State of Kansas
Exceptional Event Demonstration Package
Wichita and Topeka, KS
October 18, 2012

Department of Health and Environment
Division of Environment
Bureau of Air

July 14, 2014

This document contains blank pages to accommodate double-sided printing.

EXECUTIVE SUMMARY

In 2005, the Environmental Protection Agency (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 10, 2013, in an attempt to clarify this rule, EPA released interim 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 National Ambient Air Quality Standards (NAAQS), if EPA concurs with the demonstration submitted by the flagging agency.

Kansas, due to its geographical location and continuing extremely dry conditions is more susceptible to windblown dust events. These events are occasionally captured by various air quality monitoring equipment throughout the state, sometimes resulting in exceedances of the PM_{10} (airborne particulate matter having a nominal aerodynamic diameter less than or equal to 10 microns) NAAQS. The Kansas Department of Health and Environment (KDHE) believes that the dust event that occurred during the Fall of 2012 exemplifies these types of events. This document contains detailed information about the windblown dust event that affected the Wichita and Topeka PM_{10} monitoring sites on October 18, 2012. On this day, four monitors in Wichita exceeded the PM_{10} 24-hour NAAQS. In addition, the Topeka monitoring site, although it did not exceed the 24-hour standard, experienced several hourly data readings above the standard. KDHE contends that the exceedances that were measured October 18, 2012, at the Wichita monitoring sites and several hours of exceeding values at the Topeka monitor were the result of natural events that were not reasonably controllable or preventable. This document describing the October 18, 2012 dust event was a collaborative effort involving staff from the Kansas Department of Health and Environment's Bureau of Air. Additionally, KDHE staff consulted with staff from the National Weather Service offices in Wichita and Topeka to acquire expert advice and assist with the collection of informational data.

Section 1 of this document provides a summary of the exceptional event rules and requirements and lays out how those rules are met within this specific document.

Section 2 of this document introduces the conceptual model of the meteorological events that transpired during October 18, 2012, providing a background narrative of the exceptional event.

Section 3 of this document provides data summaries and time series graphs which help illustrate that the event of October 18, 2012 produced PM_{10} concentrations in excess of normal historical fluctuations.

Section 4 of this document details the existing PM_{10} controls in place (including area agricultural control measures) and demonstrates that despite the presence of these controls, the event of October 18, 2012 was not reasonably controllable or preventable.

Section 5 of this document establishes a clear causal connection between the natural events of October 18, 2012 and the exceedances of the 24-hour PM_{10} standard at the

monitoring stations. The evidence in this section (and the previous section on historical fluctuations) also confirms that the events in question both affected air quality and were the result of natural events.

Section 6 of this document builds upon the demonstration showing a clear causal connection between the natural event and the exceedances and concludes there would have been no exceedance on October 18, 2012 but for the presence of the natural events.

Section 7 contains conclusions that summarize the exceptional event that occurred on October 18, 2012, and relates the requirements in the EER to the information within this document.

Table of Contents

Section **Page**

List of Figures

Figure **Page**

List of Tables

Table **Page**

1. Exceptional Event Rule (EER) 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 document lays out the requirements of the EER and associated guidance, and discusses how the Kansas Department of Health and Environment (KDHE) addressed those requirements.

1.1 Procedural Requirements

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 KDHE 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), the notification of EPA of the intent to flag through 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. KDHE has addressed all of these procedural and documentation requirements.

1.1.1 Public notification that event was occurring (40 CFR 50.14(c)(1(i))

In Kansas, the National Weather Service (NWS) offices issue high wind warnings, dust advisories and dust warnings to the public. On October 18, 2012, the Wichita NWS issued a high wind warning advising citizens of high winds and dust during the day and evening across their entire forecast area. As part of this process, KDHE has worked with the NWS offices and has developed additional health related language to add to their warning products. This is discussed in more detail in Appendix F. The Wichita NWS forecast products, along with neighboring NWS sites, that were issued on October 18, 2012, are included in Appendix B.

1.1.2 Place informational flag on data in AQS (40 CFR 50.14(c)(2)(ii))

KDHE submits data into EPA's AQS. Data from both filter-based and continuous monitors operated in Kansas are submitted to AQS.

When KDHE suspects that data may be influenced by an exceptional event, KDHE 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. KDHE also submits data from continuous monitors into AQS after quality assurance is complete.

If KDHE has determined a potential exists that the monitor reading has been influenced by an exceptional event, a preliminary flag is submitted for the measurement in the AQS. The data are not official until they undergo more thorough quality assurance and quality control, leading to certification by May 1st of the year following the calendar year in which the data were collected (40 CFR 58.15(a)(2)). The presence of the flag can be confirmed in AQS.

1.1.3 Notify EPA of intent to flag through submission of initial event description by July of the calendar year following event (40 CFR 50.14(c)(2)(iii))

KDHE submitted a letter to EPA on February 25, 2013 listing the day from calendar year 2012 that KDHE intended to analyze under the Exceptional Events Rule. The exceedances that occurred on October 18, 2012, at the Wichita and Topeka sites were included. This document serves as the demonstration supporting the flagging of this data.

1.1.4 Document that the public comment process was followed for event documentation (40 CFR 50.14(c)(3)(iv))

KDHE posted this document on the KDHE webpage for public review. KDHE opened a 30-day public comment period on August 1, 2014. A copy of the public notice, along with any comments received, will be submitted as part of this document, consistent with the requirements of 40 CFR 50.14(c)(3)(iv). See Appendix A for a copy of the public notice and comments.

1.1.5 Submit demonstration supporting exceptional event flag (40 CFR 50.14(a)(1-2))

At the close of the comment period, and after KDHE has had the opportunity to consider any comments submitted on this document, KDHE will submit this document, the comments received, and KDHE's responses to those comments to EPA Region VII headquarters in Lenexa, Kansas. The deadline for the submittal of this demonstration package is December 31, 2015.

Table 1-1. Kansas monitor with PM_{10} concentrations exceeding 150µg/m^3 in October 2012.

Monitor	AQS Site Code	Date in 2012	Observed hours exceeding 150 µg/m3 (LST)	Observed 24-Hour Particulate Matter Concentration (µg/m^3)
Glenn & Pawnee (Sedgwick Co.)	20-173-0009	October 18	12:00-22:00	199.2
G. Washington & Skinner (Sedgwick Co.)	20-173-0008	October 18	12:00-22:00	193.3
Health Dept. (Sedgwick Co.)	20-173-0010	October 18	12:00-23:00	197.4
K96 & Hydraulic (Sedgwick Co.)	20-173-1012	October 18	12:00-22:00	176.5
KNI (Shawnee Co.)	20-177-0013	October 18	15:00-17:00	67.8

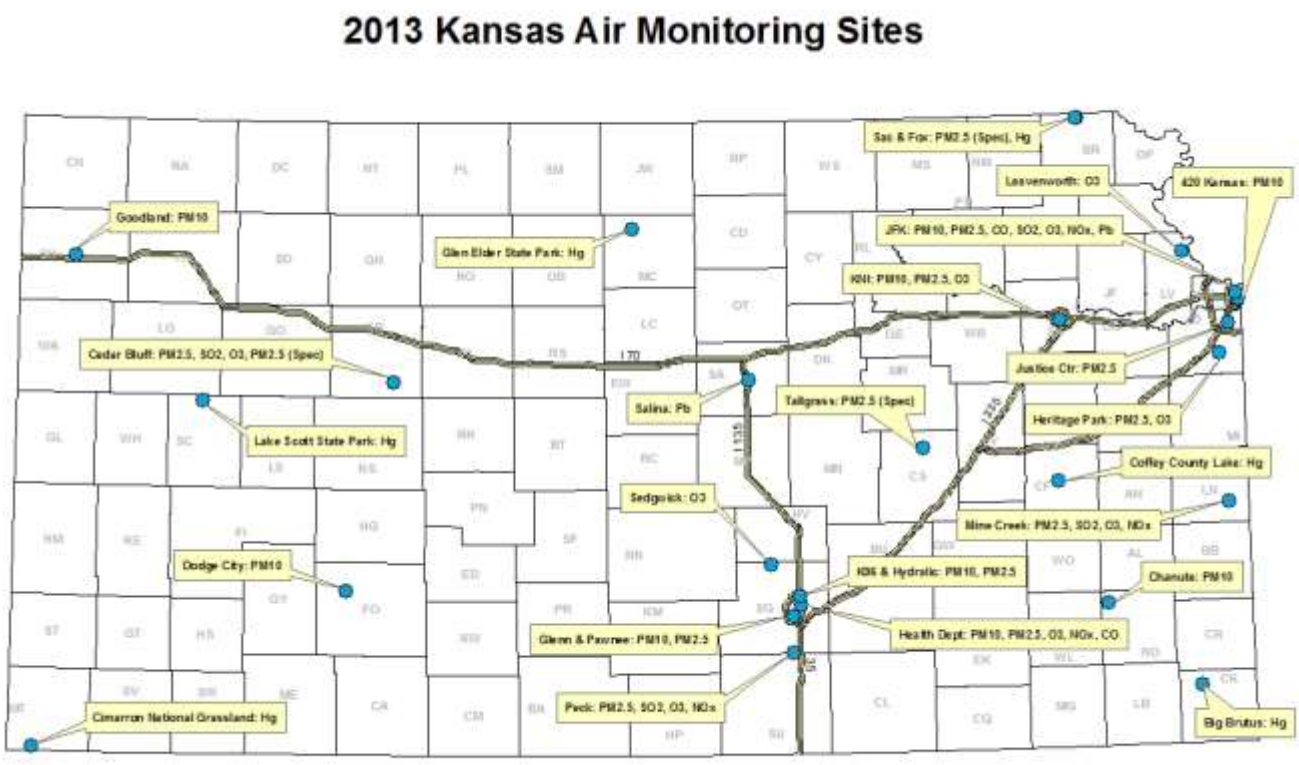


Figure 1-1. Kansas ambient air quality monitoring sites.

1.2 Documentation Requirements

Section 50.14(c)(3)(iii) 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.

Section 2 of this document introduces the conceptual model of the meteorological events that transpired on the actual event of October 18, 2012, providing a background narrative of the exceptional event and an overall explanation that "the event affected air quality". Further evidence that "the event affected air quality" is provided in Section 5. Sections 2 and 5 also provide evidence that the event was a natural event.

Section 3 of this document provides data summaries and time series graphs which help illustrate that the event of October 18, 2012 produced PM_{10} concentrations in excess of normal historical fluctuations.

Section 4 of this document details the existing area control measures (including agricultural control measures) and demonstrates that despite the presence of these controls, the event of October 18, 2012 was not reasonably controllable or preventable.

Section 5 of this document establishes a clear causal connection between the natural event of October 18, 2012 and the exceedances of the 24-hour PM_{10} standard at the monitoring stations. The evidence in this section (and the previous section on historical fluctuations) also confirms that the events in question both affected air quality and were the result of natural events.

Section 6 of this document builds upon the demonstration showing a clear causal connection between the natural event and the exceedances and concludes there would have been no exceedance on October 18, 2012 but for the presence of the natural events.

2. Conceptual Model

2.1 Geographic Setting and Climate

This section describes the geographic and climatic setting of the monitors.

2.1.1 Geographic Setting of Monitors

2.1.1.1 Sedgwick County - Wichita

Sedgwick County is in the southcentral part of Kansas (Figure 2-1). It occupies 646,022.4 acres, or 1,009.41 square miles. The topography of the county is characterized by the extreme flatness of the broad Arkansas River valley and the gently rolling slopes rising to the uplands adjacent to the valley. The highest point in the County, about 1,540 feet above sea level, is on its west edge, about 5 miles southwest of Andale. The lowest point, about 1,220 feet above sea level, is where the Arkansas River leaves the County to the south.

Wichita, the county seat, is located at 37°41′20″N 97°20′10″W (37.688889, -97.336111) at an elevation of 1,299 ft (396 m). It has a population of 385,577 and the county population is 503,889 (2012, Census Bureau). The city lies on the Arkansas River near the western edge of the Flint Hills in the Wellington-McPherson Lowlands region of the Great Plains. The city is located at the junction of Interstate 35 and U.S. Route 54 and is 157 mi (253 km) north of Oklahoma City, 181 mi (291 km) southwest of Kansas City, and 439 mi (707 km) east-southeast of Denver. Wichita's principal industrial sector is manufacturing, which accounted for 21.6 percent of area employment in 2003. Aircraft manufacturing has long dominated the local economy, and plays such an important role that it has the ability to influence the economic health of the entire region (Figure 2-2). The breakdown of land mass is as follows: Agricultural Vegetation – 331,178 ac; Shrubland & Grassland – 139,383 ac; Developed & Other Human Use – 117,527 ac; Forest & Woodland – 23,005 ac; Recently Disturbed or Modified – 22,058 ac; and Open Water – 12,859 ac.

Figure 2-1. Location of Sedgwick County and Wichita, Kansas

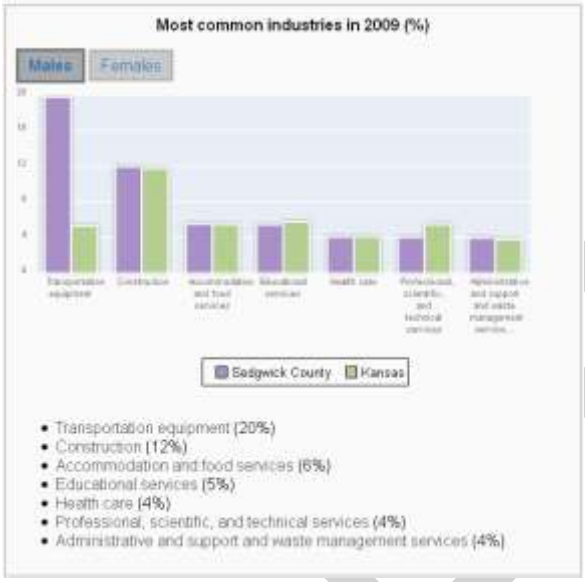


Figure 2-2. Most Common Industries in Sedgwick County, Kansas

2.1.1.2 Shawnee County – Topeka

Shawnee County is in the northeast part of Kansas (Figure 2-3). It occupies 356,044.8 acres, or 556.32 square miles. Topographically, Shawnee county is a high plateau, frequently cut by valleys of varying size. There is a total range of elevation of over 350 feet. The lowest point, where the Kansas river leaves the county, is about 800 feet, and the highest, in the southwestern corner, is over 1,150 feet above sea level.

Topeka, the county seat and state capitol, is located at 39°03′21″N 95°41′22″W (39.055833, -95.689444) at an elevation of 945 ft (288 m). It has a population of 127,939 and the county population is 178,991 (2012, Census Bureau). It is situated along the Kansas River in the central part of Shawnee County. Topeka is located at the intersection of I-70 and U.S. Highway 75. It is the origin of I-335 which is a portion of the Kansas Turnpike running from Topeka to Emporia, Kansas. Topeka is also located on U.S. Highway 24 and U.S. Highway 40 and is 59 mi (96 km) west of Kansas City, 128 mi (205 km) northeast of Wichita, and 154 mi (248 km) south of Omaha. Topeka's principal industrial sector is construction, which accounted for 10 percent of area employment in 2003 (Figure 2-4). The breakdown of land mass is as follows: Agricultural Vegetation – 163,822 ac; Shrubland & Grassland – 78,348 ac; Developed & Other Human Use – 61,450 ac; Forest & Woodland – 45,300 ac; Open Water – 6,230 ac; and Recently Disturbed or Modifiied – 832 ac.

Figure 2-3. Location of Shawnee County and Topeka, Kansas

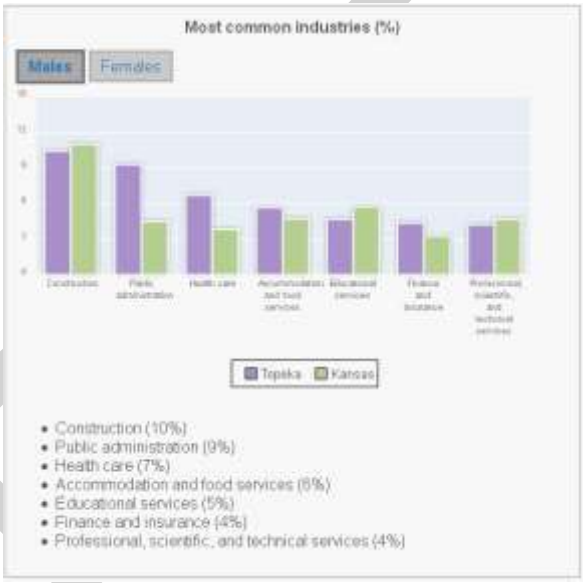


Figure 2-4. Most Common Industries in Shawnee County, Kansas

2.1.2 Climate

2.1.2.1 Sedgwick County - Wichita

Wichita lies in the northern limits of North America's humid subtropical climate zone, typically experiencing hot, humid summers and cold, dry winters. Located on the Great Plains far from any large moderating influences such as mountains or large bodies of water, Wichita often experiences severe weather with thunderstorms occurring frequently during the spring and summer months (Figure 2-5). These occasionally bring large hail as well as frequent lightning, and tornadoes sometimes occur. Winters are cold and dry, but, since Wichita is located roughly midway between Canada and the Gulf of Mexico, cold spells and warm spells are equally

frequent. Warm air masses from the Gulf of Mexico can raise mid-winter temperatures into the 50s and even 60s while cold, frigid air masses from Canada can plunge the temperature far below 0°F. Wind speed in the city averages 13 mph (21 km/h). On average, January is the coldest month, July is the hottest month, and June is the wettest month.

The average temperature in the city is 56.9°F (13.8°C). Over the course of a year, the monthly daily average temperature ranges from 32.2°F (0.1°C) in January to 81.1°F (27.3°C) in July (Figure 2-6). The high temperature reaches or exceeds 90°F (32°C) an average of 62 days a year and 100°F (38°C) an average of 12 days a year. The minimum temperature falls to or below 10°F (−12°C) on an average 8.5 days a year. During an average year, Wichita receives 32.69 inches (830 mm) of precipitation, most of which occurs in the warmer months, and experiences 88 days of measurable precipitation. The average relative humidity is 80% in the morning and 49% in the evening. Annual snowfall averages 15.6 inches (40 cm). Measurable snowfall occurs an average of ten days per year with at least an inch of snow being received on five of those days. Snow depth of at least an inch occurs an average of 15 days a year.

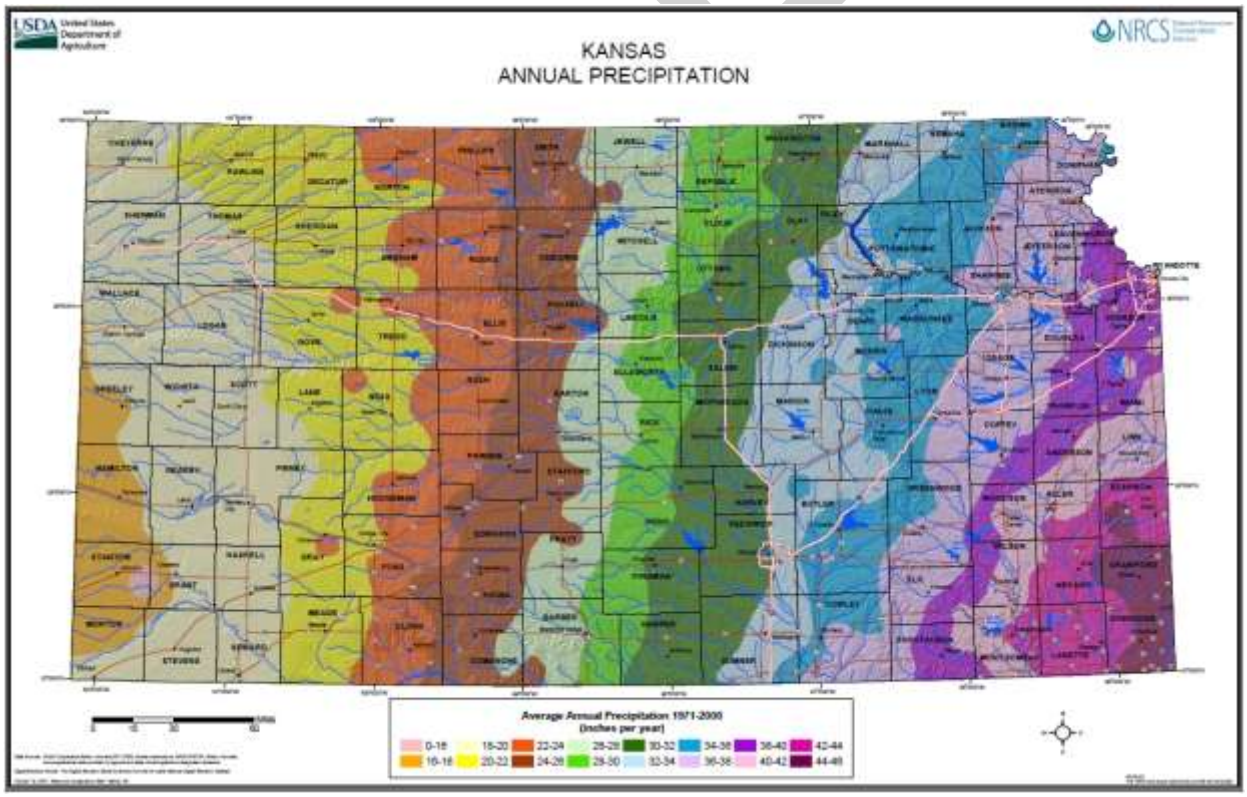


Figure 2-5. Kansas Annual Precipatation (USDA, NRCS)

Climate data for Wichita, Kansas

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °F (°C)	75 (24)	87 (31)	92 (33)	98 (37)	100 (38)	110 (43)	113 (45)	114 (46)	108 (42)	97 (36)	86 (30)	83 (28)	114 (46)
Average high °F (°C)	43 (4)	48 (7)	58 (12)	68 (17)	77 (22)	87 (29)	93 (32)	91 (31)	83 (26)	70 (19)	56 (10)	44 (5)	68 (20)
Daily mean °F (°C)	33 (1)	37 (3)	47 (8)	57 (14)	66 (19)	76 (24)	82 (28)	80 (27)	72 (22)	59 (15)	46 (8)	34 (1)	57.4 (14)
Average low °F (°C)	22 (−6)	26 (−3)	35 (2)	45 (7)	55 (13)	65 (18)	70 (21)	69 (21)	60 (16)	47 (8)	35 (2)	24 (−4)	46 (7.7)
Record low °F (°C)	−15 (−26)	−22 (−30)	−3 (−19)	15 (−9)	27 (−3)	43 (6)	51 (11)	45 (7)	31 (−1)	14 (−10)	1 (−17)	−16 (−27)	−22 (−30)
Precipitation inches (mm)	0.83 (21.1)	1.23 (31.2)	2.69 (68.3)	2.59 (65.8)	4.57 (116.1)	5.20 (132.1)	3.32 (84.3)	3.71 (94.2)	3.14 (79.8)	2.78 (70.6)	1.43 (36.3)	1.20 (30.5)	32.69 (830.3)

Source: National Weather Service

Figure 2-6. Climatology data for Wichita, Kansas (NWS)

2.1.2.2 Shawnee County - Topeka

Topeka lies in the transition between a humid continental and humid subtropical climate, with hot, somewhat humid summers and cool to cold, fairly dry winters. Over the course of a year, the monthly daily average temperature ranges from 29.7 °F (−1.3 °C) in January to 79.0 °F (26.1 °C) in July (Figure 2-7). The maximum temperature reaches 90 °F (32 °C) an average of 41.5 days per year and reaches 100 °F (38 °C) an average of 3.5 days per year. The minimum temperature falls below 0 °F (−18 °C) an average of 4 nights per year, and there are 21 days per year that stay below freezing. The average window for freezing temperatures is October 15 thru April 17.

The area receives nearly 36.5 inches (930 mm) of precipitation during an average year, with the largest share being received in May and June—the April through June period averages 33 days of measurable precipitation. Generally, the spring and summer months have the most rainfall, with autumn and winter being fairly dry. During a typical year the total amount of precipitation may be anywhere from 25 to 47 inches (64 to 120 cm). Much of the rainfall is delivered by thunderstorms. These can be severe, producing frequent lightning, large hail, and sometimes tornadoes. There are an average of 100 days of measurable precipitation per year. Winter snowfall is light, as is the case in most of the state, as a result of the dry, sunny weather patterns that dominate Kansas winters, which do not allow for sufficient moisture for significant snowfall. Winter snowfall averages almost 17.8 in (45 cm). Measurable (≥0.1 in or 0.25 cm) snowfall occurs an average of 12.9 days per year, with at least one inch (2.5 cm) of snow being received on five of those days. Snow depth of at least an inch occurs an average of 20 days per year.

Climate data for Topeka, Kansas (Topeka Municipal Airport), 1981–2010 normals [hide]													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °F (°C)	77 (25)	84 (29)	93 (34)	97 (36)	103 (39)	109 (43)	114 (46)	113 (45)	110 (43)	97 (36)	85 (29)	77 (25)	114 (46)
Average high °F (°C)	39.9 (4.4)	45.0 (7.2)	56.4 (13.6)	66.7 (19.3)	75.9 (24.4)	84.7 (29.3)	89.5 (31.9)	88.6 (31.4)	80.4 (26.9)	68.4 (20.2)	54.6 (12.6)	41.7 (5.4)	66.0 (18.9)
Average low °F (°C)	19.6 (−6.9)	23.8 (−4.6)	33.3 (0.7)	43.5 (6.4)	54.2 (12.3)	63.7 (17.6)	68.4 (20.2)	66.2 (19)	56.3 (13.5)	44.7 (7.1)	33.0 (0.6)	22.3 (−5.4)	44.1 (6.7)
Record low °F (°C)	−23 (−31)	−25 (−32)	−7 (−22)	10 (−12)	26 (−3)	36 (2)	43 (6)	40 (4)	29 (−2)	16 (−9)	−5 (−21)	−26 (−32)	−26 (−32)
Precipitation inches (mm)	.86 (21.8)	1.32 (33.5)	2.49 (63.2)	3.53 (89.7)	4.91 (124.7)	5.40 (137.2)	3.82 (97)	4.24 (107.7)	3.66 (93)	3.03 (77)	1.85 (47)	1.35 (34.3)	36.46 (926.1)
Snowfall inches (cm)	5.3 (13.5)	5.0 (12.7)	1.6 (4.1)	.3 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	.3 (0.8)	1.0 (2.5)	5.2 (13.2)	18.7 (47.6)
Avg. precipitation days (≥ 0.01 in)	5.5	6.3	9.0	9.7	11.6	11.5	8.7	8.6	7.8	8.1	6.8	6.0	99.6
Avg. snowy days (≥ 0.1 in)	3.6	3.0	1.4	.3	0	0	0	0	0	0	1.2	3.4	12.9
Mean monthly sunshine hours	176.7	169.5	213.9	231.0	269.7	294.0	325.5	291.4	234.0	213.9	159.0	151.9	2,730.5
Source #1: NOAA (extremes 1887–present),[23][24] HKO (sun only, 1961–1990)[25]													
Source #2: Weather.com (extremes)[26]													

Figure 2-7. Climatology data for Topeka, Kansas (NWS)

Strong storm systems that move through the area from the west can lead to very strong winds and resultant blowing dust. The nature of these frontal dust events is such that specific source areas are difficult to determine as strong winds associated with low pressure systems can carry dust over vast distances encompassing many source areas. Because of this, it is more appropriate to speak of general source regions for these dust storms. A vast majority of the PM_{10} impacting the Wichita and Topeka areas from this low pressure driven high wind event during October 18, originated outside of these areas. The contributing source regions to the dust event were somewhat widespread, but the majority of the PM that was transported into Sedgwick and Shawnee Counties likely came from areas of eastern Montana, eastern Wyoming, western Nebraska and western Kansas to the north and and west of Sedgwick and Shawnee Counties. The exact origin of the PM sources is often difficult to determine due to the less dense monitoring networks in the general source area.

Another important factor that contributed to this significant dust storm was the on-going long term drought across the High Plains. The October 16, 2012 U.S. Drought Monitor placed a large area of western Kansas (Figure 2-8), eastern Colorado (Figure 2-9), much of Nebraska (Figure 2-10), southern South Dakota (Figure 2-11), eastern Wyoming (Figure 2-12), and southeastern Montana (Figure 2-13) in an area in D2 (Severe) to D4 (Exceptional) drought. In addition, as can be seen in Figure 2-14, most of the High Plains states were in exceptional drought conditions at this time. In fact, rainfall in most of Kansas since the beginning of the April of 2012 leading up to the October 18th dust event had been 50-60% of normal (Figure 2-15). As will be discussed in other sections of this document, these are all potential source regions for the dust event on October 18. The abnormally dry conditions resulted in a large area of soils that were vulnerable to particulate suspension.

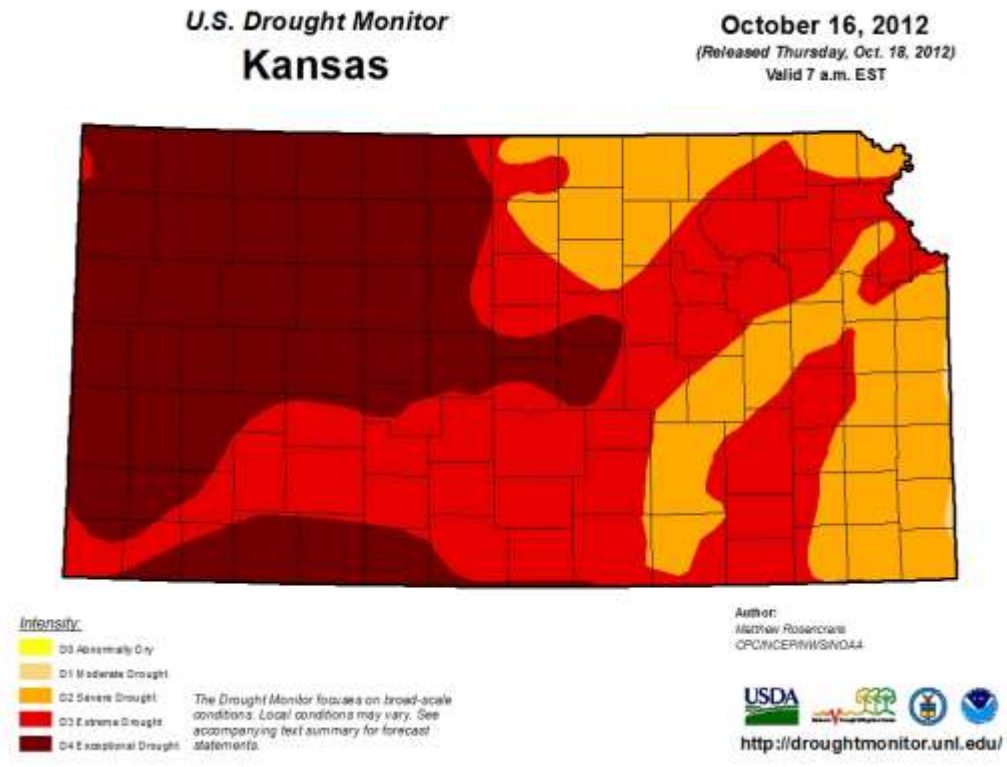


Figure 2-8. U.S Drought Monitor Data for Kansas October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

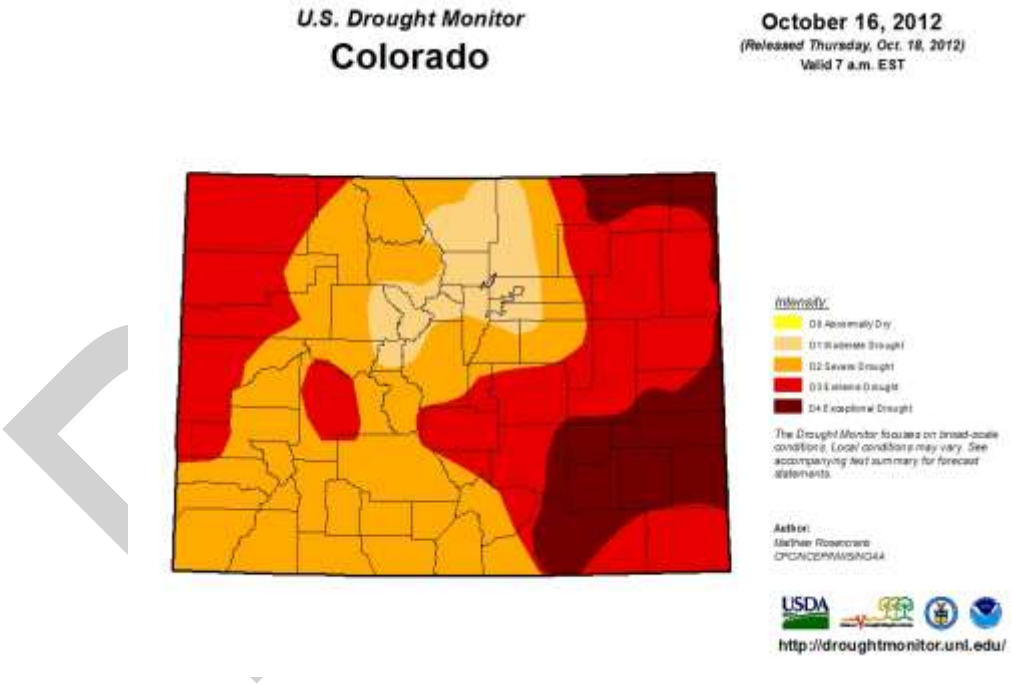


Figure 2-9. U.S. Drought Monitor Data for Colorado October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

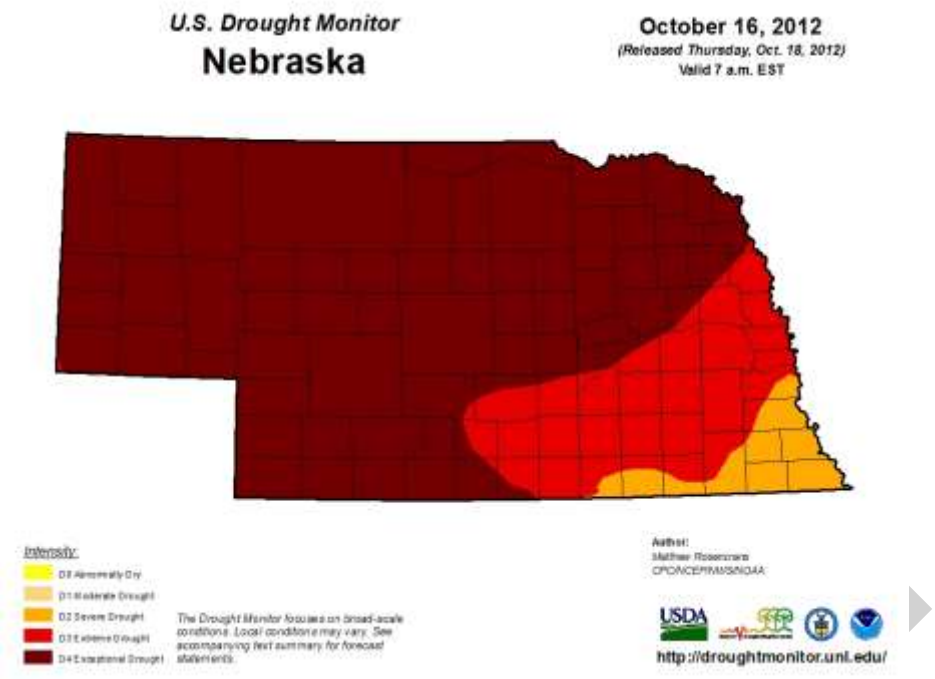


Figure 2-10. U.S. Drought Monitor Data for Nebraska October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

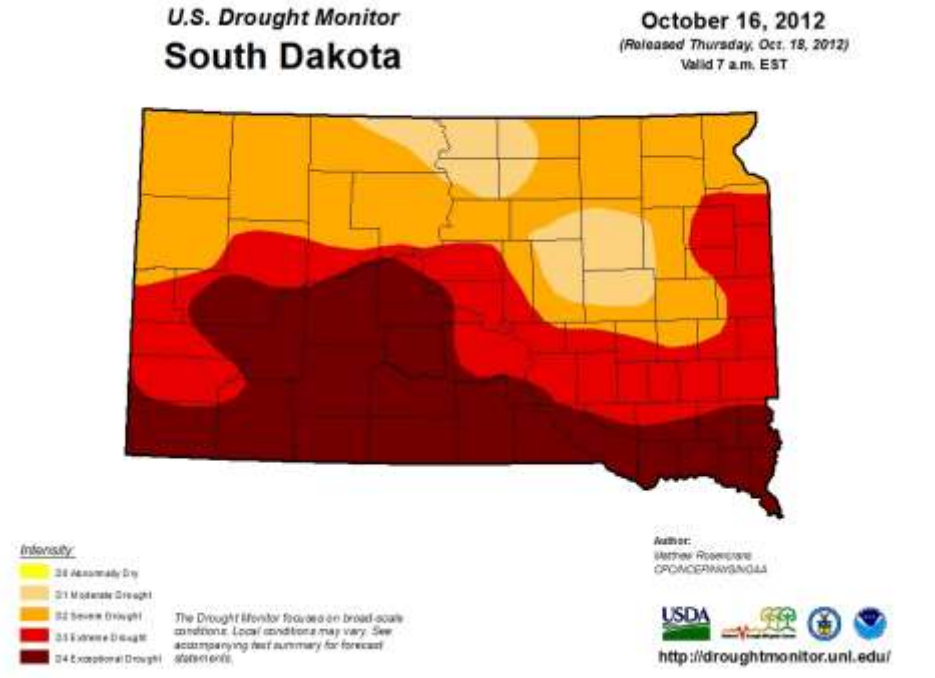


Figure 2-11. U.S. Drought Monitor Data for South Dakota October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

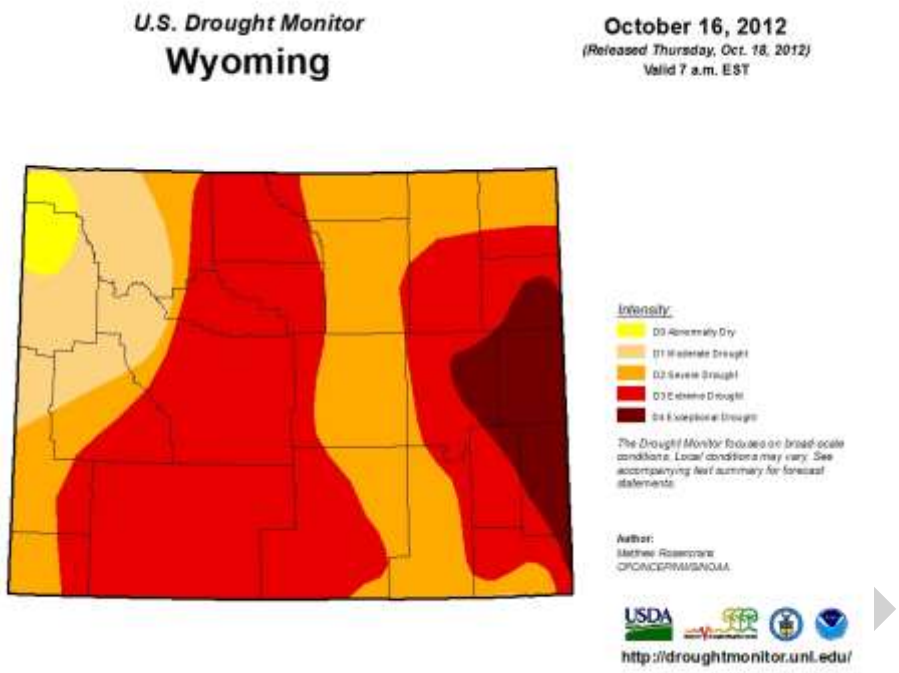


Figure 2-12. U.S. Drought Monitor Data for Wyoming October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

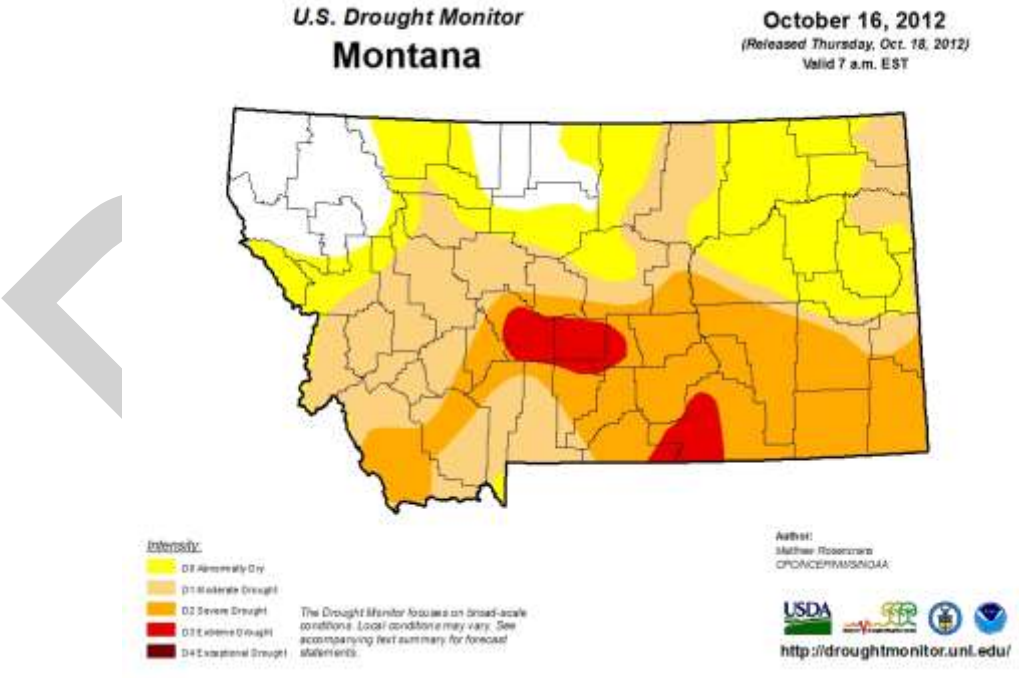


Figure 2-13. U.S. Drought Monitor Data for Montana October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

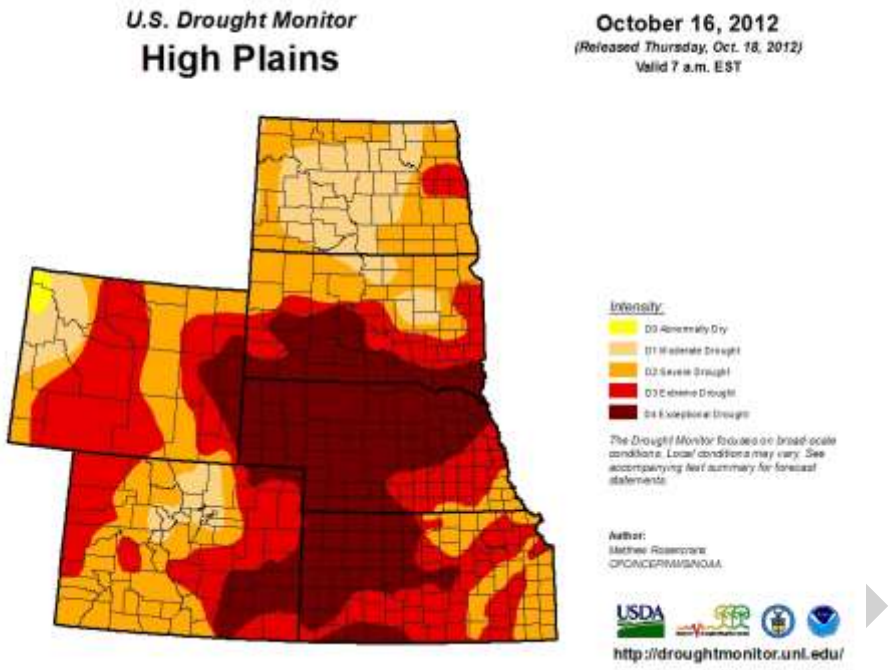


Figure 2-14. U.S. Drought Monitor Data for the High Plains October 16, 2012 (National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA))

Month of September Kansas Climate Division Precipitation Summary (inches)												
Climate Division	October 18-24			January 1 to October 24			April 1 to October 24			September 1 to October 24		
	Actual	Normal	Percent Normal	Actual	Normal	Percent Normal	Actual	Normal	Percent Normal	Actual	Normal	Percent Normal
Northwest	0.00	0.26	0	11.25	18.78	59	9.66	16.53	58	1.48	2.73	53
West Central	0.00	0.24	0	11.33	18.23	61	9.23	15.97	57	1.89	2.79	67
Southwest	0.00	0.24	0	13.56	17.85	75	10.96	15.67	69	2.96	2.75	109
North Central	0.00	0.42	0	17.32	24.68	69	14.28	21.39	66	2.82	4.54	62
Central	0.00	0.50	0	18.17	25.94	70	14.20	22.28	64	2.91	4.85	60
South Central	0.00	0.48	0	19.63	25.34	77	13.99	21.57	65	2.46	4.85	51
Northeast	0.00	0.65	0	21.42	31.54	68	16.61	27.41	61	3.37	6.68	50
East Central	0.00	0.72	0	21.42	32.56	66	15.46	27.84	55	4.97	6.87	71
Southeast	0.00	0.79	0	28.67	33.45	85	20.78	27.93	74	5.58	7.16	76
STATE	0.00	0.47	0	18.2	25.2	70	13.94	21.67	63	3.2	4.76	68
Note: 1971-2000 normal value, 100 percent =normal Source: KSU Weather Data Library												

Figure 2-15. Kansas Climate Division Precipitation Summary 2012 (KSU Weather Data Library)

2.2 Event Summary

To analyze the specific conditions on the day before and including the day when the 24-hour PM_{10} concentrations exceeded the standard (150.0µg/m^3) at the Wichita monitoring stations, in addition to several hours of readings above the standard at the Topeka air

monitoring station in October 2012, air quality and meteorological data were first collected from a wide variety of sources (Table 2-1). These sources were selected because of their high standards for data quality. Additional meteorological parameters, such as vector average winds and daily maximum temperatures, were calculated as necessary. Table 2-2 describes why these data are needed to understand and explain the processes that may lead to dust event conditions.

