control Measures

Alamosa County has also been active in addressing blowing dust as detailed below.

Unpaved Roads
Alamosa County continues to address unpaved roads and lanes that are anticipated to contribute to PM_{10} emissions in the community. As of 2002, Alamosa County was nearing the end of its five-year road paving plan and was developing their next plan with the intention of paving on a yearly basis, based on traffic, community needs/priorities, and funding availability.

In 2002, Alamosa County addressed approximately ten (10) miles of unpaved roads. This includes the stabilization of approximately five section roads, the seal coating of two roads, and the overlay (repaving) of four (4) additional roads.

In 2003, approximately 14 miles of roads were paved. This includes the Seven Mile Road (three miles long), Road 109 (one mile long), and 10th Street (also one mile long). These roads are in close proximity to the City of Alamosa, are upwind (prevailing) from the city, and have heavy traffic. Paving is anticipated to greatly reduce blowing dust and impacts in the vicinity.

No paving projects took place between 2004 and 2010 due to lack of funding. Between 2010 and 2013, the County was able to get funding but only for maintenance paving on previously paved roads that needed repair. Now that the county is caught up on maintenance paving, it is focusing on paving the remaining unpaved roads. The County's goal is to pave about 2.5 miles of unpaved road per year depending on funding availability.

As of 2013, Alamosa County has funding to pave approximately 2.5 miles of County Road 106 North (located north of Alamosa off of Highway 17) which is currently unpaved. After this paving project the County will only have 2.5 miles of unpaved road remaining on the 106 North which is anticipated to be paved in the summer of 2014.

In the summer time the County regularly hauls water and wets down the unpaved roads (mostly gravel, clay and sand) to reduce the fugitive particulate emissions. The County wets the unpaved roads on an as needed basis based on weather conditions and traffic volume. In addition, when it gets cold enough in the area, the County wets down some of the more sandy roads. Once the water soaks in and freezes, good dust suppression is seen. Road construction areas are being dampened with water for dust control. These practices reduce PM_{10} emissions in and near Alamosa. This control measure is balanced with the availability of water in the area.

Alamosa County used to assess the need to use $MgC1_2$ treatment on roads in front of residences that request such service. This practice stopped in 2004 when funding was lost. Assessments included the sensitivity to dust of residents, the materials of the road base for safety reasons, and possible environmental concerns of the neighborhood. Most requests for treatment are were granted. Other areas for treatment, such as commercial construction zones or gravel pits, are investigated on a case by case basis. The County hopes to be able to start offering this service again when funding is restored.

Dust Control Plans

Alamosa County requires dust control plans for selected construction/developments. The dust control plans are typically done through a negotiated agreement by the Alamosa Land Use Department and is supported by zoning codes.

The County may update the Comprehensive Plan to include a dust control plan. The Land Use Administrator is researching the potential for a dust control ordinance. This effort is anticipated to reduce PM_{10} emissions in Alamosa, especially as it relates to impacts on the community and high recorded PM_{10} values. At the time of this submittal (December 2013), this effort is still underway.

Wind Erosion of Open Areas

To reduce PM_{10} emissions from open areas outside of the City limits, low tilling and other soil conservation practices continue to be utilized in the community. The Mosca-Hooper Conservation District and Natural Resources Conservation Service is working on education efforts to promote cover crops and no-till agriculture. In addition, the community is using in strategic areas the Colorado State Forest Service's

program to purchase and plant shelter trees to reduce wind erosion in open areas. Nursery seedlings from the program have been sold in Alamosa County since 1956. The number of seedlings sold has varied over the last few years as illustrated in Table 21.

Table 21: Number of Seedlings Sold in Alamosa per Year.

Year:	2008	2009	2010	2011	2012	2013
Seedlings Sold:	7,432	5,963	2,805	4,197	3,327	4,231

These trees have a demonstrated advantage for the community and for air quality. Once the trees reach maturity, it is anticipated that the equivalent of 112 miles of double-rowed trees will be in place. The survival rate of the tree seedlings varies but according to the District Coordinator for the Seedling Tree Program, potted seedlings have about a 60% to 80% survival rate and the bare root seedlings have about a 40 to 60% survival rate. The Seedling Program recommends Siberian elm and Rocky Mountain juniper trees for low maintenance, drought resistance windbreaks in the valley, but offers over 40 varieties to suit specific site conditions. The Colorado State Forest Service and the Mosca-Hooper Conservation District promote the windbreak program through workshops and consulting landowners.

In addition, there is ongoing planting of trees (approximately 50) on newly developed Alamosa County property south/southwest of Alamosa (prevailing winds from southwest) and the Airport south of Alamosa for added air quality improvement. Also, The Bureau of Reclamation has an ongoing project to plant windbreaks along their Closed-Basin Canal.

Windblown Dust from Disturbed Soils

Alamosa has a semi-arid climate with approximately 7.25 inches of precipitation annually. The San Luis Valley, as noted within 25 miles of the San Luis Valley Regional Airport in Alamosa, is primarily comprised of forests (43%) and shrublands (42%). Consequently, soils in all areas are typically a mixture of silt and sand with limited vegetation due to low precipitation. In winter and spring, windstorms are common, especially in drier years. It is due to these high velocity windstorms that Alamosa experiences most of the PM_{10} problems for the area. Figure 55 illustrates potential areas of local soil disturbance that have been evaluated by the APCD for the Alamosa Adams State PM_{10} monitor.

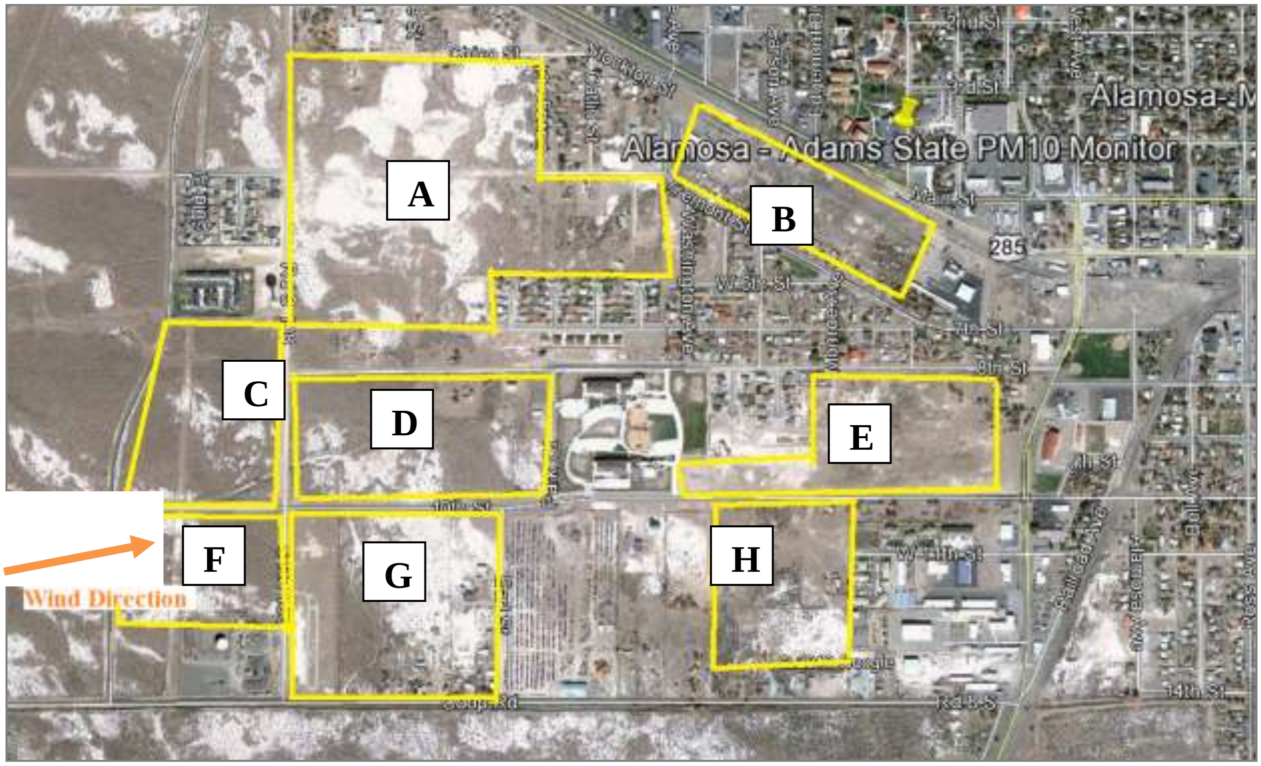


Figure 55: Relative positions of Adam's State College PM_{10} Monitor and potential disturbed soil. (Image from Google Earth 2007)

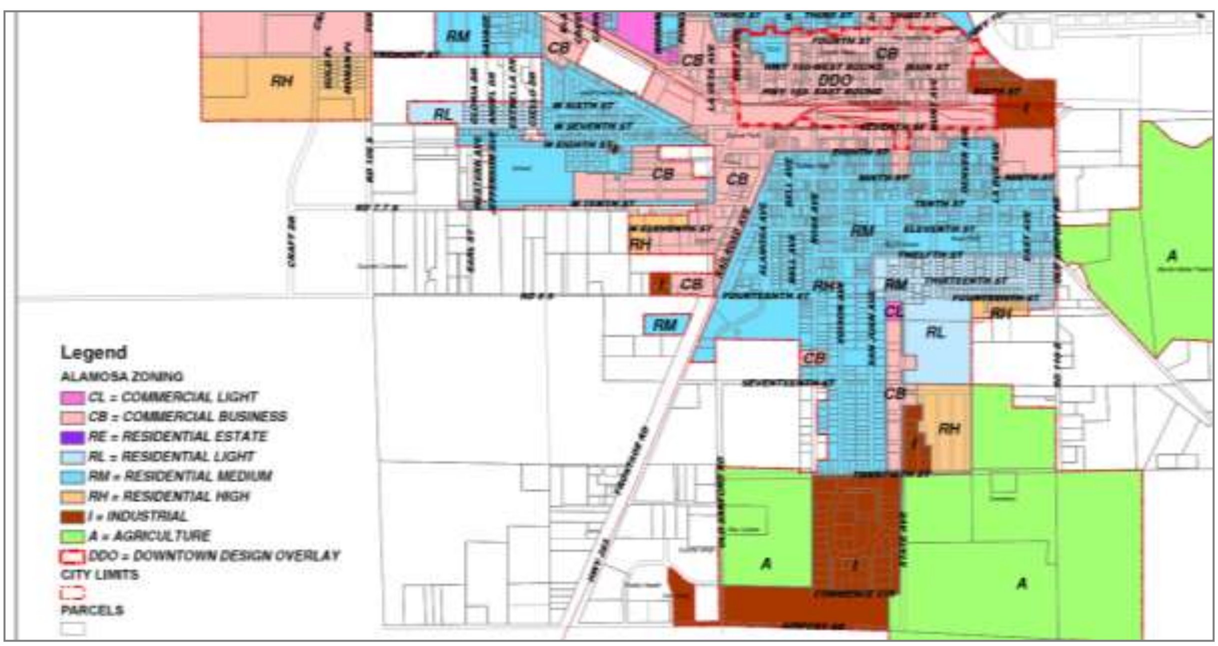


Figure 56: 2011 City of Alamosa Zoning Map (Provided by the Public Works Department)

Site A in Figure 55 (approximately 85 acres) is East of Rd S 108 and South of Chico St. It is zoned outside of the city's limits by the city as a "Parcel" as shown in Figure 56. The eastern portion of Area A is being considered for annexation into the City. A photo of site A is shown in Figure 57.

Figure 57: Site A facing north (August 2013)

Site C in Figure 55 (approximately 25 acres) is north of 10th St, West of Road 108, and east of Craft St. It is zoned outside of the city's limits by the city as a "Parcel" as shown in Figure 56. A photo of site C is shown in Figure 58.

Figure 58: Site C - Natural vegetation; Crust on soil; Undisturbed land. (August 2013)

Site D in Figure 55 (approximately 34 acres)is north of 10th street, east of Rd S 108, west of Park Ct, and south of 8th St. It is zoned outside of the city's limits by the city as a "Parcel" as shown in Figure 56. A photo of site D is shown in Figure 59.

Figure 59: Site D facing north. (August 2013)

Site F in Figure 55 (approximately 31 acres)is south of 10th St, east of Craft Dr, west of S Rd 108, and North of Coop Rd. It is zoned outside of the city's limits by the city as a "Parcel" as shown in Figure 56. A Photo of site F is shown in Figure 60.

Figure 60: Site F (August 2013)

Site G in Figure 55 (approximately 41 acres) is east of S Rd 108, north of Coop Rd, west of Earl St, and South of 10th St. It is zoned outside of the city's limits by the city as a "Parcel" as shown in Figure 56. The south end of site G is the historic Alamosa Spanish Cemetery shown in Figure 61. The cemetery is maintained by volunteers. There is a gravel walking path around the cemetery and the rest of the land is naturally vegetated with weeds and grasses. The north end of site G is privately owned land enclosed by a barbed wire fence to restrict access. The private land is naturally vegetated with native weeds and bushes as shown in Figure 62. The land is undisturbed and the soil has a thick crust.

Figure 61: Site G - South end, looking north. Spanish Cemetery (August 2013)

Figure 62: Site G -North end looking to the south. (August 2013)

Sites A, C, D, F, and G are noted by the City of Alamosa's Public Works Director and County Health Director to be vacant land with natural vegetation (i.e. shrubland, mostly Chico bush) with no artificial irrigation and no access restriction. The City emphasizes that the areas are not suited for motorized travel. These lots are not considered to be anthropogenically disturbed soils and should be considered to be natural sources as of this writing. If future high wind or other exceptional events occur, the APCD will re-assess these lots to determine if they are still natural sources.

Site B in Figure 55 (approximately 22 acres) is south of Highway 160 and north east of Tremont St. It is zoned outside of the city's limits by the city as a "Parcel" as shown in Figure 56. Site E in Figure 55 (approximately 30 acres) is north of 10th St, south of 8th St, east of Park Ct, and west of West Ave. It is zoned mostly as a "Commercial Business" as shown in Figure 56. There is a small portion in the top right corner that is zoned outside of the city's limits by the city as a "Parcel". Site H (approximately 23 acres) in Figure 55 is east of Earl St, south of 10th St, and north of Rd 8 S. It is zoned as "Commercial business", "Residential High" and a little "Industrial" as shown in Figure 56. Sites B, E, and H are naturally vegetated and potentially irrigated as shown in Figure 63. Figure 63 demonstrates that these sites are minimally (if at all) disturbed soil areas as of this writing. Photos of sites B, E, and H are shown in Figure 64, Figure 65, and Figure 67 respectively.

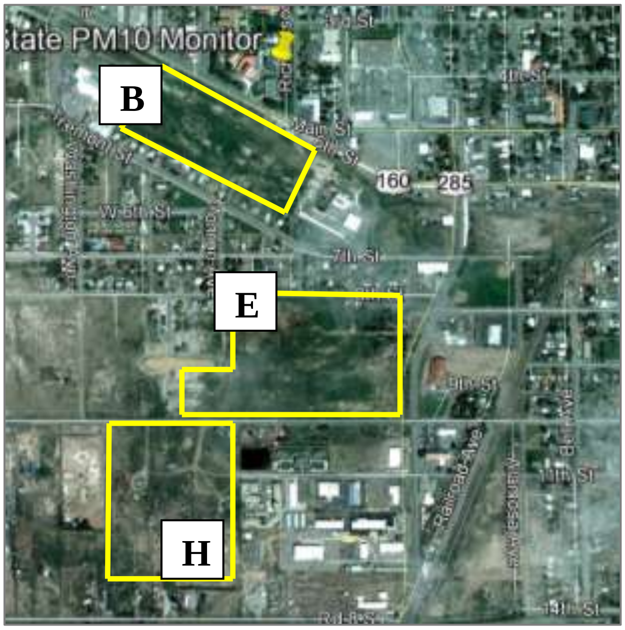


Figure 63: Sites B, E, and H with natural vegetation (Google Earth 2007)

Figure 64: Site B (August 2013)

Figure 65: Site E facing north (August 2013)

Figure 66: West end of site E is a gravel elementary school overflow parking lot (August 2013)

Figure 67: Site H with natural vegetation (August 2013)

The APCD conducted thorough assessments to determine if the potential soil disturbances shown in Figure 55 were present during the 2011 exceedances. During the course of these assessments, the APCD discovered that these sites were either reasonably controlled or considered to be natural sources during the April 3, 2011 high wind event. Therefore, these sites were not significant contributors to fugitive dust in the Alamosa area during the April 3, 2011, high wind event.

Figure 68 illustrates potential areas of local soil disturbance that have been evaluated by the APCD for the Alamosa Municipal Building (08-003-0003) PM10 monitor. The climate for this monitor is identical to the Alamosa Adams State PM10 monitor, described above.

Figure 68: Relative positions of Municipal Building PM_{10} Monitor and potential disturbed soil. (Image from Google Earth 2007)

Figure 69: 2011 City of Alamosa Zoning Map (Provided by the Public Works Department)

Site J in Figure 68 (approximately 5 acres) is south of 6th St, west of Ross Ave, east of West Ave, and north of 7th St. It is zoned by the city as "Commercial Business" as shown in Figure 69. The vacant land is undisturbed gravel, dirt, and is naturally vegetated as shown in Figure 70. The railroad runs through this narrow strip of land rendering it unlikely to be developed in the future.

Figure 70: Site J as of August 2013

Site K in Figure 68(approximately 22 acres) is east of La Due Ave, south of 6th St, north of 9th St, and west of Old Airport Rd. It is zoned by the city as "Commercial Business" and "Industrial" as shown in Figure 69. Site K is private property with restricted access located just south of the rail yard. The land is naturally vegetated and undisturbed as shown in Figure 71.

Figure 71: Site K as of August 2013

Site L in Figure 68 (approximately 3 acres) is east of West Ave, north of 10th St, south of 8th St, and west of Railroad Ave. It is zoned by the city as "Commercial Business" as shown in Figure 69. Site L is "Friends" Park that is maintained by the City of Alamosa (Figure 72). Friends Park has a well maintained gravel parking lot, a cement basketball court, an irrigated field, and a small hard packed clay BMX bike dirt track. The park is well maintained by the City and implements reasonable dust control measures on a regular basis.

Figure 72: Site L - Friends Park as of August 2013

Site M in Figure 68 (approximately 9 acres) is north of 14th St, west of Alamosa Ave, east of Railroad Ave, and south of 10th St. It is zoned by the city as “Residential Medium” as shown in Figure 69. Site M is a vacant lot behind a small apartment building. The land is natural and undisturbed. There is no irrigation but natural vegetation grows as shown in Figure 73. The soil has a crust on the surface. When asked, residents of the adjacent apartment complex did not complain about blowing dust coming from Site M.


Figure 73: Site M as of August 2013

Site N in Figure 68(approximately 26 acres) is south of 14^{th} St, north of 17^{th} St, west of Ross Ave, and east of the Frontage Road. It is zoned by the city as "Residential Medium" as shown in Figure 69. Site N, as shown in Figure 74, is vacant land that is naturally vegetated and undisturbed.

Figure 74: Site N as of August 2013

Sod and Vegetative Projects in the County

The development and construction of a local park, Eastside Park, is complete in Alamosa County. It has been completed with turf grass, shrubs, and landscape rock. No exposed soil remains.

Numerous other projects to reduce blowing dust and its impacts have happened or are happening at the County Airport. For example:

- Through additional grounds maintenance of the 40-acre Alamosa County airport south of the city, "Xeriscape" has been installed for aesthetics and dust control.
- Decorative rock and xeriscape have been implemented in the landscaping of the Alamosa County property (2007-2012). These measures have directly abated blowing dust at the Airport.
- Also, the widening of the airport's safety areas (250 feet on either side of the runway) is complete and seeding of natural grasses was incorporated in the project. Trees and grass were incorporated in the approaches to the airport and have provided additional wind-break advantages to South Alamosa.

In other areas where watering is a problem, xeriscape (the use of native drought resistant vegetation and/or rock cover) is being encouraged for County owned property and for all other property owners.

Colorado State University Co-Op Extension Office
In response to extremely dry conditions, the need to maintain area topsoil, and reduce impacts, the Colorado State University Co-Op Extension Office of Alamosa County provides the following outreach efforts and recommendations:

- Modification of grazing practices to improve protective crop cover
- Increasing crop residues left in the fields to reduce blowing dust
- Planting of Fall crops to maintain fields
- Application of manure to protect top soils from blowing away
- Staggering of the harvest to minimize blowing dust
- Outreach programs on soil conservation efforts
- Development of outreach/education materials (e.g., news articles, newsletters, fact sheets, etc.), and
- Attendance at Statewide workshop to educate other Co-Op offices to various practices to reduce blowing top soil and minimize impacts.

These control strategies are not meant to be enforceable. They are meant only to demonstrate the regional nature of cooperation in addressing blowing dust and its impacts on the community.

Natural Resources Conservation Service (NRCS)
Alamosa County is a predominately agricultural area where limited water, 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. Thus, activities that improve the topsoil and prevent its lifting during high wind events are encouraged. Some notable NRCS and agricultural examples include:

- Local Conservation Districts and farmers hold monthly meetings as an informal Soil Health Group, discussing ways to improve soil health. Cover crops, compost applications, and reduced tillage are the targeted practices. Public tours are held twice a year.
- NRCS continues to work with area farmers in the development of conservation compliance plans to also protect topsoil;
- NRCS encourages planting perennial grasses or the leaving weeds undisturbed or mowed on the corners of center pivots (instead of tilling that might lead to open, barren lands) to reduce soil blowing;
- NRCS “cost shares” on soil health practices and perennial grass seeding conservation practices with local farmers to prevent soil erosion, and;
- The NRCS is working with Colorado State University, local Water Conservation District, and Farm Service Agency to encourage retirement of marginal cropland in the Conservation Enhanced Reserve Program (CREP) and seeding those acreages back to native grass, forbs and shrubs.

Other successful agricultural practices encouraged in the area include: timing of tillage, crop rotation, amount of crop residue left on the land, and proper water usage. These control strategies are not meant to be enforceable. They are meant only to demonstrate the regional nature of cooperation in addressing blowing dust and its impacts on the community.

Please refer to the Final NEAP for Alamosa in Appendix D for more detail if needed.

5.2 Lamar

Natural Events Action Plan (NEAP)

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

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

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

Control Measures from the December 2012 Maintenance Plan

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

The EPA approval of the original PM_{10} Maintenance Plan, effective on 11/25/2005, reinstates the prevention of significant deterioration (PSD) permitting requirements in the Lamar Attainment/Maintenance area. The federal PSD requirements apply to new or modified major stationary sources which must utilize "best available control technology" (BACT).

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

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

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

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

City of Lamar

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

1. *Wind Break*
Beginning in the spring of 1997, a wind break of trees was planted north of the Power Plant monitoring site (080990001). The Russian Olive tree wind break is located approximately one half mile north of the Power Plant monitoring site and will block potential contributing blowing dust sources such as the Lamar Transfer Station and other unpaved equipment traffic areas to the north. The Russian Olive is a quick growing large shrub/small tree that thrives despite the semi-arid and windy climate of Lamar. As of October 2013, the Public Works Director states that most of the trees are still alive and in place. According to section 3.5.2.1 of EPA guidance entitled "*Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures"*, dated September 1992, one-row of trees is considered an effective windbreak.

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

2. *Landfill Controls*

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

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

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

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

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

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

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

3. *Vegetative Cover/Sod*

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

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

4. *Additional Public Works Projects*

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

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

Regulatory Measures - City

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

Burlington-Northern/Santa Fe Rail Line

The rail line running east-west of the Lamar Power Plant monitoring site was deemed to be an important PM10 source during conditions of high winds and low precipitation. Ground disturbance from vehicle traffic, which damages vegetation and breaks-up the hard soil surfaces, resulted in re-entrainment of dust from traffic, high winds or passing trains. This area is problematic in the two block area immediately west of the Power Plant monitoring site as shown in Figure 79 as Site M. Control of this open area requires a close working agreement between the Burlington-Northern/Santa Fe Railroad Company (BNSF) and the City of Lamar Public Works Department. The purpose of this BACM is to reduce the amount of particulate matter susceptible to wind erosion under high wind conditions and general re-entrainment of dust in the ambient air as a result of local train traffic passing in close proximity of the PM10 monitor.

In September 1997, the City chemically stabilized exposed lands north of the rail line between Fourth and Second Street where there was evidence of vehicle traffic. All other lands on either side of the rail road tracks between Main Street (Fifth) and Second Street and extending westward have either natural, undisturbed ground cover or it is used for commercial/recreation purposes that do not allow for significant re-entrainment (BNSF is responsible for maintaining 50 feet of property on either side of the main track). Most of these lands are leased by the City. After September 1997, the City negotiated the lease of these lands. Once acquired, a long term plan, will be developed for these lands such as restricting vehicle access, permanently stabilizing lands with vegetation and gravel, increasing park and recreational use, and using the lands for city maintenance and storage activities. As of October 2013, the Public Works Director stated that gravel has been periodically added to minimize blowing dust.

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

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

Prowers County

Prowers County Land Use Plan:

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

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

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

Windblown Dust from Disturbed Soils

The City of Lamar is located in Prowers County in southeastern Colorado. Situated along the Arkansas River and near the Kansas border, Lamar serves as the largest city and the agricultural center for southeast Colorado. The area surrounding Lamar consists of gently rolling to nearly level uplands where the dominant slopes are less than 3 percent. The climate is generally mild and semiarid. Annual precipitation is about 15 inches. Summers are long and have hot days and cool nights. In winter and spring, windstorms are common, especially in drier years. It is due to these high velocity dust storms and drought conditions that Lamar experiences most of the PM_{10} problems for the area. Figure 75 through Figure 84 illustrate potential areas of local soil disturbance that have been evaluated by the APCD for the Lamar Power Plant PM_{10} monitor (080990001).

Figure 75: Wind Direction relative to the Lamar Power Plant PM_{10} monitor for the April 3, 2011 event

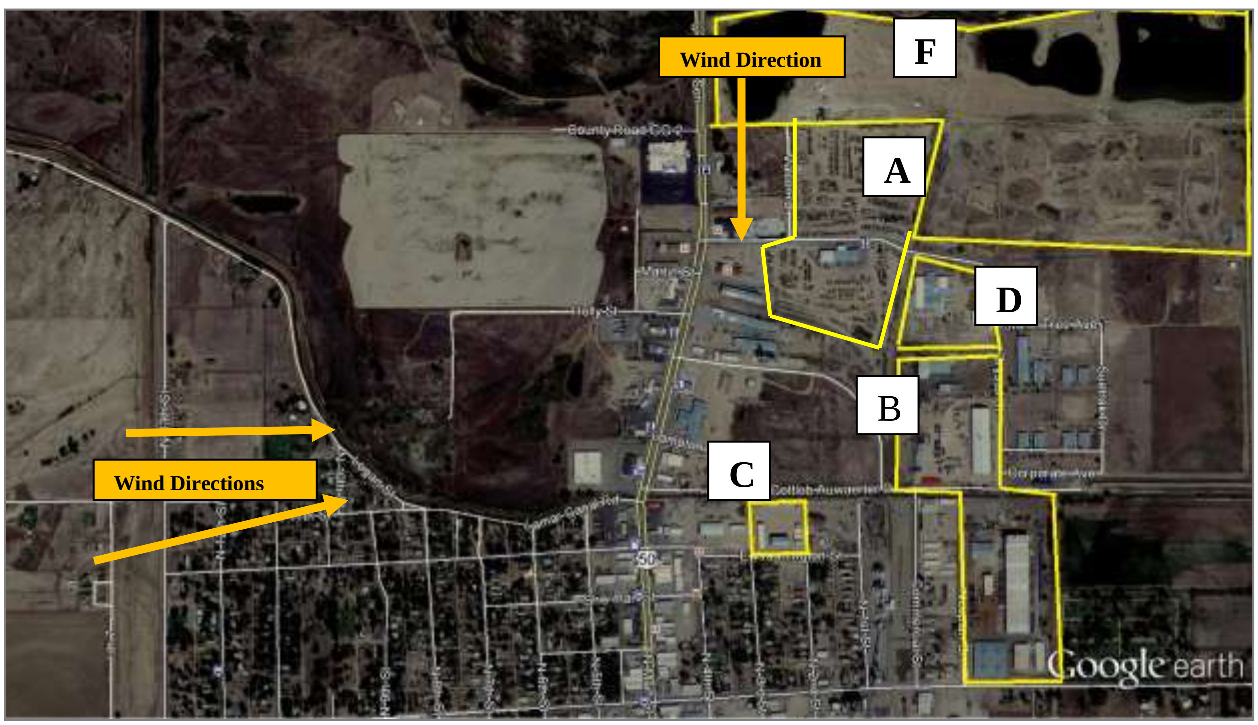


Figure 76: North of the Lamar Power Monitor (Google Earth image 8-2013)

Site A in Figure 76 is “Ranchers Supply CO INC” at 400 Crystal Street. The company started in 1961 and their products include used trucks, construction equipment, military vehicles, new and used trailers and other government surplus items. The property is used for inventory storage. To control fugitive dust emissions, onsite vehicle speeds are restricted to 10 mph. The owner states that 90% of the lot is covered in well maintained gravel. The site is watered down on an as needed basis to mitigate dust to protect assets and for pollution prevention. Also, all of the large equipment also acts as a wind block. Access to the site is restricted by a security fence. Site A, as shown in Figure 77, has reasonable dust control measures in place with regard to AQCC Regulation 1 requirements (Section III.D.1(a)). The APCD considers restricted vehicle speeds in combination with maintained gravel to be the appropriate available and practical method that is technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this storage site.

Figure 77: Site A - Ranches Supply CO INC (Google Image August 2012)

Site B in Figure 76 is located to the north of the Lamar Power PM_{10} monitor. Site B is “Ranco”, a heavy duty construction trailer manufacturing company located at 700 Crystal St. All of the property owned by Ranco is either pavement, gravel, or natural vegetation. The company informed APCD that there are no unnatural, disturbed, areas of dirt on the property that could contribute to the issue of blowing dust. The APCD considers pavement, maintained gravel, natural vegetation, and restricted access to be the appropriate available and practical methods that are technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site C in Figure 76 is located to the north of the Lamar Power PM_{10} monitor on the northeast corner of Washington St and 4th St. Site C is at 201 E Washington St. The site used to be “Big R Warehouse” but is currently owned by Prowers County and is rented out to the Colorado State Patrol for office space. The lot is covered in gravel for dust suppression, drainage, and erosion control. Within the lot, vehicle speeds are restricted to 5 mph. Access to the lot is restricted by a chain link fence. The lot is watered on an as needed basis. Site C, as shown in Figure 76, has reasonable dust control measures in place with regard to AQCC Regulation 1 requirements (Section III.D.1(a)). The APCD considers restricted vehicle speeds in combination with maintained gravel and restricted access to be the appropriate available and practical methods that are technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site D in Figure 76 is located to the north of the Lamar Power PM_{10} monitor. Site D is “C.F. Maier Composites Inc” at 500 East Crystal Street. This 57,000 square foot facility has been operating since 1990 and specializes in highly difficult fiber reinforced composites and OEM component application. C.F. Maier offers product design, development, prototype and full production of reinforced composite parts for high stress or high impact uses. The company has a paved parking lot. The rest of the lot is covered in natural vegetation. There is a short (200 ft.) well maintained gravel road that leads up to the loading dock that gets used on average one a day. Site D, as shown in Figure 76, has reasonable dust control measures in place with regard to AQCC Regulation 1 requirements (Section III.D.1(a)). The APCD considers restricted maintained gravel and natural vegetation to be the appropriate available and practical methods that are technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site F in Figure 76 is located to the north of the Lamar Power PM_{10} monitor. Site F is mined by “All-Rite Paving and Redi-Mix Inc” at 1 Valco Road. This is a concrete batch plant with a permit from CDPHE, (#85PR108). However, this facility is considered APEN exempt and emits less than 1 ton per year of PM_{10} This facility has a PM baghouse collection efficiency of 99%. Visible emissions from this source shall not exceed 20% opacity. Water sprays and magnesium chloride are used on storage piles and all unpaved roads as needed. The unpaved roads at site E are covered with gravel and the vehicle speed is restricted to 10 mph at all times. The transfer of aggregate to storage bins and trucks is entirely conducted in enclosed areas. All aggregate is washed prior to storage in order to reduce dust emissions. Access to the site is restricted by a fence. The APCD considers the enforceable conditions of the permit, including identified continuous controls such as gravel roads with miles per hour restrictions and enclosures to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on April 3, 2011 did exceed the blowing dust thresholds of 30 mph or greater and gusts of 40 mph or greater at which the APCD expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 51 mph with wind gusts up to 70 mph). Additionally, the City of Lamar took over the concrete plant in the spring of 2013 and is in the process of reseeding it and turning the site into a park for fishing and wildlife with motorized vehicles being prohibited. The City of Lamar and the Division of Wildlife are partners in this effort.

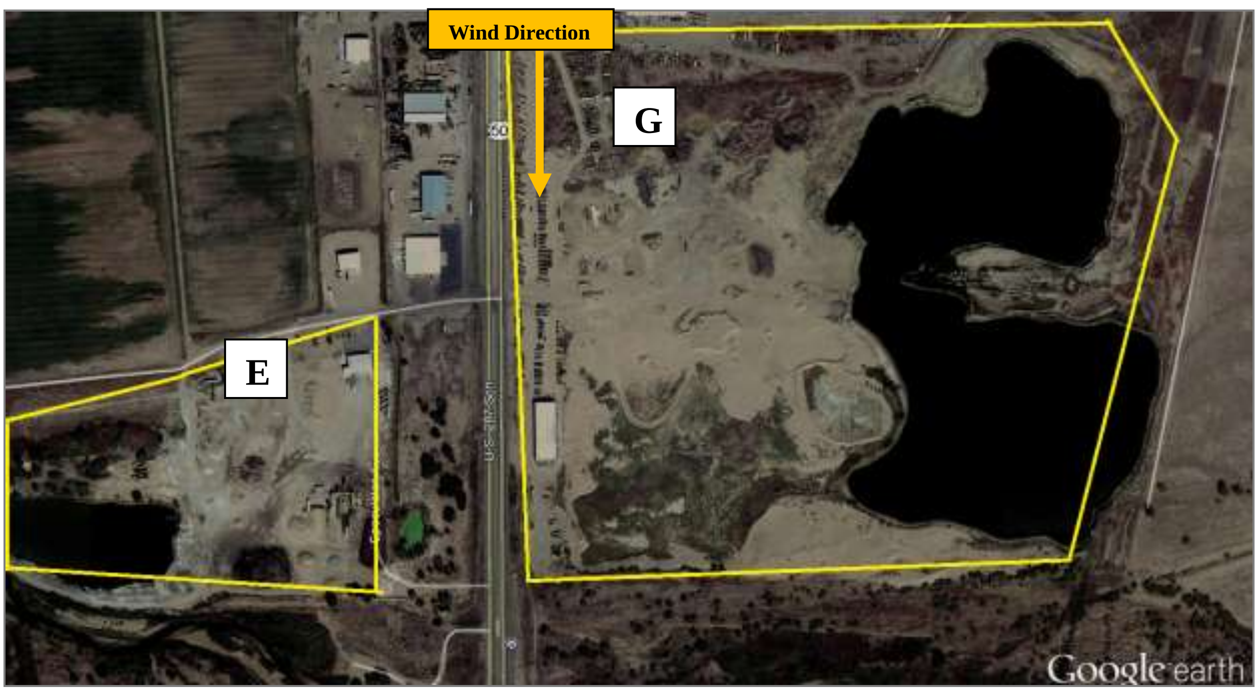


Figure 78: Further North and west of the Lamar Power Monitor (Google Earth image 8-2013)

Site E in Figure 78 is located to the northwest of the Lamar Power PM_{10} monitor. Site E is “All-Rite Paving and Redi-Mix Inc” at 200 Speculator Ave. This is a concrete batch plant with a permit from CDPHE (#12PR1396). However, this facility is considered APEN exempt and emits less than 1 ton per year of PM_{10}. This facility has a PM baghouse collection efficiency of 99%. Water spray and magnesium chloride is used on storage piles and all unpaved roads as needed. The unpaved roads at site E are covered with gravel and the vehicle speed is restricted to 10 mph at all times. The transfer of aggregate to storage bins and trucks is entirely conducted in enclosed areas. All aggregate is washed prior to storage in order to reduce dust emissions. The APCD considers the enforceable conditions of the permit, including identified continuous controls such as gravel roads with miles per hour restrictions and enclosures, to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on April 3, 2011 did exceed the blowing dust thresholds of 30 mph or greater and gusts of 40 mph or greater at which the APCDn expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 51 mph with wind gusts up to 70 mph).

Site G in Figure 78 is mined by “Carder Inc” and is located to the northwest of the Lamar Power PM_{10} monitor. Carder Inc mines for sand and gravel primarily for road construction. This site has a permit from CDPHE (#99PR0180F) and emits approximately 15 tons per year of PM_{10}. This is a wet mining operation so it produces minimal fugitive dust. The dust control measures that are part of the permit include watering the disturbed area as needed, revegetation within one year of disturbance, compacting of piles, mining moist materials, vehicles cannot exceed 10 mph on site at all times, and temporary roads are covered with gravel and watered as needed. The APCD considers the enforceable conditions of the permit, including identified continuous controls such as gravel roads with miles per hour restrictions, compaction, revegetation, watering, and extraction limitation, to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on April 3, 2011 did exceed the blowing dust thresholds of 30 mph or greater and gusts of 40 mph or greater at which the APCD expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 51 mph with wind gusts up to 70 mph).

Figure 79: West of the Lamar Power Plant PM_{10} Monitor (Google Earth image 8-2013)

Site H in Figure 79 is west of the Lamar PM_{10} monitor at 200 N 4th St. This is owned by “Heath & Son & Turpin Trucking”, a company that repairs large trucks and shared with “HVH Transportation Inc”, a freight service trucking company. This site consists of well maintained gravel. The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site I in Figure 79 is west of the Lamar PM_{10} monitor. The site is shared by a few businesses. All businesses have restricted access by fences surrounding the property. “Cowboy Corral Storage” at 102 North 4th St is one of the businesses on the lot. It has a very small gravel parking lot and is no longer in business according to the previous owner as of October 2013. The storage company has a small gravel parking lot with access being restricted by a security fence as shown in Figure 80. The lot is also shared with the “Prowers Area Transit” county bus garage. The bus garage is very small, only four bays. The garage has a concrete slab that runs to the asphalt road to avoid the busses driving on the gravel in order to mitigate fugitive dust. The gravel lot is watered on an as needed basis. The other business is an old feed supply company with grain storage as shown in Figure 81.The feed supply company is out of business and the grain elevators are not being utilized. The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Figure 80: Cowboy Corral Storage (Google Image 2012)

Figure 81: Feed Storage Company (Google Image 2012)

Site J in Figure 79 is west of the Lamar PM_{10} monitor at about 201 N 2nd Street. The gravel parking lot on site is owned by “Heath & Son & Turpin Trucking” and is shown in Figure 82. The lot is used to store trucks when not in use. This site consists of well maintained gravel. The APCD considers maintained gravel and limited access to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Figure 82: Heath & Son & Turpin Trucking Storage Lot (Google Image 2012)

Site K in Figure 79 is west of the Lamar PM_{10} monitor at about 103 North 2nd Street. It is the "Lamar Water Department". Also on site K is the "Lamar-Prowers County Volunteer Fire Department" at 300 E Poplar Street. Both sites have restricted access with security fences. The City of Lamar maintains their gravel lots by grating and watering them on an as needed basis. The APCD considers maintained gravel. limited access, grating, and watering to be the appropriate available and practical method for a small site of this size in this area of Colorado that has been designated a drought area for years, is in an economic recession, and is owned by multiple small businesses to be technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this site.

