Burning Land

Photo by Chad Wittenberg

Broken records, strained resources, and 195,000 acres of burned Kansas land.

Every Spring a new season descends on the Fire Service of Kansas. Instead of green shoots growing towards the sun, this particular season is characterized by plumes of smoke drifting upwards from burning land. Last year may not have been the busiest year in history for vegetation fires, but it was #4, with 8,483 vegetation-related fires. Vegetation fires include grass fires, brush fires, crop fires, and mixtures of grass, brush, and crop. This does not include land management burns unless the burn became out of control. The current record is held by 2006 with 10,801 fires.

Flying embers, sparks, and ash continue to be the top cause of vegetation fires. Unattended children continue to start 6% of the fires. Storms are responsible for starting 8% of the fires, which is also a historically steady amount. Over 60% of the fires occur in the Northeast and South Central regions of Kansas. The Northwest region has had the lowest number of vegetation fires for over 14 years. Each year, more than 80% of vegetation fires do not have information regarding the type of material first ignited.

Opposite Page Top: El Dorado firefighters respond to grass fires. Vision is severely hampered by the heavy smoke across the road.

Opposite Page Bottom: El Dorado Fire Department personnel FF Caleb Fistler drives a brush truck with Capt. Tony Yaghjian as the nozzleman. Brush trucks are not just water-haulers, and can be instrumental in providing safe platforms and means of escape.

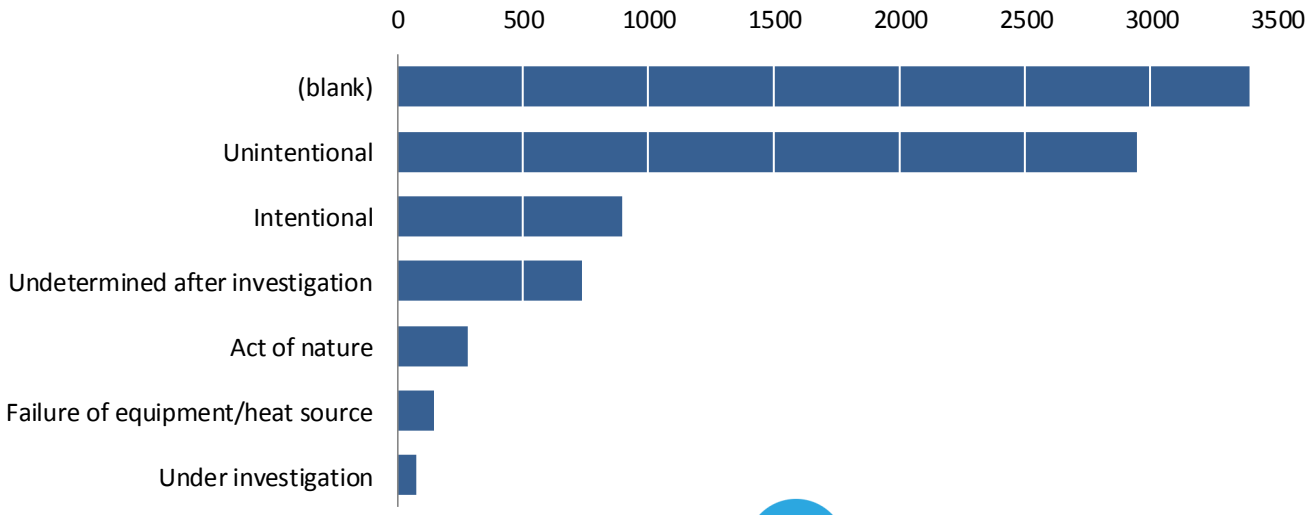
This page right: Wellsville Fire Department personnel work to extinguish a March brush/grass fire, dragging small diameter hose from a brush truck in addition to working with hand tools, turning the land for signs of fire.

Sunday became the frontrunner for busiest day of the week. Historically, Saturday has held that title. Many of the 2014 fires were rekindles of controlled grass fires. The controlled fire would be performed on Saturday without issue but hot embers would blow up the next day, requiring fire department intervention.

The hours from 2-4pm accounted for 40% of the vegetation fires. Since the KS Fire Service is estimated at 84% volunteer, this is a vulnerable time for the staffing regardless of call type. During 2014, there were 1,500 more fires that occurred during those hours than in 2013.