Table 2-1. Data types and sources used in the Exceptional Events analysis.

Type of Data	Source(s)	Location(s)	Date Range
Air Quality Data: 1-hour PM_{10} 24-hour PM_{10}	KDHE	Kansas air quality monitors	Jan. through Dec., 2008-2012
Surface meteorological data (METAR[a])	National Weather Service (NWS)	All available Kansas sites and surrounding states sites	Jan. through Dec., 2008-2012
Upper-air meteorological data (radiosonde)	NWS	Dodge City, KS (KDDC), Topeka, KS (KTOP), North Platte, NE (KLBF), Omaha, NE (KOAX), Rapid City, SD (KRAP)	October 2012
Surface and upper-level weather maps	NWS, Plymouth Weather Center, Hydrometeorological Prediction Center	National and regional	October 2012
Visible and infrared satellite imagery	NWS	National	October 2012
Daily MODIS[b] Visible satellite imagery	SSEC[c]	National	October 2012

[a] Meteorological Terminal Aviation Routine Weather Report
[b] Moderate Resolution Imaging Spectroradiometer
[c] Space Science and Engineering Center, University of Wisconsin-Madison

Table 2-2. Description of processes that influence particulate levels.

Type of Data	Relation to Particulate Levels
Surface wind speeds	Surface wind data were used to assess pollutant dispersion. Strong winds can result in higher PM levels in the atmosphere.

Trajectories (HYSPLIT[a])	Trajectory analysis was used to assess transport of pollutants. Air parcels originating in or passing through regions of higher pollution levels (e.g., dust) indicate potential transport of pollutants to downwind locations.
Upper-air soundings	Soundings were used to assess atmospheric stability (and inversions) and the likelihood that dust would remain in the lower levels of the atmosphere as opposed to being mixed into aloft layers. Confirming that the dust would most likely remain in the lower layers of the atmosphere also provides guidance on which trajectory levels are appropriate to assess dust transport.
Upper-level weather maps	500 mb weather maps were used to determine the locations of upper-level ridges and upper-level troughs.
Surface weather maps	Surface weather maps were used to determine the positions of high- and low-pressure systems and frontal boundaries in relation to the impacted monitors. These meteorological features are the primary drivers of surface wind speed and direction, and thus of pollutant dispersion and transport.
Satellite imagery	Satellite imagery was used to assess potential dust at the impacted monitors.
PM_{10} and visibility	Particle concentrations from air quality monitors and visibility observations from airports were collected to assess the presence of dust at air quality monitors.

[a] Hybrid Single Particle Lagrangian Integrated Trajectory Model

High winds can entrain and transport particulate matter (PM) to a monitoring site. These particles can consist of both PM_{10} (i.e., particles less than or equal to 10 micrometers (µm) in diameter) and $PM_{2.5}$ (i.e., particles less than 2.5 µm in diameter). High wind dust events can include both PM_{10} and $PM_{2.5}$. During the period from October 17-18, 2012, a potent storm system was moving through the northern plains.

2.2.1 October 17, 2012

On October 17, 2012, a strong storm system was located in the Northern Plains with two 988 millibar surface low pressures centered in southwest Minnesota and southern Manitoba, Canada. A large area of high pressure was also building eastward from the Pacific Northwest to Arizona as can be seen in the 12z October 17, 2012 (7a.m. CDT October 17) surface analysis in Figure 2-16. In addition, the low pressure system in the northern plains was associated with a strong upper level low located over southeastern Saskatchewan which is shown in Figure 2-17, the 500-millibar analysis for 12Z October 17, 2012 (7a.m. CDT October 17). These features and their accompanying circulations were beginning to generate strong northerly winds over the Northern Great Plains by 7 p.m. on October 17 (Figure 2-18).

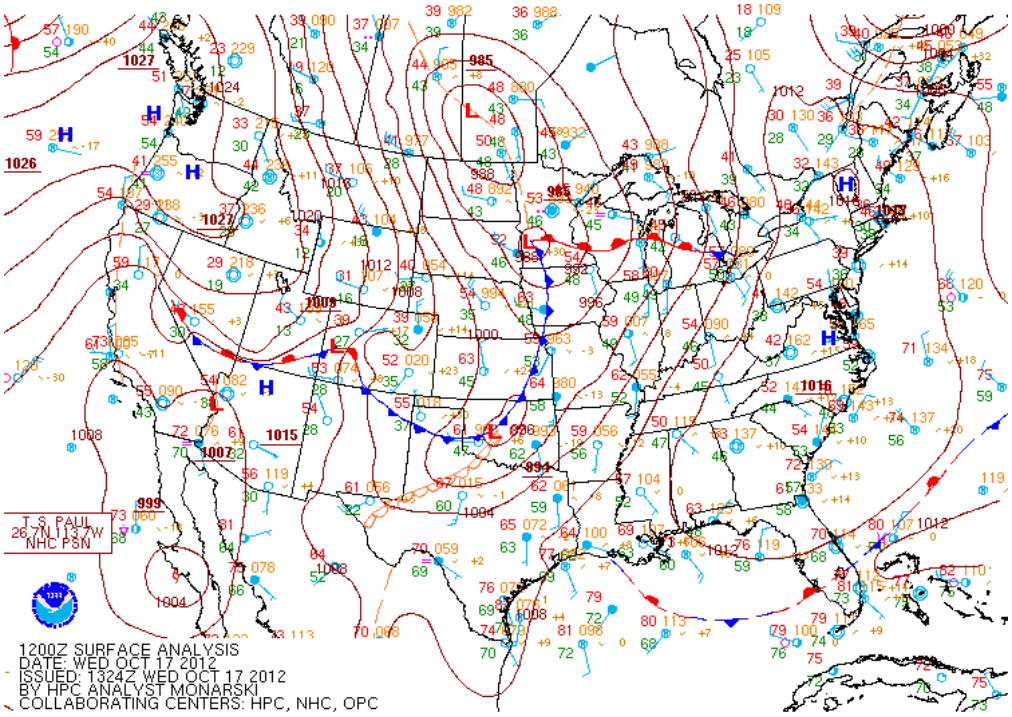


Figure 2-16. Surface analysis for 12Z October 17, 2012 (7a.m. CDT October 17)(Hydrometeorological Prediction Center)

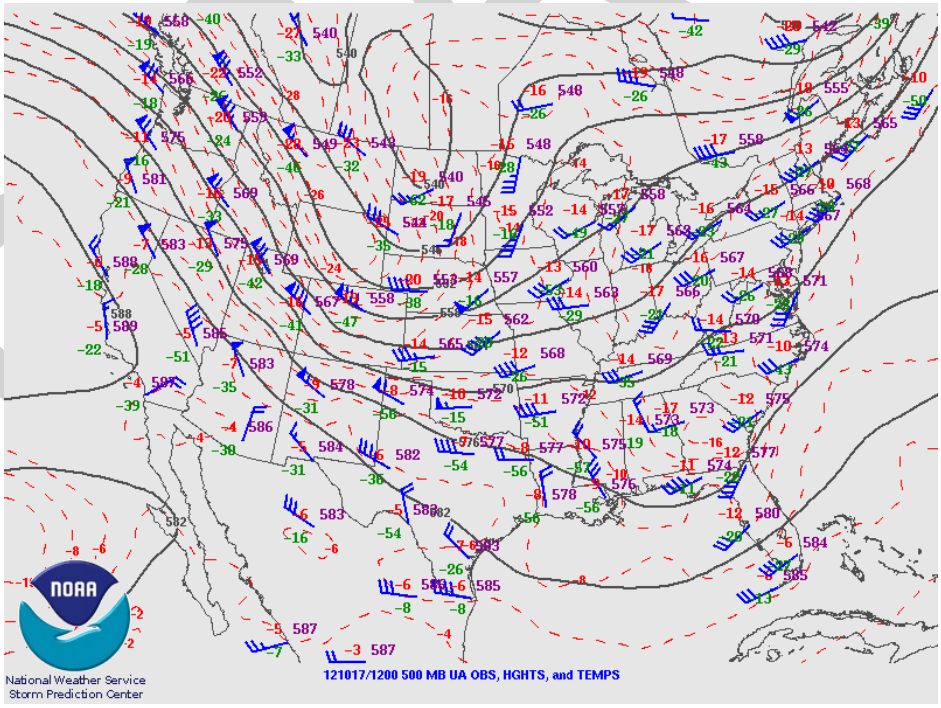


Figure 2-17. 500 mb analysis for 12Z October 17, 2012 (7a.m. CDT October 17) (NOAA-SPC)

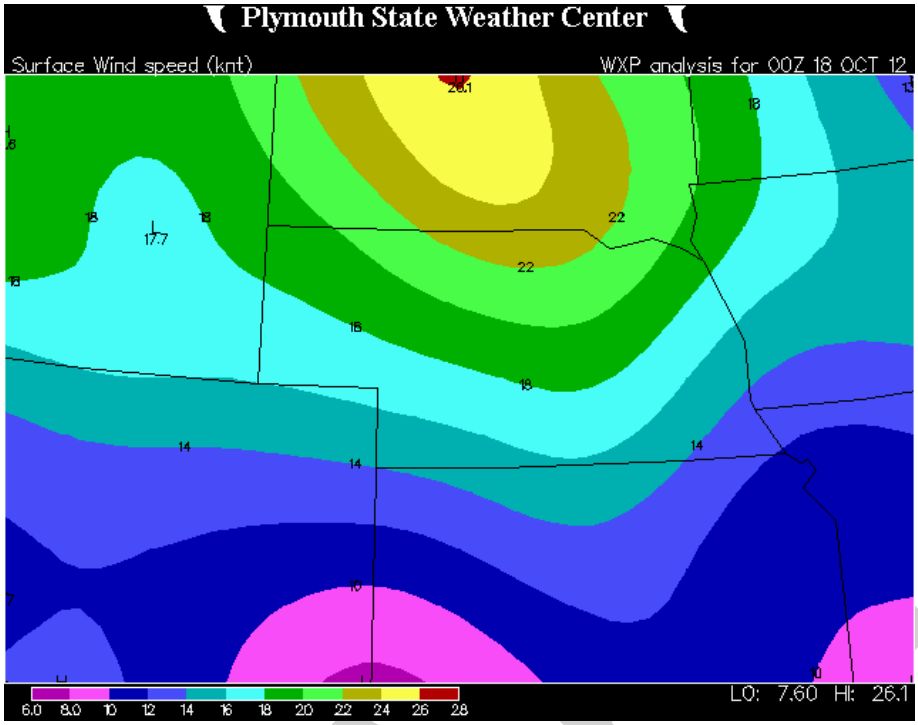


Figure 2-18. Surface wind speed (kts) for 00Z October 18, 2012 (7p.m. CDT October 17)(Plymouth State Weather Center)

2.2.2 October 18, 2012

On Thursday October 18, 2012, four air monitoring sites in Wichita, Kansas recorded exceedances of the 24-hour PM_{10} standard with concentrations of 199.2 µg/m^3, 193.3 µg/m^3, 197.4 µg/m^3 and 176.5 µg/m^3. The Wichita PM_{10} monitoring stations are sited at the following locations: the roof of the fire station at Glenn and Pawnee Streets, the roof of the fire station at G. Washington and Skinner Streets, in the parking lot of the Health Department and near the Coleman plant at K-96 and Hydraulic Ave. (Figure 2-19). Several hours of elevated continuous one-hour maximum PM_{10} readings were also recorded at the Topeka KNI monitor (Figure 2-20) with a maximum one-hour PM_{10} concentration of 241.1 µg/m^3. This monitor is located on the grounds of the Kansas Neurological Institute. The 24-hour PM_{10} concentrations at the Wichita monitoring sites were above the 99th percentile concentrations for their locations.

These exceedances and the elevated readings were the consequence of very strong gusty winds behind a deep low pressure system in the Northern Plains and building high pressure to the Rocky Mountains, in combination with dry conditions which caused significant blowing dust across parts of South Dakota, Nebraska, Colorado, Oklahoma, and Kansas. The winds were the result of two 988-millibar surface low pressure systems centered over Northern Wisconsin and far western Minnesota with a cold front trailing to the south as shown in the 12Z October 18, 2012 (7a.m. CDT October 18, 2012) surface analysis in Figure 2-21. The low pressure systems over Wisconsin and Minnesota remained nearly stationary during much of the day and had begun to decrease slightly in intensity as shown in the 00Z October 19, 2012 (7p.m. CDT October 18, 2012) surface analysis in Figure 2-22.

Figure 2-19. Wichita, KS PM_{10} Monitoring site locations (Google Earth)

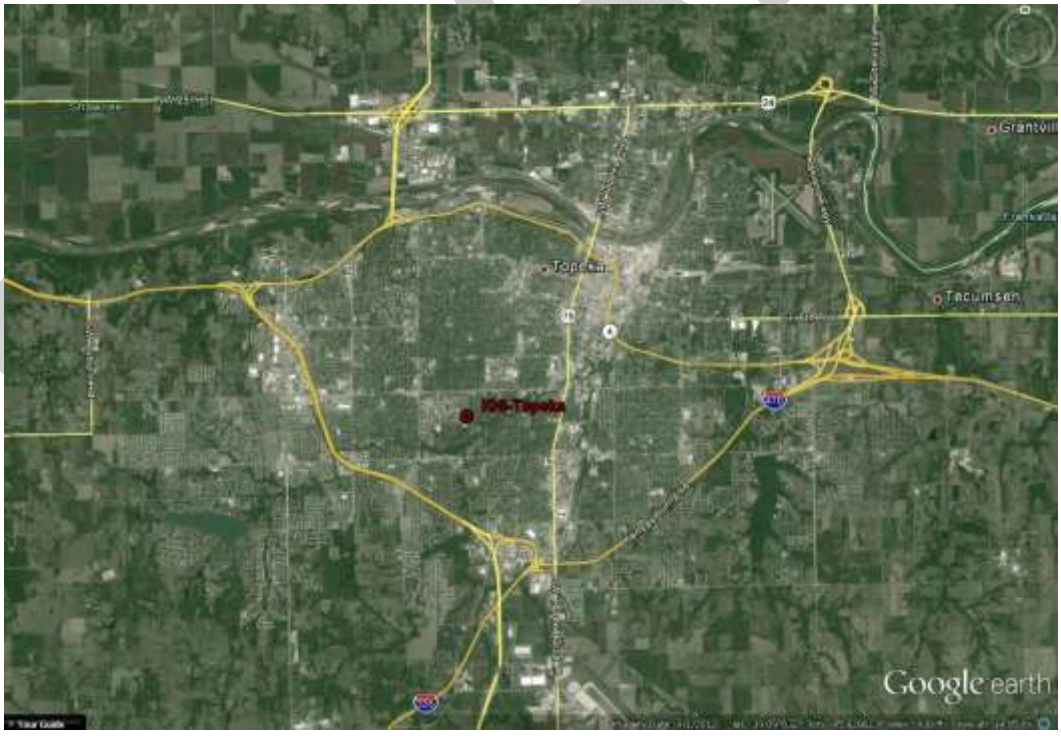


Figure 2-20. Topeka, KS PM_{10} Monitoring site location (Google Earth)

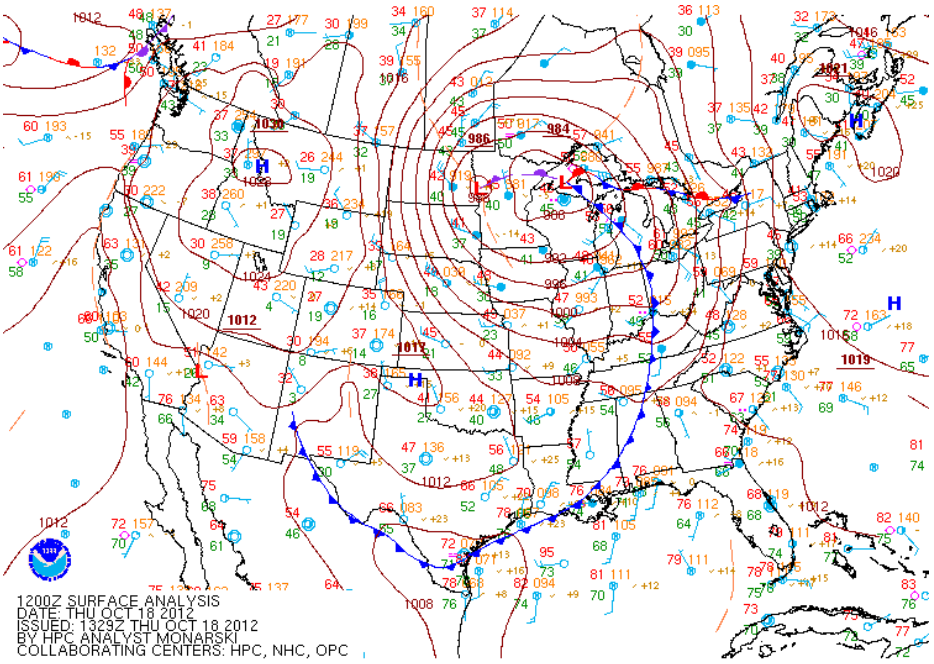


Figure 2-21. Surface analysis for 12Z October 18, 2012 (7a.m. CDT October 18)(Hydrometeorological Prediction Center)

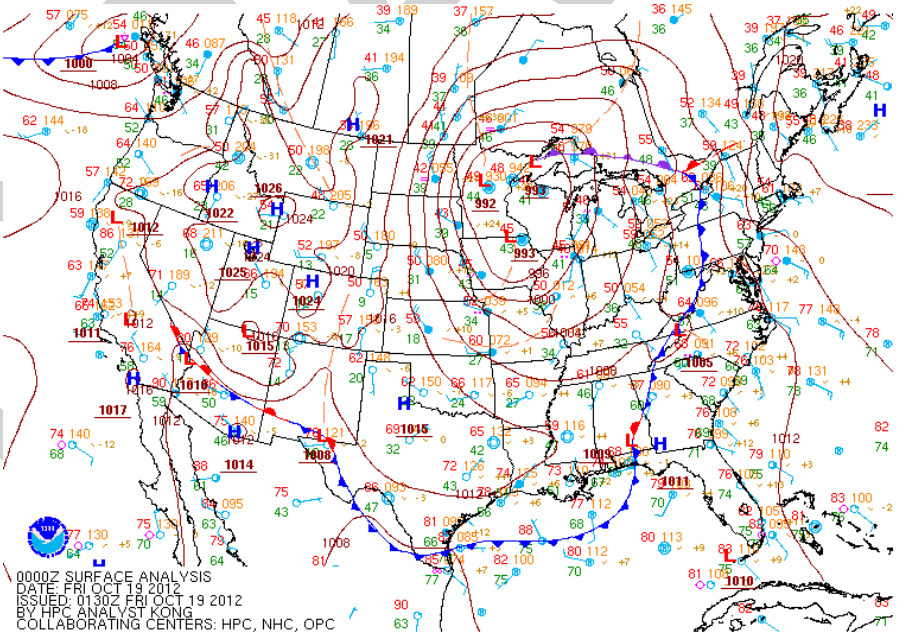


Figure 2-22. Surface analysis for 00Z October 19, 2012 (7p.m. CDT October 18)(Hydrometeorological Prediction Center)

These surface features were also associated with a strong upper level low moving into southern Minnesota which is shown in Figure 2-23, the 500-millibar analysis for 12Z October 18, 2012 (7a.m. CDT October 18, 2012). There was a localized wind maximum of 100 knots over southeast Kansas which was rotating around the base of this upper level low. Once the morning inversion lifted to a higher level, the momentum associated with these winds would have mixed down to the surface and enhanced the winds associated with the strong low pressure systems in Figure 2-22. Strong west to northwest winds continued blowing across the southern and central Great Plains, with sustained winds reaching over 34kts (37mph) in portions of northern and central Nebraska and a large area over 30kts (35mph) stretching from the Dakotas to northern Kansas by 3p.m. (Figure 2-24).

In addition, the National Weather Service offices across the region, including Goodland, KS, Dodge City, KS, Amarillo, TX, Norman, OK, Pueblo, CO and Wichita, KS. all had issued either high wind advisories or warnings with blowing dust throughout the day into the evening on this day. A couple of examples of these products are show in Figures 2-25 and 2-26 and all regional NWS products from October 18, 2012 are contained in Appendix B.

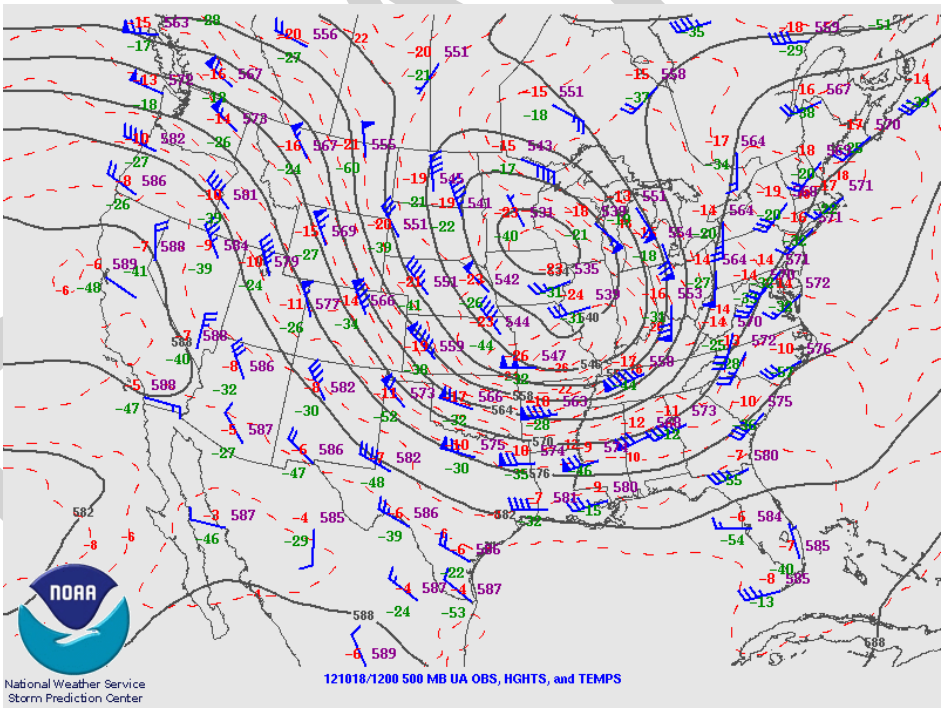


Figure 2-23. 500 mb analysis for 12Z October 18, 2012 (7a.m. CDT October 18) (NOAA SPC)

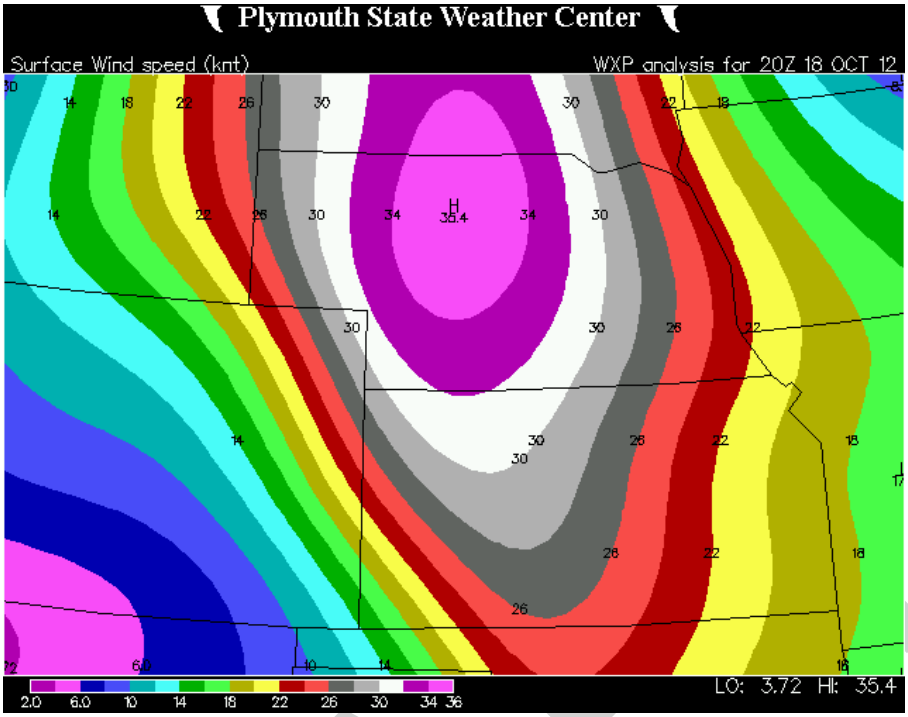


Figure 2-24. Surface wind speed (kts) for 20Z October 18, 2012 (3p.m. CDT October 18)(Plymouth State Weather Center)

396
FLUS43 KICT 182052
HWOICT

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE WICHITA KS
352 PM CDT THU OCT 18 2012

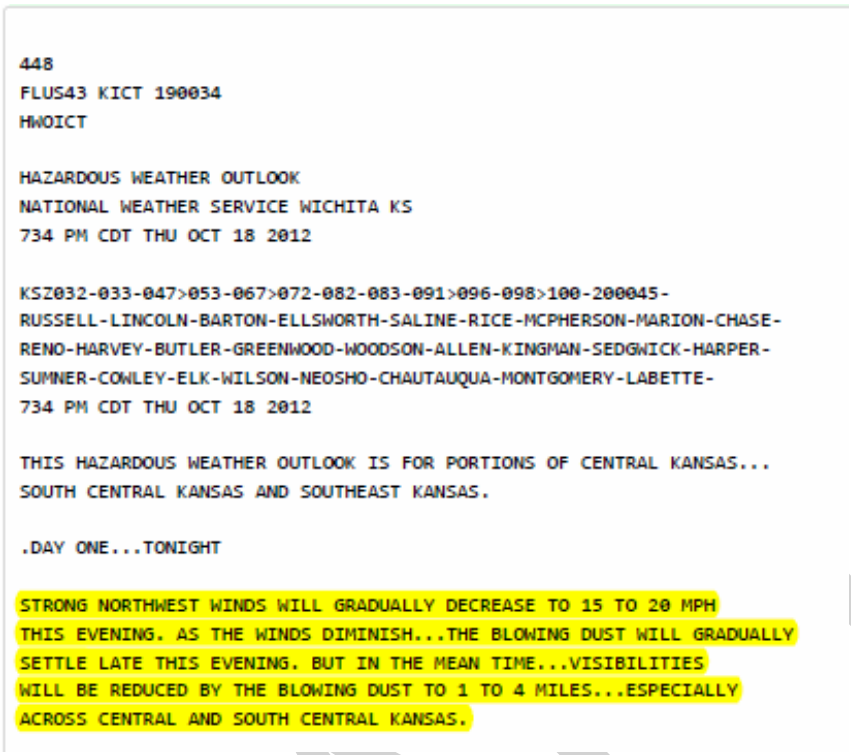
KSZ032-033-047>053-067>072-082-083-091>096-098>100-192100-
RUSSELL-LINCOLN-BARTON-ELLSWORTH-SALINE-RICE-MCPHERSON-MARION-CHASE-
RENO-HARVEY-BUTLER-GREENWOOD-WOODSON-ALLEN-KINGMAN-SEDGWICK-HARPER-
SUMNER-COWLEY-ELK-WILSON-NEOSHO-CHAUTAUQUA-MONTGOMERY-LABETTE-
352 PM CDT THU OCT 18 2012

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF CENTRAL KANSAS...
SOUTH CENTRAL KANSAS AND SOUTHEAST KANSAS.

.DAY ONE...LATE THIS AFTERNOON AND TONIGHT

STRONG NORTHWEST WINDS OF 25 TO 40 MPH WITH GUSTS OF 45 TO 55 MPH
WILL IMPACT THE ENTIRE AREA UNTIL EARLY THIS EVENING. THE
STRONGEST WINDS WILL AFFECT CENTRAL AND SOUTH CENTRAL KANSAS WHERE
VISIBILITIES WILL BE REDUCED BY BLOWING DUST TO 1 TO 4 MILES...LOCALLY
LESS THAN A MILE. PLEASE SEE THE HIGH WIND WARNING AND WIND
ADVISORY STATEMENT FOR DETAILS. THE GUSTY WINDS...DRY AIR...AND
CURED GRASSES WILL RESULT IN VERY HIGH TO CRITICAL WILDFIRE DANGER ACROSS
CENTRAL AND SOUTH CENTRAL KANSAS. PLEASE REFER TO THE RED FLAG
WARNING STATEMENTS FOR DETAILS.

Figure 2-25. Short Term Forecast issued by Wichita NWS for blowing dust October 18, 2012 (3:52p.m. CDT October 18)(Wichita NWS)



```
448
FLUS43 KICT 190034
HWOICT

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE WICHITA KS
734 PM CDT THU OCT 18 2012

KSZ032-033-047>053-067>072-082-083-091>096-098>100-200045-
RUSSELL-LINCOLN-BARTON-ELLSWORTH-SALINE-RICE-MCPHERSON-MARION-CHASE-
RENO-HARVEY-BUTLER-GREENWOOD-WOODSON-ALLEN-KINGMAN-SEDGWICK-HARPER-
SUMNER-COWLEY-ELK-WILSON-NEOSHO-CHAUTAUQUA-MONTGOMERY-LABETTE-
734 PM CDT THU OCT 18 2012

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF CENTRAL KANSAS...
SOUTH CENTRAL KANSAS AND SOUTHEAST KANSAS.

.DAY ONE...TONIGHT

STRONG NORTHWEST WINDS WILL GRADUALLY DECREASE TO 15 TO 20 MPH
THIS EVENING. AS THE WINDS DIMINISH...THE BLOWING DUST WILL GRADUALLY
SETTLE LATE THIS EVENING. BUT IN THE MEAN TIME...VISIBILITIES
WILL BE REDUCED BY THE BLOWING DUST TO 1 TO 4 MILES...ESPECIALLY
ACROSS CENTRAL AND SOUTH CENTRAL KANSAS.
```

Figure 2-26. Short Term Forecast issued by Wichita NWS for blowing dust October 18, 2012 (7:34p.m. CDT October 18)(Wichita NWS)

2.3 Conclusions

This Conceptual Model was created to provide a basic description of the weather set-up that led to the dust storm on October 18, 2012 and the PM_{10} exceedances in Sedgwick County (Wichita) and high hourly values in Shawnee County (Topeka). A more detailed analysis of the windblown dust event is included in Section 5, where a demonstration of the clear causal connection between uncontrollable natural events and the PM_{10} exceedance day is presented.

3. Historical Fluctuations

The PM_{10} concentrations measured in Sedgwick County at the Wichita monitoring sites during October 18, 2012 were the highest 24-hour average measured over the last five years. Time series plots of the 24-hour PM_{10} concentrations for the period January 1, 2008 through December 31, 2012 were created for the exceeding monitors in Sedgwick County and the monitor in Topeka. Additionally, time series plots of the daily maximum hourly average PM_{10} concentrations were created for the exceeding monitors as well as the monitor in Topeka. These additional plots were created to provide a deeper understanding of the frequency with which short-term particulate concentrations affect the area. Time series plots for two sites in Wichita (Glenn & Pawnee and Health Department) are included within this section, while the remaining plots are available in Appendix G. The graphs below show that the October 18th event was the most significant 24-hour event of the five year period.

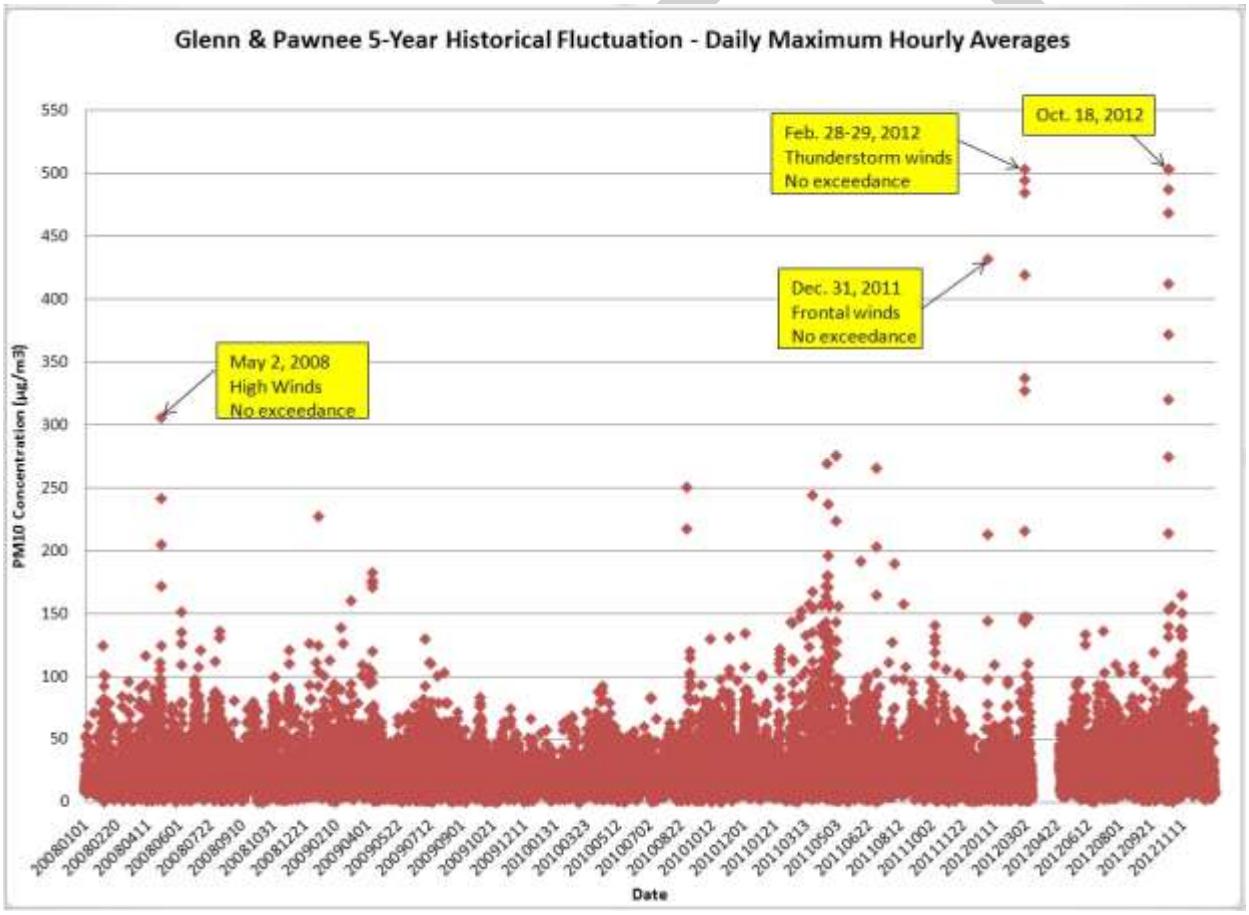


Figure 3-1. Plot of daily hourly maximum PM_{10} concentrations (2008-2012) at the Glenn & Pawnee monitoring site

Figure 3-1 shows the daily hourly maximum from the Glenn & Pawnee PM_{10} monitor. The plot shows that the October 18th, 2012 hourly average of 502.5 µg/m³ was one of the highest PM_{10} concentration recorded in the five year period between 2008 and 2012. The only other event to record a similar value was caused by wind associated with an overnight thunderstorm complex on Feb. 28-29, 2011. High winds were also responsible for the only other two hourly maximum values recorded above 300 µg/m³. Figure 3-2 below shows the daily 24-hour averages from the Glenn and Pawnee PM_{10} monitor. The plot shows that the October 18th event resulted in the highest 24-hour averaged PM_{10} concentrations in the last five years.