Site L in Figure 79 is the power plant that the Lamar PM_{10} monitor is located within at100 North 2nd Street. "Lamar Light and Power" historically operated a natural gas-fired boiler that produced steam for a 25 MW turbine/generator set. This boiler was constructed prior to 1972 and was grandfathered from construction permitting requirements. In the early 2000s, factors such as increasing costs of natural gas made the plant uneconomical to run. As a result, Lamar Light and Power purchased power and ran the natural gas-fired boiler very infrequently or not at all. In February 2006, the APCD issued a permit for Lamar Light and Power to replace the existing natural gas-fired boiler with a coal-fired circulating fluidized bed (CFB) boiler rated at approximately 42 MW. The conversion prompted legal challenges from Lamar residents partnered and WildEarth Guardians, a New Mexico-based environmental group. Lamar Light and Power settled and agreed to shut down the coal-fired power plant. The power plant was shut down on November 11, 2011. The settlement also calls for the plant to stay offline until at least 2022, when the current agreement to supply electricity to Lamar and other communities expires.

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

- Limestone and ash handling, processing, and storage are controlled by high efficiency baghouses
- Water wash-down-systems are used for flushing down any accumulated dust on walkways, platforms, and other surfaces to prevent re-entrainment of the dust into the atmosphere.
- On-site haul roads are paved, and these surfaces are inspected at least once each day in which hauling activities occur, and cleaned as needed. Various cleaning methods are used depending on the extent of dust accumulations. These activities emit less than 1 ton per year of PM_{10} and are APEN Exempt.

- All transport vehicles containing substances that potentially generate fugitive particulate matter emissions (such as trucks containing limestone, inert material, or ash) are fully enclosed, or covered with a mechanical closing lid or a tight tarp-like cover at all times while on the facility grounds except during loading / unloading operations.
- Emissions from emergency coal stockpile are effectively controlled with a water dust suppression system.

Access to the power plant is restricted by security fences. The APCD considers the enforceable conditions of the permit, including identified Best Available Control Technology (BACT) for limestone and ash handling, paving, wash-down systems, and enclosures, to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on April 3, 2011 did exceed the blowing dust thresholds of 30 mph or greater and gusts of 40 mph or greater at which the APCD expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 51 mph with wind gusts up to 70 mph).

Site M in Figure 79 is the Burlington Northern Santa Fe railroad that runs past the Lamar PM_{10} monitor to the south. On either side of the rail road tracks is gravel as shown in Figure 83. In May 1997, Burlington Northern Santa Fe placed chips (gravel) 50 feet on either side of the main track from Main Street to Second Street (three blocks) to control fugitive dust emissions from this section of the track. Graveling exposed surfaces not exposed to regular vehicle traffic is considered a permanent mitigation measure. Also, all the train tracks are raised up on 3 inch diameter rock and tracks. Areas that are not used by the railroad are allowed to be naturally vegetated with Xeriscape. With regard to AQCC Regulation 1 requirements (Section III.D), the APCD considers gravel and ‘Xeriscape’ vegetation to be the appropriate available and practical method that is technologically feasible and economically reasonable in order to minimize fugitive particulate emissions for this type of source.

Figure 83: Railroad tracks with gravel on each side (Google Image 2012)

Figure 84: 5 miles West of Lamar - "Carder Inc"- 32625 County Rd 3.75 Lamar, CO (Google Earth 2012)

Site N in Figure 84 is "Carder Inc" at 32625 County Rd 3.75 (about 5 miles west of Lamar). Carder Inc mines this site, known as the Hard Scrabble Pit, for sand and gravel primarily for road construction. This site has a permit from CDPHE (#99PR0179F) and emits about 8 tons per year of PM_{10}. This is a wet mining operation so it produces minimal fugitive dust. The dust control measures that are part of the permit include watering the disturbed area as needed, revegetation within one year of disturbance, compacting of piles, mining moist materials, vehicles cannot exceed 10 mph on site at all times, and temporary roads are covered with gravel and watered as needed. The APCD considers the enforceable conditions of the permit, including identified continuous controls such as gravel roads with miles per hour restrictions, compaction, revegetation, watering, and extraction limitation, to be technologically feasible and economically reasonable for a facility of this size in order to minimize fugitive particulate emissions for this site. The winds speeds on April 3, 2011, did exceed the blowing dust thresholds of 30 mph or greater and gusts of 40 mph or greater at which the APCD expects stable surfaces (i.e., controlled anthropogenic and undisturbed natural surfaces) to be overwhelmed (wind speeds were as high as 51 mph with wind gusts up to 70 mph). .

The APCD conducted thorough assessments to determine if the potential soil disturbances shown in Figure 76 through Figure 84 were present during the 2011 exceedances in Lamar. During the course of these assessments, the APCD discovered that these sites were either reasonably controlled or considered to be natural sources during the April 3, 2011, high wind event. Therefore, these sites were not significant contributors to fugitive dust in the Lamar area during the April 3, 2011, high wind event.

Colorado State University CO-OP Extension Office

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

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

USDA: Natural Resources Conservation Service (NRCS)

1. *Conservation Reserve Program*

Prowers County is a predominately agricultural area that is made up of 1,053,037acres of land area – 1,037,336 acres (or 92.7%) of which is land in farms.[2] For comparison, Baca County to the south is 78.4% land in farms, Bent County to the west is 88.9% land in farms, and Kiowa County to the north is 83.8% land in farms. It should be noted that cropland percentage in Bent County is lower than other Southeast Colorado counties at 21%. Figure 85 illustrates the counties of Southeast Colorado. Of the farm land acreage in Prowers County, cropland accounts for over half of the total (552,476 acres) and is approximately 53% of the total land in the county. Water, and often the lack of it, coupled with the frequent high winds experienced during late fall and early spring commonly destroy crops, encourage pests, and damage soil surfaces lending them susceptible to wind erosion, especially in recent drought years. Prowers County has been in a severe drought for almost three years, and entered an extreme drought in 2013. In 2011, most of Prowers County cropland acreage is farmed using dryland practices (versus irrigated) and consists of soils classified as highly-erodible-land (HEL) by the Department of Agriculture.

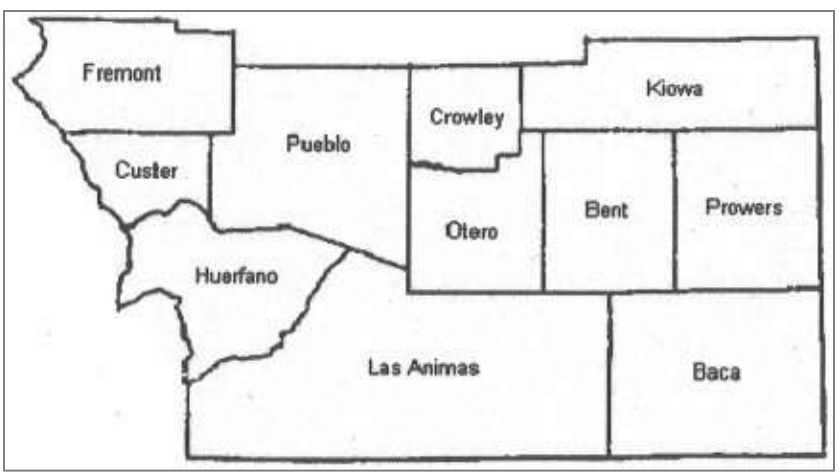


Figure 85: Southeast Colorado Counties

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

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

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

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

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

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

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

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

2. *Limestone-Graveyard Creeks Watershed Project*

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

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

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

3. *New Initiatives*

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

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

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

6.0 Summary and Conclusions

APCD is requesting concurrence on exclusion of the PM_{10} values from Alamosa-Adams State College (08-003-0001), Alamosa-Municipal Building (08-003-0003), and Lamar Power Plant (08-099-0001) on April 3, 2011.

Elevated 24-hour PM_{10} concentrations were recorded in parts of Colorado on April 3, 2011. All of the noted April 3, 2011, twenty-four-hour PM_{10} concentrations were above the 90th percentile concentrations for their locations (see Table 18). This event produced the maximum value for any sample taken in April and exceeded the 99th% value of any evaluation criteria. The statistical and meteorological data clearly shows that but for this high wind blowing dust event, Alamosa and Lamar would not have exceeded the 24-hour NAAQS on April 3, 2011. Since at least 2005, there has not been an exceedance that was not associated with high winds carrying PM_{10} dust from distant sources in these areas. This is evidence that the event was associated with a measured concentration in excess of normal historical fluctuations including background.

The PM_{10} exceedances in Alamosa and Lamar on April 3, 2011, would not have occurred if not for the following: (a) dry soil conditions over northeast Arizona, northwest New Mexico, southeast Utah, and eastern Colorado with 30-day precipitation totals below the threshold identified as a precondition for blowing dust in northeastern Arizona; (b) a surface low pressure system and vigorous cold front that were associated with a strong upper-level trough that caused strong prefrontal surface winds over the area of concern; and (c) friction velocities over regions of northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado that were high enough to allow entrainment of dust from natural sources with subsequent transport of the dust to southern Colorado in strong winds.

Surface weather maps show evidence of widespread blowing dust and winds above the threshold speeds for blowing dust on April 3. The combination of strong winds aloft and deep mixing in advance of the cold front, with tight pressure gradients behind the cold front caused regional surface winds over 40 mph with gusts exceeding 50 mph for several hours. These speeds are above the thresholds for blowing dust identified in EPA draft guidance and in detailed analyses completed by the State of Colorado *(*see *Appendix A – Grand Junction, Colorado, Blowing Dust Climatology and Appendix B - Lamar, Colorado, Blowing Dust Climatology at the end of this document*). Specifically, these high values were the consequence of high winds from an intensifying surface low pressure system and vigorous cold front in combination with dry conditions which caused significant blowing dust across Arizona, northwest New Mexico, southeast Utah and southern Colorado. These PM_{10} exceedances were due to an exceptional event associated with regional windstorm-caused emissions from erodible soil sources over a large area of northeast Arizona, northwest New Mexico, southeast Utah and southern and eastern Colorado. These sources are not reasonably controllable during a significant windstorm under abnormally dry or moderate drought conditions.

The blowing dust climatology for Grand Junction (Appendix A) and Lamar (Appendix B) indicate that the area can be susceptible to blowing dust when winds are high. Landform imagery shows that northeastern Arizona and southeastern Utah in particular have experienced a long-term pattern of wind erosion and blowing dust when winds have been southwesterly and blowing into Colorado. Forecast products from the Navy Aerosol Analysis and Prediction System model provide evidence for a widespread blowing dust event, suggesting that significant source regions for dust in Colorado were located in arid regions of Arizona, New Mexico and Colorado. NOAA HYSPLIT forward and backward trajectories provide clear supporting evidence that dust from arid regions of Arizona, northwest New Mexico and eastern Colorado caused the PM_{10} exceedances measured across portions of southern Colorado on April 3. Soils in the Four Corners area of northeast Arizona, northwest New Mexico and southeast Utah along with the plains of eastern Colorado were dry enough to produce blowing dust when winds were above the thresholds for blowing dust.

Both wind speeds and soil moisture in the Four Corners area and northeastern Arizona were conducive to the generation of significant blowing dust. Multiple sources of data for the event in question and analyses of past dust storms in this area prove that this was a natural event and, more specifically, a significant natural dust storm originating in northeastern Arizona, northwestern New Mexico, and southeastern Utah and spreading into southeastern Colorado. But for the dust storm on April 3, 2011, this exceedance would not have occurred.

Friction velocities provide a measure of the near-surface meteorological conditions necessary to cause blowing dust. Friction velocities across a wide area of northern Arizona, northwest New Mexico, southeast Utah and southern and eastern Colorado were above 1.0 meters per second on April 3, 2011. Even undisturbed desert soils normally resistant to wind erosion will be susceptible to blowing dust when friction velocities are greater than about 1.0 to 2.0 meters per second. Note that blowing dust will typically only occur where these values are high and the soils are dry and not protected by vegetation, forest cover, boulders, rocks, etc. This is why blowing dust occurred in the desert and more arid sections of northeast Arizona, northwest New Mexico, southeast Utah, and southern and eastern Colorado on April 3. These elevated friction velocities (shown in Figure 38 and Figure 39) and the data on soil moisture conditions presented elsewhere in this report, and the prevalence of winds above blowing dust thresholds (all occurring in traditional source regions in northeastern Arizona, northwestern New Mexico, and southeastern Utah) prove that this dust storm was a natural event that was not reasonably controllable or preventable.

GASP satellite imagery shows that the desert regions of northeast Arizona and northwest New Mexico along with the arid plains of eastern Colorado were source regions for the blowing dust on April 3. This is consistent with the climatology for many dust storms in Colorado as described in the Grand Junction, Colorado, Blowing Dust Climatology report contained in Appendix A and the Lamar, Colorado, Blowing Dust Climatology in Appendix B, both found at the end of this document. The observations of winds above blowing dust thresholds and restricted visibilities in the areas of concern demonstrate that this is a natural event that cannot be reasonably controlled or prevented.

As demonstrated in Section 3 and particularly in Table 16, the PM_{10} exceedances in Alamosa and Lamar on April 3, 2011, would not have occurred “but for” the large regional dust storm on April 3, 2011.

7.0 References

Draxler, R.R. and G.D. Rolph, 2012. *HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://ready.arl.noaa.gov/HYSPLIT.php).* NOAA Air Resources Laboratory, Silver Spring, MD.

Marticorena, B., G. Bergametti, D. Gillette, and J. Belnap, 1997, Factors controlling threshold friction velocity in semiarid and arid areas of the United States, *Journal of Geophysical Research 102 D19*, 23,277-23, 287.

United States Environmental Protection Agency, June 2012, *Draft Guidance on the Preparation of Demonstrations in Support of Requests to Exclude Ambient Air Quality Data Affected by High Winds under the Exceptional Events Rule.*

Appendix A - Grand Junction, Colorado, Blowing Dust Climatology January 24, 2012

There can be significant transport of regional blowing dust into Grand Junction from source regions in Utah and Arizona. While there are sources for wind-blown dust within the Grand Valley and Grand Junction itself, there is evidence from the analysis of soil features, wind and precipitation climatology, and statistical analyses of Grand Junction exceedances of the PM10 standard that regional sources often play a significant role during these blowing dust events. This document provides a weight of evidence analysis for dust transport into Colorado.

Grand Junction, Colorado, is located in a part of the country that is largely arid to semi-arid. Figure A-1 through A-3 show the annual average precipitation for Colorado, Arizona, and Utah, respectively. Grand Junction is in the Grand Valley of Western Colorado where the annual precipitation is typically less than 10 inches. Northeastern Arizona, which is frequently upwind of Grand Junction during blowing dust events, receives between 5 and 15 inches of precipitation each year. The Colorado River Basin in eastern and southeastern Utah, which is also frequently upwind of Grand Junction during blowing dust events, also receives 5 to 10 inches per year.

Figure A-4 shows the 1971-2000 monthly normal precipitation amounts for Grand Junction, Colorado. The annual average for this time period is 8.99 inches. The wettest months are March through May and August through October. The driest months are January, February, June, July, November, and December. These months receive an average of 0.57 inches per month. The annual monthly average precipitation is 0.75 inches.

Arid to semi-arid soils make much of the region susceptible to blowing dust. The map in Figure A-5 shows that portion of the Colorado Plateau (circled in red) where modern wind erosion features are common and clearly visible in Google Earth images. These features include longitudinal dunes and other sand or soil erosion structures with a predominant southwest to northeast orientation. This orientation is the result of the predominant southwesterly flow that occurs during high wind and blowing dust events in the region. Figures A-6 through A-12 present aerial views of ubiquitous erosion features in northeastern Arizona and southeastern Utah. The Painted Desert of northeastern Arizona is frequently the source for much of the blowing dust in the Four Corners region. Figure A-13 provides a particularly good satellite image of a blowing dust event originating in the Painted Desert and extending northeastward across the junction of the Four Corners (source: NASA Tera satellite, http://earthobservatory.nasa.gov/IOTD/view.php?id=37791). Strong southwesterly winds caused this blowing dust event.

The text that accompanies this image on NASA's Earth Observatory 10th Anniversary page follows below:

> "A dust storm struck northeastern Arizona on April 3, 2009. With winds over 145 kilometers (90 miles) per hour reported near Meteor Crater, east of Flagstaff, the storm reduced visibility and forced the temporary closure of part of Interstate 40, according to *The Arizona Republic.*
>
> The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite captured this image on April 3, 2009. Clear skies allow a view of multiple source points of this dust storm. The source points occur along an arc that runs from northwest to southeast.

This dust storm occurred in the area known as Arizona's Painted Desert, and the dust plumes show why. Whereas many dust plumes are uniform in color, these plumes resemble a band of multicolored ribbons, ranging from pale beige to red-brown, reflecting the varied soils from which the plumes arise. The landscapes of the Painted Desert are comprised mostly of Chinle Formation rocks—remains of sediments laid down during the time of the first dinosaurs, over 200 million years ago."

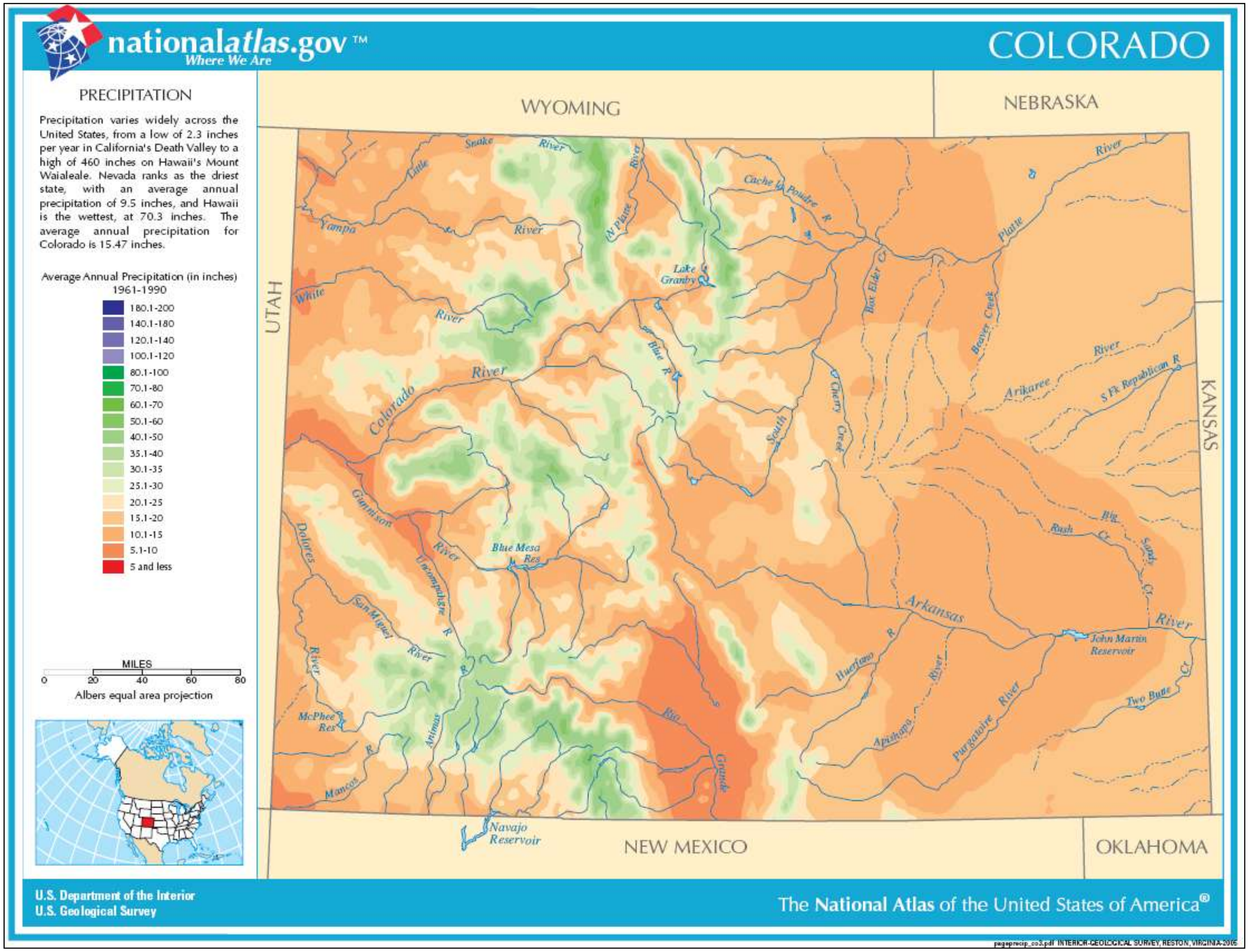


Figure A-1. Average annual precipitation in Colorado based on 1961-1990 normals.

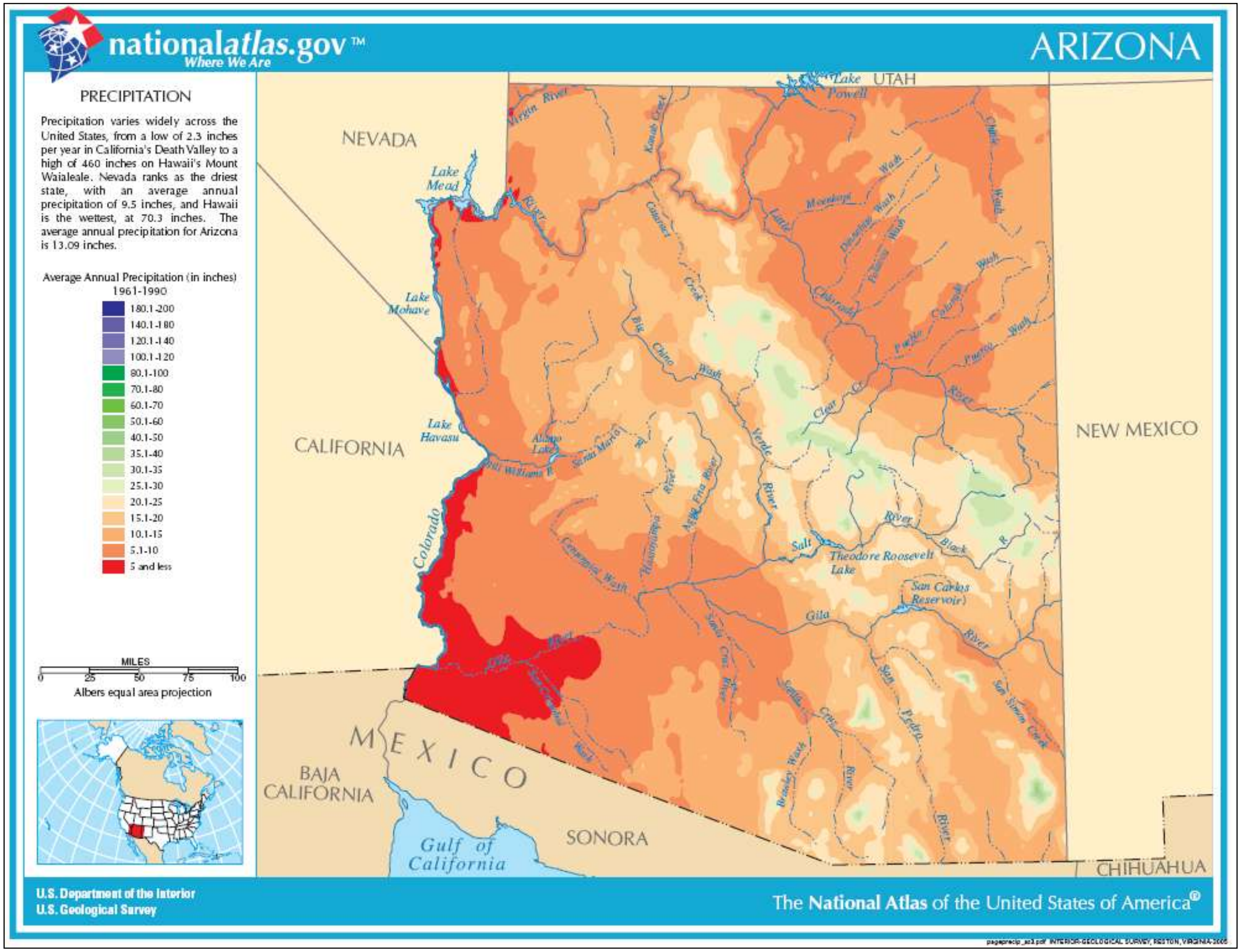


Figure A-2. Average annual precipitation in Arizona based on 1961-1990 normals.

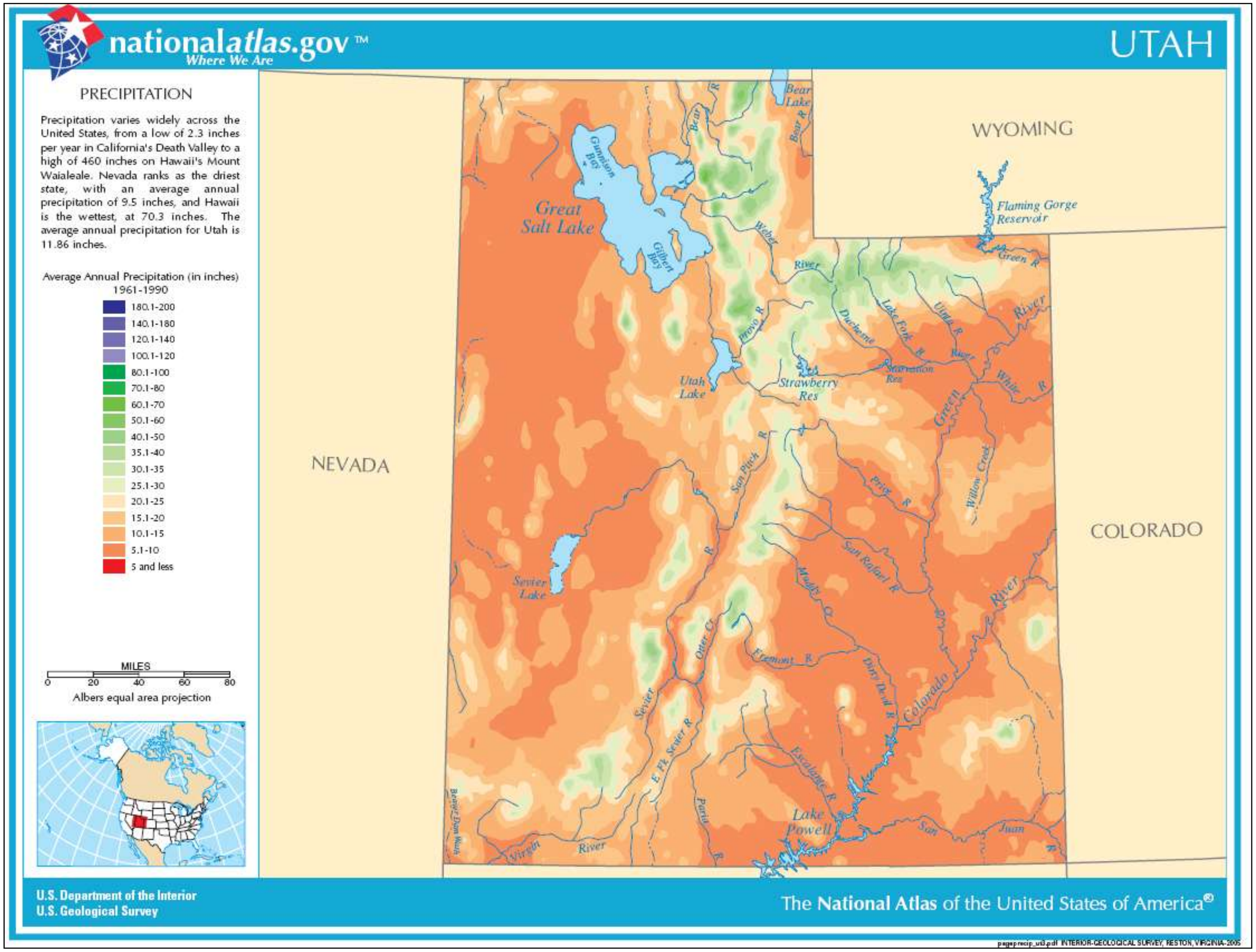


Figure A-3. Average annual precipitation in Utah based on 1961-1990 normals.

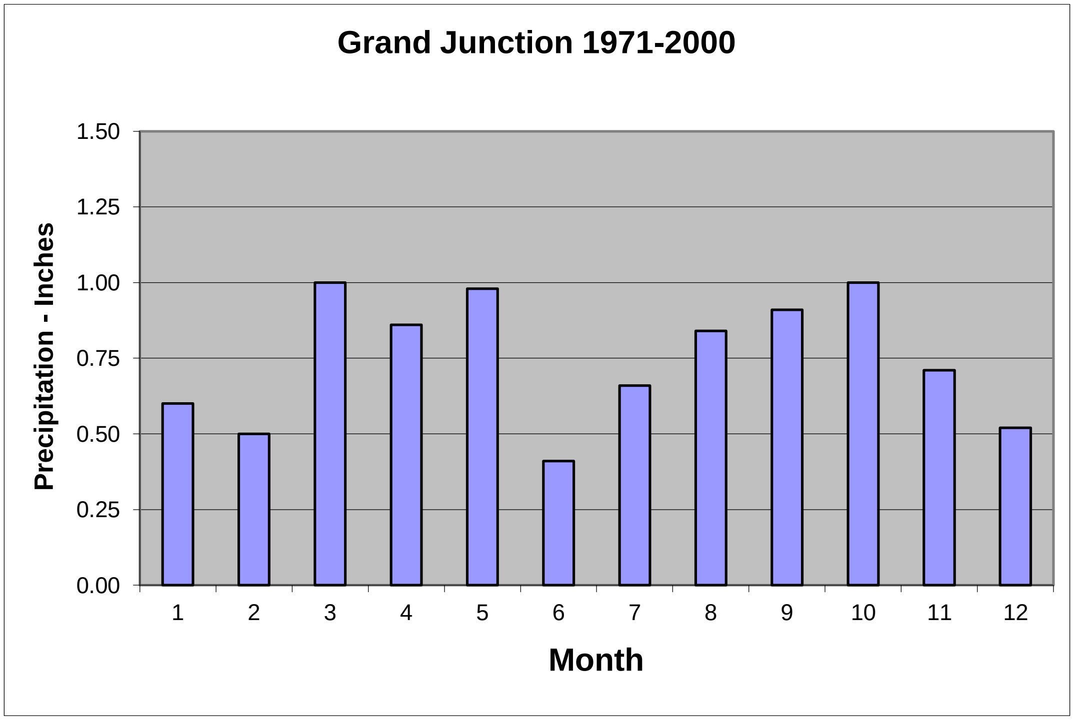


Figure A-4. 1971-2000 monthly normal precipitation in Grand Junction Colorado.

Figure A-5. The portion of the Colorado Plateau in Utah, Arizona, and New Mexico that exhibits widespread surface soil and sand erosion features in Google Earth imagery. Much of the highlighted area within Arizona is within the Painted Desert.

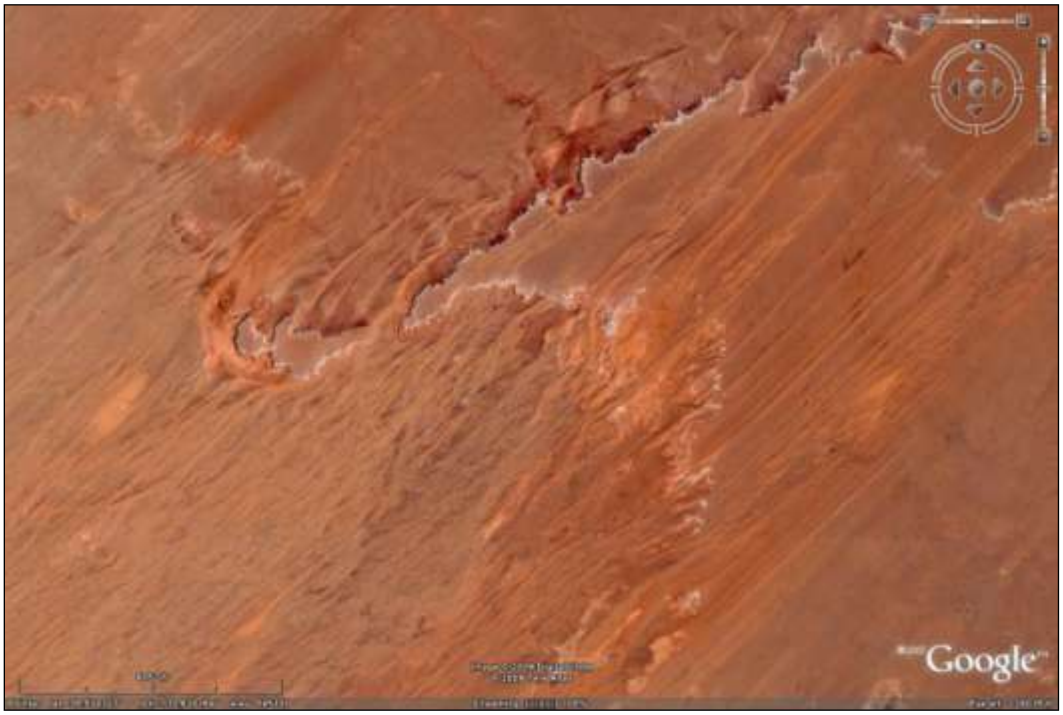


Figure A-6. Southwest to northeast soil and sand erosion structures in southeastern Utah.

Figure A-7. Southwest to northeast soil and sand erosion structures in northeastern Arizona (Painted Desert).

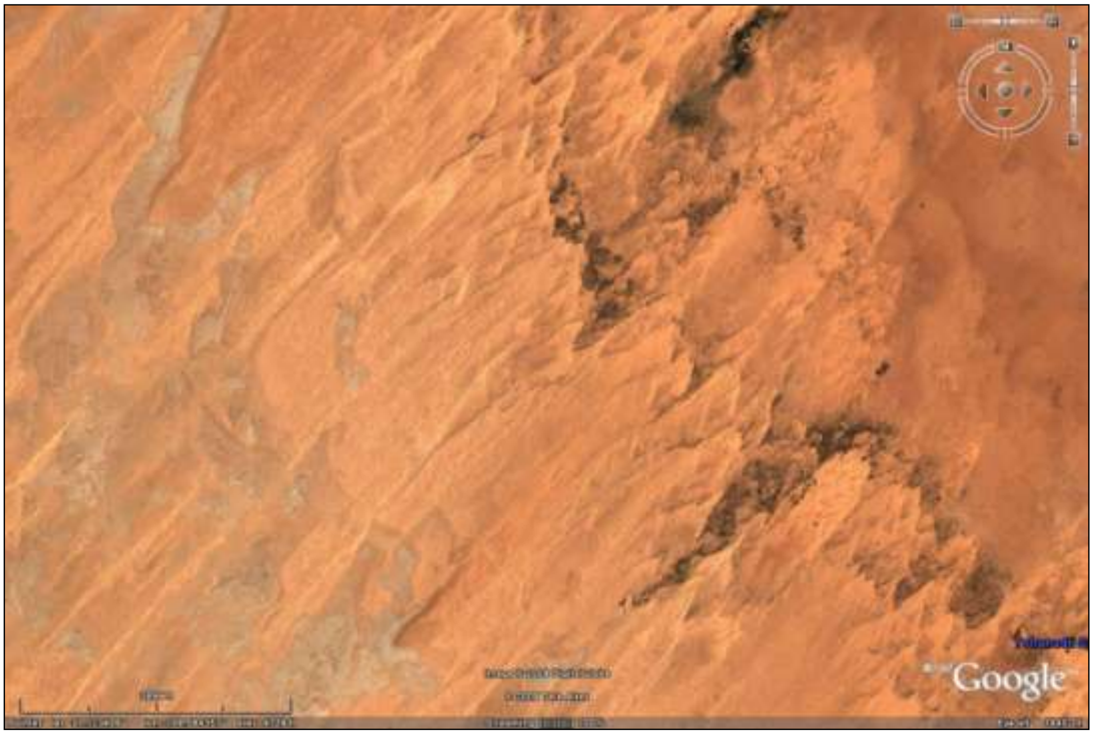


Figure A-8. Southwest to northeast soil and sand erosion structures in southeastern Utah.

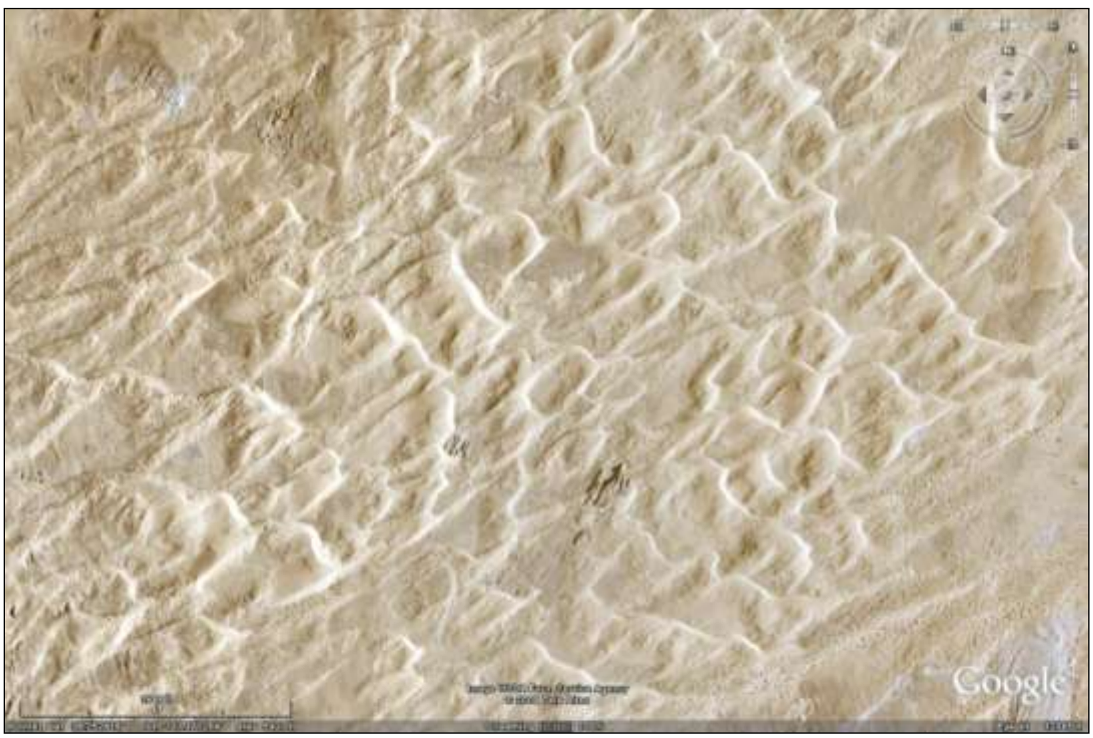


Figure A-9. Southwest to northeast soil and sand erosion structures in northeastern Arizona (Painted Desert). The slip faces of dunes (lighter bands) face in the direction of wind flow – toward the northeast.

Figure A-10. Southwest to northeast soil and sand erosion structures in southeastern Utah.

Figure A-11. Southwest to northeast soil and sand erosion structures in northeastern Arizona (Painted Desert).

Figure A-12. Southwest to northeast soil and sand erosion structures in northeastern Arizona (Painted Desert).

