1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over200

Source: The National Weather Service, www.spc.noaa.gov/faq/tornado/ef-scale.html

The wind speeds for the EF scale and damage descriptions are based on information on the NOAA Storm Prediction Center as listed in the table below. The damage descriptions are summaries. For the actual EF scale it is necessary to look up the damage indicator (type of structure damaged) and refer to the degrees of damage associated with that indicator. Information on the Enhanced Fujita Scale's damage indicators and degrees or damage is located online at www.spc.noaa.gov/efscale/ef-scale.html.

Table 3.35. Enhanced Fujita Scale with Potential Damage

Enhanced Fujita Scale			
Scale	Wind Speed(mph)	Relative Frequency	Potential Damage
EF0	65-85	53.5%	Light. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e. those that remain in open fields) are always rated EF 0).
EF1	86-110	31.6%	Moderate. Roofs severely stripped; mobile homes over turned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	10.7%	Considerable. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes complete destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165	3.4%	Severe. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown some distance.
EF4	166-200	0.7%	Devastating. Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200	<0.1%	Explosive. Strong frame houses levelled off foundations and swept away; automobile-sized missiles fly through the air in excess of 300ft.; steel reinforced concrete structure badly damaged; high rise buildings have significant structural deformation; incredible phenomena will occur.

Source: NOAA Storm Prediction Center, http://www.spc.noaa.gov/efscale/ef-scale.html

Enhanced weather forecasting has provided the ability to predict severe weather likely to produce tornadoes days in advance. Tornado watches can be delivered to those in the path of these storms several hours in advance. Lead time for actual tornado warnings is about 30 minutes.

Tornadoes have been known to change paths very rapidly, thus limiting the time in which to take shelter. Tornadoes may not be visible on the ground if they occur after sundown or due to blowing dust or driving rain and hail.

Previous Occurrences

The table below shows tornadoes recorded in the NCEI database for Lincoln County since 2000. Combined, these tornadoes accounted for $2,500,000.00 in losses for the planning area. The map, also below, shows recorded paths for Lincoln County tornadoes from 2000 to 2020.

There are limitations to the use of NCEI tornado data that must be noted. For example, one tornado may contain multiple segments as it moves geographically. A tornado that crosses a county line or state line is considered a separate segment for the purposes of reporting to the NCEI. Also, a tornado that lifts off the ground for less than 5 minutes or 2.5 miles is considered a separate segment. If the tornado lifts off the ground for greater than 5 minutes or 2.5 miles, it is considered a separate tornado. Tornadoes reported in Storm Data and the Storm Events Database are in segments.

Table 3.36. Recorded Tornadoes in Lincoln County, 2000-2020

Date	Beginning Location	Ending Location	Length (miles)	Width (yards)	EF Rating	Death	Injury	Property Damage ($)	Crop Damages
7/18/2000	Hwy 61 and Hwy 47	Troy	0.1	40	F0	0	0	0	0
7/18/2000	412 Weitkamp St	Moscow Mills	0.1	40	F0	0	0	0	0
6/13/2005	Moscow Mills	Moscow Mills	0.2	50	F0	0	0	0	0
3/13/2006	2SW Olney	3WNW Dameron	24	300	F3	0	6	2,500,000	0
3/13/2006	1E Millwood	1E Millwood	0.2	75	F1	0	0	0	0
10/2/2007	6 S SE Hawk Pt	5 S SE Hawk Pt	0.05	30	EF0	0	0	0	0
12/27/2008	1 SE Davis	1NW Hines	1.12	40	EF1	0	0	0	0
4/23/2010	1W Hawk Pt	1W Hawk Pt	0.21	20	EF0	0	0	0	0
4/23/2010	3 SW Silex	0W Millwood	0.11	10	EF0	0	0	0	0
4/23/2010	2 NNE Silex	2NNE Silex	0.14	10	EF0	0	0	0	0
1/29/2013	1 SW Chain of Rocks	1 NE Chain of Rocks	1.66	30	EF0	0	0	0	0
6/13/2015	2 WSE Hawk Pt	0N Hawk Pt	1.95	50	EF1	0	0	0	0
TOTAL	12 events					0	6	2,500,000	0

Source: National Climatic Data Center, http://www.ncdc.noaa.gov/stormevents/

The NCEI data above lists no crop damages associated with the recorded tornadoes since 2000.