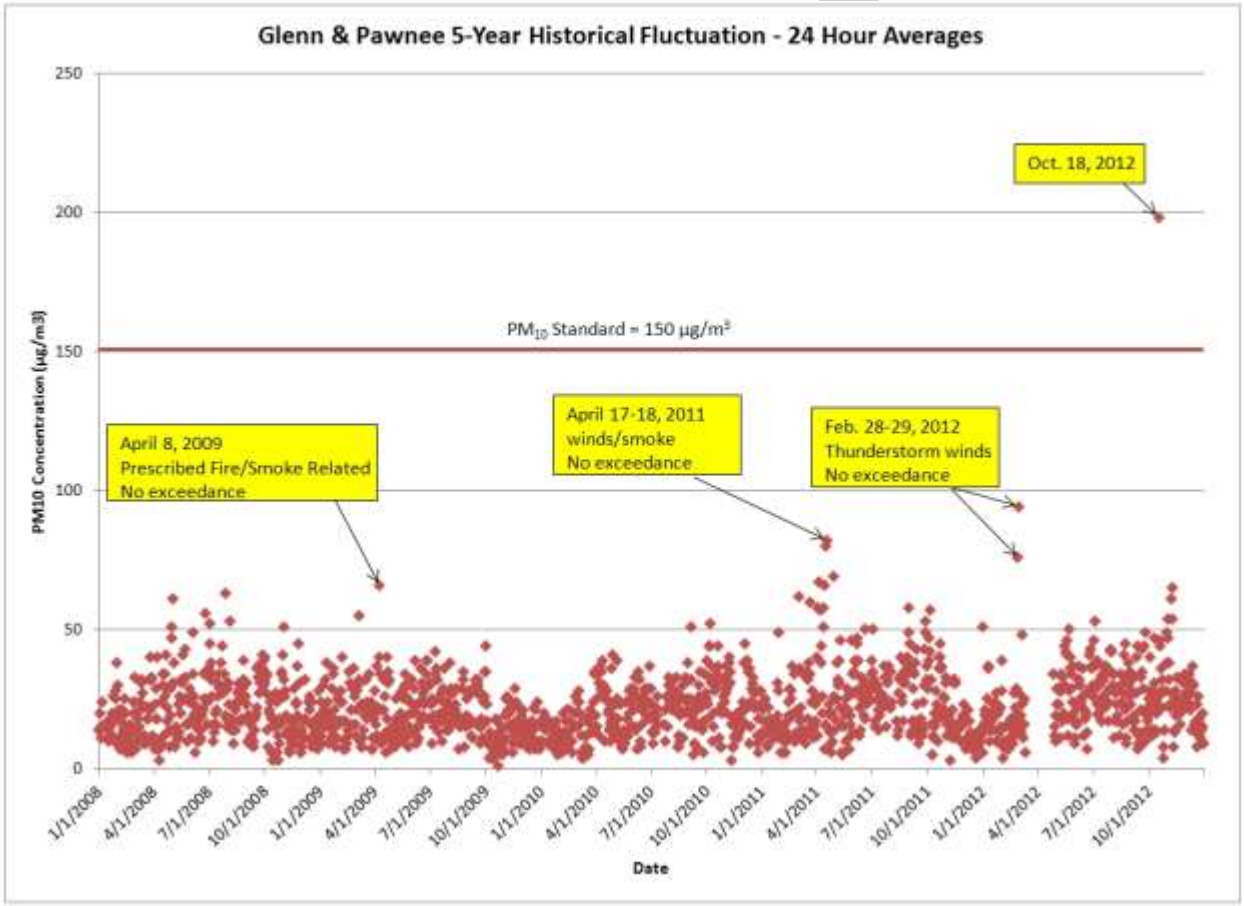


Figure 3-2. Plot of 24-hour average PM_{10} concentrations (2008-2012) at the Glenn & Pawnee monitoring site

In fact, the average 24-hour concentration of PM_{10} recorded at this site between 2008-2012 was 21.8 µg/m³ (including the 10-18-2012 value) as can be seen on Table 3-1.

Table 3-1. Glenn and Pawnee PM_{10} Monitoring Data Summary (2008-2012)

Site	Glenn & Pawnee(2008-12)
Mean	21.8
Median	20.0
Mode	17
sd	12.0
Variance	143.8
Minimum	1.0
Maximum	199.2
Count	1749
10/18/2012	199.2

The approximate percentile value that the Glenn & Pawnee October 18th, 2012 exceedance represents for its unique historical data set, for the month of the event (every sample in any October), and for the year are presented in Table 3-3. All data sets were restricted to the interval 2008 – 2012.

Table 3-2. Percentile Values for High PM_{10} Concentration at Glenn & Pawnee (2008-2012 Data)

Evaluation	Glenn & Pawnee
October 18, 2012	199.2 µg/m^3
Overall	99.9%
All October	99.3%
2012	99.6%

The Glenn & Pawnee data set was summarized by month and year. These summaries (see Tables 3-4 & 3-5) show slightly higher monthly averages in April and July; PM_{10} levels at any particular site in Kansas 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, regional agriculture activities, vehicle contributions via road dust, unpaved lots or roads, etc. While the historic monthly median values for Glenn & Pawnee are higher between June and November than the rest of the year there is little month-to-month variation. This time

frame (summer and fall) is that which is most likely to experience the meteorological and dry conditions exhibited during this event and discussed in other sections of this document. If a conservative approach is taken then a typical value should be no higher than the historic monthly 75th percentile value. The summary data for the month of October (all samples in any October from 2008 - 2012) and for 2012 is presented in Table 3-5.

Table 3-3. Monthly PM_{10} Monitoring Data Summary for Glenn & Pawnee Monitor

Site	Glenn & Pawnee (2008-2012)											
	Jan.	**Feb.**	**March**	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Mean	17.3	16.9	19.7	25.0	22.2	24.7	26.3	24.6	23.5	23.6	20.7	17.3
Median	16.0	14.0	18.0	22.0	20.0	24.0	26.0	24.0	22.0	21.0	18.0	15.0
Mode	17	10	24	10	12	24	29	17	17	8	16	8
sd	7.37	11.48	10.61	15.93	10.84	9.64	9.80	8.98	11.08	18.98	11.07	8.85
Variance	54.30	131.80	112.56	253.82	117.42	92.87	96.09	80.57	122.77	360.09	122.46	78.26
Minimum	5.0	4.0	4.0	3.0	5.0	6.0	9.0	7.0	5.0	1.0	3.0	4.0
Maximum	49.0	94.0	62.0	82.0	61.0	56.0	63.0	58.0	53.0	199.2	65.0	51.0
Count	147	141	135	125	155	150	143	147	143	155	150	151

As can be seen from this table, if the October 18th exceedance day is removed from the data set, the average for the month of October drops 1.1 µg/m^3.

Table 3-4. Month and Year Glenn & Pawnee PM_{10} Monitoring Data Summary

Site	Glenn & Pawnee			
	October (with 10-18-12 data)	October (w/o 10-18-12 data)	2012 (with 10-18-12 data)	2012 (w/o 10-18-12 data)
Mean	23.6	22.5	25.3	24.7
Median	21.0	21.0	23.0	23.0
Mode	8	8	17	17
sd	18.98	12.63	15.51	12.09
Variance	360.09	159.60	240.60	146.21
Minimum	1.0	1.0	4.0	4.0
Maximum	199.2	57.0	199.2	94.0
Count	155	154	321	320

Figure 3-3 is the overall frequency histogram. The histogram displays a well-formed density function, almost 95% of the samples values are less than 40 µg/m^3 and over 99.8% of the samples are less than 80 µg/m^3.

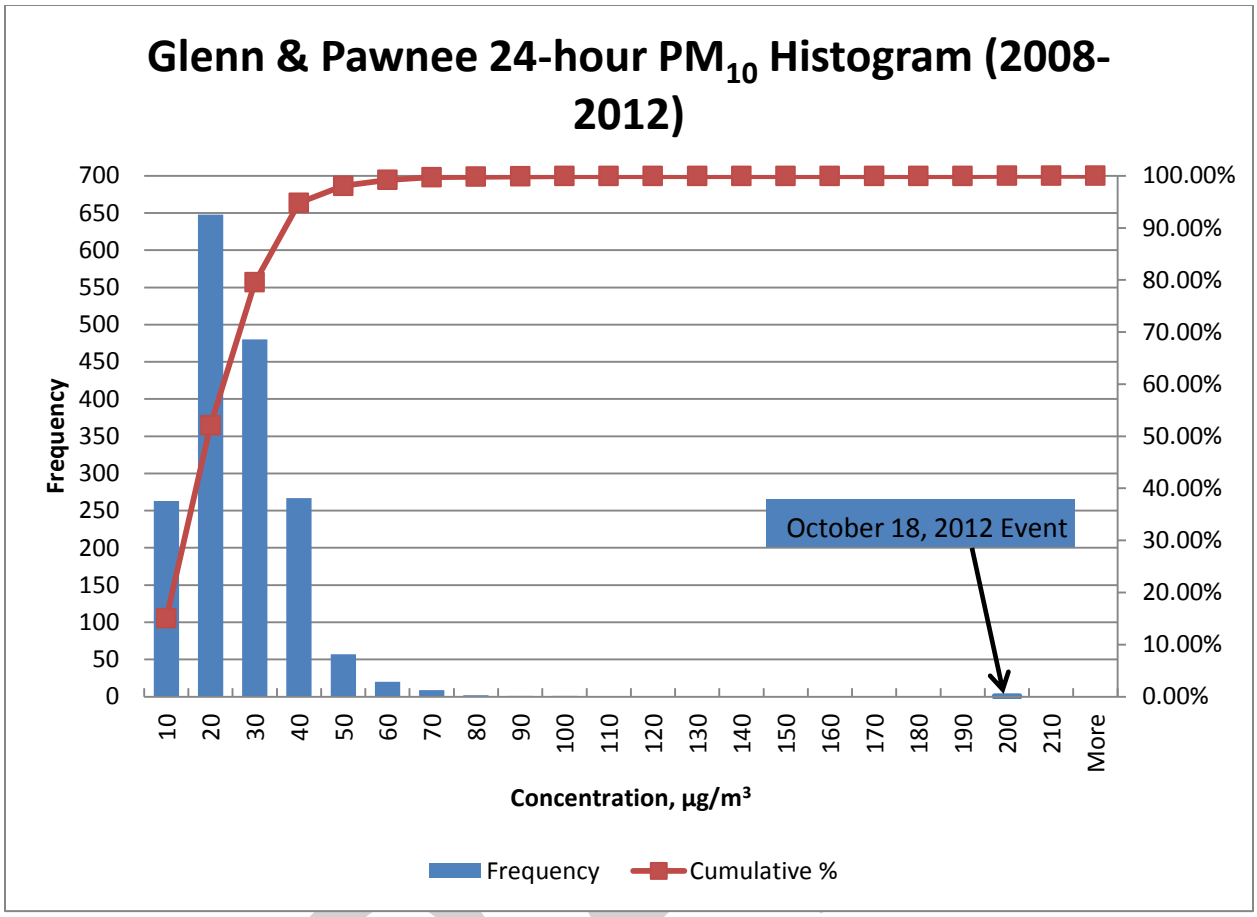


Figure 3-3. PM_{10} Histogram (2008-2012) at the Glenn & Pawnee monitoring site

Figure 3-4 shows the daily hourly maximum from the Wichita Health Department PM_{10} monitor. The plot shows that the October 18th, 2012 hourly average of 499.9 µg/m^3 was one of the highest PM_{10} concentration recorded in the five year period between 2008 and 2012. The only other event to record a similar value was caused by wind associated with an overnight thunderstorm complex on Feb. 28-29, 2011. High winds were also responsible for the four other hourly maximum values recorded above 300 µg/m^3. Figure 3-5 shows the daily 24-hour averages from the Wichita Health Department PM_{10} monitor. The plot shows that the October 18th event resulted in the highest 24-hour averaged PM_{10} concentrations in the last five years. The other high events were well below the standard for this period. Two of these events were recorded in the month of April and related to prescribed fire/smoke episodes from 2008 and 2010.

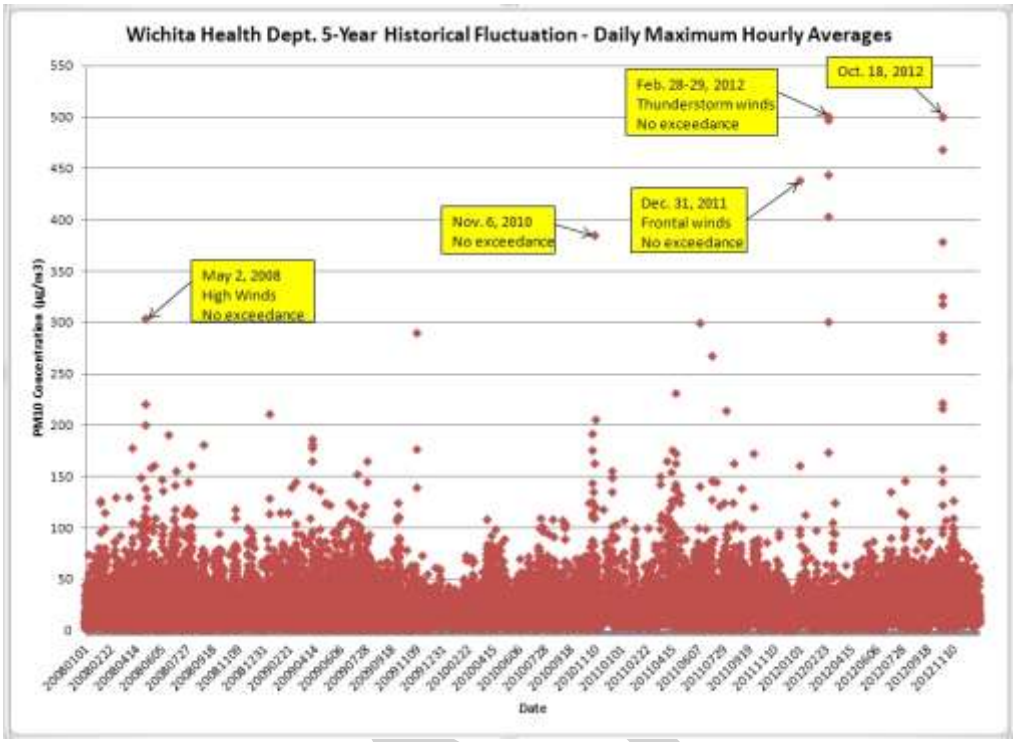


Figure 3-4. Plot of daily hourly maximum PM_{10} concentrations (2008-2012) at the Health Department monitoring site

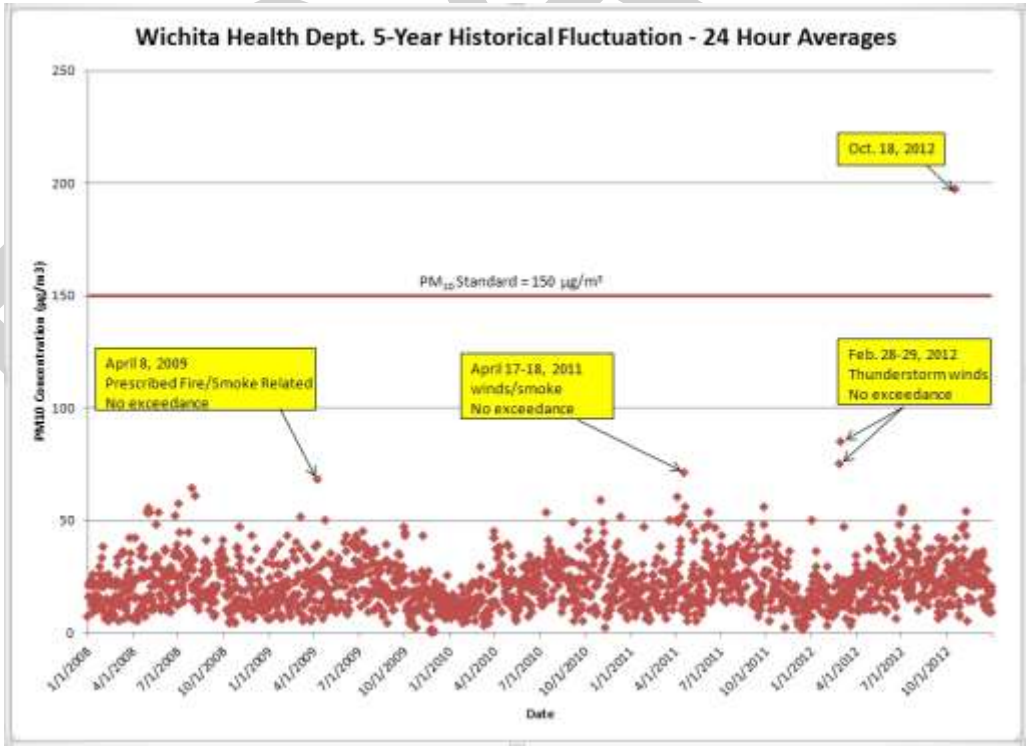


Figure 3-5. Plot of 24-hour average PM_{10} concentrations (2008-2012) at the Health Department monitoring site

In fact, the average 24-hour concentration of PM_{10} recorded at this site between 2008-2012 was 21.4 µg/m^3 (including the 10-18-2012 value) as can be seen on Table 3-6.

Table 3-5. Health Department PM_{10} Monitoring Data Summary (2008-2012)

Site	Health Dept(2008-12)
Mean	21.4
Median	20.0
Mode	10
sd	11.6
Variance	133.8
Minimum	0.0
Maximum	197.4
Count	1819
10/18/2012	197.4

The approximate percentile value that the Health Department October 18th, 2012 exceedance represents for its unique historical data set, for the month of the event (every sample in any October), and for the year are presented in Table 3-7. All data sets were restricted to the interval 2008 – 2012.

Table 3-6. Percentile Values for High PM_{10} Concentration at Health Department (2008-2012 Data)

Evaluation	Health Dept.
October 18, 2012	197.4 ug/m3
Overall	99.9%
All October	99.3%
2012	99.7%

The Health Department data set was summarized by month and year. These summaries (see Tables 3-8 & 3-9) show slightly higher monthly averages in June and July; PM_{10} levels at any particular site in Kansas 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, regional agriculture activities, vehicle contributions via road dust, unpaved lots or roads, etc. While the historic monthly median values for Health Department are higher between June and November than the rest of the year (except for the April outlier) there is little month-to-month variation. This time frame (summer and fall) is that which is most likely to experience the meteorological and dry conditions exhibited during this event and discussed in other sections of

this document. If a conservative approach is taken then a typical value should be no higher than the historic monthly 75th percentile value. The summary data for the month of October (all samples in any October from 2008 - 2012) and for 2012 is presented in Table 3-9.

Table 3-7. Monthly PM_{10} Monitoring Data Summary for Health Department Monitor

Site	Health Dept (2008-2012)											
	Jan.	**Feb.**	**March**	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Mean	16.7	16.5	18.4	23.6	21.8	25.2	27.4	24.2	22.7	22.7	20.0	16.9
Median	16.0	15.0	17.0	22.0	21.0	24.0	27.0	24.0	21.0	21.0	17.5	15.0
Mode	11	15	13	10	10	23	34	17	30	23	19	14
sd	7.59	10.76	9.66	13.17	10.58	9.88	10.11	8.82	10.39	17.69	11.92	8.80
Variance	57.57	115.88	93.40	173.42	112.03	97.66	102.20	77.85	107.88	312.86	142.20	77.46
Minimum	4.0	3.0	3.0	5.0	5.0	6.0	9.0	4.0	5.0	2.0	0.0	1.0
Maximum	47.0	85.0	51.0	71.0	55.0	53.0	64.0	61.0	56.0	197.4	59.0	51.0
Count	155	142	152	150	155	150	155	152	150	155	150	153

As can be seen from this table, if the October 18th exceedance day is removed from the data set, the average for the month of October drops 1.1 µg/m^3.

Table 3-8. Month and Year Health Department PM_{10} Monitoring Data Summary

Site	Health Department			
	October (with 10-18-12 data)	October (w/o 10-18-12 data)	2012 (with 10-18-12 data)	2012 (w/o 10-18-12 data)
Mean	22.7	21.6	23.4	22.9
Median	21.0	21.0	22.0	22.0
Mode	23	23	22	22
sd	17.69	10.68	14.07	10.73
Variance	312.86	114.13	198.04	115.20
Minimum	2.0	2.0	3.0	3.0
Maximum	197.4	46.0	197.4	85.0
Count	155	154	366	365

Figure 3-6 is the overall frequency histogram. The histogram displays a well-formed density function, almost 95% of the samples values are less than 40 µg/m^3 and over 99.9% of the samples are less than 80 µg/m^3.

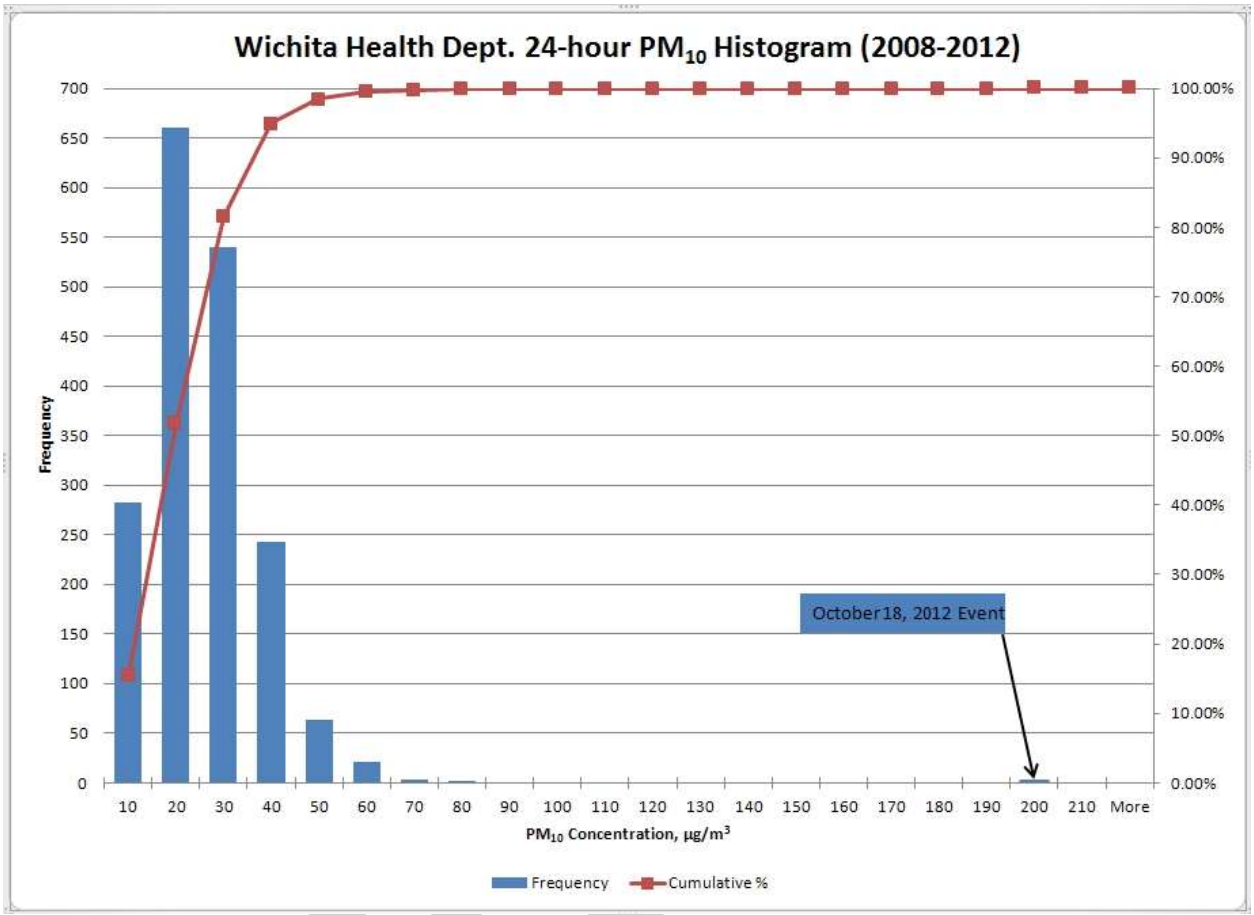


Figure 3-6. PM_{10} Histogram (2008-2012) at the Health Department monitoring site

The spatial scope of this event, addressed elsewhere in this document, was fairly broad and had an impact on PM_{10} concentrations at multiple sites. A snapshot of data from other PM_{10} sites across the state and region are shown in Table 3-10.

Table 3-9. Regional 24-hour and 1-hour PM_{10} readings for October 18, 2012

PM_{10}

October 18, 2012	24 hr Maximum	1 hr Max Continuous
Dodge City	43.8	122.6
Chanute	72.6	
G. Washington & Skinner	193.3	503.1
Glenn & Pawnee	199.2	502.5
Wichita HD	197.4	499.9
K96 & Hydraulic	176.5	500.4
KNI (Topeka)	67.8	241.1

Goodland	109.4		
420 KS (KC,KS)	66.0		
JFK (KC,KS)	47.5		
Cozad, NE	99.0		

4. Not Reasonably Controllable or Preventable

Section 50.1(j) of Title 40 CFR Part 50 requires that an event must be "not reasonably controllable or preventable" in order to be defined as an exceptional event. This requirement is met by demonstrating that despite reasonable agricultural and particulate matter control measures in place within Sedgwick and Shawnee Counties and their respective metropolitan areas, high wind conditions overwhelmed all reasonably available controls. The event occurring on October 18, 2012 was directly related to strong and gusty winds generated by an intense low pressure system and a high pressure system building over the Rockies. The strong winds overwhelmed all reasonably available controls, and were also responsible for transporting PM into the Wichita and Topeka areas from areas outside of the region. As explained in the conceptual model, an intense low pressure system and its associated strong and gusty winds, in tandem with extremely dry conditions across the region lead to a region wide dust storm across several states. As shown in Section 5, the source region for this event and the associated transported dust on October 18, 2012, came from areas outside of the Wichita and Topeka areas; primarily from western Nebraska and areas further north. While it is likely that dust was generated within the Wichita and Topeka areas as strong winds and gusts from the low pressure system and its cold front 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 the source regions. Controls on local agricultural sources of fugitive dust were in place and implemented during the event of October 18, 2012, but were not capable of controlling transported dust (PM_{10}) raised by the gusty and turbulent winds on this date.

The following section describe the Best Available Control Measures (BACM) in place during the event of October 18, 2012. The Wichita and Topeka monitors have never violated the PM_{10} standard so the areas are currently in attainment for the PM_{10} NAAQS. There are therefore no stringent PM_{10} regulations in place in Wichita, Topeka, Shawnee County, Sedgwick County or the region around the monitoring sites. There is only one regulated point source located in Sedgwick County that produces over 100 tons of PM_{10} per year.[1] In addition, there are nine other sources with PM_{10} values between 10-95 tons. Likewise, Shawnee County also has only one source of PM_{10} above 100 tons.[2] There are also five other sources of PM_{10} with values between 10-55 tons. The largest source in Shawnee county has installed fabric filters and electrostatic precipitators to control particulate matter. The largest source in Wichita has wet scrubbers installed in the facility to eliminate or control particulate matter. Some of the other mentioned sources also have fabric filters to contain their particulate matter emissions. Inspections of local potential sources performed before, during and after the event of October 18, 2012, confirmed that no unusual anthropogenic PM_{10} producing activities occurred in neither Shawnee County, Sedgwick County, Topeka or the Wichita area, nor the local areas surrounding the exceeding monitors.

The following have been identified as potential sources of blowing dust during high wind events in Kansas.

a) Tilled agricultural land;
b) sparsely vegetated or overgrazed range land;

[1] A manufacturing plant in Wichita, Kansas, that produces first-tier aerostructures.
[2] A coal-fired power station in Tecumseh, Kansas.

c) unpaved roads and parking lots;
d) urban paved roads; and
e) construction sites

The following have been identified as standard soil conservation measures which constitute agricultural BACM.

a) Reduced tillage farming practices;
b) tree rows;
c) other physical windbreaks;
    1) grass barriers;
    2) annual (e.g., sunflower) barriers;
    3) buffer strips; and
    4) “snow” fences;
d) cover crops;
e) strip cropping;
f) crop residues; and
g) emergency tillage

Soil erosion specialists at the federal and state levels have been working for approximately seventy five years to develop and evaluate potential mitigating measures. These soil conservation experts continue to implement measures that prove effective for the reduction or prevention of blowing dust. Numerous measures have been applied and are currently in place across Kansas in order to minimize the effects of wind erosion. The United States Department of Agriculture - Agricultural Research Service (USDA-ARS) Wind Erosion Research Unit (WERU) located at Kansas State University (KSU) has achieved the following:

a) Evaluated emergency till practices and demonstrated their effectiveness in halting wind erosion as it started;
b) Evaluated vegetative and non-vegetative mulches and demonstrated that standing vegetation can be five to ten times more effective at reducing wind erosion than material laying flat;
c) Evaluated the relative effectiveness of different plant species in windbreaks;
d) Established the use of feedlot wastes as an effective method for erosion control; and
e) Established the use of permanent grass wind barriers and annual crop control strips, and evaluated the relative effectiveness of their spacing, position, and size in reducing wind erosion.

As a result of this exceptional event, the KDHE, through Kansas State University’s Extension program, will again emphasize the availability of information on conservation measures for air pollutant emissions reductions and/or reduction of air quality impacts from agricultural land management and cropping operations. One way that this will be achieved is through distribution and/or reference to the following guide developed by the United States Environmental Protection Agency (EPA) and the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) – *Agricultural Air Quality Conservation Measures – Reference Guide for Cropping Systems and General Land Management, October 2012* (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1049502.pdf).

Many areas west and northwest of Wichita and Topeka, extending into western Kansas and western Nebraska, are natural grassland and farmland, much of which is planted in wheat (Figure 4-1). During 2012, this area was experiencing severe drought conditions (Figure 2-14). The drought-induced decrease in vegetative cover due to dry grassland and poor crop production resulted in increased exposure of topsoil. As a result of the increasingly dry topsoil, bare areas were covered with a layer of fine loose granules (crustal dust).

USDA: Natural Resources Conservation Service (NRCS)

1. *Conservation Reserve Program*

Sedgwick County is made up of 646,012 acres of land area – 331,178 acres (or 51.3%) of which is land in farms. Of the farm land acreage, cropland accounts for almost 98% of the total (325,877 acres). Shawnee County is made up of 355,985 acres of land area – 163,823 acres (or 46%) of which is land in farms. Of the farm land acreage, cropland accounts for almost 40% of the total (64,018 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 Sedgwick and Shawnee County cropland acreage is farmed using dryland practices (versus irrigated) and consists of some 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 decreasing in Sedgwick County as acres are replaced with urban development or replaced with crop production. The same can be said for Shawnee County in northeast Kansas. Sedgwick County contained approximately 1,800 acres of CRP, or .5% of total cropland, while Shawnee contained 4,471 acres of CRP, or 7% 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.

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. 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 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.

- USDA Announces New Highly Erodible Cropland Initiative for Conservation Reserve Program in 2012. This new initiative will assist producers with targeting their most highly erodible cropland (land with an erodibility index of 20 or greater) by enabling them to plant wildlife-friendly, long-term cover through the Conservation Reserve Program (CRP).

2. New Initiatives

While the following initiatives are not meant to be enforceable, the Natural Resources Conservation Service has many efforts underway throughout Kansas 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 Kansas Governor's office.

KANSAS STATE UNIVERSITY EXTENSION OFFICE

While the following initiatives are not meant to be enforceable, the KSU Extension Office has many efforts underway throughout Kansas 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.

The Wichita (Sedgwick Co.) and Topeka (Shawnee Co.) areas were influenced by high winds and blowing dust from the west and northwest on the day of the recorded PM_{10} exceedances. Considering the wind speeds and gusts noted during the day that the concentration above the 24-hour NAAQS was recorded (Table 1-1), it is apparent that these conditions were abnormal. The phenomena which gave rise to these blowing dust problems

was, therefore, a natural event which could not be prevented by application of BACM. With the top few inches of soil loose and the strength and short duration of this event, the farming community was unable to apply emergency tillage or other measures to aid in the reduction of blowing dust. In addition, other potential man made sources of PM_{10} in these areas would have not been able to apply any emergency measures to counter the effects of this exceptional wind event. In fact, these events occurred in spite of general area-wide application of accepted good agricultural soil conservation practices.

Figure 4-1**.** Regional (KS, OK, TX, CO, NE, NM, WY, SD) Land Cover Data Map (USGS)

On the basis of these findings, KDHE has concluded that the Wichita, Topeka, Shawnee or Sedgwick County areas could not have prevented these exceedances at the recorded particulate levels by employing additional localized urban or rural control measures. The increase in PM_{10} concentrations on the day of the recorded exceedances was 525% above normally observed levels. The October 18, 2012 value of 199.2 µg/m^3 at the Glenn & Pawnee monitoring site does not relate to the annual mean of 24.8 µg/m^3 or the monthly mean of 31.4 µg/m^3 at that site (Table 3-1 and Table 3-5). The fact that this was a natural event involving strong low pressure and associated winds that transported PM_{10} emissions into Sedgwick and Shawnee Counties, with a majority of the PM_{10} emissions recorded by the monitors in these areas coming from sources outside of the area, provides strong evidence that the event and exceedances of October 18, 2012 recorded in the Wichita and Topeka areas were not reasonably controllable or preventable.

5. Clear Causal Relationship

5.1 Summary of Results

This section demonstrates the causal relationship between the strong winds associated with an intense storm system and PM_{10} concentrations above 150 µg/m^3 that occurred in Wichita and Topeka, Kansas on October 18, 2012. In particular, this section provides evidence that (1) a large area wide dust storm affected the Wichita and Topeka monitor sites; (2) Dust (PM_{10}) from areas outside of the Wichita and Topeka areas was transported to the impacted monitors on the day when the 24-hour PM_{10} concentration was above 150 µg/m^3; and (3) the dust storm led to concentrations above 150 µg/m^3. This evidence includes discussion of source locations, meteorological conditions, satellite observations of dust, dust transport, and air quality data on the day when the 24-hour PM_{10} concentrations were above 150 µg/m^3.

Meteorological and air quality data show that the 24-hour PM_{10} concentration exceeding the NAAQS at the Wichita area monitors and the hourly exceedances at the Topeka monitor were caused by dust from intense winds associated with a strong storm system moving through the area on October 18, 2012 (based on source locations relative to the impacted monitor, wind patterns favorable for transport of dust to the impacted monitors, and reduced visibilities with dust reported in the vicinity of the impacted monitor).

5.2 Analysis Methods

Several analysis methods were used to assess whether the 24-hour PM_{10} concentrations above 150 µg/m^3 were caused by this dust storm. Source locations were analyzed in relation to the impacted monitor, and meteorological data were evaluated to determine whether conditions were favorable for transport of dust (PM_{10}) to the impacted monitor. Air quality data and visibility observations were used to assess whether dust was present at the impacted monitor.

5.2.1 Other Unusual Emissions

In addition, KDHE has reviewed media documents, and contacted local agency and KDHE district staff regarding the October day that is the subject of the exceptional event request and are unable to find any emergency conditions or other anthropogenic events that occurred on the day that would potentially cause the high particulate matter readings on the day in question.

5.2.2 Meteorological Conditions and Dust Transport

Dust transport was analyzed by reviewing surface wind observations and model air parcel trajectories.

For surface wind analysis, data from METAR sites nearest the impacted monitors were assessed. Table 5-1 shows the pairings of air quality monitors to METAR sites used throughout

this report to examine meteorological conditions near the air quality monitors. METAR sites were selected because of their known high data quality. In some locations, the nearest METAR site was located several miles from the impacted air quality monitor. However, meteorological conditions on the dust storm event day was driven by a large-scale storm (e.g., regionally homogeneous). Thus, meteorological conditions observed at the METAR sites were likely very similar to conditions at the air quality monitors. In addition, no other reliable sources of meteorological data were available. Vector winds averaged over several hours were used in this analysis because they represent pollution transport better than scalar winds. These vector winds, along with other meteorological parameters (e.g., temperature), were evaluated with surface and upper-level observations, radar, and satellite maps to obtain a comprehensive view of the meteorological pattern on the day when the 24-hour PM_{10} concentration was above 150 $\mu g/m^3$.

Table 5-1. METAR sites used to represent meteorological conditions near air quality monitors with high particulate matter concentrations.

Air Quality Monitors	METAR Site	METAR Site Location	Approx. Distance Between Air Quality and METAR Stations
Topeka KNI	KTOP	Philip Billard Municipal Airport, Topeka, KS	5.6 miles
Topeka KNI	KFOE	Topeka Regional Airport, Topeka, KS	5.6 miles
Wichita HD	KICT	Wichita Mid-Continent Airport, Wichita, KS	4 miles
Wichita Glenn & Pawnee	KICT	Wichita Mid-Continent Airport, Wichita, KS	3.73 miles
Wichita G. Wash. & Skinner	KICT	Wichita Mid-Continent Airport, Wichita, KS	7.31 miles
Wichita K96 & Hydraulic	KICT	Wichita Mid-Continent Airport, Wichita, KS	9.25 miles
Goodland	KGLD	Goodland Renner Field, Goodland, KS	1.6 miles
Cozad, NE	KLXN	Jim Kelly Field, Lexington, NE	12.3 miles

Atmospheric soundings from KTOP (Topeka, Kansas) and KDDC (Dodge City, Kansas) were used to identify temperature inversions and mixing layers. These features were assessed to determine whether dust at the surface remained in the lower levels of the atmosphere rather than mixing into aloft layers where it would not impact surface air quality monitors. Also these soundings were used to determine if high winds located above the surface but below the inversion were able to mix downward to the surface on October 18, 2012. Confirming that the dust would likely remain in the lower levels of the atmosphere by reviewing the soundings also provided guidance on which trajectory levels were appropriate to assess dust transport.

The Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) was used to create backward trajectories ending at the impacted monitor. Trajectories ending at 10, 50, and 500m above the impacted monitor was modeled to show flow patterns throughout the surface-based mixed layer where dust was likely present. Trajectory heights above the surface were also examined over the course of each trajectory path to determine whether dust remained near the surface (e.g., near the impacted monitor). Trajectory images were created at two-hour intervals during the 24-hour window contributing to the 24-hour PM_{10} concentrations above 150 $\mu g/m^3$ at the Sedgwick and Shawnee County monitors; the entire suite of trajectories created can be found in Appendix C.

5.2.3 Air Quality Conditions

Time-series of air quality and meteorological parameters were analyzed to assess the presence of dust at the impacted monitors. Specific meteorological conditions (such as dust or haze) reported at airports by human observers were considered.

5.3 Findings

This subsection contains the results of the causal relationship demonstration for the day when the 24-hour PM_{10} concentrations were elevated or above 150 $\mu g/m^3$. Potential source locations, meteorological conditions and dust transport, and air quality conditions are described for the event day.

October 18, 2012

The results below demonstrate that a regional dust storm caused the 24-hour PM_{10} exceedances at the Sedgwick County monitors and several hours above 150 $\mu g/m^3$ at the Shawnee County monitors on October 18, 2012. Factors supporting this conclusion include:

- Low-level winds and model trajectories showing transport of dust to the impacted monitors.
- Reductions in visibility, increases in PM concentrations, and visual reports of dust at or near the impacted monitors.
- 24-hour PM_{10} concentrations below 150 $\mu g/m^3$ at monitors that were not impacted by dust.
- No other unusual emission sources that would have caused the high PM_{10} concentrations.

Meteorological Conditions and Dust Transport

These exceedances and the elevated readings were the consequence of several days of strong gusty winds associated with a deepening low pressure system in the northern plains, in combination with dry conditions which caused significant blowing dust across parts of Nebraska, Kansas and Oklahoma. The strong winds were the result of a strengthening 988-millibar surface low pressure system centered over northern Wisconsin as shown in the 12Z October 18, 2012

(7a.m. CDT October 18, 2012) surface analysis in Figure 5-1. The low pressure over Wisconsin remained nearly stationary during the day as shown in the 00Z October 19, 2012 (7p.m. CDT October 18, 2012) surface analysis in Figure 5-2.