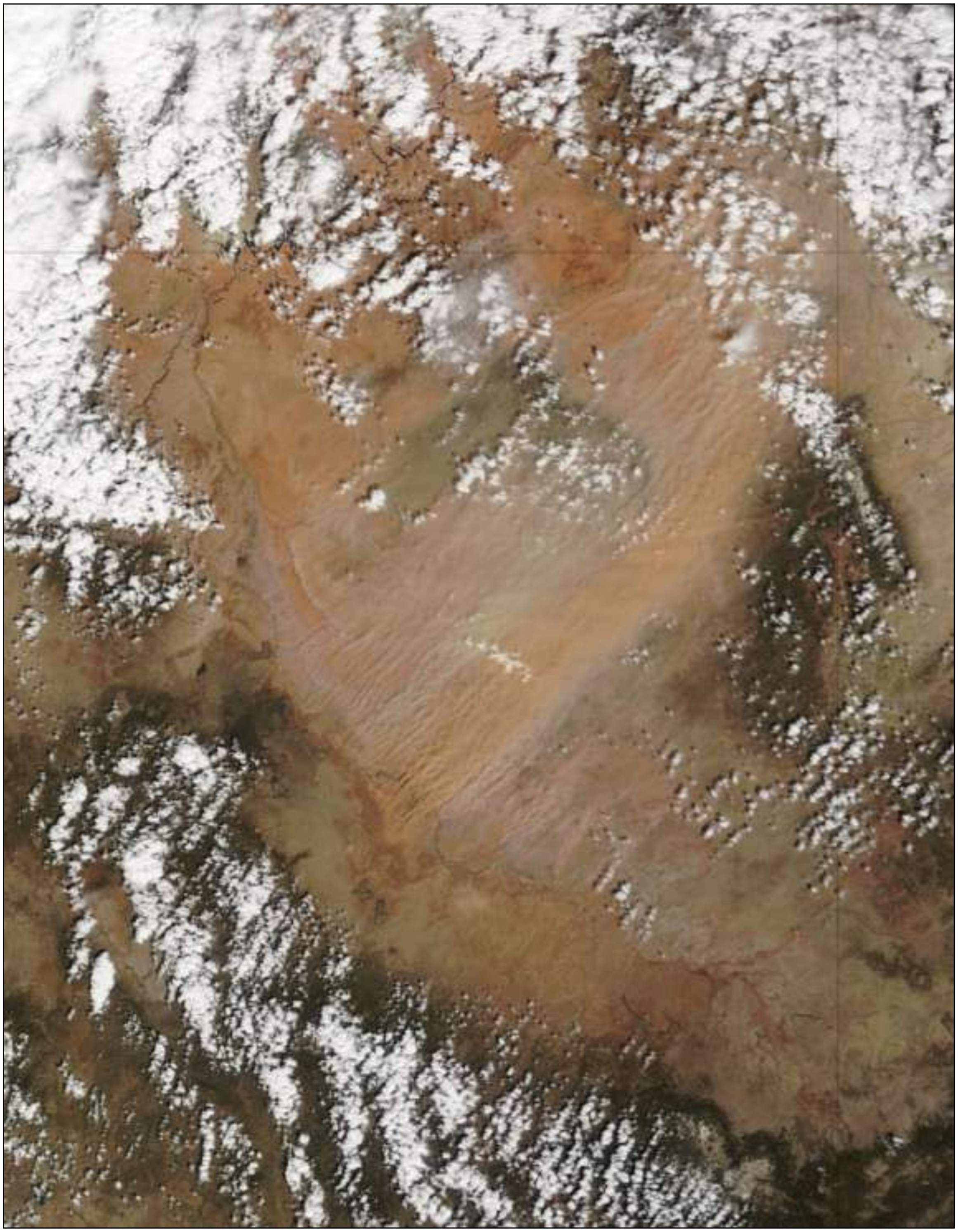


Figure A-13. NASA Tera satellite image of a dust storm on April 3, 2009, in southwesterly flow over the Painted Desert of northeastern Arizona (http://earthobservatory.nasa.gov/IOTD/view.php?id=37791).

Figure A-14 displays the surface weather map for this event (00Z April 4, 2009, or 5 PM MST April 3, 2009). A strong low pressure system in southern Colorado, strong southwesterly winds in the Four Corners area, and the blowing dust symbol (infinity sign) at Farmington (New Mexico) and Cortez (Colorado) are evident in this map. Blowing dust in this region is frequently associated with southwesterly flow.

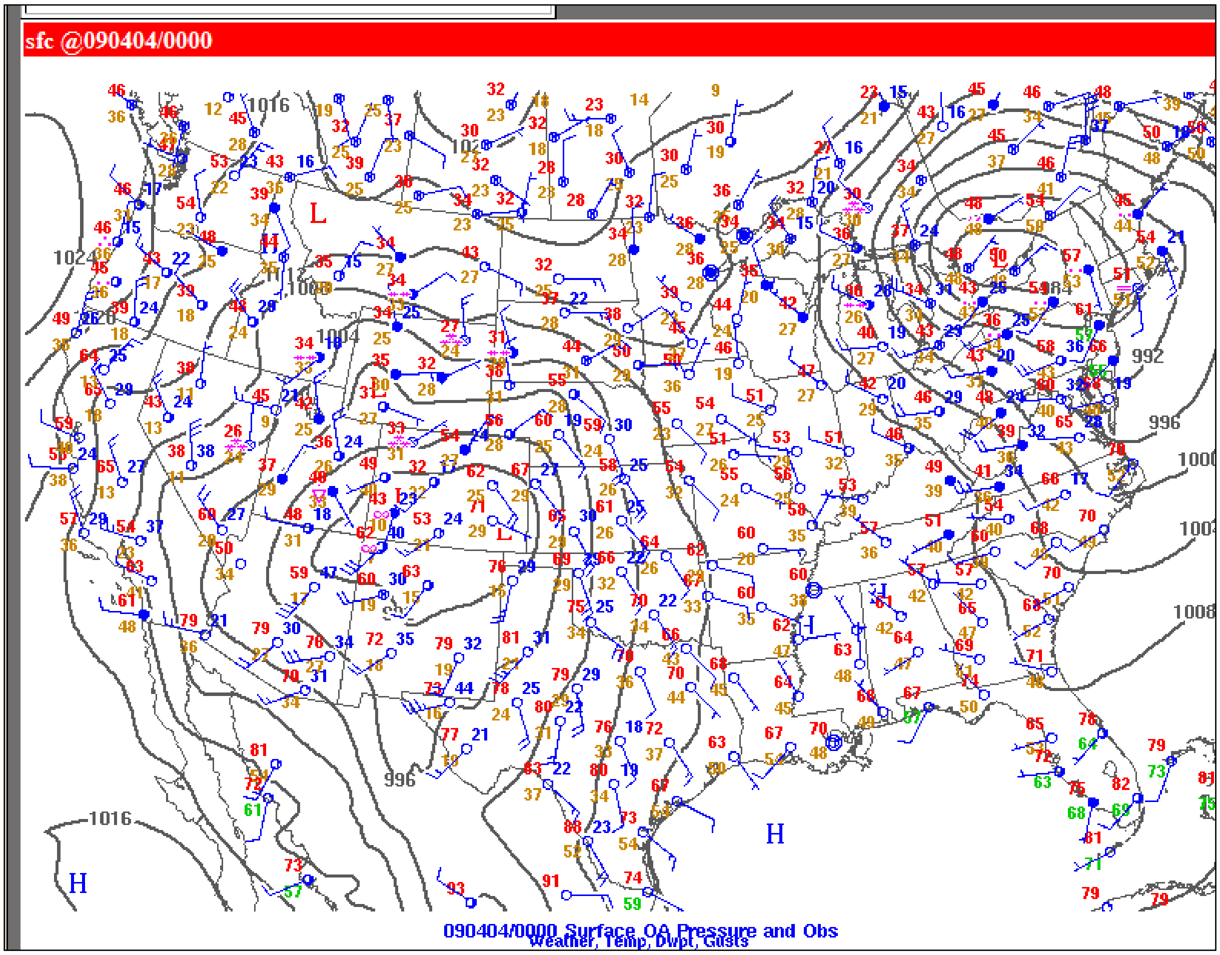


Figure A-14. Surface weather map for 00Z April 4, 2009, (5 PM MST April 3, 2009), showing a strong low pressure system in southern Colorado, strong southwesterly winds in the Four Corners area and the blowing dust symbol (infinity sign) at Farmington (New Mexico) and Cortez (Colorado).

A USGS map of the Colorado Plateau in Figure A-15 shows the prevalence of eolian or wind-blown sand deposits in southeastern Utah and northeastern Arizona. An analysis of the annual frequency of dust storms (Orgill and Sehmel, 1976) in the western half of the U.S. suggests that portions of eastern and western Utah and northeastern Arizona are source regions for blowing dust (see Figure A-16). Soil and sand structures point to the prevalence of southwesterly flow during blowing dust events, and precipitation climatology highlights the potential for blowing dust across much of the region. In addition, an analysis of back trajectories associated with high PM10 concentration events in Grand Junction discussed in the next section of this document supports the conclusion that soils in Arizona and Utah are likely significant contributors to PM10 measured during many dust storms affecting Grand Junction.

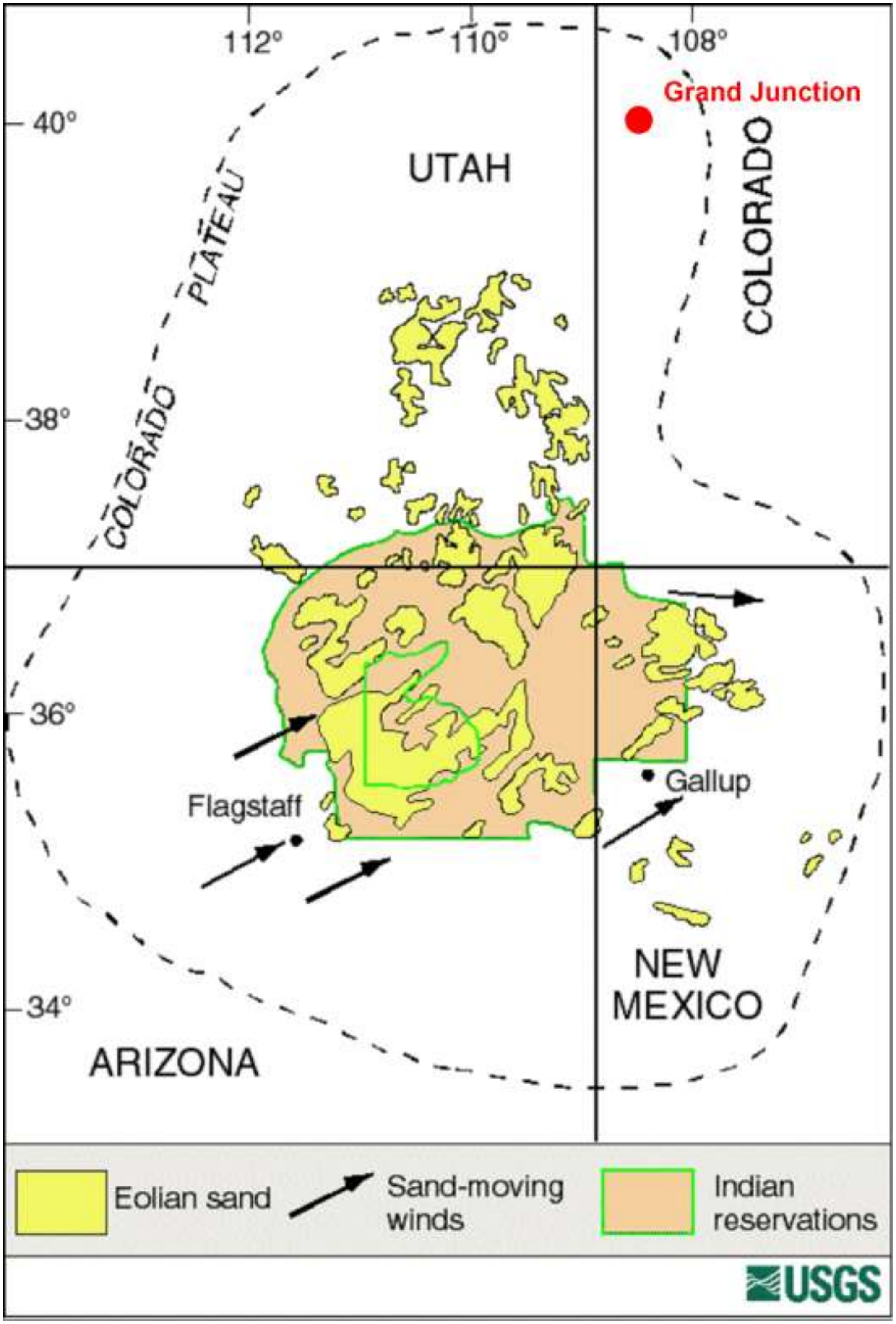


Figure A-15. USGS map of eolian sand features on the Colorado Plateau (http://geochange.er.usgs.gov/sw/impacts/geology/sand/).

Figure A-16. 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.

NOAA HYSPLIT 36-hour back trajectories were calculated for Grand Junction for the eight 24-hour periods from 2004 through early 2009 with the Powell monitor PM10 concentrations in excess of 75 ug/m3, strong regional winds, and dry soils. Trajectories were modeled every 4 hours for each day. Data presented later in this document provides evidence that the moderate to high PM10 levels on these days were from blowing dust. 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 Powell monitor concentrations measured on these days are presented in Table A-1.

The back trajectories for these high-concentration days are shown in Figure A-17. Transport was generally from the west through southwest. A high density of trajectory points is found in northeast Arizona and southeast Utah. Most of these trajectories in Figure A-17 are also consistent with transport from or across suspected or known blowing dust source regions highlighted in Figures A-5, A-13, A-15, and A-16.

Table A-1. Grand Junction Powell monitor days with concentrations in excess of 75 ug/m3 and blowing dust conditions (from 2004 through early 2009).

Year	Month	Day	Powell 24-hour PM10 concentration in ug/m3
2005	4	19	197.8
2008	4	15	116.1
2008	4	21	103.6
2004	9	3	102
2006	3	3	98.3
2008	5	21	86.7
2008	4	30	83.5
2006	6	7	77.9

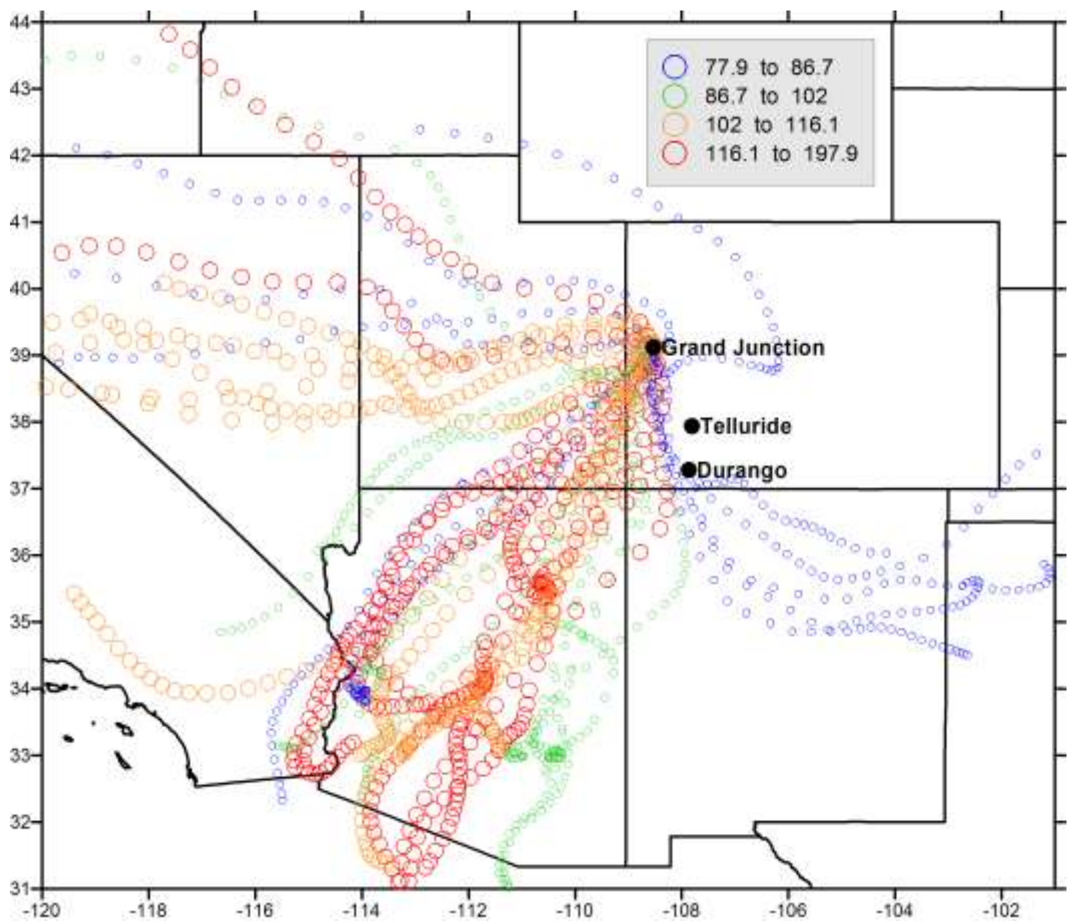


Figure A-17. NOAA HYSPLIT 36-hour back trajectories for Grand Junction for those eight 24-hour periods from 2004 through early 2009 with the Powell monitor PM10 concentrations in excess of 75 ug/m3, strong regional winds, and dry soils. Trajectory points are sized and color-coded to reflect 24-hour PM10 concentrations in ug/m3. Trajectories were calculated every 4 hours for each day.

The trajectories in Figure A-17 point to the possibility that, at times, dust from Utah and Arizona can have a major impact on Grand Junction and less of an impact elsewhere in western Colorado. This non-homogeneity is possible given the fact that dust storms are frequently organized into discreet plumes from discreet areas that maintain their integrity for long distances. An example of this can be seen in Figure A-18 that shows plumes of dust in New Mexico during a windstorm on May 20, 2008.

Figure A-19 shows the NOAA HYSPLIT back trajectories for the highest concentration day during the 2004 through early 2009 period: April 19, 2005. Twenty-four hour back trajectories for each hour during the period with high winds (using EDAS40 data and 500-meter arrival heights) show that the back trajectories for Grand Junction were more likely to have crossed the Painted Desert and southeastern Utah than those for Telluride and Durango, which measured lower PM10 concentrations on this day.

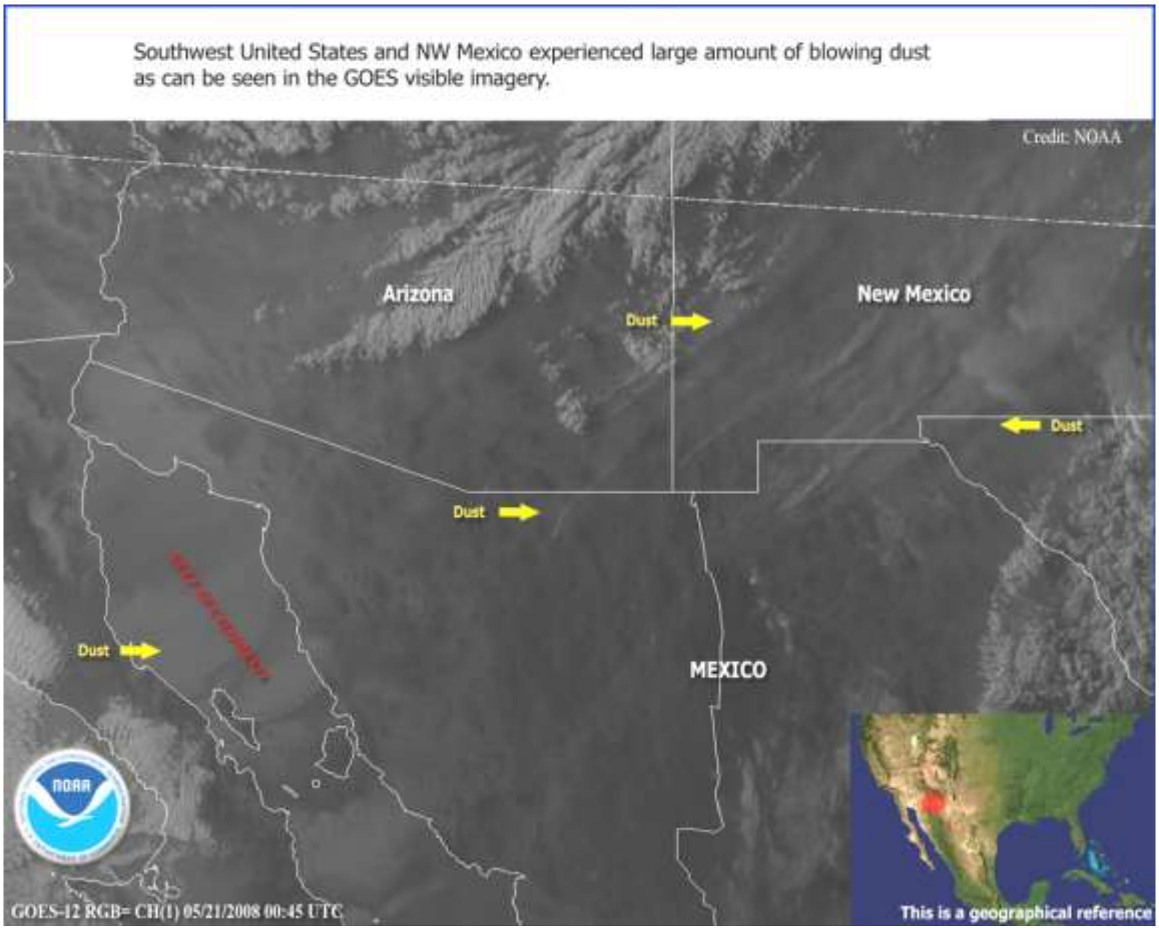


Figure A-18. Discreet plumes of blowing dust in New Mexico, Mexico, and Arizona visible in GOES satellite imagery for May 20, 2008 (http://www.osei.noaa.gov/Events/Dust/US_Southwest/2008/DSTusmx142_G12.jpg).

K-means cluster analysis has been applied to Grand Junction Powell PM10 concentrations, Grand Junction and Painted Desert 30-day total precipitation for each PM10 monitoring day, and Grand Junction and Painted Desert daily maximum wind gust speeds for each monitoring day. K-means cluster analysis is a statistical method for identifying clusters or groupings of values for many variables. For environmental variables, these clusters often represent distinct processes, conditions, or events. In this case, cluster analysis differentiates PM10 concentrations associated with strong winds, low soil moistures, and blowing dust by providing mean values for these 5 variables for 5 distinct categories of PM10 events. The period of record considered was from January 2004 through March 2009. The Hopi weather station located in the central portion of the Painted Desert was used to represent Painted Desert conditions in northeastern Arizona, and the Grand Junction National Weather Service station was used to represent Grand Junction conditions. The 30-day total precipitation values appear to be a better metric for blowing dust conditions than shorter-term totals.

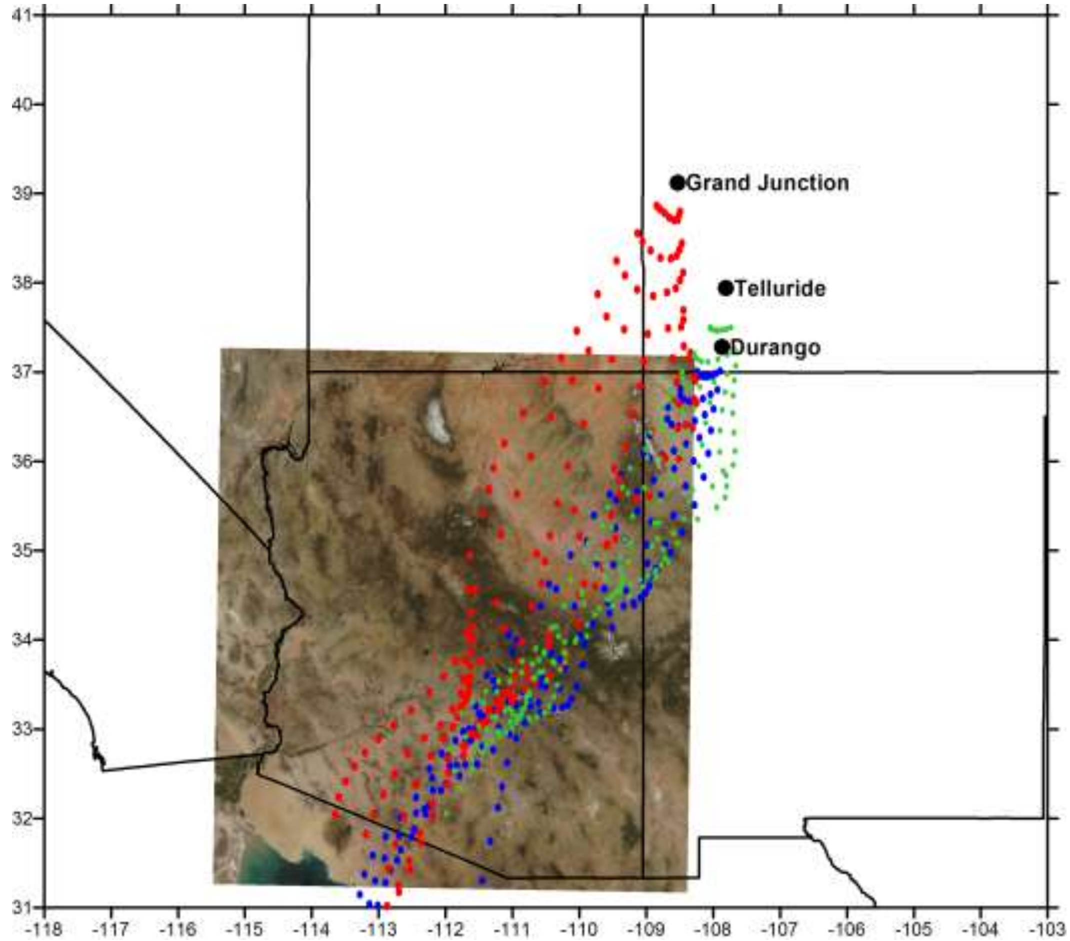


Figure A-19. 24-hour NOAA HYSPLIT back trajectories for every hour from 1500 MST to 2200 MST for Grand Junction (red), Telluride (green), and Durango (blue) for the dust storm of April 19, 2005.

The results of the cluster analysis are presented in Table A-2 below. Cluster 1 represents high soil moisture conditions, moderate gust speeds, and low PM10 concentrations. Cluster 2 represents very low soil moisture, moderate PM10, and low gust speeds. Cluster 3 represents low soil moisture, moderate gusts, and low PM10. Cluster 4 represents moderate soil moisture, low gusts, and low PM10. Finally, Cluster 5 represents high PM10, high gusts, and low soil moisture. Cluster numbers, Grand Junction Powell PM10 concentrations, and Grand Junction daily maximum gust speeds are plotted in Figure A-20.

The data in Figure A-20 clearly show that the highest PM10 concentrations tend to occur in Cluster 5 with gusts above 40 mph. The only exceedance in this period occurred on a day with a peak gust of 43 mph. Cluster 2 is likely to be indicative of wintertime inversion conditions with lighter winds and moderately elevated PM10. Figure A-21 shows the concentrations and cluster values associated with Hopi station daily maximum gust speeds. The overall pattern is similar. The highest concentration day is associated with a peak gust of 47 mph at Hopi. All of the days/events presented in Figure A-17, A-19, and Table A-1 were classified as Cluster 5.

Table A-2. K-means cluster analysis means for Grand Junction PM10 and meteorological variables.

Cluster Variables	Cluster 1 Means	Cluster 2 Means	Cluster 3 Means	Cluster 4 Means	Cluster 5 Means
Powell 24-hour PM10 in ug/m3	24.5	37.3	24.3	21.8	74.9
Hopi Wind Gust in mph	20.8	18.0	32.5	20.7	40.5
Grand Junction Wind Gust in mph	20.4	16.5	31.8	19.6	43.1
Grand Junction 30-day Precipitation	1.7	0.4	0.5	0.8	0.6
Hopi 30-day Precipitation	1.8	0.2	0.5	0.7	0.3
Count	85	120	170	147	24

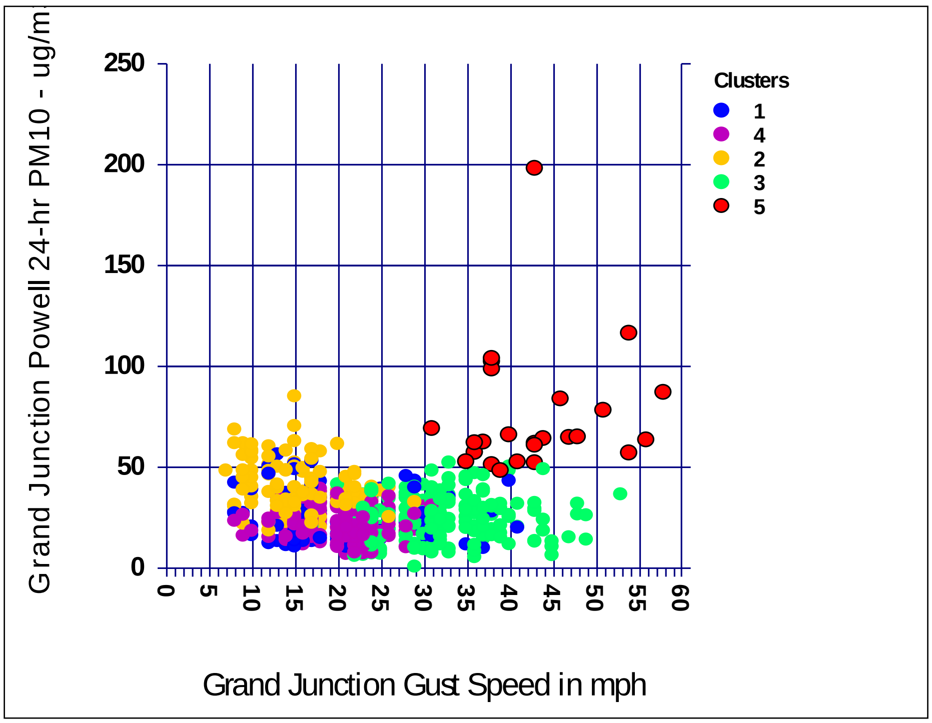


Figure A-20. Grand Junction Powell 24-hour PM10 concentrations versus Grand Junction gust speed by cluster.

Figures A-22 and A-23 show Powell PM10 concentrations versus Grand Junction and Hopi 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 Grand Junction and less than 0.50 inches at Hopi. While this is not proof that the measured dust in Grand Junction is from Arizona, it adds to the weight of evidence that the Painted Desert makes a significant contribution to PM10 concentrations in Grand Junction during many blowing dust events. Of interest in this regard are the two high concentrations (greater than 100 ug/m3) that occurred when Grand Junction 30-day precipitation totals were greater than an inch (see Figure A-22). One of these occurred when transport was from the southwest. On this day (April 21, 2008) the NOAA Satellite Smoke Text Archive reported the following (see http://www.ssd.noaa.gov/PS/FIRE/smoke.html):

"Blowing dust is seen over most of Utah (and part of western Nevada) and the dust is moving toward the northeast, reaching into northwestern Colorado and southern Wyoming."

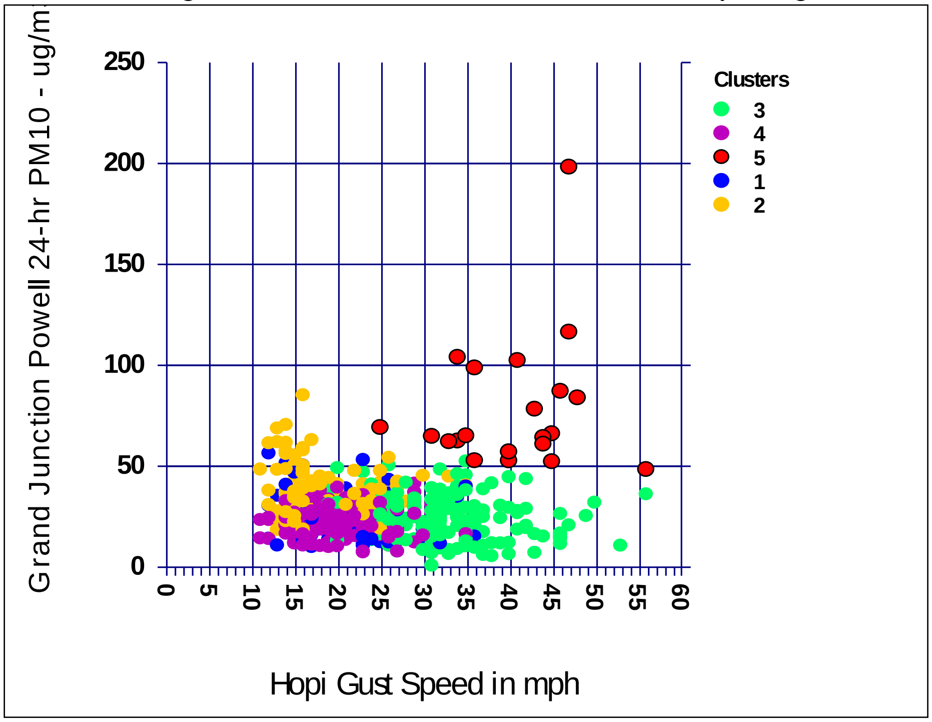


Figure A-21. Grand Junction Powell 24-hour PM10 concentrations versus Hopi gust speed by cluster.

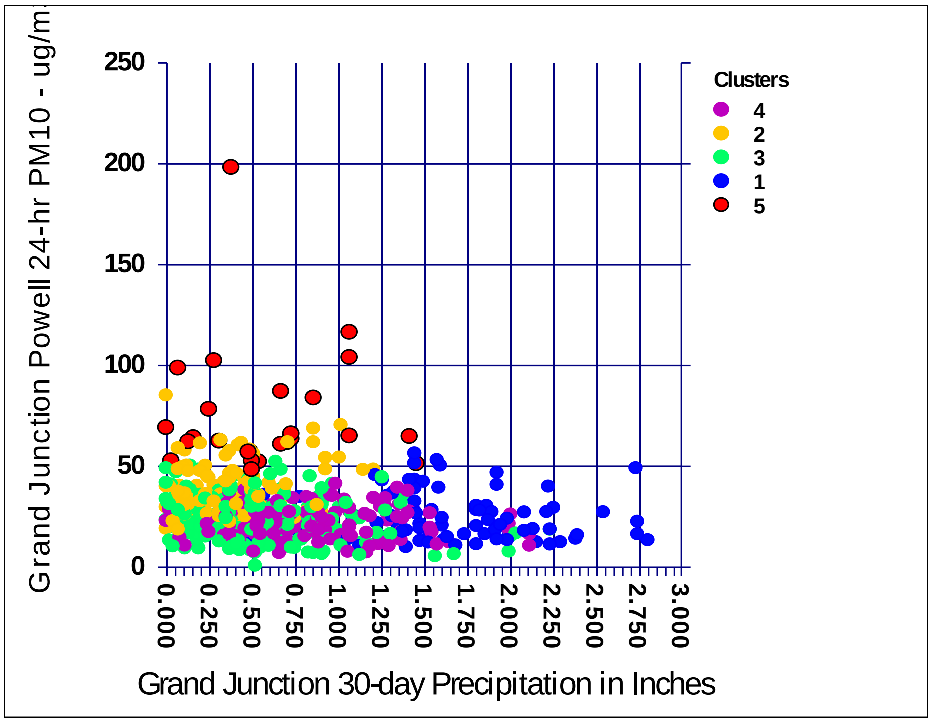


Figure A-22. Grand Junction Powell 24-hour PM10 concentrations versus Grand Junction 30-day total precipitation by cluster.

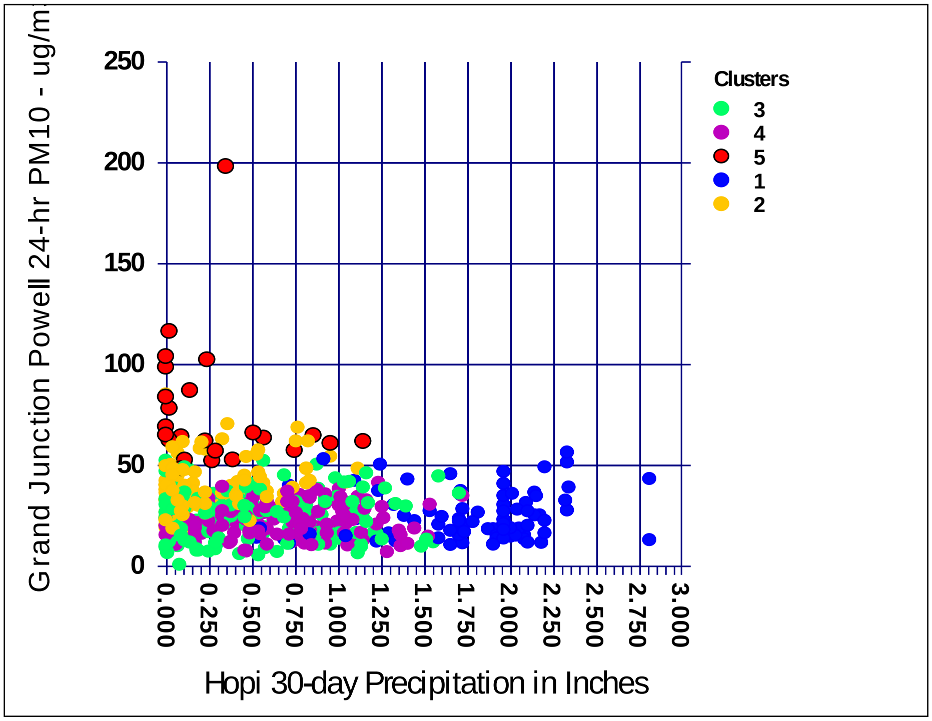


Figure A-23. Grand Junction Powell 24-hour PM10 concentrations versus Hopi 30-day total precipitation by cluster.

The other occurred on April 15, 2008, when the flow was from Arizona and southeast Utah. The transport conditions, the discrepancy between high recent precipitation in Grand Junction and low recent precipitation at Hopi for these two days, and, in one case, analyst discussion of what was visible in satellite images suggest that much of the dust might have originated from outside of the Grand Junction environment.

Figure A-24 shows Grand Junction Powell 24-hour PM10 concentrations versus peak gust wind directions at the Little Delores RAWS weather station about 25 miles west-southwest of Grand Junction. Grand Junction is situated on the floor of the Grand Valley, a major northwest to southeast trending basin than can force or channel synoptic scale flows. As a result, surface wind directions in Grand Junction may not be useful indicators of the direction of longer-range transport. Little Delores is on the Umcompahgre Plateau, and winds here are more likely to reflect the larger-scale transport directions for the region. This graph indicates that high PM10 at Grand Junction (Cluster 5) is associated with winds from the south-southeast to west-southwest at Little Delores. These directions point to dust sources in southeast Utah and northeastern Arizona. This is further evidence that dust from these areas may make a significant contribution to PM10 measured in Grand Junction during blowing dust events.