Figure 3.25. Lincoln County historic tornado events

Lincoln County Tornadoes

ID	Date	Event Num	Time	Dead	Inj	F-Scale	Beg Coor	End Coor	County
43	MAR 14, 1953	1	17:00	0	1	1	39.22 -090.75	00.00 0	113
126	APR 23, 1955	14	17:30	0	0	1	39.07 -091.15	39.18 -091.12	113
263	MAY 27, 1955	24	15:00	0	0	1	39.12 -090.72	00.00 0	113
822	DEC 18, 1957	36	12:30	0	1	1	39.00 -091.25	00.00 0	113
477	JUN 24, 1962	16	11:48	0	0	0	38.93 -090.75	00.00 0	113
571	OCT 10, 1969	23	22:10	0	0	2	38.97 -090.98	38.98 -090.93	113
83	MAR 13, 1973	6	23:30	0	1	1	39.08 -091.17	39.10 -091.15	113
206	MAY 1, 1983	16	16:25	0	0	1	38.95 -090.92	00.00 0	113
265	APR 29, 1984	13	18:20	0	0	3	38.95 -090.92	39.02 -090.75	113
143	FEB 11, 1999	9	13:53	0	0	1	39.15 -090.98	39.23 -090.88	113
383	JLY 18, 2000	26	17:58	0	0	0	38.98 -090.98	38.98 -090.98	113
384	JLY 18, 2000	27	18:35	0	0	0	38.95 -090.92	38.95 -090.92	113
138	JUN 13, 2005	16	16:25	0	0	0	38.95 -090.92	38.95 -090.92	113
143	MAR 13, 2006	57	1:36	0	0	1	39.10 -091.08	39.10 -091.08	113
1000	OCT 2, 2007	32	18:18	0	0	0	38.90 -091.10	38.90 -091.10	113
1687	DEC 27, 2008		11:10	0	0	1	39.05 -091.01	39.06 -090.99	113
128	APR 23, 2010	8	18:29	0	0	0	38.97 -091.15	38.97 -091.15	113
131	APR 23, 2010	9	18:48	0	0	0	39.10 -091.11	39.10 -091.11	113
132	APR 23, 2010	10	19:14	0	0	0	39.16 -091.06	39.16 -091.06	113

Source: http://www.tornadoproject.com/alltorns/motorn.htm#list

Probability of Future Occurrence

There were 12 tornado events during the past 21 years. That makes the probability for a tornado in any one year 57%.

Changing Future Conditions Considerations

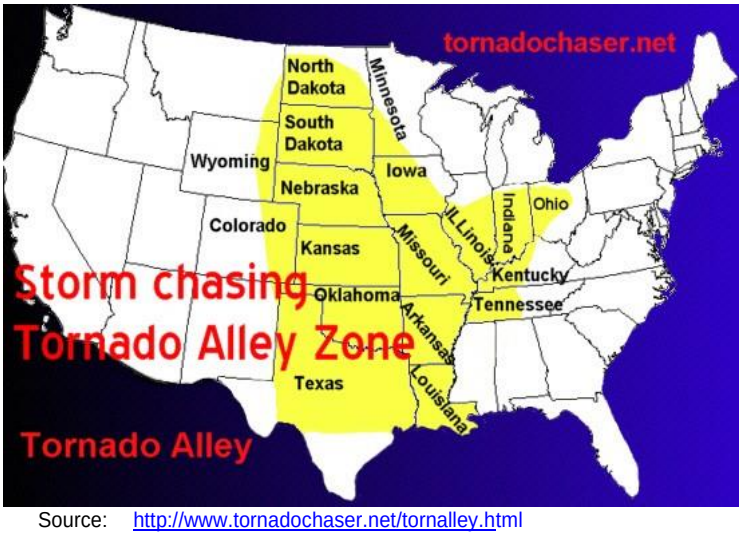
Scientists do not know how the frequency and severity of tornadoes will change. Research published in 2015 suggests that changes in heat and moisture content in the atmosphere, brought on by a warming world, could be playing a role in making tornado outbreaks more common and severe in the U.S. The research concluded that the number of days with large outbreaks have been increasing since the 1950s and that densely concentrated tornado outbreaks are on the rise. It is notable that the research shows that the area of tornado activity is not expanding, but rather the areas already subject to tornado activity are seeing the more densely packed tornadoes. Because Missouri experiences on average around 39.6 tornadoes a year, such research is closely followed by meteorologists in the state.

Vulnerability

Vulnerability Overview

Missouri's location in the central U.S. puts it squarely in the center of "Tornado Alley", an area of the country with high frequency of dangerous and destructive tornadoes.

Tornado Alley in the U.S.



Source: http://www.tornadochaser.net/tornalley.html

The method used to determine vulnerability to tornadoes across Missouri was statistical analysis of data from several sources: HAZUS building exposure value data, population density and mobile home data from the U.S. Census (2015 ACS), the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina, and storm events data (1950 to December 31, 2016) from the National Centers for Environmental Information (NCEI). It is important to realize that one limitation to the NCEI data is that many tornadoes that might have occurred in uninhabited areas, as well as some in inhabited areas, may not have been reported. The incompleteness of the data suggests that it is not appropriate for use in parametric modeling. In addition, NOAA data cannot show a realistic frequency distribution of different Fujita scale tornado events, except for recent years. Thus, a parametric model based on a combination of many physical aspects of the tornado to predict future expected losses was not used. The statistical model used for this analysis was probabilistic based purely on tornado frequency and historic losses. It is based on past experience and forecasts the expected results for the immediate or extended future.

From the statistical data collected, six factors were considered in determining overall vulnerability to tornadoes as follows: building exposure, population density, social vulnerability, percentage of mobile homes, likelihood of occurrence, and annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

Low
Low-medium
Medium
Medium-high
High

Table 3.37 Annualized Vulnerability for Tornadoes in Lincoln County

No. Tornadoes	Likelihood of Occurrence	Likelihood of Occurrence Rating	Total Annualized Property Loss	Total Annualized Property Loss Rating	Overall Vulnerability Rating	Overall Vulnerability Rating Description
Lincoln	24	0.358	$48,135	1	12	Low Medium

Source: 2018 Missouri State Hazard Mitigation Plan

Previous and Future Development

No significant increase in risk to the county from tornadoes is anticipated for Lincoln County due to its limited development opportunities.