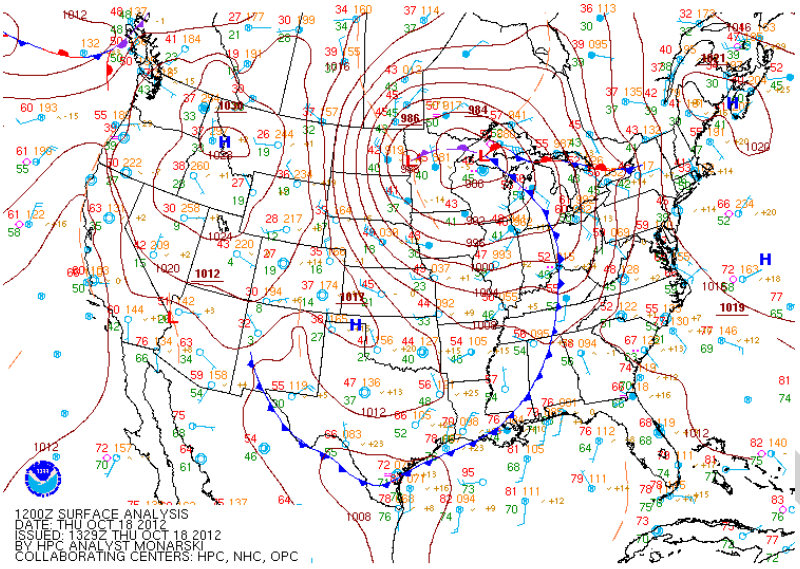


Figure 5-1. Surface analysis for 12Z October 18, 2012 (7a.m. CDT October 18)(Hydrometeorological Prediction Center)

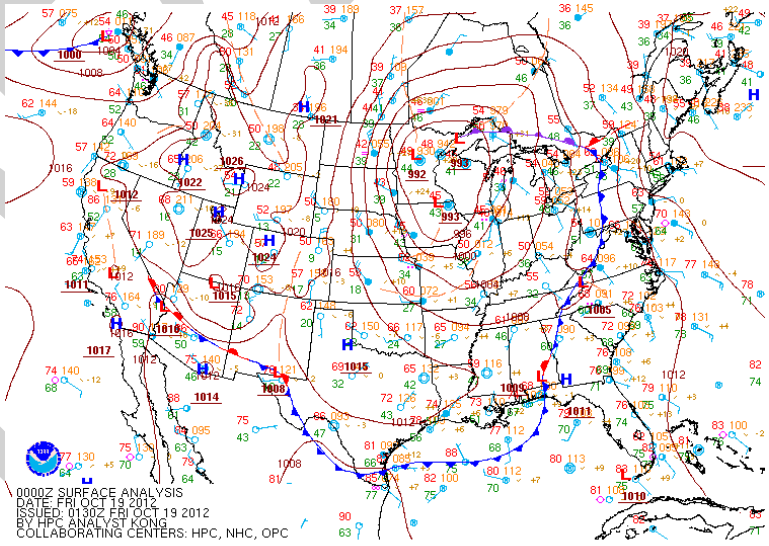


Figure 5-2. Surface analysis for 00Z October 19, 2012 (7p.m. CDT October 18)(Hydrometeorological Prediction Center)

These surface features were associated with a strong upper level low moving into northeastern Iowa and southeast Minnesota which is shown in Figure 5-3, the 500-millibar

analysis for 12Z October 18, 2012 (7a.m. CDT October 18, 2012). There was a localized wind maximum of 100 knots over southeastern Kansas which was rotating around the base of this upper level low. Strong northwesterly winds continued blowing across the southern and central Great Plains, with sustained winds now reaching over 34kts (39mph) in portions of central Nebraska and a large area over 30kts (35mph) stretching from the northcentral Kansas through much of South Dakota (Figure 5-4).

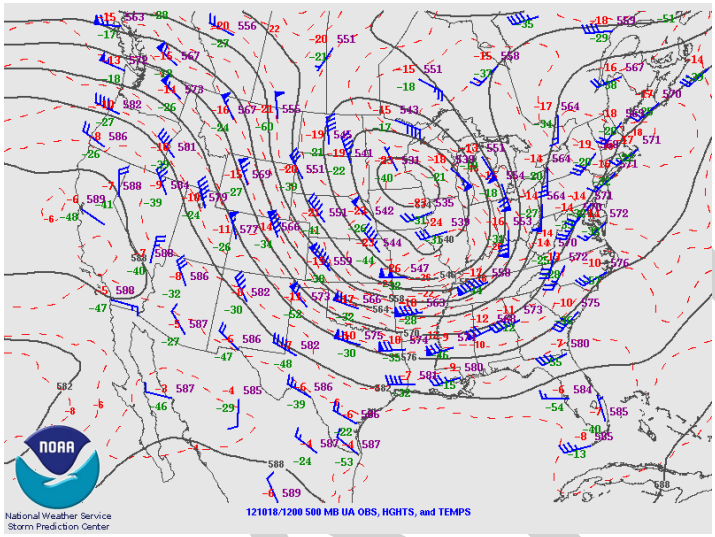


Figure 5-3. 500 mb analysis for 12Z October 18, 2012 (7a.m. CDT October 18) (NOAA SPC)

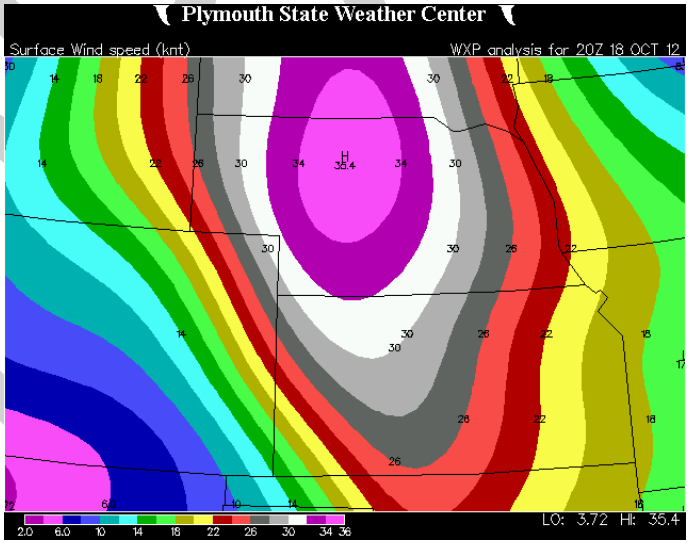


Figure 5-4. Surface wind speed (kts) for 20Z October 18, 2012 (3p.m. CDT October 18)(Plymouth State Weather Center)

The October 19, 2012, 00Z (7p.m. CDT October 18) soundings at Topeka, KS and Dodge City, KS, in Figures 5-5 and 5-6, respectively, show good vertical mixing to near 750

millibars in Topeka and 600 millibars in Dodge City . These two soundings are in the area that experienced the strong gusty surface winds on October 18, 2012. Vertical mixing below the inversions would have brought the strong winds in the 700-800 millibar speed maximum down to the surface. The combination of the mixing and the tight surface pressure gradient caused sustained surface winds of 30 to 40 mph with gusts of 35 to 60 mph. Winds of this strength will cause blowing dust if soils are dry. Sustained daily averaged wind speeds of 20 mph or greater, hourly averaged wind speeds greater than 25 mph and gusts of 40 mph or higher have been shown to cause blowing dust in Kansas (*State of Kansas PM_{10} Natural Events Action Plans (NEAP) for Morton and Sedgwick Counties*- Appendix E).[3]

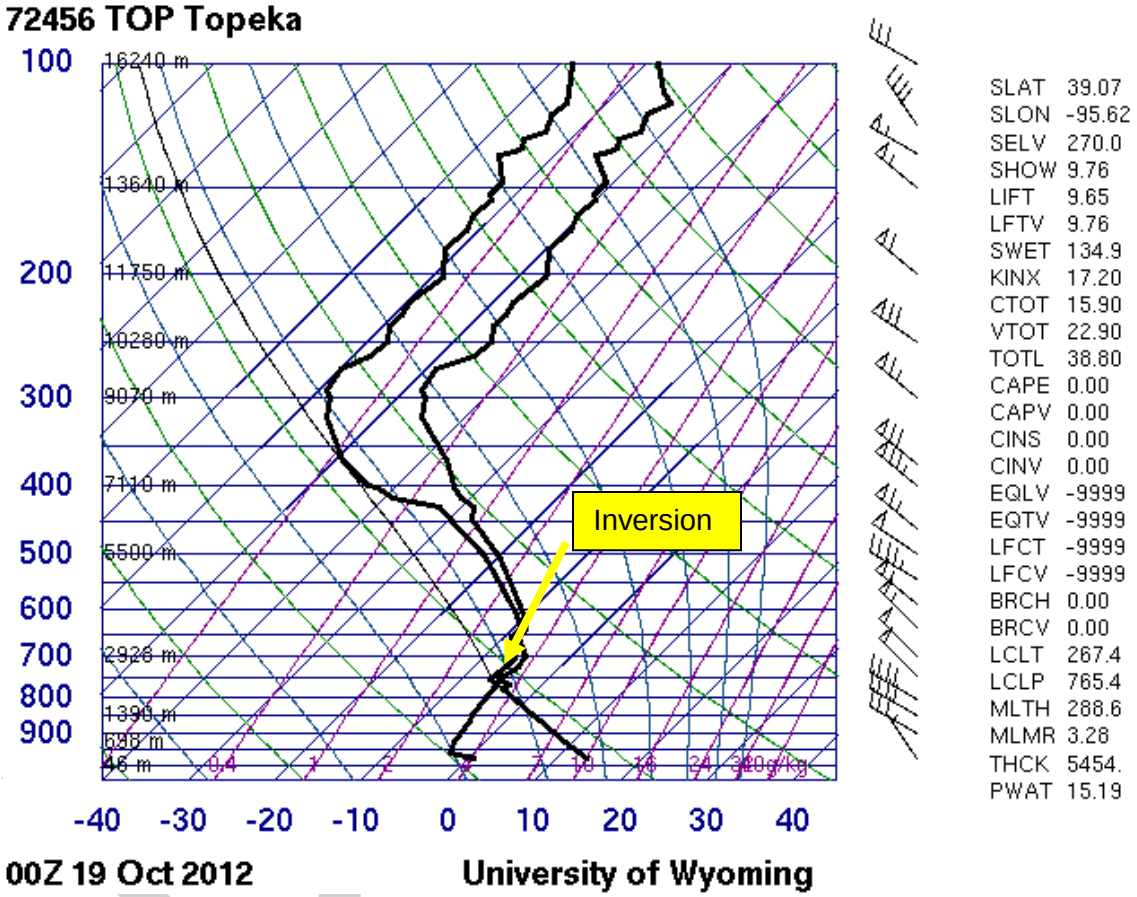


Figure 5-5. Topeka, KS sounding analysis for 00Z October 19, 2012, or 7p.m. CDT October 18, 2012, (from the University of Wyoming's archive of National Weather Service soundings)

[3] With the promulgated Exceptional Events Rule (EER) in place, the EER superseded previous natural events guidance including NEAPs (that were not approved as part of a SIP).

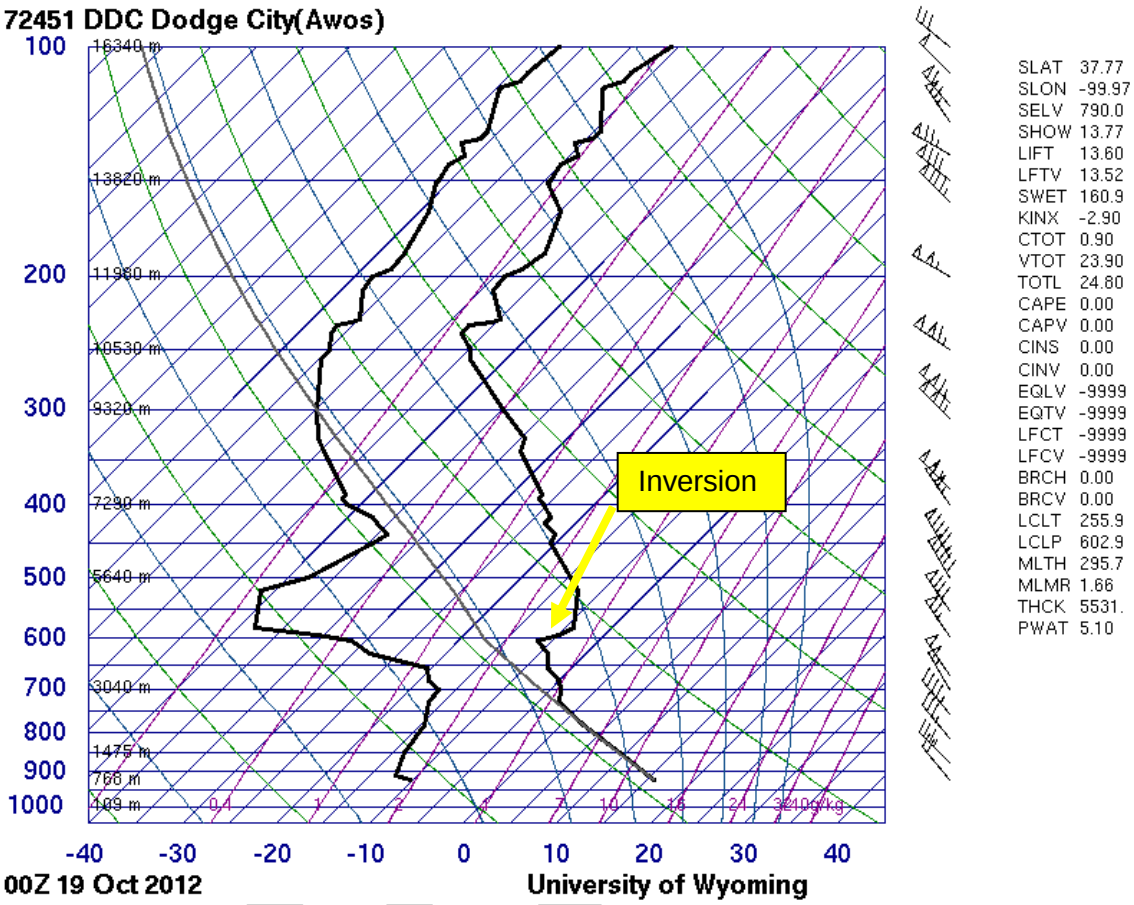


Figure 5-6. Dodge City, KS sounding analysis for 00Z October 19, 2012, or 7p.m. CDT October 18, 2012, (from the University of Wyoming's archive of National Weather Service soundings)

The two upper air sounding also show strong inversions that would have capped the atmosphere and any dust that was lifted into the air from this storm system would have remained below this layer.

Tables 5-2 through 5-5 show the National Weather Service observations for the four sites of Topeka, Goodland, Wichita and Lexington, NE. National Weather Service high wind watches, warnings and dust warnings for the area for October 18 are also shown in Appendix B. The observations show that winds in excess of the thresholds identified for elevated PM_{10} in blowing dust (*State of Kansas PM_{10} Natural Events Action Plans (NEAP) for Morton and Sedgwick Counties*- Appendix E) occurred across the area. Hourly averaged sustained winds of 25 mph or greater, wind gusts of 40 mph or greater, reduced visibility, and the weather type of "haze" are highlighted in yellow.

Table 5-2. Wind and Weather observations for Topeka, KS for October 18, 2012 (NCDC). Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow

Time in CST October 18	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in Miles
53	50	39	7		270	CLR	10
153	50	39	10		270	CLR	10
253	50	39	13	21	280	CLR	10
353	50	38	11	21	280	CLR	10
453	50	38	14	22	260	CLR	10
553	49	39	10	17	270	CLR	10
653	49	38	13		260	CLR	10
753	51	36	14	24	260	FEW090	10
853	54	31	24	33	280	FEW100	10
953	57	28	24	41	290	CLR	10
1053	59	26	15	38	280	CLR	10
1153	60	25	20	37	270	CLR	10
1253	61	25	24	38	290	BKN080	10
1353	59	29	15	30	270	OVC075	10
1453	59	29	14	30	290	OVC080	10
1553	58	32	17	26	290	OVC075	10
1653	57	37	30	43	310	BKN065 OVC075	10
1753	57	37	28	51	290	BKN065 BKN085 OVC110	10
1853	55	45	23	32	300	FEW100 BKN120	10
1953	53	49	18	37	300	BKN050 OVC090	10
2053	53	51	15	32	290	OVC048	10
2153	53	51	13	24	290	OVC050	10
2253	54	47	13		290	BKN060 OVC070	10
2353	54	47	26	34	290	OVC055	10

Table 5-3. Wind and weather observations for Goodland, KS for October 18, 2012 (NCDC). Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

Time in CST October 18	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
53	37	46	17		290	CLR	10
153	37	46	16		290	CLR	10
253	38	46	17	26	300	CLR	10
353	38	46	21	26	310	CLR	10
453	36	50	17		310	CLR	10
553	35	50	14		290	CLR	10
653	40	38	21		310	CLR	10
753	46	27	28	43	330	CLR	10
853	49	21	39	51	340	CLR	9
953	52	18	37	53	330	BKN024	7
1023	54	17	43	55	330	HAZE	1.75
1044	55	16	39	58	320	HAZE	3
1050	54	17	44	58	330	HAZE	2.5
1053	54	17	38	55	330	HAZE	2
1058	55	16	44	58	330	HAZE	3
1153	57	15	41	54	320	HAZE	6
1206	55	16	39	55	330	HAZE	3
1253	57	14	40	52	320	BKN029	7
1353	59	12	30	46	330	BKN031	7
1423	57	12	37	49	320	BKN029 BKN041	8
1432	57	13	31	45	330	BKN031	9
1446	57	11	36	52	320	BKN029	7
1453	58	11	37	49	340	BKN029	8
1522	57	10	41	52	330	SCT019	7
1553	56	11	33	48	340	FEW026	7
1653	53	13	23	33	340	CLR	10
1753	49	19	17		340	CLR	10
1853	48	19	21		350	CLR	10
1953	46	21	20	25	340	CLR	10
2053	38	30	11		290	CLR	10
2153	41	27	11		310	CLR	10
2253	39	30	13		300	CLR	10
2353	39	31	14		290	CLR	10

Table 5-4**.** Wind and weather observations for Wichita, KS for October 18, 2012 (NCDC). Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow.

Time in CST October 18	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
53	51	33	9		280	SCT120	10
153	51	35	13		280	SCT120	10
253	51	36	13		280	BKN120	10
353	52	34	17	25	280	SCT120	10
453	52	32	14	24	290	SCT120	10
553	50	36	18	26	290	FEW120	10
653	47	41	16		260	CLR	10
753	52	32	21	28	290	CLR	10
853	55	28	26	34	300	CLR	10
953	58	23	29	41	300	CLR	10
1053	60	19	28	37	320	CLR	10
1153	63	18	33	40	310	CLR	10
1253	65	18	30	47	300	CLR	9
1353	65	18	28	43	310	Blowing Dust	5
1453	65	16	29	44	300	Blowing Dust	3
1525	64	17	28	34	290	Blowing Dust	2
1553	65	16	21	33	300	Blowing Dust	2
1653	64	17	21	34	300	Blowing Dust	2
1753	63	17	17		300	Blowing Dust	2.5
1851	61	20	14		300	Blowing Dust	5
1853	61	20	14		290	Blowing Dust	5
1953	59	23	14		290	Blowing Dust	6
2053	59	22	17		290	Blowing Dust	6
2153	57	25	16		300	FEW200	7
2253	56	27	17		310	FEW200	8
2353	54	30	16		300	CLR	8

Table 5-5. Wind and weather observations for Lexington, NE for October 18, 2012 (NCDC). Speeds at or above the blowing dust thresholds and haze and reduced visibility (caused by dust) have been highlighted in yellow

Time in CST October 18	Temperature Degrees F	Relative Humidity in %	Wind Speed in mph	Wind Gust in mph	Wind Direction in Degrees	Weather	Visibility in miles
55	44	40	14		300	CLR	10
155	45	39	18	24	300	CLR	10
255	44	42	24	29	290	CLR	10
355	45	39	23	32	290	CLR	10
455	44	37	25	33	290	CLR	10
555	44	34	22	31	290	CLR	10
655	44	31	28	38	290	CLR	10
755	46	29	26	37	300	CLR	10
855	49	27	32	44	300	HZ	5
955	52	27	44	52	320	HZ	3
1055	55	27	48	56	320	HZ	2.5
1115	55	25	43	58	320	HZ	3
1155	56	27	46	53	330	HZ	4
1215	57	26	46	54	320	HZ	5
1255	56	28	44	53	310	HZ	4
1355	55	31	40	54	330	HZ	5
1455	58	29	40	47	320	OVC075	7
1515	57	29	36	55	320	HZ	5
1535	58	28	39	52	330	OVC075	7
1555	57	29	40	53	320	HZ	5
1655	57	29	38	51	330	SCT055 SCT065	7
1755	55	31	29	43	330	CLR	10
1855	53	34	30	38	330	CLR	10
1955	51	35	23	32	320	CLR	10
2055	50	38	28	36	320	CLR	10
2155	49	38	24	34	320	CLR	10

Figures 5-7 and 5-8 show the output for blowing dust from the NAAPS (Navy Aerosol Analysis and Prediction System) Global Aerosol Model for October 18, 2012. The bottom panels in Figures 5-7 and 5-8 show where dust is blowing. They show a large area of blowing dust extending from west Texas through eastern Colorado and western Kansas and continuing

northward into Canada. As the day progressed and wind speeds increased from the strong storm system approaching from the west, the concentration of dust increased dramatically across southeast Colorado and into southwest Kansas.

The NAAPS model output is based on soil moisture content, soil erodibility factors, and modeled meteorological factors conducive to blowing dust (a description of NAAPS see: http://www.nrlmry.navy.mil/aerosol_web/Docs/globaer_model.html).

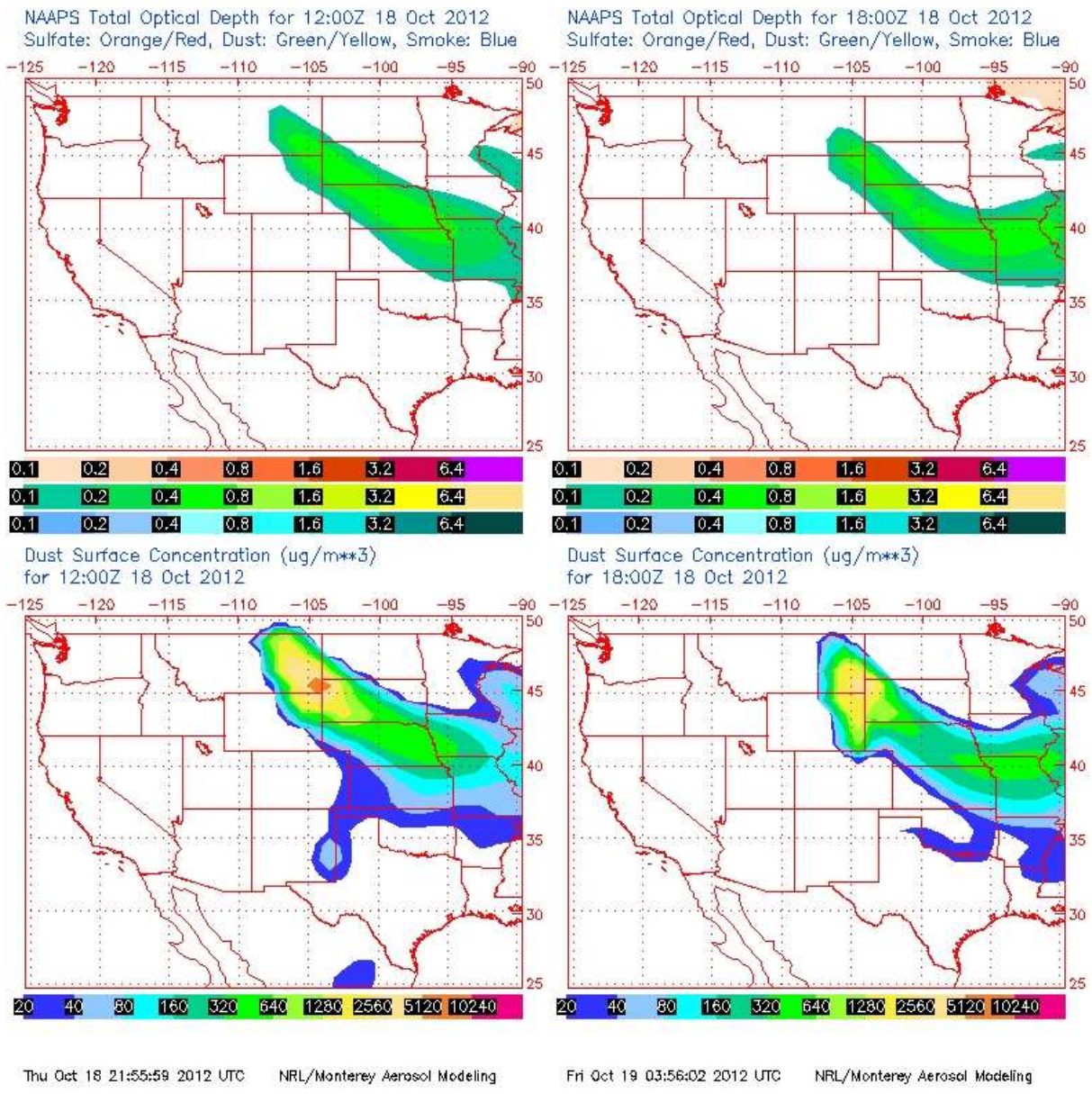


Figure 5-7. NAAPS forecasted surface dust concentrations and optical depth for 7a.m. and 1p.m. CDT October 18, 2012 (NRL/Monterey Aerosol Modeling)

Although the NAAPS forecast products can over predict dust PM_{10}, they do provide an independent calculation of the potential for blowing dust and the spatial extent of blowing dust for this event. The highest NAAPS concentrations of dust PM_{10} are in southeast Montana, western South Dakota and western Nebraska. All of the products discussed here point to a widespread, regional-scale dust storm that originated in portions of southeast Montana, western South Dakota and western Nebraska and grew to cover parts of ten states.

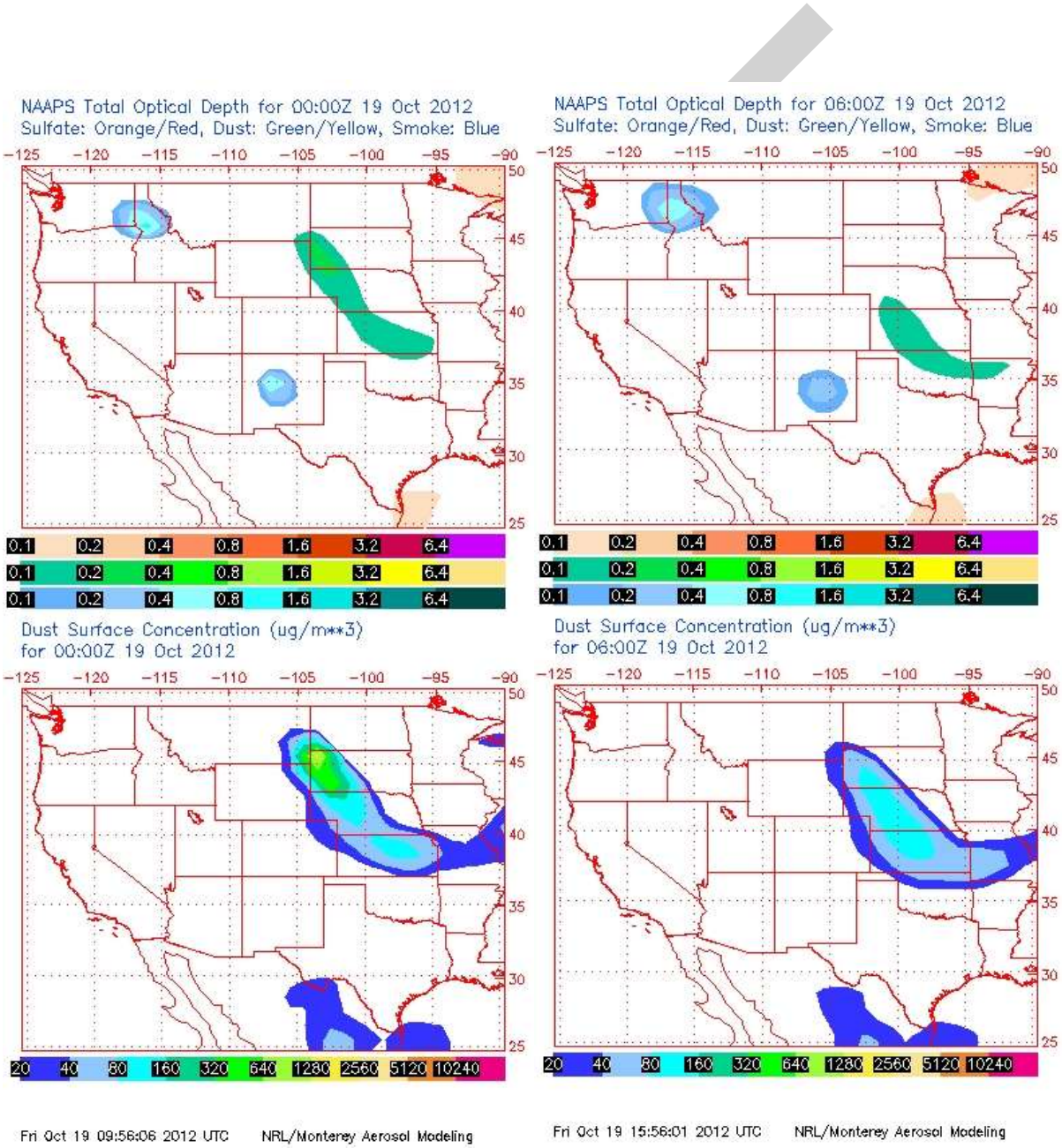


Figure 5-8. NAAPS forecasted surface dust concentrations and optical depth for 7p.m. and 1a.m. CDT October 18, 2012 (NRL/Monterey Aerosol Modeling)

Figure 5-9 is an image from the GOES visible satellite showing the on-going dust storm across parts of western Nebraska and western and central Kansas. Figures 5-10 through 5-13 are MODIS 1 km resolution Dust RGB products showing the progression of the dust throughout the day. The images were taken during the day of October 18, 2012 when the strongest winds were being recorded at various METAR sites across the region. In fact, the winds across the region during the times that these images were acquired were blowing from the northwest near 40mph with gusts between 53-58mph.

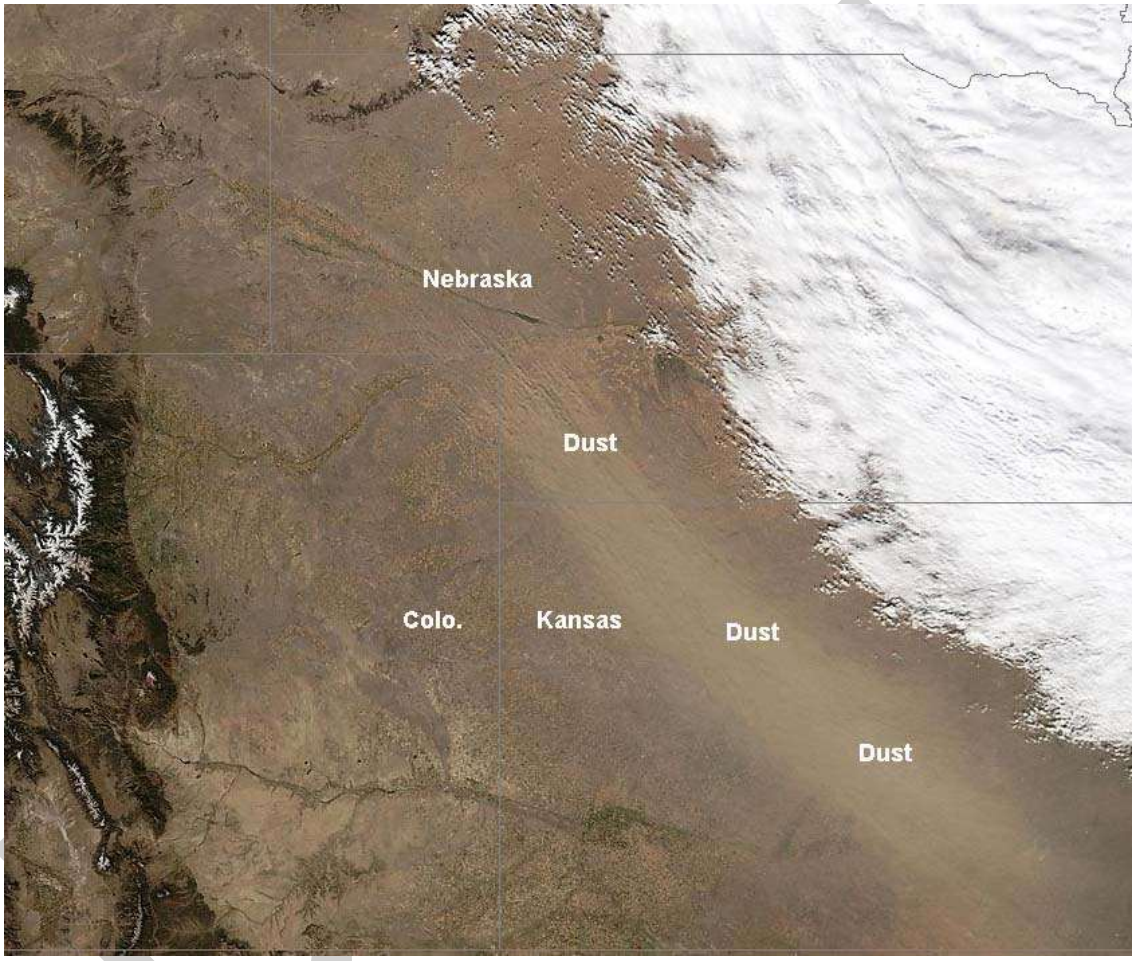


Figure 5-9. GOES visible satellite image showing ongoing dust storm @ 2015Z (3:15PM CDT) October 18, 2012. (NASA)

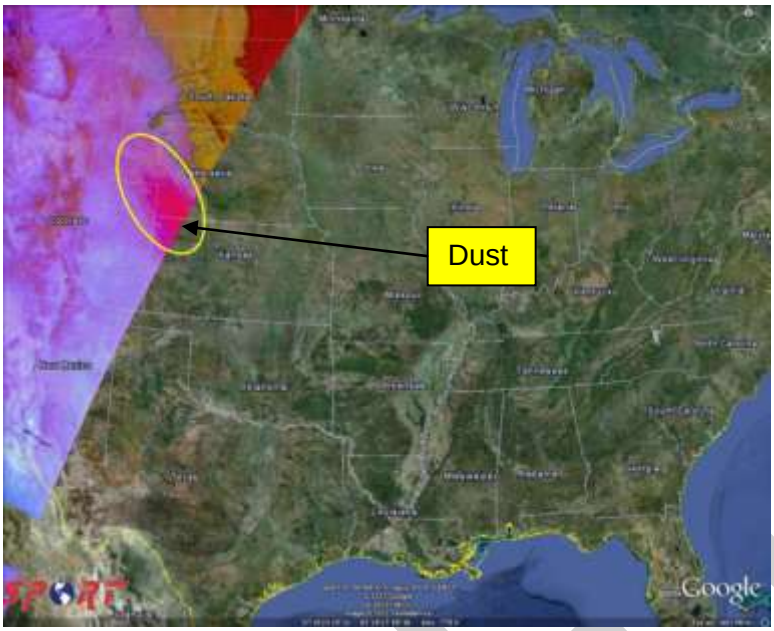


Figure 5-10. MODIS 1 km resolution Dust RGB product valid 1831Z (1:31p.m.)18 October 2012 provided by NASA/SPoRT viewed in Google Earth via KML file. The yellow circle indicates the dust plume that originated in SW Nebraska. The dust shows up as the bright pink/red colors in the dust RGB imagery.

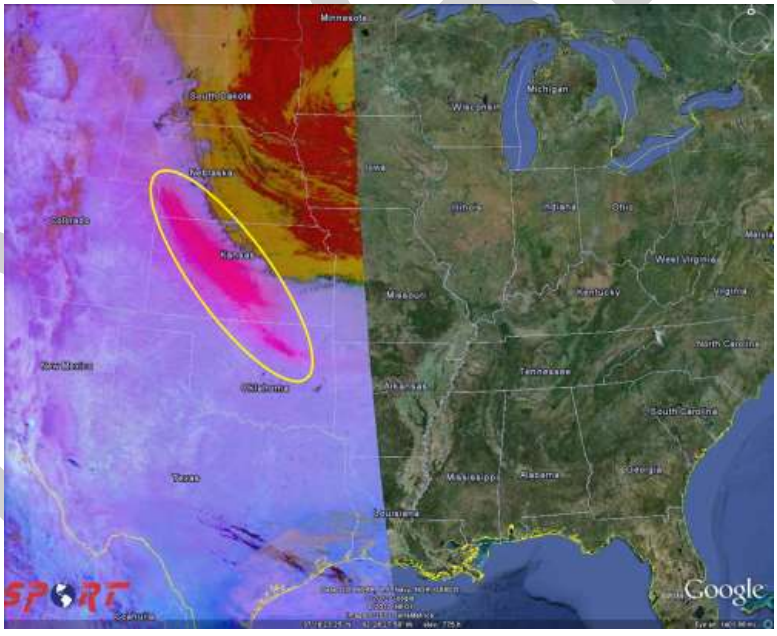


Figure 5-11. MODIS 1 km resolution Dust RGB product valid 2013Z (3:13p.m.)18 October 2012 provided by NASA/SPoRT viewed in Google Earth via KML file. The yellow circle indicates the dust plume that originated in SW Nebraska. The dust shows up as the bright pink/red colors in the dust RGB imagery.

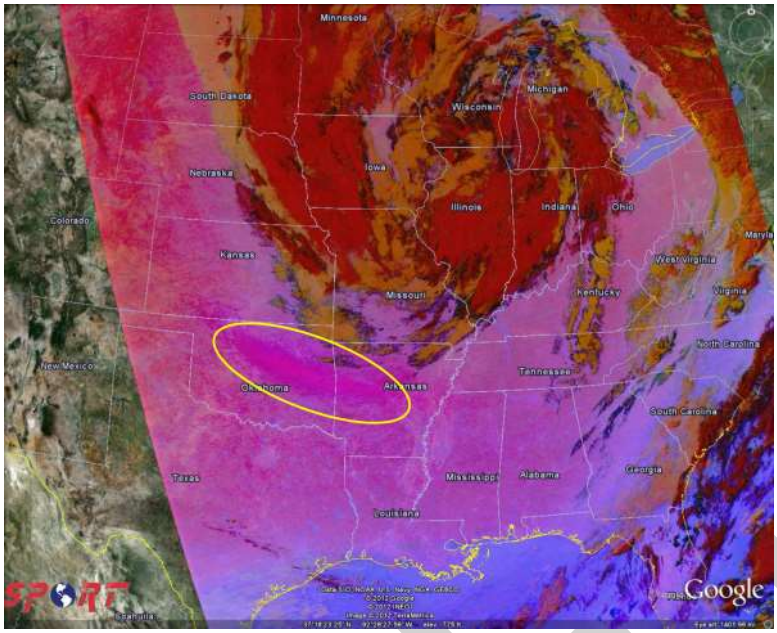


Figure 5-12. MODIS 1 km resolution Dust RGB product valid 0358Z (10:58p.m, Oct. 18)19 October 2012 provided by NASA/SPoRT viewed in Google Earth via KML file. The yellow circle indicates the dust plume that originated in SW Nebraska. In this nighttime image, the dust shows up as a brighter pink/puple color when compared to the softer pinks and light purples of the cooling surface. Notice the highest concentration of dust was across central portions of Oklahoma into western Arkansas.

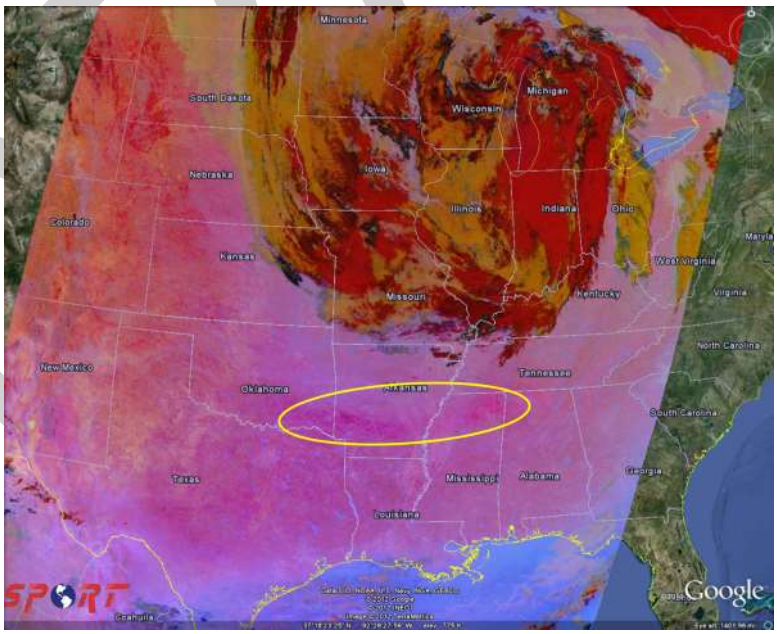


Figure 5-13. MODIS 1 km resolution Dust RGB product valid 0810Z (3:19a.m.)19 October 2012 provided by NASA/SPoRT viewed in Google Earth via KML file. The yellow circle indicates the dust plume that originated in SW Nebraska.