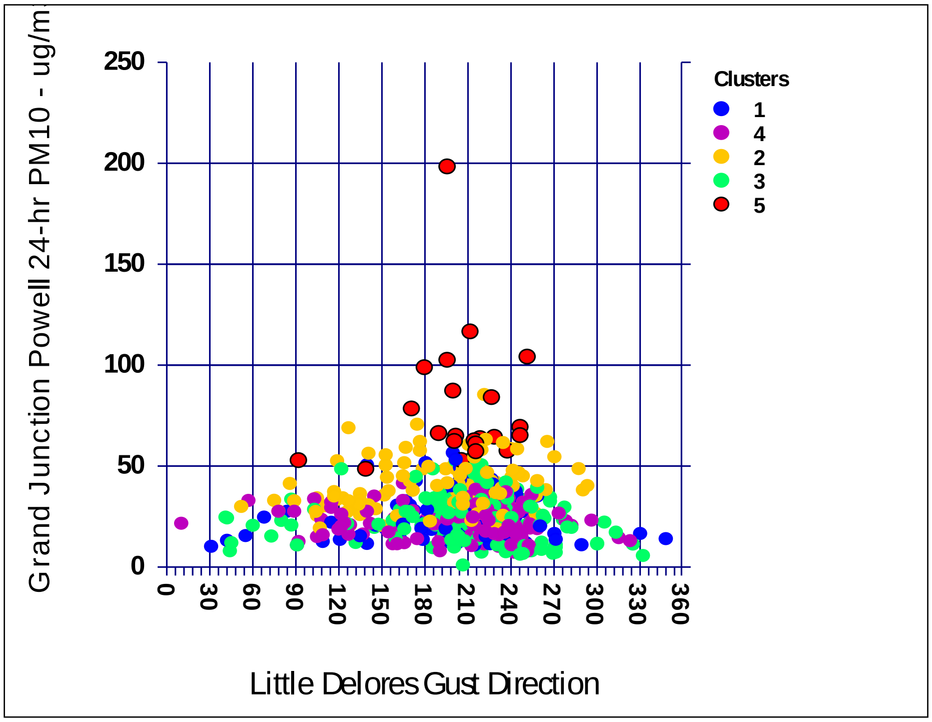


Figure A-24. Grand Junction Powell 24-hour PM10 concentrations versus peak gust wind directions at the Little Delores RAWS weather station, by cluster.

Figure A-25 presents monthly percentiles for Grand Junction gust speeds. Wind gusts generally considered to be high enough for significant blowing dusts (40 mph or higher) are within the upper 5 to 15 percent during each month of the year. Consequently, these events can be viewed as exceptional rather than normal. Gusts in this category can occur any month of the year, but are most likely in March, April, May and October. Figure A-4 shows that in Grand Junction these are typically among the wettest months of the year. It is in drier years, therefore, that blowing dust may be most prevalent during the spring and fall months. January, February, and June are typically very dry, and might be expected to have a significant proportion of blowing dust events.

Figures A-26 and A-27 show histograms for Grand Junction and Hopi wind gusts, respectively. The 95th percentile gust speed for Grand Junction is 43 mph. For Hopi it is 41 mph. For both sites, it is clear that gusts in the range that is associated with blowing dust are the exception rather than the rule. Cluster analysis also shows that the blowing dust events represent only 4% of the PM10 sample days (from Table A-2, Cluster 5 had 24 cases out of a total of 546). The weight of evidence presented in this document clearly suggests that source regions in Arizona and Utah can have a significant impact on PM10 concentrations in Grand Junction during blowing dust events and that these events occur when dry soils are affected by winds of exceptional strength. Control of these sources, which are outside of Colorado, may not be reasonably achievable or possible.

The precipitation climatology for the Four Corners area indicates that the area can be susceptible to blowing dust when winds are high. Landform imagery shows that northeastern Arizona and southeastern Utah in particular have experienced a long-term pattern of wind erosion and blowing dust when winds have been southwesterly and blowing into western and southern Colorado. Back trajectories, case studies, satellite imagery, and statistical analyses have also shown that northeastern Arizona and southeastern Utah are a significant source for blowing dust transported into Colorado. Elevated PM10 in Grand Junction during windstorms is generally associated with wind gusts of 40 mph or higher at Grand

Junction and Hopi in northeastern Arizona and southwesterly flow in Grand Junction. Elevated PM10 in Grand Junction is generally associated with 30-day precipitation totals of less than 1.00 inches at Grand Junction and less than 0.50 inches at Hopi.

Reference:

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

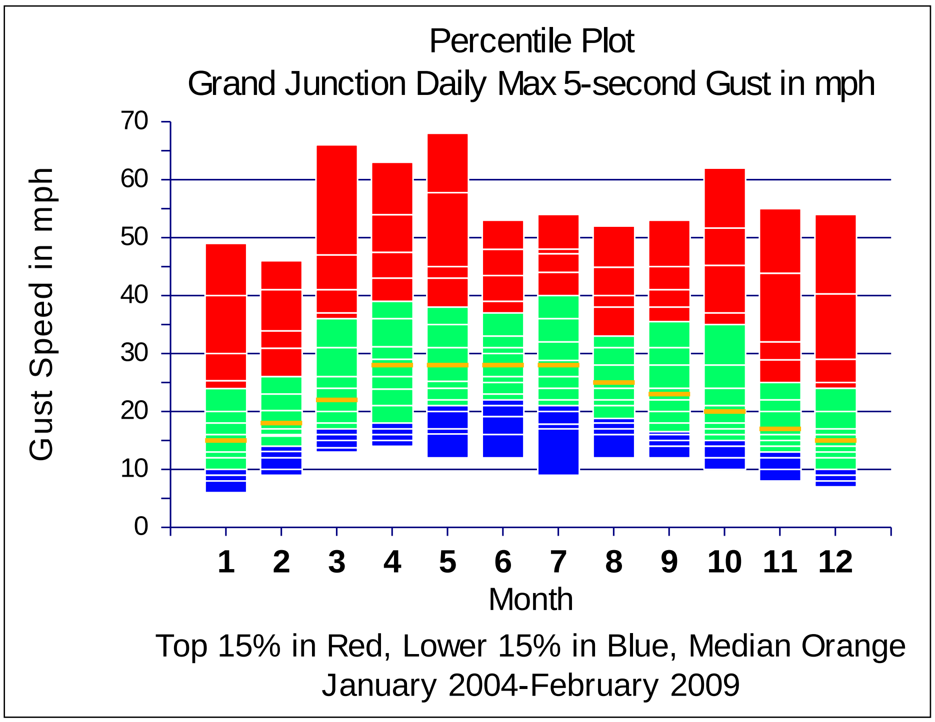


Figure A-25. Percentile plot of Grand Junction daily maximum 5-second gust speed in miles per hour showing that gusts of 40 mph or greater always occur within the top 15 percentile speeds for each month of the year.

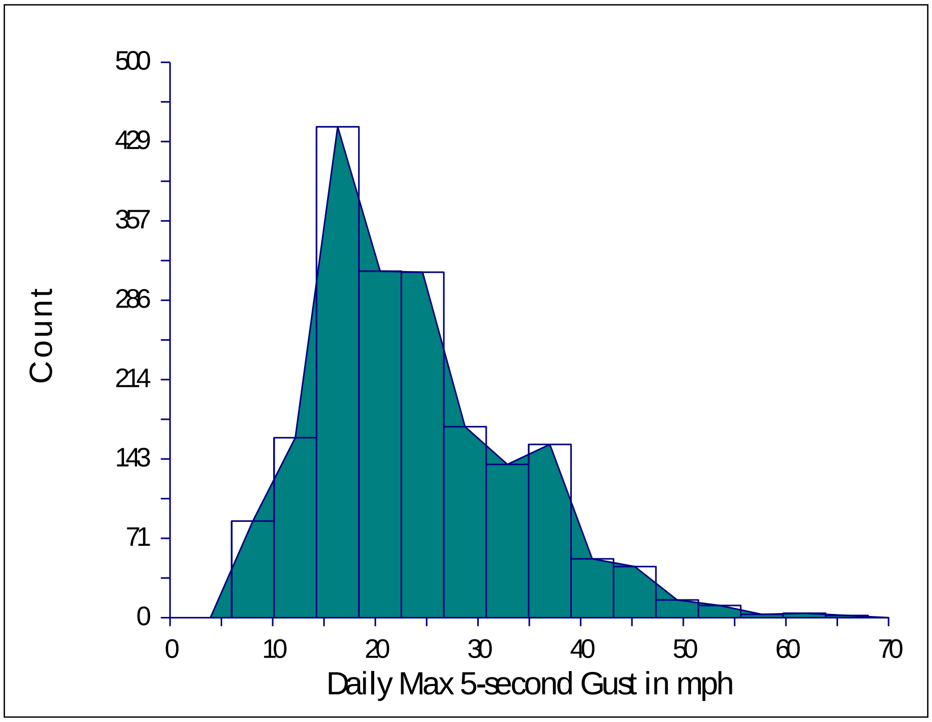


Figure A-26. Histogram of daily maximum 5-second wind gusts at Grand Junction based on January 2004 – February 2009.

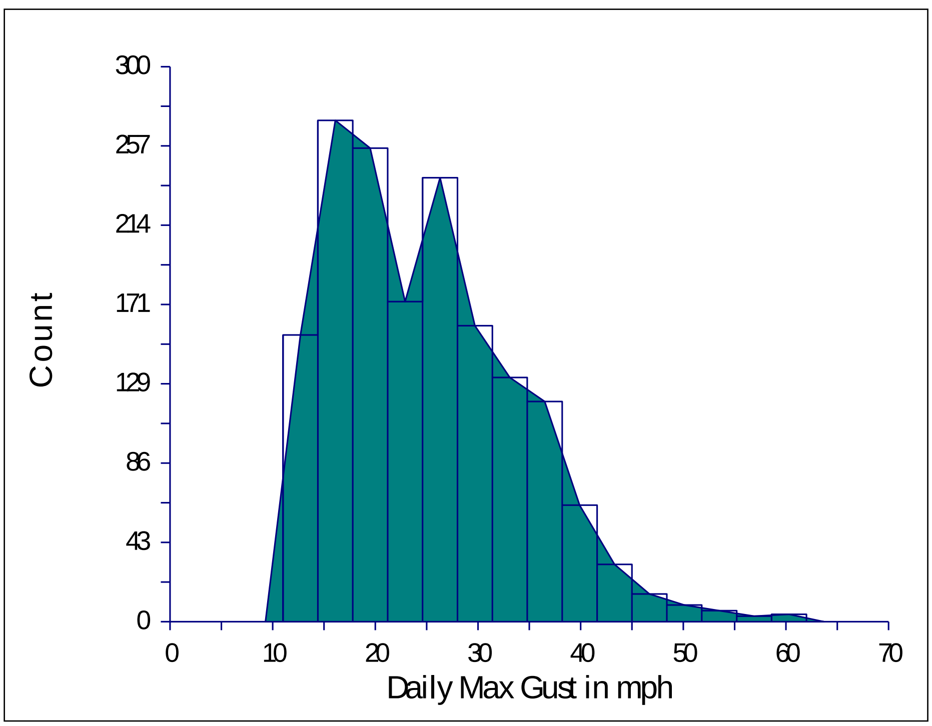


Figure A-27. Histogram of daily maximum 5-second wind gusts at Hopi based on January 2004 – February 2009.

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

Introduction – Executive Summary

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

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

Regional Precipitation

Lamar, Colorado, is located in a part of the country that is largely arid to semi-arid. Arid to semi-arid soils make much of the region susceptible to blowing dust. Figures A-1 through A-3 show the annual average precipitation for Colorado, Arizona, and New Mexico, respectively. Lamar is located in the Arkansas River Valley of southeastern Colorado where the annual precipitation is typically 10 to 20 inches. Large areas of Arizona, which can be upwind of Lamar during blowing dust events, receive between 5 and 15 inches of precipitation each year. Much of New Mexico, which is also frequently upwind of Lamar during blowing dust events, also receives only 5 to 15 inches per year. Figure A-4 shows the 1971-2000 monthly normal precipitation amounts for Lamar, Colorado, from the National Climatic Data Center. The annual average for this time period is 15.82 inches. The wettest months are May through August. The driest months are October, November, December, January, February, and March. These months receive an average of only 0.64 inches per month. The annual monthly average precipitation is 1.32 inches.

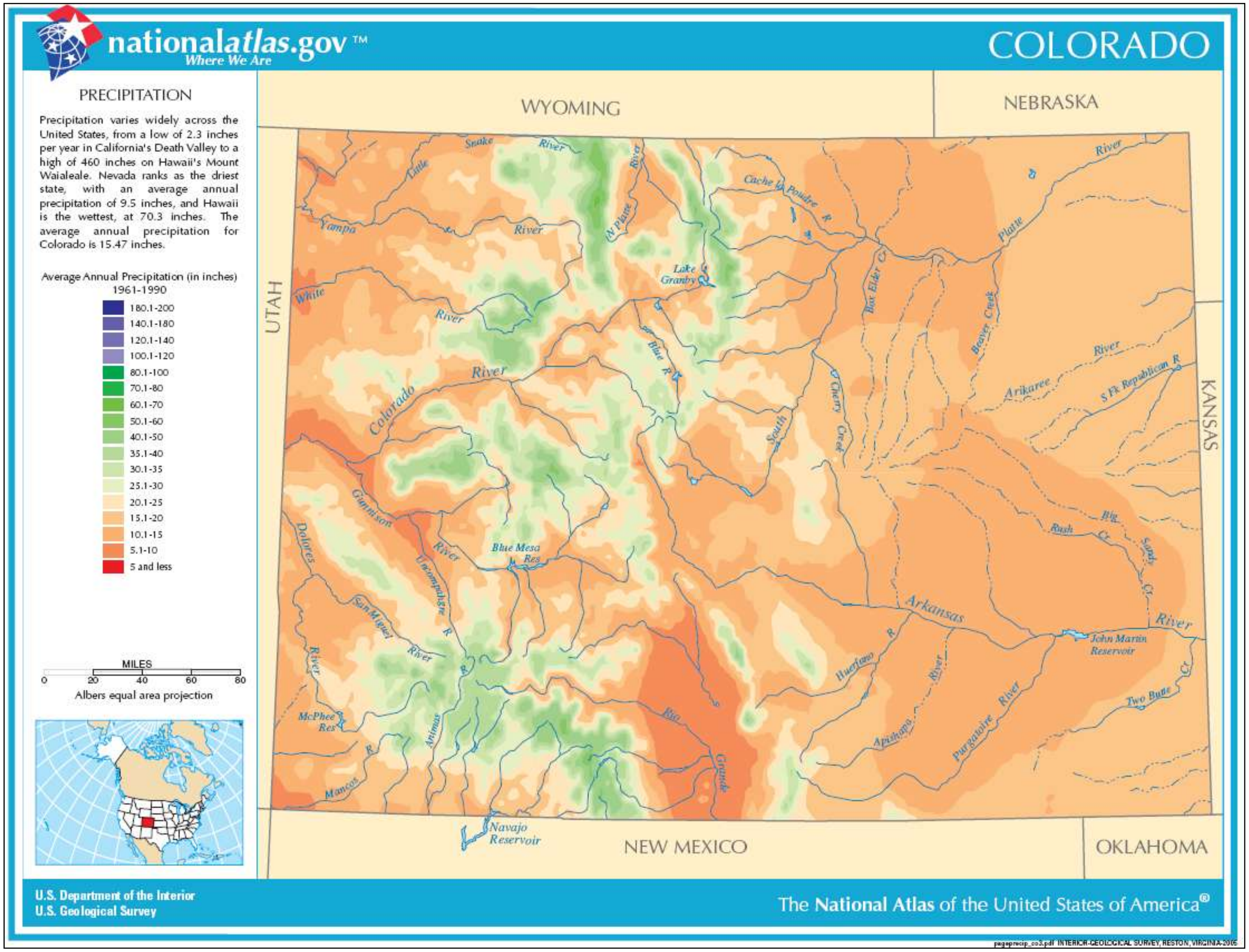


Figure A-1. Average annual precipitation in Colorado based on 1961-1990 normals.

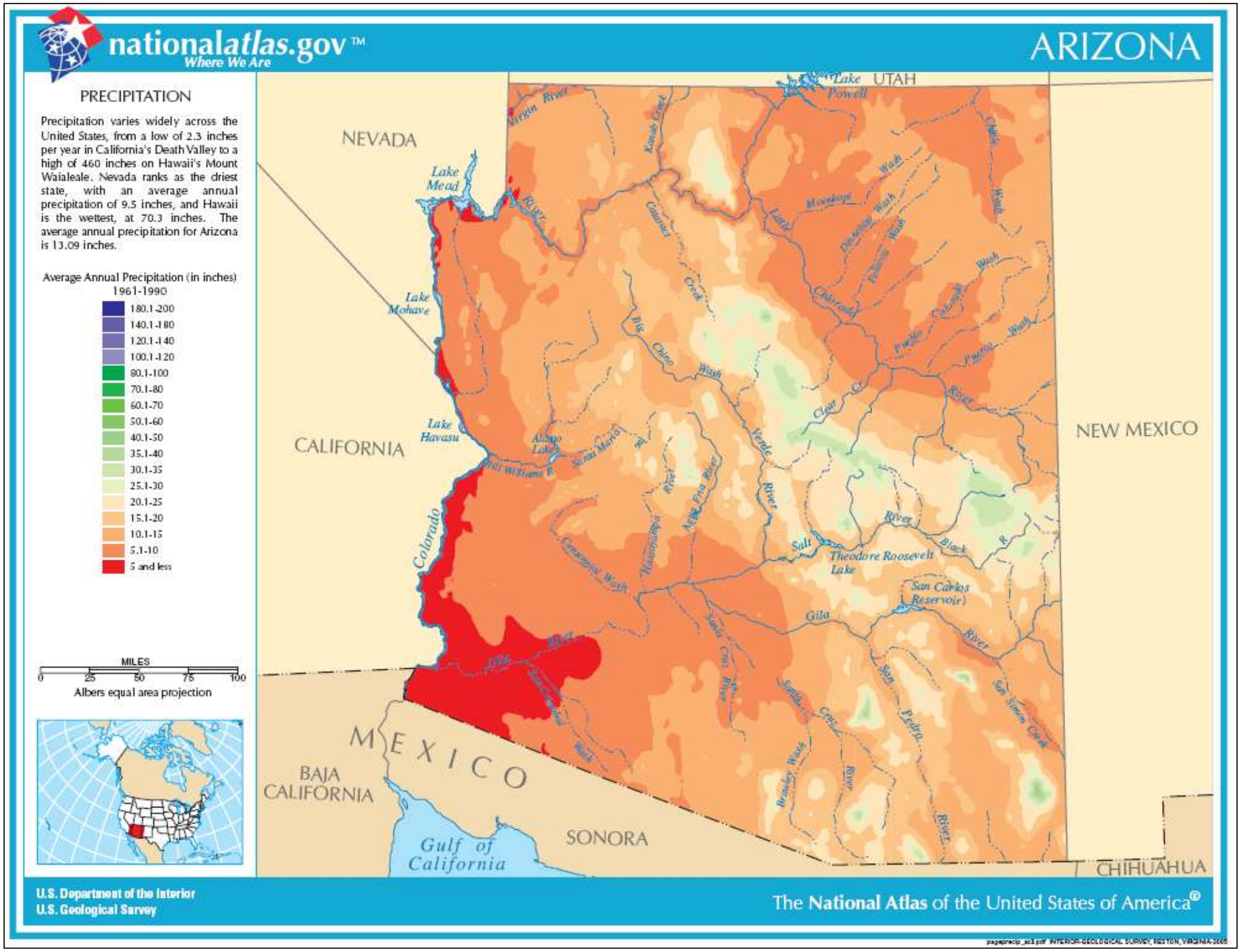


Figure A-2. Average annual precipitation in Arizona based on 1961-1990 normals.

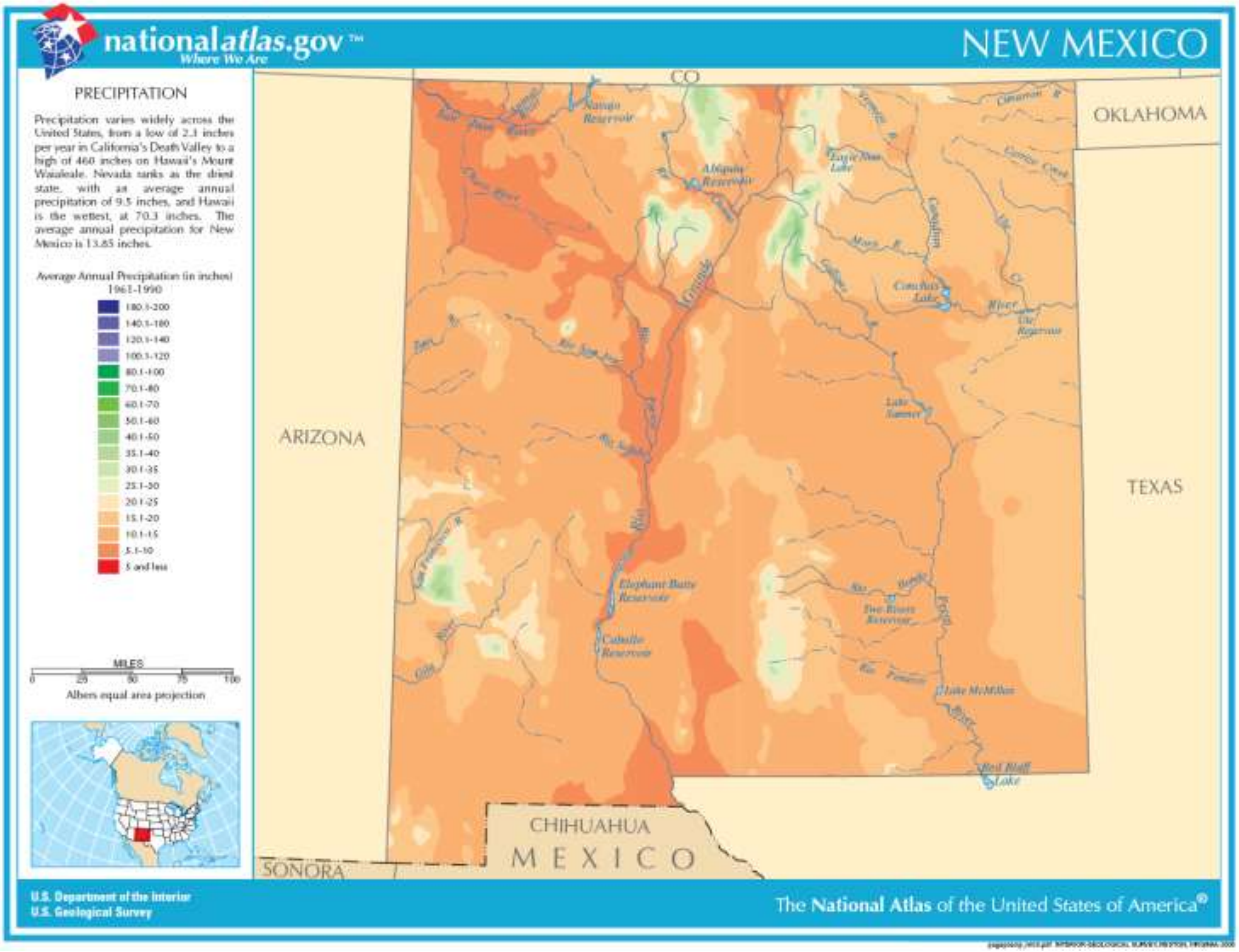


Figure A-3. Average annual precipitation in New Mexico based on 1961-1990 normals.

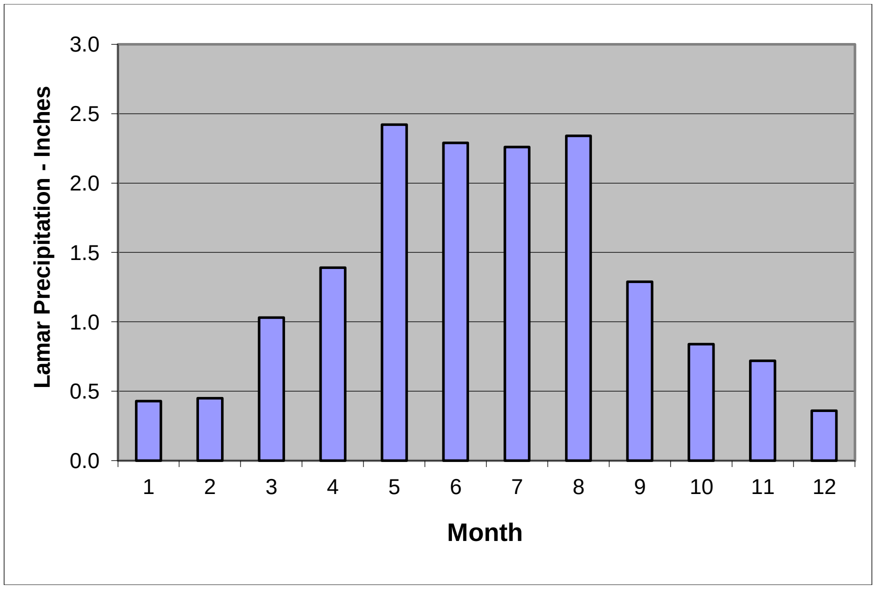


Figure A-4. 1971-2000 monthly normal precipitation in Lamar, Colorado.

Cluster Analysis

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

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

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

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

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

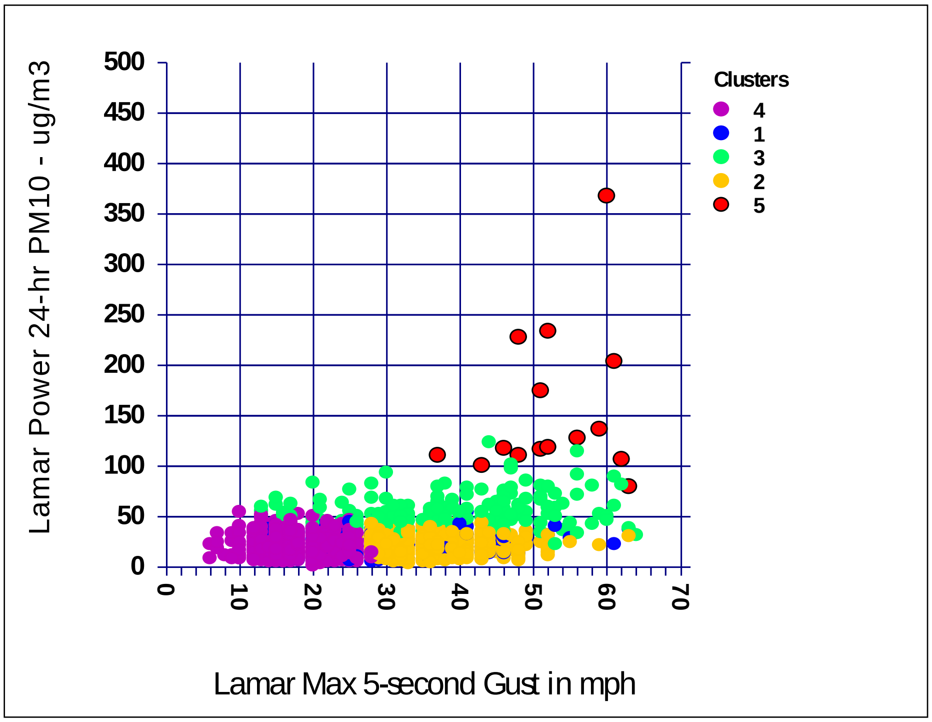


Figure A-5. Lamar Power 24-hour PM10 concentrations versus Lamar gust speed by cluster.

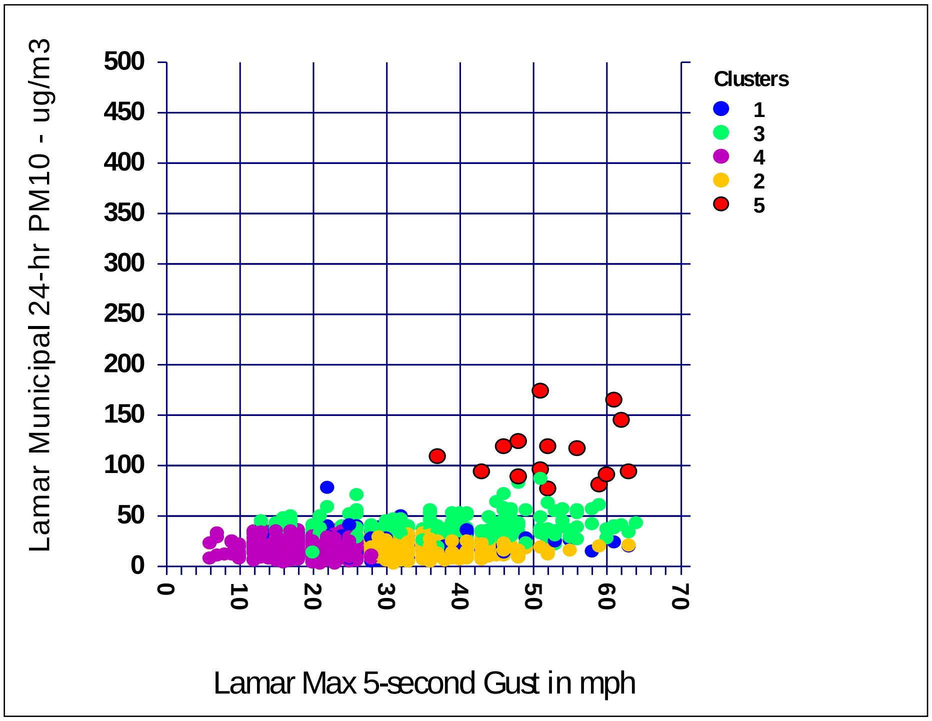


Figure A-6. Lamar Municipal Building 24-hour PM10 concentrations versus Lamar gust speed by cluster.

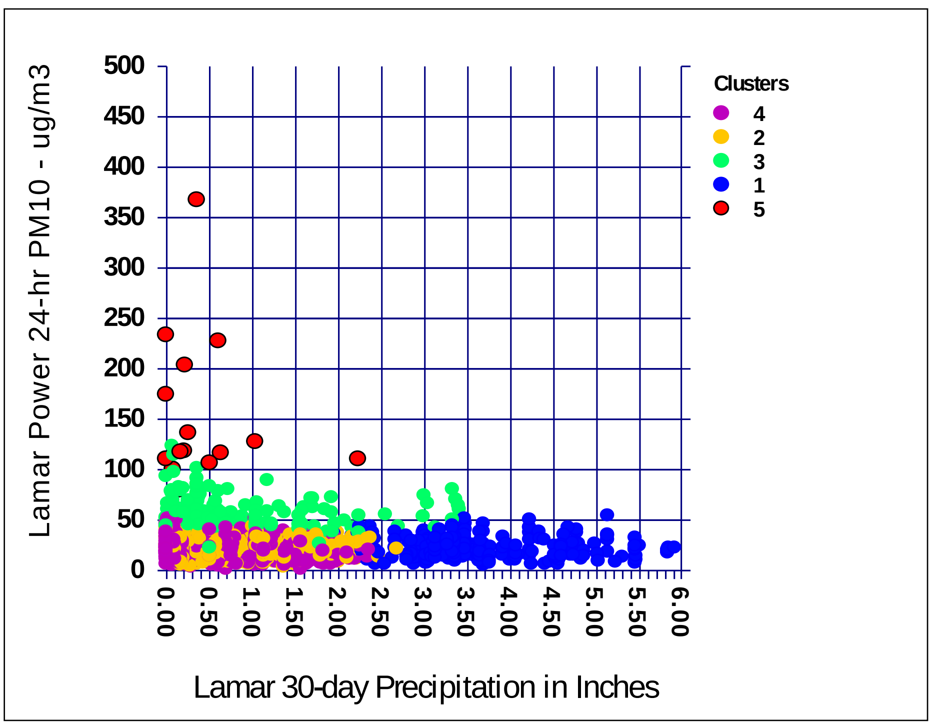


Figure A-7. Lamar Power 24-hour PM10 concentrations versus Lamar 30-day total precipitation by cluster.

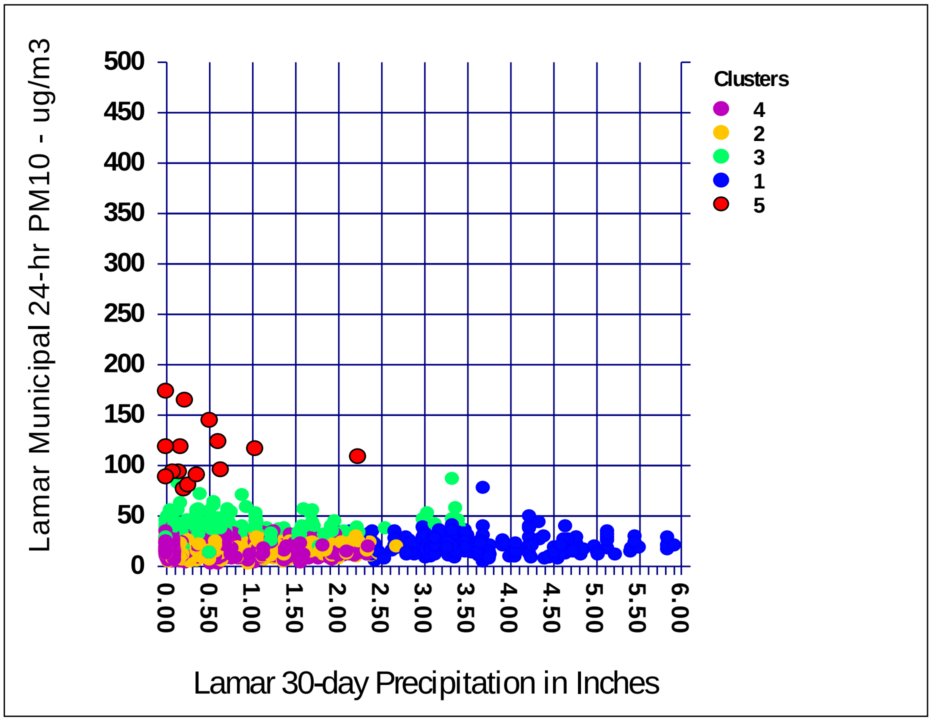


Figure A-8. Lamar Municipal Building 24-hour PM10 concentrations versus Lamar 30-day total precipitation by cluster.

High Wind and PM10 Exceedance Climatology for Lamar

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

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

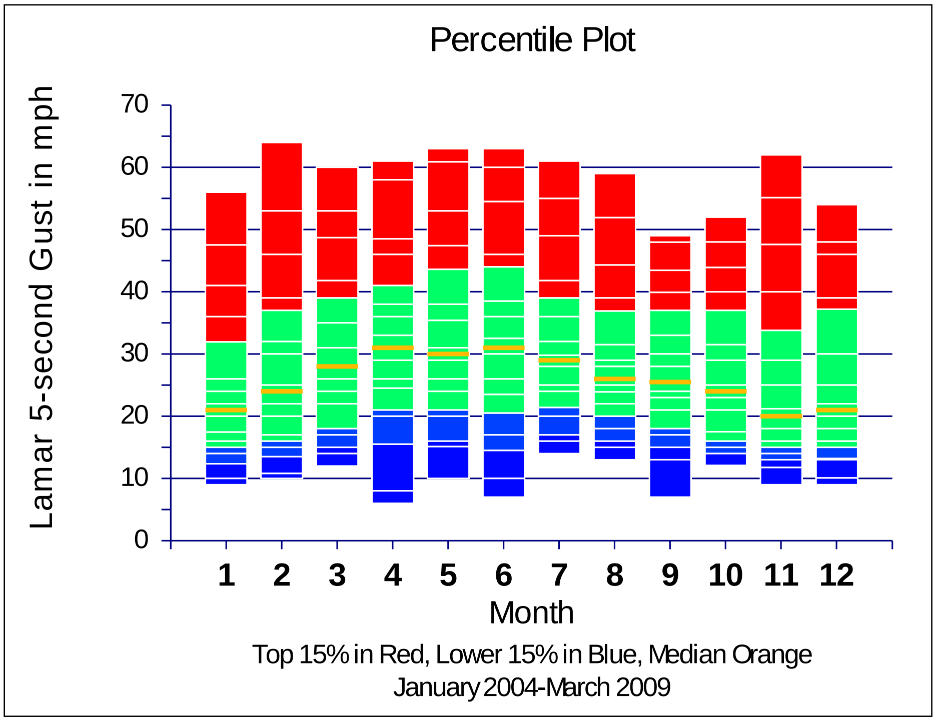


Figure A-9. Percentile plot of Lamar daily maximum 5-second gust speed in miles per hour showing that gusts of 40 mph or greater generally occur within the top 15 percentile speeds for each month of the year.

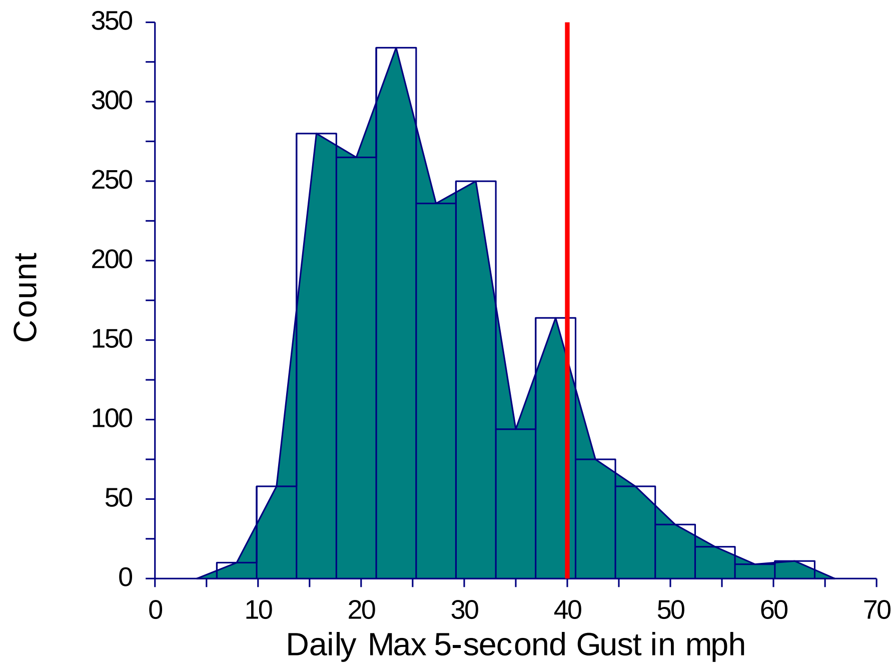


Figure A-10. Histogram of daily maximum 5-second wind gusts at Lamar based on January 2004 – March 2009. The red line at gusts of 40 mph represents the 88 percentile value.