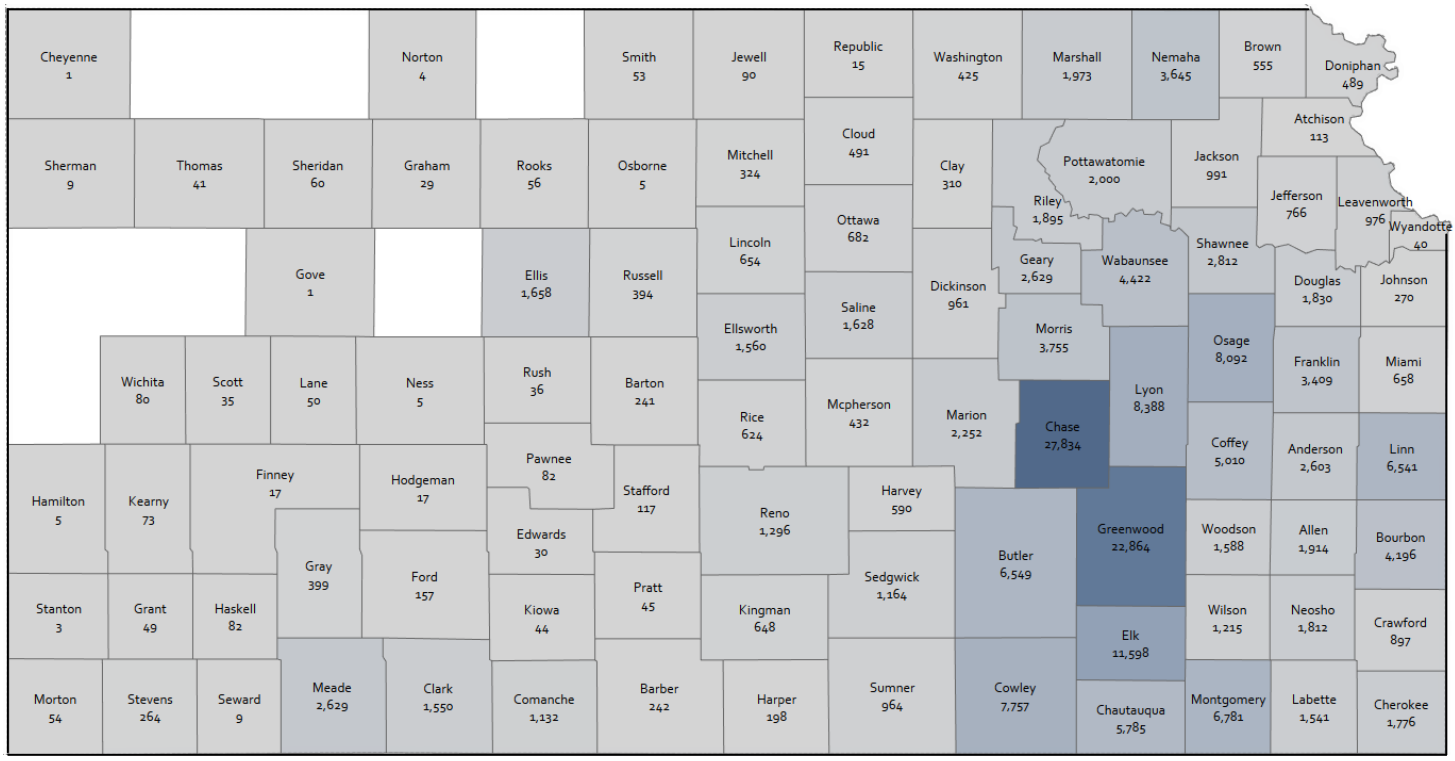
Fires caused specifically from open, outdoor fires saw a drastic increase, up from 231 to 816 vegetation fires. Outdoor fires could be controlled burns spreading embers, land owners burning piles of dead brush, and even recreational burn pits in backyards. Fires started by fireworks fell from 175 to 50. There were 896 vegetation fires marked as arson, however it is currently difficult to provide accurate numbers for arson. KFIRS defines the cause code of Intentional to mean arson and/or malicious intent but the cause code is often mistakenly applied to landowners setting a controlled burn unrelated to arson or malice.

Reported Cause Category for 2014 Vegetation Fires



Tweet us @KSFireMarshal to share a picture of your fire break or preparation prior to controlled burning!

