STANDARD HAZARD MITIGATION PLAN

FOR

THE GREAT STATE OF OKLAHOMA

January 2024

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Appendix A: State Critical Facility Risk Assessment

SECTION 1: INTRODUCTION

1.1 PLAN PURPOSE AND SCOPE

The National Preparedness Goal of the Federal Emergency Management Agency (FEMA) consists of five mission areas: Prevention, Protection, Mitigation, Response, and Recovery. The first core capability of Mitigation is planning. This document is the 2024 update of the 2019 Standard Hazard Mitigation Plan for the Great State of Oklahoma and will be referred to as "the State Plan." The purpose of the State Plan is to reduce the risks from natural hazards and to assist decision makers as they allocate resources towards reducing the effects of natural hazards. In addition, the State Plan fulfills the Federal requirement for Oklahoma to be eligible to receive the following FEMA assistance:

- Hazard Mitigation Grant Program (HMGP)
- Building Resilient Infrastructure and Communities (BRIC)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Fire Mitigation Assistance Grants-Post Fire Mitigation (FMAG-PF)
- Public Assistance Category C-G

The scope of this plan is statewide, encompassing seventy-seven counties and thirty-eight Federal and State Recognized tribes. To make this plan a useful document with comprehensive analysis, the hazards and risks will be discussed within the framework of the five Oklahoma Department of Emergency Management and Homeland Security (ODEMHS) Regional Areas depicted below.

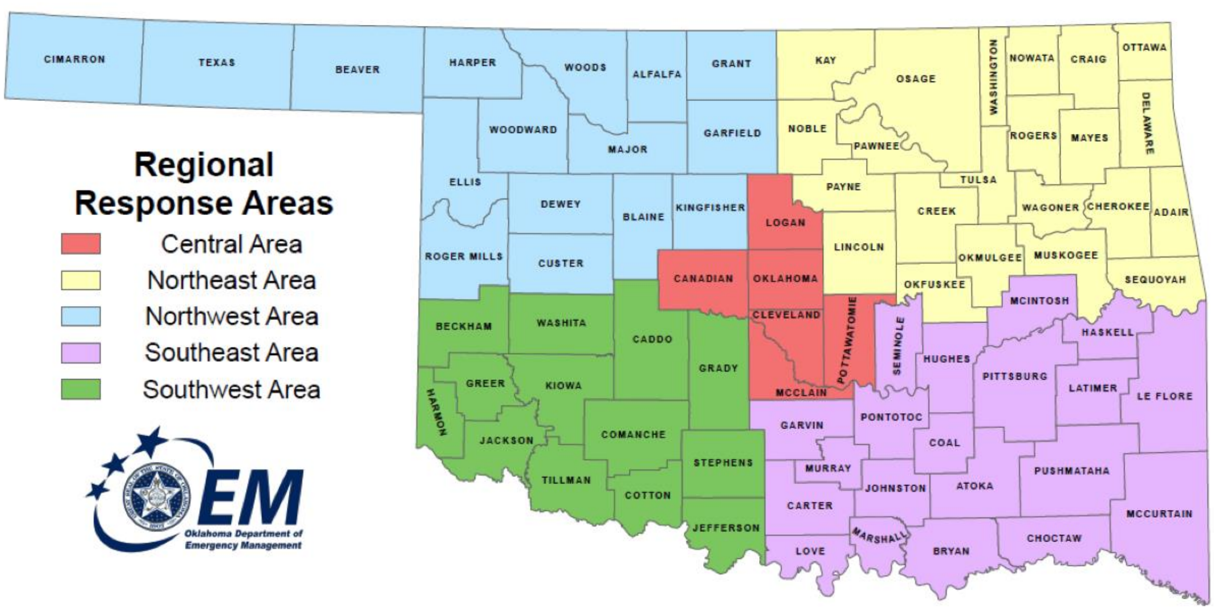


Figure 1: ODEMHS Regional Response Areas

Oklahoma was the 46th state to become part of the United States of America on November 16, 1907. The word Oklahoma is derived from two Choctaw words: *okla*, "people", and *humma*, "red". Located in the south-central region of the United States, Oklahoma is home to diverse land regions including ancient mountain ranges and eastern forests, as well as historically diverse cultures including Native American tribes and western settlers. There are currently twenty-five Native American languages still spoken in Oklahoma.

1.2 GEOGRAPHY

The Ouachita Mountains dominate southeast Oklahoma, with peaks rising as much as 2,000 feet above their base. Extreme east-central Oklahoma features the mountains of the Arkansas River Valley, rising several hundred feet above the plains. Extreme northeastern counties are part of the Ozark Plateau, marked by steep, rocky river valleys between large areas of hills and rolling plains. The western tip of the panhandle is part of the fractured terrain of the Black Mesa complex (*Figure 2)*.

Oklahoma lies entirely within the drainage basin of the Mississippi River. The two main rivers in the state are the Arkansas River, draining the northern two-thirds of the state, and the Red River, which drains the southern third and is the state's southern border. Principal tributaries of the Arkansas are the Verdigris, Grand (Neosho), Illinois, Cimarron, Canadian and North Canadian. The Washita and Kiamichi are the Red's principal tributaries in Oklahoma, and the Little River flows into the Red after it crosses into Arkansas.

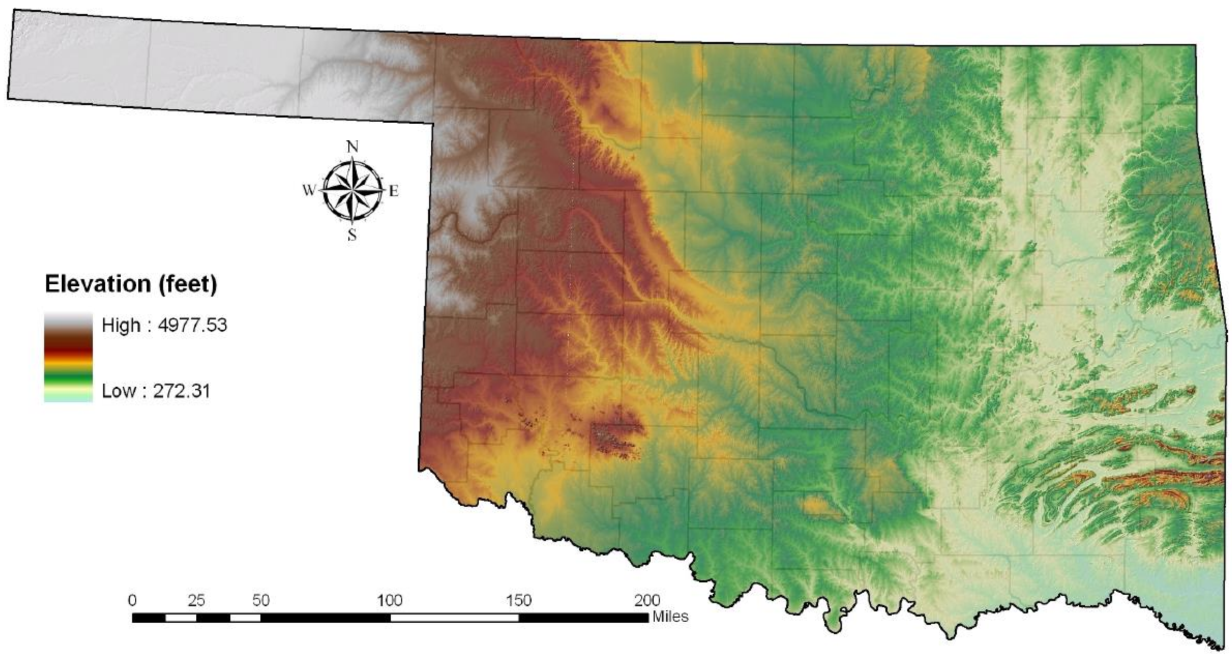


Figure 2: Elevation (in feet) above mean sea level across Oklahoma. Source: OCS.

1.3 CLIMATE

According to the Koppen climate classification, Oklahoma's climate ranges from humid subtropical in the east to semi-arid in the west. Warm, moist air moving northward from the Gulf of Mexico often exerts much influence, particularly over the southern and eastern portions of the state, where humidity, cloudiness and precipitation are resultantly greater than in western and northern sections. Summers are long and usually quite hot. Winters are shorter and less severe than those of the more northern Plains states. Periods of extreme cold are infrequent, and those lasting more than a few days are rare.

Our knowledge of climate is based on the variables that we measure, typically with surface observing stations, weather radar, satellites, weather balloons, and other instrumentation. Some weather events cannot be measured easily by automated methods (e.g., tornadoes) and must be documented by human observers.

Hence, as Oklahoma's population increased over the years, human observations of rare events became more prevalent. Even measurements of mundane variables such as temperature have become more common, with automated weather stations taking more measurements per day at more locations than in past decades. Climatologists know how to work with changes in observing intervals, sensors, techniques, and locations to provide decision makers with an historical record to better understand climate normal, extremes, and variability.

The following sections highlight some of these variables and associated events:

1.3.1 Temperature

(Source for below: https://climate.ok.gov/index.php/site/page/climate_of_oklahoma)

The mean annual temperature over the state ranges from 64 deg F along the Red River to about 59 deg F along the northern border (*Figure 3)*. It then decreases westward to 56 deg F in Cimarron County.

Temperatures of 90 deg F or greater occur, on average, about 70-75 days per year in the western panhandle and the northeast corner of the state. The average is about 110 days in southwest Oklahoma and about 80 days in the southeast. Temperatures of 100 deg F or higher occur, frequently during some years, from May through September, and very rarely in April and October. With 30-40 days at or above 100 deg F, western Oklahoma experiences more extreme summer temperatures than elsewhere in the state. Both the Panhandle and eastern Oklahoma average about 15 days above the century mark. The increased humidity in the east, however, adds to that section of the state's summertime misery.

Heat index values of 105 degrees or greater occur more than 40 times per year in the far southeast and less than 10 times per year in the far northwest. Years without 100 deg F temperatures are rare, ranging from about one of every seven years in the eastern half of the state to somewhat rarer in the west.

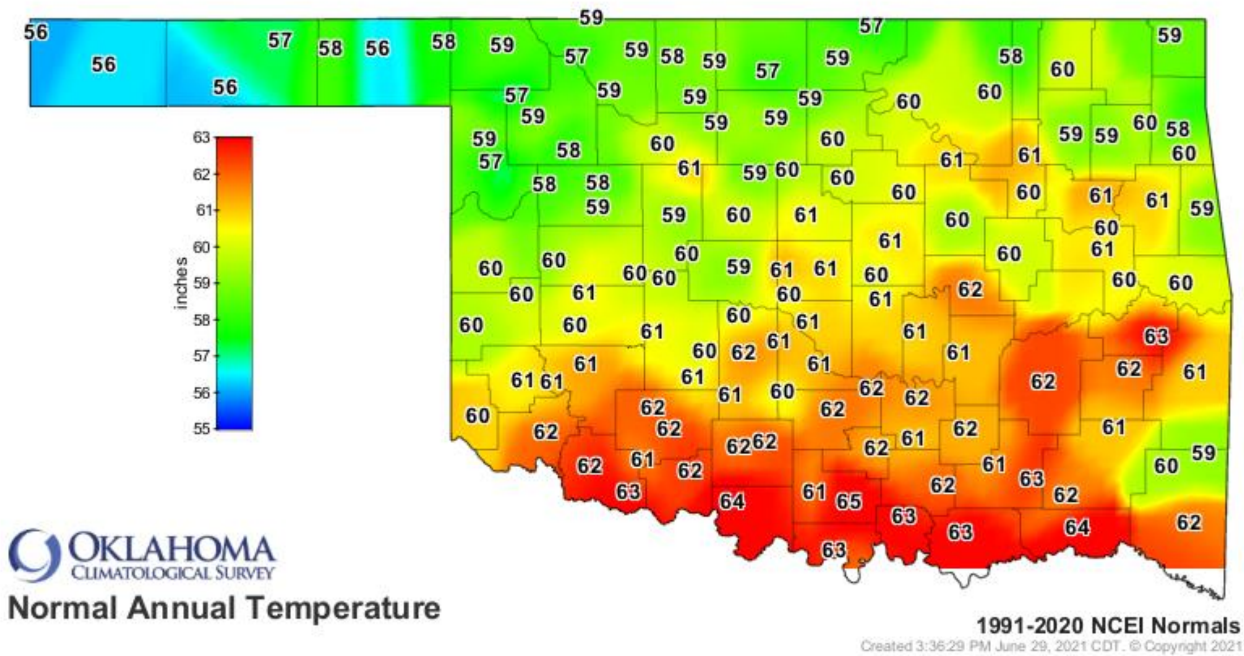


Figure 3: 30-year map of the normal annual temperature (in degrees Fahrenheit) for Oklahoma using data from 1991-2020. Source: OCS

The highest temperature ever recorded in the state was 120°F. This reading was first observed during the brutally hot summer of 1936: at Alva on July 18, at Altus on both July 19 and August 12, and at Poteau on August 10. In addition, Tishomingo observed 120°F on July 26, 1943.

Temperatures of 32°F or less occur an average of 60 days per year in the southeast. This value increases to about 110 days per year where the panhandle joins the rest of the state, and to 140 days in the western panhandle. The lowest temperature on record is -31°F, set at Nowata on February 10, 2011.

The average length of the growing season (*Figure 4*), or freeze-free period, is at a maximum of 225 to 244 days in the southern tier of counties and in the Arkansas River Valley downstream of Tulsa. The value generally decreases to about 195 days in the eastern panhandle, then more rapidly to 173 days in the western panhandle. The general northwest-to-southeast gradient is interrupted in the Ouachita Mountains, where growing seasons are three to four weeks shorter compared to surrounding areas.

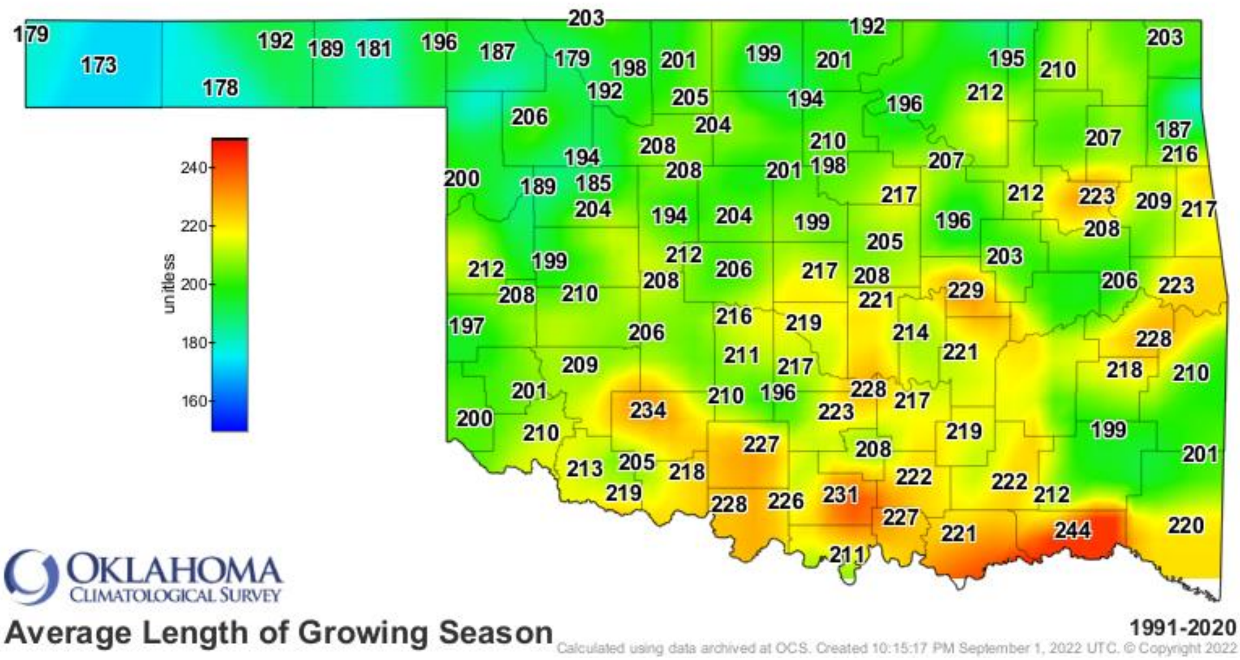


Figure 4: Map of the average length (in days) of the growing season using data from 1991 to 2020. Source: OCS.

Along the Red River, the average date of the last freeze of spring ranges from about March 15 in the east to April 1 in the west. In northern Oklahoma, the last freeze of spring occurs, on average, from about April 6 near the Missouri border to April 21 in the eastern panhandle to the last week of April in the western panhandle. Freezing temperatures have occurred as late as April 24 along the southern border and in east-central Oklahoma to about late April in northwest Oklahoma to early May in the western panhandle.

The average date of the autumn's first freeze varies from about October 17 in the western panhandle, to about October 29 along the northern border and in northwestern Oklahoma, to about the first week of November along the Red River and in the Arkansas River Valley downstream of Tulsa. Autumn freezes have occurred as early as about September 15 in the western third of the state to about October 15 in the southeast corner. Again, the Ouachita Mountains tend to differ from surrounding terrain by about two weeks during either season.

Frozen soil is not a major problem, nor much of a deterrent to seasonal activities. Its occurrence is rather infrequent, of very limited depth, and of brief duration.

1.3.2 Precipitation

The dominant feature of the spatial distribution of rainfall across Oklahoma is a sharp decrease in rainfall from east to west (*Figure 5*). Although precipitation is quite variable on a year-to-year basis (*Figure 6*), average annual precipitation ranges from about 16 inches in the far western panhandle to about 58 inches in the far southeast. Only the summer months of July and August see a substantial relaxation of this distribution. The greatest annual precipitation recorded at an official reporting station was 84.47 inches at Kiamichi Tower in the southeast in 1957. The least annual rainfall occurred during 2022 when Goodwell, in the central panhandle, observed 6.48 inches. This broke the previous all-time lowest annual rainfall record for any location in Oklahoma of 6.53 inches from Regnier in 1956.

The frequency of days with measurable precipitation follows the same gradient as the annual accumulation, increasing from 50 days per year in western Oklahoma to 100 near the Arkansas border. On average, more precipitation falls during the nighttime hours, while greatest rainfall intensities occur during late afternoon. Excessive rainfall occurs at times. Amounts of 10 inches or more for 24 hours, while rare, have been recorded. The greatest official rainfall in a 24-hour period is 15.68 inches at Enid on October 11, 1973.

The character of precipitation also varies by season. Wintertime precipitation tends to be somewhat widespread, stratiform in nature, and tied almost exclusively to synoptic-scale systems. Rainfall is the dominant precipitation type during winter for all but the Oklahoma panhandle. Summertime precipitation is almost entirely convective in nature, produced by individual thunderstorms and thunderstorm complexes. The transition seasons of spring and autumn offer both convective and stratiform precipitation. A significant portion of the state's precipitation during the transition seasons is associated with systems of severe thunderstorms.

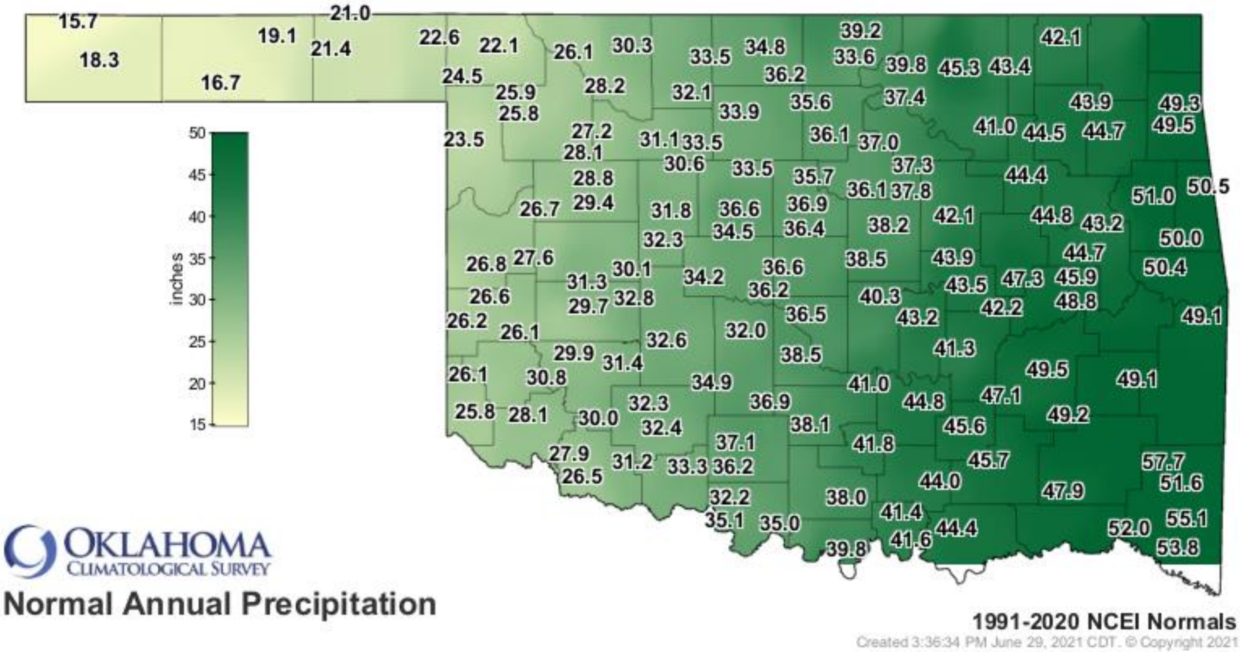


Figure 5: Map of the normal annual precipitation (in inches) for Oklahoma using data from 1991 to 2020. Source: OCS.

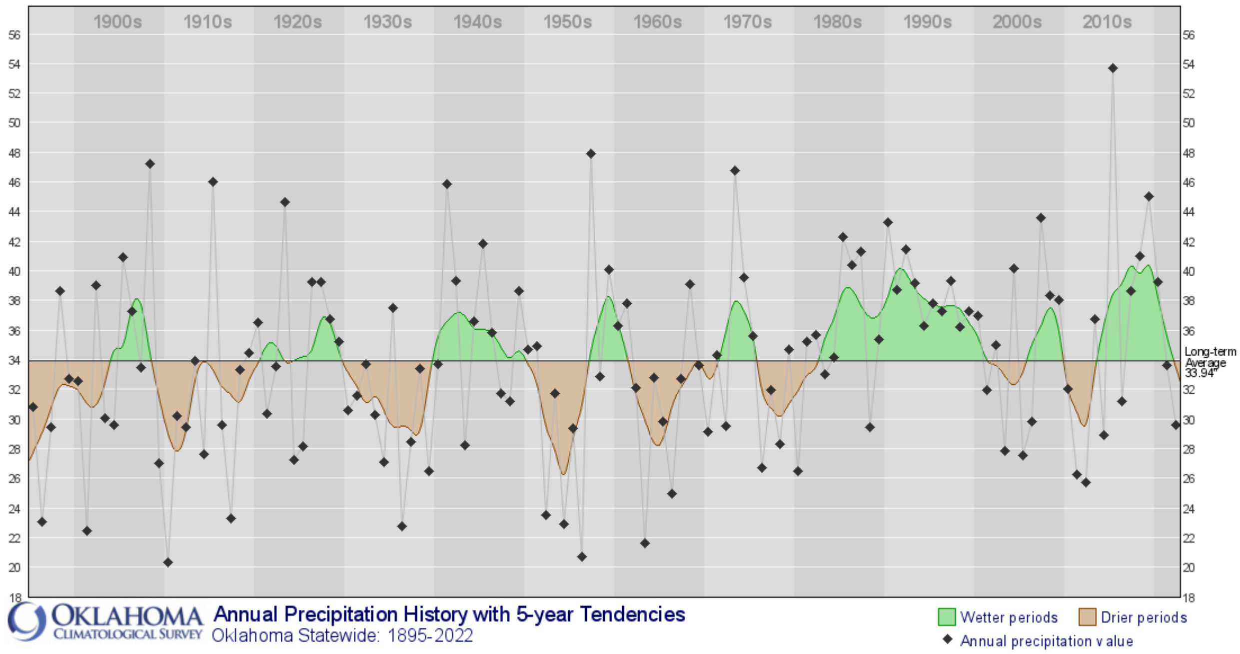


Figure 6: Graph of the statewide average annual precipitation (in inches) for Oklahoma using data from 1895 to 2022. Green shading (above the horizontal line) highlights wetter periods and brown shading (below the line) highlights drier periods than average. Source: OCS.