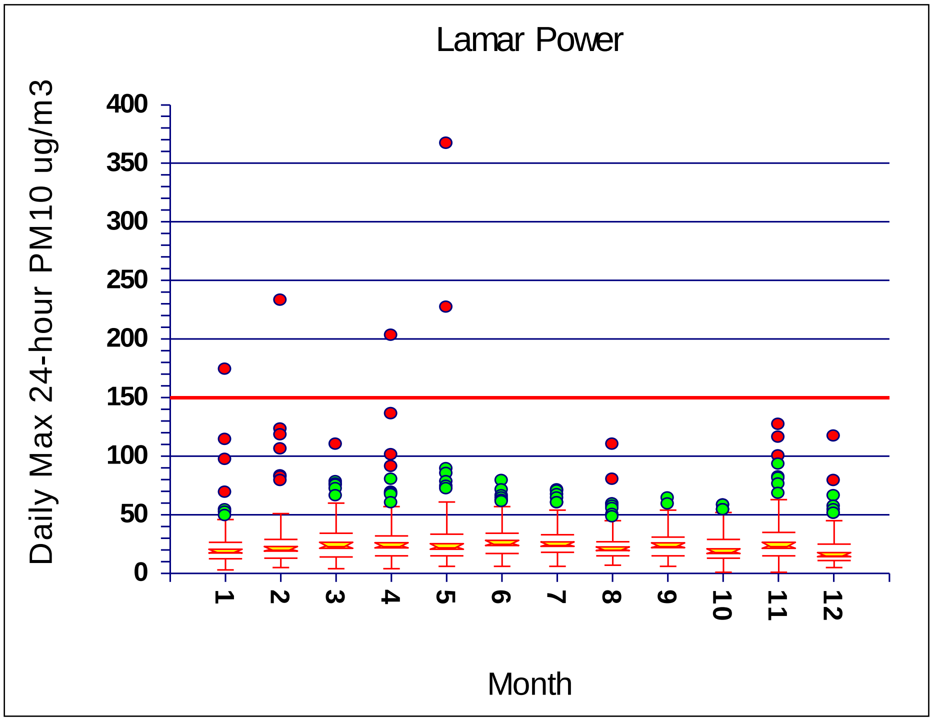


Figure A-11. Box plot of daily maximum Lamar Power 24-hour PM10 concentrations in ug/m3 by month for January 2004 through February 2009.

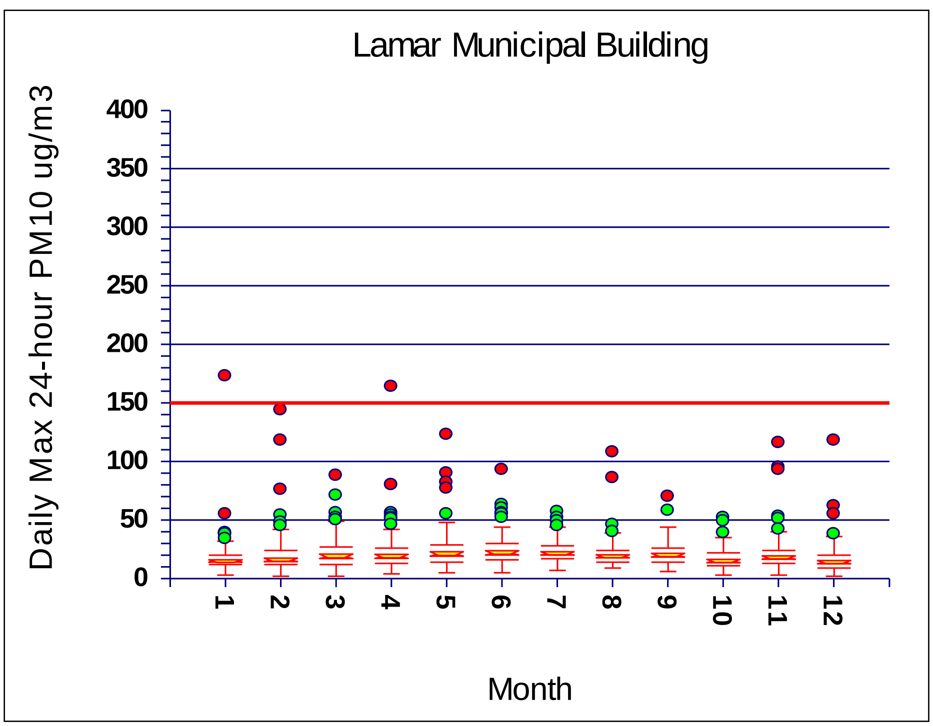


Figure A-12. Box plot of daily maximum Lamar Municipal Building 24-hour PM10 concentrations in ug/m3 by month for January 2004 through February 2009.

Back Trajectory Analyses and Source Regions

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

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

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

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

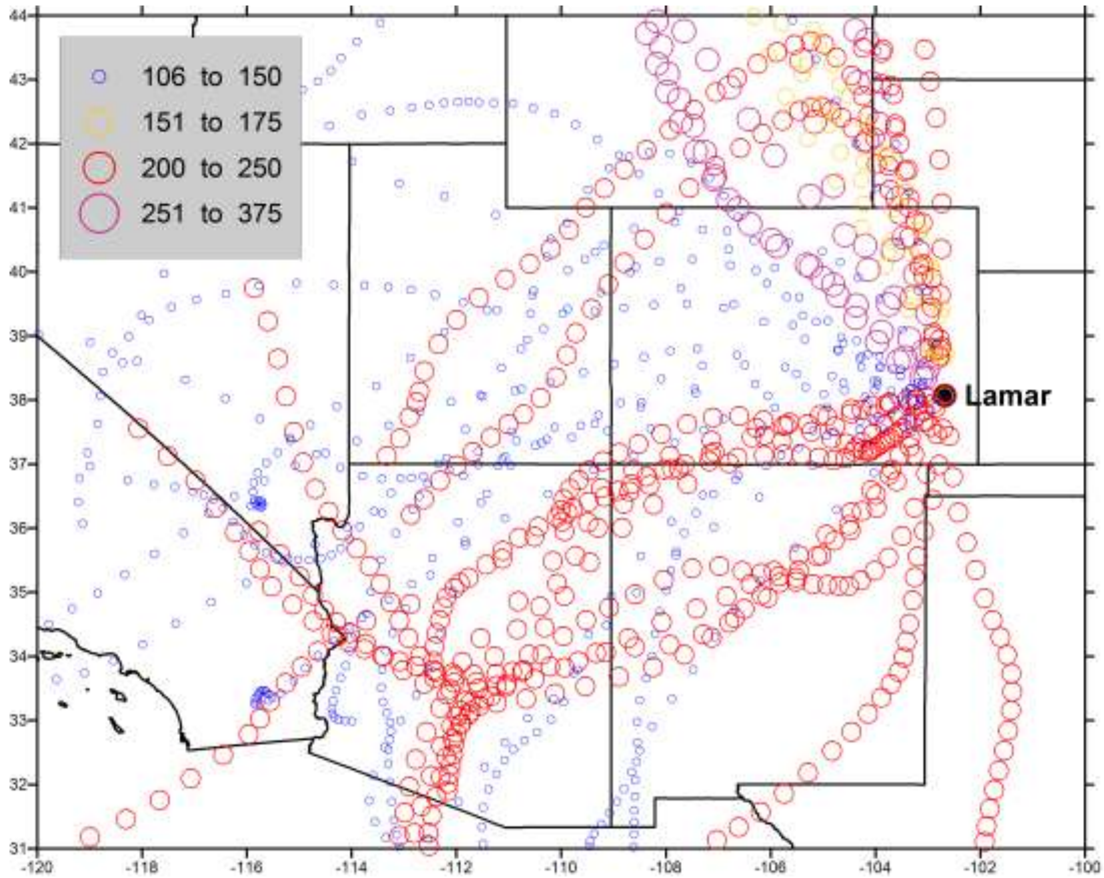


Figure A-13. NOAA HYSPLIT 36-hour back trajectories for Lamar for the periods with haze and/or elevated gusts at Lamar on the eight Cluster 5 high-concentration days shown in Table A-2. Trajectory points are sized and color-coded to reflect 24-hour PM10 concentrations at the Power Plant in ug/m3.

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

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

Dust Transport Example 1

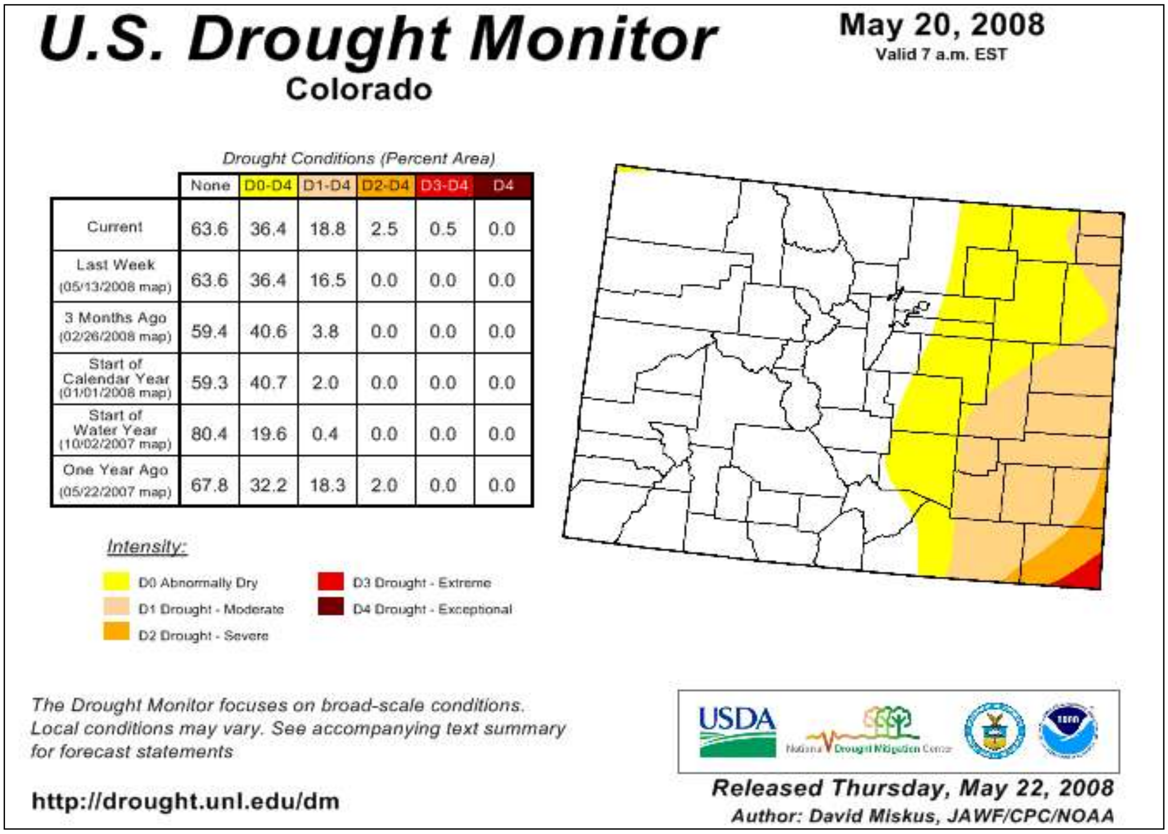
A blowing dust exceedance at Lamar on May 22, 2008, provides an example of a regional high-wind, blowing-dust event with transport from New Mexico into southeastern Colorado.

On Thursday May 22, 2008, Lamar Colorado recorded an exceedance of the twenty-four-hour PM10 standard with a concentration of 227 ug/m3 at the Lamar Power Plant. A twenty-four-hour PM10 concentration of 123 ug/m3 was measured at the Lamar Municipal Building on May 22. An intense surface low-pressure system was centered over Southeast Colorado with a strong upper level cut-off low over the Great Basin. The central pressure of the low-pressure system ranged from 985 to 987 mb while over southeast Colorado. The central pressure of the storm is significant since storms of about 1000 mb or lower were identified as a typical precondition for blowing dust in eastern Colorado when soils are dry (see reference for the *Natural Events Action Plan for High Wind Events – Lamar, Colorado* at the end of this attachment).

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

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

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



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	63.6	36.4	18.8	2.5	0.5	0.0
Last Week (05/13/2008 map)	63.6	36.4	16.5	0.0	0.0	0.0
3 Months Ago (02/26/2008 map)	59.4	40.6	3.8	0.0	0.0	0.0
Start of Calendar Year (01/01/2008 map)	59.3	40.7	2.0	0.0	0.0	0.0
Start of Water Year (10/02/2007 map)	80.4	19.6	0.4	0.0	0.0	0.0
One Year Ago (05/22/2007 map)	67.8	32.2	18.3	2.0	0.0	0.0

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

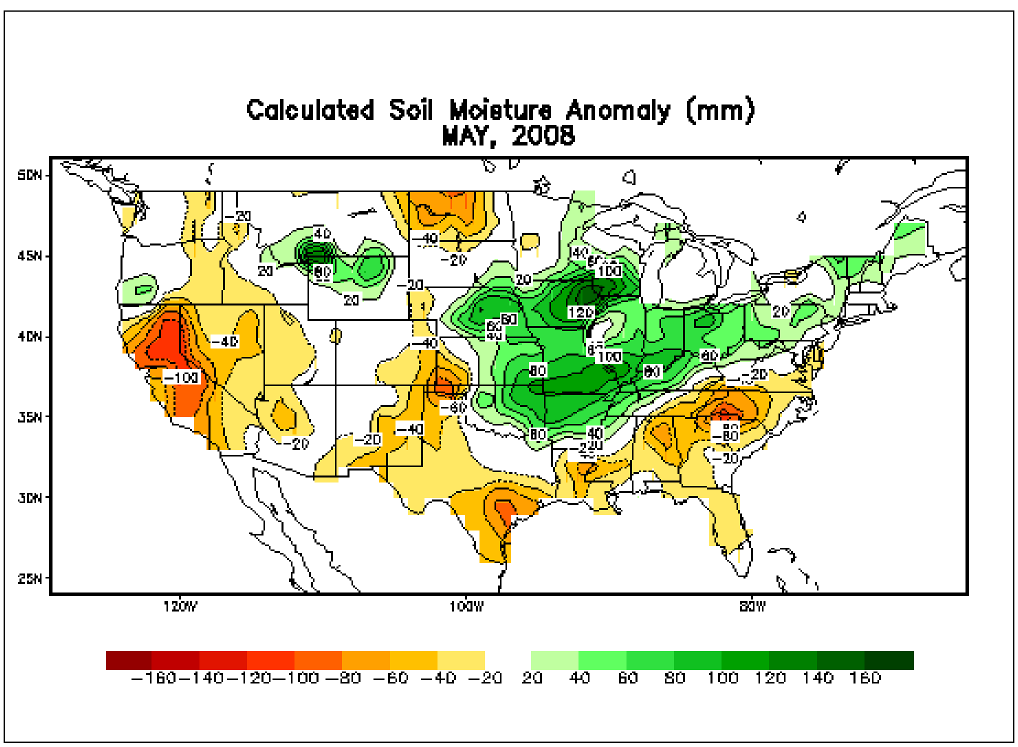


Figure A-16. Calculated Soil Moisture Anomaly (mm) May 2008 (http://www.ncdc.noaa.gov/img/climate/research/2008/may/cpc-soil-moist-anom-200806.gif).

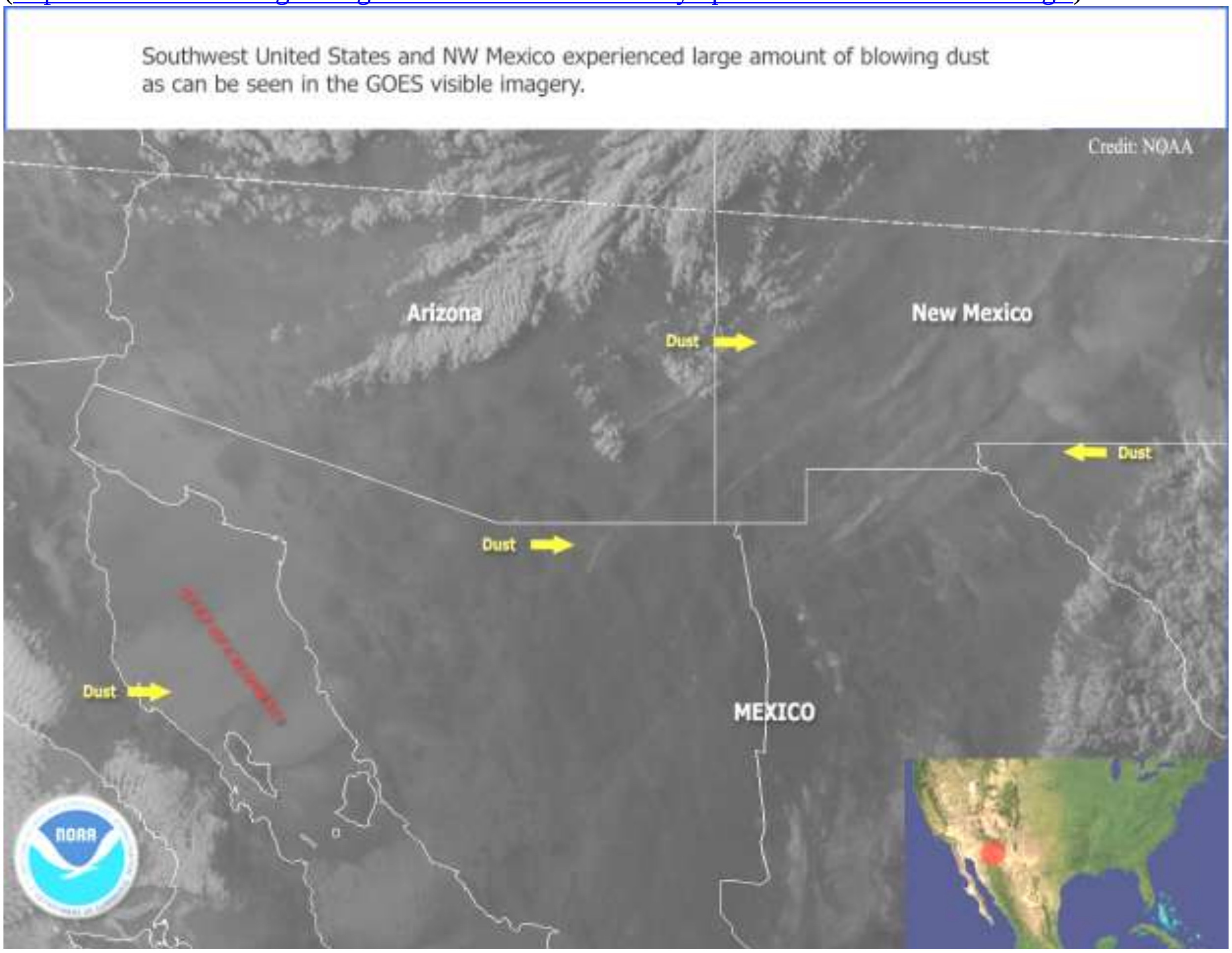


Figure A-17. Plumes of blowing dust are visible across southern Arizona, New Mexico, northern New Mexico, and the Gulf of California in this NASA MODIS satellite image for 6:45 PM MDT on May 21, 2008. (source: http://www.osei.noaa.gov/Events/Dust/US_Southwest/2008/DSTusmx142_G12.jpg)

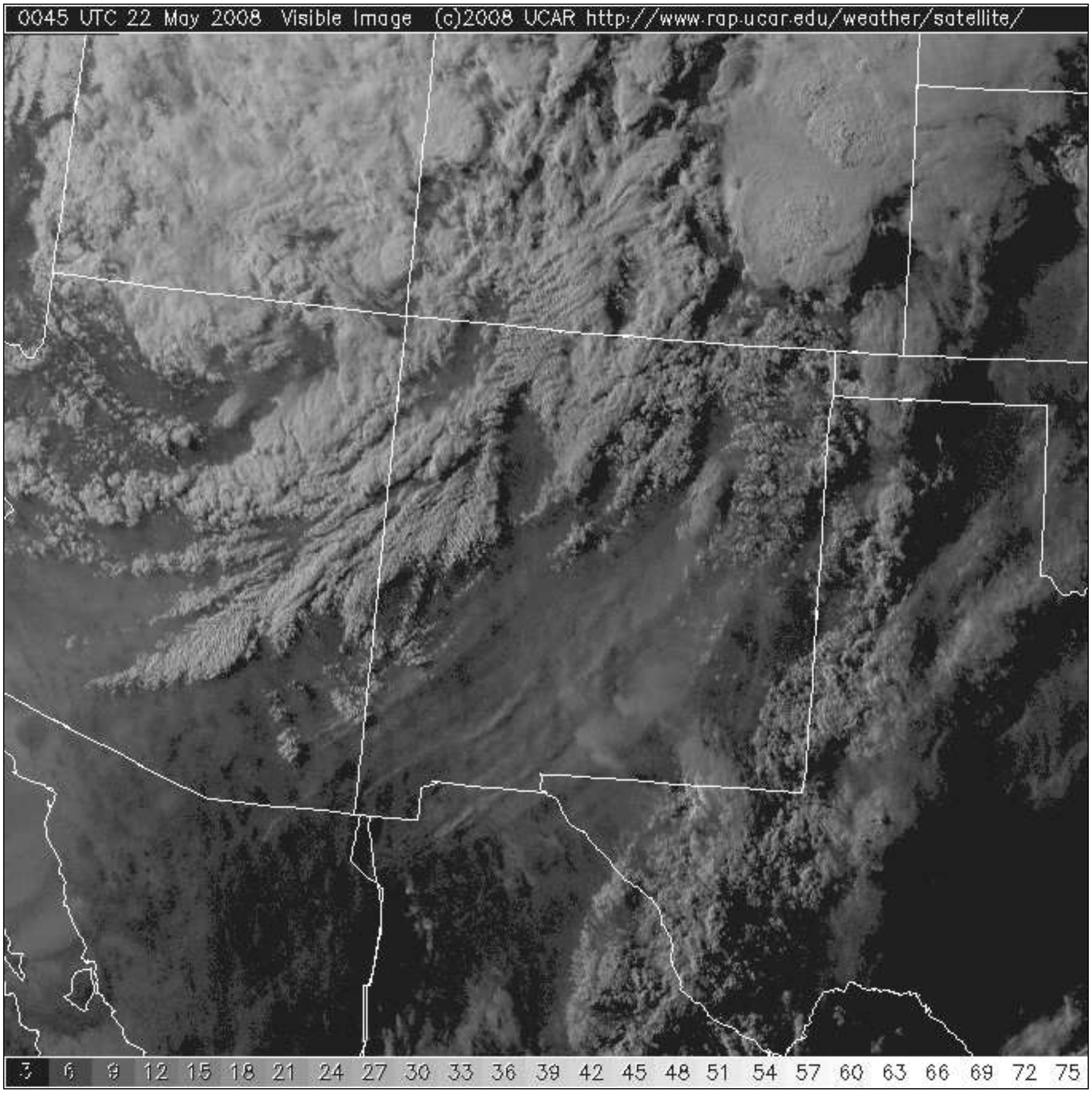


Figure A-18. Visible satellite image of the southwestern U.S. for 6:45 PM MDT on May 21, 2008, showing pronounced southwest to northeast trending plumes of blowing dust in New Mexico.

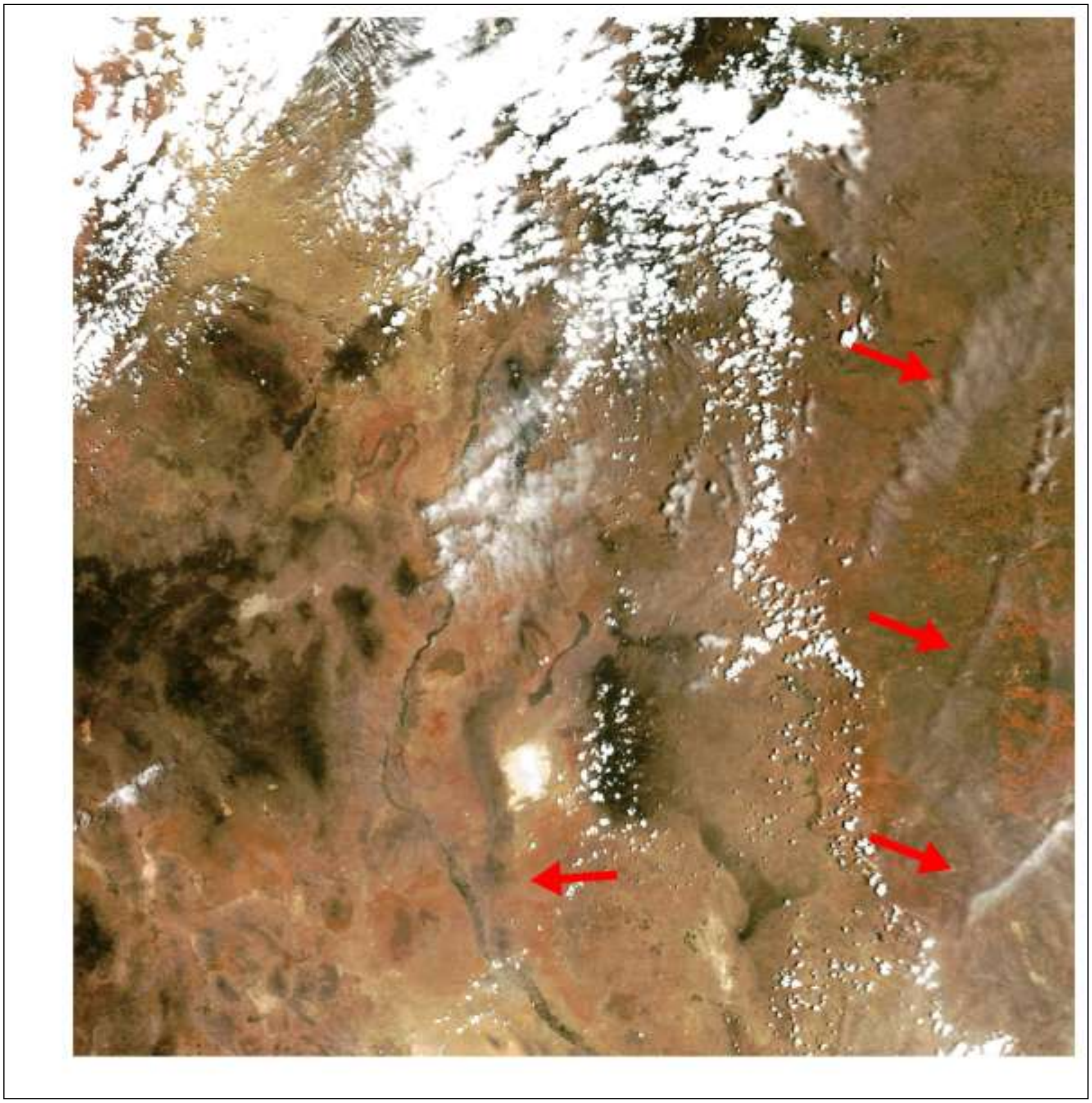


Figure A-19. Visible satellite image of New Mexico at 1:40 PM MST, May 21, 2008. Plumes and areas of blowing dust are marked with an arrow (http://activefiremaps.fs.fed.us/imagery.php?op=fire&passID=51054&month=5&year=2008).

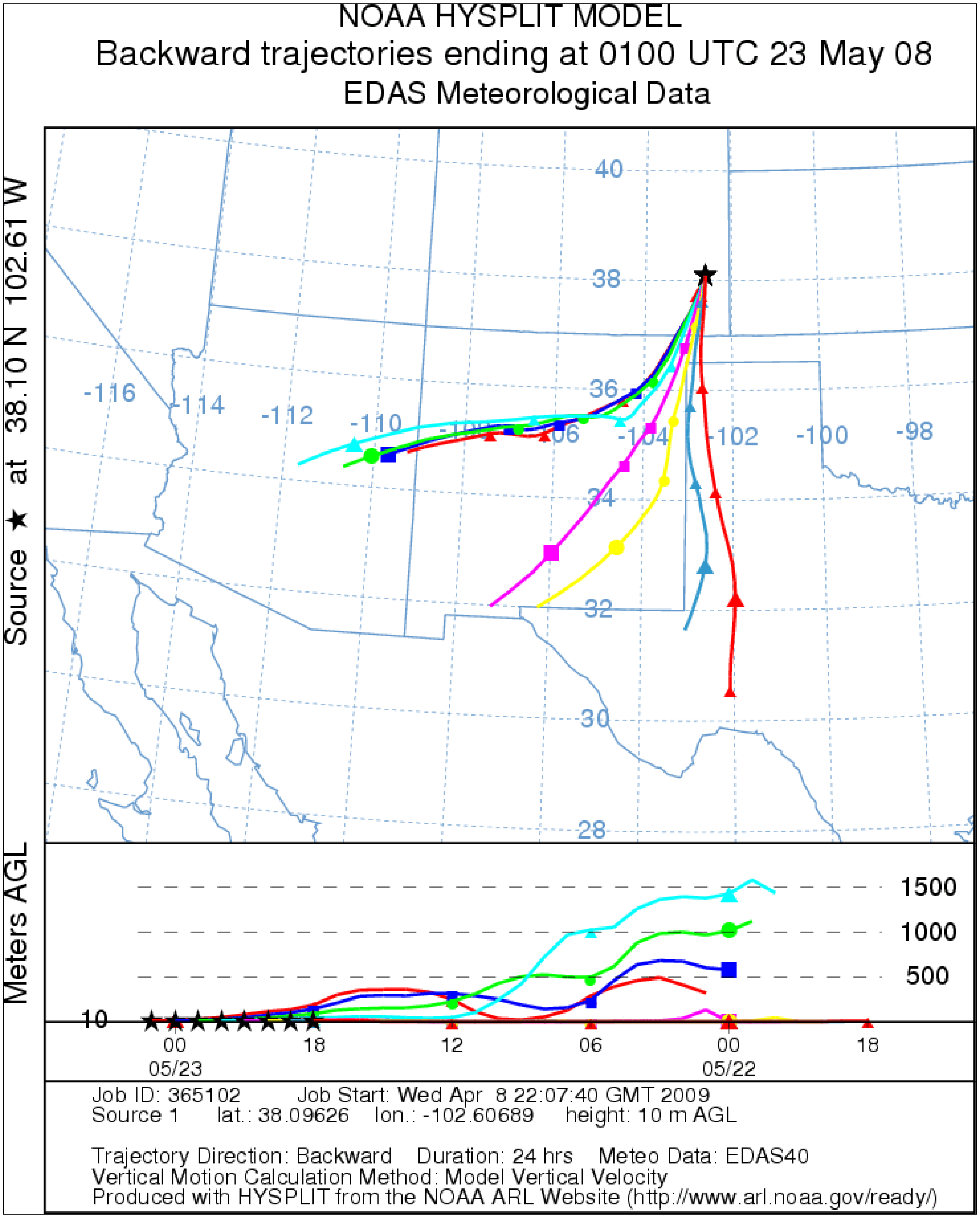


Figure A-20. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado for each hour from 11 AM MST to 6 PM MST on May 22, 2008.

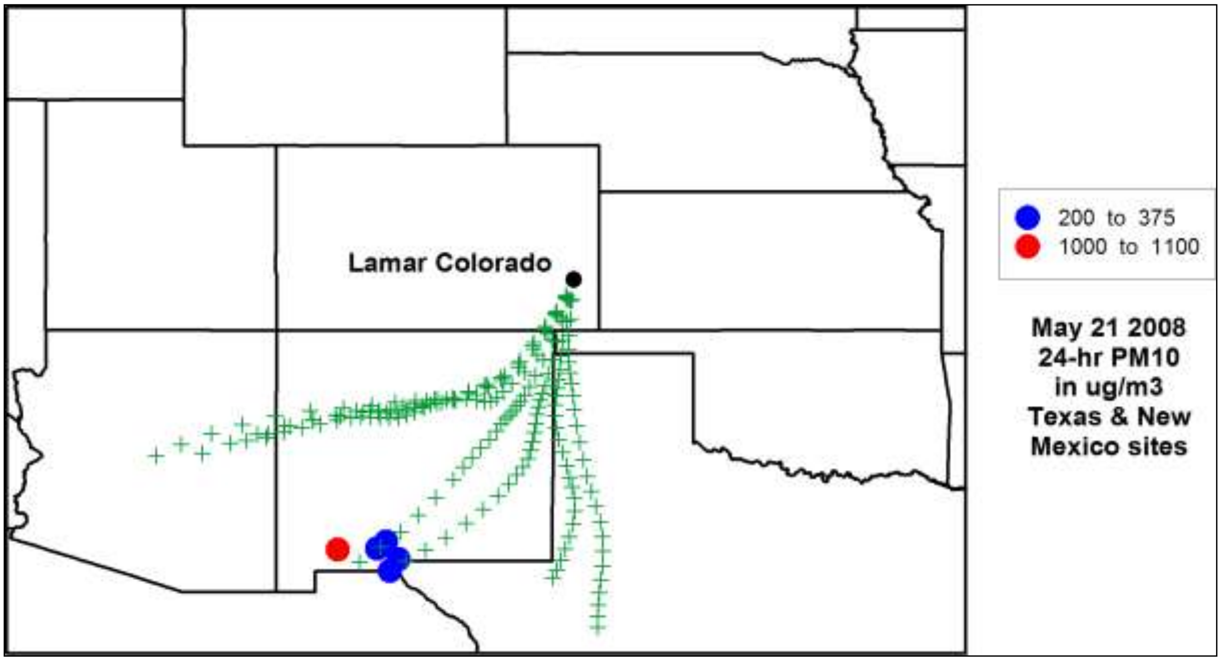


Figure A-21. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado from Figure A-20 and May 21 PM10 exceedance concentrations in southern New Mexico and Texas.

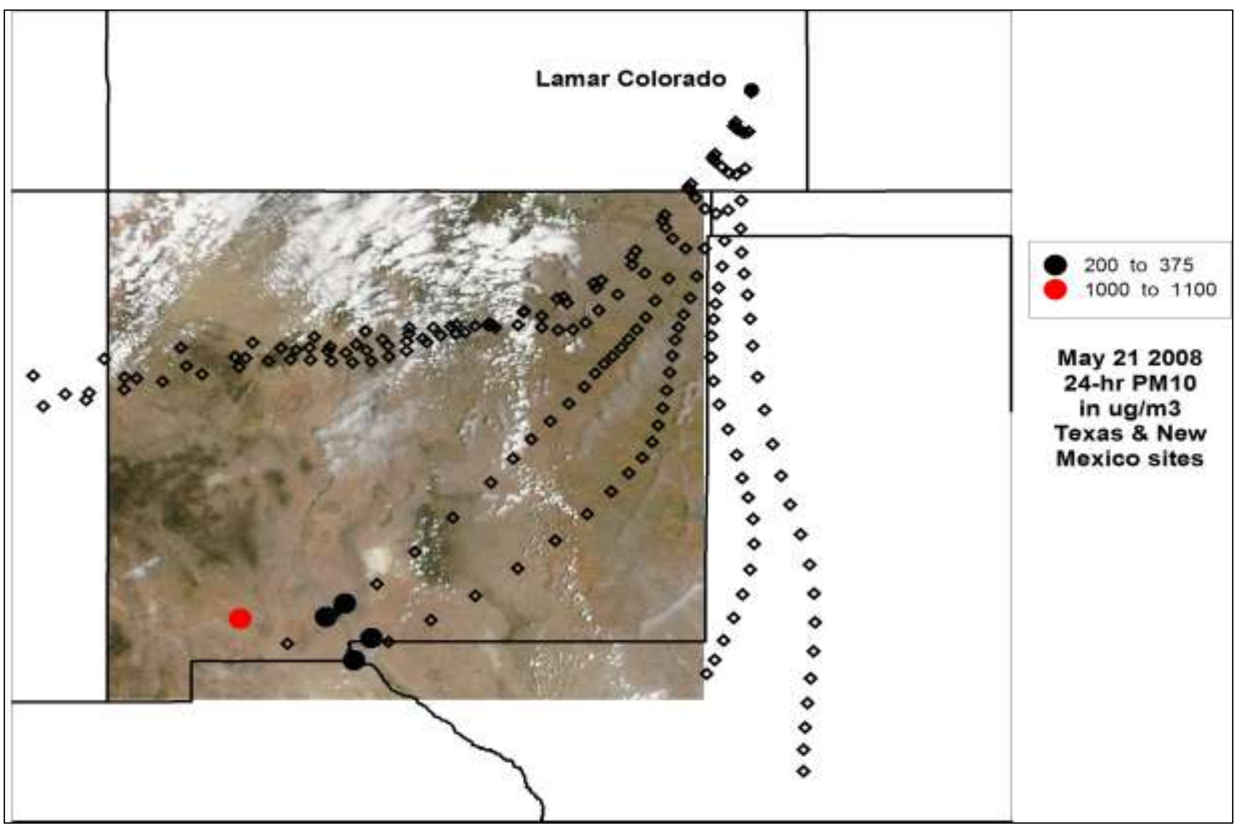


Figure A-22. NOAA HYSPLIT 24-hour back trajectories for Lamar Colorado from Figure A-20, May 21 PM10 exceedance concentrations in southern New Mexico and Texas, and May 21 visible satellite image from Figure A-19.

Dust Transport Example 2

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

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

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

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

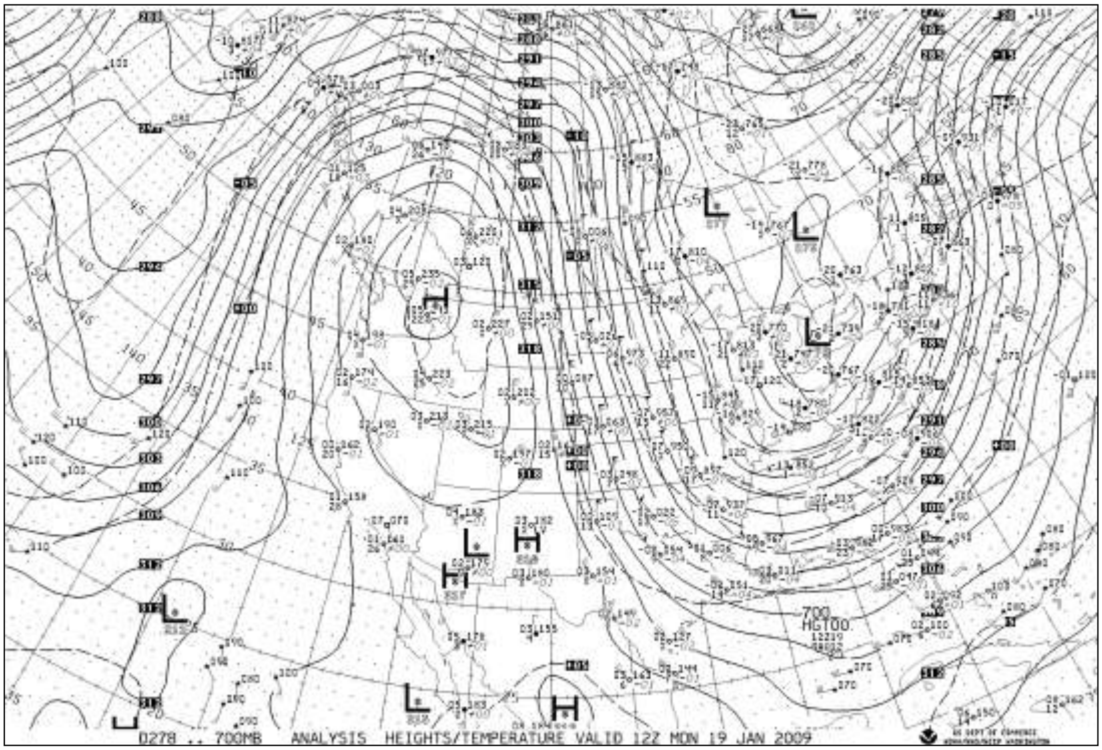


Figure A-23. 700 millibar analysis for 12Z January 19, 2009, or *5 AM MST January 19, 2009*, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

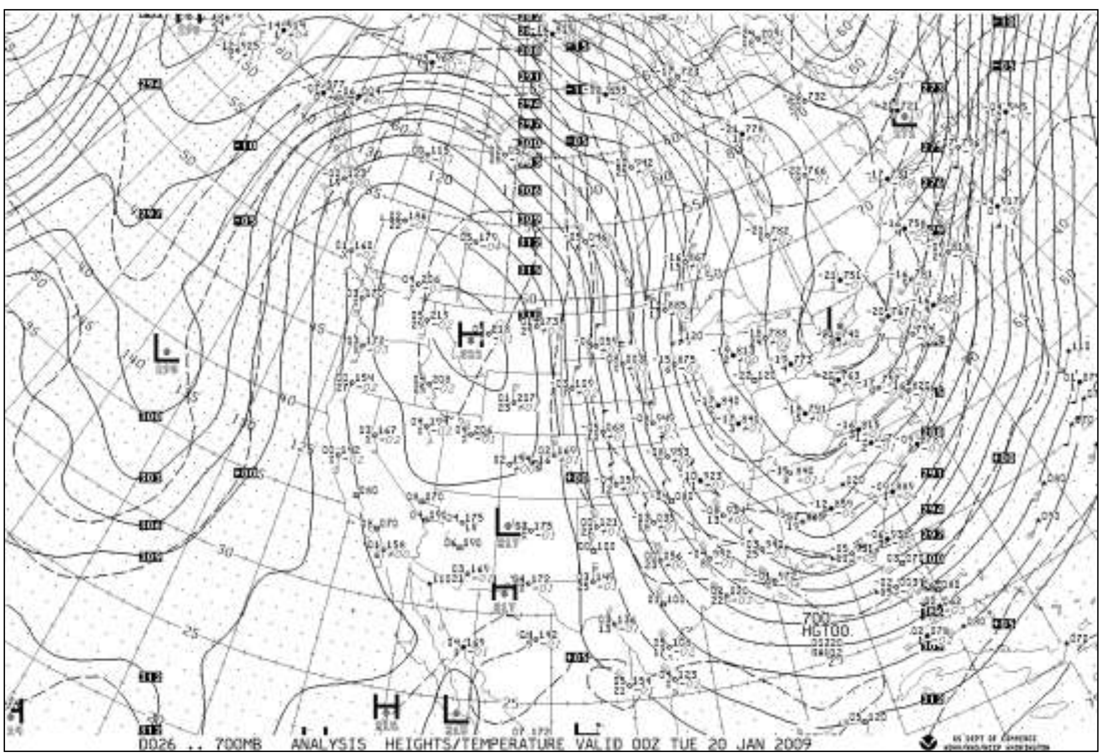


Figure A-24. 700 millibar analysis for 00Z January 20, 2009, or *5 PM MST January 19, 2009*, (from Colorado State University's archive of National Weather Service fax maps: http://archive.atmos.colostate.edu/).