Hazard Summary by Jurisdiction

Tornado events are likely to occur countywide; although statistics show that Hawk Point, Moscow Mills and Silex have been most affected by tornadoes in the past. No parts of the county are exempt from this hazard.

Problem Statement

Tornados occur in Lincoln County and they are completely random, striking at will wherever they please. The risk of a tornado is the same in any part of the county but the likelihood of death, injury, and damage is most likely in more developed parts of the county. Many residences within the county are without basements or safe rooms and few community safe rooms are available. Residents of the county could mitigate risk from tornadoes by installing sirens or other means of advanced warning and by providing personal and community safe rooms. An action plan has been included for Moscow Mills, Hawk Point and Fountain N Lakes to research and apply for tornado safe room funding.

3.4.10 Wild Fires

Hazard Profile

Hazard Description

The fire incident types for wildfires include: 1) natural vegetation fire, 2) outside rubbish fire, 3) special outside fire, and 4) cultivated vegetation, crop fire.

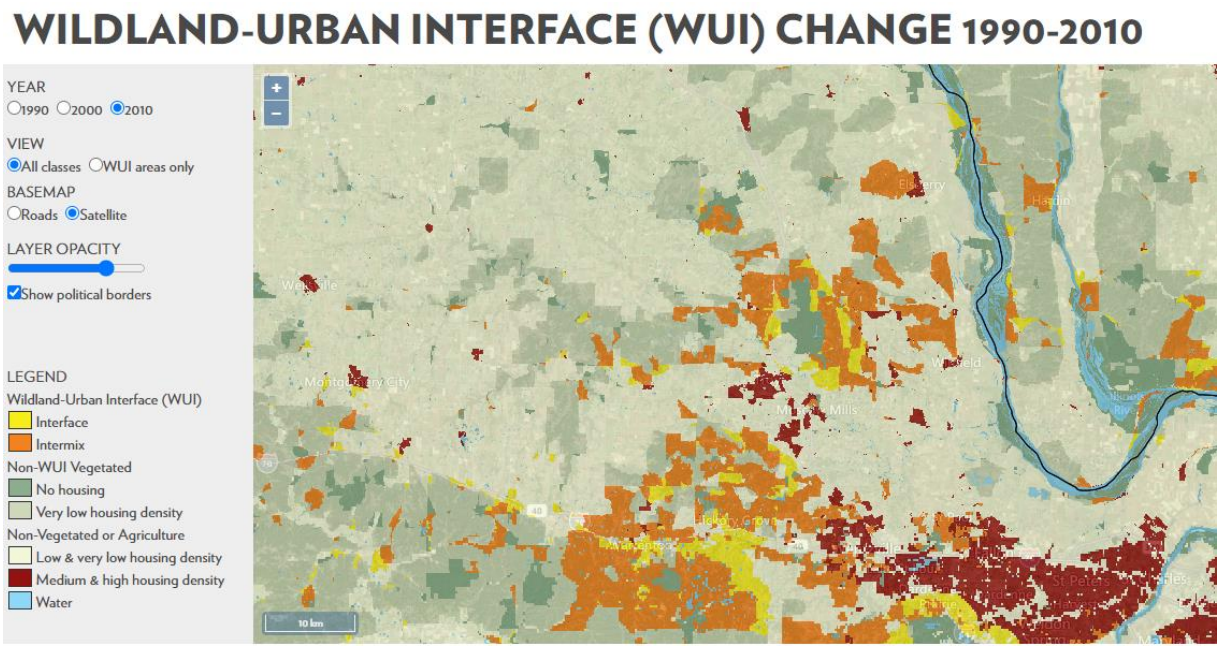
The Forestry Division of the Missouri Department of Conservation (MDC) is responsible for protecting privately owned and state-owned forests and grasslands from wildfires. To accomplish this task, eight forestry regions have been established in Missouri for fire suppression. The Forestry Division works closely with volunteer fire departments and federal partners to assist with fire suppression activities. Currently, more than 900 rural fire departments in Missouri have mutual aid agreements with the Forestry Division to obtain assistance in wildfire protection if needed.

Most of Missouri fires occur during the spring season between February and May. The length and severity of wildland fires depend largely on weather conditions. Spring in Missouri is usually characterized by low humidity and high winds. These conditions result in higher fire danger. In addition, due to the recent lack of moisture throughout many areas of the state, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper firefighting efforts, as decreasing water supplies may not prove adequate for firefighting. It is common for rural residents burn their garden spots, brush piles, and other areas in the spring. Some landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, spring months are the most dangerous for wildfires. The second most critical period of the year is fall. Depending on the weather conditions, a sizeable number of fires may occur between mid-October and late November.

Geographic Location

Damages due to wildfires would be higher in communities with more wildland–urban interface (WUI) areas. The term refers to the zone of transition between unoccupied land and human development and needs to be defined in the plan. Within the WUI, there are two specific areas identified: 1) Interface and 2) Intermix. The interface areas are those areas that abut wildland vegetation and the Intermix areas are those areas that intermingle with wildland areas. No community is more at risk than another.