Figures 5-14 and 5-15 contain back trajectory plots for Wichita and Topeka during the peak period of winds and reduced visibilities on October 18, 2012. 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 western Nebraska are completely consistent with the Wichita and Topeka exceptional event, October 18, 2012 observed dust in the GOES and MODIS imagery. Again, this shows a clear causal relationship between the dust in the source region and high PM_{10} concentrations in Wichita and Topeka.

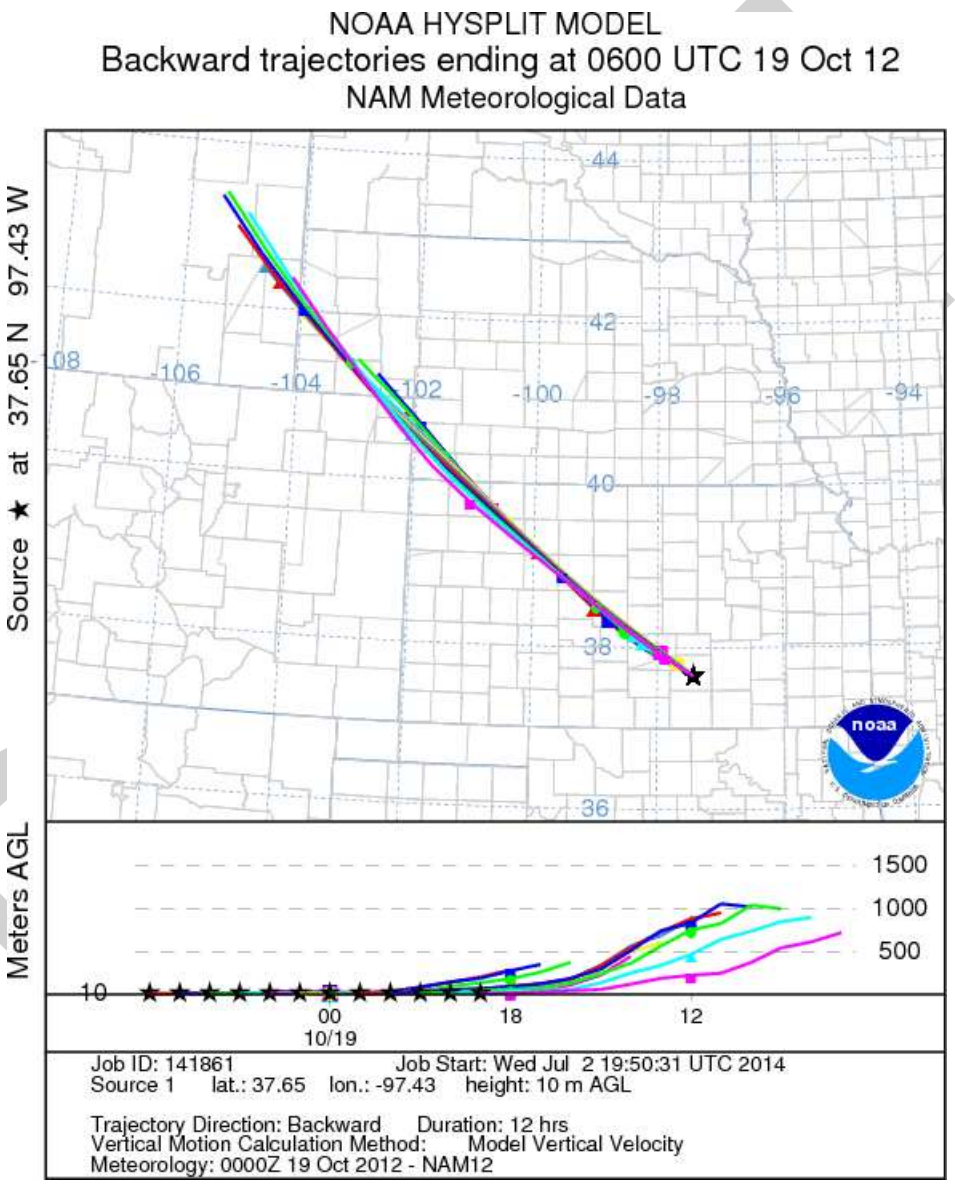


Figure 5-14. NOAA HYSPLIT 12-hour back trajectory plots for each hour during the windiest period on October 18, 2012 for Wichita, KS. The HYSPLIT model run was based on data from the high-resolution 12-kilometer grid spacing NAM numerical weather model.

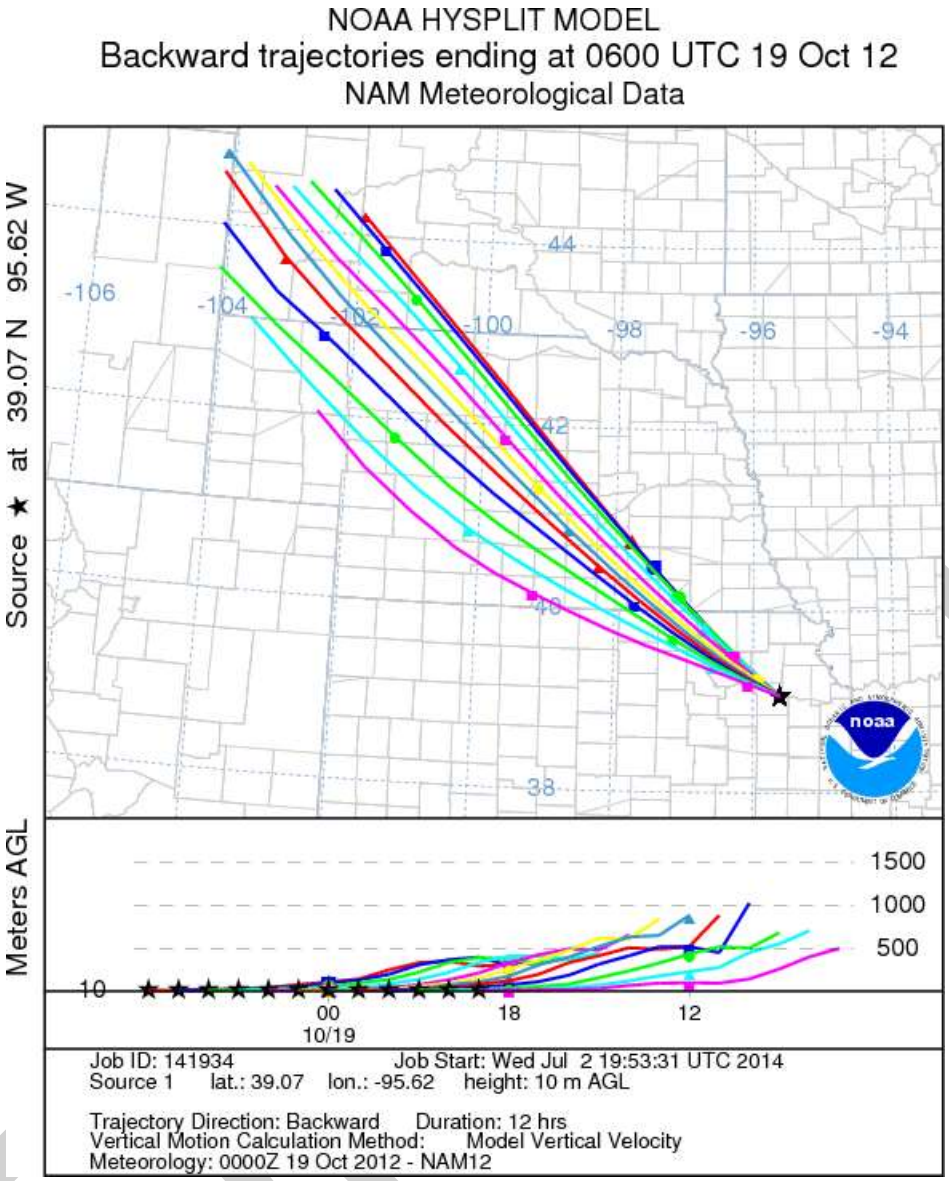


Figure 5-15. NOAA HYSPLIT 12-hour back trajectory plots for each hour during the windiest period on October 18, 2012 for Topeka, KS. The HYSPLIT model run was based on data from the high-resolution 12-kilometer grid spacing NAM numerical weather model.

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, western Nebraska, western Texas, New Mexico and Arizona are source regions for blowing dust (see Figure 5-16). The back trajectories in Figures 5-14 and 5-15 cross parts of these source areas and suggest that dust from upwind states can contribute to PM_{10} concentrations at Wichita and Topeka during regional high-wind events.

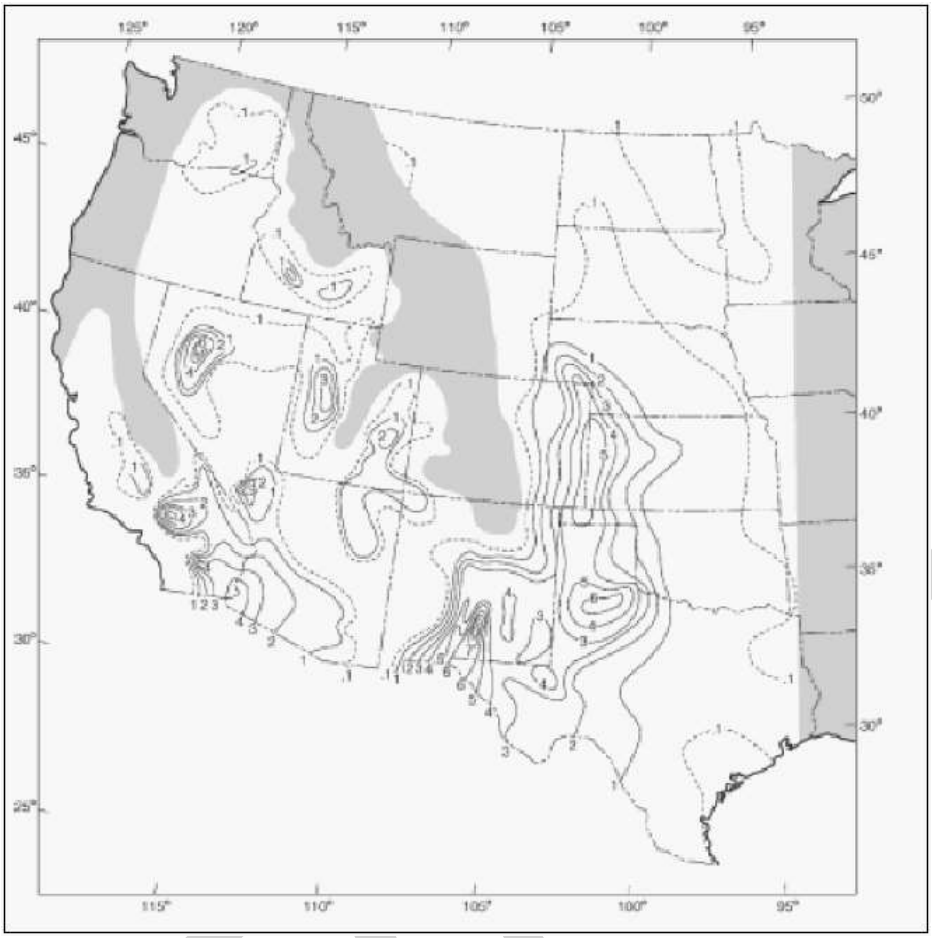


Figure 5-16. Number of dust storms per year from: Orgill, M.M., Sehmel, G.A., 1976. Frequency and diurnal variation of dust storms in the contiguous USA. **Atmospheric Environment 10**, 813–825.

The PM_{10} exceedances at Wichita and Topeka on October 18, 2012, would not have occurred if not for the following: (a) dry soil conditions over eastern Colorado, western Kansas, western Nebraska and southern South Dakota; and (b) the tight surface pressure gradient and strong upper level winds mixing to the surface that led to strong gusty surface winds over eastern Colorado, western Kansas, western Oklahoma, northern Texas and western Nebraska. Clearly the PM_{10} exceedances at Wichita and Topeka are due to an exceptional event associated with regional windstorm-caused emissions from erodible soil sources over a large area of eastern Colorado, western Kansas, western Nebraska and Oklahoma, and these sources are not reasonably controllable during a significant regional windstorm under abnormally dry or moderate to severe drought conditions.

6. "But For" Analysis

Section 50.14(c)(3)(iv)(D) in 40 CFR part 50 requires that an exceptional event demonstration must satisfy that "[t]here would have been no exceedance or violation but for the event." The prior sections of this submittal have provided detailed information that the exceedances at the Wichita and Topeka monitors on October 18, 2012 was not reasonably controllable or preventable and there is a clear causal relationship between transported PM_{10} from very strong winds associated with an intense storm system originating in areas outside of the these areas and the measured exceedances at the Wichita and Topeka monitors. The weight of evidence in these sections demonstrates that but for the existence of emissions generated by these very strong winds and associated transported PM_{10}, there would have been no exceedances of the 24-Hour PM_{10} standard.

As detailed in Section 4, all reasonable agricultural control measures were in place and actively employed before, during, and after the exceedance of October 18, 2012. Local regulatory agencies, industry and the general public were alerted to the possibility of dust storms due to very strong winds through daily forecasts and media reports. On the ground observations recorded during the events consistently identify transported or re-entrained PM_{10} (dust) as the cause of the elevated concentrations near the exceeding monitor.

As shown in Section 5, detailed maps establish a clear causal relationship between the arrival of emissions generated by very strong winds associated with a intense storm system and elevated PM_{10} concentrations at the monitor. Multiple, independent measurements of wind speed, wind direction, and visibility all point to the presence of very strong winds as the delivery vehicle for transported PM_{10} into the Wichita and Topeka areas. The source regions for the transported PM_{10} are clearly identified as areas to the north and northwest of the Wichita and Topeka areas, especially in southwest Nebraska.

Figures 6-1 and 6-2 shows the monitored values recorded at the Wichita Health Department and Topeka KNI monitors before and after the event of October 18, 2012. As you can see from the graphs, PM_{10} readings were significantly below the reading of October 18 and are more in line with expected average PM_{10} readings from this monitor in October. This is another piece of evidence that this event or exceedance would not have occurred but for the very strong winds associated with the storm system that moved through the area on October 18, 2012.

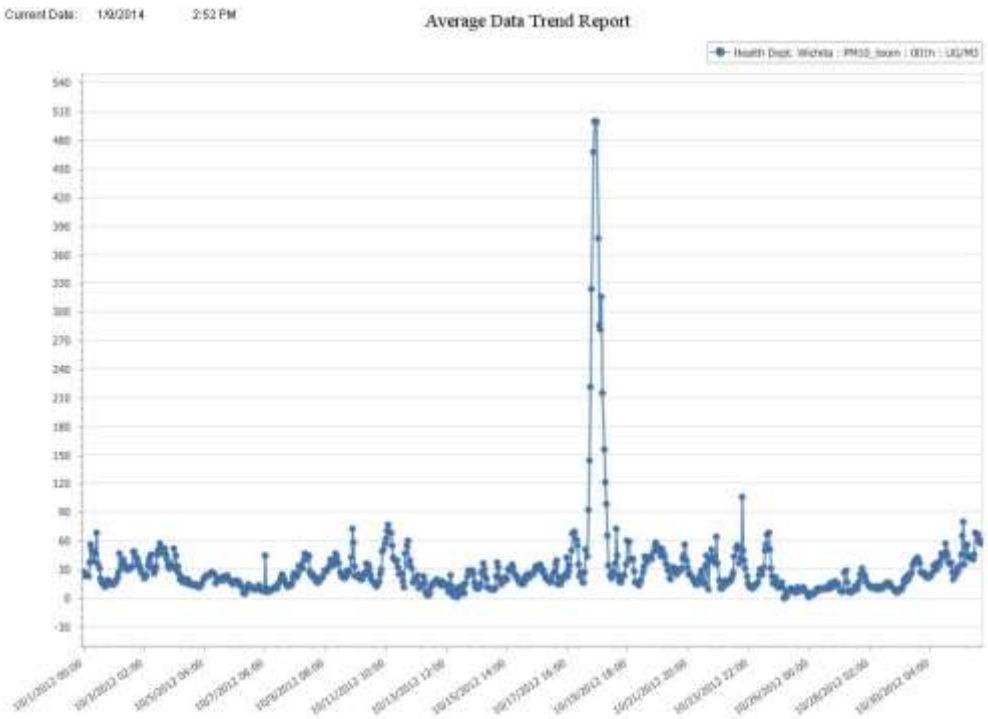


Figure 6-1. Wichita HD PM_{10} reading from October 1, 2012 to October 30, 2012

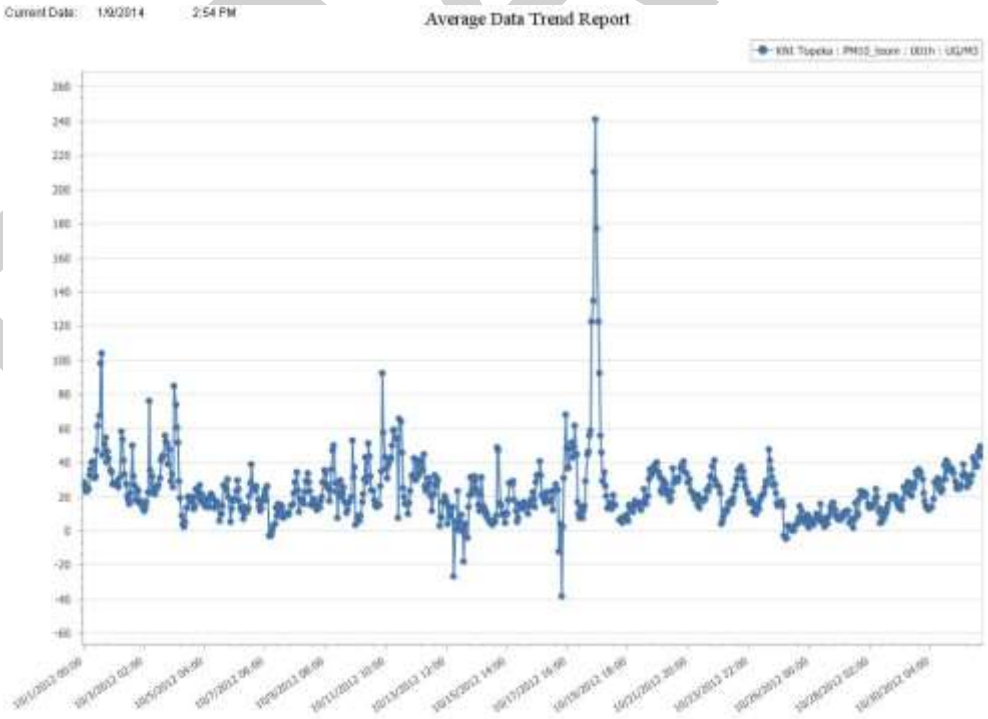


Figure 6-2. Topeka KNI PM_{10} reading from October 1, 2012 to October 30, 2012

An example of the estimation of PM_{10} due to the event at the Wichita HD is presented here and in Table 6-1. Based on the entirety of data in the Historical Fluctuations section, a conservative estimate of the "typical" values in October would have been between 29 and 34 µg/m^3 (corresponding to the 75th and 85th Percentile values) for the Wichita HD monitor. Using these conservative values as "typical" would indicate that the event provided an additional 163.4 – 168.4 µg/m^3 for the Wichita HD monitor.

Table 6-1**.** Typical October PM_{10} Values for Wichita HD

Site	Event Day Concentration (µg/m^3)	October Median (µg/m^3)	October Average (µg/m^3)	Oct. 75th % (µg/m^3)	Oct. 85th % (µg/m^3)	Est. Concentration Above Typical (µg/m^3)
Wichita HD	197.4	21.0	21.6	29	34	163.4-168.4

The body of evidence presented in this submittal provides no alternative that could tie the exceedance of October 18, 2012 to any other causal source but transported and re-entrained PM_{10} generated from very strong winds associated with an intense storm system, confirming that there would have been no exceedance but for the presence of these uncontrollable natural events.

7. Conclusions

The exceedances that occurred on October 18, 2012 satisfies the criteria of 40 CFR 50.1(j) and meets the definition of an exceptional event. These criteria are:

- The event affects air quality.
- The event is not reasonably controllable or preventable.
- The event is unlikely to reoccur at a particular location or [is] a natural event.

A. Affects Air Quality

As stated in the preamble to the Exceptional Events Rule, the event in question is considered to have affected air quality if it can be shown that there is a clear causal relationship between the monitored exceedance and the event, and that the event is associated with a measured concentration in excess of normal historical fluctuations. Given the information presented in Sections 2, 3, 4 and 5, we can reasonably conclude that the event in question affected air quality.

B. Not Reasonably Controllable or Preventable

Section 50.1(j) of Title 40 CFR Part 50 requires that an event must be "not reasonably controllable or preventable" in order to be defined as an exceptional event. This requirement is met by demonstrating that despite reasonable agricultural and source control measures in place within Sedgwick and Shawnee Counties, high wind conditions overwhelmed all reasonably available controls. Despite best available agricultural control measures, high wind conditions associated with a very strong storm system brought high concentrations of PM_{10} emissions into, and also overwhelmed controls within, the two areas. The event discussed in this document that caused the exceedance in this request (see Sections 2 and 5) was caused by very high winds that transported dust into Sedgwick and Shawnee Counties from areas largely outside of the area. The fact that this was a natural event involving strong winds that transported PM_{10} emissions into Sedgwick and Shawnee Counties, with a majority of the PM_{10} emissions recorded by the Wichita and Topeka monitors coming from sources outside of the area, provides strong evidence that the event and exceedance of October 18, 2012 were not reasonably controllable or preventable.

C. Natural Event

As discussed above, the event shown to cause this exceedance was emissions of PM_{10} driven by high winds caused by an intense storm system moving through the area on October 18, 2012. This event therefore qualifies as a predominantly natural event with only a very small anthropogenic contribution.

In summary, the exceedances of the federal 24-hour PM_{10} standard on October 18, 2012, would not have occurred but for the extreme high winds and windblown dust transport

from areas largely outside the Sedgwick and Shawnee County areas, based on the following weight of evidence:

- The high PM_{10} values at the Wichita and Topeka monitors in Section 2 shows that the timing of elevated PM_{10} event was consistent with decreased visibility and reports of blowing dust and/or haze at representative National Weather Service stations.

- Historical Fluctuation analyses and graphs in Section 3 showing five years of 24-hour average data for example exceedance monitors depict the atypically high PM_{10} concentration during the October 18, 2012 event. The elevated PM_{10} concentration during this day was exceptional from a historical perspective.

- The exceedances of the PM_{10} standard recorded on October 18 were tied to very strong winds, as can be seen National Weather Service warnings and meterological summaries of wind speeds from multiple cities in the area in Section 5.

- Figures in Section 5 show that the timing of the increases in wind speeds at monitoring locations and National Weather Service stations during the event is consistent with the timing of elevated PM_{10} concentrations recorded at the monitoring locations in the area.

- Wind directions, NAAPS dust modeling output, and back trajectories, all depicted in Section 5, help show that a major portion of the dust that impacted the Segwick and Shawnee County area monitors originated in areas located generally west and northwest of the area.

- Approximate increased PM_{10} emissions for this event was provided in Section 6 to give an idea of the magnitude of the dust storm that affected the Sedgwick and Shawnee County areas and the amount of PM_{10} that can be transported in during these types of events.

- Section 4 discusses the best available control technologies and source control technologies that are in place in the Sedgwick and Shawnee County areas in order to show that the event was not reasonably controllable or preventable. Additionally, the newspaper accounts provided in Appendix D also helps illustrate the magnitude and scale of this events which supports the claim that the exceedance recorded during this day was not reasonably controllable or preventable.

8. References

Draxler, R.R. and Rolph, G.D., 2013. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (http://www.arl.noaa.gov/HYSPLIT.php). NOAA Air Resources Laboratory, College Park, MD.

Kansas Department of Health and Environment, Morton and Sedgwick Counties, May 1998. State of Kansas PM10 Natural Events Action Plans (NEAP) for Morton and Sedgwick Counties

Knapp, Mary. Kansas State Climatologist; Personal communication; Kansas State University; Manhattan, KS; 2013.

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

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

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

2007 Census of Agriculture. Vol. 1: Chapter 2: County Level Data Kansas U.S. Dept. Of Commerce: Bureau of Census.

9. APPENDIX A – Public Comments

KDHE, in following the requirements listed in 40 CFR 50.14 (c)(3)(i) **Submission of demonstrations**, posted this Exceptional Events Demonstration Package on the Agency website for public comment from August 1 through August 31, 2014. In accordance with 40 CFR 50.14 (c)(3)(v), KDHE is documenting the public comments received in this section.

INSERT KDHE WEBPAGE ANNOUNCEMENT OF PUBLIC COMMENT PERIOD HERE

9.1 KDHE response to EPA comments

9.2 KDHE Response to Public Comments

10. APPENDIX B – Wichita and surrounding NWS offices advisory and warning products for October 18, 2012

10.1 Goodland NWS

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE GOODLAND KS
936 AM MDT THU OCT 18 2012

.UPDATE...
ISSUED AT 928 AM MDT THU OCT 18 2012

GLD VWP SHOWING SPEEDS OF 50 TO 55 KNOTS 1 TO 2K ABOVE THE SURFACE. THOMAS COUNTY JUST GOT A GUST TO 50 KNOTS. GOOD DOWNWARD MOTION INDICATED BY THE MODELS. UPPER JET IS SLOWER AND LITTLE FURTHER WEST. ALSO BETTER LAPSE RATES RESIDE A LITTLE FURTHER WEST AS WELL. SO EXPANDED THE HIGH WIND WARNING A LITTLE FURTHER WEST. ALSO AUTOMATED OBSERVATIONS AND SOME GROUND TRUTH INDICATING VISIBILITIES OF LESS THAN A MILE AND IN SOME CASES A HALF MILE. SO INTRODUCED BLOWING DUST INTO THE WEATHER GRIDS. DID NOT CHANGE ANYTHING ELSE AT THIS TIME.

&&

.SHORT TERM...(TODAY THROUGH SATURDAY NIGHT)
ISSUED AT 318 AM MDT THU OCT 18 2012

A RED FLAG WARNING IS IN EFFECT THIS AFTERNOON WITH A HIGH WIND WARNING AND WIND ADVISORY IN EFFECT THROUGH THE DAY.

PRIMARY SHORT TERM CONCERNS ARE THE DRY AND WINDY CONDITIONS EXPECTED TODAY. HAVE KEPT THE HIGHLIGHTS INTACT AS THEY LOOK TO BE ON TRACK WITH VERY FEW OVERALL CHANGES THROUGH THE SHORT TERM. TIGHTEST SURFACE PRESSURE GRADIENT WILL BE OVER THE NORTHEAST PORTION OF THE FORECAST AREA AROUND MID DAY...SO HAVE TIMED THE STRONGEST WINDS TO ALSO OCCUR AROUND MID DAY AND SLACKEN SLIGHTLY THROUGH THE AFTERNOON WITH THE REAL DECREASE IN WIND SPEED TO OCCUR AFTER SUNSET THIS EVENING. VERY DRY CONDITIONS ARE EXPECTED WITH RH VALUES BELOW 15 PERCENT THIS AFTERNOON...LEADING TO CRITICAL FIRE WEATHER DANGER WHEN COMBINED WITH THE STRONG WINDS ALSO EXPECTED THIS AFTERNOON.

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE GOODLAND KS
955 AM MDT THU OCT 18 2012

COZ090-KSZ001-013-014-028-029-190000-
/O.UPG.KGLD.WI.Y.0034.000000T0000Z-121019T0000Z/
/O.EXA.KGLD.HW.W.0010.000000T0000Z-121019T0000Z/
YUMA-CHEYENNE KS-SHERMAN-THOMAS-LOGAN-GOVE-
INCLUDING THE CITIES OF...YUMA...WRAY...ST. FRANCIS...GOODLAND...
COLBY...OAKLEY...QUINTER
955 AM MDT THU OCT 18 2012 /1055 AM CDT THU OCT 18 2012/

...HIGH WIND WARNING IN EFFECT UNTIL 6 PM MDT /7 PM CDT/ THIS
EVENING...

THE NATIONAL WEATHER SERVICE IN GOODLAND HAS ISSUED A HIGH WIND
WARNING...WHICH IS IN EFFECT UNTIL 6 PM MDT /7 PM CDT/ THIS
EVENING. THE WIND ADVISORY IS NO LONGER IN EFFECT.

* TIMING/DURATION...VERY STRONG AND GUSTY NORTHWEST WINDS ARE
  EXPECTED THROUGH LATE AFTERNOON.

* PEAK WINDS...SUSTAINED NORTHWEST WINDS OF 30 TO 45 MPH WITH
  GUSTS INTO THE 60 TO 65 MPH RANGE.

* OTHER IMPACTS...AREAS OF BLOWING DUST ARE EXPECTED. REDUCED
  VISIBILITIES HAVE BEEN REPORTED AND WILL CONTINUE TO OCCUR.
  VISIBILITIES IN SOME LOCATIONS WILL DROP TO NEAR ZERO AT TIMES.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A HIGH WIND WARNING MEANS STRONG WINDS ARE EITHER OCCURRING OR
IMMINENT WHICH COULD LEAD TO PROPERTY DAMAGE...REDUCED VISIBILITY
IN BLOWING DUST...AND LOSS OF VEHICLE CONTROL. A HIGH WIND
WARNING IS ISSUED FOR SUSTAINED WIND SPEEDS OF AT LEAST 40 MPH OR
GUSTS OF 58 MPH OR MORE.

SHORT TERM FORECAST
NATIONAL WEATHER SERVICE GOODLAND KS
244 PM MDT THU OCT 18 2012

KSZ001>004-013>016-028-029-NEZ079>081-182300-
CHEYENNE KS-DECATUR-DUNDY-GOVE-GRAHAM-HITCHCOCK-LOGAN-NORTON-RAWLINS-
RED WILLOW-SHERIDAN-SHERMAN-THOMAS-
INCLUDING THE CITIES OF...BENKELMAN...COLBY...GOODLAND...HILL CITY...
MCCOOK...NORTON...OBERLIN
244 PM MDT (344 PM CDT) THU OCT 18 2012

.NOW...

...HIGH WIND WARNING IN AFFECT UNTIL 6 PM MDT (7 PM CDT)...
BLOWING DUST WILL CONTINUE ACROSS THE AREA. NEAR ZERO VISIBILITY HAS BEEN REPORTED IN ISOLATED LOCATIONS ALONG HIGHWAY 36 AND ALSO ALONG INTERSTATE 70. SOME ACCIDENTS HAVE ALREADY OCCURRED ALONG INTERSTATE 70. MOTORISTS ACROSS THE ENTIRE AREA ARE URGED TO USE EXTREME CAUTION. VISIBILITIES WILL CHANGE RAPIDLY OVER A SHORT DISTANCE AND WILL BE NEAR ZERO AT TIMES FOR THE REST OF THE AFTERNOON.

10.2 Dodge City NWS

REGIONAL WEATHER SUMMARY FOR WESTERN KANSAS
NATIONAL WEATHER SERVICE DODGE CITY KS
1123 AM CDT THU OCT 18 2012

SKIES WERE MOSTLY CLEAR ACROSS WESTERN KANSAS DURING THE OVERNIGHT HOURS. NORTHWEST WINDS INCREASED INTO THE 15 TO 25 MPH RANGED SHORTLY BEFORE SUNRISE. LOW TEMPERATURES RANGED FROM 29 DEGREES AT GOODLAND TO 41 DEGREES AT HAYS AND HILL CITY.

A TIGHT PRESSURE GRADIENT BETWEEN HIGH PRESSURE OVER THE NORTHERN ROCKIES AND AN INTENSE SURFACE LOW PRESSURE CENTER ACROSS THE UPPER MIDWEST AND GREAT LAKES WILL CREATE VERY STRONG WINDS THIS AFTERNOON ACROSS THE REGION. HIGH WIND WARNINGS OR WIND ADVISORIES WERE IN EFFECT MAINLY FROM NEBRASKA TO KANSAS AND NORTHEASTERN COLORADO UNTIL EARLY THIS EVENING. THE STRONGEST WINDS ARE EXPECTED TO BE FROM NORTHEASTERN COLORADO AND NORTHWESTERN KANSAS TO WESTERN AND CENTRAL NEBRASKA. WINDS IN THIS AREA ARE FORECAST TO GUST TO 60 MPH. WINDS WILL BE DECREASING TONIGHT AS THE SURFACE LOW WEAKENS. WITH THE EXCEPTION OF CLOUDS FROM NORTH CENTRAL NEBRASKA TO THE NORTHEAST CORNER OF KANSAS, SKIES WILL BE MOSTLY CLEAR THROUGH TONIGHT.

HIGH TEMPERATURES THIS AFTERNOON WILL RANGE FROM THE LOWER 50S IN NORTH CENTRAL NEBRASKA TO AROUND 70 IN CENTRAL OKLAHOMA. LOWS TONIGHT WILL RANGE FROM THE MID 20S IN PARTS OF WESTERN NEBRASKA TO THE LOWER 40S IN EASTERN KANSAS AND CENTRAL OKLAHOMA.

PUBLIC INFORMATION STATEMENT
NATIONAL WEATHER SERVICE DODGE CITY KS
1239 PM CDT THU OCT 18 2012

...HIGHEST WINDS IN THE PAST 3 HOURS...

...LOCATION...	...TIME...	...WIND...
3 NW VICTORIA (ELLIS KS) (KSDOT)	1131 AM OCT 18	55 MPH
PRATT INDUSTRIAL AIRPORT AWOS SITE	1235 PM OCT 18	52 MPH
1 WNW SHALLOW WATER (SCOTT KS)	1059 AM OCT 18	52 MPH
DIGHTON (LANE KS) (2780 FT)(APRSWXNET)	1206 PM OCT 18	49 MPH
12 N JETMORE (HODGEMAN KS) (KSDOT)	1100 AM OCT 18	48 MPH
HAYS REGIONAL AIRPORT AWOS SITE	1035 AM OCT 18	47 MPH
MEDICINE LODGE ASOS SITE (BARBER KS)	1138 AM OCT 18	47 MPH
QUIVERA REMOTE AUTOMATED WEATHER STATIO	1059 AM OCT 18	44 MPH
4 SW SAWYER (BARBER KS) (APRSWXNET)	1143 AM OCT 18	44 MPH
DODGE CITY, KS (FORD KS) (ASOS)	1152 AM OCT 18	44 MPH
3 W FORD (FORD KS) (2420 FT)(KSDOT)	1008 AM OCT 18	42 MPH
4 WSW FRIEND (FINNEY KS) (APRSWXNET)	1110 AM OCT 18	42 MPH
1 NNE DODGE CITY (FORD KS) (APRSWXNET)	1135 AM OCT 18	41 MPH
6 W SCOTT STATE LAKE (SCOTT KS)	1120 AM OCT 18	41 MPH
GARDEN CITY REGIONAL AIRPORT	1154 AM OCT 18	41 MPH

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE DODGE CITY KS
217 PM CDT THU OCT 18 2012

...VERY STRONG WINDS WILL DEVELOP BY LATE MORNING AND CONTINUE THROUGH EARLY EVENING...

.A TIGHT PRESSURE GRADIENT BETWEEN HIGH PRESSURE OVER THE NORTHERN ROCKIES AND AN INTENSE SURFACE LOW PRESSURE CENTER ACROSS THE UPPER MIDWEST WILL CREATE VERY STRONG WINDS TODAY ACROSS THE REGION. STRONGER WINDS IN THE LOWER TO MIDDLE LEVELS OF THE ATMOSPHERE WILL ALSO MIX DOWN TO THE SURFACE THROUGH THE AFTERNOON HOURS.

KSZ064-078>081-089-090-190000-
/O.UPG.KDDC.WI.Y.0037.000000T0000Z-121019T0000Z/
/O.EXA.KDDC.HW.W.0008.000000T0000Z-121019T0000Z/
HODGEMAN-FORD-EDWARDS-KIOWA-PRATT-COMANCHE-BARBER-
INCLUDING THE CITIES OF...JETMORE...HANSTON...DODGE CITY...
BUCKLIN...KINSLEY...LEWIS...GREENSBURG...HAVILAND...PRATT...
COLDWATER...PROTECTION...MEDICINE LODGE...KIOWA...SUN CITY
217 PM CDT THU OCT 18 2012

...HIGH WIND WARNING IN EFFECT UNTIL 7 PM CDT THIS EVENING...

THE NATIONAL WEATHER SERVICE IN DODGE CITY HAS ISSUED A HIGH WIND WARNING...WHICH IS IN EFFECT UNTIL 7 PM CDT THIS EVENING. THE WIND ADVISORY IS NO LONGER IN EFFECT.

* TIMING...NORTHWESTERLY WINDS WILL CONTINUE THROUGH THIS AFTERNOON.

* WINDS...WINDS WILL BE NORTHWESTERLY AT 35 TO 45 MPH WITH GUSTS TO AROUND 60 MPH.

* IMPACTS...MOTORISTS...ESPECIALLY THOSE DRIVING HIGH PROFILE VEHICLES... WILL ENCOUNTER DIFFICULT DRIVING CONDITIONS. COMMUTERS ARE ALSO ENCOURAGED TO USE EXTRA CAUTION ON WEST TO EAST ROADWAYS.

PUBLIC INFORMATION STATEMENT
NATIONAL WEATHER SERVICE DODGE CITY KS
351 PM CDT THU OCT 18 2012

...HIGHEST WINDS IN THE PAST 6 HOURS...

...LOCATION...	...TIME...	...WIND...
MEDICINE LODGE ASOS SITE (BARBER KS)	152 PM OCT 18	59 MPH
1 WNW SHALLOW WATER (SCOTT KS)	1259 PM OCT 18	58 MPH
DODGE CITY, KS (FORD KS) (ASOS)	144 PM OCT 18	56 MPH
4 SW SAWYER (BARBER KS) (APRSWXNET)	252 PM OCT 18	55 MPH
3 NW VICTORIA (ELLIS KS) (KSDOT)	1131 AM OCT 18	55 MPH
PRATT INDUSTRIAL AIRPORT AWOS SITE	1255 PM OCT 18	53 MPH
12 N JETMORE (HODGEMAN KS) (KSDOT)	1230 PM OCT 18	52 MPH
3 W FORD (FORD KS) (2420 FT)(KSDOT)	123 PM OCT 18	51 MPH
1 NNE DODGE CITY (FORD KS) (APRSWXNET)	145 PM OCT 18	50 MPH

10.3 North Platte, NE NWS

SPECIAL WEATHER STATEMENT
NATIONAL WEATHER SERVICE NORTH PLATTE NE
1035 AM CDT THU OCT 18 2012

NEZ004>010-022>029-035>038-056>059-069>071-094-182200-
SHERIDAN-EASTERN CHERRY-KEYA PAHA-BOYD-BROWN-ROCK-HOLT-GARDEN-
GRANT-HOOKER-THOMAS-BLAINE-LOUP-GARFIELD-WHEELER-ARTHUR-MCPHERSON-
LOGAN-CUSTER-DEUEL-KEITH-PERKINS-LINCOLN-CHASE-HAYES-FRONTIER-
WESTERN CHERRY-
INCLUDING THE CITIES OF...GORDON...RUSHVILLE...VALENTINE...
SPRINGVIEW...SPENCER...AINSWORTH...BASSETT...ONEILL...OSHKOSH...
HYANNIS...MULLEN...THEDFORD...DUNNING...TAYLOR...BURWELL...
BARTLETT...ARTHUR...TRYON...STAPLETON...BROKEN BOW...CHAPPELL...
BIG SPRINGS...OGALLALA...GRANT...NORTH PLATTE...IMPERIAL...
HAYES CENTER...CURTIS...EUSTIS...CODY...MERRIMAN...KILGORE
1035 AM CDT THU OCT 18 2012 /935 AM MDT THU OCT 18 2012/

AT 1030 AM CDT...EXTREME WIND CONDITIONS CREATING DIFFICULT TRAVEL ACROSS WESTERN AND NORTH CENTRAL NEBRASKA. WIND GUSTS OF 60 MPH OR GREATER ARE CAUSING LOCALIZED AREAS OF REDUCED VISIBILITY AS DUST IS LOFTED INTO THE ATMOSPHERE. THE LATEST OBSERVATIONS ARE REPORTING VISIBILITIES OF A COUPLE MILES OR LESS ALONG AREA ROADWAYS...HOWEVER MOTORISTS ACROSS SOUTHWEST NEBRASKA HAVE NOTED ZERO VISIBILITY AT TIMES. ALL MOTORISTS ACROSS WESTERN AND NORTH CENTRAL NEBRASKA NEED TO REMAIN ALERT FOR RAPID CHANGE IN VISIBILITY...INCLUDING MOTORISTS TRAVELING ON INTERSTATE 80.

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE NORTH PLATTE NE
1059 AM CDT THU OCT 18 2012

.UPDATE...