2014 Total Acres Burned per County



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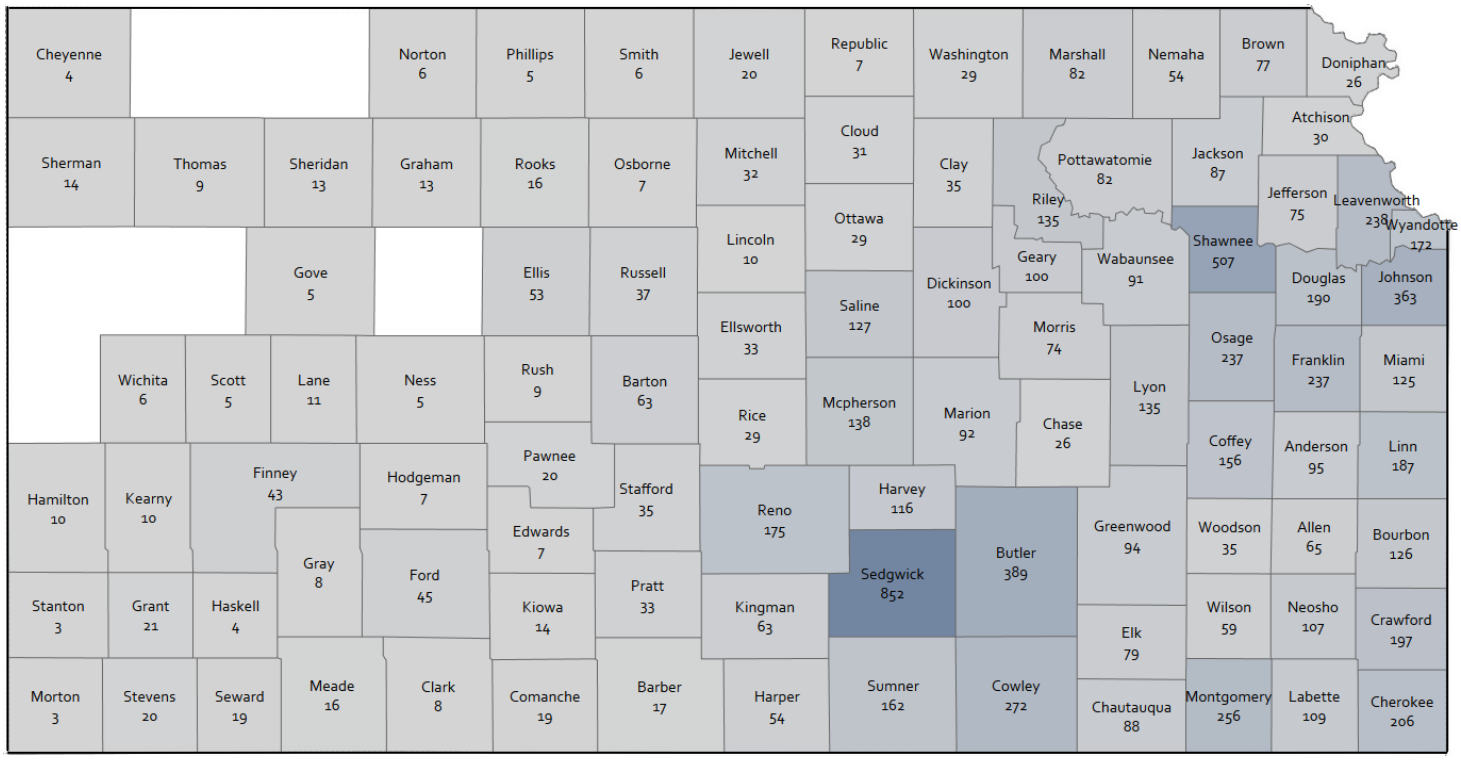


March fires the last 14 years

Year	Fires	Acres Burned	Aid Given	Vegetation Fires	Firefighter Injuries
2014	3,995	110,000	1,321	2,927	28
2013	1,081	3,526	252	502	8
2012	1,782	25,203	407	996	13
2011	1,878	68,063	495	1,142	8
2010	1,233	12,511	285	586	4
2009	2,346	27,567	675	1,430	13
2008	1,923	23,795	448	1,081	16
2007	2,130	12,364	480	1,215	13
2006	2,902	91,490	726	1,783	17
2005	2,734	48,095	701	1,730	22
2004	1,685	7,340	308	804	6
2003	1,837	21,468	368	917	9
2002	2,883	48,961	608	1,840	12
2001	1,556	2,928	254	684	22

Smashing Records

An aggressive fire season slammed the Fire Service during March, becoming the largest month in reported KFIRS history (1996-present). The previous record was held by July 2012 with 3,500 fires.