Average annual snowfall (*Figure 7*) increases from less than two inches in the extreme southeast to 32 inches in the western panhandle. The frequency of snow events also increases sharply along the same gradient. Locations in southeast Oklahoma have gone several years between events, while northwestern Oklahoma typically records several snow events in one winter.

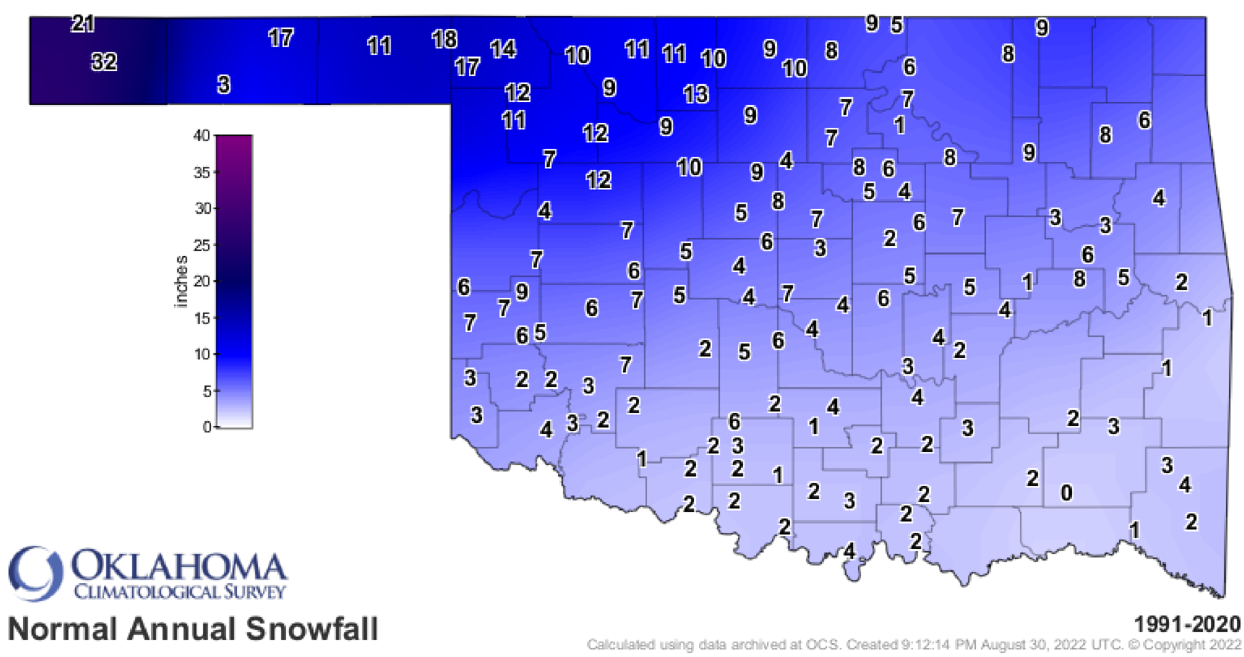


Figure 7: Map of the normal annual snowfall (in inches) for Oklahoma using data from 1991 to 2020. Source: OCS.

1.3.3 Floods

Floods of major rivers and tributaries may happen during any season, but they occur with greatest frequency during those spring and autumn months associated with greatest rainfall. Such floods cost many lives and property damage during the first 50 years of statehood, but flood prevention programs have reduced the frequency and severity of such events. Flash flooding of creeks and minor streams remains a serious threat, especially in urban and suburban areas, where development and removal of vegetation have increased runoff.

1.3.4 Drought

Drought is a recurring part of Oklahoma's climate cycle, as it is in all the Plains states. Almost all of Oklahoma's usable surface water comes from precipitation that falls within the state's borders. Therefore, drought in Oklahoma is tied almost entirely to local rainfall patterns (i.e., the influence of upstream events on drought is very small). Western Oklahoma is slightly more susceptible to drought because precipitation there tends to be more variable (percentage-wise) and marginal for dryland farm applications.

Drought episodes can last from a few months to several years. Those that last a few months can elevate wildfire danger and impact municipal water use. Seasonal droughts can occur at any time of the year, and those that coincide with crop production cycles can cause billions of dollars of damage to the farm economy. Multi-season and multi-year episodes can severely impact large reservoirs, streamflow, and groundwater.

Since modern climatological record-keeping began in the 1890s, the state has seen six major multi-year, regional drought events. These occurred in the late 1890s, from 1909-18, 1930-40, 1952-58, 1962-72, and 2010-15. (*Figure 6*). Each of these episodes contained at least one year of above-normal rainfall. The drought of the 1930s is associated with the Dust Bowl of the Great Plains, when socioeconomic conditions, agricultural practices and drought forced the largest emigration of Oklahomans in state history.

The agricultural impact of drought is increasingly mitigated on a farm-by-farm and year-by-year basis through irrigation of crops, mostly with groundwater. This practice dominates much of the panhandle and some of the rest of western Oklahoma.

1.3.5 Thunderstorms and Tornadoes

On average, thunderstorms occur about 55 days per year in eastern Oklahoma, decreasing to about 45 days per year in the southwest. The annual rate increases to near 60 days annually in the extreme western panhandle. Late spring and early summer are the peak seasons for thunderstorms. December and January, on average, feature the fewest thunderstorms.

Frequent cold fronts, a favorable jet stream, and dry line development make springtime the preferred season for violent thunderstorms, although they can occur at any time of year. Severe weather threats during spring include squall lines, mesoscale convective systems, heat bursts, and rotating supercell thunderstorms that can produce very large hail, damaging winds, and tornadoes. Autumn marks a secondary severe weather season, but the relative frequency of supercell thunderstorms is much lower than during spring. Individual thunderstorms are common during the summer but tend to be less severe and shorter lived. These storms can produce locally heavy rain and hail.

Tornadoes are a particular hazard in Oklahoma (*Figure 8*). Since 1950, an average of 57 tornadoes have been observed annually within the state's borders. Tornadoes can occur at any time of year but are most frequent during springtime. Three-fourths of Oklahoma's tornadoes have occurred during April, May, and June. May's average of 24 tornado observations per month is the greatest. The winter months each average about one tornado per month.

Severe weather can occur at any time of day, but the maximum frequency for severe weather is from mid-afternoon to sunset. About 80 percent of tornadoes are observed between noon and midnight Central Standard Time, with the peak hours being between 4:00 and 8:00 PM.

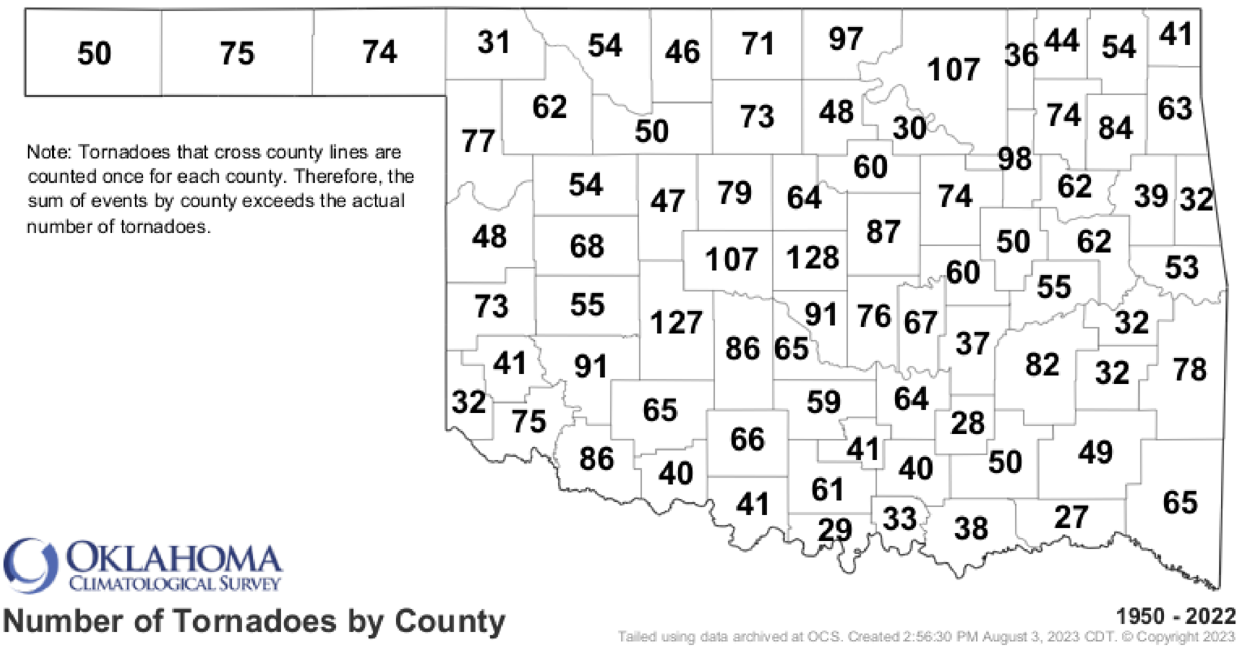


Figure 8: Map of the number of tornadoes recorded by county using data from 1950 to 2022. Source: OCS.

1.3.6 Other Climatic Features

Annual average relative humidity ranges from about 55 percent in the panhandle to just over 75 percent in the east and southeast. On average, cloudiness increases from west to east across Oklahoma. The annual fraction of possible sunshine observed ranges from about 60 percent in eastern Oklahoma to near 75 percent in the panhandle. These fractions are highest in the summer and lowest in the winter for all portions of the state.

Average annual lake evaporation varies from 48 inches in the extreme east to 65 inches in the southwest, numbers that far exceed the average yearly rainfall in those areas. Evaporation and percolation into the soil expend about 80 percent of Oklahoma's precipitation.

Prevailing winds are from the south to southeast throughout most of the state from the spring through autumn months. These prevailing winds typically are from the south to southwest in far western Oklahoma, including the panhandle. The winter wind regime is roughly equally split between northerly and southerly winds.

(Source: http://climate.ok.gov/index.php/site/page/climate_of_oklahoma)

1.4 DEMOGRAPHY

Oklahoma's population has steadily increased since Statehood in 1907, with the exception of a slight decrease in population levels from 1930-1960 due to drought and economic depression. Since 2010, Oklahoma's population has grown from about 3.7 million people to 3.9 million people.

US Census Data by Year	Total Population
2021	3,986,639
2020	3,959,353
2019	3,956,971
2018	3,943,488
2017	3,930,864
2016	3,921,207
2015	3,904,353
2014	3,875,008
2013	3,849,840
2012	3,815,298
2011	3,785,232
2010	3,759,529

Continuing a trend that's been taking place for several decades, Oklahoma's population is continuing to shift from rural communities to urban and suburban areas. Canadian County, just east of Oklahoma City, was the fastest growing county in Oklahoma, jumping from 115,541 people in 2010 to 154,405 in 2020, an increase of more than 30%. The next five fastest growing counties were McClain (20.7% increase), Logan (18.4%), Cleveland (15.6%), Tulsa (10.9%) and Oklahoma (10.8%). Oklahoma's two largest cities are Oklahoma City (the State Capital) and Tulsa. Counties that lost population were scattered throughout rural Oklahoma, with Blaine County in western Oklahoma losing nearly 27% of its population from 2010 to 2020.

(Table Source: https://www.census.gov/quickfacts/fact/table/OK,US/PST045217
https://www.census.gov/data/tables/2017/demo/popest/state-total.html)

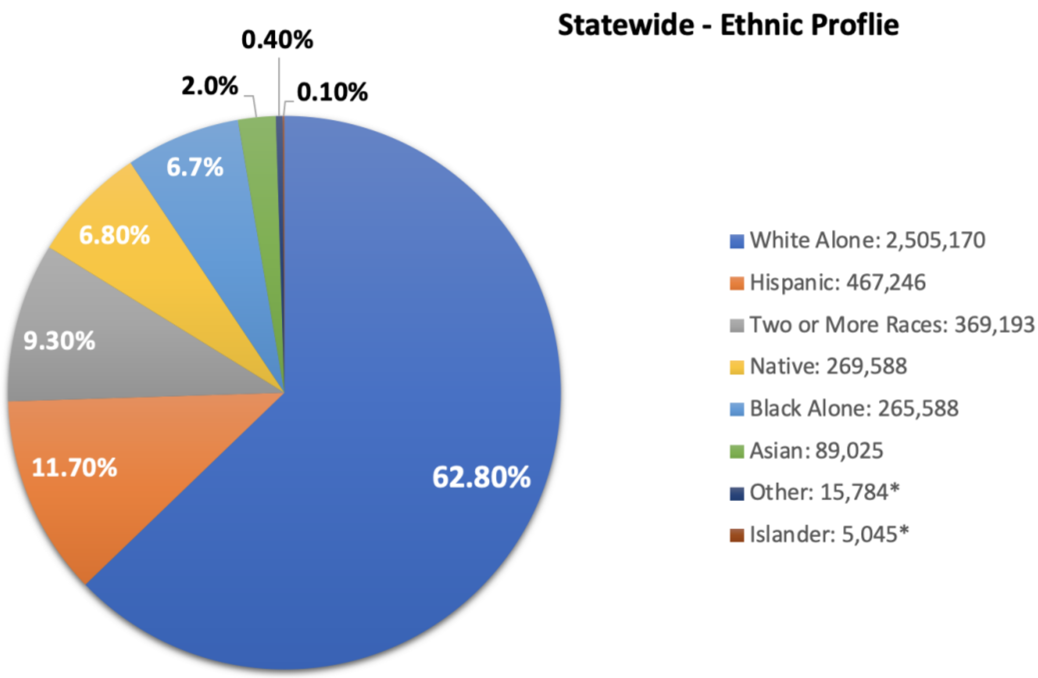


Figure 9: Oklahoma Statewide Ethnic Profile. Source: US Census.

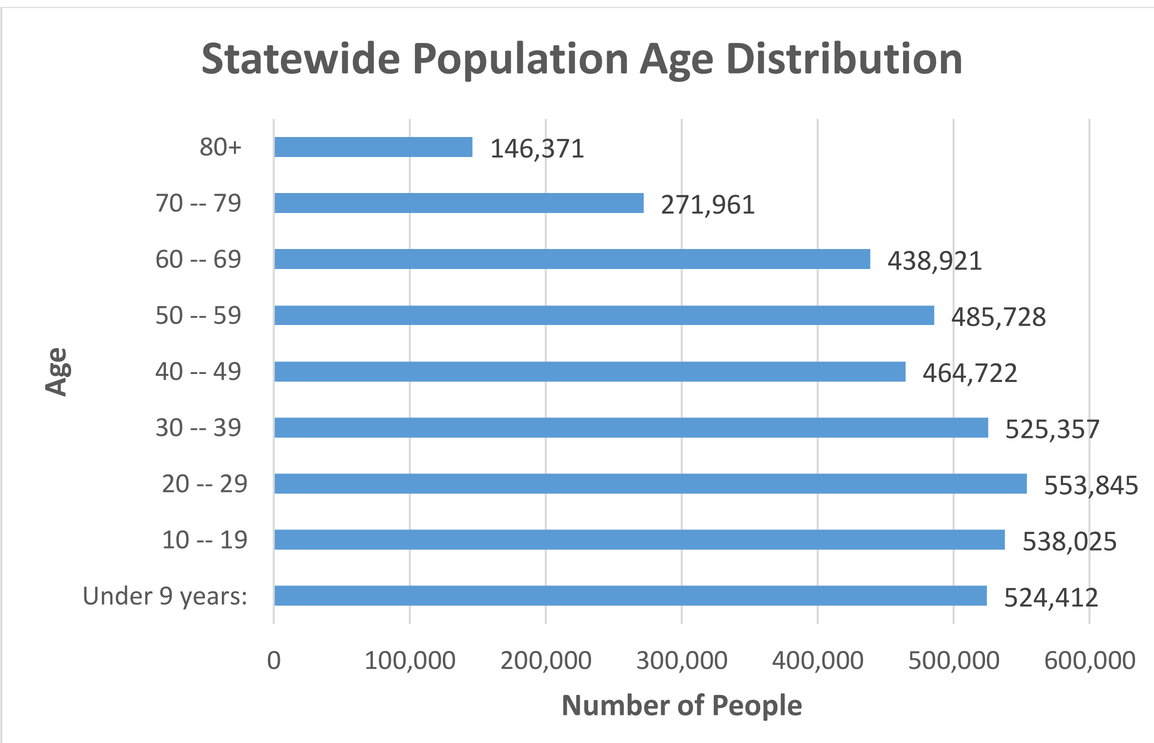


Figure 10: Oklahoma Population Age Distribution. Source: US Census.

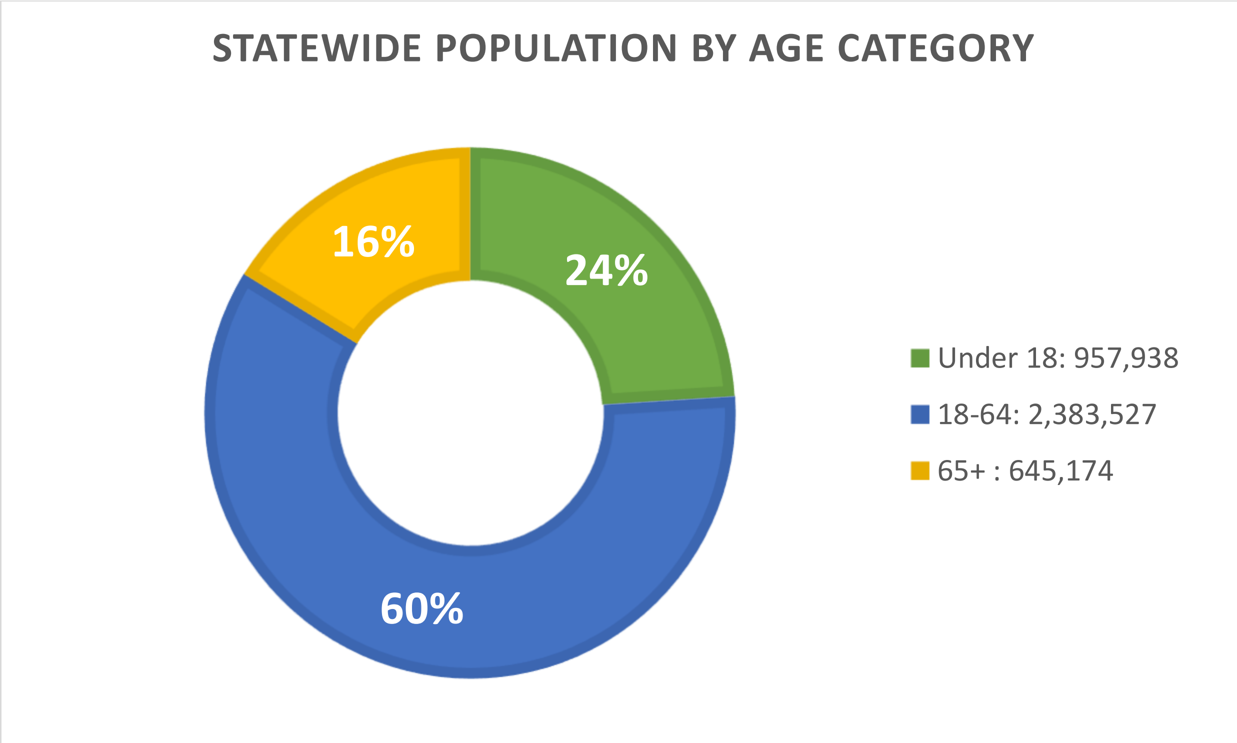


Figure 11: Oklahoma Population by Age Category. Source: US Census.

1.5 ECONOMY

Industry	Dollar Amount (Millions)	Percent of GDP (2022)
Private Industries	$164,095	86%
• Mining, quarrying, and oil and gas extraction	$26,319	14%
• Finance, insurance, real estate, rental, and leasing	$25,279	13%
• Professional and business services	$18,144	10%
• Manufacturing	$16,858	9%
• Educational services, health care, and social assistance	$14,366	8%
• Retail trade	$11,444	6%
• Transportation and warehousing	$9,483	5%
• Wholesale trade	$8,780	5%
• Arts, entertainment, recreation, accommodation, and food services	$6,936	4%
• Information	$6,870	4%

• Construction	$4,707	3%
• Other services (except government and government enterprises)	$3,429	2%
• Utilities	$3,247	2%
• Agriculture, forestry, fishing, and hunting	$1,979	1%
Government and government enterprises	$27,030	14%
TOTAL (Private and Government)		**100%**

Source:
https://apps.bea.gov/itable/?ReqID=70&step=1#eyJhcHBpZCI6NzAsInN0ZXBzIjpbMSwyNCwyOSwyNSwzMSwyNiwyNywzMF0sImRhdGEiOltbIlRhYmxlSWQiLCI1MTIiXSxbIkNsYXNzaWZpY2F0aW9uIiwiTkFJQ1MiXSxbIk1ham9yX0FyZWEiLCIwIl0sWyJTdGF0ZSIsWyIwIl1dLFsiQXJlYSIsWyI0MDAwMCJdXSxbIlN0YXRpc3RpYyIsWyItMSJdXSxbIlVuaXRfb2ZfbWVhc3VyZSIsIkxldmVscyJdLFsiWWVhciIsWyIyMDIyIiwiMjAyMSIsIjIwMjAiLCIyMDE5IiwiMjAxOCJdXSxbIllllYXJCZWdpbiIsIi0xIl0sWyJZZWFyX0VuZCIsIi0xIl1dfQ==

2021 Top 15 Employers in Oklahoma

Employer	Employee Estimate
Department of Defense	69,000-70,000
Wal-Mart Associates, Inc. (includes seasonal)	38,500-39,500
Amazon (Fulfillment, Amazon Web Services & Whole Foods)	11,000-11,500
Integris Health, Inc.	9,600-9,700
Hobby Lobby Store Inc	7,700-7,800
Oklahoma State University	7,000-7,100
Chickasaw Nation (gaming and non-governmental business)	6,800-6,900
U.S. Postal Service	6,700-6,800
Saint Francis Hospital Inc	6,400-6,500
Department of Veterans Affairs/U.S. Veterans Administration	6,300-6,400
OK Department of Human Services	6,300-6,400
University of Oklahoma (Norman Campus)	6,000-6,100
Mercy Health (MHM Support Services)	5,900-6,000
OU Health Sciences Center (Board of Regents)	5,900-6,000
Braum's, Inc.	5,600-5,700

(Source: 2021 Statewide Estimate, https://www.okcommerce.gov/doing-business/data-reports/reports/oklahomas-largest-employers/)

1.6 CHANGES IN DEVELOPMENT

Land use and development patterns continue to change throughout the state of Oklahoma as the population continues to change. Although most of the state has seen an increase in development in one way or the other, there are areas who have seen more than others.

Increases in population place more people at risk to different natural hazards depending on where they live within the state. For hazards such as wildfire, flood and dam failure, these risks can be dangerous to jurisdictions when:

- Developing residential or commercial infrastructure within areas prone to wildfire (such as areas within the WUI index) without the required defensible space, correct building materials, water storage, or evacuation plans in place.
- Developing residential neighborhoods or commercial infrastructure without the correct drainage runoff infrastructure in place.
- Developing residential neighborhoods or commercial infrastructure within flood-prone areas, such as a 100-yr floodplain.