SENT AN UPDATE TO ACCOUNT FOR THE BLOWING DUST...WITH NUMEROUS METARS REPORTING VISIBILITY OF 2 MILES OR LESS ACROSS SOUTHWEST NEBRASKA. KLNX WSR-88D SHOWING VWP SPEEDS OF 60 KTS AT 500M...WITH NUMEROUS 60 MPH OR GREATER WIND REPORTS COMING IN NOW. CURRENT HIGH WIND AND RED FLAG WARNINGS ARE ON TRACK...NO CHANGES NEEDED TO THE HEADLINES. OTHERWISE...DID CUT BACK PRECIPITATION MENTION ACROSS NORTH CENTRAL NEBRASKA TO JUST SPRINKLES...THERE IS STILL AN OVERCAST DECK...BUT PRECIPITATION HAS REMAINED MAINLY TO THE EAST.

&&

.PREV DISCUSSION... /ISSUED 644 AM CDT THU OCT 18 2012/

AVIATION...

FOR 12Z TAFS...VERY STRONG NORTHWEST WINDS TO IMPACT KLBF AND KVTN TERMINALS TODAY.

WITH SATELLITE INDICATING THE STORM CENTER CURRENTLY IN SOUTHWESTERN MINNESOTA BUILDING BACK TO THE SOUTHWEST...VERY STRONG WINDS GUSTING TO NEAR 50KT CURRENTLY OBSERVED AT KVTN. WIND OVER CENTRAL AND WESTERN NEBRASKA WILL INCREASE AND BECOME 300-320 AT 35-42G50-55KT. SOME DECREASE IS EXPECTED LATE AFTERNOON TO EARLY EVENING TO 25-35G35-45KT FROM 310-330 WITH FURTHER DECREASE TO 15-25G20-30KT BY 03Z.

SPECIAL WEATHER STATEMENT
NATIONAL WEATHER SERVICE NORTH PLATTE NE
112 PM CDT THU OCT 18 2012

NEZ004>010-022>029-035>038-056>059-069>071-094-190000-
SHERIDAN-EASTERN CHERRY-KEYA PAHA-BOYD-BROWN-ROCK-HOLT-GARDEN-
GRANT-HOOKER-THOMAS-BLAINE-LOUP-GARFIELD-WHEELER-ARTHUR-MCPHERSON-
LOGAN-CUSTER-DEUEL-KEITH-PERKINS-LINCOLN-CHASE-HAYES-FRONTIER-
WESTERN CHERRY-
INCLUDING THE CITIES OF...GORDON...RUSHVILLE...VALENTINE...
SPRINGVIEW...SPENCER...AINSWORTH...BASSETT...ONEILL...OSHKOSH...
HYANNIS...MULLEN...THEDFORD...DUNNING...TAYLOR...BURWELL...
BARTLETT...ARTHUR...TRYON...STAPLETON...BROKEN BOW...CHAPPELL...
BIG SPRINGS...OGALLALA...GRANT...NORTH PLATTE...IMPERIAL...
HAYES CENTER...CURTIS...EUSTIS...CODY...MERRIMAN...KILGORE
112 PM CDT THU OCT 18 2012 /1212 PM MDT THU OCT 18 2012/

AT 1 PM CDT...EXTREME WIND CONDITIONS CREATING HAZARDOUS TRAVEL ACROSS WESTERN AND NORTH CENTRAL NEBRASKA. WIND GUSTS OF 60 TO 70 MPH ARE CAUSING AREAS OF REDUCED VISIBILITY AS DUST IS LOFTED INTO THE ATMOSPHERE. LATEST OBSERVATIONS ARE REPORTING VISIBILITIES OF A COUPLE MILES OR LESS ALONG AREA ROADWAYS...HOWEVER LOCALIZED AREAS OF ZERO VISIBILITY HAVE BEEN REPORTED ACROSS THE SAND HILLS REGION...NIOBRARA RIVER VALLEY...SOUTHWEST NEBRASKA AND THE INTERSTATE 80 CORRIDOR. CONDITIONS ON INTERSTATE 80 WEST OF BIG SPRINGS HAS BEEN DESCRIBED AS A BROWN OUT. ALL MOTORISTS NEED TO REMAIN ALERT FOR CHANGING VISIBILITY AND EXPECT DIFFICULT IF NOT IMPOSSIBLE DRIVING CONDITIONS.

PUBLIC INFORMATION STATEMENT
NATIONAL WEATHER SERVICE NORTH PLATTE NE
151 PM CDT THU OCT 18 2012

...HIGHEST WINDS IN THE PAST 12 HOURS...

...LOCATION...	...TIME...	...WIND...
3 E BIG SPRINGS (KEITH NE) (MESOWEST)	1130 AM OCT 18	70 MPH
BROKEN BOW AIRPORT (CUSTER NE) (ASOS)	1058 AM OCT 18	68 MPH
VALENTINE AIRPORT (CHERRY NE) (ASOS)	1112 AM OCT 18	67 MPH
3 E OGALLALA (KEITH NE) (MESOWEST)	1145 AM OCT 18	66 MPH
AINSWORTH AIRPORT (BROWN NE) (AWOS)	135 PM OCT 18	64 MPH
ONEILL AIRPORT (HOLT NE) (AWOS)	1115 AM OCT 18	64 MPH
VALENTINE NWR (CHERRY NE) (RAWS)	1114 AM OCT 18	63 MPH
OGALLALA AIRPORT (KEITH NE) (AWOS)	1155 AM OCT 18	63 MPH
IMPERIAL AIRPORT (CHASE NE) (ASOS)	1056 AM OCT 18	62 MPH
6 ESE OSHKOSH (GARDEN NE) (MESOWEST)	1200 PM OCT 18	62 MPH
7 SE CHAPPELL (DEUEL NE) (MESOWEST)	1200 PM OCT 18	61 MPH
NORTH PLATTE AIRPORT (LINCOLN NE)	1053 AM OCT 18	61 MPH
CRESCENT LAKE NWR (GARDEN NE) (RAWS)	1158 AM OCT 18	60 MPH
6 S SPRINGVIEW (KEYA PAHA NE)	1157 AM OCT 18	59 MPH
THEDFORD AIRPORT (THOMAS NE) (AWOS)	115 PM OCT 18	55 MPH
14 N JOHNSTOWN (BROWN NE) (MOCOMAGNET)	1205 PM OCT 18	53 MPH
8 ESE LISCO (GARDEN NE) (MESOWEST)	1000 AM OCT 18	51 MPH

10.4 Wichita, KS NWS

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE WICHITA KS
317 AM CDT THU OCT 18 2012

.DISCUSSION...

MAIN CONCERNS FOR THE SHORT TERMS CONTINUE TO BE THE STRONG NORTHWEST WINDS FOR THURSDAY AND THE FIRE DANGER ASSOCIATED WITH THEM.

THE UPPER LEVEL LOW OVER MINNESOTA AND IOWA IS DEEPENING AND MOVING SLOWLY SOUTHEAST ALONG WITH THE SURFACE LOW OVER WISCONSIN. WINDS ON THE BACKSIDE OF THIS LOW ARE DEPICTING A NICE UNIDIRECTIONAL FLOW STACKED WITH A 130-140 KNOT JET STREAK NEAR THE TROPOPAUSE. A TIGHT SURFACE GRADIENT EXISTS WESTWARD FROM THE LOW TO THE NORTHERN HIGH PLAINS...WHERE IN SOUTH DAKOTA WINDS HAVE BEEN 30-40 KNOTS WITH SOME SITES GUSTING UP TO 50 KNOTS THROUGHOUT THE NIGHT. THIS GRADIENT AND THE WINDS WITH IT ARE MAKING THEIR WAY INTO NEBRASKA AND SHOULD BE AFFECTING NORTHERN KANSAS SHORTLY. SIMILAR MAGNITUDES OF THE SURFACE GRADIENT ARE PROGGED TO REACH CENTRAL KANSAS BY THURSDAY MORNING AROUND 15Z...SO HAVE DECIDED TO UPGRADE THE WIND ADVISORY TO A HIGH WIND WARNING FOR RUSSELL AND BARTON COUNTIES. DEPENDING ON THE PROGRESSION OF THE GRADIENT AND THESE WINDS THE HIGH WIND WARNING MAY NEED TO BE EXPANDED. BY THE AFTERNOON THE SURFACE GRADIENT RELAXES SLIGHTLY...BUT BOUNDARY LAYER MIXING SHOULD MAINTAIN THE HIGH WINDS WITH 850MB SPEEDS OF 40+ KNOTS COVERING A GOOD AMOUNT OF THE CWA.

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE WICHITA KS
1242 PM CDT THU OCT 18 2012

.AVIATION...18Z TAFS KRSL/KSLN/KHUT/KICT/KCNU

THE MAIN AVIATION FORECAST CONCERN CONTINUES TO THE BE THE EXTREMELY STRONG NORTHWESTERLY WINDS.

AN INTENSE UPPER LEVEL STORM SYSTEM AND ASSOCIATED SURFACE LOW HAVE CAUSED A VERY TIGHT PRESSURE GRADIENT ACROSS THE CENTRAL AND NORTHERN PLAINS. STRONG WINDS JUST ABOVE THE SURFACE ARE MIXING DOWN IN ADDITION TO THE PRESSURE GRADIENT INDUCED WINDS. WINDS SO FAR HAVE GUSTED TO 45 KTS IN CENTRAL KANSAS AND THAT IS EXPECTED TO CONTINUE THROUGH THE DAY. SUSTAINED SPEEDS OF 30-40 KTS AND GUSTS OF 35 TO 45 KTS WILL BE WIDESPREAD WITH SOME HIGHER GUSTS. WITH DRY SOILS...BLOWING DUST WILL ALSO BE A CONCERN AND COULD REDUCE VISIBILITIES. HAVE DROPPED VISIBILITIES IN A TEMPO GROUP THIS AFTERNOON FOR KRSL/KSLN/KHUT BUT ONLY TO MVFR...IFR VISIBILITIES ARE POSSIBLE...BUT NOT EXPECTED TO BE FOR LONG PERIODS OF TIME.

WINDS WILL DECREASE AS THE SUN GOES DOWN AND MIXING DECREASES...BUT THE STRONG PRESSURE GRADIENT WILL KEEP WINDS UP OVERNIGHT. THE SYSTEM WILL MOVE OFF FRIDAY...BUT WINDS WILL BE BREEZY IN THE MORNING BEFORE THE SURFACE RIDGE MOVES THROUGH. ONCE THAT HAPPENS WINDS WILL QUICKLY DROP OFF.

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE WICHITA KS
309 PM CDT THU OCT 18 2012

.DISCUSSION...

MAIN FORECAST CONCERNS: STRONG WINDS/WILDFIRE DANGER POTENTIAL IN THE SHORT TERM.

TONIGHT-FRIDAY:
STRONG UPPER LEVEL CYCLONE OVER THE UPPER MISSISSIPPI VALLEY THIS AFTERNOON...WILL BE SLOW TO PUSH EAST REACHING THE GREAT LAKES BY LATE FRIDAY. THIS WILL BE IN RESPONSE TO UPSTREAM UPPER TROUGHING MOVING INTO THE PACIFIC NORTHWEST AND SOUTHWEST CANADA. PEAK MIXING/STRONGEST WINDS SHOULD DIMINISH TOWARD SUNSET AS LOW-LEVEL TEMPERATURE INVERSION ATTEMPTS TO ESTABLISH ITSELF...ALTHOUGH WINDS WILL REMAIN GUSTY INTO THE EVENING HOURS. 00Z EXPIRATION TIME ON WIND HEADLINES LOOKS REASONABLE AT THIS TIME. WILL MENTION AREAS OF BLOWING DUST IN OUR SOUTHWESTERN COUNTIES UNTIL EARLY EVENING WITH VSBYS MAINLY IN THE 1-4 MILE RANGE...LOCALLY LESS THAN 1 MILE. THE WINDS WILL NOT BE AS STRONG FRIDAY WITH THE UPPER SYSTEM MOVING EAST...HOWEVER BREEZY NORTHWEST WINDS WILL BE COMMON FOR MUCH OF THE DAY. THE SUSTAINED WINDS HOLDING UP SOME TONIGHT SHOULD PREVENT FROST/FREEZE CONCERNS. PATCHY FROST NOT OUT OF QUESTION LATE FRIDAY NIGHT IN CENTRAL/SOUTHEAST KS WITH DECOUPLED WINDS AND CLEAR SKIES.

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE WICHITA KS
314 PM CDT THU OCT 18 2012

KSZ032-047-190000-
/O.CON.KICT.HW.W.0001.000000T0000Z-121019T0000Z/
RUSSELL-BARTON-
INCLUDING THE CITIES OF...RUSSELL...GREAT BEND
314 PM CDT THU OCT 18 2012

...HIGH WIND WARNING REMAINS IN EFFECT UNTIL 7 PM CDT THIS EVENING...

A HIGH WIND WARNING REMAINS IN EFFECT UNTIL 7 PM CDT THIS EVENING.

* TIMING...VERY STRONG WINDS WILL CONTINUE UNTIL EARLY THIS EVENING.

* WINDS...NORTHWEST WINDS OF 35 TO 40 MPH WITH GUSTS OF 50 TO 55 MPH.

* IMPACTS...STRONG WINDS WILL MAKE DRIVING DIFFICULT...ESPECIALLY FOR PERSONS DRIVING LIGHTWEIGHT OR HIGH PROFILE VEHICLES. DRIVERS SHOULD BE AWARE OF STRONG CROSSWINDS. AREAS OF BLOWING DUST WILL REDUCE VISIBILITIES TO 1 TO 4 MILES...LOCALLY LESS THAN 1 MILE.

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE WICHITA KS
352 PM CDT THU OCT 18 2012

KSZ032-033-047>053-067>072-082-083-091>096-098>100-192100-
RUSSELL-LINCOLN-BARTON-ELLSWORTH-SALINE-RICE-MCPHERSON-MARION-CHASE-
RENO-HARVEY-BUTLER-GREENWOOD-WOODSON-ALLEN-KINGMAN-SEDGWICK-HARPER-
SUMNER-COWLEY-ELK-WILSON-NEOSHO-CHAUTAUQUA-MONTGOMERY-LABETTE-
352 PM CDT THU OCT 18 2012

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF CENTRAL KANSAS...
SOUTH CENTRAL KANSAS AND SOUTHEAST KANSAS.

.DAY ONE...LATE THIS AFTERNOON AND TONIGHT

STRONG NORTHWEST WINDS OF 25 TO 40 MPH WITH GUSTS OF 45 TO 55 MPH
WILL IMPACT THE ENTIRE AREA UNTIL EARLY THIS EVENING. THE
STRONGEST WINDS WILL AFFECT CENTRAL AND SOUTH CENTRAL KANSAS WHERE
VISIBILITIES WILL BE REDUCED BY BLOWING DUST TO 1 TO 4 MILES...LOCALLY
LESS THAN A MILE. PLEASE SEE THE HIGH WIND WARNING AND WIND
ADVISORY STATEMENT FOR DETAILS. THE GUSTY WINDS...DRY AIR...AND
CURED GRASSES WILL RESULT IN VERY HIGH TO CRITICAL WILDFIRE DANGER ACROSS
CENTRAL AND SOUTH CENTRAL KANSAS. PLEASE REFER TO THE RED FLAG
WARNING STATEMENTS FOR DETAILS.

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE WICHITA KS
734 PM CDT THU OCT 18 2012

KSZ032-033-047>053-067>072-082-083-091>096-098>100-200045-
RUSSELL-LINCOLN-BARTON-ELLSWORTH-SALINE-RICE-MCPHERSON-MARION-CHASE-
RENO-HARVEY-BUTLER-GREENWOOD-WOODSON-ALLEN-KINGMAN-SEDGWICK-HARPER-
SUMNER-COWLEY-ELK-WILSON-NEOSHO-CHAUTAUQUA-MONTGOMERY-LABETTE-
734 PM CDT THU OCT 18 2012

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF CENTRAL KANSAS...
SOUTH CENTRAL KANSAS AND SOUTHEAST KANSAS.

.DAY ONE...TONIGHT

STRONG NORTHWEST WINDS WILL GRADUALLY DECREASE TO 15 TO 20 MPH
THIS EVENING. AS THE WINDS DIMINISH...THE BLOWING DUST WILL GRADUALLY
SETTLE LATE THIS EVENING. BUT IN THE MEAN TIME...VISIBILITIES
WILL BE REDUCED BY THE BLOWING DUST TO 1 TO 4 MILES...ESPECIALLY
ACROSS CENTRAL AND SOUTH CENTRAL KANSAS.

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE WICHITA KS
925 PM CDT THU OCT 18 2012

.UPDATE...

TIGHT PRESSURE GRADIENT THAT LED TO THE STRONG NW WINDS...WILL GRADUALLY SHIFT FURTHER TO THE EAST OVERNIGHT. COULD STILL SEE SOME WIND GUSTS TO 25 MPH REMAIN ACROSS CENTRAL AND SOUTH CENTRAL KS AT LEAST UNTIL MIDNIGHT. THE GUSTY WINDS DIMINISHING WILL ALSO LEAD TO THE WIDESPREAD DUST THAT DROPPED SOUTHEAST ACROSS MOST OF THE WESTERN HALF OF THE FORECAST TO DIMINISH OR SETTLE AS THE NIGHT PROGRESSES. MAY SEE SOME VISIBILITIES OF 2 TO 5 MILES CONTINUE FOR A FEW MORE HOURS ACROSS SOUTH CENTRAL KS...WHERE THE STRONGEST WINDS WILL STILL BE LOCATED UNTIL MIDNIGHT. IT WILL ALSO TAKE A LITTLE WHILE FOR ALL THIS DUST TO SETTLE...AS MIXING TO 4000-6000 FEET LOFTED ALOT OF DUST PARTICULATES INTO THE AIR. ALREADY SEEING SIGNS OF IMPROVEMENT OVER CEN KS WHERE WINDS ARE BEGINNING TO DIMINISH.

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE WICHITA KS
1031 PM CDT THU OCT 18 2012

KSZ032-033-047>053-067>072-082-083-091>096-098>100-200345-
RUSSELL-LINCOLN-BARTON-ELLSWORTH-SALINE-RICE-MCPHERSON-MARION-CHASE-
RENO-HARVEY-BUTLER-GREENWOOD-WOODSON-ALLEN-KINGMAN-SEDGWICK-HARPER-
SUMNER-COWLEY-ELK-WILSON-NEOSHO-CHAUTAUQUA-MONTGOMERY-LABETTE-
1031 PM CDT THU OCT 18 2012

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF CENTRAL KANSAS...
SOUTH CENTRAL KANSAS AND SOUTHEAST KANSAS.

.DAY ONE...TONIGHT

BLOWING DUST WILL GRADUALLY SUBSIDE AROUND MIDNIGHT OR SHORTLY AFTER OVER SOUTH-CENTRAL AND SOUTHEAST KANSAS. UNTIL THEN...VISIBILITIES WILL BE REDUCED AS LOW AS 2 MILES.

10.5 Topeka, KS NWS

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE TOPEKA KS
402 AM CDT THU OCT 18 2012

.DISCUSSION...

EARLY THIS MORNING...WATER VAPOR SATELLITE IMAGERY SHOWED A DEEP UPPER LEVEL LOW ACROSS SOUTHERN MN WITH AN UPPER LEVEL TROUGH AXIS EXTENDING SOUTHEASTWARD ACROSS THE LOWER MS RIVER VALLEY.

A VERY TIGHT PRESSURE GRADIENT AT THE 700MB AND 850MB LEVELS WERE NOTED ACROSS ND AND SD. SURFACE WINDS EARLY THIS MORNING ACROSS CENTRAL SD WERE SUSTAINED BETWEEN 40 TO 45 KTS WITH GUSTS TO 50 KTS.

TODAY...THE DEEP UPPER LOW WILL SLOWLY MOVE SOUTHEAST ACROSS NORTHEAST IA AND SOUTHWEST WI. THE PRESSURE GRADIENT AT 850MB WILL TIGHTEN ACROSS THE NORTHERN AND CENTRAL PLAINS. THE CORE OF THE STRONGEST 850MB WINDS OF 50 TO 60 KTS WILL EXTEND ACROSS THE EASTERN DAKOTAS...SOUTHEAST ACROSS CENTRAL AND EASTERN NE. 850MB WINDS WILL INCREASE ACROSS EASTERN KS TO 40 TO 45 KTS DURING THE MORNING HOURS. SFC HEATING THROUGH THE MID AND LATE MORNING HOURS WILL ALLOW THE MIXED BOUNDARY LAYER TO DEEPEN TO ABOUT 800 TO 750 MB. NEARLY DRY ADIABATIC LAPSE RATES FROM THE SURFACE TO AROUND 800MB WILL ALLOW THE STRONGER WINDS ALOFT TO MIX DOWN TOWARDS THE SURFACE. NORTHWEST SURFACE WINDS WILL GRADUALLY INCREASE TO OR ABOVE 30 MPH ACROSS MUCH OF THE CWA BY 1100 AM. THE NORTH CENTRAL COUNTIES MAY SEE SUSTAINED NORTHWEST SURFACE WINDS REACH TO NEAR 40 MPH. WINDS GUSTS WILL RANGE FROM NEAR 50 MPH ACROSS NORTH CENTRAL KS...WITH 40 MPH WIND GUSTS ACROSS THE REMAINDER OF THE CWA. HIGH TEMPERATURES WILL ONLY WARM INTO THE UPPER 50S TO LOWER 60S. RESIDUAL MOISTURE WILL BEGIN TO WRAP AROUND THE 850MB LOW OVER NORTHERN IA AND MOVE SOUTHEAST ACROSS EASTERN NE INTO THE EXTREME NORTHEAST COUNTIES OF THE CWA. MINOR H5 TROUGHS MAY WRAP AROUND THE H5 LOW OVER SOUTHERN MN AND MAY PROVIDE ENOUGH ASCENT FOR SCATTERED TO ISOLATED SHOWERS TO DEVELOP LATE THIS AFTERNOON ACROSS NEMAHA...BROWN AND JACKSON COUNTIES. THE INCREASE CLOUD COVER ACROSS EXTREME NORTHEAST KS MAY LIMIT THE DEEPER MIXING ALLOWING THE SFC WINDS TO BE SLIGHTLY WEAKER.

FIRE WEATHER PLANNING FORECAST
NATIONAL WEATHER SERVICE TOPEKA KS
516 AM CDT THU OCT 18 2012

...RED FLAG WARNING IN EFFECT FROM 10 AM THIS MORNING TO 7 PM CDT THIS EVENING FOR NORTH CENTRAL KANSAS...

.DISCUSSION...

STRONG NORTHWEST WINDS OF 30 TO 40 MPH WITH GUSTS OF 40 TO 50 MPH...LOW RH'S OF 20 TO 25 PERCENT AND STEEP LOW-LEVEL LAPSE RATES WILL CREATE AN ENVIRONMENT FAVORABLE FOR EXTREME FIRE DANGER. ATTM...THE CRITICAL FUELS APPEAR TO BE LOCATED ACROSS NORTH CENTRAL KS AND THE RED FLAG WARNING WILL BE ISSUED FOR NORTH CENTRAL KS FROM 1000 AM THROUGH 700 PM THIS EVENING. IF UPDATED FUEL STATUS SHOW DRIER FUELS FARTHER EAST LATER THIS MORNING THEN THE RED FLAG WARNING MAY NEED TO BE EXPANDED EASTWARD ACROSS THE CWA. THE REMAINDER OF THE AREA WILL SEE A VERY HIGH FIRE DANGER. ALL OUTDOOR BURNING SCHEDULED FOR TODAY ACROSS THE CWA WILL NEED TO BE POSTPONED.

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE TOPEKA KS
1140 AM CDT THU OCT 18 2012

KSZ008>012-020>024-026-034>040-054>056-058-059-190000-
/O.CON.KTOP.WI.Y.0011.000000T0000Z-121019T0000Z/
REPUBLIC-WASHINGTON-MARSHALL-NEMAHA-BROWN-CLOUD-CLAY-RILEY-
POTTAWATOMIE-JACKSON-JEFFERSON-OTTAWA-DICKINSON-GEARY-MORRIS-
WABAUNSEE-SHAWNEE-DOUGLAS-LYON-OSAGE-FRANKLIN-COFFEY-ANDERSON-
INCLUDING THE CITIES OF...MARYSVILLE...HIAWATHA...CONCORDIA...
CLAY CENTER...MANHATTAN...ABILENE...JUNCTION CITY...TOPEKA...
LAWRENCE...EMPORIA...OTTAWA
1140 AM CDT THU OCT 18 2012

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

A WIND ADVISORY REMAINS IN EFFECT UNTIL 7 PM CDT THIS EVENING.

* TIMING...THE STRONG WINDS WILL CONTINUE THROUGH THE EARLY EVENING...WITH THE PEAK OF THE SPEEDS EXPECTED TO OCCUR THROUGH 5 PM.

* WINDS...NORTHWEST WINDS WITH SUSTAINED SPEEDS OF 25 TO 35 MPH AND GUSTS TO 45 MPH.

* IMPACTS...DRIVERS OF VANS...CAMPERS...TRAILERS...OR OTHER HIGH-PROFILE VEHICLES SHOULD BE ALERT TO THE DANGERS OF THESE WINDS...PARTICULARLY ON NORTH TO SOUTH ORIENTED ROADS.

PUBLIC INFORMATION STATEMENT
NATIONAL WEATHER SERVICE TOPEKA KS
725 PM CDT THU OCT 18 2012

...HIGHEST WINDS IN THE PAST 12 HOURS...

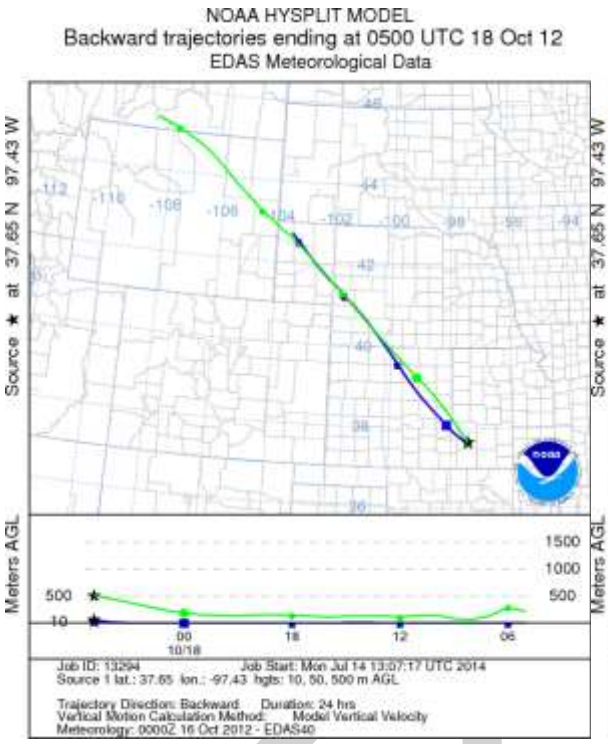
...LOCATION...	...TIME...	...WIND...
2 NW LEONA (BROWN KS) (APRSWXNET)	547 PM OCT 18	52 MPH
2 WSW ABILENE (DICKINSON KS)	1104 AM OCT 18	51 MPH
CONCORDIA BLOSSER MUNICIPAL (CLOUD KS)	102 PM OCT 18	51 MPH
TOPEKA, KS (SHAWNEE KS) (877 FT)(ASOS)	653 PM OCT 18	51 MPH
3 SSW LECOMPTON (DOUGLAS KS) (MESOWEST)	1010 AM OCT 18	47 MPH
3 NNE NEW STRAWN (COFFEY KS)	228 PM OCT 18	47 MPH
4 E ADMIRE (LYON KS) (MESOWEST)	1201 PM OCT 18	45 MPH
FORBES FIELD AIRPORT (SHAWNEE KS)	602 PM OCT 18	45 MPH
3 WNW TOPEKA (SHAWNEE KS) (KSDOT)	554 PM OCT 18	43 MPH
EMPORIA MUNICIPAL AIRPORT (LYON KS)	240 PM OCT 18	43 MPH
7 W MAYETTA (JACKSON KS) (RAWS)	524 PM OCT 18	41 MPH
3 SSW LECOMPTON (DOUGLAS KS) (KSDOT)	1010 AM OCT 18	41 MPH
FORT RILEY (MARSHALL AAF) (GEARY KS)	1104 AM OCT 18	41 MPH
LAWRENCE MUNICIPAL AIRPORT (DOUGLAS KS)	1256 PM OCT 18	41 MPH
1 ESE MANHATTAN (RILEY KS) (KSDOT)	1102 AM OCT 18	40 MPH
2 N PAULINE (SHAWNEE KS) (KSDOT)	1032 AM OCT 18	40 MPH
MANHATTAN REGIONAL AIRPORT (RILEY KS)	952 AM OCT 18	40 MPH

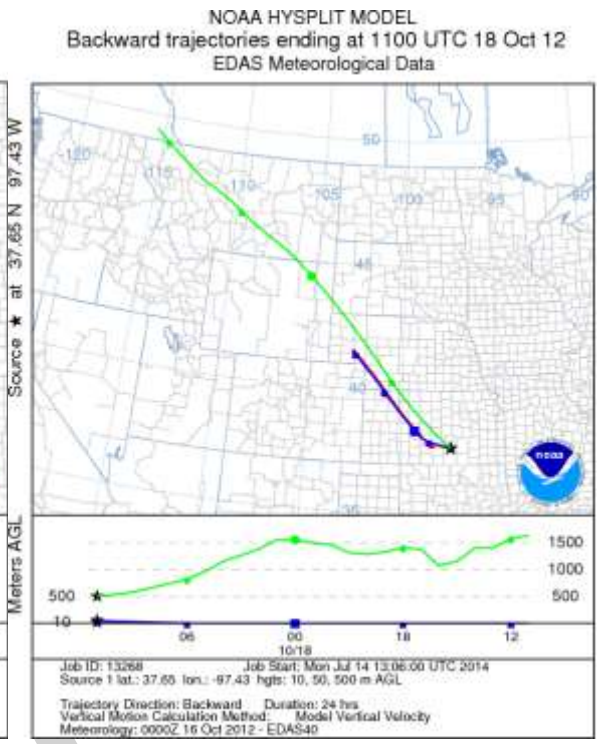
...ADDITIONAL REPORTS FROM AROUND THE REGION...

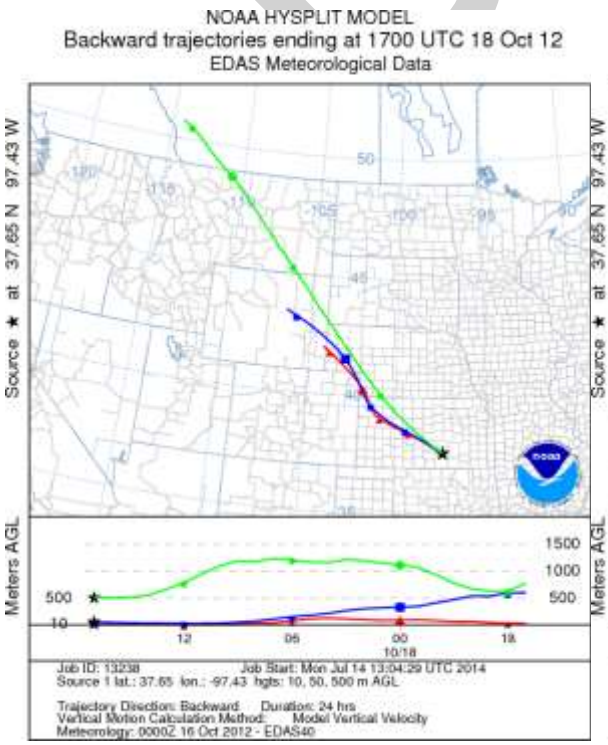
PIERRE MUNICIPAL AIRPORT (HUGHES SD)	934 AM OCT 18	71 MPH
RAPID CITY REGIONAL AP (PENNINGTON SD)	821 AM OCT 18	70 MPH
ORD EVELYN SHARP FLD ARPT (VALLEY NE)	216 PM OCT 18	70 MPH
GOODLAND,KS (SHERMAN KS) (ASOS)	1105 AM OCT 18	61 MPH
MCCOOK NE AIRPORT (RED WILLOW NE)	953 AM OCT 18	60 MPH
MEDICINE LODGE ASOS SITE (BARBER KS)	152 PM OCT 18	59 MPH
DODGE CITY, KS (FORD KS) (ASOS)	144 PM OCT 18	56 MPH
SALINA MUNICIPAL AIRPORT (SALINE KS)	1053 AM OCT 18	51 MPH
RUSSELL MUNICIPAL AIRPORT (RUSSELL KS)	153 PM OCT 18	49 MPH
HUTCHINSON MUNICIPAL AIRPORT (RENO KS)	1234 PM OCT 18	47 MPH
STROTHER FIELD AIRPORT (COWLEY KS)	130 PM OCT 18	44 MPH
5 WSW DOWNTOWN WICHITA (SEDGWICK KS)	353 PM OCT 18	44 MPH

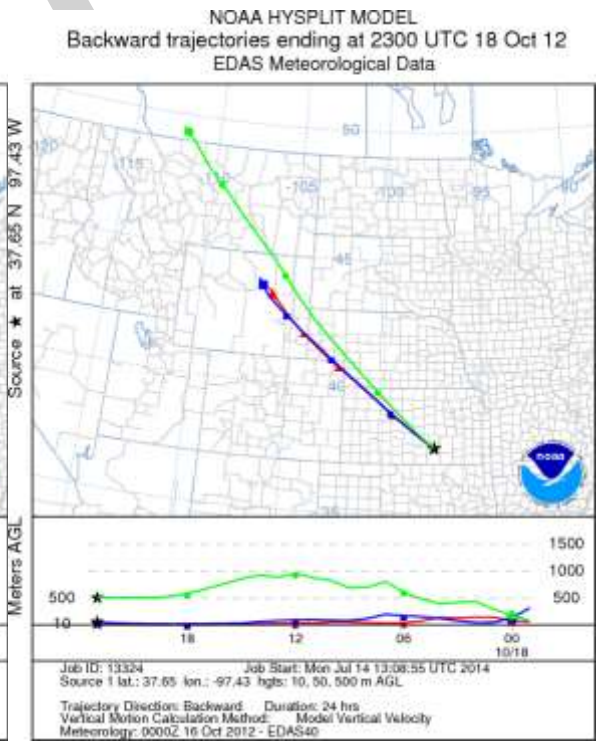
11. APPENDIX C - Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) Runs on Oct. 18, 2012

11.1 Wichita, KS

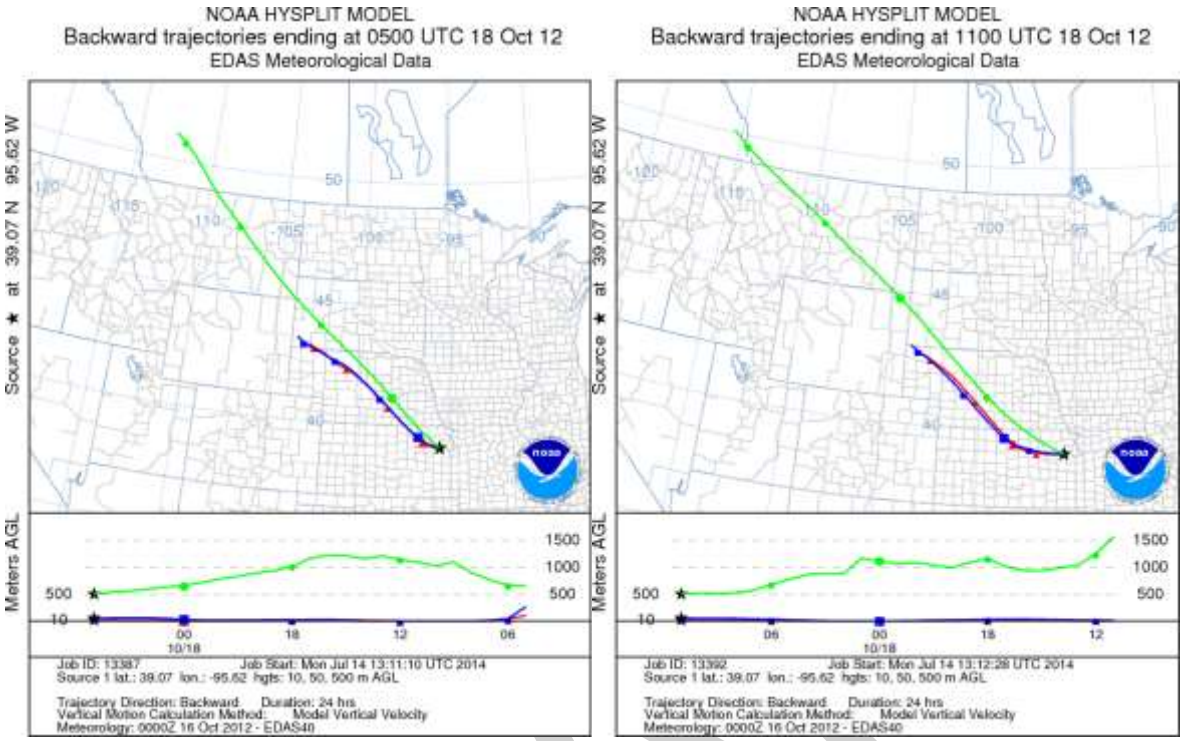








11.2 Topeka, KS



12. APPENDIX D – Newspaper Accounts of October 18, 2012 Dust Storm

High winds create Dust Bowl effect over Wichita area | Wichita Eagle

Welcome, Guest
Log In | Register

Print edition: Subscribe | Manage Account | E-Eagle: Digital Edition

The Wichita Eagle
Kansas.com

47°F
67°/42°
Complete Forecast

Home | News | Business | Sports | Opinion | Life | Entertainment | Obituaries | Jobs | Auto | Real Estate | Classifieds | Find n Save | Place an Ad

Breaking News | Local | Crime & Courts | Nation & World | Databases | Weather | Politics | Education | Lottery | Weird News | Video | Blogs

Last updated: 6:45 p.m. Search Kansas.com Web Web Search powered by YAHOO! SEARCH Go Thursday, Oct. 18, 2012

High winds create Dust Bowl effect over Wichita area

By ROY WENZL
The Wichita Eagle

Published Thursday, Oct. 18, 2012, at 6:37 p.m.
Updated Thursday, Oct. 18, 2012, at 6:43 p.m.

ARTICLE COMMENTS

Email Print Order Reprints Tweet 4 +1 1

The dust over Wichita got so thick Thursday afternoon that it reminded some people of photos from the 1930s Dust Bowl, or as meteorologist Brad Ketcham said, of the early 1950s, another time when the ground got dry and the dust flew.

Some of the particles in Thursday's air likely came all the way from Nebraska, Ketcham said.

"If you look at the satellite view, you can see the plume of dust starting in southwest Nebraska and blowing on down through Great Bend, Wichita, and all the way to Winfield," he said.

The dust got blown up into the atmosphere as high as 3,000 to 4,000 feet, producing not only the gray around us but the strange orange or gold sunset seen in some parts of the state.

A low pressure system that developed over the Great Lakes produced winds out of the northwest here, with gusts as high as 46 mph Thursday in Wichita, he said. Gusts in Salina and Russell reached 50 mph, he said.

With winds like that, the dry conditions, and many fields freshly broken up in autumn cultivation, the dust took off.

The Oklahoma Highway Patrol shut down an eight-mile stretch of I-35 in northern Oklahoma near Blackwell because the dust storm caused near-blackout conditions and at least one multi-vehicle traffic accident. The highway patrol said visibility was less than 10 feet as gusts as high as 55 mph blew dust over the roadway.

Local police said nearly three dozen cars and tractor-trailers were involved. Blackwell Police Chief Fred LeValley said nine people were injured, but there were no fatalities.

Steve Austin, a county commissioner in the affected area, said visibility was terrible.

"It looked like a huge fog was over the city of Ponca City," he said. "We've had dust storms before, but I don't remember anything of this magnitude in years."

The winds and dust were expected to diminish after sunset, Ketcham said. Friday, as the low

Photos
« 1 of 2 »

Brian Corn/The Wichita Eagle | Buy this photo
The skyline of Wichita was partially obscured by blowing dust Thursday afternoon. (October 18, 2012)

- Dust storm causes multi-car accident near Kansas-Oklahoma state line

MOST READ STORIES NEW BLOG POSTS

1. Bruce Haertl will cut back at KWCH
2. Man, 18, killed in southeast Wichita crash
3. High winds create Dust Bowl effect over Wichita area
4. Dust storm causes multi-car accident near Kansas-Oklahoma state line
5. Police arrest three men, question woman in Valley Center bank robbery
6. Traveling Vietnam War memorial pauses in Valley Center
7. 'Perversion files' show locals helped Boy Scouts cover up
8. SEARCHABLE DATABASE: Daily booking report from Sedgwick County Jail
9. Hawker Beechcraft to explore options with its jet business
10. Opinion Line (Oct. 19)

http://www.kansas.com/2012/10/18/2537342/high-winds-create-dust-bowl-effect.html[10/19/2012 10:21:50 AM]

High winds create Dust Bowl effect over Wichita area | Wichita Eagle

pressure system over the Great Lakes moves east, the day should be mostly sunny with a high around 68.