Of the nearly 4,000 reported March 2014 fires, 73% of all fires were vegetation related.

March wasn't just the highest in terms of sheer number of fires. It also became the biggest single month for burning acres with at least 110,000 total burned acres. That's roughly 172 square miles burned in a single month. For reference, Wyandotte County is 151 square miles. There were fewer acres burned in entire years: 2001 (22,590 acres), 2002 (108,270 acres), 2003 (74,675 acres), 2004 (46,758 acres), 2007 (42,735 acres), 2008 (90,839 acres), 2009 (80,701 acres), 2010 (64,849 acres), and 2013 (22,696 acres).

March accounted for the highest number of hours spent on fire calls with 5,810 hours, setting a new record in KFIRS for hours spent on fire calls during a single month. April 2006 previously held the record with 3,780 hours, fully 2,030 fewer hours.

In a perfect illustration of the strain on resources, the 1,500 acre fire pictured at left occurred on 3/30/2014 in Silver Lake (Shawnee County). A dozen fire departments responded to the fire, protecting structures. At one point, four additional fires burned unchecked with no available crews in Shawnee County left to respond. The Silver Lake fire rekindled the next day but was extinguished quickly. Aerial photo captured by Investigator Wally Roberts from the Office of the State Fire Marshal. [Note: the reports for this fire were not submitted to KFIRS. The acres and damage cannot be included in the State statistics. Total acres burned in the above left table are at least 1,500 acres too low, as are the total acres for Shawnee County in the map opposite.]

A Perfect Pairing

by Christopher "Chip" Redmond from Kansas State University Weather Data Library

What do you get when you add grass fire data to weather data? Answer: A beautiful marriage of information.

The Setup: Creating a tinderbox

To understand what happened in 2014, we have to go all the way back to 2012, which was the 15th driest year on record for Kansas. The drought continued into Spring and Summer 2013 which stunted the vegetation growth but by Winter 2013/2014, the remaining fine fuels were bone dry. Unfortunately, so were all the leftover now-dead 100/1,000 hour fuels which cured in the drought. Spring 2014 (Jan-May) continued the drought, leaving us with the second driest Spring on record with only 5.04 in of precipitation. The statewide Spring average is 9.61 in. Spring is traditionally the burning season, and Kansas wasn't ready for it.

Term	Description	Interesting Point to Know
Fuel Loading	Amount of fuel in an acre that could burn under extreme conditions	Remains constant on a yearly basis
Available Fuel	Amount of fuel in an acre that will burn under current conditions	Rapidly changes based on moisture and weather
Fine Fuel	Fuels that dry readily and are rapidly consumed by fire	Plants with rosins or waxes that can react the same way
1-hour fuel	Plants less than 0.25" in diameter	Rapidly loses moisture to the atmosphere
10-hour fuel	Plants in diameter from 0.25"-1"	Compacted/piled fuels take longer to dry out and ignite
100-hour fuel	Plants in diameter from 1"-3"	Flatter plants will dry out faster, even with thick
1,000 hour fuel	Plants in diameter from 3"-8"	Loosely arranged fuels will dry out faster

March & April 2014: High Impact Days

The Spring burning season is normally 61 days long. During 29 of those days, more than 1,000 acres were burned statewide each day. These high impact days stretched a nearly continuous period from March 9 to April 21. While several different weather patterns affected critical fire behavior development, the main driver of fire weather in 2014 were dry, cold frontal passages after a day or two of warm, drier air.

Left: A Mulvane Fire Department firefighter extinguishes a grass fire on 1/19/2014.

Right: Soldier Township Fire Department in Shawnee County uses heavy equipment to tear apart burning bales, ignited by a grass fire on 3/27/2014.

Misplaced Security

There were 31 high impact days during 2014 where more than 1,000 acres were burned in a single fire or statewide. All but six of these high impact days were associated with a cold front within 24 hour of the fire(s) starting. The majority of acres were burned within 24 hours of a frontal passage, but typically burned before the frontal passage was within 100 miles. This pattern indicates that land managers tried to burn controlled grass fires ahead of the front during optimal conditions, but the fires were not totally extinguished before the front passed. The passing cold fronts reignited or created new fires. Post-frontal conditions are typically dry with very breezy winds, further increasing the fire behavior.