In addition, increase in population leads to an increase in socially vulnerable populations. New developments can lead to displacement of underserved populations and socially vulnerable populations such as those suffering from homelessness or those in low-income housing. Also, increases in population and new development place more state assets at risk to different natural hazards depending on where they are located within the state.

https://www.okcommerce.gov/wp-content/uploads/Oklahoma-State-and-County-Population-Projections-Through-2070.pdf

According to the Oklahoma Department of Commerce, the following demographic changes are forecasted to occur in the next several decades for Oklahoma:

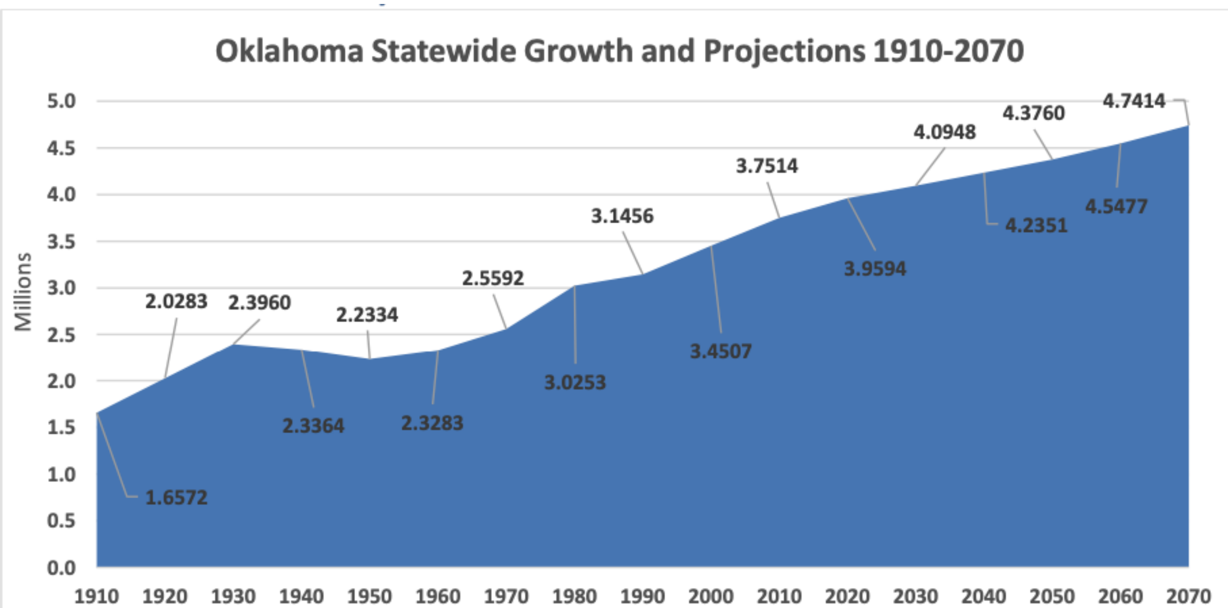


Figure 12: Oklahoma Statewide Growth and Projections 1910-2070. Source: OK Department of Commerce

Oklahoma’s population is projected to top 4.5 million by the time the state celebrates its 150th birthday.

- By the 2030 census, Oklahoma’s population will edge close to 4.1 million.
- By the 2050 census, Oklahoma’s population will top 4.37 million.
- By 2070, Oklahoma’s population will edge closer to 4.75 million.

Over the next 50 years, Oklahoma’s population is forecasted to grow at an average annual rate of 0.395%.

Counties surrounding present day Tulsa and Oklahoma City metro areas are forecasted to see substantial population growth. In 2020, the 14 counties currently included in the Tulsa and Oklahoma City metropolitan statistical areas (MSAs) combined to represent 61.7% of the state's population, but by 2070 those same 14 counties are forecast to represent 68% of the state's total population.

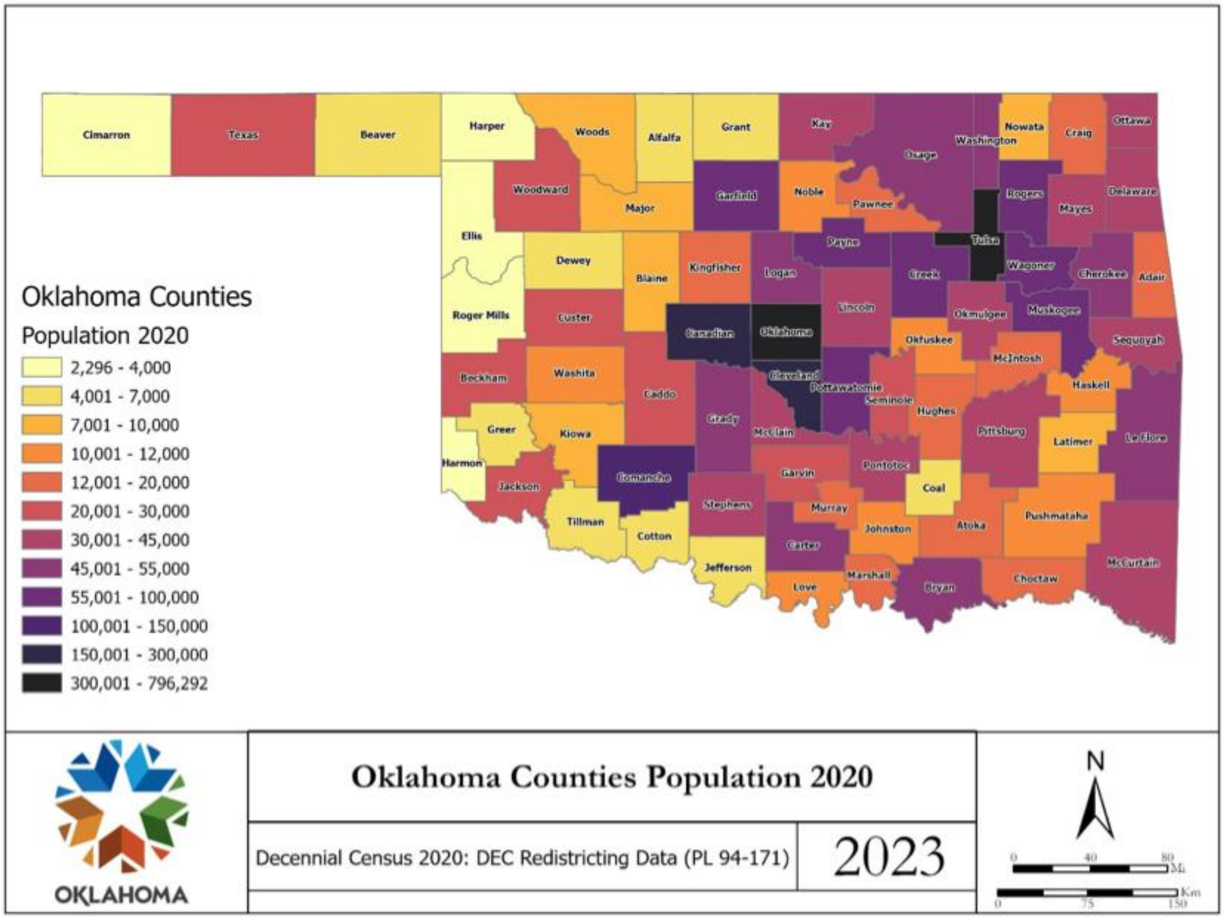


Figure 13: Oklahoma Counties Population 2020. Source: OK Department of Commerce

2020 Population for Counties That Make Up Present Day Tulsa and OKC MSAs			
Creek	71,754	Canadian	154,405
Okmulgee	36,706	Cleveland	295,528
Osage	45,818	Grady	54,795
Pawnee	15,553	Lincoln	33,458
Rogers	95,240	Logan	49,555
Tulsa	669,279	McClain	41,662
Wagoner	80,981	Oklahoma	796,292
Total Tulsa MSA	1,015,331	Total OKC MSA	1,425,695
Percent of Statewide Total	**25.6%**		**36.0%**

Source: US Census Bureau, Decennial Census

2070 Population Forecast for Counties That Make Up Present Day Tulsa and OKC MSAs			
Creek	73,468	Canadian	339,197
Okmulgee	30,404	Cleveland	368,526
Osage	38,102	Grady	48,817
Pawnee	13,570	Lincoln	33,136
Rogers	100,501	Logan	68,442
Tulsa	822,204	McClain	49,189
Wagoner	93,700	Oklahoma	1,145,555
Total Tulsa MSA	1,171,948	Total OKC MSA	2,052,861
Percentage of Statewide total	24.7%		43.3%

Source: Oklahoma Department of Commerce

On the other side, there are 43 counties in Oklahoma that are predicted to experience a population decline over the next 50 years. Many of these counties are in western Oklahoma, and experienced their peak population levels in 1910, shortly after Oklahoma achieved statehood.

Counties forecast to experience population decline between 2020 and 2070				
Adair	Cotton	Jackson	McIntosh	Pushmataha
Atoka	Craig	Jefferson	Muskogee	Seminole
Beaver	Delaware	Kay	Noble	Sequoyah
Blaine	Ellis	Kiowa	Nowata	Stephens
Caddo	Grady	Latimer	Okmulgee	Texas
Choctaw	Greer	Le Flore	Osage	Tillman
Cimarron	Harmon	Lincoln	Ottawa	Washita
Coal	Haskell	Marshall	Pawnee	
Comanche	Hughes	Mayes	Pittsburg	

Even since the 2020 census, Oklahoma's municipalities have changed. The U.S. Census Bureau provided population change estimates since the 2020 census (*Figure 14*). Municipalities in metropolitan areas have continued to grow faster than more rural communities. In terms of percent change, some of the fastest growers in Oklahoma from 2020 to 2022 are:

- Newcastle (+16.9%), Piedmont (+12.8%), and Mustang (+10.5%) in the OKC metro
- Collinsville (+10.9%) and Coweta (+7.5%) in the Tulsa metro
- Medicine Park (+9.2%) and Cache (+5.5%) in the Lawton metro

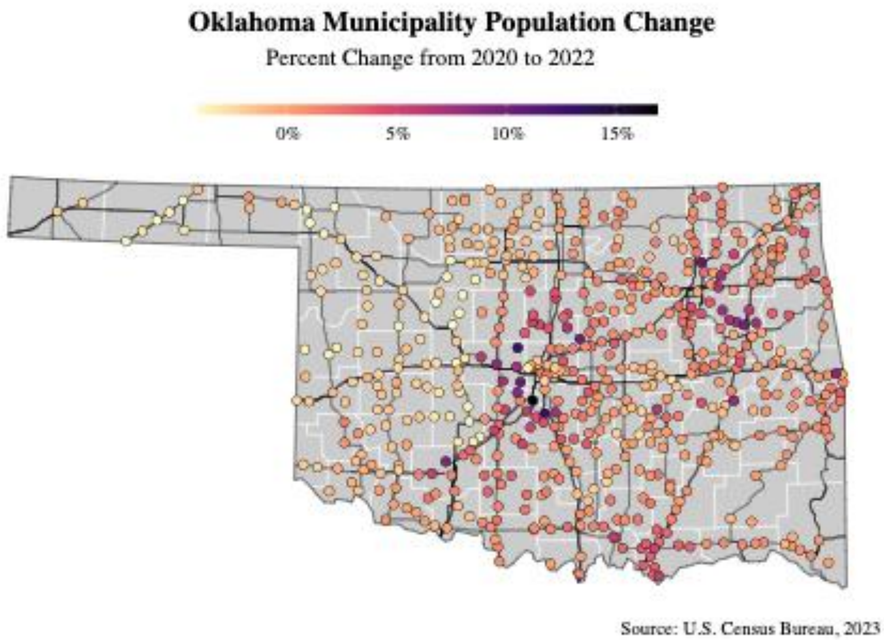


Figure 14: Oklahoma Municipality Population Change. Source: Oklahoma State University (https://extension.okstate.edu/announcements/community-and-economic-development/population-change-in-oklahoma-counties-and-municipalities.html)

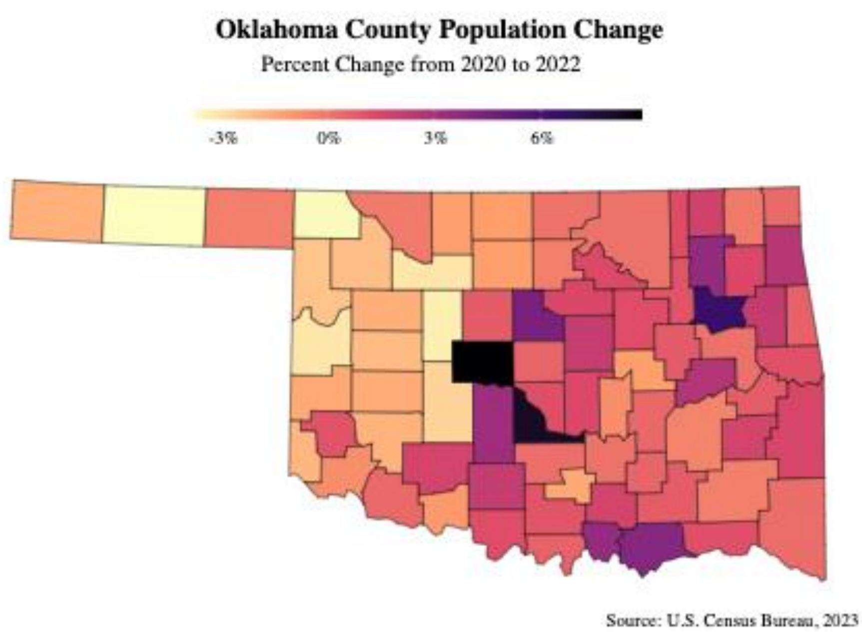


Figure 15: Oklahoma County Population Change. Source: Oklahoma State University (https://extension.okstate.edu/announcements/community-and-economic-development/population-change-in-oklahoma-counties-and-municipalities.html)

Climate Change in Oklahoma

In the coming decades, Oklahoma will become warmer, and both floods and droughts may be more severe. Most of Oklahoma did not become warmer during the last 50 to 100 years. But soils have become drier, annual rainfall has increased, and more rain arrives in heavy downpours. In the coming decades, summers are likely to be increasingly hot and dry, which would reduce the productivity of farms and ranches, change parts of the landscape, and possibly harm human health. Hot days can be unhealthy—even dangerous. Seventy years from now, Oklahoma is likely to have three to four times as many days above 100°F as it has today. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. The elderly may be particularly prone to heat stress and other heat-related health problems, including dehydration, cardio- vascular strain, and lung problems. Those with low incomes may also be vulnerable if they lack air conditioning. In Chapter 3, discussion about each identified hazard and climate change impacts is discussed.

Case Study: Hochatown, Oklahoma

As more and more people are moving to Oklahoma and cities continue to expand, more people are at risk of hazards, especially flooding and wildfires. In addition, people seek to visit areas of the state for vacations and recreational activities. One of the rapidly growing locations for cabin rentals and outdoor activities in Oklahoma is Broken Bow Lake. Over the last couple of decades, private landowners have built homes, luxury cabins, roads, and other infrastructure in this area, including in the town Hochatown and the surrounding area.

Hochatown is also near the Ouachita National Forest, the oldest and largest national forest in the southern U.S. It includes the westernmost range for native tree species such as shortleaf pine, loblolly pine, and bald cypress. The region supports an abundance of ecological and biological diversity including bison, elk, a rich freshwater mussel community, the endangered red-cockaded woodpecker, and the rare leopard darter. The beauty and recreational attractions of the Hochatown area changed the main economic industry from timber to tourism. Currently 80% of housing structures are weekend rental cabins spread out over roughly 25,000 acres. This has led to increased wildfire risk in areas where forests and buildings intermingle, known as the wildland-urban interface. The number of rental cabins in the area has grown from around 500 to more than 1,500 in the past 10 years. Today, about 80 percent of the structures are weekend rental cabins spread out over roughly 25,000 acres.

Figure 16: Development bordering the Ouachita National Forest near Hochatown in 2003 (left) & 2019 (right), demonstrating the rapid land use change that has occurred in the area. Source: USDA Forestry Service.

The booming cabin rental industry has not only transformed the local economy, but also shifted much of the land ownership from long-time residents to developers and second homeowners who do not live in the area. The beauty and recreation opportunities provided by Broken Bow Lake and the Ouachita National Forest have made the Hochatown area a prime tourist destination, but the lack of visitors' wildfire awareness, combined with the roads and infrastructure of cabins in the region, create a challenge for the tribal, state, and federal entities responsible for managing fire in the Hochatown area. Now more than ever there is a need to not only educate residents of the area about wildfire risk but also inform tourists in short-term rentals that they are staying in a high wildfire risk area. The need for an efficient local response system to notify people in the area during a wildfire has become paramount. Contacting short-term renters is a major logistical challenge for local fire suppression crews because renter contact information may not be readily available. Another challenge is that many of the rental properties have no clear address, making it difficult for fire crews to locate the properties in the event of a wildfire. The long history of tribal and federal land rights issues in the area also makes determining jurisdiction in responding to fires a complex issue.

Sources for above:
https://storymaps.arcgis.com/stories/3517fbd7c4f44ffa8c6c5ceb1603bac5

https://www.fs.usda.gov/research/srs/news/featured/history-culture-and-wildfire-risk-hochatown-oklahoma

SECTION 2:
THE PLANNING PROCESS

2.1 Planning Process Activities, Timeline and Milestones

This plan update was coordinated and executed by the State Hazard Mitigation Officer (SHMO), ODEMHS Hazard Mitigation Staff, and the State Hazard Mitigation Team (SHMT).

The planning process began in July 2022, when the SHMO presented the plan update timeline to the SHMT, and discussions began among team members as to how we could build upon and strengthen the current State HM Plan. Local, State and Federal partners were contacted via email to begin the process of updating the State Plan. Stakeholders were requested to review their agency descriptions, mitigation programs, and provide input to the strategy and goals of the State Plan. These inputs were collected, reviewed, and revision were incorporated into the State Plan update throughout 2022 and 2023.

The SHMT has met quarterly since its kickoff meeting in April 2022. In addition, there have been regular meetings between the SHMO, ODEMHS's HM Staff, and U.S. Army Corps of Engineers personnel. The drafting of the plan update began in July 2022.

2.2 Involvement and Coordination with Agencies and Stakeholders during the Planning Process

The establishment of Oklahoma's State Hazard Mitigation Team is required by state statue Title 63, Public Health and Safety, 63 O.S. §683.6, 2016 and is under the coordination of the State Hazard Mitigation Officer (SHMO) who may appoint ad hoc committees for the purpose of reviewing or researching issues. The SHMT provides expertise to the planning process, including historical perspectives, risk assessments, building codes, land use, transportation, and infrastructure.

Oklahoma's State Hazard Mitigation Team (SHMT)

Agency	State HM Team Member Title	Team Member Status
OK Department of Emergency Management (ODEMHS)	SHMO	Participation required by OK statue Title 63
National Weather Service (NWS)	Director	Stakeholder Subject Matter Expert
U.S. Department of Agriculture (USDA)	State Executive Director	Stakeholder Subject Matter Expert
U.S. Army Corps of Engineers (USACE)	Chief, Emergency Management	Stakeholder
U.S. Department of Housing and Urban Development	Senior Management Analyst	Stakeholder
Oklahoma Department of Education (DOE)	State Superintendent	Stakeholder
U.S. Bureau of Indian Affairs (BIA)	Director	Stakeholder

U.S. Bureau of Land Management (BLM)	Regional Director	Stakeholder
U.S. Bureau of Reclamation (BOR)	Emergency Management Coordinator	Stakeholder Subject Matter Expert
U.S. Fish and Wildlife Service	Field Coordinator	Stakeholder
USGS, Oklahoma Water Science Center	Director	Stakeholder
National Park Service (NPS)	Chickasaw Nat. Rec Area	Stakeholder
Small Business Administration (SBA)	Regional Administrator	Stakeholder
American Red Cross (ARC)	Director/OKC	Stakeholder
Association of County Commissioners of Oklahoma	Executive Director	Participation required by OK statue Title 63
Oklahoma Department of Agriculture - Forestry Division	Director	Participation required by OK statue Title 63 Subject Matter Expert
Oklahoma Climatological Survey	University Meteorologist, OU Office of Emergency Preparedness	Participation required by OK statue Title 63 Subject Matter Expert
Oklahoma Department of Commerce	Regional Development Specialist	Participation required by OK statue Title 63
Oklahoma Conservation Commission	Administrative Programs Manager	Participation required by OK statue Title 63
Oklahoma Emergency Management Association	President	Participation required by OK statue Title 63
Oklahoma Department of Environmental Quality (DEQ)	Emergency Response Coordinator	Participation required by OK statue Title 63
Oklahoma Floodplain Managers Association (OFMA)	Chair	Stakeholder
Oklahoma Geological Survey (OGS)	Director	Stakeholder Subject Matter Expert
Oklahoma Department of Health	Emergency Manager	Participation required by OK statue Title 63
Oklahoma State Historical Society	Historic Archeologist/Section 106 Program Coordinator	Participation required by OK statue Title 63
Oklahoma Department of Human Services	Human Resource Manager	Participation required by OK statue Title 63
Oklahoma Insurance Commission	Community Outreach Supervisor	Participation required by OK statue Title 63
Oklahoma Municipal League	Executive Director	Participation required by OK statue Title 63
Oklahoma Department of Transportation	Executive Director	Participation required by OK statue Title 63
Oklahoma Water Resource Board (OWRB)	State NFIP Coordinator	Participation required by OK statue Title 63 Subject Matter Expert

Oklahoma Department of Wildlife Conservation	Executive Director	Participation required by OK statue Title 63
Oklahoma Corporation Commission	Executive Director	Participation required by OK statue Title 63 Subject Matter Expert
Office of the State Fire Marshall	State Fire Marshall	Participation required by OK statue Title 63
Oklahoma Department of Labor	Commissioner	Participation required by OK statue Title 63
State Chancellor/Designee, OK State System of Higher Education	Director of Business Services	Participation required by OK statue Title 63
Oklahoma Department of Career and Technology Education	State Director	Participation required by OK statue Title 63
Oklahoma Office of Homeland Security	Critical Infrastructure Protection Coordinator	Stakeholder

During the planning process, the SHMT decided to find a more descriptive way to evaluate hazards and risk analysis. This was accomplished by coordinating hazard profile updates with subject matter experts.