The dust blew thick enough Thursday that "you could almost taste it in the air," Ketcham said. "I've got a feeling, though, that everyone is going to need to do a car wash."

Contributing: Associated Press

Reach Roy Wenzl at 316-268-6219 or rwenzl@wichitaeagle.com.

Friday, Oct. 19, 2012

Blowing dirt creates travel woes in Kan., Okla.

From Staff and Wire Reports

THE ASSOCIATED PRESS

The rear of one car sits on top of another following a crash on Interstate 35 on Thursday near Blackwell, Okla. A massive dust storm swirling reddish-brown clouds over northern Oklahoma triggered a multi-vehicle accident, forcing police to shut down the heavily traveled roadway amid near blackout conditions. The highway patrol said nearly three dozen cars and tractor-trailers were involved. Nine people were injured, but there were no fatalities.

2 comments »

Latest by Topeka_Resident 42 weeks 2 days ago

Oklahoma wasn't the only state to experience Dust Bowl-like conditions that created travel hazards Thursday.

In western Kansas, dirt blown by high winds led directly to one injury accident and contributed to another.

"We had (troopers) talking about pockets of zero visibility," Tod Hileman, public resource officer for the Kansas Highway Patrol's Troop D in Hays, said of conditions along Interstate 70 in the Goodland and Colby areas.

Hileman said two of four accidents worked Thursday by Troop D could be attributed directly to high-velocity wind conditions.

A Lansing woman was injured when her eastbound car struck the rear of another vehicle that had slowed upon entering a dust storm on I-70 about 10 miles east of Colby. Patrol reports identified the injured woman as Brenda M. Kenney, 49, of Lansing. The accident was reported at 12:25 p.m.

Hileman said another accident involved an oversized load that was overturned by high winds in the area.

I-70 was never closed. Hileman said Friday that winds had diminished considerably and that blowing dust was no longer a factor.

Interstate 35 in Oklahoma just south of the Kansas state line didn't fare as well Thursday.

A massive dust storm swirling reddish-brown clouds over northern Oklahoma triggered a

http://m.cjonline.com/news/2012-10-19/blowing-dirt-creates-travel-woes-kan-okla[8/12/2013 9:08:00 AM]

multivehicle accident along I-35, forcing police to shut down part of the heavily traveled roadway amid near blackout conditions.

In a scene reminiscent of the Dust Bowl days, choking dust suspended on strong wind gusts shrouded the interstate that links Dallas and Oklahoma City to Kansas City. Video from television station helicopters showed the four-lane highway virtually disappearing into billowing dust on the harsh landscape near Blackwell, Okla., plus dozens of vehicles scattered in the median and on the shoulders.

"I've never seen anything like this," said Jodi Palmer, a dispatcher with the Kay County (Okla.) Sheriff's Office. "In this area alone, the dirt is blowing because we've been in a drought. I think from the drought everything's so dry and the wind is high."

The highway patrol said the dust storm caused a multicar accident, and local police said nearly three dozen cars and tractor-trailers were involved. Blackwell Police Chief Fred LeValley said nine people were injured, but there were no fatalities.

State transportation workers were called to close the highway between US-60 highway and Oklahoma 11, an eight-mile stretch of the cross-country roadway just south of the Kansas state line.

"We have very high winds and blowing dust causing a near blackout condition," Capt. James West, of the Oklahoma Highway Patrol, said Thursday afternoon. He said visibility was less than 10 feet.

The stretch of closed roadway reopened Thursday evening after crews cleaned up debris and waited for winds to die down, Oklahoma Department of Transportation spokesman Cole Hackett said.

The area has suffered through an extended drought, and many farmers had recently loosened the soil while preparing for the winter wheat season.

"You have the perfect combination of extended drought in that area, and we have the extremely strong winds," said Gary McManus, the Oklahoma associate state climatologist. "Also, the timing is bad because a lot of those farm fields are bare. The soil is so dry, it's like powder. Basically what you have is a whole bunch of topsoil waiting for the wind to blow it away. It's no different from the 1930s than it is now."

Steve Austin, a Kay County commissioner, said visibility was terrible.

"It looked like a huge fog was over the city of Ponca City," he said. "We've had dust storms before, but I don't remember anything of this magnitude in years."

CLIMATE CENTRAL

Researching and reporting the science and impacts of climate change

Powerful Windstorm Winds Down in Plains, Midwest

Published: October 19th, 2012 , *Last Updated:* October 19th, 2012
By Andrew Freedman

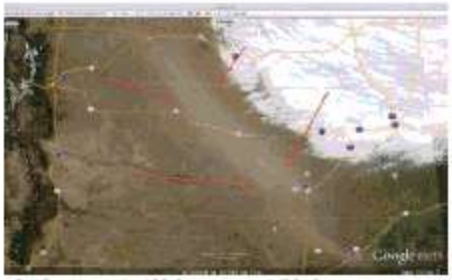
A massive windstorm is finally winding down after it snarled traffic, helped burn down a tiny North Dakota town, and caused a dust storm that spawned a multi-vehicle accident in Oklahoma. The winds flipped tractor trailer trucks onto their sides in South Dakota, as drivers were unable to maintain control against hurricane-force crosswinds.

Tractor trailer trucks that were blown off of Interstate 90 in South Dakota.
Credit: National Weather Service (via Facebook).

The storm, which was centered across the Upper Midwest but has since drifted eastward and weakened, was a powerful area of low pressure fueled by the strong temperature contrast between cooler and drier Canadian air masses and warmer and more humid air well to the south. These types of storms are actually rather common in the fall, when such large temperature contrasts tend to occur. An even more powerful October storm occurred in about the same area in 2011, for example.

The storm produced wind damage across a large area, from North Dakota and Montana all the way to Colorado, Kansas, and Illinois. It also helped spark an outbreak of severe thunderstorms that spawned several tornadoes in some Southern states, including two twisters that were ranked as EF-3 twisters on the Enhanced Fujita Scale.

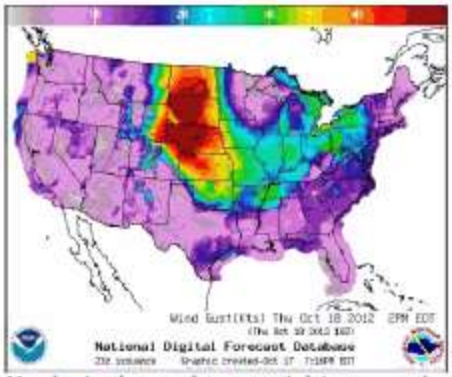
While the severe thunderstorms were noteworthy, it was the massive area of strong winds that proved to be the top story. The National Weather Service had warned of the high wind threat several days in advance, and it lived up to its billing, possibly even exceeding expectations.



The dust storm in Oklahoma was visible from space, as this satellite image shows (arrows added to point out the dust plume.
Click to enlarge the image. *Credit: CIMSS Satellite Blog.*

According to The Weather Channel, there were 132 reports of sustained winds or wind gusts of at least 58 mph for the period ending at 6 a.m. Eastern time on Friday. Five of those reports were for hurricane-force gusts of at least 75 mph. For the last three days, the tally is even more noteworthy, with nearly 400 reports of strong wind gusts, including 25 reports of hurricane-force wind gusts.

The strong winds helped spread a wildfire that destroyed the tiny town of Bucyrus, N.D. The town only had a population of about two dozen prior to the fire, but now all of those people have been displaced.



Map showing the area of strongest winds in orange and red colors, indicating winds of at least tropical storm

Since the region that was hit hard by the wind storm is the same area that has been going through a withering drought, it's no surprise that the storm caused problems with airborne dust. A dust storm swept across Oklahoma, closing off Interstate 35 for a time, and the dust was blown southeastward into neighboring states.

According to a report on weather.com, one eyewitness, Jodi Palmer, a dispatcher with the Kay County Sheriff's Office, placed the blame for the dust event squarely on the drought: "In this area alone, the dirt is blowing because we've been in a drought. I think from the drought everything's so dry and the wind is high."

Oklahoma has been one of the hardest hit drought states, although in recent weeks there has been some slight improvement there.

Related Content
October Snowstorm Adds to 2011's Billion Dollar Weather Disasters
Mother Nature on Steroids

Dust storm shuts down interstate in northern Okla. - News - Boston.com

Dust storm shuts down interstate in northern Okla.

The rear of a car sits on top of another following a crash on Interstate 35 on Thursday, Oct. 18, 2012, near Blackwell, Okla. A massive dust storm swirling reddish-brown clouds over northern Oklahoma triggered a multi-vehicle accident, forcing police to shut down the heavily traveled roadway amid near blackout conditions. The highway patrol said the dust storm caused a multi-car accident, and local police said nearly three dozen cars and tractor-trailers were involved. Blackwell Police Chief Fred LeValley said nine people were injured, but there were no fatalities. (AP Photo/The Ponca City News, Rolf Clements) MANDATORY CREDIT

By JUSTIN JUOZAPAVICIUS
Associated Press / October 18, 2012

TULSA, Okla. (AP) — A massive dust storm swirling reddish-brown clouds over northern Oklahoma triggered a multi-vehicle accident along a major interstate Thursday, forcing police to shut down part of the heavily traveled roadway amid near blackout conditions.

In a scene reminiscent of the Dust Bowl days, choking dust suspended on strong wind gusts shrouded Interstate 35, which links Dallas and Oklahoma City to Kansas City, Mo. Video from television station helicopters showed the four-lane highway virtually disappearing into billowing dust on the harsh landscape near Blackwell, plus dozens of vehicles scattered in the median and on the shoulders.

Dust storm shuts down interstate in northern Okla. - News - Boston.com

"I've never seen anything like this," said Jodi Palmer, a dispatcher with the Kay County Sheriff's Office. "In this area alone, the dirt is blowing because we've been in a drought. I think from the drought everything's so dry and the wind is high."

The highway patrol said the dust storm caused a multi-car accident, and local police said nearly three dozen cars and tractor-trailers were involved. Blackwell Police Chief Fred LeValley said nine people were injured, but there were no fatalities.

State transportation workers were called into to close the highway between U.S. 60 and Oklahoma 11, an 8-mile stretch of the cross-country roadway.

"We have very high winds and blowing dust causing a near blackout condition," Capt. James West of the Oklahoma Highway Patrol said Thursday afternoon. He said visibility was less than 10 feet.

The stretch of closed roadway reopened Thursday evening after crews cleaned up debris and waited for winds to die down, Oklahoma Department of Transportation spokesman Cole Hackett said.

The area is just south of the Kansas state line in far northern Oklahoma. Interstate 35 runs from the Mexican border in south Texas to Duluth, Minn.

A red flag fire warning was in place for parts of northern Oklahoma on Thursday, as was a blowing dust advisory.

The National Weather Service forecast for the area said winds would subside to 20 mph or lower overnight but that gusts as high as 28 mph could continue. Calm winds were expected by Friday night.

The area has suffered through an extended drought and many farmers had recently loosened the soil while preparing for the winter wheat season.

"You have the perfect combination of extended drought in that area ... and we have the extremely strong winds," said Gary McManus, the Oklahoma associate state climatologist.

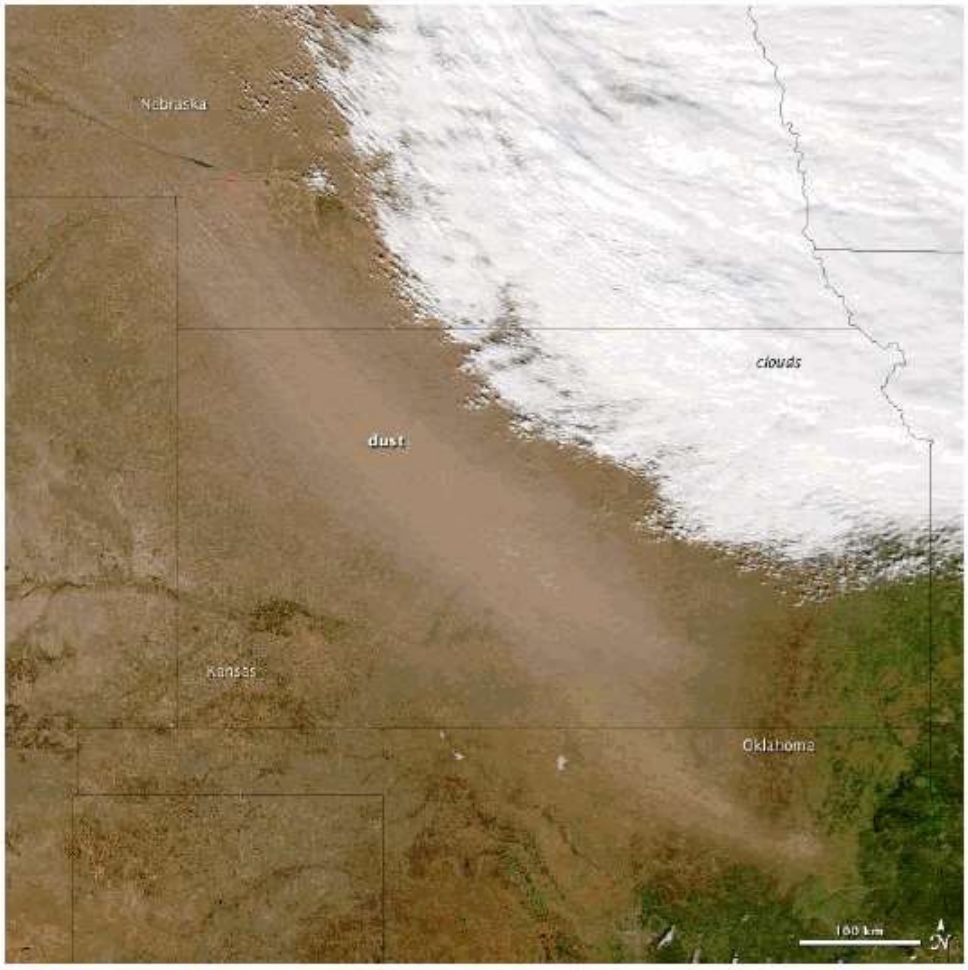
"Also, the timing is bad because a lot of those farm fields are bare. The soil is so dry, it's like powder. Basically what you have is a whole bunch of topsoil waiting for the wind to blow it away. It's no different from the 1930s than it is now."

Steve Austin, a Kay County commissioner, said visibility was terrible.

"It looked like a huge fog was over the city of Ponca City," he said. "We've had dust storms before, but I don't remember anything of this magnitude in years." ■

Dust Storm in the Great Plains : Image of the Day http://earthobservatory.nasa.gov/IOTD/view.php?id=79459

Home Images Global Maps Features News & Notes Search



download large image (2 MB, JPEG, 3200x4200) acquired October 18, 2012
download GeoTIFF file (18 MB, TIFF) acquired October 18, 2012
download Google Earth file (KMZ) acquired October 18, 2012

Parched by months of drought and searing heat, the Great Plains of the United States endured a widespread dust storm in mid-October 2012. Severe winds blew soil and sediment across hundreds of miles, closing highways and reminding longtime residents of the Dust Bowl years of the 1930s and the severe dust storms of the 1950s.

The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite captured this natural-color image of dust storms in the prairies of the United States around 1:15 p.m. Central Daylight Time on October 18, 2012. The dust appeared to have source points in southern Nebraska, though more localized sources in Kansas and Oklahoma also may have contributed. Many farms in the region are

plowed in the fall for the planting of winter crops, so soils were loosened and ready for pickup by the wind.

Gale-force northwest winds—with gusts approaching hurricane force—blew along the western edge of a storm system that stretched from the Canadian border to Kansas. The storm was the result of the collision of a warm, humid air mass from the southern United States with colder, drier air from Canada, a familiar occurrence in autumn in the middle of North America. High winds carried dust and dirt as much as 3,000 to 4,000 feet (900 to 1,200 meters) into the atmosphere, according to local weather reports.

Authorities in several states reported near-blackout conditions in some places and wind gusts powerful enough to tip trucks driving along open highways. Portions of Interstate 35 in Kansas and Oklahoma, as well as Interstate 80 in Wyoming, had to be shut down due to accidents and poor visibility.

References

Associated Press, via Yahoo News (2012, October 18) Dust storm shuts down interstate in northern Oklahoma. Accessed October 19, 2012.

Casper Star-Tribune (2012, October 18) Wyoming DOT re-opens I-80 east of Cheyenne. Accessed October 19, 2012.

Climate Central (2012, October 19) Powerful Windstorm Winds Down in Plains, Midwest. Accessed October 19, 2012.

Climate Central (2012, October 18) Winter Wheat Crop Now Feeling Impact of U.S. Drought. Accessed October 19, 2012.

National Weather Service (2012, October 19) Damaging winds expected to quiet by end of today, conditions mostly return to near normal. Accessed October 19, 2012.

The Wichita Eagle (2012, October 18) High winds create Dust Bowl effect over Wichita area. Accessed October 19, 2012.

NASA image courtesy Jeff Schmaltz LANCE/EOSDIS MODIS Rapid Response Team, GSFC. Caption by Mike Carlowicz.

Instrument:
Aqua - MODIS

The Wide World of SPoRT

Fostering interaction between product developers and end users

Feeds: Posts Comments

Dust Storm in the Plains Captured Well in MODIS Dust RGB Imagery…

October 19, 2012 by wfohunkris

On Thursday, October 18th, high winds affected drought-stricken areas of the central high plains as a tight pressure gradient developed between a broad low pressure system in the upper Midwest and a ridge of high pressure centered over the Inter-Mountain West. Surface winds gusting around 50-70 mph were common across an area from the Dakotas through western and central portions of Nebraska and Kansas. With much of this area experiencing exceptional (D4) drought conditions (Figure 1), a large plume of dust was generated mainly in western Nebraska, which then spread rapidly downstream.

Wyoming DOT re-opens I-80 east of Cheyenne

October 18, 2012 6:00 pm • By JEREMY FUGLEBERG Star-Tribune business editor

(0) Comments

Interstate 80 is open across Wyoming again, hours after state officials closed it from Cheyenne to the Nebraska border Thursday afternoon due to dust storms and vehicles crashes caused by high winds in the area.

The Wyoming Department of Transportation closure marked the western edge of road closures and accidents across the central and northern plains as winds gusting to 60 to 80 mph swept across the plains from Kansas to the Canadian border.

The high winds wreaked havoc in the region, tipping truck trailers, cutting power and spreading wildfires still burning in western Nebraska and western South Dakota.

Wyoming is on the western edge of the weather system causing the high winds. Southeastern Wyoming -- from Niobrara County south to Laramie County -- remains under a high wind warning from the National Weather Service.

Reach Jeremy Fugleberg at 307-266-0623 or jeremy.fugleberg@trib.com. Read his blog at http://trib.com /news/opinion/blogs/boom/ and follow him on Twitter: @jerenergy.

Wichita, KS

13. APPENDIX E – 1998 State of Kansas PM_{10} Natural Events Action Plans (NEAP) for Morton and Sedgwick Counties

STATE OF KANSAS PM_{10} NATURAL EVENTS ACTION PLANS
(NEAP)
FOR MORTON AND SEDGWICK COUNTIES

Revision 0
1 May 1998

Kansas Department of Health and Environment
Division of Environment

Bureau of Air and Radiation
Forbes Field, Building 283
Topeka, KS 66620

TABLE OF CONTENTS

FORWARD

During the first calendar quarter of 1996, high winds coupled with extremely dry soil conditions caused exceedances of the National Ambient Air Quality Standard (NAAQS) for PM_{10} (airborne particulate matter having a nominal aerodynamic diameter less than or equal to 10 microns) then in effect. In May 1996, the United States Environmental Protection Agency (EPA) issued a Natural Events Policy memorandum to address such exceedances resulting from natural events. This policy is applicable to emissions caused by natural events since 1 January 1994. Although these events occurred prior to issuance of the policy memorandum, EPA has required, via retroactive implementation, preparation of Natural Events Action Plans for the affected areas in Kansas (i.e., Morton and Sedgwick counties).

Prior to the Natural Events Policy memorandum, natural events were treated together with other "exceptional events", and documented exceedances due to high winds were "flagged" with a "High Winds" code when submitted to the Aerometric Information Retrieval System (AIRS). Concurrence was obtained from EPA after completion of their review of documentation. For regulatory purposes, the use of flagged data associated with an exceptional event was considered on a "case-by-case" basis.

Current federal policy requires preparation and implementation of a Natural Events Action Plan (NEAP) for each area affected by naturally-caused exceedances of the NAAQS for PM_{10}. Documented exceedances due to high winds are flagged with a "High Winds" code upon submission to AIRS, and EPA concurrence is required. Subsequent to EPA concurrence, exceedances due to natural events are excluded from NAAQS attainment status determinations, provided that a NEAP is implemented within the time frame established by the policy memorandum. Failure to prepare a NEAP will result in redesignation of affected areas as nonattainment, and the State will also be required to adopt a federally-enforceable revision of its State Implementation Plan (SIP).

This document contains separate, but similar, PM_{10} Natural Events
Action Plans for Morton and Sedgwick counties in the state of Kansas. Each of these plans is a free-standing document, subject to independent review and revision. For this reason, each plan (designated as "NEAP Part I" and "NEAP Part II") includes a separate Signatures/Approvals page and its own Table of Contents.

Appendices at the end of this document contain information relevant to blowing dust (i.e., high levels of PM_{10}) associated with high wind events. This information is essential to an understanding of the frequency and magnitude of PM_{10} high wind events on the Great Plains.

A special thank you is included here for the assistance provided by Dr. Ed Skidmore and his staff at the United States Department of Agriculture - Agricultural Research Service (USDA-ARS) Wind Erosion Research Unit (WERU) located at Kansas State University (KSU). The WERU exists because there is much more to this problem than dust in the atmosphere.

PREAMBLE

During the background review of high wind events for preparation of a Natural Events Action Plan (NEAP) for Morton and Sedgwick Counties, similarities between recent events and those of the Dust Bowl era were evident. Information obtained from the United States Department of Agriculture - Agricultural Research Service (USDA-ARS) Wind Erosion Research Unit (WERU) located at Kansas State University (KSU) provides verification that events frequently occur across the Great Plains which closely resemble those which caused the Dust Bowl. These events continue to occur in spite of significant expenditures of public funds directed at their prevention.

In southwestern Kansas, as well as throughout much of the Great Plains, February, March, and April have long been referred to as "the blow months" because this period consistently brings the winds of the highest velocities. High winds in this region often begin in the latter half of January, and sometimes continue well into the month of May.

A prolonged drought, lasting from 1932 through 1938, was the basic cause of the Dust Bowl; this period is still referred to by many residents of the Great Plains as "the Dirty Thirties". Successive failures of the winter wheat crop and drought damage to vegetation on untilled land left large expanses of dry topsoil exposed. Beginning in the spring of 1932, the Dust Bowl eventually grew to encompass an area covering approximately 97 million acres, including most of the Texas and Oklahoma panhandles, northeastern New Mexico, southeastern Colorado, and southwestern Kansas. Damage extended northward as far as the Dakotas. The "blow area", where wind erosion was the worst, centered on the area between Goodwell, Oklahoma and Liberal, Kansas. By the mid-1930s, the "blow area" had expanded to include some 50 million acres, much of it in southwestern Kansas.

One of the most effective strategies employed by the federal government during and following the Dirty Thirties was removal of land from cultivation. This strategy was initially focused on tracts of "submarginal" land (i.e., land with poor crop yield potential), and was employed in southwestern Kansas. Morton County, Kansas, was the most severely damaged county in the United States during the Dust Bowl. The federal government purchased an expanse of land that was considered submarginal, but had been planted in winter wheat during the Great Depression as crop prices fell and the drought intensified. During the Dust Bowl, this land was thus deliberately taken out of production in an attempt to reestablish grassland and prevent continued wind erosion. It has been designated as the Cimarron National Grassland since 1960.

Other federal programs were initiated which actually paid farmers to take land out of production. Over the years, these programs evolved into the Conservation Reserve Program (CRP). This program offers payments to farmers for maintaining qualifying tracts of land in grass. It is no random coincidence that there are both a National Grassland and a very large allotment of CRP land in southwestern Kansas.

With the return of more normal annual precipitation and the outbreak of the Second World War, massive agricultural expansion took place during the 1940s. Drought returned in the 1950s, and so did uncontrollable blowing dust. This drought, which ended in the spring of 1957, prompted farmers in

southwestern Kansas to turn to irrigation.

Recently proposed changes in the CRP prompted the Kansas Department of Health and Environment, Bureau of Air and Radiation (KDHE/BAR), to initiate ambient air quality monitoring for particulate matter in southwestern Kansas. With the threat of CRP acreage being brought back under the plow, a special study was initiated in order to obtain background particulate data. One of the KDHE/BAR monitoring sites was located on the Cimarron National Grassland near Elkhart, in Morton County, Kansas. Another KDHE/BAR monitoring site was located near the town of Richfield, also in Morton county. An exceedance of the 24 hour PM_{10} standard occurred at the Richfield site during the "blow months" of 1996, and the U.S. Environmental Protection Agency (EPA) subsequently required filing of a NEAP for Morton County. It should be noted that the CRP was not changed as proposed, and that the special study has been discontinued until CRP land reverts to crop production.

Information provided by the WERU indicates that blowing dust was
a widespread problem across Kansas during the first quarter of 1996. This is confirmed by the information concerning drought conditions and particulate concentrations in Appendix B. Some of this dust was blown into the state from southeastern Colorado and the Oklahoma panhandle. The regional nature of these events is documented in photographs contained in Appendix A. Exceedances of the 24 hour PM_{10} standard recorded in the Wichita-Sedgwick County area in January and March (Appendix B, newspaper clippings) were also due to blowing dust, some of which blew in from northern Oklahoma. Dust clouds were observed as far away as Tuttle Creek Reservoir near Manhattan, in the northeast quadrant of Kansas. This information emphasizes that Kansas is faced with a regional problem from which a NEAP will never provide relief; localized controls alone will be of limited effectiveness in solving the problem. The regional nature of the problem of wind erosion in the Great Plains is also clearly evident in the wind erosion map which appears in Appendix C.

Wind erosion damage to the soil remains a significant problem. Over half of the 284 million acres of cropland in the United States is designated as "highly erodible" land. It is estimated that approximately 5 million acres of land are moderately to severely damaged by wind erosion annually. This amount is expected to increase if the 35 million acres of CRP land are brought back into agricultural production.

Soil conservation efforts have indeed reduced soil erosion rates across the Great Plains, but there are good years, and there are bad years. The potential for blowing dust ALWAYS exists in southwestern Kansas. Although federal agencies such as the U. S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (and their state and local implementing partnerships) are responsible for soil conservation efforts and have made significant progress over the last sixty years, no complete solution to the problem has been achieved. After soil has begun to move, virtually nothing can be done to stop it until the winds cease. This is the full-time challenge that the WERU and the entire agricultural community face, and they are better equipped to work at it than either KDHE or EPA. The wind still blows in the Dust Bowl, and when combined with drought and sparse vegetation, dust storms still occur.

STATE OF KANSAS PM_{10} NATURAL EVENTS ACTION PLAN
(NEAP)
FOR MORTON COUNTY

NEAP Part I

Revision 0
1 May 1998

Kansas Department of Health and Environment
Division of Environment
Bureau of Air and Radiation
Forbes Field, Building 283
Topeka, KS 66620

TABLE OF CONTENTS

0 SIGNATURES/APPROVALS

Originating Unit: _____ (Signature, Author)

_____

(Date)

Air Monitoring Services Section: _____ (Signature, Section Chief)

_____

(Date)

Air Planning and Assessment Section:_____
(Signature, Section Chief)

_____

(Date)

Bureau of Air and Radiation: _____
(Signature, Bureau Director)

_____

(Date)

Southwest District Office: _____
(Signature, DEA)

_____

(Date)

Division of Environment: _____
(Signature, Director)

_____

(Date)

1 INTRODUCTION

1.1 Purpose and Scope of Plan

The United States Environmental Protection Agency (EPA) and Kansas Department of Health and Environment, Bureau of Air and Radiation (KDHE/BAR), recognize that the ability to control PM_{10} (airborne particulate matter having a nominal aerodynamic diameter less than or equal to 10 microns)is severely limited during certain natural events. In May 1996, EPA issued a Natural Events Policy to address such situations. This document has been developed in accordance with EPA's policy, and presents the Natural Events Action Plan (NEAP) for an area within the state of Kansas affected by PM_{10} exceedances of the National Ambient Air Quality Standard (NAAQS) due to natural events. The United States Environmental Protection Agency has identified three categories of natural events affecting the PM_{10} NAAQS: 1) volcanic and seismic activity, 2) wildland fires, and 3) high wind events.

Of the categories listed above, high wind events are the most probable to cause PM_{10} to exceed the NAAQS in Kansas. This plan is intended to address ambient PM_{10} concentrations in Kansas due to dust raised by unusually high winds. Such events will be considered natural events if the dust: 1) originated from nonanthropogenic sources, or 2) originated from anthropogenic sources controlled with best available control measures (BACM).

This plan has been specifically prepared in response to high wind events which occurred in Morton County, Kansas, near the town of Richfield, in January of 1996, when high winds coupled with extremely dry conditions raised dust into the atmosphere. These uncontrollable natural high wind events resulted in one exceedance of the 24-hour standard then in effect for PM_{10}. Documentation of these events is provided in Appendix B.

1.2 The 24-Hour National Ambient Air Quality Standard (NAAQS) for PM_{10}

The EPA considers the ambient air quality to be unhealthy when the 24-hour PM_{10} NAAQS is exceeded. The short-term PM_{10} NAAQS is exceeded when the 24-hour average concentration is greater than 150 micrograms per cubic meter (ug/m3). The 24-hour NAAQS is violated when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m3 is greater than 1.0, as determined by procedures described in Appendix K of 40 CFR 50.

1.3 Definition of High Winds for PM_{10} Natural Events

The definition of high winds for the purpose of this plan shall be as follows:

A daily averaged wind speed greater than 20 miles per hour (mph) or an hourly averaged wind speed greater than 25 mph or gusts greater than 40 mph with no precipitation, or only a trace of precipitation (i.e., scattered drops that do not completely wet or cover an exposed area up to a rate of 0.01 inch per

hour).*

* A general wind threshold for raising of dust is considered to be 6 meters per second, equivalent to a wind speed of 13.4 mph. The actual threshold will vary with soil type, moisture, etc.

According to the Beaufort Wind Strength Scale, a Force 4 ("Moderate Breeze") is equivalent to a wind speed of 13-18 mph. (It should be noted that average annual wind speeds in southwestern and south central Kansas fall within the range of 10 - 15 mph.) It is defined as the wind strength at which dust and paper are raised from the ground. A daily averaged wind speed of 20 mph could thus be reasonably considered to continue to raise and also maintain blowing dust in the atmosphere.

A Force 6 ("Strong Breeze") is equivalent to a wind speed of 25-31 mph. It is defined as the wind strength at which large tree branches move and open wires begin to whistle. An hourly averaged wind speed of 25 mph could be reasonably considered to continue to raise and also maintain blowing dust in the atmosphere.

2 PUBLIC EDUCATION AND NOTIFICATION

2.1 Identification of Individuals Most at Risk

The following persons are usually considered to be most at risk for adverse health effects from inhalation of airborne particulate matter, and thus comprise the target population of this plan:

1) Children;
2) elderly persons;
3) individuals with impaired pulmonary function,
    a) asthma;
    b) chronic bronchitis; and
    c) chronic obstructive pulmonary disease (COPD; i.e., emphysema);
4) individuals with cardiovascular disease; and
5) immunosuppressed persons.

2.2 Implementation of Education and Notification

The EPA Natural Events Policy requires public education concerning natural events. It also requires that the public must be informed whenever a natural event is imminent. EPA's Natural Events Policy memorandum states that the air quality is considered unhealthy whenever the 24-hour PM_{10} NAAQS is exceeded. Advance public notification concerning an imminent dust storm will require an accurate forecasting procedure. Since no such procedure is presently known to KDHE/BAR, it is not feasible to commit to such notification except through annual general notices.

In order to facilitate future implementation of a forecasting method and subsequent development and implementation of a public health advisory mechanism, EPA is encouraged to commit resources to relevant research. To promote timely development of such a system, KDHE/BAR are committed to support any organization in their request for EPA funding for relevant research, and to assist in evaluation of potential methods for applicability to dust storms affecting Kansas. Organizations interested in such research exist. Any forecasting/public health advisory system that proves to be both reliable and cost-effective will be considered by KDHE/BAR.

This NEAP addresses the following educational goals:

1) Educate the public about the harmful health effects of high concentrations of PM_{10}; and
2) Inform the public that certain types of natural events may affect the air quality of a given area.

These public education goals will be addressed on an annual basis through public service announcements. For this purpose, the Southwest District Office of KDHE (KDHE/SWDO) will issue the following statement for publication in Morton County newspapers during January of each year:

PUBLIC NOTICE
OF
POTENTIAL ADVERSE HEALTH EFFECTS ASSOCIATED
WITH ELEVATED LEVELS OF AIRBORNE DUST

On 28 January 1996, the Kansas Department of Health and Environment (KDHE) measured elevated levels of particulate matter in the air in Morton County, Kansas. Subsequent evaluation of this occurrence has been conducted by KDHE, and has clearly demonstrated the cause to be blowing dust associated with high winds and dry soil conditions.

During dry conditions in Kansas, there is a potential for blowing dust associated with high winds. The amount of particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) contained in this blowing dust may exceed the National Ambient Air Quality Standard (NAAQS) and reach levels high enough to cause adverse health effects when inhaled. Children, elderly persons, immunosuppressed persons, and individuals with impaired respiratory and/or cardiovascular function are particularly susceptible to the adverse health effects associated with inhalation of airborne particulate matter. During natural high wind events which generate high levels of airborne particulate matter, it is advisable to limit outdoor activities and remain indoors with doors and windows closed as much as possible.

During periods of blowing dust, it is also recommended that excessive physical exertion and exposure to tobacco smoke and other respiratory irritants be avoided. Persons taking regular medications are advised to ensure that they have at least a five-day supply on hand. Individuals with chronic medical conditions should consider contacting a health care provider at the onset of any of the following symptoms: headache, repeated coughing, wheezing, chest tightness or pain, difficulty in breathing, excessive phlegm production, or nausea. It is suggested that all individuals avoid vigorous outdoor activity.

This notice is applicable when local weather forecasts indicate a possibility of high winds (sustained winds above 20 miles per hour (mph) or gusts greater than 40 mph without precipitation) in the local area.

This notification is being issued by KDHE as a public service and to assure compliance with the U. S. Environmental Protection Agency's policies related to the protection of public health in areas affected by elevated levels of particulate matter due to natural events. Questions regarding this notice should be directed to the Kansas Department of Health and Environment, Southwest District Office at (316) 225-0596.

3 ABATEMENT OR MINIMIZATION OF CONTROLLABLE SOURCES OF PM_{10}

3.1 Potential Sources of PM_{10} During High Wind Events

The following have been identified as potential sources of blowing dust during high wind events in Kansas. Omission of a source from this list does not preclude its future identification as a potential source.

a) Tilled agricultural land;
b) sparsely vegetated or overgrazed range land;
c) unpaved roads and parking lots;
d) urban paved roads; and
e) construction sites

3.2 Identification and Application of Best Available Control Measures (BACM)

The Natural Events Policy issued by EPA provides for identification and application of Best Available Control Measures (BACM) to sources of soil that have been disturbed by anthropogenic activities. Determination of BACM should follow EPA's technical guidance for the determination of BACM for fugitive dust sources contained in the Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, EPA-450/2-92-004, September 1992. These BACM will be evaluated by KDHE/BAR in consultation with KDHE/SWDO.

3.2.1 Use of conservation farming practices on agricultural lands

The following have been identified as standard soil conservation measures which constitute agricultural BACM. Omission of any soil conservation measure from this list does not preclude its evaluation and application in the future.

a) Reduced tillage farming practices;
b) tree rows;
c) other physical windbreaks;
    1) grass barriers;
    2) annual (e.g., sunflower) barriers;
    3) buffer strips; and
    4) "snow" fences;
d) cover crops;
e) strip cropping;
f) crop residues; and
g) emergency tillage

3.2.2 Abatement and suppression of dust from other sources

The following have been identified as measures which can be employed for mitigation of blowing dust from other sources. Omission of any measure from this list does not preclude its evaluation and application in the future.

a) Application of chemical dust suppressants to unpaved roads, parking lots, and open areas with exposed soil;
b) wet vacuuming of urban paved roads and parking lots;
c) dust suppression at construction sites,
    1) water spraying of exposed soil;
    2) application of chemical dust suppressants; and
    3) use of surface coverings; and
d) restriction/prohibition of off-road vehicle activities

3.3 Undefined BACM

If appropriate BACM are not defined for contributing anthropogenic sources in question, KDHE/BAR should attempt to identify specific measures for implementation. This will be accomplished in two phases, 1) identification of potential mitigating measures, and 2) initial implementation by means of pilot tests for evaluation of the effectiveness of the measures.

3.3.1 Mitigating Measures

Soil erosion specialists at the federal and state levels have been working for approximately sixty years to develop and evaluate potential mitigating measures. These soil conservation experts continue to implement measures that prove effective for the reduction or prevention of blowing dust.

Numerous measures have been applied and are currently in place across the Great Plains in order to minimize the effects of wind erosion. The United States Department of Agriculture - Agricultural Research Service (USDA-ARS) Wind Erosion Research Unit (WERU) located at Kansas State University (KSU) has achieved the following:

a) Evaluated emergency till practices and demonstrated their effectiveness in halting wind erosion as it started;
b) Evaluated vegetative and non-vegetative mulches and demonstrated that standing vegetation can be five to ten times more effective at reducing wind erosion than material laying flat;
c) Evaluated the relative effectiveness of different plant species in windbreaks;
d) Established the use of feedlot wastes as an effective method for erosion control; and
e) Established the use of permanent grass wind barriers and annual crop control strips, and

evaluated the relative effectiveness of their spacing, position, and size in reducing wind erosion.

3.3.2 Pilot Tests

Pilot testing and evaluation of experimental measures continue to be conducted by soil erosion specialists. These federally funded research efforts, which include experimental evaluation of erosion abatement, control, and prevention techniques, continue throughout the Great Plains.

3.4 Evaluation of BACM

The area south and southwest of Richfield, extending into northwestern Oklahoma and southeastern Colorado, is natural grassland and farmland, much of which is planted in wheat. During the first quarter of 1996, this area was experiencing drought conditions (Appendix B). The drought-induced decrease in vegetative cover due to dry grassland and poor germination of the winter wheat crop resulted in increased exposure of topsoil. As a result of the freezing and thawing of increasingly dry topsoil, bare areas were covered with a layer of fine loose granules (crustal dust).

It is recognized that the Richfield, Morton County area was influenced by high winds and blowing dust from the south and southwest on the day of the recorded PM_{10} exceedance. Considering the wind speeds and gusts noted during the day that the concentration above the 24-hour NAAQS was recorded (Appendix B, Table 3), it is apparent that these conditions were abnormal. The phenomena which gave rise to these blowing dust problems were, therefore, natural events which could not be prevented by application of BACM. With the top few inches of soil loose, and the lower portion frozen, the farming community was unable to apply emergency tillage or other measures to aid in the reduction of blowing dust. In fact, it is likely that these events occurred in spite of general area-wide application of accepted good agricultural soil conservation practices.

After the recorded exceedance, a fire, which had been attributed to downed power lines in the Oklahoma panhandle, spread into southwestern Kansas and destroyed vegetation across a very large expanse of CRP land. Wind erosion of soil in southwestern Kansas continued through the month of May.

On the basis of these findings, KDHE has concluded that the Richfield (population 47; 1997 Kansas estimate) area or Morton County (population 3399; 1997 Kansas estimate) could not have prevented these exceedances at the recorded particulate levels by employing localized urban control measures. The increase in PM_{10} concentration on the day of the recorded exceedance was 549% above normally observed levels. The 28 January value of 203 ug/m^3 at the monitoring site (3.25 miles north of Richfield) does not relate to the quarterly mean of 37 ug/m^3 at that site (Appendix B, Table 2).

3.5 Implementation Strategy

In view of the apparent regional nature of this problem, it seems clear that no single state agency has

the resources or regional coverage required to increase the effectiveness of established soil erosion programs. The impact of implementation of short-term, localized control measures at the state level would be negligible when faced with the combination of conditions that resulted in the elevated levels of PM_{10} described in this plan. To be effective in reducing such dust excursions at their source, a regional systems approach which includes consideration of factors such as cropping patterns, soil types, and climatological information must be implemented. KDHE will be working closely with USDA representatives in Kansas to emphasize the continued importance of regional efforts coordinated through federal, state, and local actions directed at reducing soil erosion. Concurrently, KDHE will continue to assure that the public is aware of the potential health consequences of elevated levels of airborne particulate.