Figure 3.26. Wild Land / Urban Interface of Lincoln County



Source: University of Wisconsin-Madison (SILVIS LAB)

Strength/Magnitude/Extent

Wildfires damage the environment, killing some plants and occasionally animals. Firefighters have been injured or killed, and structures can be damaged or destroyed. The loss of plants can

heighten the risk of soil erosion and landslides. Although Missouri wildfires are not the size and intensity of those in the Western United States, they could impact recreation and tourism in and near the fires.

Wildland fires in Missouri have been mostly a result of human activity rather than lightning or some other natural event. Wildfires in Missouri are usually surface fires, burning the dead leaves on the ground or dried grasses. They do sometimes "torch" or "crown" out in certain dense evergreen stands like eastern red cedar and shortleaf pine. However, Missouri does not have the extensive stands of evergreens found in the western US that fuel the large fire storms seen on television news stories.

While very unusual, crown fires can and do occur in Missouri native hardwood forests during prolonged periods of drought combined with extreme heat, low relative humidity, and high wind. Tornadoes, high winds, wet snow and ice storms in recent years have placed a large amount of woody material on the forest floor that causes wildfires to burn hotter and longer. These conditions also make it more difficult for fire fighters suppress fires safely.

Often wildfires in Missouri go unnoticed by the general public because the sensational fire behavior that captures the attention of television viewers is rare in the state. Yet, from the standpoint of destroying homes and other property, Missouri wildfires can be quite destructive.

No information is available for the planning area that connects damages from wildfires to associated structural fires.

Previous Occurrences

The following table captures wildfires reported to the Missouri Department of Natural Resources for Lincoln County inclusive of January 2002 through December 2020. Data was not available prior to 2002.

Table 3.38. Lincoln County Wildfires, 2002-2020

Cause	Number of Incidents	Acres Burned
Arson	8	21
Campfire	6	19.25
Children	8	8.15
Debris	247	935
Equipment	26	539
Fireworks	0	0
Lightning	3	3
Miscellaneous	36	257
Not Reported	3	1
Railroad	1	0
Powerline	2	0.02
Smoking	20	51.5
Unknown	198	971

TOTAL	**558**	**2,805.92**

Source: Missouri Department of Natural Resources, Fire Reporting, December 2020

No wildfire events were reported by school districts.

Probability of Future Occurrence

There were 558 wildfire events reported over a 19-year period for an average of 30 fire events per year. However, during the same reporting period, no damage to structures occurred, leading us to conclude that damage to structures from wildfires, while possible, is unlikely.

Changing Future Conditions Considerations

Higher temperatures and changes in rainfall are unlikely to substantially reduce forest cover in Missouri, although the composition of trees in the forests may change. More droughts would reduce forest productivity, and changing future conditions are also likely to increase the damage from insects and diseases. But longer growing seasons and increased carbon dioxide concentrations could more than offset the losses from those factors. Forests cover about one-third of the state, dominated by oak and hickory trees. As the climate changes, the abundance of pines in Missouri's forests is likely to increase, while the population of hickory trees is likely to decrease 0.
Higher temperatures will also reduce the number of days prescribed burning can be performed. Reduction of prescribed burning will allow for growth of understory vegetation – providing fuel for destructive wildfires. Drought is also anticipated to increase in frequency and intensity during summer months under projected future scenarios. Drought can lead to dead or dying vegetation and landscaping material close to structures which creates fodder for wildfires within both the urban and rural settings.

Vulnerability

Vulnerability Overview

With over 14 million acres, Missouri ranks seventh in the northeast region of the U.S. in forest land area. Although the National Fire Incident Reporting System does capture data on wildfires, it was determined that the Department of Conservation historical wildfire data was the best resource. The Department of Conservation data has more individual events recorded per county. Therefore, this data appeared to be more comprehensive. Some fire departments report to both data sets. So, adding the two sets of data together would have double-counted fires. From the Department of Conservation wildfire data from 1993 to 2016, it was determined that the average annual number of wildfires in Missouri was 3,209 burning an average annual 52,099 acres.

The table below was taken from the 2018 State Plan. The method used to determine vulnerability to wildfires fires across Missouri was a GIS comparative analysis of wildland urban interface and intermix (WUI) areas against building exposure data to determine the types, numbers, and estimated values of buildings at risk to wildfire. This GIS-based analysis utilized data from several sources: the Missouri Spatial Data Inventory Service (MSDIS), HAZUS building exposure value data, and wildland urban interface and intermix area data from the University of Wisconsin-Madison SILVIS Lab.

To calculate estimated values of buildings at risk, buildings values available in the HAZUS census

block data were used to determine an average value for each property type. This average value per property type was then applied to the number of structures in the WUI areas, by type, to calculate an overall estimated value of buildings at risk by type. In addition to counts and values of structures at risk, an estimated population impacted for each county was calculated based on the number of residential properties in the WUI areas multiplied by the average household size.

Table 3.39 Wildfire Vulnerability of Lincoln County, 2018 State Plan

County	Number of Structures	Value of Structures	Population
Lincoln	**8,185**	**$1,293,611,285**	**14,375**
Agriculture	2,999	$8,078,126	
Commercial	40	$63,585,052	
Education	2	$1,189,542	
Government	1	$1,374,650	
Industrial	9	$49,187,077	
Residential	5,134	$1,170,196,838	

Source: 2018 Missouri State Plan

Impact of Previous and Future Development

There is significant growth in unincorporated areas of the county, City of Troy, Moscow Mills, Winfield and Elsberry increasing the exposure to wild fire damage. However, as stated earlier, the risk is low now and does not promise to increase significantly in the near term.