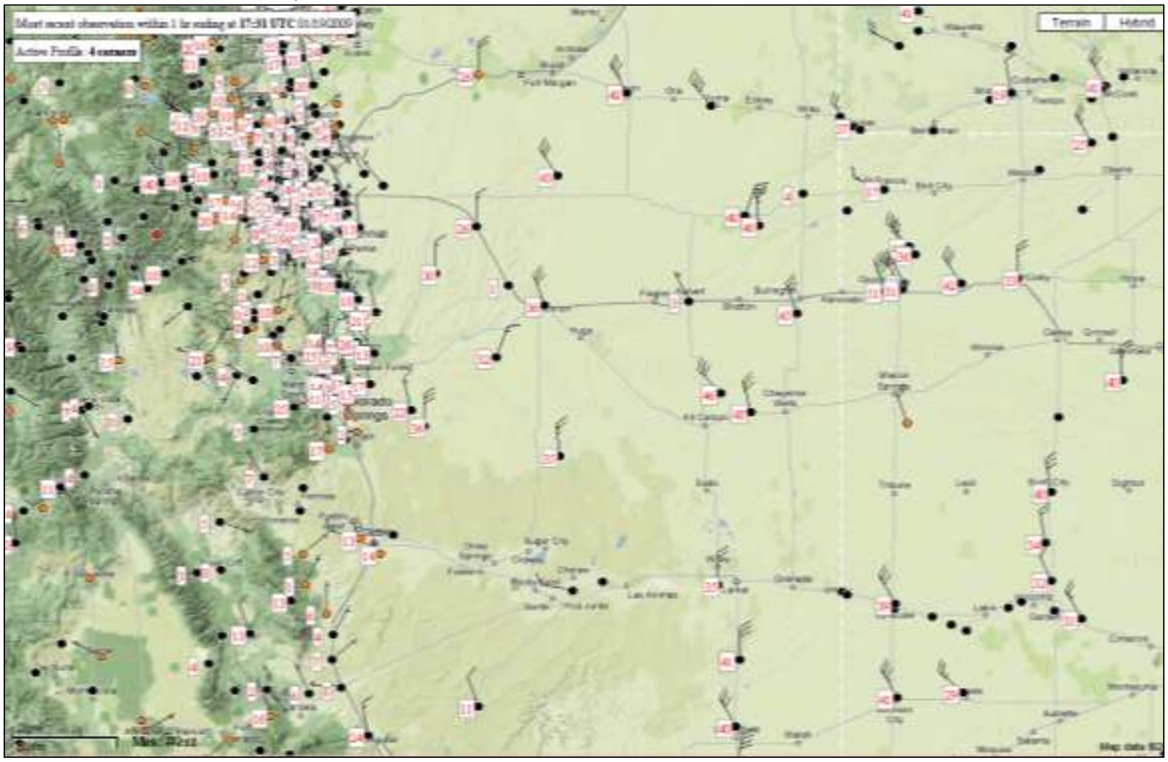


Figure A-25. Wind directions and gust speeds in mph in eastern Colorado and western Kansas 17:31 UTC January 19, 2009 (10:31 AM MST on January 19, 2009). (http://mesowest.utah.edu/index.html)

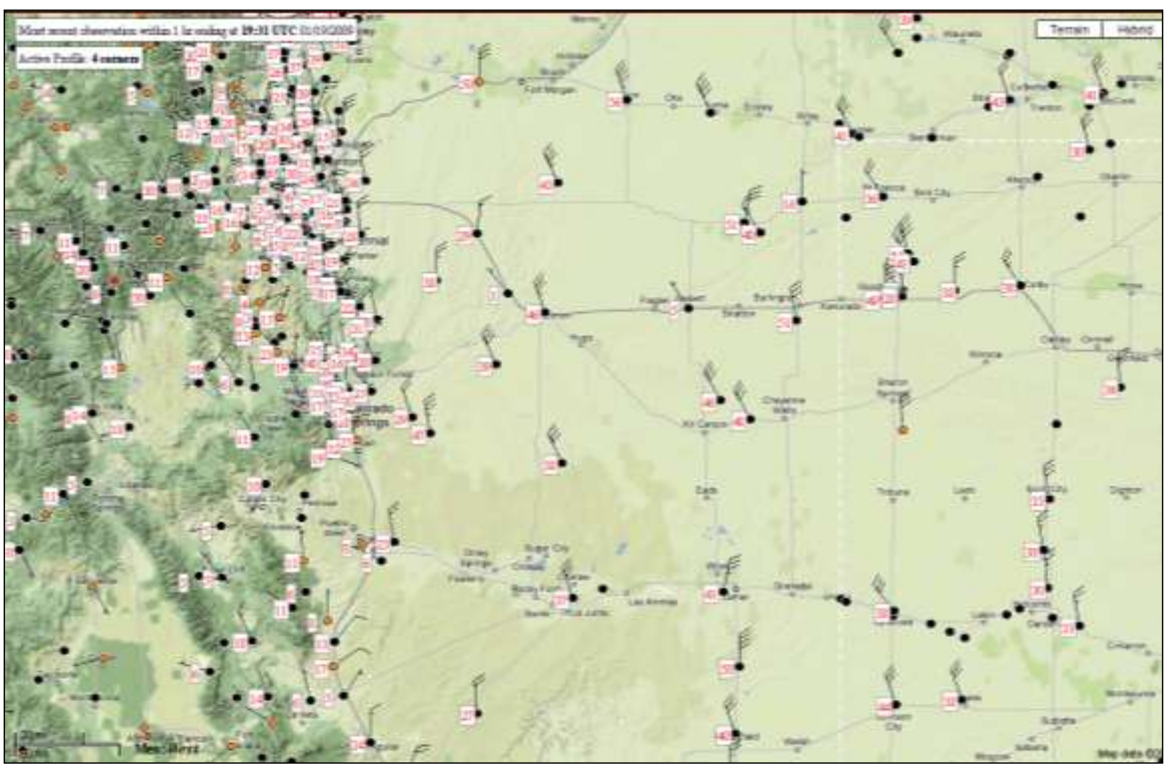


Figure A-26. Wind directions and gust speeds in mph in eastern Colorado and western Kansas 19:31 UTC January 19, 2009 (12:31 PM MST on January 19, 2009). (http://mesowest.utah.edu/index.html) Figure A-27 shows the percent of normal precipitation for Colorado during January 2009. Most of eastern Colorado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

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

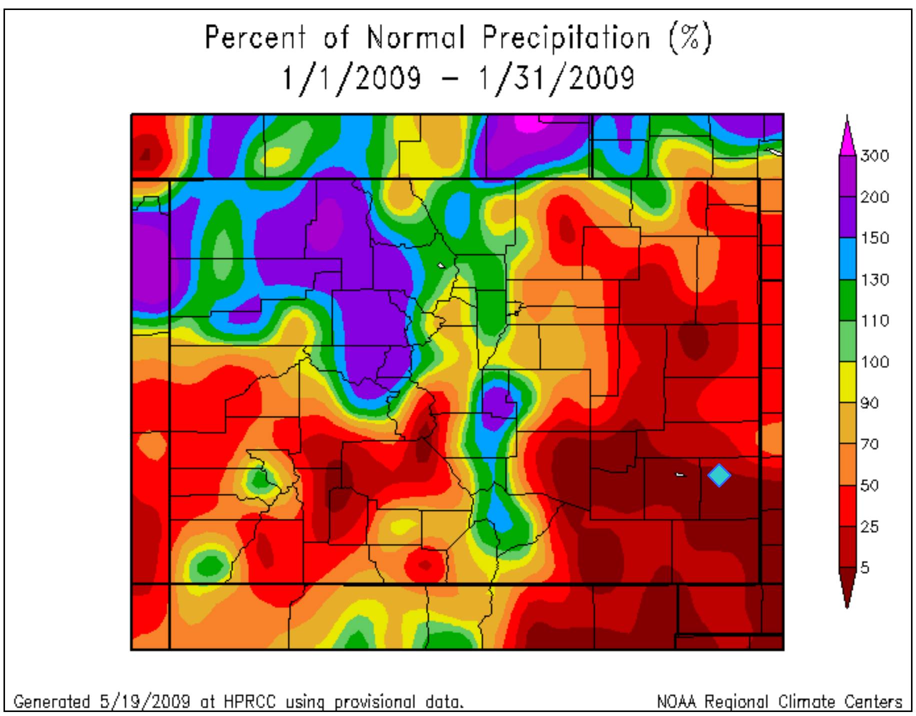


Figure A-27. Percent of Normal Precipitation for January 2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_userdate&daterange=Jan&year=09). Blue diamond shows the approximate location of Lamar.

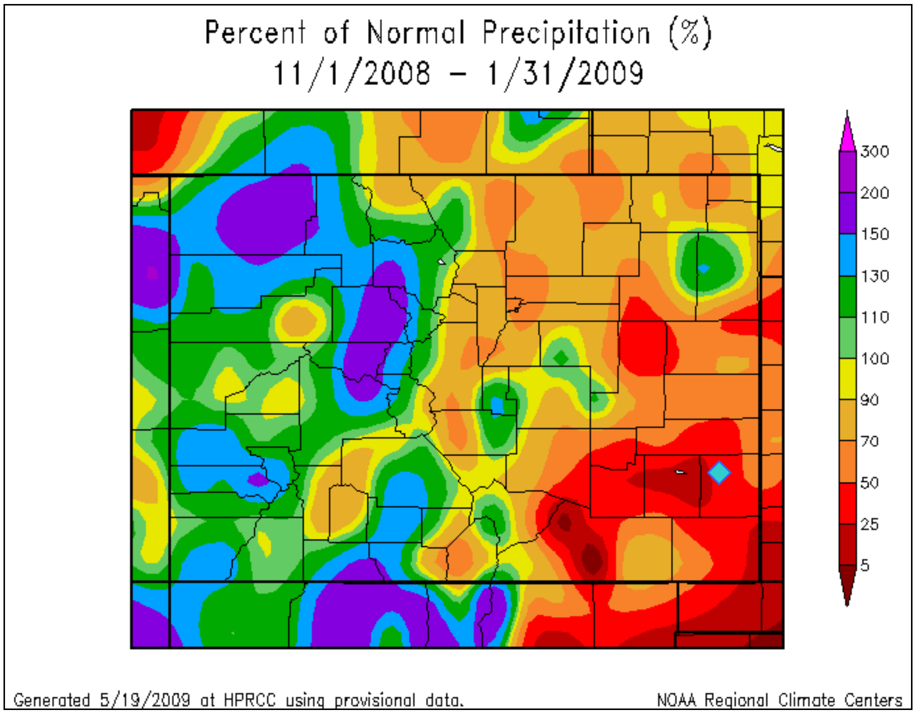


Figure A-28. Percent of Normal Precipitation for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm). Blue diamond shows the approximate location of Lamar.

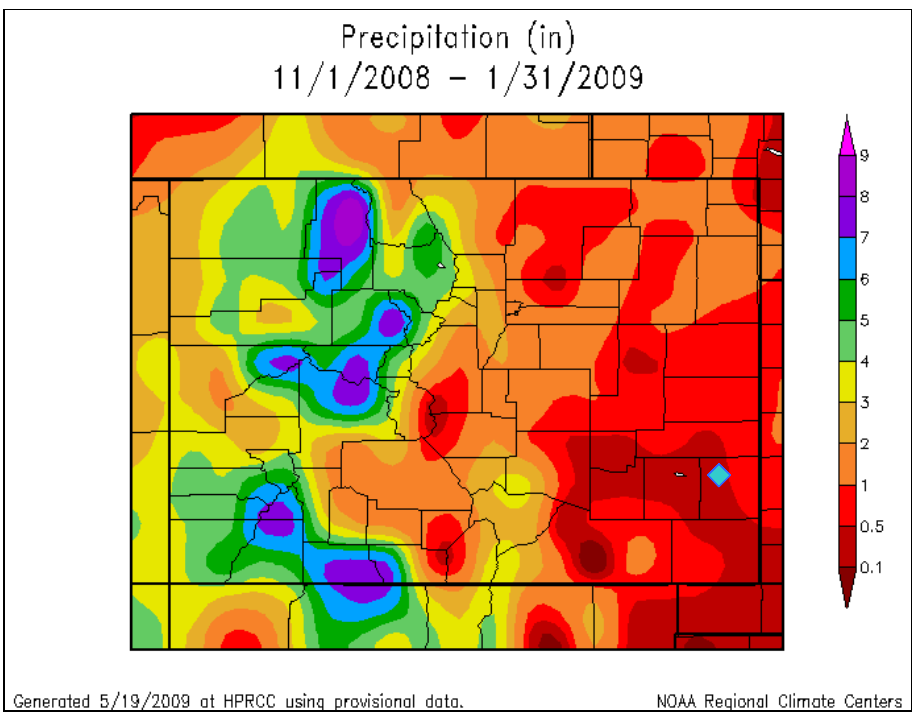


Figure A-29. Precipitation in inches for 11/1/2008 – 1/31/2009, source High Plains Regional Climate Center (http://www.hprcc.unl.edu/maps/current/index.php?action=update_product&product=PNorm). Blue diamond shows the approximate location of Lamar.

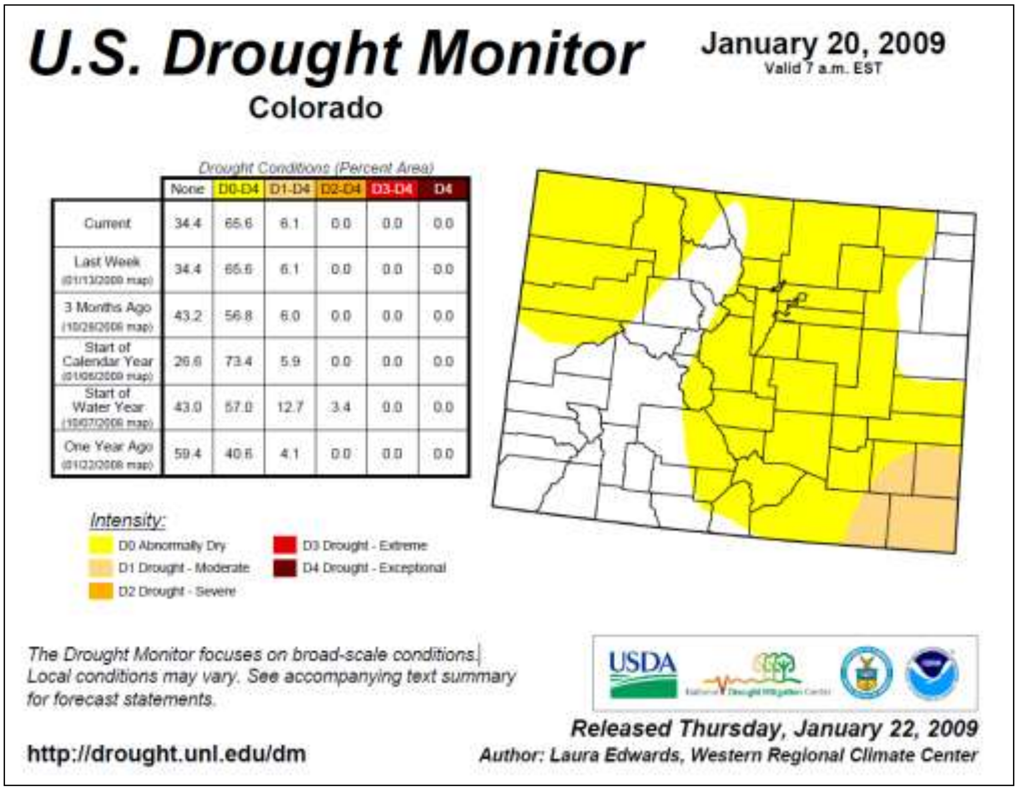


Figure A-30. Drought status for the Colorado on January 20, 2009 (source: the USDA, NOAA, and the National Drought Mitigation Center at: http://drought.unl.edu/dm/archive.html).

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

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

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

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

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

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

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

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

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

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

(a)

(b)

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

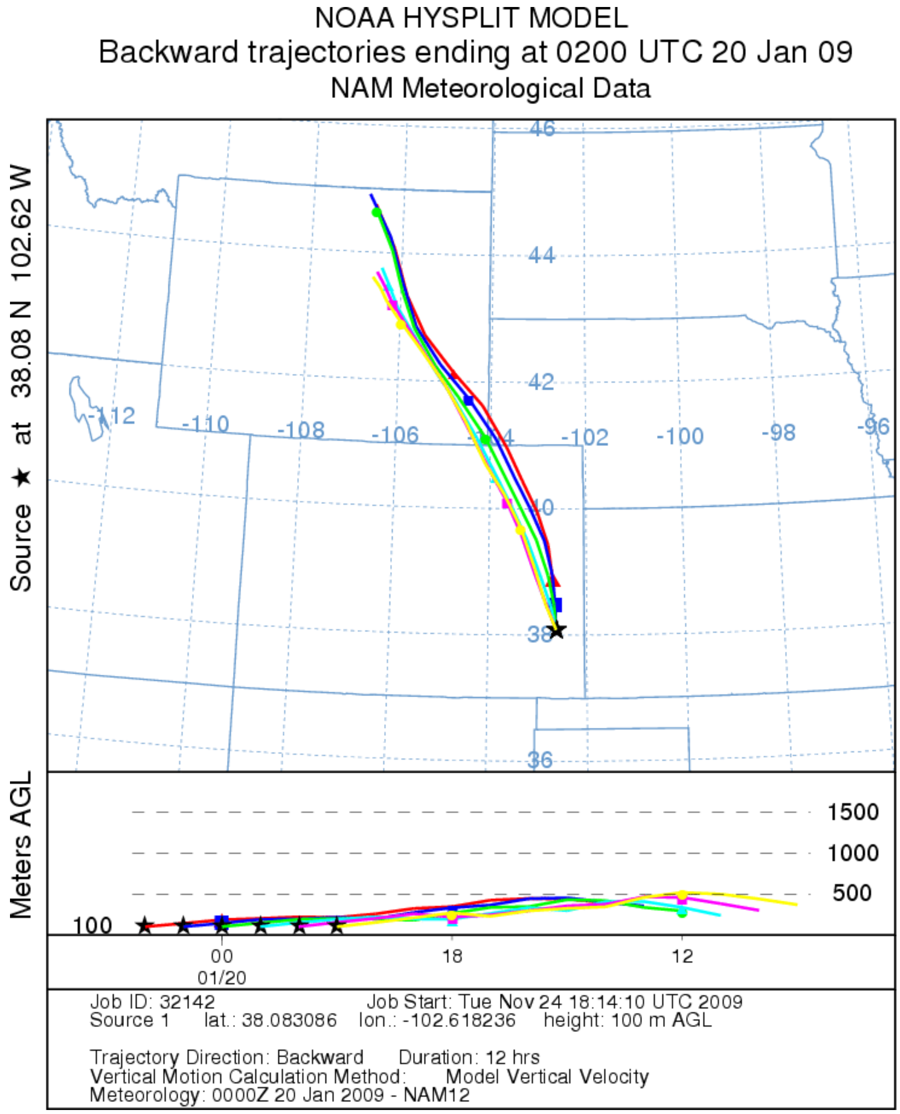


Figure A-32. NOAA HYSPLIT 12-hour back trajectory plots for each hour during the windiest period on January 19, 2009. The HYSPLIT model run was based on data from the high-resolution 12-kilometer grid spacing NAM numerical weather model.

Landform Signs of Blowing Dust

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

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

Source Areas and Emissions Controls

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

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

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

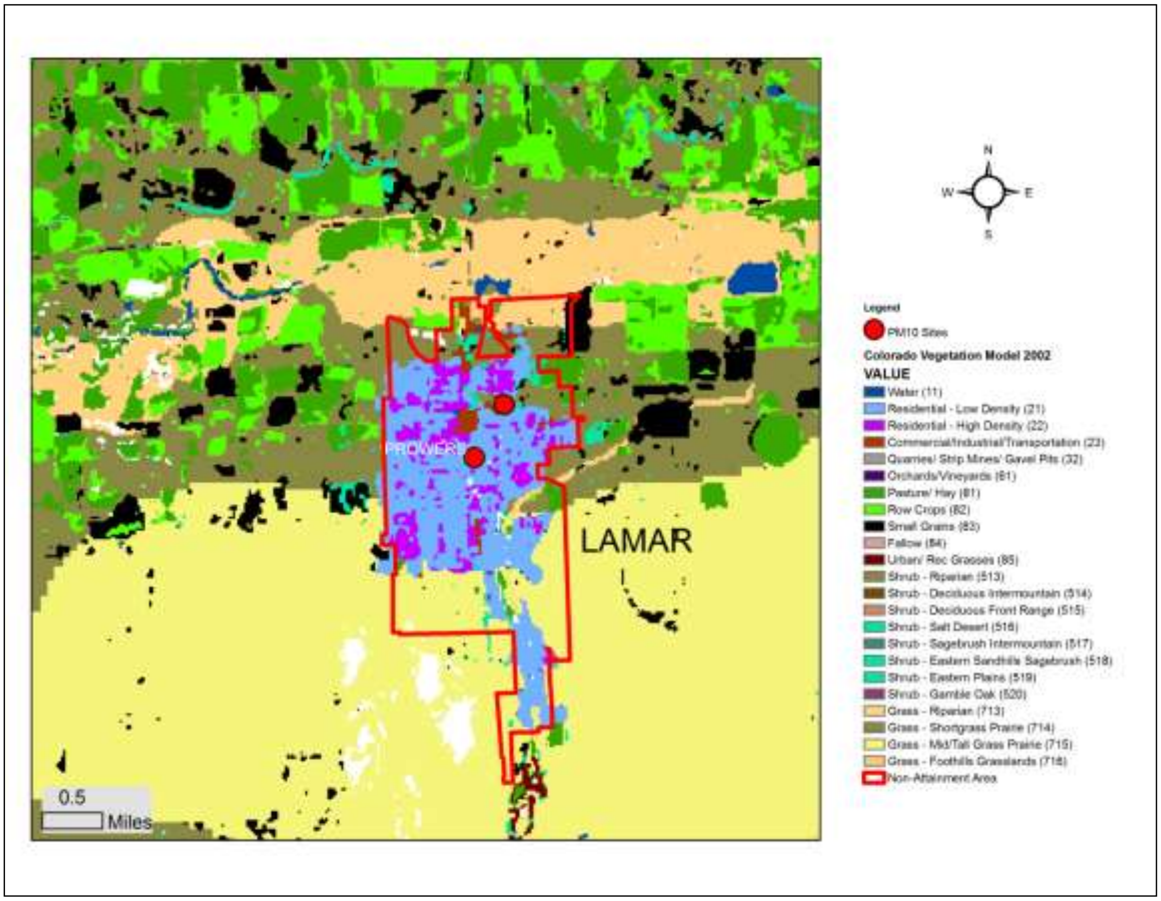


Figure A-34. The Lamar PM10 Non-attainment Area (outlined in red) and vegetative cover and land use categories.

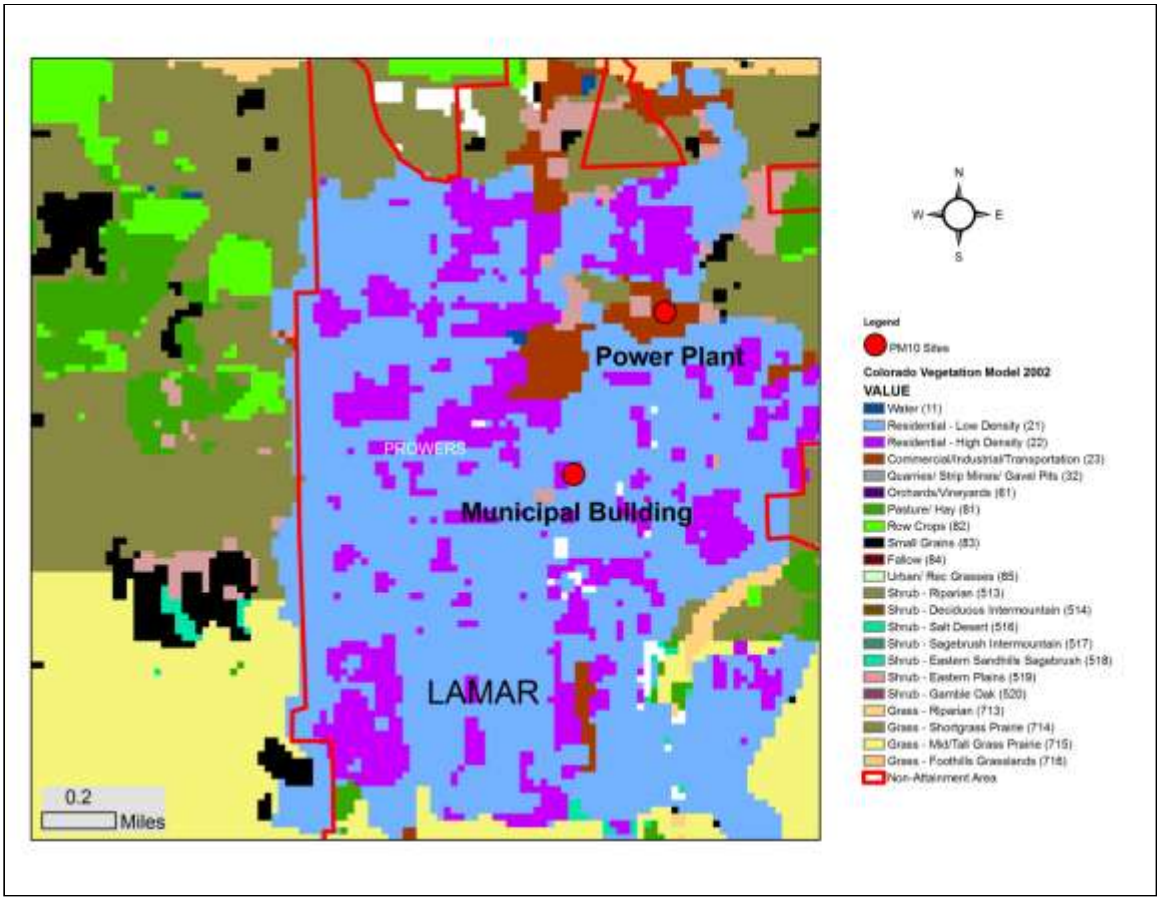


Figure A-35. The Lamar PM10 Non-attainment Area (outlined in red), locations of the Lamar PM10 monitors, and vegetative cover and land use categories.

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

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

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

The second category of blowing dust sources considered here are natural and agricultural sources in eastern Colorado. Dryland farming is the dominant farming type in southeastern Colorado and occurs on areas with highly erodible soils. The wheat-sorghum-fallow system is common in much of eastern and southeastern Colorado. The wheat-sorghum-fallow system is generally a planting of wheat, followed by a planting of sorghum and then a period with the land left fallow to allow the soil to recover. According to the Colorado State Extension publication 0.5160 (http://www.ext.colostate.edu/pubs/crops/00516.html), "soils under no-till production systems store more water than soils on conventional stubble mulch systems and allow conversion to more intense crop rotations." Sorghum is a plant suited for dry arid climates with a very extensive root system that holds soil in place as well as helping soil stay moist. Lands in these crop systems are shown in several of the land use maps presented below as small grain croplands (in black). Croplands in this system are typically left fallow for as much as 14 months to allow natural soil water content a chance to recover between crops. If sufficient no-till or low tillage practices are not followed, these lands can be significant sources for blowing dust during the fall, winter, and spring of the year, and they may also be significant sources of dust even with reasonable agricultural controls applied.

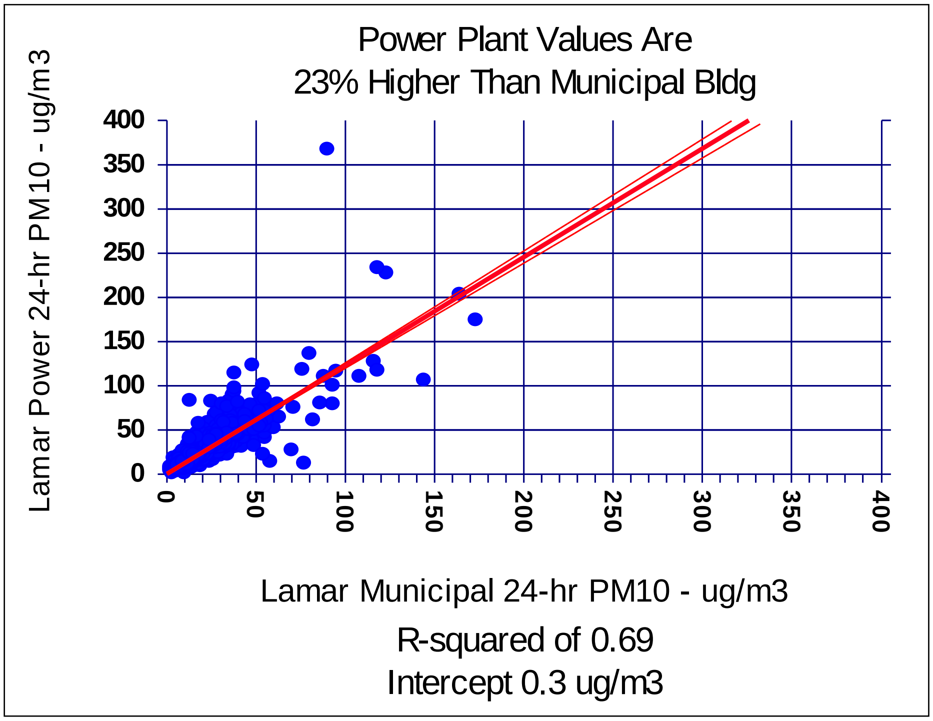


Figure A-37. Linear regression between Lamar Power Plant and Municipal Building PM10 concentrations for January 2004 through February of 2009. (The slope is 1.23.)

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

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

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

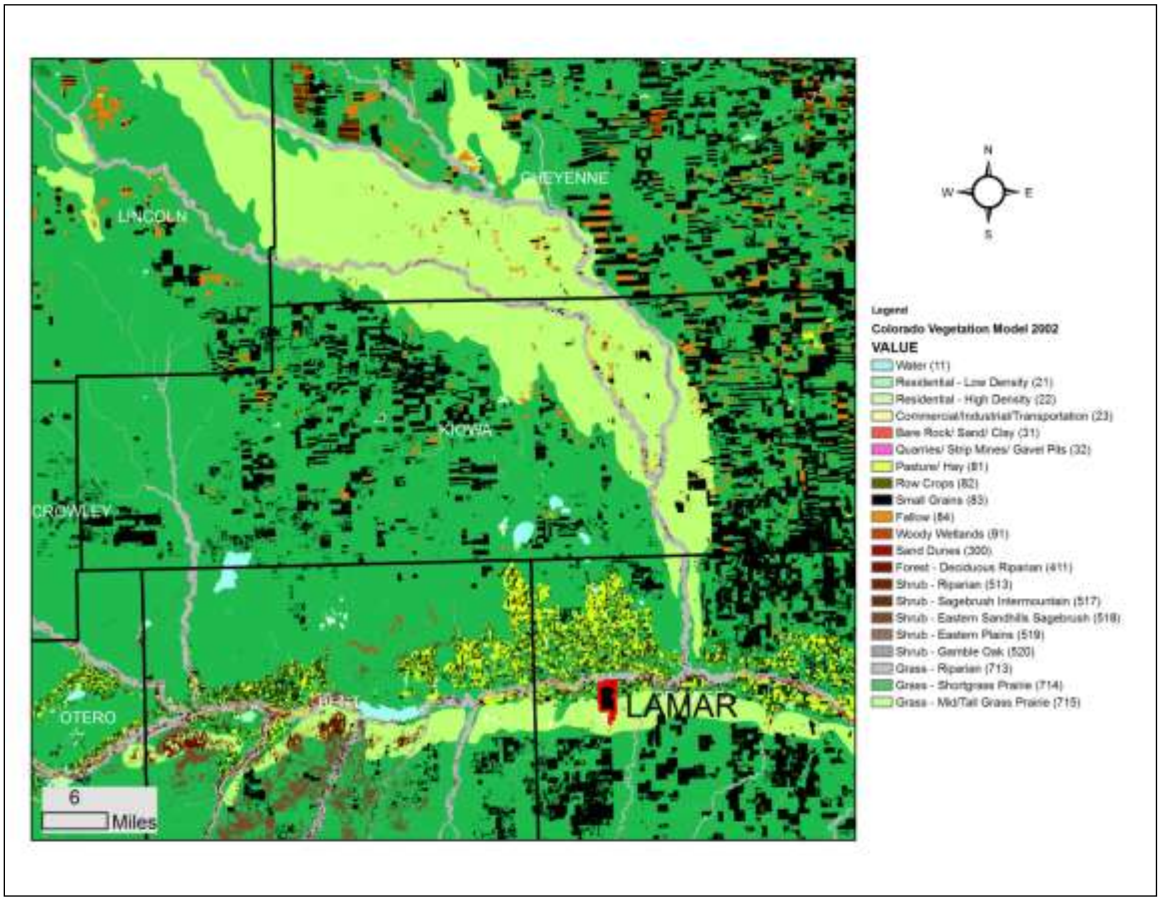


Figure A-39. Vegetative cover and land use categories in the vicinity of Lamar, Colorado.

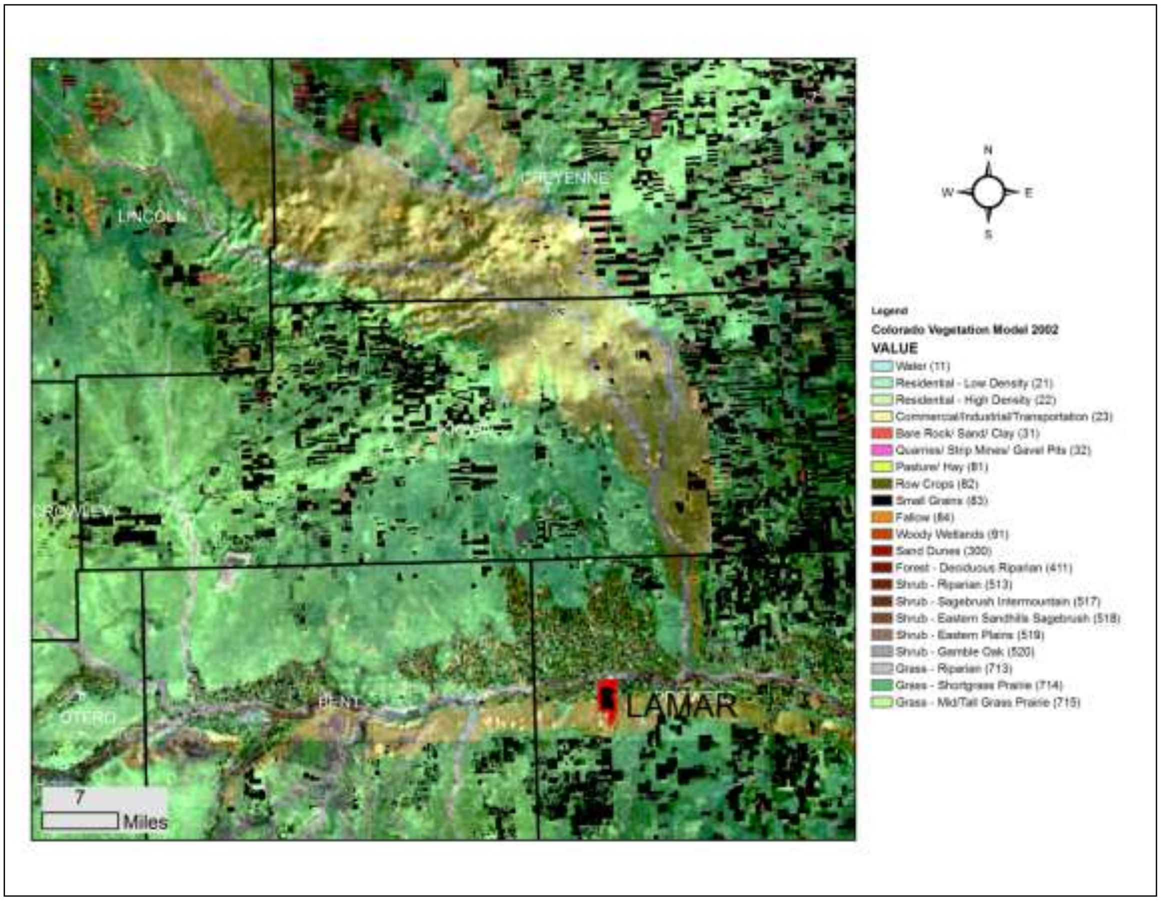


Figure A-40. Vegetative cover and land use categories in the vicinity of Lamar, Colorado, superimposed with the satellite image from Figure A-38 for April 18, 2004.

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

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

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

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

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

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

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

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

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

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

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

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

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

> "The Continuous CRP program (CCRP), a subset of the Conservation Reserve Program, offers year round enrollment and increased incentives to keep these small sensitive areas in permanent cover.
>
> **Practice Incentive Payment (PIP) -** This is an additional incentive of 40% of eligible practice establishment costs.
>
> **Signing Incentive Payment (SIP) -** This is a one time incentive payment for signing the Continuous CRP contract.
>
> **Rental Incentive Payment -** This is an additional incentive payment equal to the shown percentage of the CRP rental rate. All of the above incentives are in addition to the regular CRP rental payment. For more information on CCRP, contact your local USDA Service Center."