The following agencies were requested to provide subject matter expertise on the following hazards:

Hazard	Agency	Subject Matter Expert (SME) Name and Position
Dam Failure	Oklahoma Water Resources Board (OWRB)	**Yohanes Sugeng:** Engineering Manager **Zachary Hollandsworth:** Engineering Manager **Aaron Milligan:** Environmental Programs Manager **Johnathon Phillips:** Environmental Programs Manager
	Army Corps of Engineers (USACE)	**William Smiley:** Chief EM Readiness and Contingency Operations
	Bureau of Reclamation	**Matthew Warren:** Civil Engineer
	Oklahoma Corporation Commission (OCC)	

		Matt Skinner: Regulatory Program/Public Information Manager **Kelsey Schwartz:** Programs Manager **Brandy Wreath:** Director of Administration
Drought	Oklahoma Climatological Survey (OCS) Southern Climate Impacts Planning program (SCIPP)	**Gary McManus:** State Climatologist **Mark Shafer:** Deputy Director
Earthquake	Oklahoma Geological Survey (OGS) Oklahoma Corporation Commission (OCC)	**Dr. Jacob Walter:** State Seismologist **Dr. Nick Hayman:** Director **Dr. Netra Regmi:** Hazards Geologist **Matt Skinner:** Regulatory Program/Public Information Manager **Kelsey Schwartz:** Programs Manager **Brandy Wreath:** Director of Administration
Soil Hazards: Expansive Soils, Landslides, Soil Subsidence	Oklahoma Geological Survey (OGS)	**Dr. Jake Walter:** State Seismologist **Dr. Nick Hayman:** Director **Dr. Netra Regmi:** Hazards Geologist
Extreme Heat	Oklahoma Climatological Survey (OCS) Southern Climate Impacts Planning program (SCIPP)	**Gary McManus:** State Climatologist **Mark Shafer:** Deputy Director
Flood	Oklahoma Water Resources Board (OWRB)	**Yohanes Sugeng:** Engineering Manager **Zachary Hollandsworth:** Engineering Manager **Aaron Milligan:** Environmental Programs Manager **Johnathon Phillips:** Environmental Programs Manager

	Army Corps of Engineers (USACE)	**William Smiley:** Chief EM Readiness and Contingency Operations
Severe Storms: Lightning, Hail	Oklahoma Climatological Survey (OCS) Southern Climate Impacts Planning program (SCIPP) National Weather Service- Norman (NWS)	**Gary McManus:** State Climatologist **Mark Shafer:** Deputy Director **Rick Smith:** Warning Coordination Meteorologist **Todd Lindley:** Science & Operations Officer
High Winds	Oklahoma Climatological Survey (OCS) Southern Climate Impacts Planning program (SCIPP) National Weather Service- Norman (NWS)	**Gary McManus:** State Climatologist **Mark Shafer:** Deputy Director **Rick Smith:** Warning Coordination Meteorologist **Todd Lindley:** Science & Operations Officer
Tornado	Oklahoma Climatological Survey (OCS) Southern Climate Impacts Planning program (SCIPP) National Weather Service- Norman (NWS)	**Gary McManus:** State Climatologist **Mark Shafer:** Deputy Director **Rick Smith:** Warning Coordination Meteorologist **Todd Lindley:** Science & Operations Officer
Wildfire	Oklahoma Dept. of Agriculture, Forestry Division/ODEMHS Field Services	**Andy James:** Fire Management Chief **Mark Goeller:** Forestry Services Director
Winter Storm	Oklahoma Climatological Survey (OCS) Southern Climate Impacts Planning program (SCIPP) Oklahoma Corporation Commission (OCC)	**Gary McManus:** State Climatologist **Mark Shafer:** Deputy Director **Matt Skinner:** Regulatory Program/Public Information Manager

		Kelsey Schwartz: Programs Manager **Brandy Wreath:** Director of Administration
	Oklahoma Municipal Power Authority	**Jennifer Rogers:** Director of Member Services
	National Weather Service- Norman (NWS)	**Rick Smith:** Warning Coordination Meteorologist **Todd Lindley:** Science & Operations Officer

Subject Matter Experts (SME) were elected by ODEMHS hazard mitigation planning staff based on which of the state's profiled hazards would best suit their area of expertise and whether they were able to provide data that could be incorporated into the HMPU for that hazard. SMEs were contacted via email in early August 2022 asking them to read through their agency description and hazard profile, as well as schedule a meeting with ODEMHS hazard mitigation planning staff to address how best they could provide information for their designated hazard(s). The first set of meetings took place September 12-15, 2022. Everyone listed in the table met with ODEMHS staff in person during these dates. Follow up meetings with SMEs took place in early February 2023. All meetings, as well as correspondence over email, proved valuable in providing information to update agency descriptions, funding sources, programs with a mitigation strategy, and hazard profiles such as listing specific locations, vulnerabilities, and impacts. SMEs were able to provide their knowledge on each hazard as well as maps and data from studies that ODEMHS planning staff may not have had access or knowledge of without their expertise.

Of particular importance and usefulness was the data received from the Oklahoma Geological Survey (OGS) and Oklahoma Corporation Commission (OCC) regarding earthquakes. Since the last hazard mitigation plan update, there has been a decrease in earthquake activity, and these two agencies were able to provide information as to why there was an increase in activity leading up to the last update, and why we are seeing a decrease since. Another SME of great value in providing information includes Oklahoma Dept. of Agriculture, Forestry Division who worked closely with HM plans staff to provide much needed wildfire data and information they felt was left out in the last plan update.

In addition to the hazard data, the ODEMHS planning staff engaged with other State and Federal agencies during the planning process to assess each principal SHMT agencies' respective capabilities and function. The SHMT meetings proved to be a valuable opportunity for agencies and stakeholders to provide input on natural hazard risk assessment and the impact on communities across Oklahoma. The following areas below discuss the coordination process of specific areas of interest:

Area of Interest	How the State Coordinated with other Agencies and Stakeholders
Emergency Management	SHMT planning meetings were open to other Emergency Managers across OK, which resulted in the attendance and opportunity for feedback of local community personnel.
Economic Development	Analyzed trends in Oklahoma's economy and employment with OK Dept. of Commerce, focusing on the most important industries and employers throughout the State.
Land Use and Development	Coordinated with USACE personnel to evaluate land use trends and analyze how new development increases/decreases the impact of natural hazards.
Housing	Discussed the mitigation capabilities of the U.S. Dept. of Housing and Urban Development (HUD) with HUD's Senior Management Analyst, focusing on the purpose and scope of Community Development Block Grants.
Health and Social Services	Reviewed agency core functions and mitigation capability with OK Department of Human Services personnel.
Infrastructure	Obtained the most current list of Critical Facilities across OK, coordinating with USACE and OMES personnel to include this information in the GIS risk analysis.
Natural and Cultural Resources	Discussed natural systems with USACE, with particular attention paid to waterways and high hazard dams. Reviewed agency core functions and mitigation capability with U.S. Bureau of Indian Affairs and the State Historic Preservation Office (SHPO).

2.3 Integrating the Planning Process into Other State Planning

EMAP, the voluntary standards, assessment, and accreditation process for disaster preparedness programs throughout the country, fosters excellence and accountability in emergency management and homeland security programs, by establishing credible standards applied in a peer review accreditation process.

The ANSI/EMAP 4-2016 Emergency Management Standard by EMAP is the set of 64 standards by which programs that apply for EMAP accreditation are evaluated.

The Emergency Management Standard covers:
- Program Management, Administration and Finance, and Laws and Authorities
- Hazard Identification, Rick Assessment and Consequence Analysis
- Hazard Mitigation
- Prevention
- Operational Planning and Procedures
- Incident Management
- Resource Management, Mutual Aid and Logistics

- Communications and Warning
- Facilities
- Training
- Exercises, Evaluations and Corrective Action
- Emergency Public Education and Information

In April 2018, ODEMHS was accredited by EMAP, in accordance with the Emergency Management Accreditation requirements. Currently, ODEMHS is in the process of updating their accreditation with EMAP.

SECTION 3:
HAZARD IDENTIFICATION AND RISK ASSESSMENT

3.1 Hazard Overview and List of Declared Events

Through the planning process it was decided the following natural hazards would be profiled in the State Plan:

Dam Failure	*Severe Storms (Hail, Lightning)*
Drought	*Soil Hazards (Earthquake, Landslides, Expansive Soils/Soil Subsidence)*
Extreme Heat	*Tornado*
Flooding	*Wildfire*
High Winds	*Winter Storms (Freezing Rain, Ice, and Snow)*

These hazards are listed in alphabetical order, and not prioritized in order of risk and vulnerability. Included within certain hazard profiles are generally accepted methods in various disciplines of that hazard's measurement, impact, or scale. Probability and occurrence data was retrieved for each hazard and was considered to best reflect the hazard and its periodicity to the planning area. Specific events and occurrences were included in certain profiles as a benchmark to reference occurrences of that hazard.

3.2 Probability and Risk Analysis Criteria Element

Each hazard in the State Plan was analyzed using probability, severity, warning time, and duration data to calculate the Calculated Priority Risk Index (CPRI). This multi-faceted approach enables State and Local users of the State Plan to prioritize the effects of each hazard in a more complete way.

Calculated Priority Risk Index (CPRI)

The vulnerability assessment builds upon the previously developed hazard information by identifying the community assets and development trends and intersecting them with the hazard profiles to assess the potential amount of damage that could be caused by each hazard event.

CPRI Formula

CPRI = (Probability Score x .45) + (Magnitude Severity Score x .30) + (Warning Time Score x .15) + (Duration Score x .10)

Definitions of CPRI Categories

Probability – a guide to predict how often a random event will occur. Annual probabilities are expressed between 0.001 or less (unlikely) up to 1 (highly likely). An annual probability of 1 predicts that a natural hazard will occur at least once per year. Assigned weighting factor is 45%.

Impact – indicates the impact to a community through potential fatalities, injuries, property loss, and/or losses of services. The vulnerability assessment gives information that is helpful in making this determination for each community. Assigned weighting factor is 30%.

Warning Time – plays a factor in the ability to prepare for a potential disaster and to warn the public. The assumption is that more warning time allows for more emergency preparations and public information. Assigned weighting is 15%.

Duration – relates to the span of time local, state, and/or federal assistance will be necessary to prepare, respond, and recover from a potential disaster event. Assigned weighting factor is 10%.

https://www.steelecountyemergency.com/wp-content/uploads/2019/07/MHMP-Section-4a.pdf

Probability

Score	Description	Explanation
1	Unlikely	Less than 10% probability in any given year (below 1 in 10 chance of occurring), history of events is less than 10% likely or the event is unlikely but there is a possibility of its occurrence.
2	Possible	Between 10% and 19% probability in any given year (less than 1 in 5 chance of occurring), history of events is greater than or equal to 10% but less than 20%, or the event is possible to occur
3	Likely	Between 20% and 33% probability in any given year (up to 1 in 3 chance of occurring), history of events is greater than or equal to 20% and but less than 33%, or the event is likely to occur
4	Highly Likely	More than 33% probability in any given year (event has up to a 1 in 1 chance of occurring), history of events is greater than 33% likely or the event is highly likely to occur.

Impact

Score	Description	Explanation
1	Negligible	Less than 10% of property severely damaged, shutdown of facilities and services for less than 24 hours, and/or injuries/illnesses treatable with first aid
2	Limited	10% to 25% of property severely damaged, shutdown of facilities and services for more than a week, and/or injuries/illnesses that do not result in permanent disability
3	Critical	More than 25% and up to 50% of property severely damaged, shutdown of facilities and services for at least 2 weeks, and/or injuries/illnesses that result in permanent disability.
4	Catastrophic	More than 50% of property severely damaged, shutdown of facilities and services for more than 30 days, and/or multiple deaths

Warning Time

Score	Description
1	More than 24 hours warning time
2	12 to up to 24 hours warning time
3	6 to up to 12 hours warning time
4	Minimal or no warning (Less than 6 hours warning)

Duration

Score	Description
1	6 hours or less
2	Up to 1 day
3	Up to 1 week
4	More than 1 week

Overall Hazard Ranking

Low: The event has a minimal impact on the planning area.

Moderate: The event's impacts on the planning area are noticeable but not devastating.

High: The criteria consistently fall in the high classifications and the event is likely/highly likely to occur with severe strength over a significant to extensive portion of the planning area.

Natural Hazard	Probability	CPRI	Overall Ranking*
Dam Failure	Unlikely	2.50	Low
Drought	Likely	2.80	High
Extreme Heat	Likely	2.30	High
Flood	Highly Likely	3.75	High
High Wind	Possible	1.85	Moderate
Severe Storm	Highly Likely	3.05	High
Soil Hazards	Possible	1.90	Low
Tornado	Possible	2.15	Moderate
Wildfire	Possible	2.10	Moderate
Winter Storm	Possible	1.95	Moderate

*The overall hazard ranking was compiled by utilizing the probability score, CPRI and discussion between the Oklahoma Hazard Mitigation Plan Steering Committee Meetings.

3.3 Oklahoma Disaster Declarations 2012-2022

Year of Declaration	Declaration Title	Disaster Number
2012	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4064
2013	OK Severe Winter Storm and Snowstorm	DR-4109
2013	OK Severe Storms and Tornadoes	DR-4117
2013	OK Severe Winter Storm	DR-4164
2015	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4222
2015	OK Severe Winter Storms and Flooding	DR-4247
2015	OK Severe Winter Storms and Flooding	DR-4256
2016	OK Severe Storms and Flooding	DR-4274
2017	OK Severe Winter Storm	DR-4299
2017	OK Severe Storms, Tornadoes, and Flooding	DR-4315
2017	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4324
2019	OK Flooding	EM-3411

2019	OK Severe Storms, Straight-Line Winds, Tornadoes, and Flooding	DR-4438
2019	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4453
2019	Muscogee Creek Nation Severe Storms, Straight-line Winds, Tornadoes, and Flooding	DR-4456
2020	OK Severe Winter Storm	DR-4575
2021	OK Severe Winter Storm	EM-3555
2021	OK Severe Winter Storms	DR-4587
2022	OK Severe Storms, Tornadoes, and Flooding	DR-4657
2022	Muscogee Creek Nation Severe Storms, Tornadoes, and Flooding	DR-4670

3.4 Hazard Profiles Elements

The following data will be discussed in each hazard profile:

HAZARD PROFILE ELEMENTS	DATA TO BE DISCUSSED
DESCRIPTION	A brief explanation of each hazard.
LOCATION	A description of which areas of the state experience this hazard. When needed, maps will accompany the narrative description.
PREVIOUS OCCURRENCES	Previous occurrence events that are relevant and information of the hazard.
PROBABILITY AND RISK CALCULATION	A summary of the probability, impact, warning time, and duration of the event. Narrative regarding if the risk from the hazard is expected to increase or decrease in the future.
VULNERABILITY AND IMPACT	A summary of jurisdictions and/or regions most threatened by each hazard and a summary of jurisdictions most susceptible to damage and loss from hazard events related to population and assets (such as infrastructure, critical facilities, systems, and potential dollar losses).
EFFECTS OF CLIMATE CHANGE	A description of how climate change impacts will affect each hazard.

3.4.1 DAM FAILURE

Description

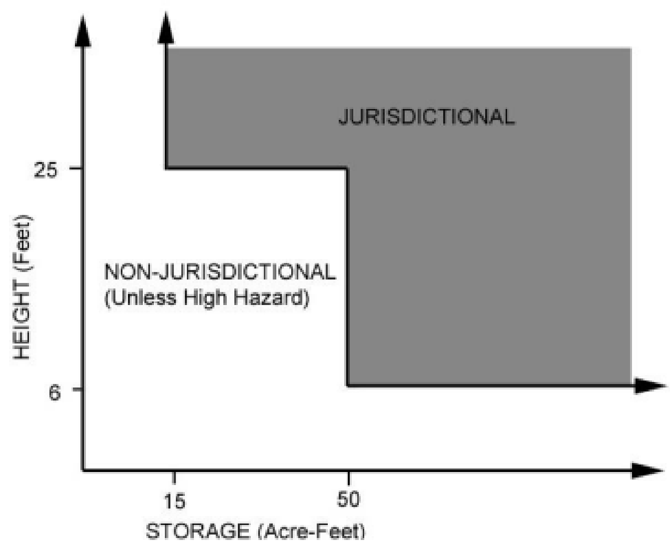
The Federal Emergency Management Agency (FEMA) defines a dam as "an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water." Dams typically are constructed of earth, rock, concrete, or tailings (chaff) from mining operations. A dam failure is the collapse, breach, or other failure resulting in downstream flooding. The amount of water impounded in the reservoir behind a dam is measured in acre-feet. As a function of upstream topography, even a very small dam may impound or detain many acre-feet or millions of gallons of water.

A break in a dam produces an extremely dangerous flood situation because of the high velocities and large volumes of water. In the event of a dam failure, the potential energy of the water stored behind even a small dam can cause great property damage, as well as loss of life if there are people downstream from the dam. The extent of this inundation may be minimal to uninhabited farmland or catastrophic in an urban environment.

Dam failures are most likely to happen for one of these reasons:

- Overtopping caused by water spilling over the top of a dam
- Structural failure of materials used in dam construction
- Cracking caused by movements like the natural settling of a dam
- Inadequate maintenance and upkeep.
- Piping when seepage through a dam is not properly filtered and soil particles continue to progress and form sinkholes in the dam.
- Geological instability caused by changes to water levels during filling or poor surveying.
- Human, computer or design error.

Flooding can occur downstream from a dam without the structure being breached. Sometimes, to prevent overtopping and catastrophic failure, dams are forced to make emergency releases of large amounts of water, which can cause downstream flooding.



OWRB Jurisdictional Sizes of Dams

Any dam that has a height of 25 feet or more from the natural streambed and/or 50 acre-feet or more of storage capacity, is under the jurisdiction of the Oklahoma Water Resources Board (OWRB).

The OWRB also classifies dams as high hazard, significant-hazard, and low hazard, depending on the downstream populations and infrastructure. The hazards are based on first, potential for loss of life from a breach and secondly from the level of economic damage that will occur downstream from a breach. *Figure 1* identifies the risk and required inspection frequency for these dams.

Hazard-Potential Classification	Risk Involved with Dam Failure	Inspection Frequency
High	probable loss of human life	annually, by a registered professional engineer
Significant	no probable loss of human life but can cause economic loss or disruption of lifeline facilities	every three years by a registered professional engineer
Low	no probable loss of human life and low economic loss	every five years

Figure 1: Hazard Potential and required inspection frequency. Source: OWRB Dam Safety.

Hazard Potential Classification for Dams

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected.	Yes (but not necessary for this classification)

A dam is considered small if it has maximum storage of less than 10,000 acre-feet and a maximum height of less than 50 feet. Intermediate size dams are those which have a maximum storage of between 10,000 and 50,000 acre-feet and have a maximum height of between 50 and 100 feet. Large size dams are those which have a maximum storage of over 50,000 acre-feet and have a maximum height of over 100 feet.

An acre-foot is the volume of water that covers an acre of land to a depth of one foot, or approximately 325,000 gallons. An acre-foot is equal to 43,560 cubic feet.

Water discharge is measured in cubic feet per second (cfs). A cubic foot contains about 7.5 gallons of water. One cubic foot per second equals about 450 gallons per minute.

Of the 4,960 dams in the state of Oklahoma, the OWRB has classified 446 as High Hazard and 209 as Significant Hazard. Not all these dams would impact a jurisdiction within the state directly, but many jurisdictions within inundation zones to these dams would be at risk if a dam were to fail.

Levee Failure

According to the Federal Emergency Management Agency, a levee is “a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding.” OWRB Jurisdictional Sizes of Dams Levees are considered structural flood control projects and are generally constructed to protect floodplain development. Until the late 1960s, structural measures such as levees were the dominant approach to riverine floodplain management.

Levee failures can cause catastrophic floods, releasing sudden walls of water that can sweep across lands thought to be protected by the structure. Thus, levees may create a false sense of security, increasing the amount of property at risk of flooding as people and businesses locate behind levees and floodwalls, believing they are totally safe. In addition, levees, dams, and other structural measures are extremely costly and can disrupt or destroy the natural environment.

According to the USACE National Levee Inventory Database, there are 79 Levee Systems in Oklahoma. The 79 are composed of the following;

(6) USACE Federally Constructed and Operated.

(6) USACE Federally Constructed/ Operated by Public Sponsor

(67) Locally Constructed and Operated

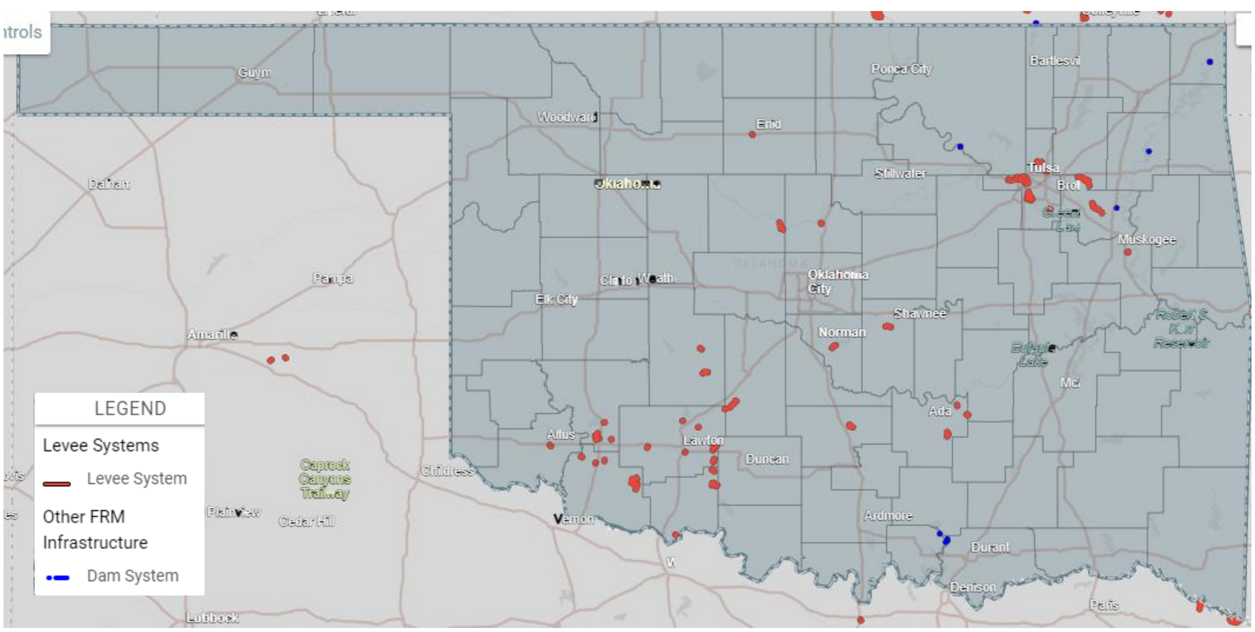


Figure 2: Levee Systems in Oklahoma. Source: OWRB.

Location

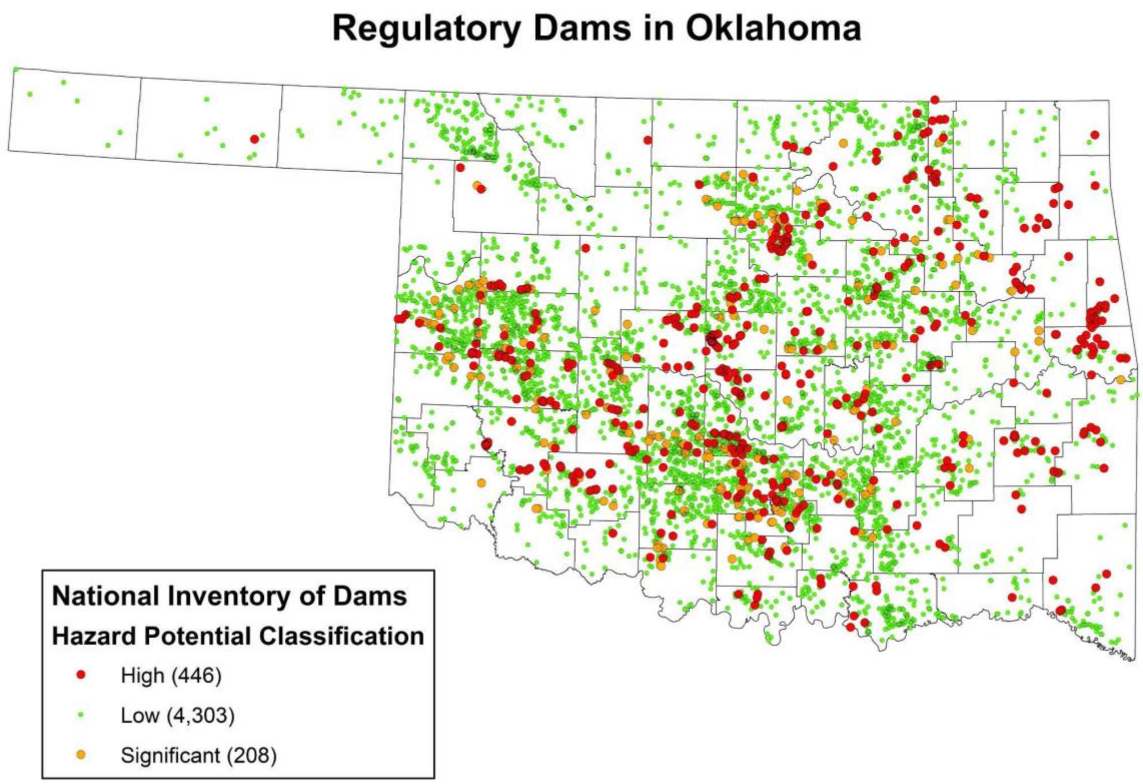


Figure 3: National Inventory of Dams. Source: OWRB.