Hazard Summary by Jurisdiction

There is significant growth in unincorporated areas of the county, City of Troy, Moscow Mills, Winfield and Elsberry increasing the exposure to wild fire damage. The new building permit data is provided under future land use & development section on page 3.18.

Problem Statement

Wildfires in Lincoln County are frequent and numerous; however, damage is slight and limited to crop land and pastures. Jurisdictions concerned about wildfires spreading into their built environment should review their land use code and/or local ordinances to address density and quantity of development within the WUI area, as well as, emergency access, landscaping and water supply.

3.4.11 Winter Weather / Snow / Ice / Severe Cold

Hazard Profile

Hazard Description

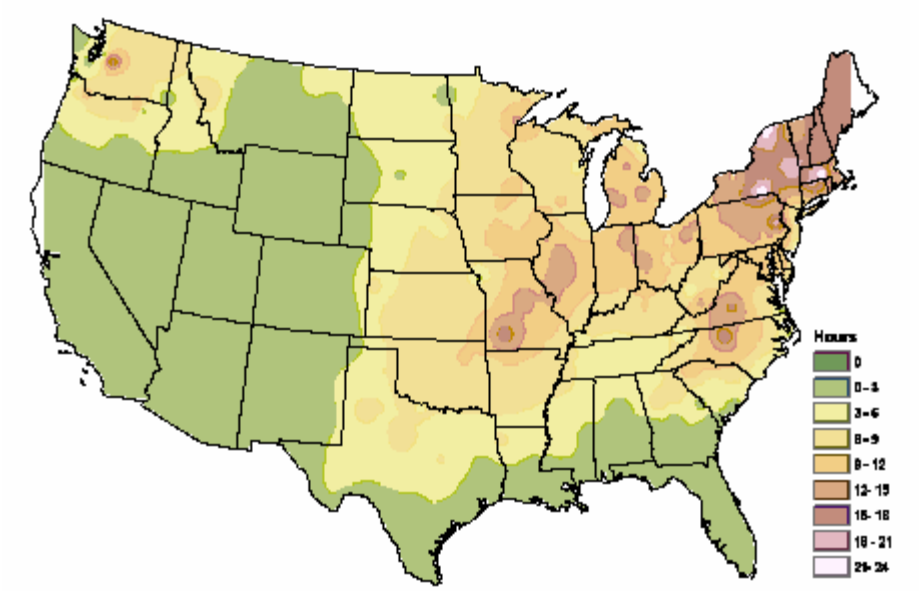
A major winter storm can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. The National Weather Service describes different types of winter storm events as follows.

- Blizzard—Winds of 35 miles per hour or more with snow and blowing snow reducing visibility to less than ¼ mile for at least three hours.
- Blowing Snow—Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- Snow Squalls—Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- Snow Showers—Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- Freezing Rain—Measurable rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces, such as trees, cars, and roads, forming a coating or glaze of ice. Most freezing-rain events are short lived and occur near sunrise between the months of December and March.
- Sleet—Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects.

Geographic Location

The entire county is vulnerable to heavy snow, ice, extreme cold temperatures and freezing rain. The figure below shows the county within the area of a circle that receives 12-18 hours of freezing rain per year.

Table 3.39. NWS Statewide Average Number of Hours per Year with Freezing Rain



Source: American Meteorological Society. “Freezing Rain Events in the United States.” http://ams.confex.com/ams/pdfpapers/71872.pdf

Strength/Magnitude/Extent

Severe winter storms include heavy snowfall, ice, and strong winds which can push the wind chill well below zero degrees in the planning area. For severe weather conditions, the National Weather Service issues some or all of the following products as conditions warrant across the State of Missouri. NWS local offices in Missouri may collaborate with local partners to determine when an alert should be issued for a local area.

Winter Weather Advisory — Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. Often the greatest hazard is to motorists.

Winter Storm Watch — Severe winter conditions, such as heavy snow and/or ice are possible within the next day or two.

Winter Storm Warning — Severe winter conditions have begun or are about to begin.

Blizzard Warning — Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.

Ice Storm Warning -- Dangerous accumulations of ice are expected with generally over one quarter inch of ice on exposed surfaces. Travel is impacted, and widespread downed trees and power lines often result.

Wind Chill Advisory -- Combination of low temperatures and strong winds will result in wind chill readings of -20 degrees F or lower.

Wind Chill Warning -- Wind chill temperatures of -35 degrees F or lower are expected. This is a life-threatening situation.

Previous Occurrences

The table shows NCEI reported events and damages in Lincoln County for the past 21 years.