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

Conclusions and Summary

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

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

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

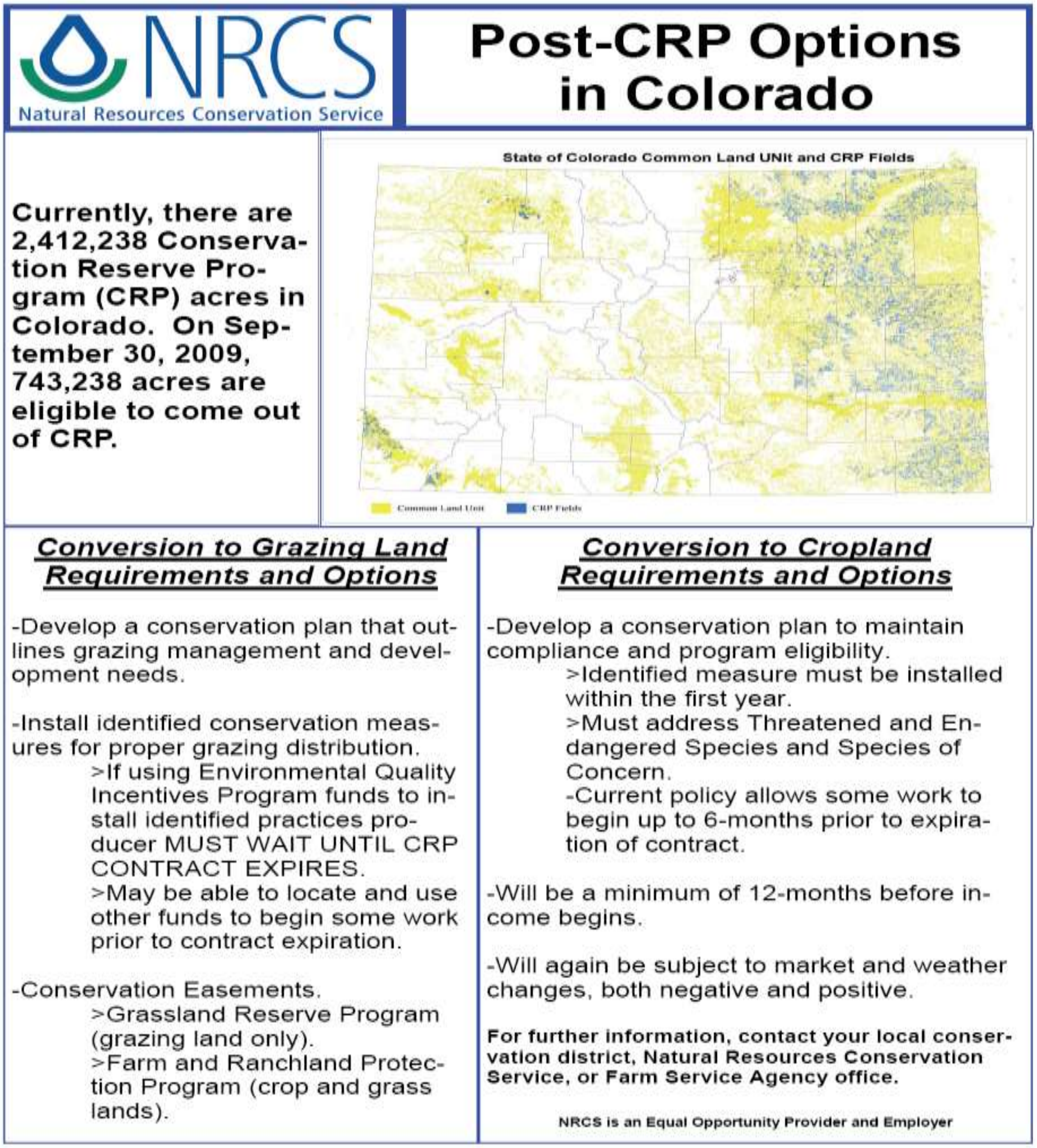


Figure A-41. Colorado NRCS overview of Post-CRP options in Colorado.

Planning

Getting Started with a Conservation Plan

As a Conservation Reserve Program (CRP) contract nears its end, landowners will be making decisions on what to do next with their land.

Before deciding what to do when a CRP contract expires, it is important to consider several factors including soil productivity and limitations, past yields, commodity prices, production, conversion or renovation costs, and other required investments.

The Natural Resources Conservation Service (NRCS) encourages landowners to visit their local NRCS field office for assistance with developing a comprehensive conservation plan prior to making a decision on expired CRP contracts.

An NRCS-approved conservation plan is critical and is developed by first understanding the resource needs and a landowner's desired land use goals, then created based on sound, scientific practices.

These assessments help NRCS technicians develop solutions that best match each landowner's goals with the needs of the land.

At the very least, expired CRP contracts, which will be returned to crop production needs to get an updated conservation plan on file since many parcels are operating under outdated plans.

Colorado CONSERVATION PLANNING

NRCS
Natural Resources Conservation Service

Eugene Backhaus
Resource Conservationist
655 Parfet Street, E200C
Lakewood, CO 80215
PH: 720-544-2868

The Natural Resources Conservation Service (NRCS) provides technical and financial assistance to help agricultural producers and others care for the land.

NRCS has six mission goals that include:

- High quality, productive soils
- Clean and abundant water
- Healthy plant and animal communities
- Clean air
- An adequate energy supply; and
- Working farm and ranch lands

www.co.nrcs.usda.gov

April 2009

For more information contact:

720-544-2868

Options for

Expired Conservation Reserve Program Lands

in Colorado

NRCS
Helping People Help the Land

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.

United States Department of Agriculture
Natural Resources Conservation Service

Expiring CRP Options—Transition to Grazingland

USDA Natural Resources Conservation Service — Colorado | March 2009

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

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

Potential Payments for CRP transition to Grazingland

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

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

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

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

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

References:

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

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

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

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

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

Appendix C - Weather Warnings and Advisories for April 3, 2011

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WWUS75 KABQ 031856
NPWABQ

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
1256 PM MDT SUN APR 3 2011

...VERY STRONG AND POTENTIALLY DAMAGING WINDS WILL CONTINUE...

.THE COMBINATION OF A POTENT UPPER LEVEL TROUGH APPROACHING FROM
THE NORTHWEST AND A STRENGTHENING SURFACE GRADIENT WILL RESULT IN
STRONG AND POTENTIALLY DAMAGING WINDS ACROSS MUCH OF THE AREA.
THE STRONGEST WINDS WILL CONTINUE ALONG AND EAST OF THE
CENTRAL MOUNTAIN CHAIN WITH WINDS CONTINUING TO STRENGTHEN
ELSEWHERE IN NEW MEXICO...ESPECIALLY IN WEST CENTRAL AND SOUTHWEST
NEW MEXICO. SUSTAINED SOUTHWEST WINDS OF 35 TO 45 MPH WITH
OCCASIONAL GUSTS REACHING 60 TO 70 MPH WILL BE COMMON. BLOWING
DUST WILL CONTINUE TO REDUCE VISIBILITIES BELOW 3 MILES THROUGH
THE AFTERNOON. ACROSS THE EASTERN PLAINS AND DUST PRONE AREAS OF
CENTRAL AND WESTERN NEW MEXICO...VISIBILITIES BELOW ONE MILE TO
NEAR ZERO MAY BE ENCOUNTERED AT TIMES. ALTHOUGH WINDS WILL BEGIN
SLOWLY DIMINISHING FROM WEST TO EAST THIS EVENING...STRONG WINDS
ARE LIKELY TO PERSIST ACROSS MUCH OF THE FAR EAST AND SOUTH
TONIGHT.

NMZ502-505>508-519-520-040200-
/O.CON.KABQ.HW.W.0004.000000T0000Z-110404T0200Z/
CHUSKA MOUNTAINS-WEST CENTRAL PLATEAU-WEST CENTRAL MOUNTAINS-
WEST CENTRAL HIGHLANDS-SOUTHWEST MOUNTAINS-ALBUQUERQUE METRO AREA-
LOWER RIO GRANDE VALLEY-
1256 PM MDT SUN APR 3 2011

...HIGH WIND WARNING REMAINS IN EFFECT UNTIL 8 PM MDT THIS
EVENING...

A HIGH WIND WARNING REMAINS IN EFFECT UNTIL 8 PM MDT THIS
EVENING.

* LOCATION...THE MIDDLE AND LOWER RIO GRANDE VALLEY WESTWARD TO
  THE ARIZONA STATE LINE TO INCLUDE THE INTERSTATE 40 CORRIDOR
  FROM ALBUQUERQUE TO GALLUP...AND THE CHUSKA...WEST CENTRAL
  MOUNTAINS AND UPPER GILA REGION.

* WINDS...SUSTAINED FROM THE SOUTHWEST AT 35 TO 45 MPH WITH
  GUSTS TO 60 AND 65 MPH. THE HIGHER PEAKS WILL LIKELY
  EXPERIENCE EVEN STRONGER GUSTS.

* TIMING...WINDS WILL CONTINUE TO STRENGTHEN WITH THE STRONGEST
  WINDS EXPECTED FROM MID TO LATE AFTERNOON. WINDS WILL DIMINISH
  TO BELOW WARNING THRESHOLDS BY MID-EVENING.