There are 446 dams that are classified as “High hazard” in Oklahoma. High hazard dams are those where failure will probably cause loss of human life.

There are 209 dams that are classified as “Significant hazard”. Significant hazard dams are those where failure would result in no probable loss of human life but can cause economic loss or disruption of lifeline facilities.

There are 4,305 dams that are classified as “Low”. Low Hazard Dams are those where failure would result in no probable loss of human life and low to limited economic loss or disruption of lifeline facilities.

The 446 high hazard dams in Oklahoma include 69 federally constructed and maintained dams that are not regulated by the State of Oklahoma. These additional dams are operated on federally built and controlled lakes throughout Oklahoma that are under control of federal agencies including the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and the Natural Resources Conservation Service of the USDA. These Federally controlled dams have not been profiled due to their ownership status and limited availability of risk and breach impact information due to federal regulations.

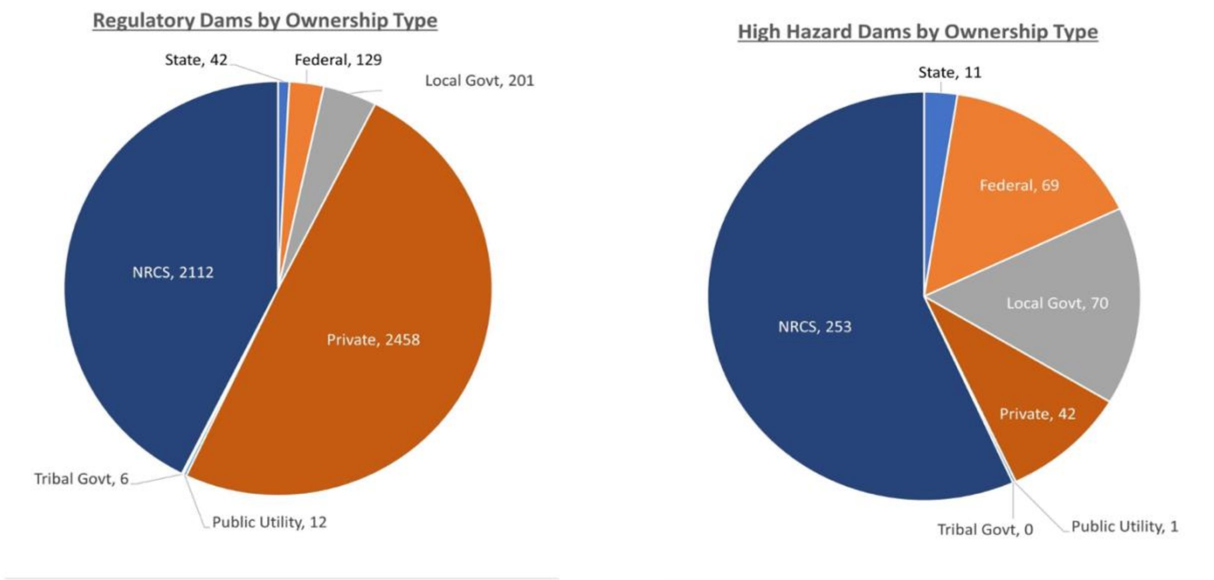


Figure 4: Dams by ownership type. Source: OWRB.

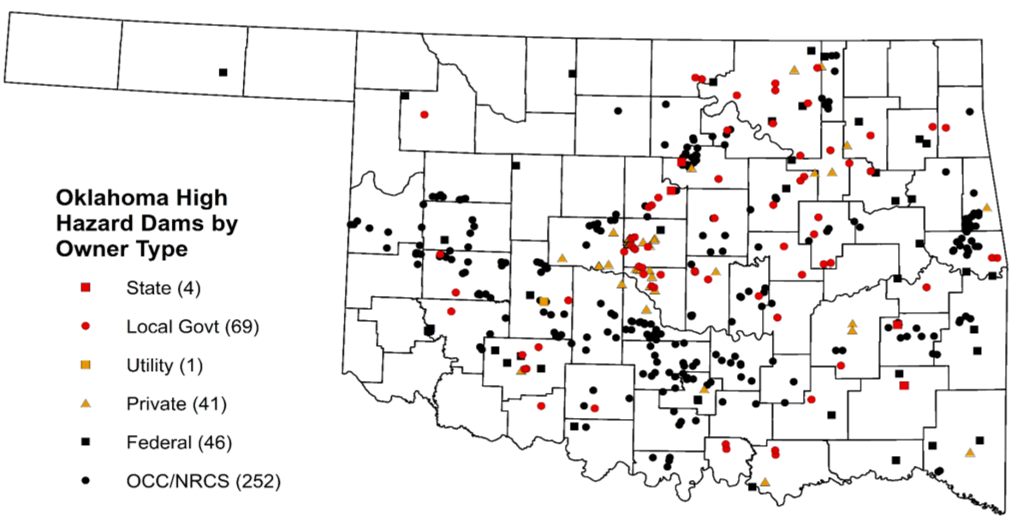


Figure 5: Oklahoma High Hazard Dams by Owner Type. Source: OWRB.

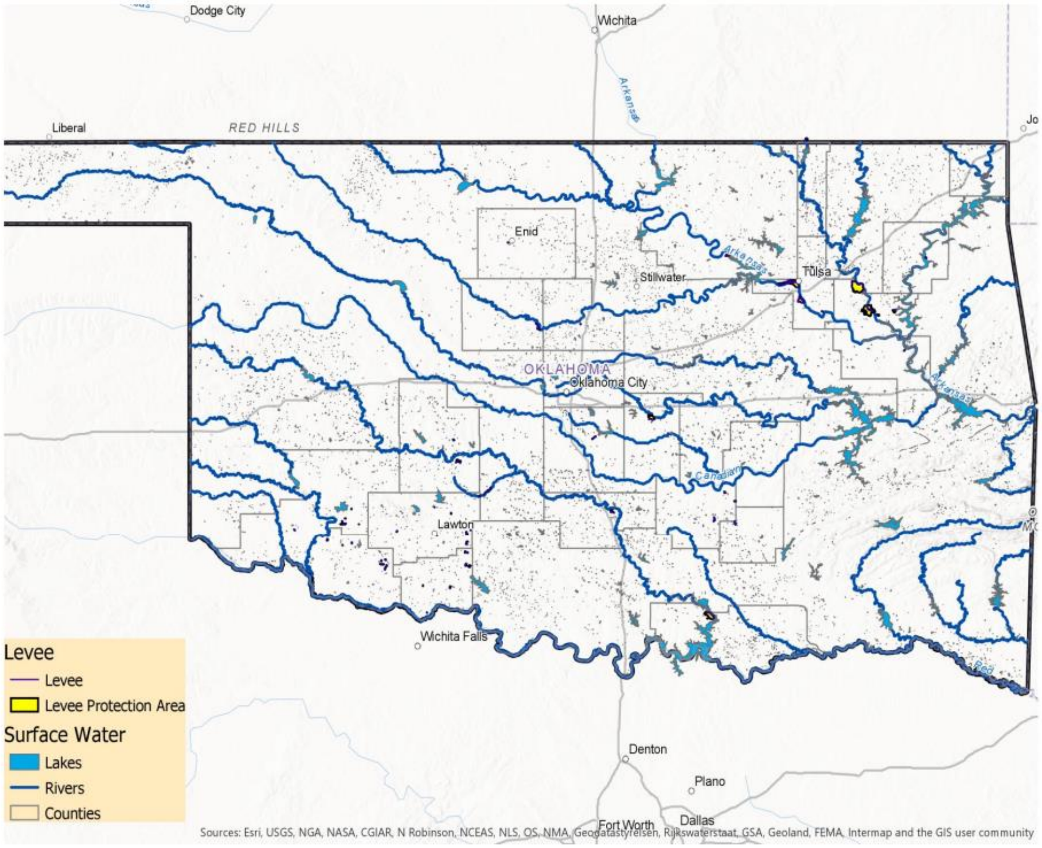


Figure 6: Levees in Oklahoma. Source: OWRB.

Previous Occurrence

There is no comprehensive list of dam failures or incidents that have occurred in Oklahoma. While there is no recorded case in Oklahoma of the failure of a high or significant hazard potential dam that has resulted in loss of life, there have been several incidents that have occurred in which dams have completely failed, and many others where the integrity of a dam was severely compromised and required immediate action to prevent catastrophic failure. Below is a non-exhaustive list of eight dams in Oklahoma that have experienced significant safety incidents.

1945 Wewoka	High Hazard	Complete Failure
1992 Fairfax	High Hazard	Severe Seepage without Failure
2007 Sugar Creek Site-44	High Hazard	Severe Embankment Erosion
2015 Wilson C.	Sig. Hazard	Complete Overtopping Failure
2015 Granada	High Hazard	Near Overtopping
2019 Cushing Lake	High Hazard	Partial Failure, Structural/Foundation
2019 Lakeside of Oakdale	High Hazard	Partial Failure, Structural/Piping

2021 Waxhoma	High Hazard	Partial Failure, Structural/Piping
2022 New Beggs	High Hazard	Severe Overtopping, Damage without Failure

Probability and Risk Calculation

The potential for future dam breaks, while *Unlikely*, is still possible considering the age of many dams throughout the state.

The CPRI for Dam Failure for the State of Oklahoma is:				
Probability	+ Impact	+ Warning Time	+ Duration	= CPRI
(1 x .45)	+ (4 x .30)	+ (3 x .15)	+ (4 x .10)	= 2.50

Vulnerability and Impact

Jurisdictions who are in proximity and downstream to dams that are designated as High Hazard by OWRB have the highest potential vulnerability. This vulnerability includes probable loss of life, significant to overwhelming physical damage to infrastructure and loss of economic resources.

The Oklahoma Water Resources Board regulates over 4,700 jurisdictional dams in Oklahoma which provide flood control, drinking water supply, irrigation, livestock water supply, and recreation. There are many significant impacts in the event of dam failure. Some of the most notable impacts include flash flooding, loss of life, property damage, disruption of lifeline facilities, loss of water supply, displacement of people from their homes, and environmental impacts.

Some of the major dam locations in Oklahoma are those that serve as water supply sources and those in highly populated areas. Dams provide a reservoir for many communities' main sources of potable water. Regardless of community size, the loss of a drinking water reservoir from dam failure would have a significant impact on the community that relies on that water supply. Dams classified as high hazard potential are those where dam failure could potentially cause loss of life. High hazard potential dams located in populated areas could have large downstream populations at risk in the event of dam failure.

Dam maintenance and rehabilitation can pose a financial burden on underserved communities or jurisdictions with limited financial resources. Also, underserved communities or jurisdictions may not have secondary sources of potable water, so the loss of the reservoir from dam failure could leave entire communities without water.

Below are some of the major state regulated dam locations in Oklahoma. These dams have high downstream populations at risk and/or serve as major water supply for large communities.

Dam Owner: **Oklahoma City Water Utilities Trust**
Water supply for population of over 630,000

NID ID	*Dam Name*	*Population at Risk*
OK02535	Hefner	55,481
OK02537	Overholser	68,043
OK02580	Stanley Draper	1,380

Dam Owner: **City of Tulsa**
Water supply for population over 400,000

NID ID	*Dam Name*	*Population at Risk*
OK11023	Yahola	18
OK11025	Spavinaw	800
OK11026	Eucha	802

Dam Owner**: City of Lawton**
Water supply for population over 90,000

NID ID	*Dam Name*	*Population at Risk*
OK00450	Lawtonka Lake	6,805
OK00452	Lake Ellsworth	5,276

Impact on Utilities:

Electricity - The Grand River Dam Authority (GRDA) is a non-profit Oklahoma agency created to control, develop, and maintain the Grand River waterway. It was created by the Oklahoma state legislature in 1935, and is headquartered in Vinita, Oklahoma. GRDA was designed to be self-funding from the sales of electricity and water. According to GRDA's 2022 Annual Report, the agency had nearly US $670 million in operating revenue for 2022, compared to nearly US $397 million in 2020. GRDA operates three hydroelectric facilities and two reservoirs, Grand Lake, Lake Hudson, and the Salina Pumped Storage Project, which includes Lake W. R. Holway. It also owns and operates the GRDA Energy Center (formerly named the GRDA Coal-Fired Complex). GRDA's jurisdiction covers 24 counties in northeastern Oklahoma. GRDA transmits and delivers this electricity across its 24-county service area in Northeast

Oklahoma via a sophisticated energy delivery system. GRDA sells electricity to three customer classes: municipals, electric cooperatives, and industries.

Gas - Transmission pipelines could be breached both through trees being uprooted, affecting the lines in their dripline, and ground being washed out, exposing the pipelines to damage.

Transportation Systems (Highways, Public Transportation, Railway, Airports) - Significant flooding caused by dam failures or high releases would cause some regional road flooding for highways, limiting access to the area. Bridges crossing the nearby rivers and creeks may be overtopped, further limiting ground transportation. In parts of the state such as Mayes County, virtually all major access routes through the county are vulnerable to dam failure including State Hwy 20, State Hwy 28, State Hwy, 82, US Hwy 69, US Hwy 412.

Regional Electrical Service - Southwestern Power Administration (SWPA) was established in 1943 by the Secretary of the Interior as a Federal Agency that today operates within the Department of Energy under the authority of Section 5 of the Flood Control Act of 1944. As one of four Power Marketing Administrations in the United States, Southwestern markets hydroelectric power in Arkansas, Kansas, Louisiana, Missouri, Oklahoma, and Texas from 24 U.S. Army Corps of Engineers multipurpose dams. By law, Southwestern's power is marketed and delivered primarily to public bodies such as rural electric cooperatives and municipal utilities. Southwestern has over one hundred such "preference" customers, and these entities ultimately serve over eight million end-use customers. Southwestern operates and maintains 1,380 miles of high-voltage transmission lines, substations, and a communications system that includes microwave, VHF radio, and state of-the-art fiber optics.

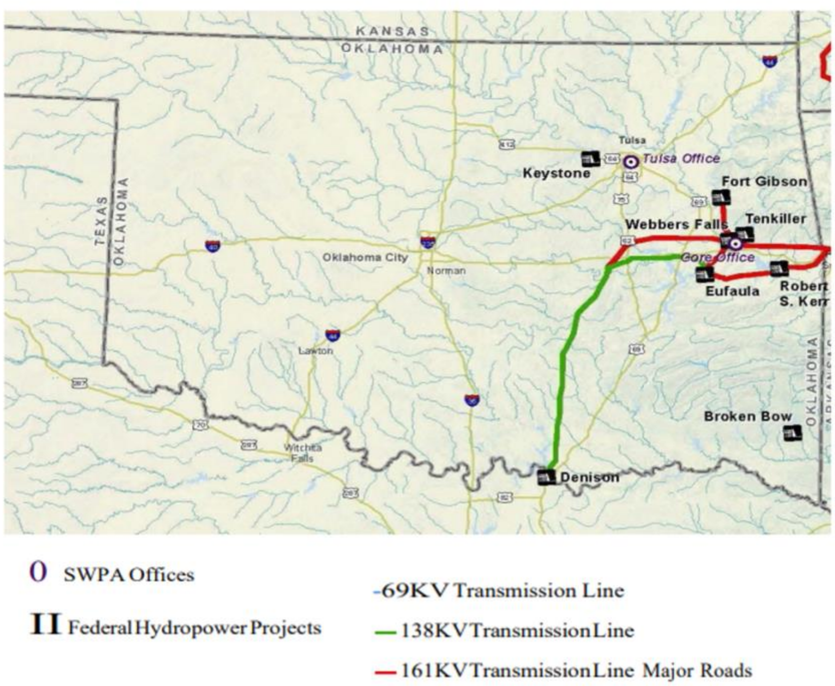


Figure 7: High Voltage Transmission lines. Source: SWPA.

Potential Effects of Climate Change on Dams

The primary concern with the effects of climate change on the safety of dams in Oklahoma is the ability of our existing dams to safely pass storm flows. Dams must be designed to be able to withstand very extreme rainfall events to prevent failure from overtopping, which has been responsible for about 35% of all dam failures that have occurred.

Dams in Oklahoma are required to be designed using an extreme precipitation scenario called Probable Maximum Precipitation (PMP), which is the theoretical maximum precipitation depth that is meteorologically possible for a given location and duration. In 2019, OWRB partnered Applied Weather Associates (AWA) and neighboring states to update the PMP used for the region. The AWA report, *Regional Probable Maximum Precipitation Study for OK, AR, LA, MS* states:

> "The effect of climate change on the number and intensity of extreme rainfall events is unknown as of the date of this report. With a warming of the atmosphere, there can potentially be an increase in the available atmospheric moisture for storms to convert to rainfall (e.g. Kunkel et al., 2013). However, storm dynamics play a significant role in that conversion process and the result of a warming climate on storm dynamics is not well understood. A warmer climate may lead to a change in the frequency of storms and/or a change in the intensity of storms, but there is no definitive evidence to indicate the trend or the magnitude of potential changes regarding PMP level rainfall (Herath et al., 2018). Based on these discussions, it is apparent that the current practice of PMP determination should not be modified to address potential changes associated with climate change. This study has continued the practice of assuming no climate change, as climate trends are not considered when preparing PMP estimates" (WMO 2009, Section 1.1.1).

Because the potential effects of climate change are inconclusive regarding the most extreme events modeled by the PMP, these estimates should be regularly visited to remain current as new data arrives, to ensure that dams and other critical water infrastructure can be protected against extreme flooding.

About 65% of dam failures are caused by internal erosion, foundation defects, structural failure, or other causes. These failure modes most often ultimately relate to either improper construction or maintenance practices. These more common failure modes exist regardless of climate change variables and must be addressed by effective dam safety programs to ensure proper maintenance, design, and construction practices are being followed.

HHPD Section

The table below lists the projects that have been partially funded through the HHPD Rehab program by fiscal year:

Year	Selected Subrecipient	Dam Name	NIDID	Subrecipient Federal Award	Cost Share Contribution
FY19	Oklahoma State University	Lake Carl Blackwell	OK01388	$217,750.00	$117,250.00
	OK Dept. of Tourism	Carlton Lake	OK02175	$59,269.00	$31,914.08
FY20	City of Guthrie	Guthrie Lake	OK02123	$100,555.00	$35,194.25
	OK Dept. of Tourism	Clayton Lake	OK21490	$83,962.00	$29,386.70
FY21	Oklahoma City Water Utilities Trust	Overholser	OK02537	$552,500.00	$297,500.00
	City of Okmulgee	Okmulgee	OK01362	$44,362.00	$23,888.00
	City of Shawnee	Shawnee City Lake Dam No. 1	OK11039	$65,000.00	$35,000.00
	City of Lawton	Lawtonka	OK00450	$105,634.37	$56,882.74
	City of Lawton	Ellsworth	OK00452	$86,017.03	$46,316.87
FY22	Oklahoma City Water Utilities Trust	Overholser	OK02537	$509,100.00	$274,131.00
	City of Lawton	Ellsworth	OK00452	$925,251.00	$498,212.00

A few weeks before the Notice of Funding Opportunity (NOFO) is posted FEMA gathers condition assessment data from the National Inventory of Dams to make their list of eligible projects. The grant application period typically opens in May, but this is not confirmed yet for the FY23. OWRB's grant application is typically due in July, then in September the grant is awarded and OWRB will find out how much will be given for the program, which FEMA bases upon their list of eligible projects for each state that applied. OWRB must use the current NOFO's selection criteria to select eligible projects on a priority basis. They will then contact all eligible sub-applicants based on their priority ranking to find participants and select those that can meet all the additional requirements and have an eligible project planned.

As of May 2023, FEMA has not yet reported a NOFO release date for FY23. Provided from OWRB, the current list of eligible dams from FY22 are as follows:

Eligibility Statement: The state of Oklahoma **has a dam safety program**. All the dams on the list below are **high hazard potential dams** with **state approved EAPs**. None of these dams were **built by USDA/NRCS or licensed by FERC**. All the listed dams **fail to meet the minimum dam safety standards** and have a **documented dam safety deficiency** that was **not caused by lack of routine operation and maintenance or deferred maintenance.**

Initial HHPD Eligibility:

Dam Name	NIDID
Ellsworth	OK00452
Sahoma Lake	OK00566
Stigler Lake	OK00699
Hominy Lake	OK01344
Okmulgee Lake	OK01362
Lake Carl Blackwell	OK01388
Guthrie Lake	OK02123
Carlton Lake	OK02175
Sportsmans Club	OK02426
Overholser	OK02537
Weleetka	OK10076
Jim Hall Lake	OK10237
Wewoka	OK10487
Hobart	OK10494
Clinton Lake	OK10497
Cushing Lake	OK10642
Waxhoma	OK10731
Shell Creek Lake Dam	OK11015
Hunter	OK11027
Shawnee City Lake No.1	OK11039
Pawhuska Lake Dam	OK11044
Nichols Lake	OK11079
Blue River Dam	OK21346
Clayton Lake	OK21490
Lawtonka	OK00490

Ongoing HHPD projects include: Overholser, Ellsworth, Lawtonka, and Shawnee No.1.

Projects currently being finalized include: Carlton, Clayton, Blackwell, and Okmulgee.

See specific HHPD Chapter for more information.

3.4.2 DROUGHT

Description

A drought is defined as "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area." (Glossary of Meteorology). In easier to understand terms, a drought is a period of unusually persistent dry weather that persists long enough to cause serious problems such as crop damage and/or water supply shortages. The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area.

There are four different ways that drought can be defined.

- *Meteorological* - a measure of departure of precipitation from normal. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.

- *Agricultural* - refers to a situation where the amount of moisture in the soil no longer meets the needs of a particular crop.

- *Hydrological* - occurs when surface and subsurface water supplies are below normal.

- *Socioeconomic* - refers to the situation that occurs when physical water shortages begin to affect people.

Location

Drought can be experienced across the entire state of Oklahoma. As seen on the figures below, almost the entire state of Oklahoma has seen at least one level of drought based on the U.S. Drought monitor, from 2019 to 2022. The Oklahoma panhandle just itself saw the entire range of the drought monitor, while counties such as Adair and Sequoyah saw No level of drought to D0 (Abnormally Dry).

The following U.S. Drought Monitor maps provided below correspond with the date of events listed in the previous occurrence section.

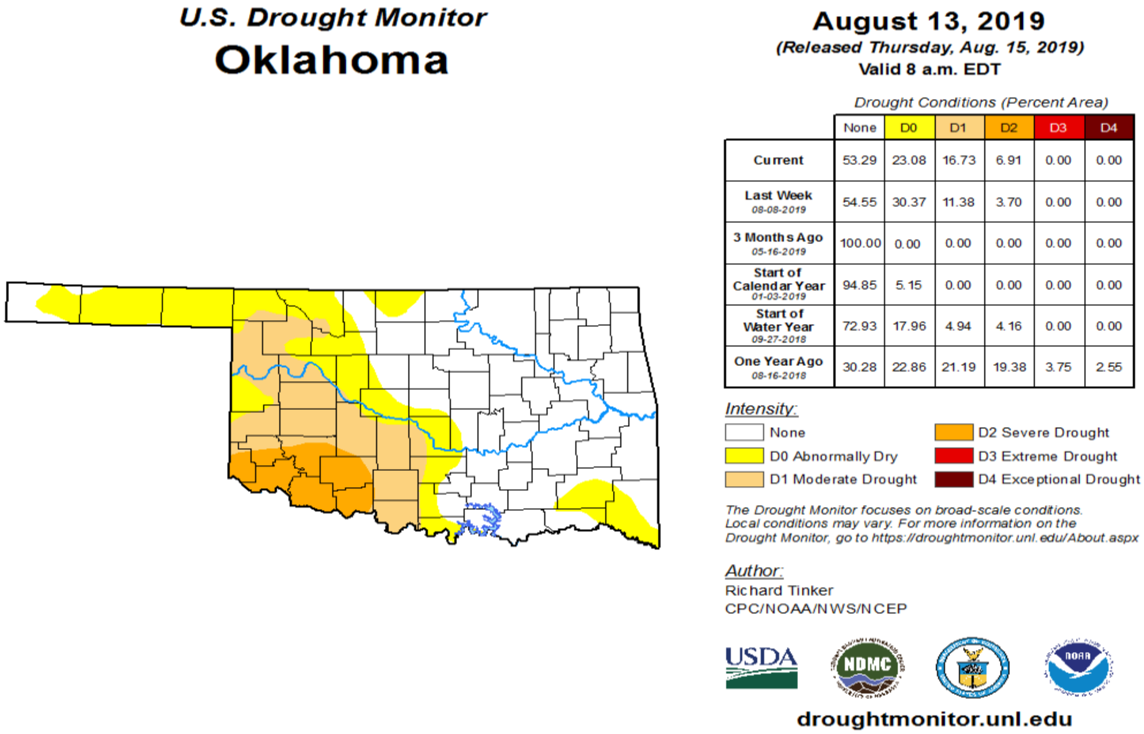


Figure 8: U.S. Drought Monitor August 13, 2019. Source: National Drought Mitigation Center.