Table 3.40. NCDC Lincoln County Winter Weather Events Summary, 2000 - 2020

Type of Event	Inclusive Dates	Magnitude	# of Injuries	Property Damages	Crop Damages
Winter Storm	1/28/2000-1/29/2000	NA	0	$ 0	$ 0
Winter Storm	3/11/2000-3/11/2000	NA	0	$ 0	$ 0
Heavy Snow	12/13/2000	NA	0	$ 0	$ 0
Winter Storm	1/26/2001-1/26/2001	NA	0	$ 0	$ 0
Winter Storm	2/25/2002-2/25/2002	NA	0	$ 0	$ 0
Winter Storm	3/2/2002-3/2/2002	NA	0	$ 0	$ 0
Winter Storm	3/25/2002-3/26/2002	NA	0	$ 0	$ 0
Winter Storm	12/24/2002-12/24/2002	NA	0	$ 0	$ 0
Winter Storm	1/1/2003-1/2/2003	NA	0	$ 0	$ 0
Winter Storm	2/23/2003-2/23/2004	NA	0	$ 0	$ 0
Winter Storm	12/13/203-12/13/2003	NA	0	$ 0	$ 0
Winter Storm	1/25/2004-1/25/2004	NA	0	$ 0	$ 0
Winter Storm	11/24/2004-11/24/2004	NA	0	$ 0	$ 0
Winter Storm	12/8/2005-12/8/2005	NA	0	$ 0	$ 0
Winter Storm	11/30/2006-11/30/2006	NA	0	$ 0	$ 0
Winter Storm	12/1/2006-12/1/2006	NA	0	$ 0	$ 0
Ice Storm	1/12/2007-1/14/2007	NA	0	$ 0	$ 0
Winter Weather	12/6/2007-12/6/2007	NA	0	$ 0	$ 0
Ice Storm	12/8/2007-12/12-2007	NA	0	$ 0	$ 0
Heavy Snow	12/15/2007-12/15/2007	NA	0	$ 0	$ 0
Heavy Snow	12/15/2007-12/15/2007	NA	0	$ 0	$ 0
Heavy Snow	2/1/2008-2/1/2008	NA	0	$ 0	$ 0
Cold/Wind Chill	1/1/2010-1/12/2010	NA	0	$ 0	$ 0
Winter Weather	1/6/2010-1/7/2010	NA	0	$ 0	$ 0
Heavy Snow	1/19/2011-1/20/2011	NA	0	$ 0	$ 0
Winter Storm	1/31/2011-1/31/2011	NA	0	$ 0	$ 0

Type of Event	Inclusive Dates	Magnitude	# of Injuries	Property Damages	Crop Damages
Winter Storm	2/1/2011-2/1/2011	NA	0	$ 0	$ 0
Blizzard	2/1/2011-2/2/2011	NA	0	$ 0	$ 0
Winter Storm	2/21/2013-2/21/2013	NA	0	$ 0	$ 0
Heavy Snow	3/24/2013-3/24/2013	NA	0	$ 0	$ 0
Winter Storm	1/5/2014-1/5/2014	NA	0	$ 0	$ 0
Cold/Wind Chill	1/6/2014-1/6/2014	NA	0	$ 0	$ 0
Winter Storm	2/4/2014-2/5/2014	NA	0	$ 0	$ 0
Heavy Snow	12/15/2015-12/16/2015	NA	0	$ 0	$ 0
Heavy Snow	11/15/2018-11/15/2018	NA	0	$ 0	$ 0
Heavy Snow	1/11/2019-1/13/2019	NA	0	$ 0	$ 0
Winter Storm	12/15/2019-12/15/2019				
TOTAL	37 events	NA	0	$ 0	$ 0

Table 3.41. Presidential Declarations, Lincoln County Severe Winter Storms, 2000 - 2020

The table below lists Presidential Declared Severe Winter Storms that included the planning area. Note that the declaration dates will not coincide with the dates of the disasters.

Declaration Date	Description	Declaration Type	Disaster No.
December 29, 2006	Severe Winter Storm	Presidential	1673-DR
January 14, 2007	Severe Winter Storm	Presidential	1676-DR
December 12, 2007	Severe Winter Storm	Presidential	3281-DR
December 27, 2007	Severe Winter Storm	Presidential	1736-DR
January 30, 2009	Severe Winter Storm	Presidential	3303-DR
February 17, 2009	Severe Winter Storm	Presidential	1822-DR
January 31, 2011	Severe Winter Storm and Snowstorm	Presidential	1961-DR

Source: FEMA Declared Disasters

Winter weather, in the form of ice, sleet, freezing rain, and freezing temperatures can extract a toll on crop production in the planning area. The table below shows the USDA's Risk Management Agency payments for insured crop losses in the planning area as a result of freezing temperatures and cold winter conditions for the past 21 years. No losses due to ice, sleet, freezing rain, or snow were reported.

Table 3.42. Crop Insurance Claims Paid in Lincoln County as a Result of Cold Conditions, 2000 – 2020

Crop Year	Acres	Dollars
2000	0.00	0.00
2001	110.57	4,990.00
2002	0.00	0.00
2003	180.00	20,160.00
2004	0.00	0.00
2005	8.60	159.00
2006	0.00	0.00
2007	242.50	10,694.00
2008	0.00	0.00
2009	104.09	14,158.00
2010	0.00	0.00
2011	344.15	142,160.55
2012	138.90	18,846.00
2013	0.00	0.00
2014	485.55	69,328.00
2015	0.00	0.00
2016	0.00	0.00
2017	0.00	0.00

Crop Year	Acres	Dollars
2018	100.15	6,078.00
2019	17.07	58.14
2020	0.00	0.00
TOTAL	1,731.58	286,631.69

Source: USDA Risk Management Agency, https://www.rma.usda.gov/data/cause

Probability of Future Occurrence

Lincoln County experienced harsh winter weather that resulted in crop losses during 10 of the past 21 years. From this data, we can calculate the annual probability of winter weather crop losses as 47%, or an average of .47 events per year.