Weather Environment	Description	High Impact Days	Total Fires	Total Acres Burned	Fire burning +1k acres
Frontal Passage	At/along frontal boundary	2	296	9,375	2
Pre-frontal	100 miles or less ahead of frontal boundary	6	836	36,231	10
Post-frontal	100 miles or less behind frontal boundary	4	331	15,661	6
No frontal boundary at time of fire	No frontal boundary within 100 miles but within 24 hours	13	1,545	72,546	12
No frontal boundary	No boundary within 24 hours before/after time of fire	6	703	22,785	2

April Showers Bring May Flowers

After a five day peak ending April 2, a strong storm system brought much needed rain to portions of Kansas. Widespread thunderstorms crossed much of the Flint Hills, and April 3rd brought some rain and snow for northwest Kansas which quieted fires. No significant fires occurred after April.

A second weather system briefly heightened the fire danger during April 9-12, but as the system matured, widespread storms developed across the Flint Hills again, leading to moisture recovery in grasses and other fine fuels. These two rains initiated a widespread green-up of vegetation. May was much calmer, possibly attributed to the green-up of vegetation and numerous Red Flag Warnings that prevented prescribed burning. Even dry, windy days remained relatively quiet.

3/20/2014: 17,000 acres up in smoke

Despite Red Flag Warnings, this day burned the most acres of any day, largely due to a single fire in Chase County burning 11,500 acres. Wichita recorded a temperature of 69F with a relative humidity of 10% and southerly winds at 15mph. The day was characterized by an active upper level pattern with a large trough over eastern US and an associated deepening surface low over the Great Lakes.

A strong cold front crossed the state two days prior, dragging an air mass of much cooler/drier air from western Canada. On the 20th, high pressure centered over Louisiana brought Southwest desert air into Kansas. A strengthening pressure gradient developed gusty southerly winds across eastern Kansas.

A **trough** is an elongated area of low atmospheric pressure that can occur either at the Earth's surface or at higher altitudes, commonly associated with cooler than normal temperatures.

Upper-level troughs influence many surface weather features, including the formation and movement of surface low pressure areas and the locations of clouds and precipitation.

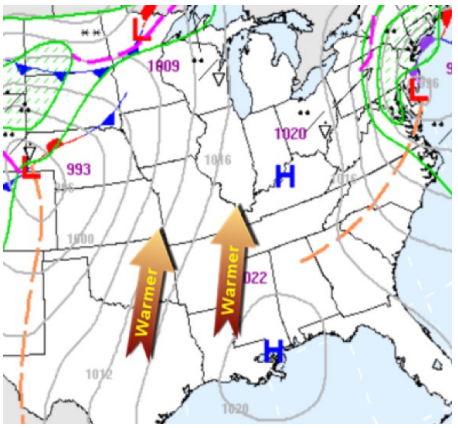
3/29/2014-3/30/2014: 1st and 2nd Busiest Days

The most wildfires of any day within 2014 occurred on the 29th with 310 fires. The 30th was the second busiest day with 308 fires. A 3,000 acre fire in Elk County occurred on the 29th. Greenwood and Coffey counties each had a fire over 1,000 acres on the 30th. Red Flag Warnings were issued for the 30th.

In a very similar scenario to 3/20/14, another strong trough and associated low cold front over the Great Lakes had crossed Kansas two days prior. This time the high pressure was oriented from east Texas, centered over Missouri, and moved northeastward into Quebec. This was once again helping to bring in dry air from the southwestern US into Kansas.

On the 30th, a second trough deepening across western US began ejecting over the Rockies with cyclogenesis occurring in the western Nebraska Panhandle. This developing low enhanced the pressure gradient across Kansas with high pressure still entrenched from Louisiana to Quebec, creating strong southerly winds across the southern Plains. Dry conditions combined with very warm temperatures 10-15F above normal, low relative humidity 15-20%, and south/southeasterly winds 20-25mph, fueling wildfires.

Warmer air movement 3/29/2014 from TX.



Cyclogenesis is the development or strengthening of cyclonic circulation in the atmosphere (a low pressure area).