* VISIBILITY...WIDESPREAD REDUCTIONS TO 3 MILES IN BLOWING DUST
  WILL BE POSSIBLE WITH VISIBILITIES REDUCED TO LESS THAN A HALF
  MILE AT TIMES IN DUST PRONE AREAS.
```

* LOCAL IMPACTS...LOCALIZED AREAS CAN EXPECT ABRUPT REDUCTIONS TO VISIBILITY IN BLOWING DUST. STRONG CROSS WINDS WILL ALSO CREATE TREACHEROUS DRIVING CONDITIONS ESPECIALLY ALONG NORTHWEST TO SOUTHEAST ORIENTED ROADS SUCH AS INTERSTATE 40 NEAR THE CONTINENTAL DIVIDE...STRETCHES OF INTERSTATE 25 FROM ALBUQUERQUE SOUTH AND U.S. HIGHWAYS 60 AND 380. LOOSE OBJECTS MAY BECOME AIRBORNE...AND GUSTS IN EXCESS OF 60 MPH MAY CAUSE DAMAGE TO TREES...POWERLINES...AND ROOFING MATERIAL.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

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

EXTREMELY HAZARDOUS DRIVING CONDITIONS CAN BE EXPECTED... ESPECIALLY FOR MOTORISTS IN HIGH PROFILE VEHICLES WHO SHOULD CONSIDER DELAYING TRAVEL.

&&

$$

NMZ521>526-533>540-040200-
/O.CON.KABQ.HW.W.0004.000000T0000Z-110404T0200Z/
SANDIA/MANZANO MOUNTAINS-ESTANCIA VALLEY-CENTRAL HIGHLANDS-
SOUTH CENTRAL HIGHLANDS-UPPER TULAROSA VALLEY-
SOUTH CENTRAL MOUNTAINS-GUADALUPE COUNTY-QUAY COUNTY-CURRY COUNTY-
ROOSEVELT COUNTY-DE BACA COUNTY-CHAVES COUNTY PLAINS-
EASTERN LINCOLN COUNTY-SOUTHWEST CHAVES COUNTY-
1256 PM MDT SUN APR 3 2011

...HIGH WIND WARNING REMAINS IN EFFECT UNTIL 8 PM MDT THIS EVENING...

A HIGH WIND WARNING REMAINS IN EFFECT UNTIL 8 PM MDT THIS EVENING.

* LOCATION...CENTRAL MOUNTAIN RANGES FROM THE SANDIAS AND MANZANOS SOUTHWARD TO THE SOUTH CENTRAL MOUNTAINS EASTWARD TO THE TEXAS STATE LINE. THIS INCLUDES THE I-40 CORRIDOR FROM TIJERAS CANYON EASTWARD...THE EAST CENTRAL PLAINS AND CHAVES COUNTY.

* WINDS...SUSTAINED FROM THE SOUTHWEST AT 35 TO 45 MPH WITH GUSTS OF 60 TO 70 MPH. THE HIGHER PEAKS WILL LIKELY EXPERIENCE EVEN STRONGER GUSTS.

* TIMING...WINDS WILL CONTINUE TO STRENGTHEN WITH THE STRONGEST WINDS EXPECTED FROM MID TO LATE AFTERNOON. WINDS SHOULD DIMINISH TO BELOW WARNING THRESHOLDS BY MID EVENING...BUT THEY WILL REMAIN STRONG AND GUSTY WELL INTO THE NIGHT... ESPECIALLY NEAR THE SOUTH CENTRAL MOUNTAINS. IN THE FAR EASTERN PLAINS WINDS WILL TURN NORTHERLY OVERNIGHT...AND WILL BECOME VERY GUSTY AGAIN AS A POWERFUL FRONT ARRIVES.

* VISIBILITY...WIDESPREAD REDUCTIONS TO 3 MILES IN BLOWING DUST WILL BE POSSIBLE WITH VISIBILITIES REDUCED TO LESS THAN A HALF MILE AT TIMES IN DUST PRONE AREAS.

* LOCAL IMPACTS...LOCALIZED AREAS CAN EXPECT ABRUPT REDUCTIONS TO VISIBILITY IN BLOWING DUST. STRONG CROSS WINDS WILL ALSO CREATE TREACHEROUS DRIVING CONDITIONS ESPECIALLY ALONG NORTHWEST TO SOUTHEAST ORIENTED ROADS SUCH AS U.S. HIGHWAY 285. LOOSE OBJECTS MAY BECOME AIRBORNE...AND GUSTS IN EXCESS OF 60 MPH MAY CAUSE DAMAGE TO TREES...POWERLINES...AND ROOFING MATERIAL.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

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

EXTREMELY HAZARDOUS DRIVING CONDITIONS CAN BE EXPECTED... ESPECIALLY FOR MOTORISTS IN HIGH PROFILE VEHICLES WHO SHOULD CONSIDER DELAYING TRAVEL.

&&

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NMZ512>515-518-527>532-040200-
/O.CON.KABQ.HW.W.0004.000000T0000Z-110404T0200Z/
WEST SLOPES SANGRE DE CRISTO MOUNTAINS-
NORTHERN SANGRE DE CRISTO MOUNTAINS ABOVE 9500 FEET/RED RIVER-
SOUTHERN SANGRE DE CRISTO MOUNTAINS ABOVE 9500 FEET-
EAST SLOPES SANGRE DE CRISTO MOUNTAINS-SANTA FE METRO AREA-
RATON RIDGE/JOHNSON MESA-FAR NORTHEAST HIGHLANDS-
NORTHEAST HIGHLANDS-UNION COUNTY-HARDING COUNTY-
EASTERN SAN MIGUEL COUNTY-
1256 PM MDT SUN APR 3 2011

...HIGH WIND WARNING REMAINS IN EFFECT UNTIL 8 PM MDT THIS EVENING...

A HIGH WIND WARNING REMAINS IN EFFECT UNTIL 8 PM MDT THIS EVENING.

* LOCATION...ALONG AND EAST OF THE SANGRE DE CRISTO MOUNTAINS TO INCLUDE THE THE NORTHEAST HIGHLANDS...INTERSTATE 25 CORRIDOR BETWEEN GLORIETA AND RATON PASS...AND THE NORTHEAST PLAINS.

* WINDS...SUSTAINED FROM THE SOUTHWEST AT 35 TO 45 MPH WITH OCCASIONAL GUSTS TO 60 AND 70 MPH. THE HIGHER PEAKS WILL LIKELY EXPERIENCE EVEN STRONGER GUSTS.

* TIMING...WINDS WILL QUICKLY STRENGTHEN THROUGH THE MORNING WITH THE STRONGEST WINDS EXPECTED FROM MIDDAY TO LATE AFTERNOON. WINDS WILL DIMINISH TO BELOW WARNING THRESHOLDS THIS EVENING...BUT THEY WILL REMAIN STRONG AND GUSTY WELL INTO THE NIGHT. IN THE NORTHEAST PLAINS WINDS WILL TURN NORTHERLY AS A POWERFUL COLD FRONT MOVES THROUGH.

* VISIBILITY...WIDESPREAD REDUCTIONS TO 3 MILES IN BLOWING DUST WILL BE POSSIBLE AT THE LOWER ELEVATIONS WITH VISIBILITIES REDUCED TO LESS THAN A HALF MILE AT TIMES IN DUST PRONE AREAS.

* LOCAL IMPACTS...LOCALIZED AREAS CAN EXPECT ABRUPT REDUCTIONS TO VISIBILITY IN BLOWING DUST. STRONG CROSS WINDS WILL ALSO CREATE TREACHEROUS DRIVING CONDITIONS ALONG NORTHWEST TO SOUTHEAST ORIENTED ROADS SUCH AS U.S. HIGHWAYS 64...84...AND 87. LOOSE OBJECTS MAY BECOME AIRBORNE...AND GUSTS IN EXCESS OF 60 MPH MAY CAUSE DAMAGE TO TREES...POWERLINES...AND ROOFING MATERIAL.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

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

EXTREMELY HAZARDOUS DRIVING CONDITIONS CAN BE EXPECTED... ESPECIALLY FOR MOTORISTS IN HIGH PROFILE VEHICLES WHO SHOULD CONSIDER DELAYING TRAVEL.

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NMZ501-503-504-509>511-516-517-040200-
/O.CON.KABQ.WI.Y.0016.000000T0000Z-110404T0200Z/
NORTHWEST PLATEAU-FAR NORTHWEST HIGHLANDS-NORTHWEST HIGHLANDS-
SAN FRANCISCO RIVER VALLEY-SAN JUAN MOUNTAINS-JEMEZ MOUNTAINS-
UPPER RIO GRANDE VALLEY-LOWER CHAMA RIVER VALLEY-
1256 PM MDT SUN APR 3 2011

...WIND ADVISORY REMAINS IN EFFECT UNTIL 8 PM MDT THIS EVENING...

A WIND ADVISORY REMAINS IN EFFECT UNTIL 8 PM MDT THIS EVENING.

* LOCATION...NORTHWEST PORTION OF NEW MEXICO FROM THE LOWER RIO CHAMA RIVER AND UPPER RIO GRANDE VALLEYS TO THE FOUR CORNERS. THIS INCLUDES THE SAN JUAN AND JEMEZ MOUNTAINS. ALSO THE SAN FRANCISCO RIVER VALLEY IN THE UPPER GILA REGION.

* WINDS...SUSTAINED FROM THE SOUTHWEST AT 25 TO 35 MPH WITH OCCASIONAL GUSTS TO 55 MPH. THE HIGHER PEAKS WILL LIKELY EXPERIENCE EVEN STRONGER GUSTS.

* TIMING...WINDS WILL CONTINUE TO STRENGTHEN THROUGH MID TO LATE AFTERNOON. WINDS WILL DIMINISH THIS EVENING.

* VISIBILITY...WIDESPREAD REDUCTIONS TO 3 MILES IN BLOWING DUST WILL BE POSSIBLE WITH VISIBILITIES REDUCED TO LESS THAN A HALF MILE AT TIMES IN DUST PRONE AREAS.

* LOCAL IMPACTS...LOCALIZED AREAS CAN EXPECT ABRUPT REDUCTIONS TO VISIBILITY IN BLOWING DUST. STRONG CROSS WINDS WILL ALSO CREATE TREACHEROUS DRIVING CONDITIONS ESPECIALLY ALONG

NORTHWEST TO SOUTHEAST ORIENTED ROADS SUCH AS U.S. HIGHWAYS
550 AND 84. LOOSE OBJECTS MAY BECOME AIRBORNE...AND GUSTS IN
EXCESS OF 60 MPH MAY CAUSE DAMAGE TO TREES...POWERLINES...AND
ROOFING MATERIAL.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

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

&&

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WWUS75 KFGZ 031623
NPWFGZ

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE FLAGSTAFF AZ
923 AM MST SUN APR 3 2011

...TODAYS WIND ADVISORY NEW START NOW 9 AM...

SURFACE WIND OBSERVATIONS AT 9 AM SHOW SOUTHWEST WIND
GUSTS FROM 40 TO 54 MPH OCCURRING ON THE EAST AND NORTH SIDES
OF THE MOGOLLON RIM FROM THE HOUSE ROCK VALLEY TO ST JOHNS.

AZZ004>017-039-040-040030-
/O.EXT.KFGZ.WI.Y.0011.110403T1623Z-110404T0300Z/
KAIBAB PLATEAU-MARBLE AND GLEN CANYONS-GRAND CANYON COUNTRY-
COCONINO PLATEAU-YAVAPAI COUNTY MOUNTAINS-
NORTHEAST PLATEAUS AND MESAS HWY 264 NORTHWARD-CHINLE VALLEY-
CHUSKA MOUNTAINS AND DEFIANCE PLATEAU-
LITTLE COLORADO RIVER VALLEY IN COCONINO COUNTY-
LITTLE COLORADO RIVER VALLEY IN NAVAJO COUNTY-
LITTLE COLORADO RIVER VALLEY IN APACHE COUNTY-
WESTERN MOGOLLON RIM-EASTERN MOGOLLON RIM-WHITE MOUNTAINS-
BLACK MESA AREA-NORTHEAST PLATEAUS AND MESAS SOUTH OF HWY 264-
INCLUDING THE CITIES OF...FREDONIA...PAGE...
GRAND CANYON VILLAGE...SUPAI...PRESCOTT...CHINLE...KAYENTA...
WINDOW ROCK...GANADO...WINSLOW...HOLBROOK...SNOWFLAKE...
ST. JOHNS...SPRINGERVILLE...FLAGSTAFF...SHOW LOW...DILKON
923 AM MST SUN APR 3 2011

...WIND ADVISORY NOW IN EFFECT UNTIL 8 PM MST THIS EVENING...

THE WIND ADVISORY IS NOW IN EFFECT UNTIL 8 PM MST THIS EVENING.

* TIMING: SOUTHWEST WINDS ARE OCCURRING IN THE ADVISORY AREA...AND
PEAK WIND SPEEDS ARE EXPECTED THIS AFTERNOON.

* WINDS: SOUTHWEST WINDS OF 20 TO 35 MPH WITH GUSTS OF 45 TO 55
MPH ARE EXPECTED...ESPECIALLY FROM THE MOGOLLON RIM
NORTHEASTWARD.

* IMPACTS: AREAS OF BLOWING DUST AND REDUCED VISIBILITY ARE
 POSSIBLE. CROSS WINDS MAY MAKE DRIVING DIFFICULT.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A WIND ADVISORY MEANS THAT SUSTAINED WINDS OF 30 TO 39 MPH...OR
GUSTS FROM 40 TO 57 MPH...ARE EXPECTED. WINDS THIS STRONG CAN
MAKE DRIVING DIFFICULT...ESPECIALLY FOR HIGH PROFILE VEHICLES.
CONSIDER SECURING LOOSE BELONGINGS ON YOUR PROPERTY. ADDITIONAL
WEATHER INFORMATION IS ON THE WEB AT WWW.WEATHER.GOV/FLAGSTAFF.

&&

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WWUS75 KPUB 032307
NPWPUB

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE PUEBLO CO
507 PM MDT SUN APR 3 2011

COZ087-088-093-094-097>099-040200-
/O.EXT.KPUB.HW.W.0004.000000T0000Z-110404T0200Z/
WALSENBURG VICINITY/UPPER HUERFANO RIVER BASIN BELOW 7500 FT-
TRINIDAD VICINITY/WESTERN LAS ANIMAS COUNTY BELOW 7500 FT-
LA JUNTA VICINITY/OTERO COUNTY-EASTERN LAS ANIMAS COUNTY-
LAS ANIMAS VICINITY/BENT COUNTY-LAMAR VICINITY/PROWERS COUNTY-
SPRINGFIELD VICINITY/BACA COUNTY-
INCLUDING...WALSENBURG...TRINIDAD...LA JUNTA...ROCKY FORD...
BRANSON...KIM...LAS ANIMAS...LAMAR...SPRINGFIELD...WALSH
507 PM MDT SUN APR 3 2011

...HIGH WIND WARNING NOW IN EFFECT UNTIL 8 PM MDT THIS EVENING...

THE HIGH WIND WARNING HAS BEEN EXTENDED UNTIL 8 PM MDT THIS
EVENING.

* LOCATION...THE SOUTHERN SOUTHEAST COLORADO COUNTIES...INCLUDING
 OTERO...BENT...PROWERS...LAS ANIMAS...HUERFANO AND BACA.

* CAUSE AND TIMING...A STRONG COLD FRONT WILL SWEEP ACROSS THE
 INTERSTATE 25 CORRIDOR AND SOUTHEAST PLAINS LATE THIS AFTERNOON
 AND EARLY THIS EVENING...STRONG WINDS WILL CONTINUE UNTIL MID
 EVENING...AND THEN GRADUALLY DECREASE.

* WIND...WINDS WILL SHIFT TO THE NORTH AT 50 TO 60 MPH AS A STRONG
 COLD FRONT MOVES BY.

* IMPACT...THESE WINDS CAN ALSO CAUSE POWER DISRUPTIONS AND DOWN
 TREES. THE THREAT OF WILDFIRES IS VERY HIGH TODAY...AND SHOULD
 YOU FIND YOU ARE IN THE PATH OF A FIRE...BE PREPARED TO
 EVACUATE IMMEDIATELY. AREAS OF BLOWING DUST AND REDUCED
 VISIBILITY ARE ALSO POSSIBLE...ESPECIALLY SOUTH OF THE
 ARKANSAS RIVER.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

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

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

&&

$$

COZ089-093>099-031315-
/O.NEW.KPUB.HW.W.0004.110403T1300Z-110404T0000Z/
CROWLEY COUNTY-LA JUNTA VICINITY/OTERO COUNTY-
EASTERN LAS ANIMAS COUNTY-WESTERN KIOWA COUNTY-
EASTERN KIOWA COUNTY-LAS ANIMAS VICINITY/BENT COUNTY-
LAMAR VICINITY/PROWERS COUNTY-SPRINGFIELD VICINITY/BACA COUNTY-
INCLUDING...ORDWAY...OLNEY SPRINGS...LA JUNTA...ROCKY FORD...
BRANSON...KIM...EADS...SHERIDAN LAKE...LAS ANIMAS...LAMAR...
SPRINGFIELD...WALSH
101 AM MDT SUN APR 3 2011

...HIGH WIND WARNING IN EFFECT FROM 7 AM THIS MORNING TO 6 PM MDT
THIS EVENING...

THE NATIONAL WEATHER SERVICE IN PUEBLO HAS ISSUED A HIGH WIND
WARNING...WHICH IS IN EFFECT FROM 7 AM THIS MORNING TO 6 PM MDT
THIS EVENING.

* LOCATION...THE SOUTHEAST PLAINS...INCLUDING
 CROWLEY...OTERO...KIOWA...BENT...PROWERS...BACA AND EASTERN LAS
 ANIMAS COUNTY.

* CAUSE AND TIMING...A STRONG WEATHER DISTURBANCE WILL SPREAD DAMAGING
 WIND GUSTS ACROSS THE SOUTHEAST PLAINS THIS MORNING THROUGH LATE
 THIS AFTERNOON.

* WIND...WEST WINDS 35 TO 45 MPH WITH GUSTS TO AROUND 60 MPH AT
 TIMES.

* IMPACT...THESE WINDS WILL CAUSE STRONG CROSS WINDS ON NORTH
 SOUTH ORIENTED ROADWAYS IN THE AREA.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

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

THESE WINDS CAN CAUSE LIGHTWEIGHT OBJECTS TO BECOME DANGEROUS
AIRBORNE PROJECTILES. HIGH PROFILE VEHICLES AND VEHICLES PULLING

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TRAILERS CAN BE FLIPPED BY CROSSWINDS. BLOWING DUST CAN QUICKLY
REDUCE VISIBILITY TO NEAR ZERO...RESULTING IN HAZARDOUS DRIVING
CONDITIONS AND ACCIDENTS INVOLVING MOTORISTS TAKEN BY SURPRISE.
BLOWING DUST OR SAND CAN ALSO BE A HEALTH HAZARD FOR THOSE WITH
RESPIRATORY PROBLEMS. SECURE LIGHTWEIGHT OBJECTS. AVOID TRAVELING
ON ROADS WITH CROSSWINDS.

&&
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Air Quality Advisory
Colorado Department of Public Health and Environment

Denver Metro/Front Range:
No Advisories - No Action Day

Other Areas:
Blowing Dust Advisory: Strong winds and dry soils will lead to areas of blowing dust between 8 AM and 8 PM on Sunday in southwestern, south-central and southeastern Colorado including Cortez, Durango, Pagosa Springs, Alamosa, Pueblo, Lamar, La Junta, and Springfield. In areas where significant blowing dust is present, unusually sensitive people including the elderly, the very young, and those with respiratory illnesses such as asthma should avoid prolonged exertion; everyone else should limit prolonged exertion.

Appendix D - Final Natural Events Action Plan For High Wind Events, Alamosa, Colorado

FINAL NATURAL EVENTS ACTION PLAN

FOR

HIGH WIND EVENTS

ALAMOSA, COLORADO

Colorado Department
of Public Health
and Environment

CITY OF ALAMOSA,
ALAMOSA COUNTY,
and
COLORADO AIR POLLUTION CONTROL DIVISION
4300 Cherry Creek Drive South
Denver, Colorado 80222-1530
(303) 692-3100

May 2003

I. EXECUTIVE SUMMARY

On March 31 and April 9, 1999 and again on April 18 and December 17, 2000, the monitor located in Alamosa, Colorado recorded exceedances of the 24-hour National Ambient Air Quality Standard (NAAQS) for PM_{10} (particulate matter having a nominal aerodynamic diameter equal to or less than 10 microns). Each of these exceedances was associated with high winds and blowing dust in the Alamosa area.

Recognizing that certain uncontrollable natural events, such as high winds, wildfires, and volcanic/seismic activity can have on the NAAQS, the Environmental Protection Agency (EPA) issued a Natural Events Policy (NEP) on May 30, 1996. The NEP sets forth procedures through the development of a Natural Events Action Plan (NEAP) for protecting public health in areas where the PM_{10} standard may be violated due to these uncontrollable natural events. The guiding principles of the policy are:

1. Federal, State, and local air quality agencies must protect public health;

2. The public must be informed whenever air quality is unhealthy;

3. All valid ambient air quality data should be submitted to the EPA Aerometric Information Retrieval System (AIRS) and made available for public access;

4. Reasonable measures safeguarding public health must be taken regardless of the source of PM_{10} emissions; and,

5. Emission controls should be applied to sources that contribute to exceedances of the PM_{10} NAAQS when those controls will result in fewer violations of the standards.

In response to Alamosa's four exceedances of the PM_{10} NAAQS in 1999 and 2000, the Colorado Department of Public Health and Environment's Air Pollution Control Division (Division), in conjunction with the City of Alamosa, Alamosa County, and other agencies developed a NEAP for the Alamosa area. The referenced NEAP was developed based on Natural Events Policy that calls for states to "develop a NEAP for any area where natural events cause or have caused a PM_{10} NAAQS to be violated within eighteen (18) months of the date of the violation." April 18, 2000 was the triggering event for the development of the NEAP. The referenced NEAP was developed and submitted to EPA in October 2001. A revised version of the NEAP (including U.S. EPA recommendations) was submitted February 2002. A copy of the letter of concurrence for these submittals is available in the Appendix.

The Natural Events Policy also indicates that in attainment areas (such as Alamosa), best available control measures (BACM) must be implemented within three (3) years after the triggering event. With that, this *Final Natural Events Action Plan for Alamosa, Colorado* includes BACM not identified in the February 2002 submittal and includes additional efforts in the community to limit blowing dust and its impacts on public health.

The *Final Natural Events Action Plan* also addresses PM_{10} exceedances experienced in the area that have occurred since the December 17, 2000 event.

The plan provides analysis and documentation of the exceedances as attributable to uncontrollable natural events due to unusually high winds. In addition, the NEAP is designed to protect public health, educate the public about high wind events; mitigate health impacts on the community during future events; and, identify and implement Best Available Control Measures (BACM) for anthropogenic sources of windblown dust.

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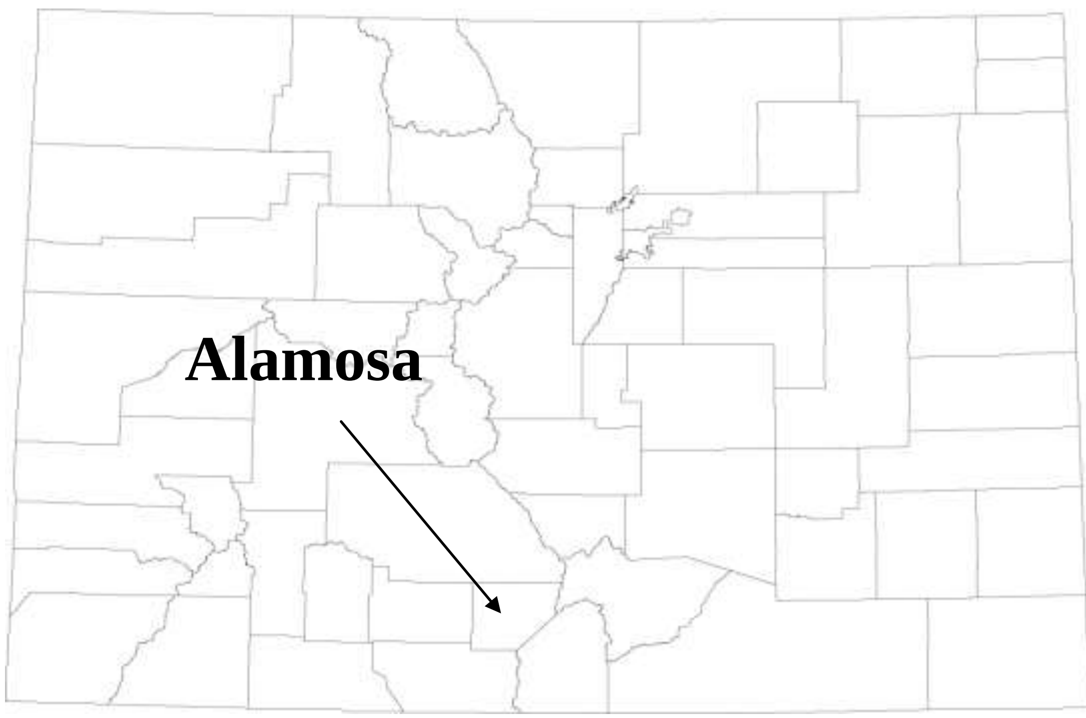
II. INTRODUCTION

The City of Alamosa is located in Alamosa County in south central Colorado. Situated in the San Luis Valley, Alamosa serves as one of the largest cities and the agricultural center for south central Colorado. The area surrounding Alamosa consists of gently rolling to nearly level uplands where the dominant slopes are less than 3 percent. The climate is generally mild and semiarid. Annual precipitation is about 7.5 inches. Summers are considered short and cool, with winters long and cold. In winter and spring, windstorms are common, especially in drier years. It is due to these high velocity windstorms that Alamosa experiences most of the PM_{10} problems for the area.

Area Map



On March 31 and April 9, 1999 and again on April 18 and December 17, 2000 the PM_{10} monitor located on the roof of Alamosa's Adams State College recorded exceedances of the primary 24-hour NAAQS for PM10. The PM_{10} concentrations of 263 $\mu g/m^3$, 190 $\mu g/m^3$, 238 $\mu g/m^3$, and 217 $\mu g/m^3$ respectively, were recorded on these days - as were unusually high wind speeds and little or no precipitation. The circumstances surrounding the Alamosa exceedances has provided adequate reason for the Division to believe the high wind events and blowing dust have caused exceedances of the NAAQS that otherwise would not have occurred.

As required by the NEP, each of the exceedances was flagged by the Division's Technical Services Program in the AIRS system. The flags appear after the recorded values in AIRS with the descriptor code "A" for high winds. According to EPA guidance the type and amount of documentation provided for each event should be sufficient to demonstrate that the natural event occurred, and that it impacted a particular monitoring site in such a way as to cause the PM_{10} concentrations measured. This documentation has been previously submitted to EPA.

Recognizing the need to protect public health in areas where PM_{10} exceeds the NAAQS due to natural events such as the unusually high winds, a Natural Events Action Plan has been developed for the Alamosa area based on the NEP guidance. This plan outlines specific procedures to be taken in response to future high wind events. In short, the purpose of the plan is to:

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

A. Background

High winds are common to the southern region of Colorado. Under some conditions, these winds are strong enough to lift particulate matter into the air and cause elevated levels of PM_{10} above the Federal and State standards. Due to observed problems in Alamosa, particulate monitoring of total suspended particulate pollution was instituted at the Adams State College monitoring site in 1970. In 1989, monitoring for PM10 began.

More recently, an additional monitoring site has been established in the Alamosa area. Specifically, a second PM10 monitor was established at the Alamosa Municipal Building to ensure adequate coverage of local air quality monitoring and to ensure protection of public health. This monitor, like the first PM_{10} monitor at Adams State College, operates on an everyday sampling protocol.

Alamosa's monitoring history shows that the annual PM_{10} standard of 50 $\mu g/m^3$ (averaged over an annual period) has never been exceeded. The 24-hour PM_{10} standard of 150 $\mu g/m^3$ has been exceeded on a number of occasions. However, all exceedances have been due to natural events. The associated weather conditions on each of the exceedance days conform to a repeated pattern of regional high winds and blowing dust. In each case an intense, fast-moving, surface low-pressure system tracked through Colorado. Typically these systems had surface lows that were not collocated with a closed upper low or nearly-closed upper level trough. This distinction is important because the collocated or vertically "coupled" systems usually bring significant up slope snow or rain to the region. The intensity of the lows associated with the PM_{10} exceedances is evident in the average central pressure of 990 mb (corrected to sea level). This value is typical of a deep, well-organized system. Such well-organized systems usually generate high winds in the vicinity of the low center.

The NEP applies only to emissions caused by natural events that have occurred since January 1, 1994. Only those high wind events experienced since that time are addressed by this NEAP. This submittal includes those exceedances occurring since the previous NEAP submittal as well. See table on page 6 for more details of all area exceedances.

B. The Natural Events Policy

1. <u>Background</u>

On May 30, 1996, EPA issued the Natural Events Policy in a memorandum from Mary D. Nichols, Assistant Administrator for Air and Radiation. In this memorandum EPA announced its new policy for protecting public health when the PM_{10} NAAQS are violated due to natural events. Under this policy three categories of natural events are identified as affecting the PM_{10} NAAQS: (1) volcanic and seismic activity; (2) wildland fires; and, (3) high wind events. Only high wind events will be addressed in this NEAP.

Based on EPA's natural events policy high winds are defined as uncontrollable natural events under the following conditions: (1) the dust originated from non-anthropogenic sources; or, (2) the dust originated from anthropogenic sources controlled with best available control measures (BACM). Furthermore, the conditions that create high wind events vary from area to area with soil type, precipitation, and the speed of wind gusts.

2. <u>Content</u>

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

1. Analysis and documentation of the event should show a clear causal relationship between the measured exceedance and the natural event. The type and amount of documentation provided should be sufficient to demonstrate that the natural event occurred, and that it

impacted a particular monitoring site in such a way as to cause the PM_{10} concentrations measured.

2. Establish education programs. Such programs may be designed to educate the public about the short-term and long-term harmful effects that high concentrations of PM_{10} could have on their health and inform them that: (a) certain types of natural events affect the air quality of the area periodically, (b) a natural event is imminent, and (c) specific actions are being taken to minimize the health impacts of events.

3. Minimize public exposure to high concentrations of PM_{10} through a public notification and health advisory program. Programs to minimize public exposure should (a) identify the people most at risk, (b) notify the at-risk population that a natural event is imminent or currently taking place, (c) suggest actions to be taken by the public to minimize their exposure to high concentrations of PM_{10}, and (d) suggest precautions to take if exposure cannot be avoided.

4. Abate or minimize appropriate contributing controllable sources of PM_{10}. Programs to minimize PM_{10} emissions for high winds may include: the application of BACM to any sources of soil that have been disturbed by anthropogenic activities. The BACM application criteria require analysis of the technological and economic feasibility of individual control measures on a case-by-case basis. The NEAP should include analyses of BACM for contributing sources. If BACM are not defined for the anthropogenic sources in question, step 5 listed below is required.

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

6. Periodically reevaluate: (a) the conditions causing violations of a PM_{10} NAAQS in the area, (b) the status of implementation of the NEAP, and (c) the adequacy of the actions being implemented. The State should reevaluate the NEAP for an area every 5 years at a minimum and make appropriate changes to the plan.

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

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

rules are not revised.

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

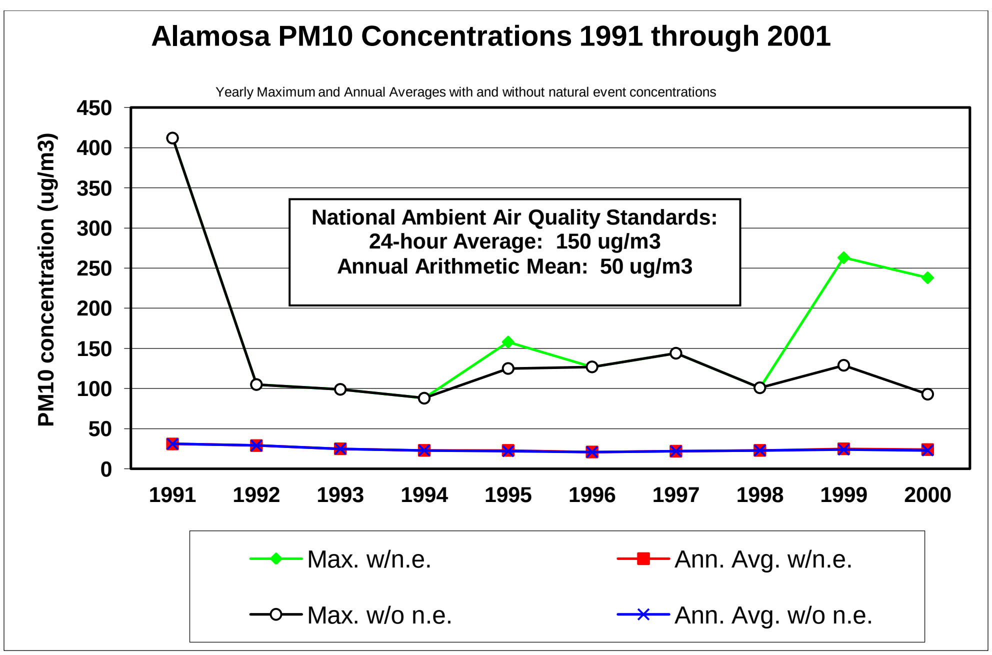
The following text describes the Alamosa NEAP and its conformance with the above-described EPA guidance on natural events.

III. NATURAL EVENTS ACTION PLAN

A. Element 1: Documentation & Analysis

On March 31 and April 9, 1999 and again on April 18 and December 17, 2000, the air quality monitor located in Alamosa, Colorado recorded exceedances of the 24-hour National Ambient Air Quality Standard (NAAQS) for PM_{10} (Figure 1). Each of these exceedances was associated with unusually high winds in the Alamosa area (Table 1).

Figure 1. Recent Alamosa PM10 Concentrations



n.e.- Natural Event

On October 29, 1999 and again on March 30, 2000 the Division submitted documentation to EPA Region VIII in support of Alamosa's most recent exceedances of the PM_{10} NAAQS due to natural events. The documentation contained monitoring data, meteorological data, PM_{10} filter analysis and receptor model results, maps of the area, news accounts of the events and other miscellaneous supporting material. On July 3, 2001, EPA concurred that the aforementioned natural events were, in fact, high wind events (Table 1). The EPA letter of concurrence can be found in the Appendix of this NEAP.

More recently (since the February 2002 submittal), several additional exceedances of the PM_{10} NAAQS have been experienced in the community. These exceedances were recorded at the Adams State site only; none have been seen at the recently sited PM_{10} monitor at the Municipal Complex. Details are included in the table below and documentation for these events is on file with EPA.

Table 1. Recent 24 Hour PM-10 Values in Alamosa Colorado

EVENT Date	**PM-10 Concentration**	***Details***
3/31/99	263 $\mu g/m^3$	Natural Event- EPA concurrence on July 3, 2001
4/9/99	190 $\mu g/m^3$	Natural Event- EPA concurrence on July 3, 2001
4/18/00	238 $\mu g/m^3$	Natural Event- EPA concurrence on July 3, 2001
12/17/00	217 $\mu g/m^3$	Natural Event- EPA concurrence on July 3, 2001
2/8/02	215 $\mu g/m^3$	Natural Event Under EPA consideration
2/25/02	182 $\mu g/m^3$	Natural Event Under EPA consideration
3/23/02	164 $\mu g/m^3$	Natural Event Under EPA consideration
5/21/02	160 $\mu g/m^3$	*Natural Event Under EPA consideration*

Taken together, the supporting documentation establishes a clear, casual relationship between the measured exceedances and the natural events as required by the NEP. On the days of Alamosa's PM_{10} exceedances, unusually high winds and/or wind gusts were experienced over a prolonged period of time. For example, meteorological data in and around the area (Trinidad, Colorado) demonstrate that on April 18, 2000, maximum wind speeds were over 41 miles per hour and gust speeds were as high as nearly 59 miles per hour. Meterological data for the December 18, 2000 event indicate that gusts were as high as 49 miles per hour in the Alamosa area. Both events were coupled with dry periods of weather.

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

The analysis and documentation of the natural high wind events fulfill Element 1 as described on page 3 of this NEAP.

B. Element 2: Public Education Programs

The purpose of this program is to inform and educate the public about the problem. The Division has worked with the City of Alamosa, Alamosa County Commissioners, and interested stakeholders to educate the public about the problems associated with elevated levels of PM_{10} in the Alamosa area. Several meetings have taken place with the City and County governments to discuss these issues and to develop a plan to address future high wind events in Alamosa. Elements of the public education program include: informing the public when air quality in the area is unhealthy; explaining what the public can expect when high wind events occur; what steps will be taken to control dust emissions during future high wind events; and, how to minimize the public's exposure to high concentrations of PM_{10} during high wind conditions. The public notification and education programs will include but are not limited to:

- An informational and health-related brochure has been and will continue to be distributed by the local governments, the Alamosa County Health Nurses, and Alamosa County conservation and agricultural extension agencies to sensitive populations (elderly and local school districts) as well as the general public. Distribution of the *Blowing Dust Health Advisory Brochure* began in March 2000. A copy of this brochure is available in the Appendix. More recent (since the February 2002 submittal of the NEAP) activities include: 1) the revision of the area brochure to highlight additional activities in the community and make the document more reader friendly; 2) a review of the effectiveness of the brochure distribution in the community. The brochure is now available at additional sites in the community (e.g., County Land Use office), and; 3) the development of a Spanish version of the brochure.

- Beginning in February 2002, blowing dust watches and health advisories are being issued by the Alamosa County Public Health Nursing office during the high wind season (see Appendix for details). More recent (since the February 2002 submittal of the NEAP) activities include: 1) expanding the public education effort to include staff from the County Land Use office; 2) meetings with city, county, and local public health nurse to devise improved ways to educate/reach the community regarding blowing dust and its impacts.

- Media press releases for both the print and local radio will be issued in the community as needed. More recent (since the February 2002 submittal of the NEAP) activities include: 1) newspaper articles highlighting the significant impacts of the drought on blowing dust in the Alamosa area (e.g., "Biblical Level Help Needed for Drought," *The Denver Post,* April 22, 2002. This referenced article also highlighted some of the mitigation strategies underway to limit impacts), and; 2) identifying possible Public Service Announcement outlets for additional outreach into the community and the ongoing development of an area press release on the NEAP development and control strategies.

- Meetings have been held to review the requirements of and local involvement in the NEAP. Other meetings will be convened as deemed necessary by State and/or local agencies.

- Advertising at local meetings (e.g. Sunshine Festival - Summer 2003) of ongoing efforts to reduce blowing dust and its impacts. This is new effort not part of the February 2002 submittal.

- Development of a logo/brand to better familiarize area residents to the NEAP and components of that plan including the blowing dust advisory. An example of that logo can be found on the revised *Blowing Dust Health Advisory Brochure,* located in the Appendix. This is new effort not part of the February 2002 submittal.

- Ongoing development of educational materials to be made available through the County's tax announcement (2004). These educational materials will be distributed in the mail alongside tax announcements and are expected to go to all area residents (approximately 13,000 notices). Materials are likely to be in both English and Spanish. This is new effort not part of the February 2002 submittal.

- The Division in conjunction with the area County Public Health Nurse is revising the blowing dust education/notification procedure to highlight public health issues associated with blowing dust.

- Finally, County building inspectors will also educate citizens (home owners and contractors) about blowing dust issues and strategies to minimize such. This will be done in all construction zones in the county and documented as an item on the inspector's checklist of building issues covered during the permitting process. This is new effort not part of the February 2002 submittal.

This section fulfills the requirement of Element 2 as described on page 4.

C. Element 3: <u>Public Notification Program and Health Advisory Program</u>

The Blowing Dust Health Advisory program will notify the public that a high wind/blowing dust event is imminent or currently taking place, and will include an advisory suggesting what actions can be taken to minimize PM_{10} emissions and exposure to high concentrations of particulate matter.

Advisories are issued by the Alamosa area Public Health Nursing office, with forecasting assistance provided by the National Weather Service (Pueblo) and the Colorado Air Pollution Control Division. Since 2002, five (5) advisories have been issued locally. The forecasting methodology, the public education brochure, and a copy of the text of blowing dust forecasts and health advisories are provided in the Appendix.

Alamosa County will be investigating, during 2003, the possibility of modifying the 911 data base for reverse notification of sensitive populations during high wind events. This is new activity not included in the February 2002 submittal.

Finally, high winds are currently being documented to determine if the Division and the local agencies can better address these issues. For example, the Alamosa County Public Health Nursing office maintains records of all blowing wind events and the associated notifications. Included in this analysis is a rudimentary review of the high wind data to identify patterns of events and possible solutions to minimize public exposure. Given the drought conditions affecting the Alamosa area over the past several years, no consistent pattern (outside of extremely dry conditions and lack of rainfall) has been noted. Nonetheless, the Division is committed to continually investigating this issue and improving the advisory as possible. Ongoing review of those records will continue to investigate patterns of the exceedances and the notifications. This is a new activity that was not part of the February 2002 submittal and demonstrates additional efforts by the Division and the local agencies to minimize blowing dust and protect public health.

This section fulfills the requirement of Element 3 as described on page 4.

D. Element 4: <u>Determination and Implementation of BACM</u>

1. <u>BACM Determination</u>

According to the NEP, Best Available Control Measures (BACM) must be implemented for anthropogenic sources contributing to NAAQS exceedances in attainment and unclassifiable areas, like Alamosa. BACM must be in place for those contributing sources within *three years* after the first NAAQS violation attributed to high wind event(s) for sources in the Alamosa area. BACM must be in place no later than April 18, 2003. BACM for PM_{10} are defined (in 59 F.R. 42010, August 16, 1994) as techniques that achieve the maximum degree of emissions reduction from a source as determined on a case-by-case basis considering technological and economic feasibility.

On September 2, 1999 the Division attended several meetings in Alamosa with officials representing the City of Alamosa and Alamosa County Commissioners. Discussed were the monitoring data, meteorological data, potential contributing sources to the high wind events, the development of a NEAP, and possible control measures. In addition, meetings in December 2001 and February 2002 and numerous correspondences at other times have covered the same. The meetings, coupled with the analyses of the supporting documentation, identified two distinct sets of circumstances that lead to Alamosa's high wind/blowing dust exceedances of the PM_{10} NAAQS:

10. High concentrations of PM_{10} caused by a mixture of anthropogenic and non-anthropogenic sources coming largely from outside the area under high wind conditions; and,

2. Prolonged climatic conditions of low precipitation over an extended period of time that act to dry area soils, making them more susceptible to airborne activity under high wind conditions.

Discussions with the community stakeholders also covered local agricultural practices. Alamosa County is a predominately agricultural area where a lack of water, 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.

Other potential contributing sources may include construction sites, wind erosion of open areas, paved and unpaved roads, residential wood burning, and/or open burning. See below for more details on each of these potentially contributing sources and their consideration for BACM.

2. BACM Options Considered

Based on the contributing source analysis and/or in review with community stakeholders, the following BACM options were considered as possible PM_{10} control measures for the community:

a) Street Sweeping Activities- community street sweeping programs have demonstrated effectiveness in other communities. Such activities were considered as a local control measure. Expanding the current street sweeping program was also reviewed.

b) Construction/Demolition Activity – local ordinances to control emissions from construction and demolition sites have been implemented in other parts of the state with good success.

c) Wind Erosion of Open Areas – several practices were reviewed regarding the wind erosion of open areas, including both local and regional efforts.

d) Control of Stationary Source Emissions- as identified elsewhere in this NEAP, a review of stationary sources and their relative contribution to overall PM concentrations was completed. It was determined that six PM-10 sources exist in the area, appearing to contribute a small amount of particulate matter to the overall inventory.

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

Also, periodic assessments to determine if traffic levels on unpaved roads surpass Colorado Regulation No. 1 limits were considered. If daily traffic counts exceed 200 trips per day on unpaved roads, state regulations apply that reduce PM-10 emissions from those roads. Specifically, periodic assessments of traffic levels on unpaved roads within the city limits and within one mile of the city limits were considered. State regulation calls for a road traffic count and dust control plan for roads that exceed the 200 trips threshold.

In addition, Alamosa currently suggests that drivers maintain their vehicles at a slow speed on unpaved roads and other dirt surfaces to reduce dust emissions.

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

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

h) Avoidance of Dust Producing Equipment- The effectiveness of avoiding the use of dust producing equipment has also been considered. Currently Alamosa discourages the use of dust-producing equipment (e.g., leaf blowers) in an effort to reduce PM_{10} emissions and does so through public education and outreach efforts.

(i) Reducing or Postponing Tilling and Plowing or Other Agricultural Practices that Contribute to PM_{10} Emissions- It is well recognized that dust-producing activities such as tilling, plowing, and other agricultural practices increase the amount of PM_{10} released. As such, these control measures were discussed as part of the effort to reduce PM_{10} impacts on Alamosa. Review of existing and potentially future control practices were considered at the local, regional, state, and federal (e.g., Natural Resources Conservation Service) level.

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

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

Alamosa PM_{10} Stationary Source Emissions

To ensure that PM_{10} emissions from local stationary sources are not a significant contributing factor to area exceedances, an emission inventory was prepared and reviewed. Identified stationary sources are as follows: Public Service Company (natural gas/fuel oil plant), Rakhra Mushroom Farm Corporation (coal-fired boilers and one natural gas fired boiler), Rocky Mountain Soils (fugitive dust emissions), Rogers Family Mortuary (crematorium), San Luis Valley Regional Medical Center (biomedical waste incinerator), and Southwest Ready Mix (concrete batch plant). While no emission inventory of natural sources was prepared as part of this NEAP, appreciation for the significant sand dunes at Great Sand Dunes National Monument highlights that these few and limited stationary sources have very little effect on the total PM_{10} emission inventory for the Alamosa area. The following table demonstrates their limited impacts on the total emission estimation.

Alamosa PM_{10} Emission Inventory (circa 2003)

Source	Emissions in lbs/day
Public Service Company of Colorado	44.4
Southwest Ready Mix	4.4
San Luis Valley Regional Medical Center	0.1
Rakhra Mushroom Farm Corp.	11.1
Rocky Mountain Soils, Inc.	11.5
Rogers Family Mortuary	0.5
TOTAL EMISSIONS	***72.1***

Limited Stationary Source Impacts

The largest of these stationary sources, Public Service Company of Alamosa (PSC), is 44.4 pounds per day of particulate matter (as reported to the Colorado APCD). At PSC, the site consists of two turbines that can run on natural gas, #1 fuel oil, #2 fuel oil, or a combination thereof. PSC must stay in compliance with Colorado Air Quality Regulation No. 1 particulate standard. PSC must also meet the state 20% opacity standard.

Other Alamosa area stationary sources have considerably smaller particulate matter emissions than PSC and their own existing control measures in place. For example:

Southwest Ready-Mix has a concrete batch plant in the City of Alamosa. Southwest Ready-Mix has several outside storage piles for their raw materials (sand & aggregate). There exists a sprinkler system at the facility to keep these piles watered. Cement and fly ash are stored in silos, each controlled with a baghouse to capture particulate when the silos are being loaded. When all of the raw materials are loaded into the concrete trucks, 25% of the total water is loaded first, followed by rock, sand, cement, and then the remaining water. This helps to minimize the particulate emissions from the truck during loading. The baghouses are part of the Southwest Ready-Mix permit, and as such are required. This source is also subject to the 20% opacity standard. Finally, Southwest Ready-Mix may be upgrading their baghouses.

San Luis Valley Regional Medical Center has a permit for a biomedical waste incinerator, which is natural gas fired. The incinerator is subject to New Source Performance Standards which limit opacity to 10% and also has a particulate standard. Ash removal from the incinerator must be done in an enclosed area to limit particulate emissions. Ash must be completely enclosed during transport as well.

3. BACM Options Discounted

Several BACM options were discounted from further consideration based on meteorological analysis, on-site inspections, and discussions with local government officials and sources.

Woodburning curtailment was discounted because high wind events are actually beneficial to good atmospheric clearing of particulate matter. In addition, woodburning curtailment was not recognized as an effective control measure on high wind days. Lastly, many of the community citizens rely on woodburning as their sole source of home heating- reducing or eliminating wood burning is thus not an option.

BACM of stationary sources at great distances from the City were discounted as their impacts would be negligible, if seen at all.

Finally, for this revised NEAP (since the February 2002 submittal), the community remains committed to meet BACM in all instances, as feasible. For example, meetings with local officials indicate that the ongoing regional drought may significantly impact the amount of water available as a control measure (e.g., watering of roads to reduce PM_{10}). With that, water restrictions (and related economic impacts of the drought) will likely dictate the utility of this control measure.

4. BACM Implemented

Refer to the stakeholder agreements for details of selected BACM.

IV. STAKEHOLDER AGREEMENTS

The City of Alamosa, Alamosa County, the Division, and participating federal agencies have been working diligently to identify contributing sources and to develop appropriate BACM as required by the Natural Events Policy. A copy of relevant agreements and supplemental information are included in the Appendix**.** This section fulfills the requirements of Element 4 as described on page 4.

City of Alamosa

The City of Alamosa has been active in addressing potential PM_{10} sources within the Alamosa area through various efforts. Some of these efforts, plus other potential future measures, include the adoption of local ordinances to reduce PM_{10}. Copies of current ordinances and any related commitments are included in the Appendix.

Street Sweeping
Currently, the City of Alamosa sweeps on an every 6-week schedule or as needed, as determined by local officials on a case by case situation (e.g., following each snowstorm and/or where sand was applied). Sweeping occurs on every single City street with an emphasis on the downtown corridor where public exposure is expected to be greatest. In fact, street sweeping in the downtown corridor currently takes place three times per week.

In addition, the City recently agreed to lease/own a new TYMCO 600 (brush-assisted head) sweeper. Efforts are underway to get this effective piece of equipment into place immediately. This new sweeper will complement a mobile mechanical sweeper already in use.

Unpaved Roads within the City
While very few unpaved roads exist in the City of Alamosa, the city did recently annex new land. This annexation includes roadways not currently paved. The City of Alamosa is discussing the paving of these annexed roads. At a minimum, the City of Alamosa commits to continually provide in-kind engineering services for the development of the annexed lands.

Sod/Vegetative Cover Projects in the City of Alamosa
The development and construction of a local park, Eastside Park, is underway in Alamosa. It is anticipated that sodding at the park will take place this year. This commitment is anticipated to reduce blowing dust from this previously undeveloped site.

Alamosa County

Alamosa County has also been active in addressing blowing dust and is preparing county ordinance as such. Examples can be found below and available supporting documents in the Appendix.

Unpaved Roads
Alamosa County is presently addressing unpaved roads and lanes that are anticipated to contribute to PM_{10} emissions in the community. As of 2002, Alamosa County was nearing the end of its five-year road paving plan and was developing their next plan with the intention of paving on a yearly basis, based on traffic and community needs/priorities.

In 2002, Alamosa County addressed approximately ten (10) miles of unpaved roads. This includes the stabilization of approximately five section roads, the seal coating of two roads, and the overlay (repaving) of four (4) additional roads.

For 2003, approximately 14 miles of roads are scheduled for paving. This includes the Seven Mile Road (three miles long), Road 109 (one mile long), and 10th Street (also one mile long). These roads are in close proximity to the City of Alamosa, are upwind (prevailing) from the city, and have heavy traffic. Paving is anticipated to greatly reduce blowing dust and impacts in the vicinity.

In addition, once it gets cold enough in the area, the County will wet down some of the more sandy roads. Once the water soaks in and freezes, it is anticipated that good dust suppression will be seen. These commitments are anticipated to reduce PM_{10} emissions in and near Alamosa. This control measure will be balanced with the availability of water in the area.

Finally, Alamosa County assesses the need to use $MgC1_2$ treatment on roads in front of residences that request such service. Assessments include the sensitivity to dust of residents, the materials of the road base for safety reasons, and possible environmental concerns of the neighborhood. Most requests for treatment are granted. Road construction areas are being dampened with water for dust control. Other areas for treatment, such as commercial construction zones or gravel pits, are investigated on a case by case basis.

Dust Control Plans

Alamosa County is considering changes in local ordinances governing dust control plans at construction sites. This will be addressed through the revision of Alamosa County's Comprehensive Plan and supporting zoning codes. Alamosa County is currently reviewing language from other successful dust control programs for inclusion in their local ordinances. The process is due for completion in December 2003 or early 2004 and will specifically include dust control language. This effort is anticipated to reduce PM_{10} emissions in Alamosa, especially as it relates to impacts on the community and high recorded PM_{10} values. The Division commits to providing copies of this language to EPA upon finalization and availability.

Wind Erosion of Open Areas

To reduce PM_{10} emissions from open areas outside of the City limits, low tilling and other soil conservation practices will continue to be utilized in the community. In addition, the community is using in strategic areas the State of Colorado Agricultural Office's program to purchase and plant shelter trees to reduce wind erosion in open areas. These trees have a demonstrated advantage for the community and for air quality. Once the trees reach maturity, it is anticipated that the equivalent of 112 miles of double-rowed trees will be in place.

In addition, there is ongoing planting of trees (approximately 50) on newly developed Alamosa County property south/southwest of Alamosa (prevailing winds from southwest) and the Airport south of Alamosa for added air quality improvement.

These commitments are anticipated to further reduce the PM-10 emissions in Alamosa.

Sod and Vegetative Projects in the County
Numerous projects to reduce blowing dust and its impacts have happened or are happening at the County Airport. For example:

- Through additional grounds maintenance of the 40-acre Alamosa County airport south of the city, grass is being grown for aesthetics and dust control.

- Sodding and the placement of decorative rock and ground cover will be implemented in the landscaping of the Alamosa County property, as well. These measures will directly abate blowing dust at the Airport.

- Also, the widening of the airport's safety areas (250 feet on either side of the runway) is now complete and seeding of natural grasses was incorporated in the project. Trees and grass were incorporated in the approaches to the airport and have provided additional wind-break advantages to South Alamosa.

In other areas where watering is a problem, xeriscape (the use of native drought resistant vegetation and/or rock cover) is being encouraged for County owned property and for all other property owners.

These efforts are anticipated to further reduce PM_{10} emissions in Alamosa.

Open Burning Issues at the County
The Colorado air pollution control laws and regulations prohibit open burning throughout the state unless a permit has been obtained from the appropriate air pollution control authority. In granting or denying any such permit, the authority will base its action on the potential contribution to air pollution in the area, climatic conditions on the day or days of such burning, and the authority's satisfaction that there is no practical alternate method for the disposal of the material to be burned. No open burning is allowed when local wind speeds exceed 5 miles per hour.

Colorado State University Co-Op Extension Office
In response to extremely dry conditions, the need to maintain area topsoil, and reduce impacts, the Colorado State University Co-Op Extension Office of Alamosa County provides the following outreach efforts and recommendations:

- Modification of grazing practices to improve protective crop cover
- Increasing crop residues left in the fields to reduce blowing dust
- Planting of Fall crops to maintain fields
- Application of manure to protect top soils from blowing away
- Staggering of the harvest to minimize blowing dust

- Outreach programs on soil conservation efforts
- Development of outreach/education materials (e.g., news articles, newsletters, fact sheets, etc.), and
- Attendance at Statewide workshop to educate other Co-Op offices to various practices to reduce blowing top soil and minimize impacts

These control strategies are not meant to be enforceable. They are meant only to demonstrate the regional nature of cooperation in addressing blowing dust and its impacts on the community.

Natural Resources Conservation Service
As stated elsewhere in this NEAP, Alamosa County is a predominately agricultural area where limited water, 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. Thus, activities that improve the topsoil and prevent its lifting during high wind events are encouraged. Some notable NRCS and agricultural examples include:

- Cover crops and perennial crops (e.g., alfalfa) are recommended to protect soils;
- NRCS works with area farmers in the development of conservation compliance plans to also protect topsoil;
- NRCS encourages the use of perennial crops or the leaving in place of weeds on the corners of area acreage (instead of tilling that might lead to open, barren lands) to reduce the lifting of topsoil;
- NRCS “cost shares” on conservation practices with local farmers to prevent soil erosion, and;
- The NRCS works with Colorado State University to identify other strategies that minimize blowing dust.

Other successful agricultural practices encouraged in the area include: timing of tillage, crop rotation, amount of crop residue left on the land, and proper water usage.

These control strategies are not meant to be enforceable. They are meant only to demonstrate the regional nature of cooperation in addressing blowing dust and its impacts on the community.

Natural Events Policy guidance indicates that control options must be implemented within three years of the exceedance in question. For Alamosa, BACM must be in place no later than April 18, 2003. This submittal is meant to meet that three year commitment.

This section fulfills the requirement of Element 4.

V. PUBLIC REVIEW AND PERIODIC EVALUATION

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

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

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

- Briefing of the San Luis Valley County Commissioners, "Air Quality Briefing," San Luis Valley County Commissioners' Association Meeting, September 1999.
- "Control Alamosa's Dust? Lots of Luck." Newspaper article appearing in *Pueblo Chieftan* indicating the area is developing a plan (NEAP) to address blowing dust – November 1, 2001.
- Briefing of the Alamosa City Council, "Alamosa Air Quality and the Development of a Local Natural Events Action Plan," a meeting to reintroduce the NEAP to City Council staff, February 6, 2002.
- Placement of *Natural Events Action Plan for Alamosa, Colorado* at the area library (Southern Peaks Public Library) for public review, February 2002.
- "Odd Issues Keep Alamosa Busy." Newspaper article appearing in *Valley Courier* indicating NEAP being developed and available for public review at the Southern Peaks Public Library, February 2002.
- Briefing of the Alamosa City Council, "Alamosa Natural Events Action Plan," a meeting to incorporate comments from the City Council, local stakeholders, and the public, February 20, 2002.
- Briefing of the Colorado Air Quality Control Commission, "Natural Events Action Plan for Alamosa, Colorado," May 2002.
- Briefing of the Colorado Air Quality Control Commission, "Alamosa Natural Events Action Plan – Final Activities," January 2003.
- Public Notice, "Natural Events Action Plan for Alamosa, Colorado" Available for Public Review and Comment at the Public Library, April 2003.
- "Media Advisory" notifying public of upcoming Alamosa City Council meeting to

discuss the NEAP, monthly city council meeting agenda published in the area newspaper, May 2003.

- "Media Advisory" notifying public of City Council meeting to discuss the NEAP, Channel Ten Cable Access Channel Public Service Announcement, May 2003.
- Briefing of the Alamosa City Council, "Final Alamosa Natural Events Action Plan," May 2003.

Periodic Evaluation

EPA's Natural Events Policy guidance requires the state to periodically reevaluate: 1) the conditions causing violations of the PM_{10} NAAQS in the area, 2) the status of implementation of the NEAP, and 3) the adequacy of the actions being implemented. The State will reevaluate the NEAP for Alamosa at a minimum of every 5 years and make appropriate changes to the plan accordingly.

Evaluation of the effectiveness of the NEAP included several key strategies to ensure protection of public health and a robust plan. Strategies included: review of Natural Events Policy in specific relation to the Alamosa community, review of the effectiveness/appropriateness of ongoing control strategies, consideration of new/additional control options, review of meteorological and climatological conditions leading to blowing dust, review of local and regional PM_{10} monitoring data, discussions with other States (e.g., South Dakota, Washington) and Federal (US EPA) personnel regarding NEAP updates and protocols, review of the established emission inventory and identification of any new emission sources, review of the blowing dust advisory protocol and notification records, public/stakeholder meetings and community outreach/education efforts, etc.

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

The Division commits to evaluate the NEAP at a minimum of every five years.

Submittal to EPA

The NEAP was submitted in its initial form to EPA in October 2001. Following EPA comment and input from stakeholders, appropriate changes were made to the NEAP. The Alamosa City Council heard and approved the NEAP in February 2002. Since that period, meetings with local agencies and stakeholders have led to finalization of stakeholder agreements (found elsewhere in the NEAP). The *Final Natural Events Action Plan for Alamosa, Colorado* and its Best Available Control Measures, where feasible, are presented here as required under the Natural Events Policy.

This section fulfills the requirements of Elements 6, 7, 8, and 9 as described on page 4 and 5.

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

REVISED (2003)

NATURAL EVENTS ACTION PLAN FOR

HIGH WIND EVENTS LAMAR, COLORADO

Prepared by:

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and

CITY OF LAMAR PROWERS COUNTY

COMMISSIONERS

I. EXECUTIVE SUMMARY

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

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

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

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

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

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

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II. INTRODUCTION

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

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

Lamar Area PM10 Exceedances

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

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

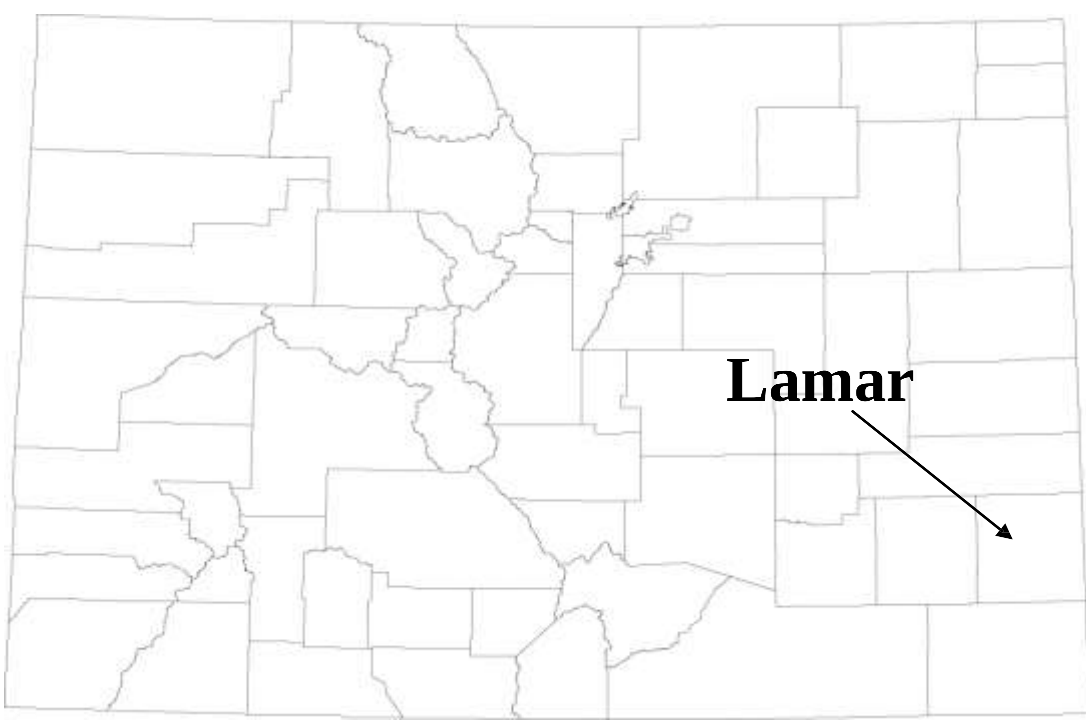
The circumstances surrounding the Lamar exceedances have provided adequate reason for the Division, in consultation with the City of Lamar and Prowers County, to believe the blowing dust due to high wind events have caused exceedances of the NAAQS that otherwise would not have occurred.

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

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

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

Plan Area



A. Background

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

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

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

B. The Natural Events Policy

1. Background

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

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

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

2. Content

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

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

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

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

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

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

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

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

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

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

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

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

III. NATURAL EVENTS ACTION PLAN

Element 1: Documentation & Analysis

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

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

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

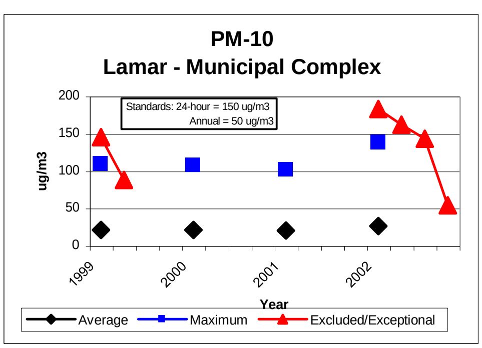
Taken together, the supporting documentation establishes a clear, casual relationship between the measured exceedances and the natural events as required by the NEP. On the days of Lamar's PM10 exceedances, unusually high winds and/or wind gusts were experienced over a prolonged period of time. On March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

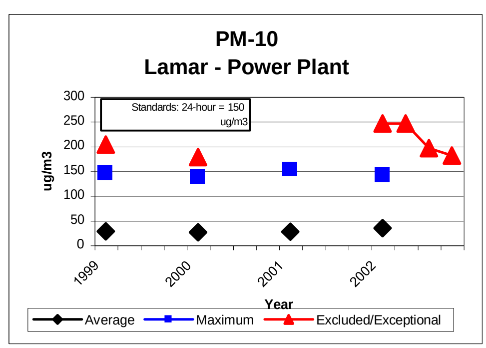
an hourly wind speed average of 31.1 mph and six consecutive hours of winds blowing from the west at 24 -
31.1 mph. On January 17, 1996, eleven consecutive hours of strong north winds blew from between 21-28 mph. The strongest wind gust recorded that day was 41.5 mph. No precipitation was measured either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

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

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

Lamar Area Exceedances at Both Municipal Complex and Power Plant





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

Element 2: Public Education Programs

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

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

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

- Numerous public meetings have also been conducted. Additional activities/commitments of this revised (2003) NEAP include: 1) To gauge community understanding of air quality issues, a local focus group was convened. Through this focus group, an air quality survey was developed to further gauge community awareness and willingness to address other air quality issues. A copy of the survey is included in the Appendix, and; 2) Division staff have participated in local events (e.g., County Fair) to pass out high wind/blowing dust literature and answer questions related to the NEAP and local control strategies to minimize PM10 exposure.

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

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

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

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

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

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

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

Advisories will be issued by the Lamar area Environmental Health Southeastern offices with forecasting assistance provided by the Division and the National Weather Service. The forecasting methodology - approved as part of the 1998 NEAP submittal and agreed to all parties listed elsewhere in this NEAP -alongside the public brochure and the forecasting and health advisory protocols are included in the appendix.

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

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

Element 4: <u>Determination and Implementation of BACM</u>

1. <u>BACM Determination</u>

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

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

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

- Prolonged climatic conditions of low precipitation over an extended period of time that act to dry area soils making them more susceptible to airborne activity under high wind conditions.

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

BACM Options Considered

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Lamar Stationary Sources Emission Inventory

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

Current Lamar PM10 Emission Inventory (circa 2003)

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

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

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

BACM Options Discounted

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

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

<u>BACM Implementation</u>
Refer to the stakeholder agreements for details on the selected BACM.

III. STAKEHOLDER AGREEMENTS

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

<u>City of Lamar</u>

The City of Lamar has been very active in addressing potential PM10 sources within the Lamar area through efforts such as sodding baseball fields, implementing and enhancing a street sweeping program, and chip-seal paving of many unpaved roads. In addition to these type of control measures already taken by the City, the Public Works Department implemented the following BACM within the area:

1. *Wind Break*

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

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

2. *Landfill Shutdown*

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

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

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

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

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

3. *Vegetative Cover/Sod*

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

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

4. *Additional Public Works Projects*

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

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

Burlington-Northern/Santa Fe Rail Line

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

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

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

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

USDA: NATURAL RESOURCES CONSERVATION SERVICE

1. *Conservation Reserve Program*

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

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

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

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

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

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

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

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

2. *Limestone-Graveyard Creeks Watershed Project*

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

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

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

3. *New Initiatives*

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

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

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

COLORADO STATE UNIVERSITY CO-OP EXTENSION OFFICE

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

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

PROWERS COUNTY

Prowers County Land Use Plan

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

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

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

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

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

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

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

PUBLIC REVIEW AND PERIODIC EVALUATION

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

Stakeholder Involvement

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

Public Review

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

- "Air Quality Documentation in Support of High Wind Events in Lamar available for Public Review/Comment at the Lamar Public Library…" February 1997

- Briefing of the Prowers County Board of Commissioners, February 1997

- "Media Advisory" notifying the public of upcoming Lamar City Council meeting to discuss the NEAP, January 1998

- Briefing the Lamar City Council, January 1998

- Dissemination of the "Blowing Dust Health Advisory Brochure - Lamar Area" through the Southeast Land and Environment offices, January 1998 through the present

- Briefing of the Colorado Air Quality Control Commission, February 1998

- "Lamar Area Air Quality Natural Events Action Plan to be Available for Public Review" at the Lamar Public Library and Lamar City Complex - February 6 through March 6, 1998" this notice was published in the Lamar Daily News on February 6, 1998

- Briefing of the Lamar City Council on the PM10 Maintenance Plan, including a discussion of the Maintenance Plan's relationship to attainment status and the use of other air quality tools (e.g., Lamar NEAP), August 2000

- "Media Advisory" notifying the public of an upcoming Lamar area meeting to discuss air quality issues. This notice ("Lamar Air Quality Topic of Public Meeting Tonight") was published in the Lamar Daily News, August 29, 2000

- Local meeting with public to discuss air quality issues in the Lamar area including the planned PM10 Maintenance Plan, the area Natural Events Action Plan, and other initiatives to reduce blowing dust and its impacts on the public, August 2000

- Briefing of the Prowers County Board of Commissioners on the PM10 Maintenance Plan including a discussion of the Maintenance Plan's relationship to attainment status and the use of other air quality tools (e.g., Lamar NEAP), August 2000

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

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

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

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

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

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

- Briefing the Lamar City Council, April 2003

Periodic Evaluation

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

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

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

Submittal to EPA

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

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

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

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

3. NEP. p. 8.

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

5. NEP. p. 9.

6. NEP. p. 5.

7. NEP. p. 5.

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