Changing Future Conditions Considerations

According to the 2018 State Plan, a shorter overall winter season and fewer days of extreme cold may have both positive and negative indirect impacts. Warmer winter temperatures may result in changing distributions of native plant and animal species and/or an increase in pests and non-native species. Warmer winter temperatures will result in a reduction of lake ice cover. Reduced lake ice cover impacts aquatic ecosystems by raising water temperatures. Water temperature is linked to dissolved oxygen levels and many other environmental parameters that affect fish, plant, and other animal populations. A lack of ice cover also leaves lakes exposed to wind and evaporation during a time of year when they are normally protected. As both temperature and precipitation increase during the winter months, freezing rain will be more likely. Additional wintertime precipitation in any form will contribute to saturation and increase the risk and/or severity of spring flooding. A greater proportion of wintertime precipitation may fall as rain rather than snow.

Vulnerability

Vulnerability Overview

Heavy snow can bring a community to a standstill by inhibiting transportation (in whiteout conditions), weighing down utility lines, and by causing structural collapse in buildings not designed to withstand the weight of the snow. Repair and snow removal costs can be significant. Ice buildup can collapse utility lines and communication towers, as well as make transportation difficult and hazardous. Ice can also become a problem on roadways if the air temperature is high enough that precipitation falls as freezing rain rather than snow.

Buildings with overhanging tree limbs are more vulnerable to damage during winter storms when limbs fall. Businesses experience loss of income as a result of closure during power outages. In general heavy winter storms increase wear and tear on roadways though the cost of such damages is difficult to determine. Businesses can experience loss of income as a result of closure during winter storms.

Overhead power lines and infrastructure are also vulnerable to damages from winter storms. In particular ice accumulation during winter storm events damage to power lines due to the ice weight on the lines and equipment. Damages also occur to lines and equipment from falling trees and tree limbs weighted down by ice. Potential losses could include cost of repair or replacement of damaged facilities, and lost economic opportunities for businesses.

Secondary effects from loss of power could include burst water pipes in homes without electricity during winter storms. Public safety hazards include risk of electrocution from downed power lines. Specific amounts of estimated losses are not available due to the complexity and multiple variables associated with this hazard. Standard values for loss of service for utilities reported in FEMA's 2009 BCA Reference Guide, the economic impact as a result of loss of power is $126 per person per day of lost service.

The method the state used to determine vulnerability to severe winter weather across Missouri was statistical analysis of data from several sources: National Centers for Environmental Information (NCEI) storm events data (1996 to December 31, 2016), HAZUS Building Exposure Value data, housing density data from the U.S. Census (2015 ACS), and the calculated Social Vulnerability Index for Missouri Counties from the Hazards and Vulnerability Research Institute in the Department of Geography at the University of South Carolina.

From the statistical data collected, five factors were considered in determining overall vulnerability to severe winter weather as follows: housing density, building exposure, social vulnerability, likelihood of occurrence, and average annual property loss. Based on natural breaks in the statistical data, a rating value of 1 through 5 was assigned to each factor. These rating values correspond to the following descriptive terms:

1) Low
2) Low-medium
3) Medium
4) Medium-high
5) High

To determine potential financial loss estimates to severe winter weather in Missouri, the available historical property loss data was annualized. In the case of frequently occurring weather-related hazards such as severe winter weather, annualized historical loss data is considered to be the best resource for determining future potential losses. As discussed above in the vulnerability overview for this hazard, the planning team obtained historical loss data from the NCEI Storm Event Database for Blizzard, Heavy Storm Ice Storm, Winter Storm and Winter Weather for the period from 1996 to December 2016. The 2018 State Plan gives Lincoln County an Overall Vulnerability Rating of "Low Medium" and estimates the annualized property loss to be $286.

Table 3.43 Annualized Winter Weather Property Loss for Lincoln County

Annualized Blizzard Property Loss ($)	Annualized Heavy Snow Property Loss ($)	Annualized Ice Storm Property Loss ($)	Annualized Winter Storm Property Loss ($)	Annualized Winter Weather Property Loss ($)	Total Annualized Winter Weather Property Loss ($)
$0	$0	$0	$0	$0	$0

Source: 2018 Missouri State Hazard Mitigation Plan

Potential Losses to Existing Development

Annual crop losses due to winter weather have averaged $13,649 per year for the past 21 years. As per the State Plan, the annual loss is $0. There is no reason to doubt an average annual

winter weather loss to Lincoln County of around $13,000.

Previous and Future Development

The not so fast pace development forecast for Lincoln County will not impact future losses.

Hazard Summary by Jurisdiction

All areas of the planning area are at equal risk. All public schools serving Lincoln County have temperature controlled classrooms. Each school has a process for early dismissal due to severe winter weather. All nursing homes are temperature controlled.

Problem Statement

Severe winter weather is a risk for Lincoln County. However, historical trends do not indicate a significant risk to life or property. Exercise of good judgement will yield the best results at the lowest costs. It will be helpful for communities to have generators in case of power outages during severe winter weather events and to update the list of special needs vulnerable populations.