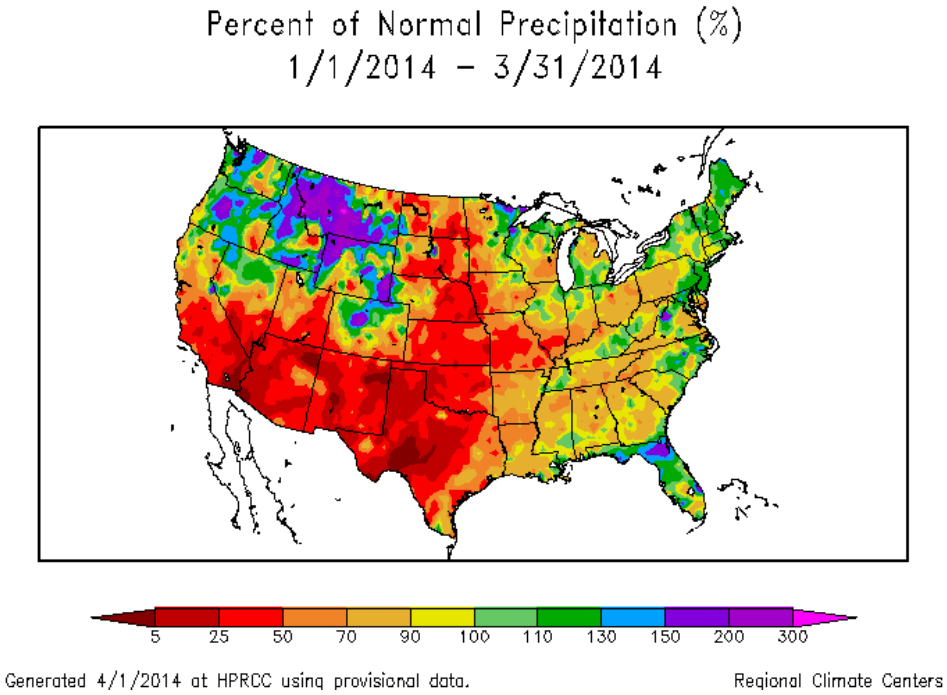
Pressure gradient is a physical quantity that describes which direction and at what rate the pressure changes the most rapidly around a particular location.

3/31/2014:4,528 acres in one county

Four 1,000+ acre fires occurred on this day. Two were located in Montgomery County, one in Coffey County, and another in Wabaunsee County.

The previous low pressure over the Nebraska Panhandle shifted northeastward deepening substantially as the trough strengthened and became negatively tilted. The associated cold front swept across Kansas during the day dropping temperatures and shifting winds out of the northwest at 20-25mph. These critical conditions were exemplified by low relative humidity in the middle teens as well as very poor overnight recovery preceding the event in the middle 50% range.

The atmosphere is most unstable with a **negatively tilted trough**. Cold air moves above warm air, creating stronger winds with increased chances for severe weather.



Early Winter 2014

Fires burning more than 1,000 acres occurred during March and April, with the exception of two occurring on January 26 and another on February 19. Prior to each fire, above-normal temperatures and low relative humidity led to a day or more of heating and drying fuels. Lower moisture is typical in winter across the Plains. Adding in the higher temperatures led to quickly drying fine fuels. Warmups typically only last one to two days before a cold front pushes through. Strong winds accompany the fronts, encouraging extreme fire behavior on January 26. However, the February 19 fire wasn't proceeded by a cold front. Instead, the event was characterized by abnormally strong southeasterly winds, more typical of early spring.

Conclusion

Weather data was analyzed for the area of the highest acre-to-fire ratio for each high impact day. Average conditions for all days with 1,000+ acres burned statewide were: temperature of 64F, relative humidity of 29%, and southerly winds of 12mph. These conditions do not meet criteria to issue a Red Flag Warning from the National Weather Service for eastern Kansas where the majority of high impact days occurred. This implies that suppressing wildland fires in Kansas grasslands is very difficult, even outside of Red Flag Warnings. Small scale influences like light winds could contribute to erratic and/or unpredictable fire movement. This is aided by the time of the year and cured, dead fuels available. Very dry conditions from the start of 2014 made containing any fire (planned or not) troublesome, even when prescribed fires were lit in optimal conditions.

Weather Environment	Days	Avg Wind (mph)	Avg Temp (F)	Avg Relative Humidity
Frontal passage	2	19.6	56	37%
Pre-frontal	6	11.8	70	36%
Post-frontal	4	13.9	70	19%
No frontal boundary at time of fire	13	11.3	71	28%
No frontal boundary	6	8.9	62	34%
NWS Red Flag Criteria (Topeka)		>15		<20%