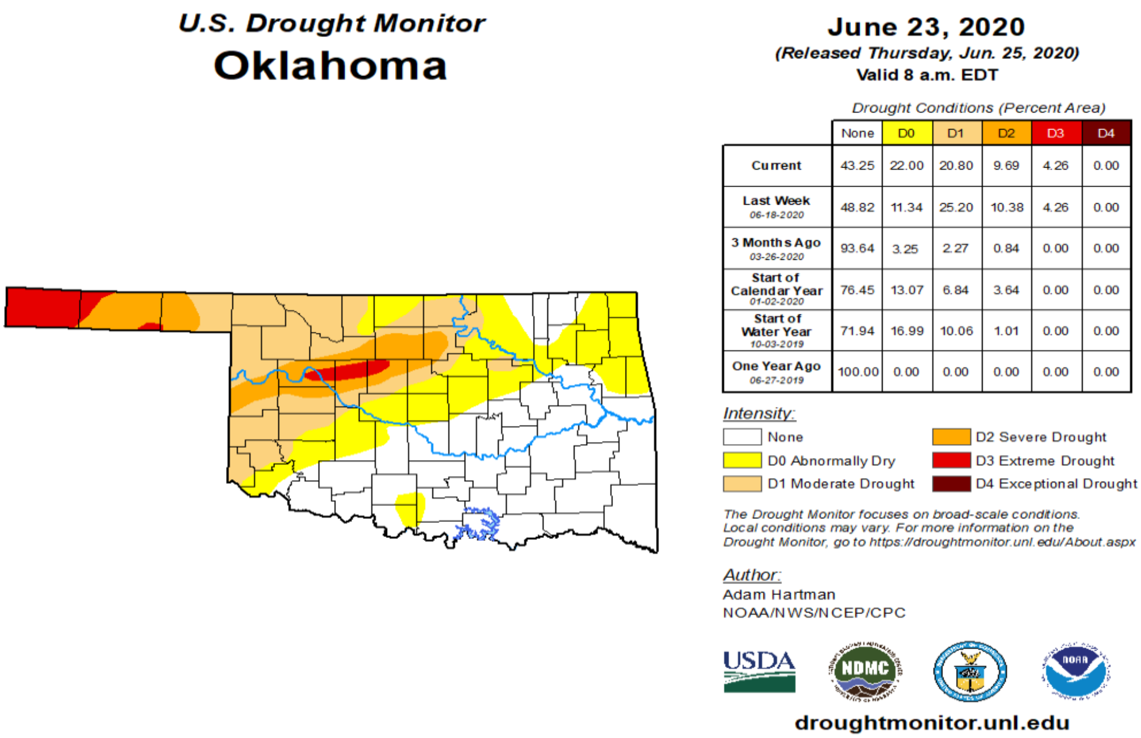
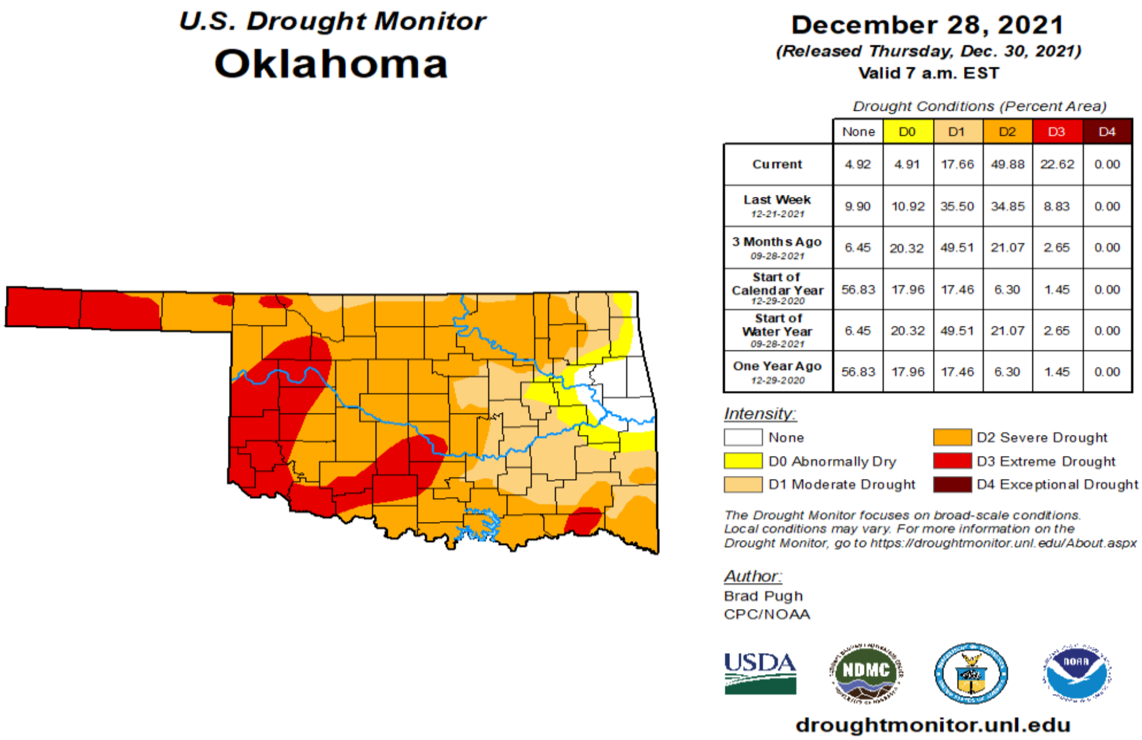
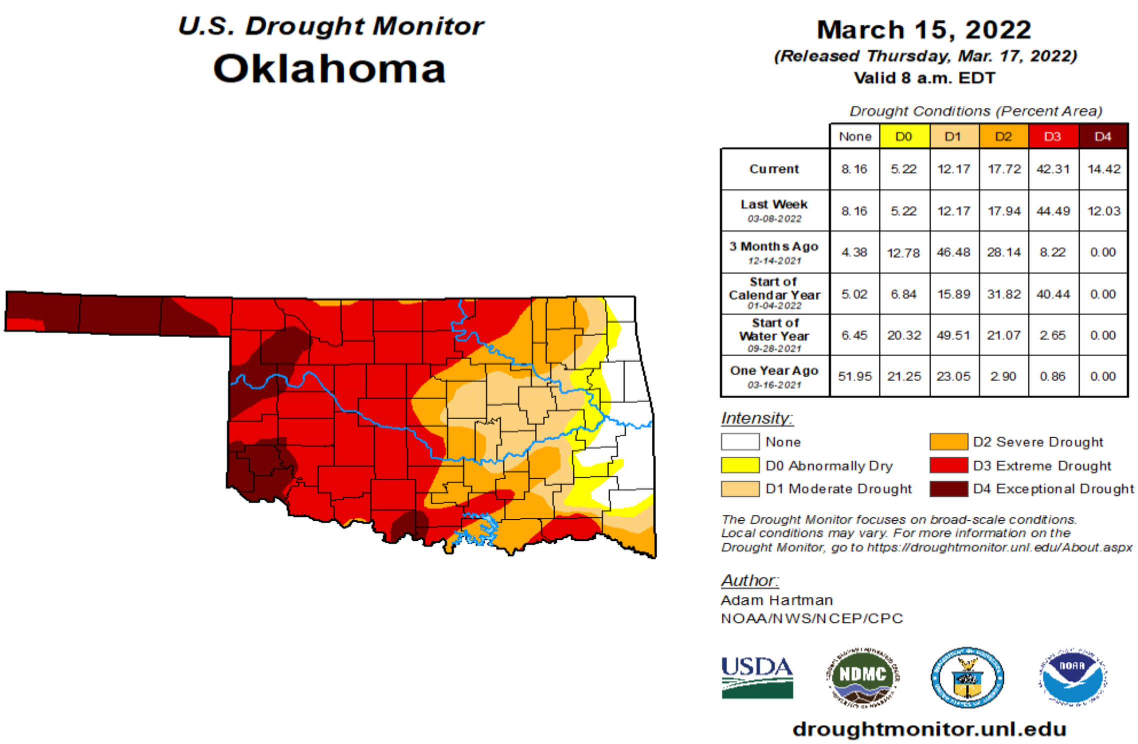


Figure 9: U.S. Drought Monitor June 23, 2020. Source: National Drought Mitigation Center.



	None	D0	D1	D2	D3	D4
Current	4.92	4.91	17.66	49.88	22.62	0.00
Last Week 12-21-2021	9.90	10.92	35.50	34.85	8.83	0.00
3 Months Ago 09-28-2021	6.45	20.32	49.51	21.07	2.65	0.00
Start of Calendar Year 12-29-2020	56.83	17.96	17.46	6.30	1.45	0.00
Start of Water Year 09-28-2021	6.45	20.32	49.51	21.07	2.65	0.00
One Year Ago 12-29-2020	56.83	17.96	17.46	6.30	1.45	0.00

Figure 10: U.S. Drought Monitor December 28, 2021. Source: National Drought Mitigation Center.



	None	D0	D1	D2	D3	D4
Current	8.16	5.22	12.17	17.72	42.31	14.42
Last Week 03-08-2022	8.16	5.22	12.17	17.94	44.49	12.03
3 Months Ago 12-14-2021	4.38	12.78	46.48	28.14	8.22	0.00
Start of Calendar Year 01-04-2022	5.02	6.84	15.89	31.82	40.44	0.00
Start of Water Year 09-28-2021	6.45	20.32	49.51	21.07	2.65	0.00
One Year Ago 03-16-2021	51.95	21.25	23.05	2.90	0.86	0.00

Figure 11: U.S. Drought Monitor August 13, 2019. Source: National Drought Mitigation Center.

Previous Occurrence

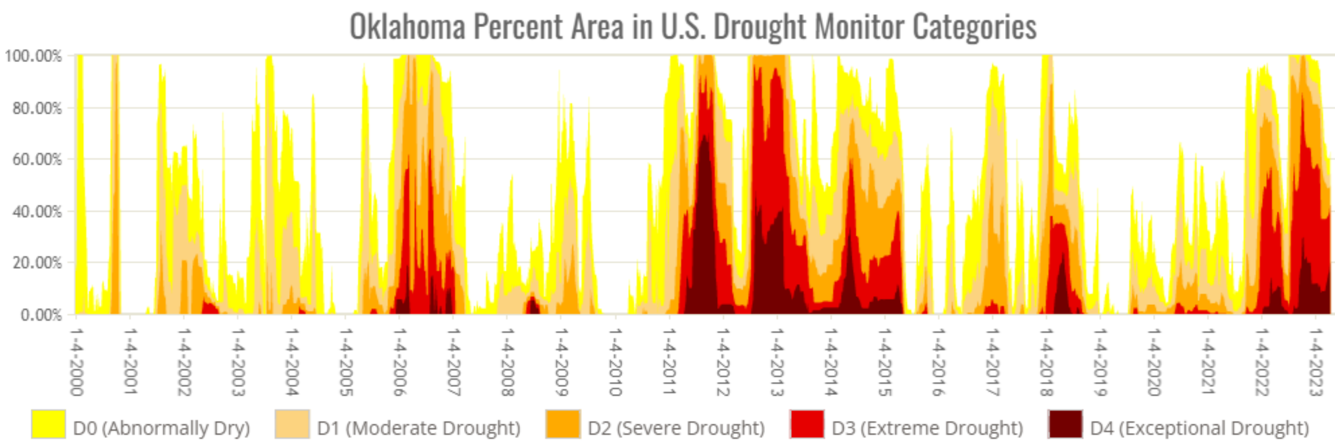


Figure 12: Percent of Oklahoma under D0-D4 Level of Drought Since 2000. Source: OCS.

Category	Description	Possible Impacts	Palmer Drought Severity Index (PDSI)
D0	Abnormally Dry	Going into drought: • Short-term dryness slowing planting, growth of crops or pastures Coming out of drought: • Some lingering water deficits • Pastures or crops not fully recovered	-1.0 to -1.9
D1	Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	• Crop or pasture losses likely • Water shortages common • Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

Figure 13: U.S. Drought Monitor Categories. Source: National Drought Mitigation Center.

The graph above details the percent of the state that was under the Drought Designator of D0 through D5 from 2000 through April of 2023. Those areas on the graph that have multiple drought classifications and multi-year periods indicate those periods that have been classified as having a drought. The classification of the category of Droughts is detailed in the following graph, including their associated impacts, of which the state may experience all five levels of drought classification.

Since the last plan update in 2019, the peak for drought according to the chart above was in August of 2019. No area of the state was in a D3-D4 status of Extreme Drought, but approximately 7% was in a D2 Severe Drought, 16.7% was under D1 Moderate Drought, and 23.1% of the state area was classified as D0, Abnormally Dry. Making a total of approximately 46.8% of the state area in a drought level of D0-D4.

In 2020 the peak for drought was in June when approximately 4.3% of the state area was in a D3-D4 status of Extreme Drought. Approximately 9.7% was in a D2 Severe Drought, 21% of the area was under D1 Moderate Drought, while 22% was classified as D0, Abnormally Dry. Making a total of approximately 56.8% of the state area in a drought level of D0-D4.

In 2021 the peak for drought was at the end of December when approximately 22.6% of the state area was in a D3-D4 status of Extreme Drought. Approximately 50% was in a D2 Severe Drought, 17.7% was under D1 Moderate Drought, while 4.9% was classified as D0, Abnormally Dry. Making a total of approximately 95.1% of the state area in a drought level of D0-D4.

In 2022 the peak for drought was in March when approximately 14.4% of the state area was in a D4 status of Exceptional Drought while 42.3% was in a D3 status of Extreme Drought. Approximately 17.7% was in a D2 Severe Drought, 12.2% of the area was under D1 Moderate Drought, and 5.2% was classified as D0, Abnormally Dry. Making a total of approximately 91.8% of the state area in a drought level of D0-D4.

Another source that can be used to measure drought is The Palmer Drought Severity Index (PDSI), *Figure 10* depicts prolonged (months, years) abnormal dryness or wetness. It is a standardized index that spans -10 (dry) to +10 (wet). Based on the Palmer Drought Index, Oklahoma can experience the entire range.

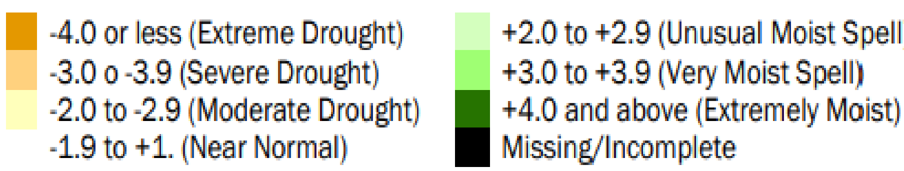


Figure 14: Palmer Drought Severity Index (PDSI). Source: UCAR.

Probability and Risk Calculation

The probability of experiencing a drought anywhere in Oklahoma is *Likely*.

The CPRI for Drought for the State of Oklahoma is:				
Probability	+ Impact	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (3 x .30)	+ (1 x .15)	+ (4 x .10)	= 2.8

Vulnerability and Impact

The State of Oklahoma's vulnerability to drought is rated as *Likely* due to the effect on its livestock, agriculture, and therefore, the economy. This rating was based on previous occurrences, probability of future events and the cycle of drought that plagues the state of Oklahoma.

There are many vulnerabilities to drought and the impacts can be seen in various ways across the state of Oklahoma. Depending on the timing and length of individual drought episodes, the impacts can vary across the state. The most direct impact of drought can be seen as economic rather than loss of life or destruction of property. Economic loss is one of the greatest impacts of drought that is usually experienced in agricultural communities. Drought can be damaging to crops and livestock due to the increased wildfire risks, reduced water supply, and the increase in insect infestations, plant disease and wind erosion. A vast majority of the state of Oklahoma is made up of rural communities who are dependent on agriculture for their economy, so impacts such as these can be devastating for a community. It should also be noted that lake and outdoor recreation is a sector that can experience significant effects during periods of drought in areas of the state where outdoor recreational activities take place and are even used as a source of revenue for the economy. Lowered water levels on lakes not only influence the water supply but can also produce damage to docks and marinas that line the lake which can lead to a significant cost of repair and loss of business.

Droughts rid the soil and vegetation from essential moisture, creating potentially dangerous vegetative fuels for wildfires (for further discussion on wildfires, please refer to Section 3.3.9). During periods of drought, the risk of wildfires in certain areas of the state can lead to burn bans being put in place to help limit the risk of a wildfire occurring. If a wildfire were to occur during a period of drought, there is also a risk of a shortage of water supply to battle the wildfire.

A shortage of water supply can affect emergency situations such as battling wildfires, businesses, farmers and even as far down as individuals' daily lives. As most of us could say in our daily life, it is hard to put into perspective the amount of water we use daily. Between showers, restrooms, laundry, dishes, cooking, watering the lawn, etc. it is hard to imagine the level of our daily lives that would be affected if there were a water shortage. During a drought, water conservation ordinances or other water bans might be put into place to conserve water. These ordinances might look different throughout the state, and most have different levels to them that can be put into effect depending on the needs of the jurisdiction and on the level of drought they are facing. Schools within the state can also see impacts from a water shortage. If water supply were to be interrupted due to a drought, schools might no longer be able to water their ball fields and greenery on their campuses. This could lead to ball fields getting dry and cracked which could lead to school kids being injured and/or the complete shutdown of these fields and sports/activities. The loss of greenery on school campuses can also lead to dead or dry vegetation that could be used to fuel a wildfire.

During times of drought a lack of rainfall can lead to reservoirs and other water sources that are being depleted with no source to replenish for consumption. This can lead to a lack of available water sources while also increasing the risk for what is available to become contaminated. Because of these risks, it is important to have a backup source of water readily available, which may not be an option for some jurisdictions or even populations within the state of Oklahoma. Having backup water sources during times of drought is essential if a water shortage may occur. Smaller jurisdictions with smaller budgets may not be able to purchase backup water, or maybe not in the amount needed for their jurisdiction in the event of a water shortage. This is cause for concern because this may lead to those within the jurisdiction to not have a backup source of water, which can lead to sickness, a loss of business such as crops, or they might need to leave the area. Those with little to no backup water sources may need to seek out water sources from nearby jurisdictions which can lead to a depletion of the sources they have available for their jurisdiction. Specific populations that are vulnerable during the case of a water shortage during times of drought are the homeless, who may not have readily available water in any situation; the disabled and elderly who may not be able to easily leave their homes to access water; those with a language barrier who may not be able to ask where to seek water; those with no means of transportation which may make it harder to access water especially if they have to leave their jurisdiction to seek it; etc.

Other vulnerabilities to drought may be the depletion of soil moisture which can result in cracks and shifts in the ground as well as in structures above it, which can lead to issues, repairs, and costs for the built environment. Underground utility lines such as sewer, water and gas lines may experience damages also due to moisture depletion in soil due to the soil contracting and shifting which can impact the integrity of these utility lines.

According to the U.S. Drought Monitor created by the National Drought Mitigation Center, some of the impacts associated with drought from January 2012 through January 2023 are as follows.

2012:

June - Water conservation ordinance in Enid, OK to take place when drought depletes the city’s water supply. During phase one even number addresses are allowed to water on even-numbered days while odd-numbered addresses may water on odd-numbered days. During phase two water restrictions will take place and only hand watering will be allowed.

July - The city of Enid was forced to enact phase one of their conservation ordinance due to the city pumping 16- 17 million gallons of water daily, with a max capacity of 19 million gallons.

2017:

February - Due to ongoing drought and parched vegetation increasing the fire danger, Oklahoma was placed in a National Fire Advisory for two weeks while Cole, Haskell and Marshall counties were placed under a burn ban. Oklahoma’s Army National Guard sent two of its Black Hawk teams to Tulsa to fight any wildfires that would start due to the strong winds and severe drought they were facing.

March - Due to high winds and a continued severe drought, Oklahoma wildfires destroyed more than 782,000 acres.

2018:

January - Due to drought conditions, the growth of winter wheat and other cold-season forage was slowed while pasture conditions continued to grow poor and deteriorate. This led to cattle being forced to be sent to market early.

April - 52 counties were under a State of Emergency as more than 200,000 acres of land were burned from a wildfire due to high winds and severe drought.

2020:

West Central Oklahoma experienced wheat faltering while pastures and rangelands across the state were continuing to deteriorate. Due to the lack of moisture, Oklahoma's winter wheat crop landed in a critical stage.

2022:

July - For two weeks, the City of Mustang Fire Department suspended all burn permits due to dry conditions, heat, and humidity.

Impacts of Medical Marijuana on Drought

In 2018, Oklahoma legalized medical marijuana farming, but the law did not limit the amount of marijuana grown. As a result, marijuana farming increased in a very short time. As of 2023 there are 6,781 marijuana growing facilities across the state. The highest concentration of these facilities is in the following counties: Cleveland, Oklahoma, Logan, and Tulsa, but every county across the state has a grow facility.

Marijuana is a crop that requires high water demand, which puts a strain on water resources during normal conditions, and particularly during times of Drought. In 2021, representatives from the Oklahoma Rural Water Association presented information to the OK House Agriculture Committee regarding how marijuana grow houses are impacting rural water systems. This increase in demand is taxing some of the rural water infrastructure systems which are aging.

Another vulnerability is the increased presence of black-market marijuana, and how the production of marijuana far exceeds what is necessary to supply the state's medical marijuana demand. Law enforcement officials have stated that the high volume of marijuana production coming out of Oklahoma is one of the main suppliers of US black market marijuana, and some of the farms are being run by illegal cartels. This further taxes the state's water resources.

Oklahoma regularly experiences Drought, and it is expected to continue, if not increase, in the future. The impact of having a high-water demand crop, particularly one whose production far exceeds the state's demand for medical marijuana, puts all water resource infrastructure at risk. It negatively impacts residents, municipal water supplies, ranchers, and other farming operations. In addition, criminal cartels who operate marijuana grow facilities in Oklahoma will most likely not adhere to any municipal water restrictions during times of Drought, furthering the cascading consequences to the population and their water sources.

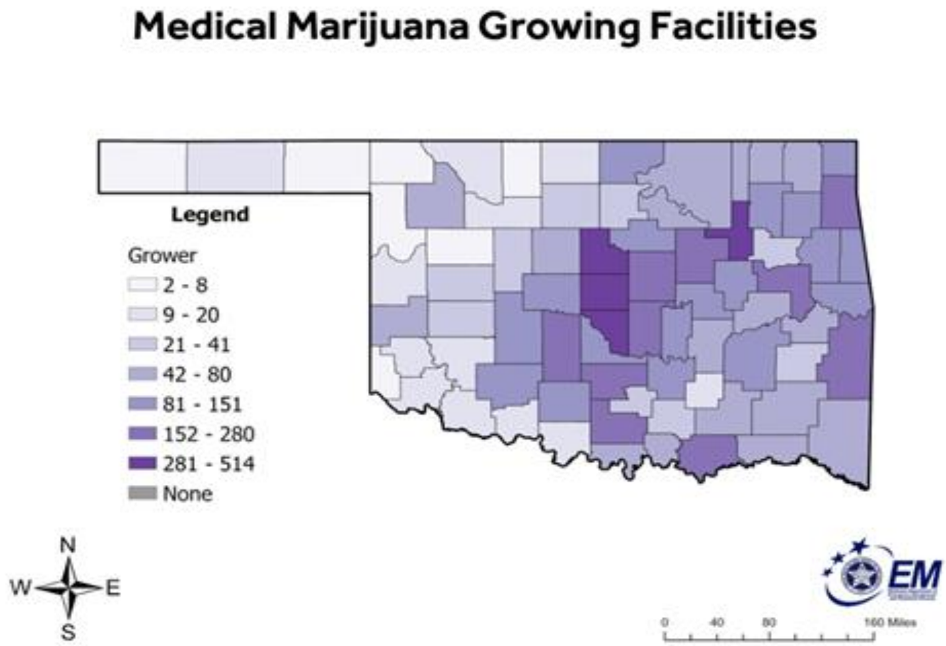


Figure 15: Medical Marijuana Growing Facilities. Source: ODEMHS.