3.4.12 Hazardous Materials Release (Fixed Facility and Transportation Accidents)

Hazard Profile

A hazardous material is any substance or material in a quantity or form that may pose a reasonable risk to health, the environment, or property. The category of hazardous materials release includes incidents involving substances such as toxic chemicals, fuels, nuclear wastes and/or products, and other radiological and biological or chemical agents. For the purposes of this analysis, only accidental or incidental releases of hazardous materials from two different kinds of incidents are addressed: fixed facility and transportation- related accidents. In consideration of recent worldwide and national events, incidents involving terrorism or national attacks, which involve hazardous materials of any type, are addressed in Section 2.1 CBRNE Attack, Section 3.5.2 Terrorism, and Section 2.8 Special Events.

Hazardous Materials Fixed-Facility Accident

Generally, with a fixed facility, the hazards are pre-identified. The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 requires industries to report on the storage, use and releases of hazardous substances to federal, state, and local governments. Facilities in Missouri must submit an emergency and hazardous chemical inventory form to the Missouri Emergency Response Commission, their Local Emergency Planning Committee (LEPC), and local fire departments annually. The inventory forms require basic facility identification information, employee contact information for both emergencies and non- emergencies, and information about chemicals stored or used at the facility.

Hazardous Materials Transportation Accidents

Transportation accidents address the transport of hazardous materials by rail, road, water, pipeline, and air. In these events, the exact location of a hazardous materials accident is not possible to predict. The close proximity of railroads, highways, waterways, pipelines, airports, and industrial facilities to populated areas, schools, and businesses could put a large number of individuals in danger at any time. In addition, essential service facilities, such as police and fire stations, hospitals, nursing homes, and schools near major transportation routes in the State are also at risk from potential hazardous materials transportation incidents.

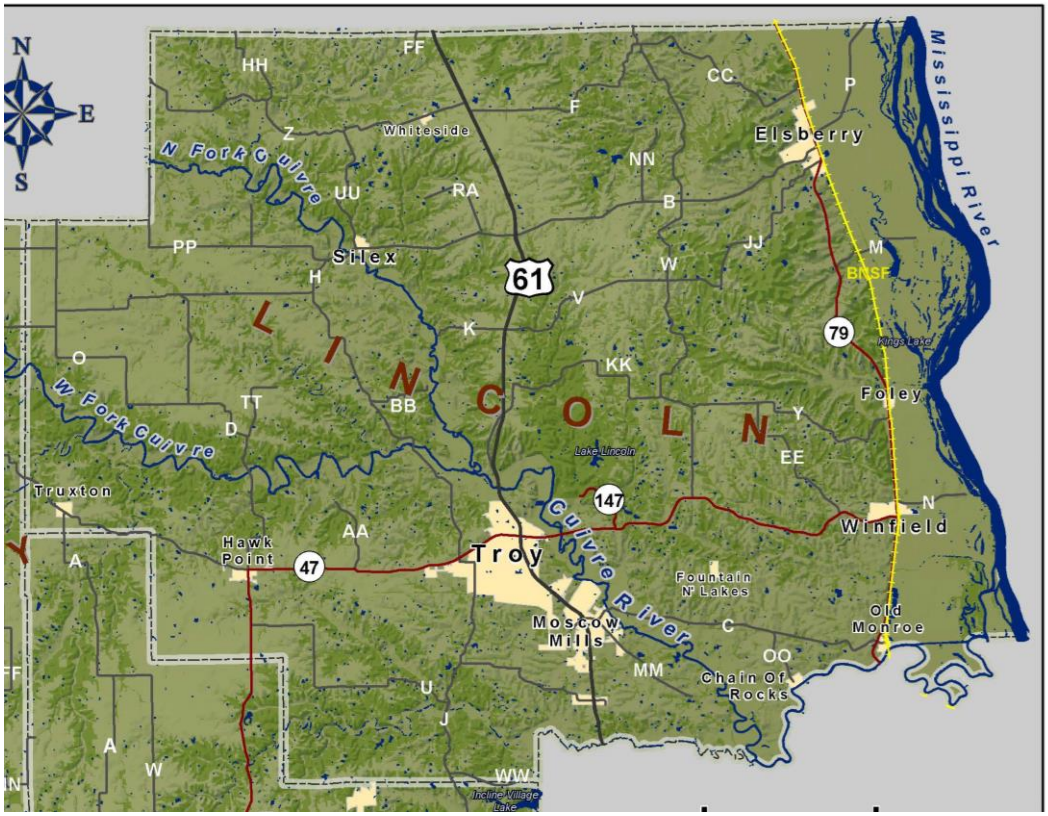
Pipelines

Pipelines in Missouri include both large-diameter lines carrying energy products to population centers, as well as small-diameter lines delivering natural gas to local businesses and residences. For the purposes of hazardous materials incidents, pipeline transport focuses on hazardous liquids, including crude oil, petroleum products, anhydrous ammonia and carbon dioxide. Within Missouri, there are approximately 1,847 miles of pipeline carrying crude oil, 1,372 miles of pipeline carrying highly volatile liquids, flammables, and toxic liquids; and 1,913 miles of pipeline carrying refined petroleum products.

Geographic Location

Hazardous materials releases can occur anywhere in Lincoln County. However, the highest probability will be near major highways, railroads, pipelines, and fixed Tier II facilities. The first map below identifies the major transportation routes in the planning area and the second map shows major pipelines. As per the State Plan, there are 88 Tier II facilities out of which 24 facilities store extremely hazardous substances.

Figure 3.27. Major Transportation Routes in Lincoln County



Source: Boonslick RPC