4 PERIODIC REVIEW OF NATURAL EVENTS ACTION PLAN (NEAP)

This Natural Events Action Plan will be reviewed by KDHE/BAR in conjunction with KDHE/SWDO at least once in every five years. The focus of this review will be the re-evaluation of conditions causing exceedances and violations of the NAAQS for PM_{10}. The review will also consider the implementation status of the plan, as well as the adequacy of actions taken. A Periodic Review Report will be prepared by KDHE/BAR in order to summarize the findings of the review process.

STATE OF KANSAS PM_{10} NATURAL EVENTS ACTION PLAN (NEAP) FOR SEDGWICK COUNTY

NEAP Part II

Revision 0
1 May 1998

Kansas Department of Health and Environment
Division of Environment
Bureau of Air and Radiation
Technical Services Section
Forbes Field, Building 283
Topeka, KS 66620

TABLE OF CONTENTS

0 SIGNATURES/APPROVALS

Originating Unit: _____ (Signature, Author)

_____

(Date)

Air Monitoring Services Section: _____ (Signature, Section Chief)

_____

(Date)

Air Planning and Assessment Section:_____
(Signature, Section Chief)

_____

(Date)

Bureau of Air and Radiation: _____
(Signature, Bureau Director)

_____
(Date)

Wichita-Sedgwick County
Department of Community Health: _____
(Signature, Director)

_____ (Date)

Division of Environment: _____
(Signature, Director)

_____
(Date)

1 INTRODUCTION

1.1 Purpose and Scope of Plan

The United States Environmental Protection Agency (EPA), Wichita-Sedgwick County Department of Community Health (WSCDCH), and Kansas Department of Health and Environment, Bureau of Air and Radiation (KDHE/BAR), recognize that the ability to control PM_{10} (airborne particulate matter having a nominal aerodynamic diameter less than or equal to 10 microns)is severely limited during certain natural events. In May 1996, EPA issued a Natural Events Policy to address such situations. This document has been developed in accordance with EPA's policy, and presents the Natural Events Action Plan (NEAP) for an area within the state of Kansas affected by PM_{10} exceedances of the National Ambient Air Quality Standard (NAAQS) due to natural events. The United States Environmental Protection Agency has identified three categories of natural events affecting the PM_{10} NAAQS: 1) volcanic and seismic activity, 2) wildland fires, and 3) high wind events.

Of the categories listed above, high wind events are the most probable to cause PM_{10} to exceed the NAAQS in Kansas. This plan is intended to address ambient PM_{10} concentrations in Kansas due to dust raised by unusually high winds. Such events will be considered natural events if the dust: 1) originated from nonanthropogenic sources, or 2) originated from anthropogenic sources controlled with best available control measures (BACM).

This plan has been specifically prepared in response to high wind events which occurred in Sedgwick County, Kansas in January and March of 1996, when high winds coupled with extremely dry conditions raised dust into the atmosphere. These uncontrollable natural high wind events resulted in

exceedances of the 24-hour standard then in effect for PM_{10}. Documentation of these events is provided in Appendix B.

1.2 The 24-Hour National Ambient Air Quality Standard (NAAQS) for PM_{10}

The EPA considers the ambient air quality to be unhealthy when the 24-hour PM_{10} NAAQS is exceeded. The short-term PM_{10} NAAQS is exceeded when the 24-hour average concentration is greater than 150 micrograms per cubic meter (ug/m3). The 24-hour NAAQS is violated when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m3 is greater than 1.0, as determined by procedures described in Appendix K of 40 CFR 50.

1.3 Definition of High Winds for PM_{10} Natural Events

The definition of high winds for the purpose of this plan shall be as follows:

A daily averaged wind speed greater than 20 miles per hour (mph) or an hourly averaged wind speed greater than 25 mph or gusts greater than 40 mph with no precipitation, or only a trace of precipitation (i.e., scattered drops that do not completely wet or cover an exposed area up to a rate of 0.01 inch per hour).*

* A general wind threshold for raising of dust is considered to be 6 meters per second, equivalent to a wind speed of 13.4 mph. The actual threshold will vary with soil type, moisture, etc.

According to the Beaufort Wind Strength Scale, a Force 4 ("Moderate Breeze") is equivalent to a wind speed of 13-18 mph. (It should be noted that average annual wind speeds in southwestern and south central Kansas fall within the range of 10 - 15 mph.) It is defined as the wind strength at which dust and paper are raised from the ground. A daily averaged wind speed of 20 mph could thus be reasonably considered to continue to raise and also maintain blowing dust in the atmosphere.

A Force 6 ("Strong Breeze") is equivalent to a wind speed of 25-31 mph. It is defined as the wind strength at which large tree branches move and open wires begin to whistle. An hourly averaged wind speed of 25 mph could be reasonably considered to continue to raise and also maintain blowing dust in the atmosphere.

2 PUBLIC EDUCATION AND NOTIFICATION

2.1 Identification of Individuals Most at Risk

The following persons are usually considered to be most at risk for adverse health effects from inhalation of airborne particulate matter, and thus comprise the target population of this plan:

1) Children;
2) elderly persons;
3) individuals with impaired pulmonary function,
    a) asthma;
    b) chronic bronchitis; and
    c) chronic obstructive pulmonary disease (COPD; i.e., emphysema);
4) individuals with cardiovascular disease; and
5) immunosuppressed persons.

2.2 Implementation of Education and Notification

The EPA Natural Events Policy requires public education concerning natural events. It also requires that the public must be informed whenever a natural event is imminent. EPA's Natural Events Policy memorandum states that the air quality is considered unhealthy whenever the 24-hour PM_{10} NAAQS is exceeded. Advance public notification concerning an imminent dust storm will require an accurate forecasting procedure. Since no such procedure is presently known to KDHE/BAR, it is not feasible to commit to such notification except through annual general notices.

In order to facilitate future implementation of a forecasting method and subsequent development and implementation of a public health advisory mechanism, EPA is encouraged to commit resources to relevant research. To promote timely development of such a system, KDHE/BAR are committed to support any organization in their request for EPA funding for relevant research, and to assist in evaluation of potential methods for applicability to dust storms affecting Kansas. Organizations interested in such research exist. Any forecasting/public health advisory system that proves to be both reliable and cost-effective will be considered by KDHE/BAR.

This NEAP addresses the following educational goals:

1) Educate the public about the harmful health effects of high concentrations of PM_{10}; and
2) Inform the public that certain types of natural events may affect the air quality of a given area.

These public education goals will be addressed on an annual basis through public service announcements. For this purpose, WSCDCH will issue the following statement for publication in major newspapers during January of each year:

PUBLIC NOTICE
OF
POTENTIAL ADVERSE HEALTH EFFECTS ASSOCIATED
WITH ELEVATED LEVELS OF AIRBORNE DUST

On 28 January 1996 and 4 March 1996, the Kansas Department of Health and Environment (KDHE) and the Wichita-Sedgwick County Department of Community Health (WSCDCH) measured elevated levels of particulate matter in the air in Sedgwick County, Kansas. Subsequent evaluation of this occurrence has been conducted by KDHE, and has clearly demonstrated the cause to be blowing dust associated with high winds and dry soil conditions.

During dry conditions in Kansas, there is a potential for blowing dust associated with high winds. The amount of particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) contained in this blowing dust may exceed the National Ambient Air Quality Standard (NAAQS) and reach levels high enough to cause adverse health effects when inhaled. Children, elderly persons, immunosuppressed persons, and individuals with impaired respiratory and/or cardiovascular function are particularly susceptible to the adverse health effects associated with inhalation of airborne particulate matter. During natural high wind events which generate high levels of airborne particulate matter, it is advisable to limit outdoor activities and remain indoors with doors and windows closed as much as possible.

During periods of blowing dust, it is also recommended that excessive physical exertion and exposure to tobacco smoke and other respiratory irritants be avoided. Persons taking regular medications are advised to ensure that they have at least a five-day supply on hand. Individuals with chronic medical conditions should consider contacting a health care provider at the onset of any of the following symptoms: headache, repeated coughing, wheezing, chest tightness or pain, difficulty in breathing, excessive phlegm production, or nausea. It is suggested that all individuals avoid vigorous outdoor activity.

This notice is applicable when local weather forecasts indicate a possibility of high winds (sustained winds above 20 miles per hour (mph) or gusts greater than 40 mph without precipitation) in the local area.

This notification is being issued by KDHE as a public service and to assure compliance with the U. S. Environmental Protection Agency's policies related to the protection of public health in areas affected by elevated levels of particulate matter due to natural events. Questions regarding this notice should be directed to the Wichita-Sedgwick County Department of Community Health at (316) 268-8302.

3 ABATEMENT OR MINIMIZATION OF CONTROLLABLE SOURCES OF PM_{10}

3.1 Potential Sources of PM_{10} During High Wind Events

The following have been identified as potential sources of blowing dust during high wind events in

Kansas. Omission of a source from this list does not preclude its future identification as a potential source.

a) Tilled agricultural land;
b) sparsely vegetated or overgrazed range land;
c) unpaved roads and parking lots;
d) urban paved roads; and
e) construction sites

3.2 Identification and Application of Best Available Control Measures (BACM)

The Natural Events Policy issued by EPA provides for identification and application of Best Available Control Measures (BACM) to sources of soil that have been disturbed by anthropogenic activities. Determination of BACM should follow EPA's technical guidance for the determination of BACM for fugitive dust sources contained in the Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, EPA-450/2-92-004, September 1992. These BACM will be evaluated by WSCDCH in consultation with KDHE/BAR.

3.2.1 Use of conservation farming practices on agricultural lands

The following have been identified as standard soil conservation measures which constitute agricultural BACM. Omission of any soil conservation measure from this list does not preclude its evaluation and application in the future.

a) Reduced tillage farming practices;
b) tree rows;
c) other physical windbreaks;
    1) grass barriers;
    2) annual (e.g., sunflower) barriers;
    3) buffer strips; and
    4) "snow" fences;
d) cover crops;
e) strip cropping;
f) crop residues; and
g) emergency tillage

3.2.2 Abatement and suppression of dust from other sources

The following have been identified as measures which can be employed for mitigation of blowing dust from other sources. Omission of any measure from this list does not preclude its evaluation and

application in the future.

a) Application of chemical dust suppressants to unpaved roads, parking lots, and open areas with exposed soil;
b) wet vacuuming of urban paved roads and parking lots;
c) dust suppression at construction sites,
    1) water spraying of exposed soil;
    2) application of chemical dust suppressants; and
    3) use of surface coverings; and
d) restriction/prohibition of off-road vehicle activities

3.3 Undefined BACM

If appropriate BACM are not defined for contributing anthropogenic sources in question, WSCDCH should attempt to identify specific measures for implementation. This will be accomplished in two phases, 1) identification of potential mitigating measures, and 2) initial implementation by means of pilot tests for evaluation of the effectiveness of the measures.

3.3.1 Mitigating Measures

Soil erosion specialists at the federal and state levels have been working for approximately sixty years to develop and evaluate potential mitigating measures. These soil conservation experts continue to implement measures that prove effective for the reduction or prevention of blowing dust.

Numerous measures have been applied and are currently in place across the Great Plains in order to minimize the effects of wind erosion. The United States Department of Agriculture - Agricultural Research Service (USDA-ARS) Wind Erosion Research Unit (WERU) located at Kansas State University (KSU) has achieved the following:

a) Evaluated emergency till practices and demonstrated their effectiveness in halting wind erosion as it started;
b) Evaluated vegetative and non-vegetative mulches and demonstrated that standing vegetation can be five to ten times more effective at reducing wind erosion than material laying flat;
c) Evaluated the relative effectiveness of different plant species in windbreaks;
d) Established the use of feedlot wastes as an effective method for erosion control; and
e) Established the use of permanent grass wind barriers and annual crop control strips, and evaluated the relative effectiveness of their spacing, position, and size in reducing wind erosion.

3.3.2 Pilot Tests

Pilot testing and evaluation of experimental measures continue to be conducted by soil erosion specialists. These federally funded research efforts, which include experimental evaluation of erosion abatement, control, and prevention techniques, continue throughout the Great Plains.

3.4 Evaluation of BACM

The area south and southwest of Wichita, extending into northern Oklahoma, is farmland. This area was experiencing drought conditions, and the winter wheat crop had therefore not germinated, leaving bare ground in the fields. As a result of the freezing and thawing of increasingly dry topsoil, these bare areas were covered with a layer of fine loose granules (crustal dust).

It is recognized that the Sedgwick County area was influenced by high winds and blowing dust from the south and southwest. Considering the wind speeds and gusts noted during the days that concentrations above the 24-hour NAAQS were recorded (Appendix B, Table 3), it is apparent that these conditions were abnormal. The phenomena which gave rise to these blowing dust problems were, therefore, natural events which could not be prevented by application of BACM. With the top few inches of soil loose, and the lower portion frozen, the farming community was unable to apply emergency tillage or other measures to aid in the reduction of blowing dust. In fact, it is likely that these events occurred in spite of general area-wide application of accepted good agricultural soil conservation practices.

On the basis of these findings, KDHE has concluded that the Wichita area could not have prevented these exceedances at the recorded particulate levels by employing localized urban control measures. The increases in PM_{10} concentrations ranged from 634% to 1238% above normally observed levels. For example, the 28 January value of 184 ug/m^3 at the George Washington Blvd. site does not relate to the quarterly mean of 29 ug/m^3 at that site. The 28 January value of 359 ug/m^3 at the Coleman Co. site also does not relate to that site's quarterly mean of 29 ug/m^3 (Appendix B, Table 2).

3.5 Implementation Strategy

In view of the apparent regional nature of this problem, it seems clear that no single state agency has the resources or regional coverage required to increase the effectiveness of established soil erosion programs. The impact of implementation of short-term, localized control measures at the state level would be negligible when faced with the combination of conditions that resulted in the elevated levels of PM_{10} described in this plan. To be effective in reducing such dust excursions at their source, a regional systems approach which includes consideration of factors such as cropping patterns, soil types, and climatological information must be implemented. KDHE will be working closely with USDA representatives in Kansas to emphasize the continued importance of regional efforts coordinated through federal, state, and local actions directed at reducing soil erosion. Concurrently, KDHE will

continue to assure that the public is aware of the potential health consequences of elevated levels of airborne particulate.

4 PERIODIC REVIEW OF NATURAL EVENTS ACTION PLAN (NEAP)

This Natural Events Action Plan will be reviewed by WSCDCH in conjunction with KDHE/BAR at least once in every five years. The focus of this review will be the re-evaluation of conditions causing exceedances and violations of the NAAQS for PM_{10}. The review will also consider the implementation status of the plan, as well as the adequacy of actions taken. A Periodic Review Report will be prepared by WSCDCH in order to summarize the findings of the review process.

SUMMARY

The Dust Bowl was a regional problem that required intervention at the national level. There are federal agencies (and their corresponding state and local partners) with decades of experience in dealing with wind erosion of soil. Soil loss rates are much lower than they were during the Dirty Thirties, but these can be grossly elevated by high wind events during periods of drought.

The United States Department of Agriculture - Agricultural Research Service (USDA-ARS) and Natural Resources Conservation Service (USDA-NRCS) study land use, assess the condition of land, and, with the assistance of state and local agricultural agencies and organizations, develop and apply conservation measures to prevent soil loss. In Kansas, wind erosion concerns are being addressed, in part, through the USDA-NRCS Environmental Quality Incentives Program (EQIP). Morton County falls within a designated priority area (i.e., the three southwestern counties of Kansas) for which special erosion control contracts lasting three to five years have been developed. Through continued efforts, such programs have significantly reduced the annual impact of wind erosion of soil.

In light of the regional nature of blowing dust across the Plains States and the long-term federally-coordinated commitment to the problem, it would be inappropriate to create a new independent state-level authority to address this problem. No individual state has authorities or resources to implement a regional project of this nature. Application of short-term, localized control measures alone at the state level would have little or no measurable effect. Specialists in the field of agricultural wind erosion continue to emphasize that a regional systems approach which includes consideration of cropping patterns, soil types, climatological information, and other factors is required.

Only a truly regional approach coordinated at the federal level can have significant impact on events of this type that vary from state to state and have broad geographic implications. Existing federal efforts might be well-served by additional involvement in these programs on the part of EPA along with affected states as stakeholders. Funding from EPA for USDA-ARS research and USDA-NRCS application efforts (and their state and local implementing partners) could prove highly beneficial in accelerating improvements in air quality related to high wind events.

REFERENCES

1. Code of Federal Regulations, Title 40, Part 50 (40 CFR 50), Appendix K.

2. Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures; EPA-450/2-92-004; September 1992.

3. Svobida, Lawrence. Farming the Dust Bowl: A First-hand Account from Kansas; University Press of Kansas; Lawrence, KS; 1986. (Originally published as: An Empire of Dust; The Caxton Printers, Ltd.; 1940.)

4. Wind Erosion Research Unit (USDA-ARS/WERU) website at Kansas State University; www.weru.ksu.edu; 1998.

5. Newspaper Articles Concerning Dry Conditions, High Winds, and Blowing Dust; The Wichita Eagle; 30 January and 5 March 1996.

6. Wind Erosion Map; Map 1004069; USDA-SCS National Cartographic Center; Ft. Worth, TX; 1988.

7. Knapp, Mary. Kansas State Climatologist; Personal communication; Kansas State University; Manhattan, KS; 1998.

8. Nichols, Mary D. Memorandum Regarding Areas Affected by PM_{10} Natural Events; U. S. EPA; 1996.

9. Kaiser, Wayne A. Letter to John Irwin, Director, Kansas Department of Health and Environment, Bureau of Air and Radiation, Regarding Implementation of a Natural Events Action Plan for Morton and Sedgwick Counties; U. S. EPA, Region VII Office; Kansas City, KS; 24 October 1997.

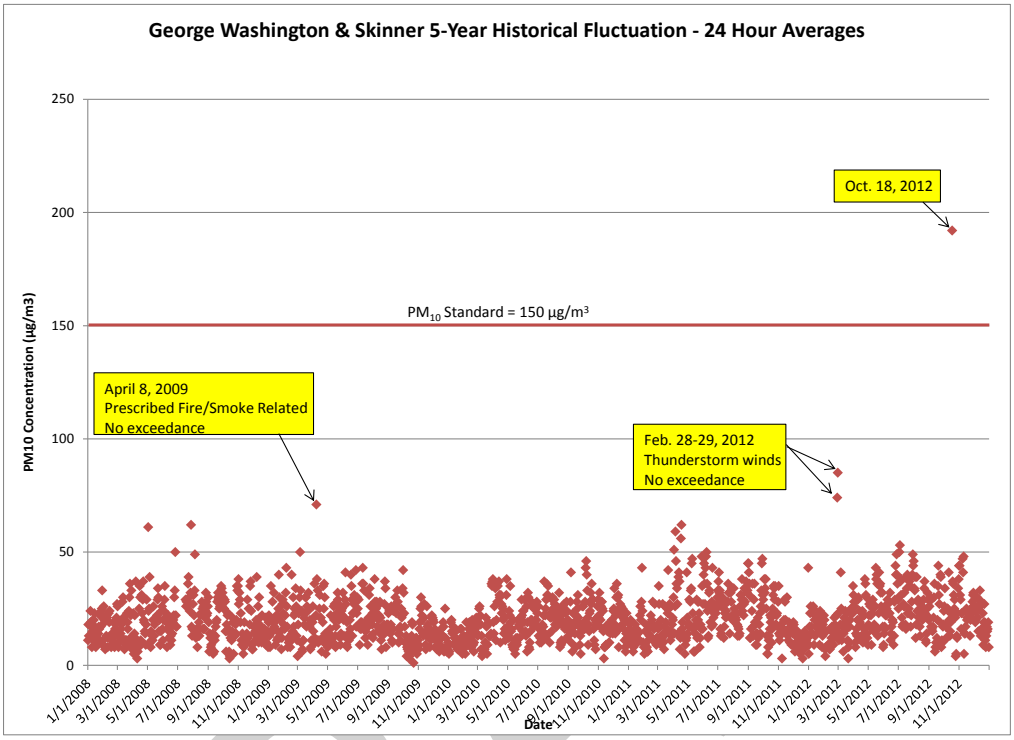
14. APPENDIX F – Additional Language for National Weather Service Products

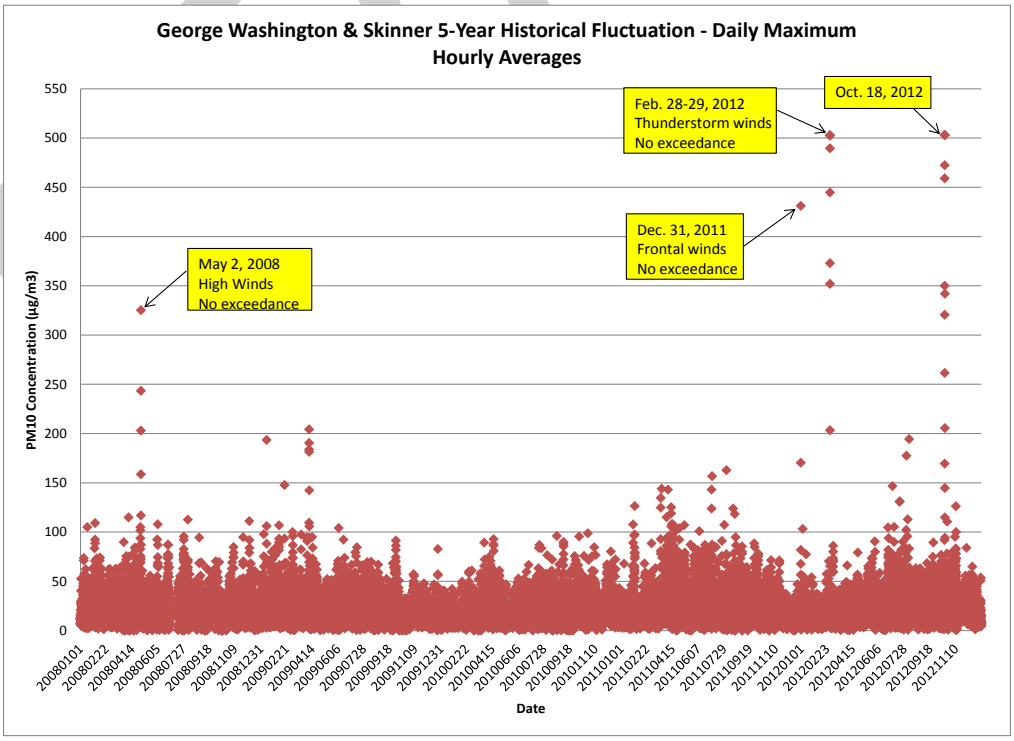
As part of the development of these recent exceptional event requests, the KDHE and the regional National Weather Service offices worked together to develop additional language that will be added to National Weather Service (NWS) dust advisory and dust warning products issued during future dust events in the Kansas forecast areas. This language will advise listeners of the potential health effects associated with these dust events and some proactive steps that they may perform to protect themselves from these events.

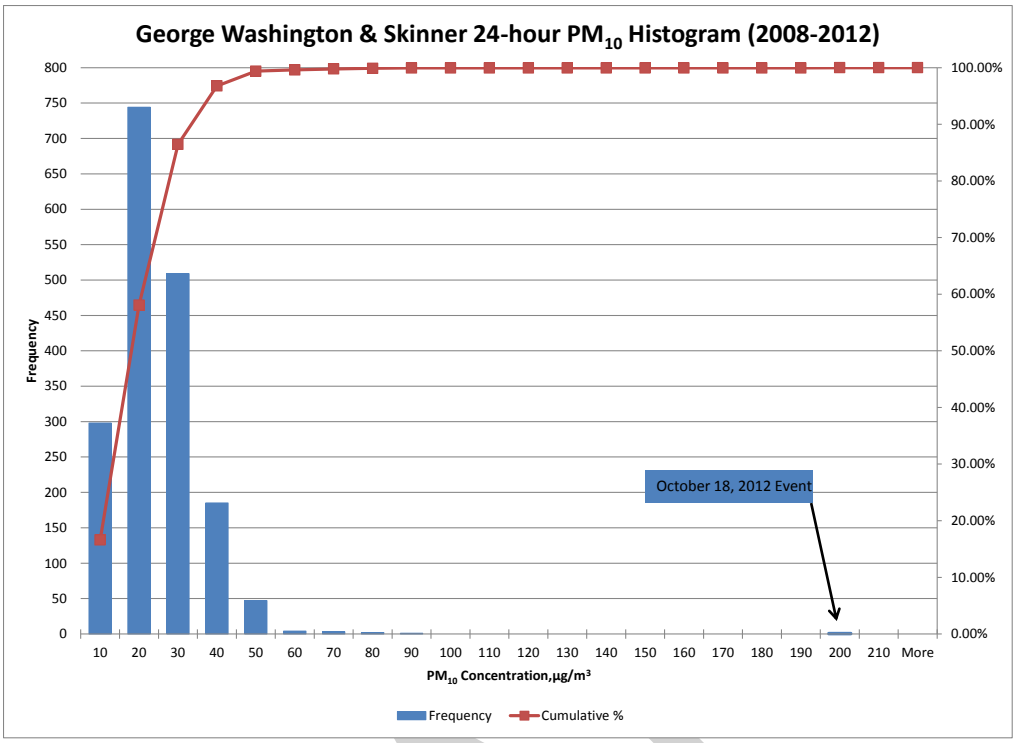
"*The Kansas Department of Health and Environment recommends that you take preventative measures during this dust (or wind) event, such as staying indoors or wearing protective breathing masks if outside. High dust concentrations can cause respiratory problems, decrease lung activity, aggravate asthma, and lead to potential heart-related problems, especially with children, elderly, or those with pre-existing respiratory conditions.*"

15. APPENDIX G - Historical Flucuations

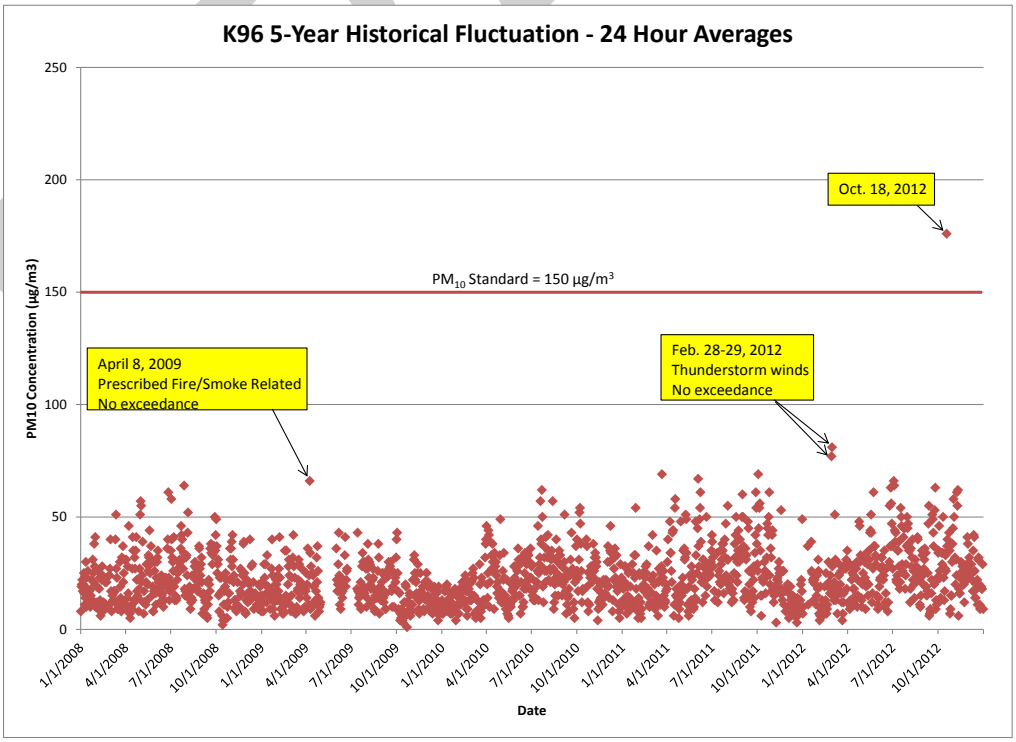
15.1 George Washington & Skinner

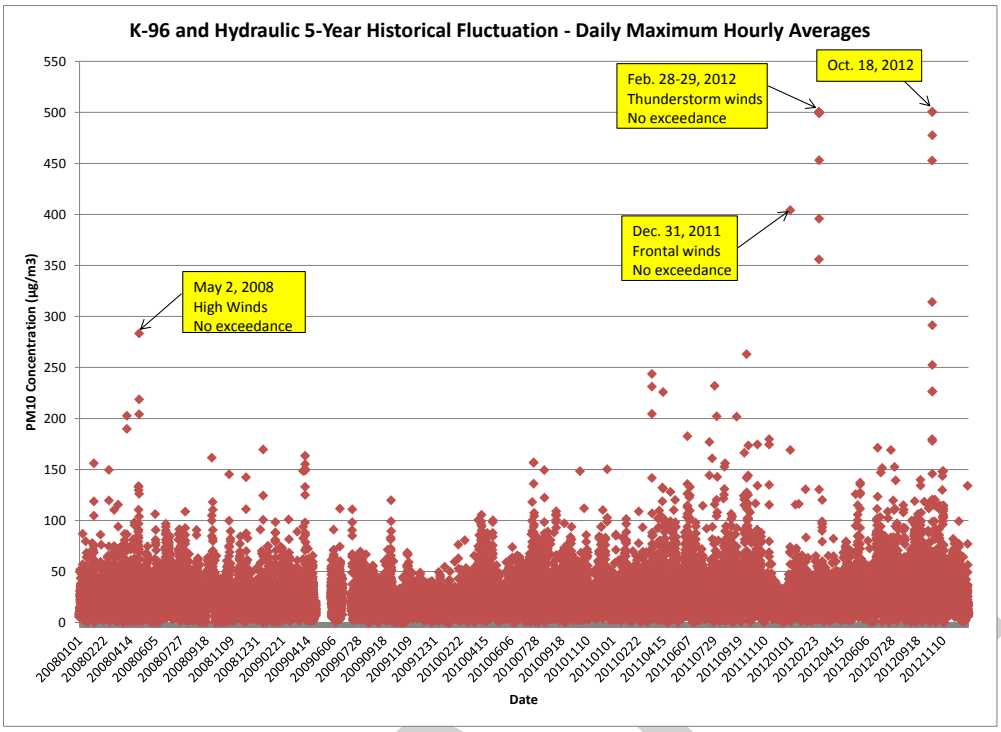


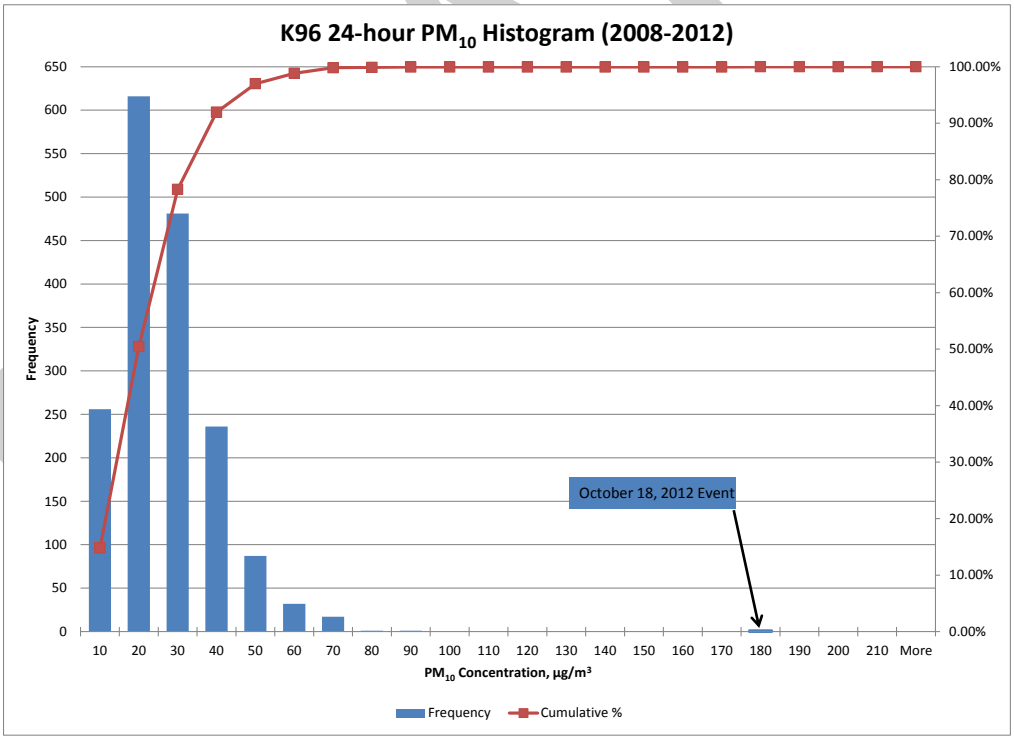




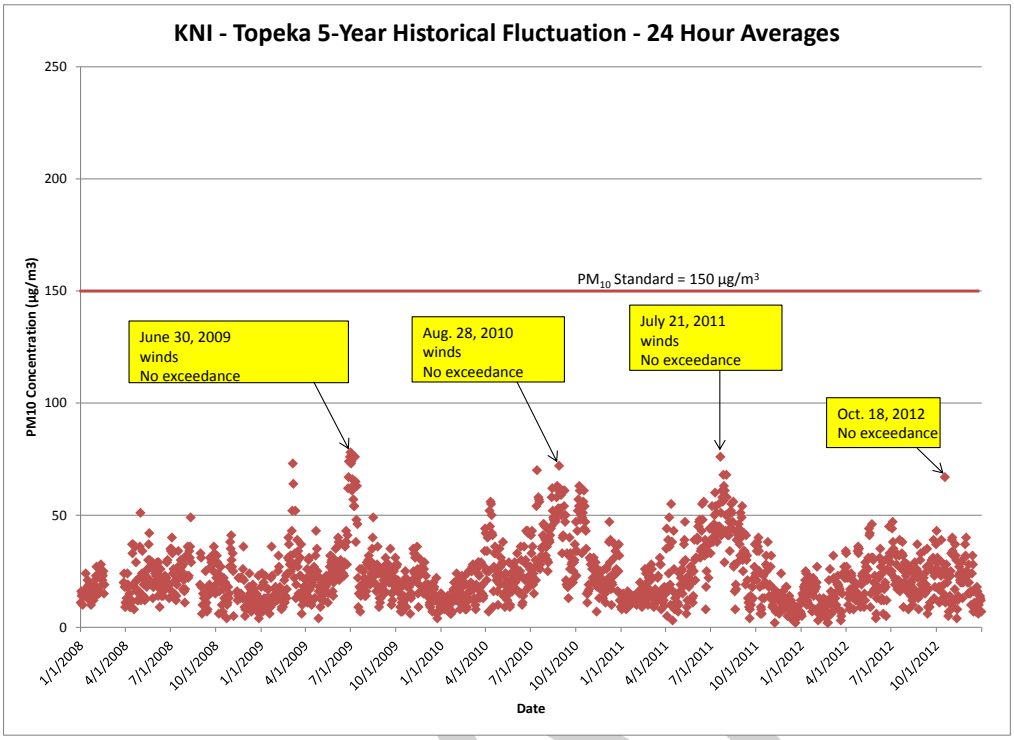
15.2 K96 & Hydraulic

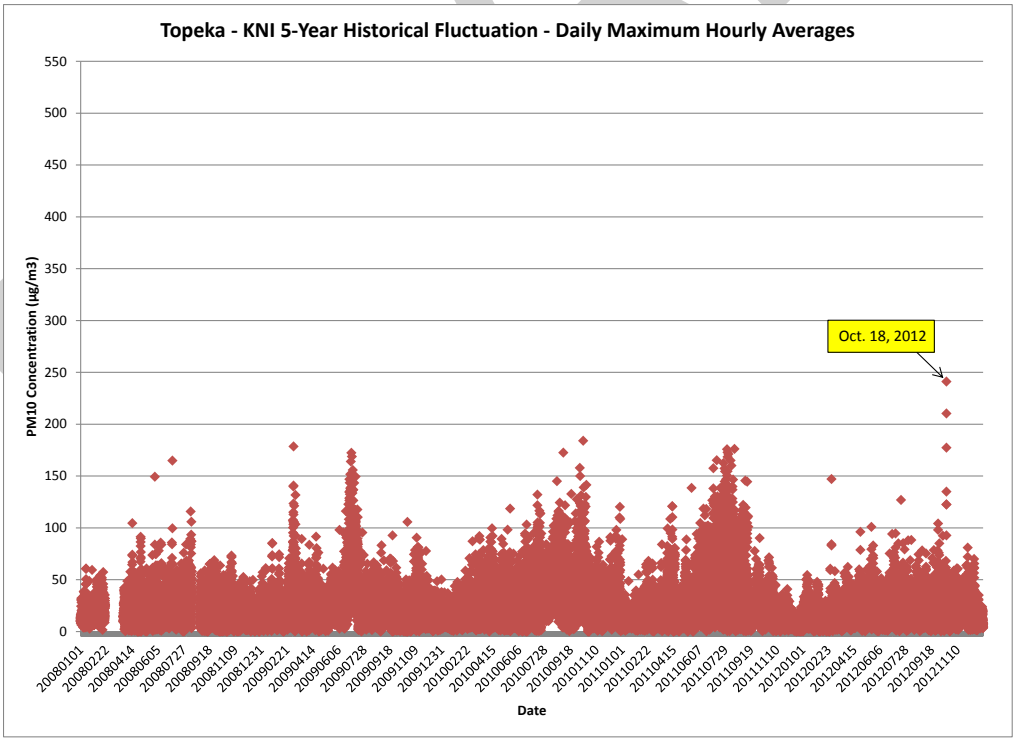


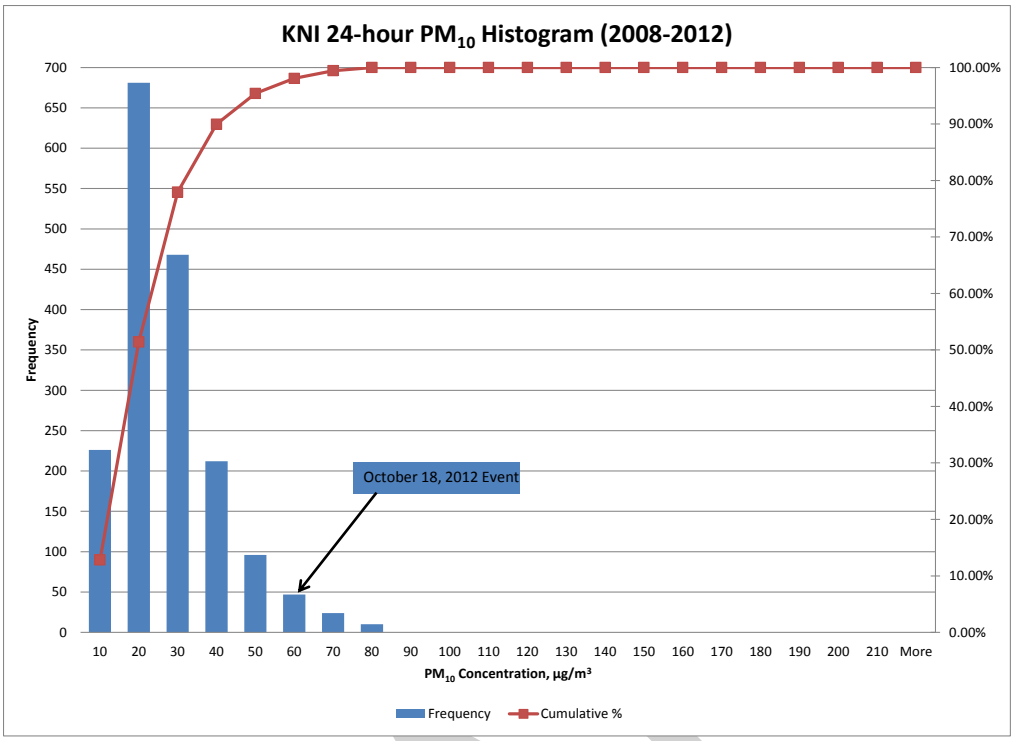

K-96 and Hydraulic 5-Year Historical Fluctuation - Daily Maximum Hourly Averages
PM10 Concentration (µg/m3)
Date
Feb. 28-29, 2012
Thunderstorm winds
No exceedance
Oct. 18, 2012
Dec. 31, 2011
Frontal winds
No exceedance
May 2, 2008
High Winds
No exceedance


K96 24-hour PM10 Histogram (2008-2012)
Frequency
PM10 Concentration, µg/m3
October 18, 2012 Event
Frequency
Cumulative %

15.3 KNI (Topeka)






KNI 24-hour PM10 Histogram (2008-2012)
Frequency
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
October 18, 2012 Event
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 More
PM10 Concentration, µg/m3
Frequency
Cumulative %