In addition, according to FEMA's National Risk Index for Drought, Oklahoma experiences a wide range of risk. The Oklahoma panhandle counties of Cimarron, Texas, and Beaver, as well as a few in the central-eastern part of the state rank the highest with a "relatively moderate" risk of drought. There are only three counties in the state with a "very low" risk of drought. Apart from two counties with no rating, all other counties in the state have a "relatively low" risk rating to drought.

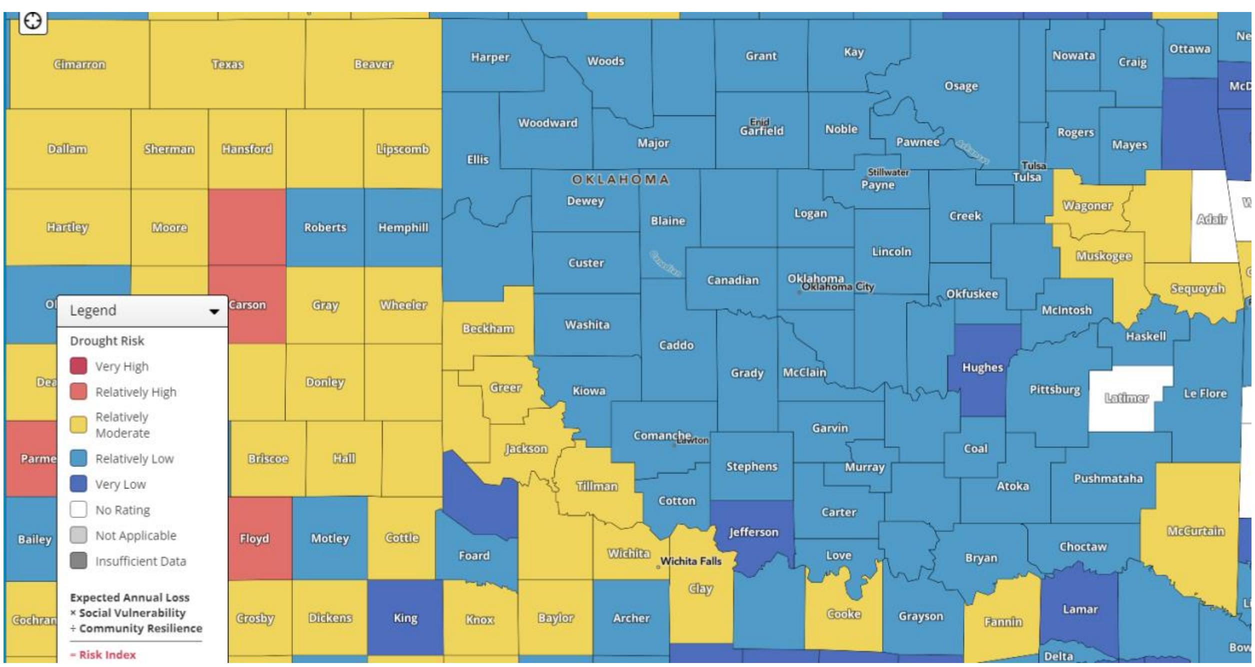


Figure 16: FEMA Risk Index for Drought in Oklahoma. Source: FEMA.

Effects of Climate Change

Drought has always been part of Oklahoma's climate because of highly variable precipitation patterns. However, droughts are projected to increase in severity and frequency in the future (Frankson et al. 2022). Even if annual precipitation amounts do not change much, higher temperatures will increase evaporation from lakes, soils, and plants, stressing agricultural and natural systems. Models project that Oklahoma will experience a decrease in soil moisture across all seasons by the end of the century, with the greatest decrease in the summer (Wehner et al. 2017). Further, rising temperatures will lead to increased demand for water and energy, which could stress natural resources (Shafer et al. 2014). Projections of overall annual precipitation do not indicate a clear trend. Although summer precipitation is projected to decrease slightly across the state (Figure X), the decreases are smaller than natural variations. Even if summer precipitation remains the same, higher temperatures will increase evaporation rates and decrease soil moisture, leading to increased intensity of future droughts and increased risk of severe wildfires.

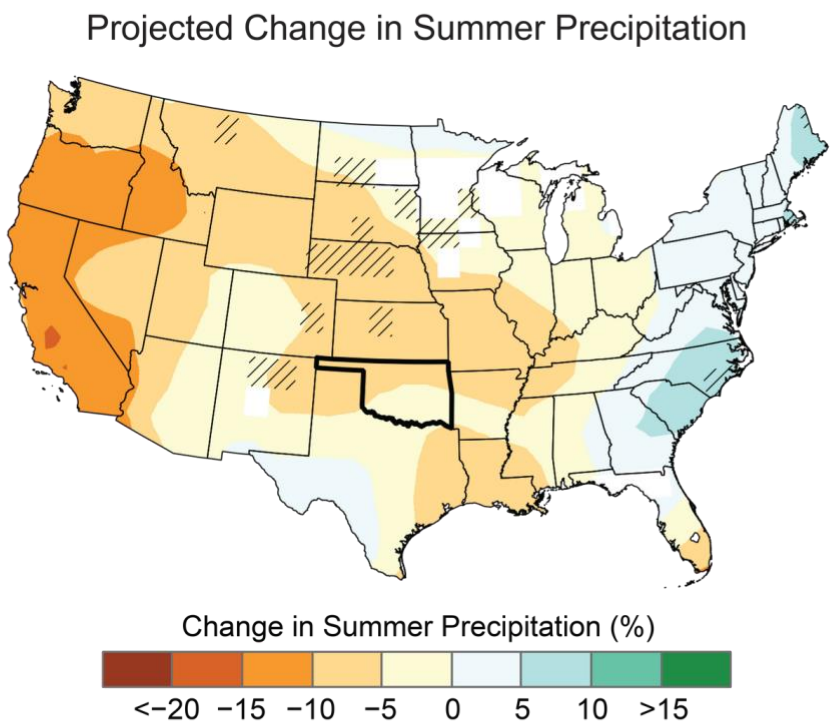


Figure 17: Change in Summer Precipitation. Source: NCICS (https://statesummaries.ncics.org/chapter/ok/).

3.4.3 EXTREME HEAT

Description

Extreme heat is defined as unusual hot weather (maximum, minimum, daily average) over a region persisting at least two consecutive days based on local climatological conditions, with thermal conditions recorded above given thresholds (WMO 2015). There is no uniform set of attributes that define a heat wave, but events involving persistent hot extreme temperatures can produce negative impacts on ecosystems, the local economy, and human morbidity and mortality. The onset of a heat wave can be subtle and does not result in structural damage like other meteorological events. Extreme heat waves in urban areas can be particularly harmful due to the urban heat island environment in which they occur. Even in rural areas extreme temperatures can significantly damage crops, especially if too hot of temperatures occur during critical growth periods. Certainly, hot temperatures dramatically increase the rate of evaporation off crop fields and farmers must irrigate at much higher rates to maintain growth. Meteorologists use different ways to describe heat waves, including daytime high and overnight low temperatures, duration, moisture, and relation to the climate variability observed at a given location.

Location

The entire state of Oklahoma can experience Extreme Heat. The figure below provided from the Oklahoma Climatological Survey shows the average number of days per year with temperatures above 90 degrees from 1991 through 2020. The entire state of Oklahoma experienced an average of at least 40 days per year with temperatures above 90 degrees, with the southwestern part of the state experiencing over an average of 100 days per year with temperatures above 90 degrees. Many parts of the state also experience temperatures over 100 degrees with southwest Oklahoma having the most days.

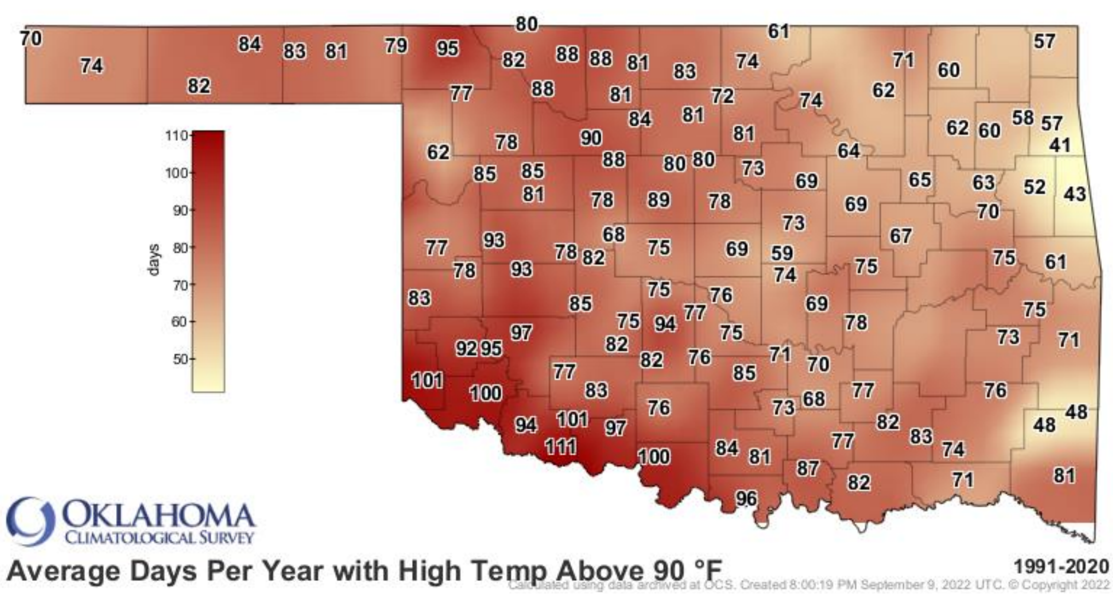


Figure 18: Average number of days per year when the high temperature is 90°F or hotter. Source: OCS.

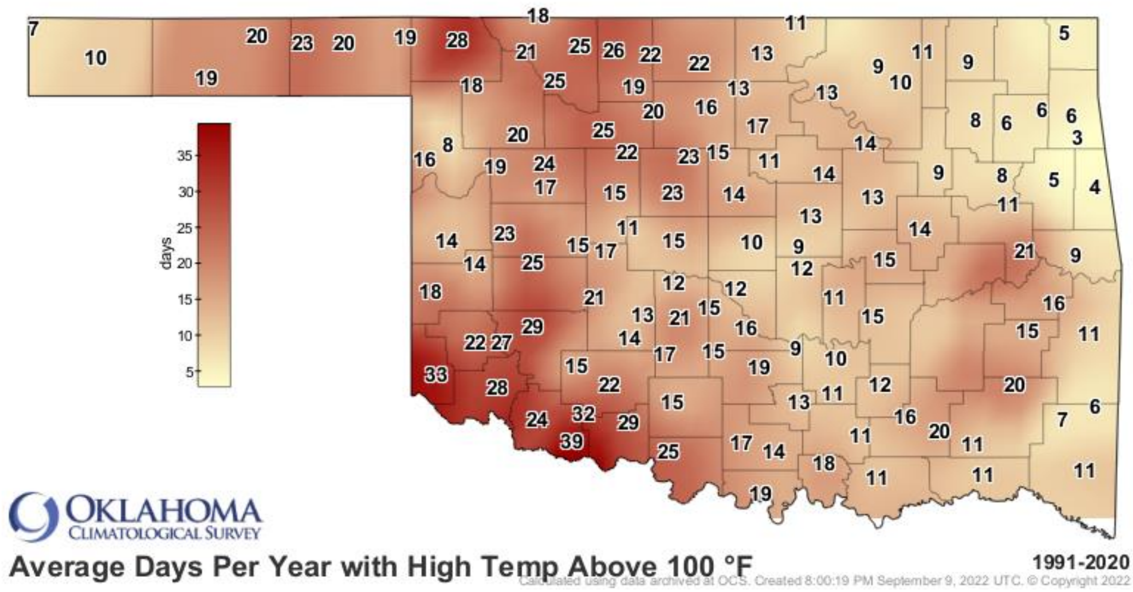
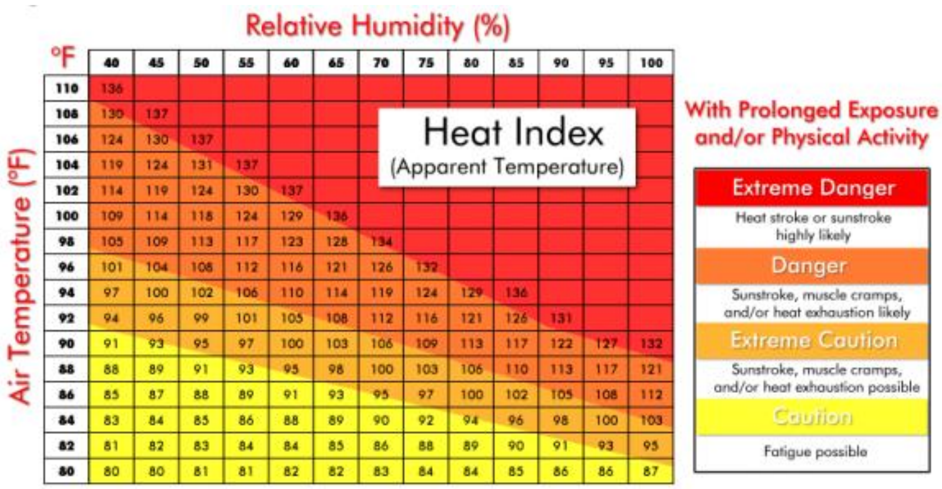


Figure 19: Average number of days per year when the high temperature is 100℉ or hotter. Source: OCS.

Previous Occurrence

As mentioned in the Location section, the entire state of Oklahoma can experience extreme heat. Although the typical period for Oklahomans to experience temperatures above 90 degrees is June through August, high temperatures can be seen anytime of the year. The figures above (in the location section) show the average number of days per year with temperatures above 90 and 100 degrees from 1991 through 2020. Alfalfa, Cotton, Custer, Dewey, Grady, Harmon, Harper, Jackson, Jefferson, Love, Marshall, Major, Tillman, and Woods are just a few of the counties who experienced a high number of days with temperatures above 90 and 100 degrees.

A source that can be used to “measure” extreme heat, is the Heat Index and Heat Disorders Table. This table displays varying degrees of caution depending on the relative humidity combined with the temperature. The shaded zones on the chart indicate varying symptoms or disorders that could occur depending on the magnitude or intensity of the event. “Caution” is the first level of intensity where fatigue due to heat exposure is possible. “Extreme Caution” indicates that sunstroke, muscle cramps or heat exhaustion are a possibility. “Danger” level means that these symptoms are likely. “Extreme Danger” indicates that heat stroke or sunstroke is highly likely. The entire state of Oklahoma is susceptible to the entire range depicted in this chart, as temperatures in Oklahoma can be seen above 100 degrees.



°F	40	45	50	55	60	65	70	75	80	85	90	95	100
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	102	106	110	114	119	124	129	136			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	106	109	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Figure 20: Heat Index Chart. Source: NWS.

Another source that can be used for extreme heat is the Wet Bulb Globe Temperature (WBGT) metric. According to the National Weather Service (NWS), this is a measure of the heat stress in direct sunlight, which considers: temperature, humidity, wind speed, sun angle and cloud cover. This is different from the heat index, which takes into consideration temperature and humidity and is calculated for shady areas. WBGT can be used to relate temperature levels to their effects on human health and is a good element to monitor for those who work or exercise in direct sunlight. What to do while doing outdoor activities when the WBGT is high will be provided in the vulnerabilities and impacts section.

Risk	WBGT	Heat Impacts
Low	80°F - 85°F	Body stressed After 45 minutes.
Moderate	85°F - 88°F	Body stressed after 30 minutes. Heat cramps likely (painful contraction of muscles, weakness).
High	88°F - 90°F	Body stressed after 20 minutes. Heat exhaustion likely (dizziness, nausea, vomiting, headache, fainting, disorientation, weakness).
Extreme	> 90°F	Body stressed after 15 minutes. Heat stroke likely (extremely high body temperature, confusion, convulsions, unconsciousness, death).

Figure 21: Wet Bulb Globe Temperature (WBGT) and corresponding heat impacts. Source: NWS.

Probability and Risk Calculation

The probability of experiencing extreme heat anywhere in Oklahoma is *Likely*.

The CPRI for Extreme Heat for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(3 x .45)	+ (2 x .30)	+ (1 x .15)	+ (2 x .10)	= 2.3

Vulnerability and Impact

Extreme heat can take its toll on all people within the state of Oklahoma, however, there are certain populations within the state who have a higher risk of the effects of extreme heat. These populations include but are not limited to the following:

- Individuals 65 years and older, especially those who live under the poverty line
- Children under 5 years old, especially infants
- Socially isolated individuals
- Disabled individuals
- Individuals under the influence of alcohol or medications
- Individuals and families living below the poverty line
- Outdoor workers
- Those without homes
- Those without access to air conditioning

For schools within the state of Oklahoma, children playing outside during recess, outdoor events, or during sporting events are at an increased risk of heat illness during times of extreme heat. It can be easy for these individuals to miss signs of oncoming heat illnesses. Many individuals may also have a lack of education on heat illness and what to do to prevent it and how to care for it. When temperatures reach 90 degrees and above, people and animals are more likely to suffer sunstroke, heat cramps, and heat exhaustion.

The local Red Cross, public utilities, fire agencies, County health department, and other volunteer organizations implement short-term programs such as fan and air conditioner distribution, senior checkups, and voluntary or mandatory water conservation. Communities and rural residents have historically managed to address short-lived Drought or Extremely Hot/Dry Seasonal Weather with volunteer activities such as those mentioned above. Cooling stations can also be set up and utilized during extreme heat events especially during times where there is a loss of power. Extreme heat can cause brownouts and loss of power due to the electricity grids inability to keep up with the demand, but this is not the only time the power can be lost during extreme heat. Oklahoma is no stranger to severe weather and severe weather can happen any time of the year. If severe weather were to take place during the summer months and cause damage, there could be a loss of power for those affected, and a loss of power means a loss of air conditioning. Cooling stations should then be utilized for those without power to have access to air conditioning. Generators are also needed at all critical facilities, including schools, to maintain operability in a power outage during times of extreme heat. It is also recommended for towns, cities and/or counties to have a procedure in place to assist the underserved populations such as those who have no access to power, or air conditioning. Having a cooling station available during the hottest days of the summer, or during days of extreme heat, that is available for those who might not have resources otherwise, would be beneficial.

The loss of livestock and crops because of extreme temperature events has the potential to affect the economic stability for parts of the state who are primarily an agriculture-based community, the loss of livestock and crops would directly affect residents in these areas.

Municipal water systems often have an increased burden of keeping sufficient water supply to their citizens during periods of extreme heat, especially when low or no rainfall is occurring. During periods of extreme heat, towns to cities to counties within the state are at risk of a decrease or loss of water supply due to the large demand needed. If water supply gets too low, some areas may need to implement water conservation laws and practices until the water supply is back in order. This could lead to schools not being able to water their fields properly which could lead to cracks and dry spots in ball fields which could lead to injury to school kids.

According to NWS, what to do while doing outdoor work or activities when the WBGT is high:

1) *Take frequent breaks in the shade*. Strenuous outdoor activities should be limited, especially when in direct sunlight where there is little ventilation.
2) *Drink plenty of water or other non-alcoholic fluids*. The body needs water to keep cool so drink plenty of fluids even if you do not feel thirsty.
3) *Don’t get too much sun*. Sunburn makes heat dissipation much more difficult.

In addition, according to FEMA’s National Risk Index for heat waves, Oklahoma experiences a wide range of risk. Oklahoma and Tulsa County rank the highest with a “very high” risk to heat waves while counties in the northeast part of the state such as Creek, Rogers, Wagoner, and Sequoyah, have a “relatively high” risk to heat waves. Apart from the Oklahoma panhandle, counties throughout the western half of Oklahoma have a “relatively low” risk rating to heat waves.

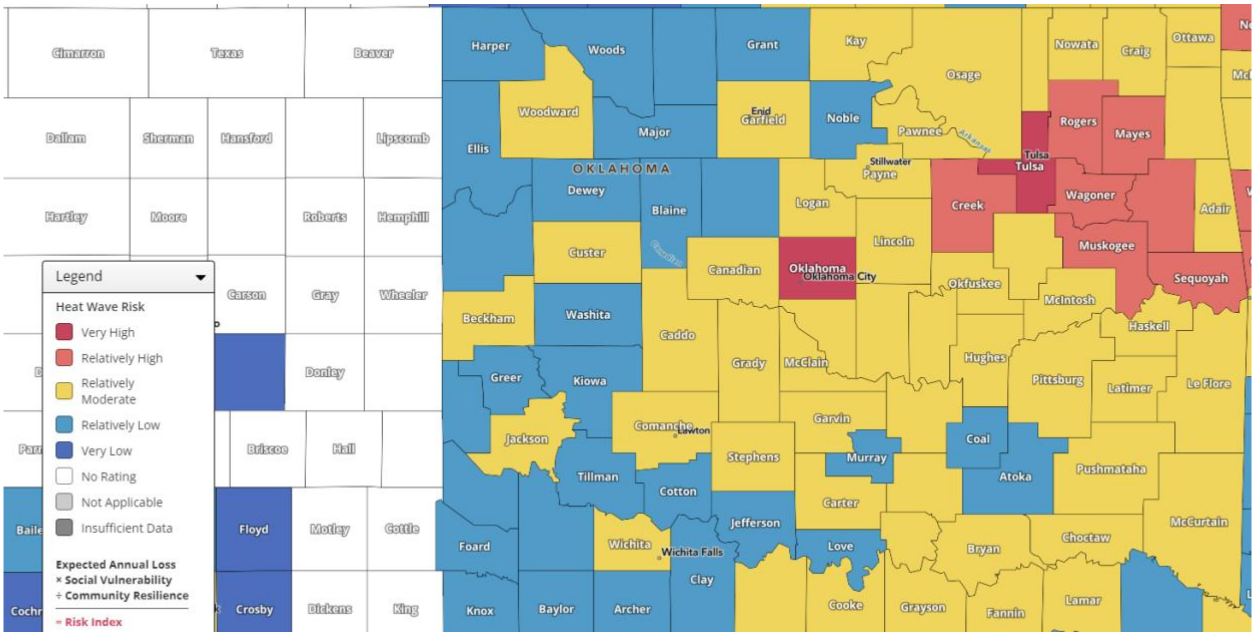


Figure 22: FEMA Risk Index for Extreme Heat in Oklahoma. Source: FEMA.

Effects of Climate Change

South Central Climate Adaptation Science Center or South Central CASC predicts that temperatures across the region will continue to increase throughout the future. In the figures below there is a low versus a high scenario and the difference between these scenarios they believe are dependent on whether there is a significant reduction in greenhouse gas emissions.

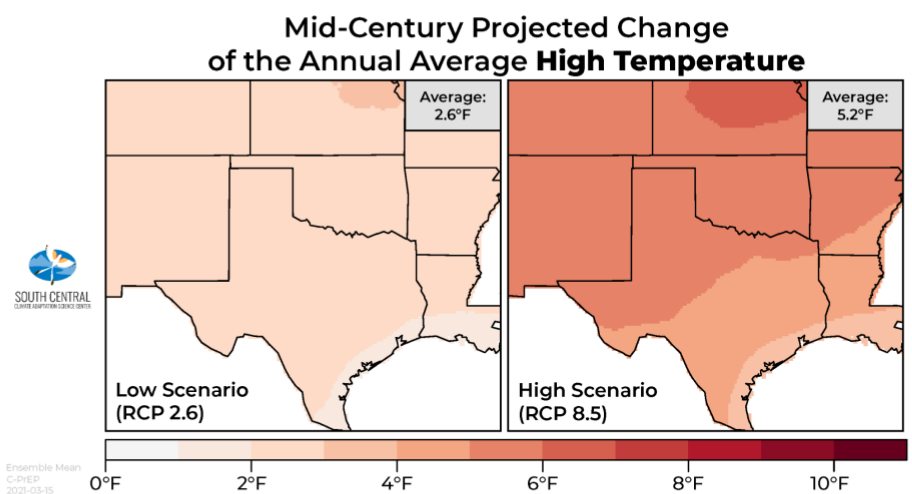


Figure 23: Projected Mid-century (2036-2065) change in annual average high temperature. Source: South Central CASC.

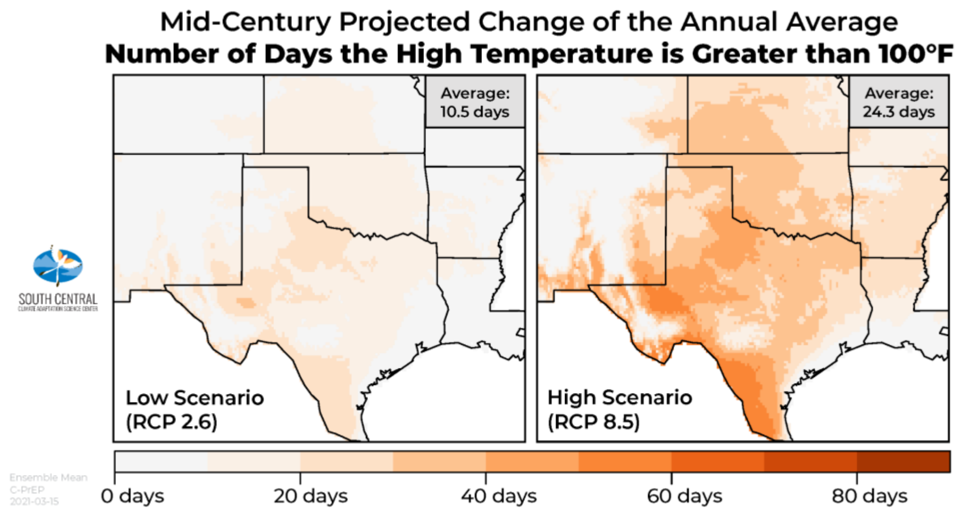


Figure 24: Projected Mid-century change in annual number of days with temperatures greater than 100 degrees. Source: South Central CASC.

3.4.4 FLOODING

Description

A flood is a natural event for rivers and streams. There are many types of flooding that occur in Oklahoma including: river flooding, flash flooding, and urban flooding.

- *River flooding* is when a river exceeds the channel carrying capacity and overflows onto the surrounding floodplain. The amount of flooding is usually a function of the amount of precipitation in an area, the amount of time it takes for rainfall to accumulate, previous saturation of local soils, and the terrain around the river system,
- *Flash flooding* occurs when the precipitation rate becomes so large that local waterway drainage cannot discharge the runoff. It can develop very quickly during or immediately after a nearby heavy rainfall. The primary threat from flash flooding is often to human life and safety, while the slower onset and more widespread nature of river flooding causes the primary threat to be economic and property damage.
- *Urban flooding* is the inundation of land or property in a built environment, particularly in more densely populated areas, caused by rainfall overwhelming the capacity of drainage systems, such as storm sewers.

Several factors determine the severity of floods, including rainfall intensity and duration. Below is a table identifying the contributing factors to flash-flooding hazard and vulnerability in Oklahoma.

Factor	Effect
Precipitation Rate	Storm cells that follow each other can repeatedly deposit large amounts of water on the same watershed, overwhelming its ability to handle runoff.
Training Echoes	Steeper topography (hills, canyons, etc.) will move runoff into waterways more quickly, resulting in a quicker response to precipitation.
Slope of Watershed	Watersheds that are linear in nature tend to collect runoff in a manner that the runoff arrives downstream at different times. In watersheds that are more square or circular shaped, runoff tends to arrive downstream within a shorter timeframe, intensifying the flooding effect. This factor becomes more significant with larger watersheds.
Saturation of Soils	Saturated or near-saturated soils can greatly reduce the rate at which water can soak into the ground. This can increase runoff dramatically independently of precipitation amounts.
Hardened Soils	Extremely dry soils can develop a “crust” or resistance to infiltration. This is especially true in areas of recent wildfire, where plant oils or resins may cause the soil to be even more water-resistant.
Urbanization	The urban environment usually intensifies the response to heavy precipitation.

	The two dominant urban factors are: 1) increased impervious surface coverage, which prevents infiltration and dramatically increases runoff; and 2) Urban systems are designed to remove water from streets and byways as quickly as possible. This accelerates the natural response to precipitation by placing runoff in waterways much more quickly.

Location

The conditions that lead to flash flooding can happen anywhere in Oklahoma, during any season, and at any time of day. Riverine flooding may occur anywhere in Oklahoma near a river, creek, or stream. Additional flood risk information is being updated and revised for communities where flood hazards are currently unmapped or un-modernized.

Below is a map showcasing the number of repetitive loss properties per county for the state of Oklahoma. As can be seen, most of the state has at least one repetitive loss property, as 52 of the 77 counties have reported losses. Notable areas seen on the map include Tulsa County with 260 losses; Oklahoma County with 169 losses; Ottawa County with 142 losses; Comanche County with 97 losses; and Logan County with 58 losses. Just these five counties alone had 56% or 726 of the 1,292 of the repetitive loss properties within the state.

Counties with no reports most likely mean there is no participation in the National Flood Insurance Program (NFIP), or there could be a lack of reports or flood insurance in these areas. Flooding can be experienced anywhere in the state of Oklahoma, so that is why it can be important to seek out flood insurance, especially if your jurisdiction is a participant in NFIP because lower rates might be available.

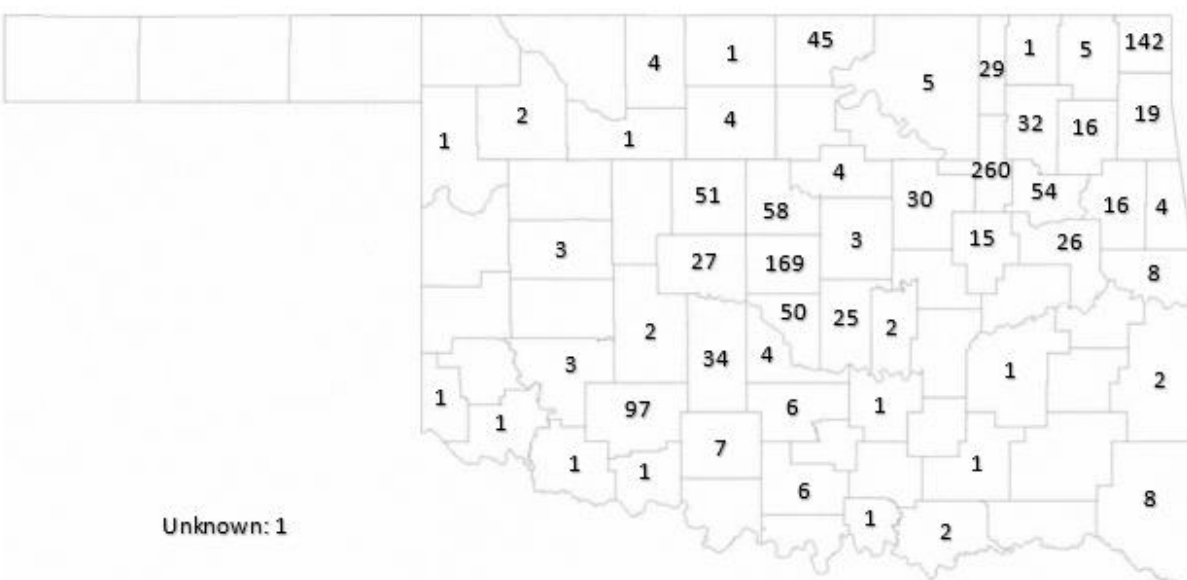


Figure 25: Repetitive Loss Properties per County as of 7/31/2023. Source: ODEMHS/OWRB.

Below is a map of Base Level Engineering (BLE) showcasing the Base Flood Elevation (BFE) available (green) and in progress (blue). FEMA region 6 has a goal to have Oklahoma completely covered in the next 3-5 years. https://webapps.usgs.gov/infrm/estBFE/

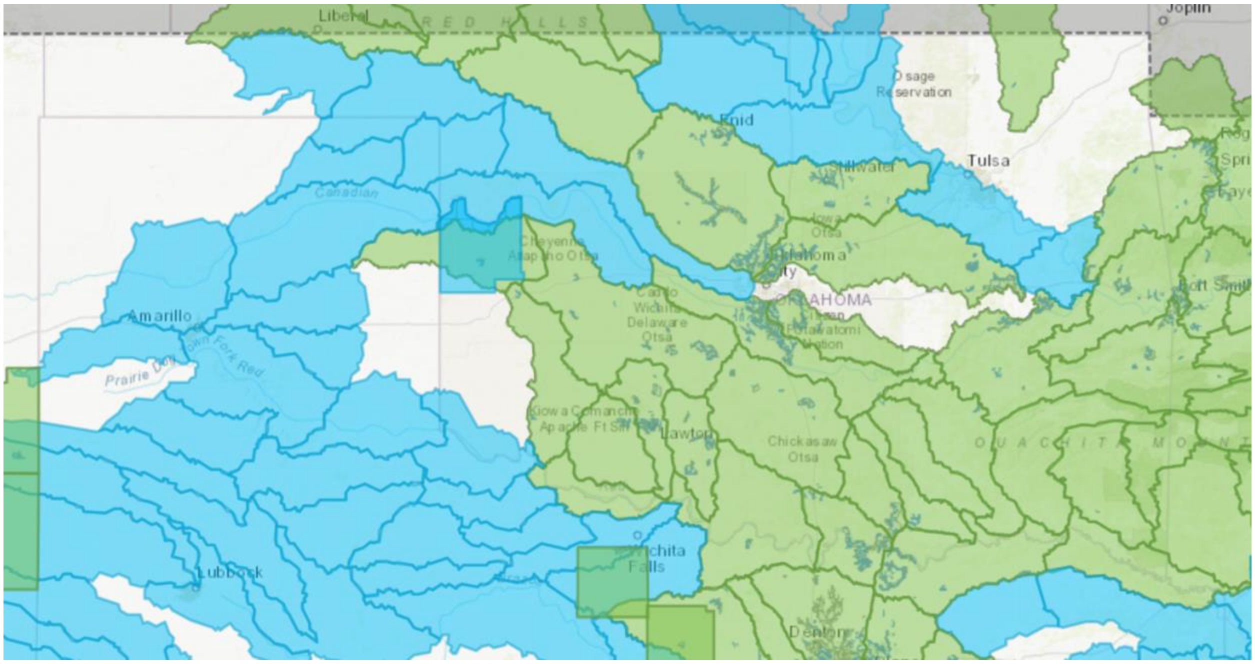


Figure 26: BLE map of Oklahoma. Source: USGS.

Previous Occurrences:

May 2019 Flooding

In May 2019, nearly 10” – 20” of rain fell in northern Oklahoma and southern Kansas. This resulted in Major and Record flooding for numerous rivers in May 2019. There were 31 crests above the Major flood category at 17 river forecast points in the National Weather Service Tulsa Hydrologic Service Area (HSA). In total, 29 of the 34 river forecast points in the HSA exceeded flood stage, corresponding to 200-400% of the normal May rainfall across northern Oklahoma.

The confluence of three large river basins, the Upper Arkansas, Verdigris, and Grand-Neosho basins, all of which received the heaviest rainfall this month, occurs near Muskogee, OK, where very severe flooding occurred as the three rivers merged into the Arkansas River. The major flooding then continued downstream along the Arkansas River through east central Oklahoma and west central Arkansas, despite the lower rainfall totals directly over this region. Backwater flooding also occurred along the tributaries of the larger rivers. Numerous river forecast points were above flood stage for a week or more, with a handful remaining above flood stage for more than 2 weeks.

Three of NWS Tulsa River Forecasts Points, the Arkansas River near Ponca City, the Arkansas River at Van Buren, and Bird Creek at Avant, exceeded their record stages. The USGS final determination for the crest for Bird Creek at Avant was 36.31'. In addition, based on information from the U.S. Army Corps of Engineers (USACE) Tulsa District, 11 reservoirs in the Arkansas, Verdigris, and Neosho River basins set new record pool levels*, 6 of which are within the NWS Tulsa HSA.

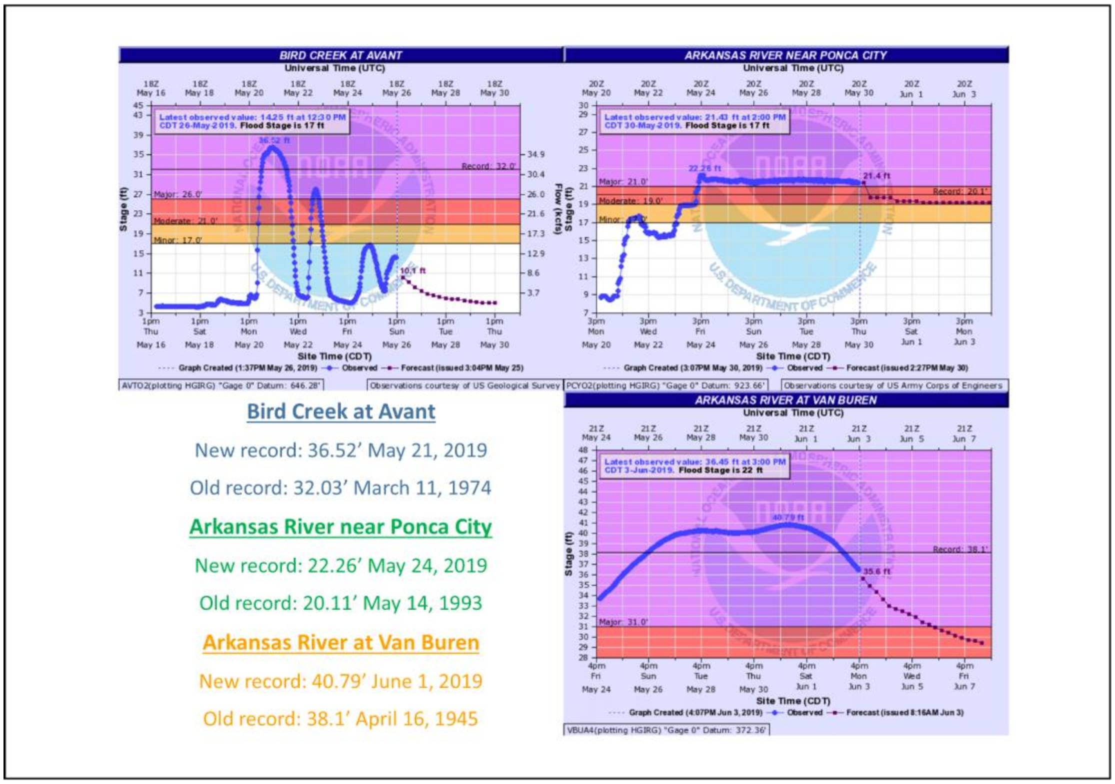


Figure 27: River Gauge readings from 2019 record flooding. Source: NWS Tulsa.

On May 21st, city leaders and emergency personnel held a press conference, saying the southern part of the county — like Jenks and Bixby — should be prepared to evacuate as a precaution.

The tremendous amount of rain filled into Keystone Lake, causing the Army Corps of Engineers to up their release rate at the Keystone Dam. David Williams with the Army Corps of Engineers stated:

> "You will see the impacts throughout Tulsa by daybreak tomorrow if we're going 160K, tonight, you'll see that by daybreak and it will continue at that rate throughout the weekend. That's the plan".

By Wednesday, May 22, schools, like Jenks Public Schools, began to announce Wednesday was the last day of school, due to the City of Jenks issuing a State of Emergency. School officials announced Jenks commencement ceremony would remain as scheduled for that night.

The City of Tulsa began to release maps for citizens that showed the impact of the 215,000 CFS release from Keystone Dam. That release was the minimum they could release to keep Keystone Lake from topping floodgates. If that happened, the floodgates wouldn't work, and the dam would fail. By Thursday, May 23, Tulsa city officials prepared for the worst after the Army Corps of Engineers announced an increase in the rate of water released at the Keystone Dam to 250,000 cubic feet per second.

Authorities said this would have a major impact on areas of Tulsa County and people needed to prepare to evacuate.

On Tuesday, May 28, Mayor G.T. Bynum, along with city officials and the Tulsa Area Management Agency, held a news conference informing people to prepare for the worst-case scenario -- the worst flooding in the history of Tulsa. Levees were tested in ways they had never been tested before, Bynum said, and residents who lived behind levees were encouraged to relocate. The Army Corps of Engineers released 275,000 cubic feet per second (cfs) from Keystone Dam. In the absence of additional rainfall, the Corps said it would continue at this level of outflow through Thursday. Officials said they would keep a close watch on the potential rainfall overnight in the event the release rate increased.

Good news arrived by Thursday, May 30. No rain in the forecast meant the Green Country community could survey the damage caused by the heavy impact of flood waters. By Friday morning, the Arkansas River fell into the "minor" flood stage. The Keystone Dam release rate gradually began to decrease to 190,000 cubic feet per second.

View of the Arkansas River flooding Webbers Falls, OK on May 31, 2019, looking southeast/downstream. Photo credit: Steve Piltz Inset from Google Earth.

View of the Arkansas River at its crest on May 31, 2019 along the OK/AR state line, looking west. Fort Smith, AR is on the left; Moffett, OK completely under water on the right. Photo credit: Steve Piltz Inset from Google Earth.

Figure 28: Arial Images of 2019 record flooding. Source: NWS Tulsa.

Since 2013, Oklahoma has experienced the following federally declared disasters that have had flooding as an element of the disaster:

Year of Declaration	Declaration Title	Disaster Number
2015	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4222
2015	OK Severe Winter Storms and Flooding	DR-4247
2015	OK Severe Winter Storms and Flooding	DR-4256

2016	OK Severe Storms and Flooding	DR-4274
2017	OK Severe Storms, Tornadoes, and Flooding	DR-4315
2017	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4324
2019	OK Flooding	EM-3411
2019	OK Severe Storms, Straight-Line Winds, Tornadoes, and Flooding	DR-4438
2019	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4453
2019	Muscogee Creek Nation Severe Storms, Straight-line Winds, Tornadoes, and Flooding	DR-4456
2022	OK Severe Storms, Tornadoes, and Flooding	DR-4657
2022	Muscogee Creek Nation Severe Storms, Tornadoes, and Flooding	DR-4670

Probability and Risk Calculation

The probability to experience flooding anywhere in Oklahoma is *Highly Likely*.

The CPRI for Flooding for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (4 x .30)	+ (3 x .15)	+ (3 x .10)	= 3.75

Vulnerability and Impact

Nearly 210,000 people in Oklahoma are living in flood prone areas (defined as FEMA's 100-year floodplain). This represents more than 5 percent of Oklahoma's total population. As flooding is one of the most dangerous natural hazards to human life, it is important to strive to mitigate this hazard. Driving through flooded areas accounts for most flood-related deaths. Busy roadways can become locations for accidents or drownings. In addition, residents trapped in their homes are at risk of rising waters as well. Some groups of people who are more vulnerable to flooding are the elderly, disabled, lower-income citizens, and those with a language barrier. These groups may not be able to evacuate their house on their own, which may make them more likely to not want to evacuate at all, putting them at an increased risk to flooding. These vulnerable groups may not be able to use or understand electronic communication networks during emergency events like social media messaging or alerts such as WEA alerts via smart phones, which frequently carry natural hazard alerts. Without these alerts, or understanding of these alerts, these people have an increased risk of danger if they are blind-sided by flooding and are not able to safely evacuate.

In the U.S., some minority communities, low-income groups, people with limited English proficiency, and certain immigrant groups are at increased risk of exposure given their higher likelihood of living in risk-prone areas and locations with poorly maintained infrastructure (Gamble et al. 2016). A number of studies documents that socially vulnerable groups often inhabit flood-prone areas due to societal barriers related to social stratification. Exposure of these communities has been well-examined in the U.S. (e.g., Lee and Jung 2014: Adeola and Picou 2012)

(https://www.epa.gov/system/files/documents/2021-09/appendix-i_inland-flooding.pdf)

Evacuations can be necessary for communities who are either at risk of flooding or are already experiencing a flooding event. Residents directed to evacuate their homes due to the threat of rising flood waters without appropriate transportation could be putting themselves at a greater risk and require emergency rescues. Likewise, those directed to evacuate but not willing to leave their homes may resist such instruction, which also places them at risk, and could require emergency services later when floodwaters are at a heightened level. Other evacuations during times of flooding can include nursing homes, hospitals, schools, and other critical facilities. These facilities have evacuation plans in place and ideally need time before the natural hazard such as flooding takes place to prevent risking the safety of those inside the facilities. If these facilities are not able to evacuate before the natural hazard starts then patients, staff, students, etc. would be put at risk while trying to evacuate. Transportation, access to other facilities, as well as access to other resources, could be limited if evacuation were to take place after a flooding event has started.

All structures in the planning area are at risk of flooding, though not all structures share a uniform risk. The level of flooding can be dependent on different factors including location, topography, soil moisture, built environment, accessible drainage, etc. All these factors can increase or even decrease a structure's risk to flooding. Structures built within a floodplain or at a location with a higher estimated Base Flood Elevation (BFE), could be at a higher risk of experiencing flooding. Because a structure is located here does not mean they will experience more flooding than those who are not located in a floodplain or area with a higher BFE, it just means that they could be at a higher risk of experiencing any kind of flooding during a rainfall event, or specifically during a 1% annual chance storm event. Most larger jurisdictions within the state should have regulations such as floodplain ordinances in place to help regulate building within floodplains, but smaller jurisdictions such as towns may not have the staff or resources to put these in place, or even enforce them. This puts residents at a higher risk of experiencing flooding if they were to build within a floodplain. But whether you live within or without a floodplain, flood insurance is recommended to protect your home from damages that may take place during a flood event.

As new neighborhoods and housing are being built throughout the state of Oklahoma, the built environment and landscapes are changing, leading to a change in vulnerabilities that may not have been seen previously. As new neighborhoods and shopping centers are being built around other previously built neighborhoods, officials in Oklahoma are seeing an increase in vulnerabilities such as flooding, than what was seen before. As mentioned in the City of Oklahoma City's Hazard mitigation Plan, the city of Oklahoma City and nearby cities such as Yukon and Mustang have seen an increase in population and growth, and along with this an increase in new building construction. They've found along with this new construction an increased vulnerability risk to flooding as a recent storm event in Canadian County in July 2020 produced heavy rainfall resulting in excessive runoff which resulted in localized flash flooding. Reports were made for street flooding requiring road closures, as well as flash flood waters that entered yards, garages and homes causing damage. This event resulted in 18 homes with flood damage. It was later identified that the cause of flooding was from a concrete stormwater channel behind one of the homes that flows into a nearby creek. Several of these homes were built in 2019 and because of the increase in construction in the last few years, the channel and creek were not improved to account for and handle the new home additions and the additional runoff they would cause.

As mentioned in the previous paragraph, another vulnerability throughout the state is inadequate drainage. This is due to an increase in the built environment, outdated infrastructure and resources, and lack of resources to keep these drainage systems clear of obstructions. During heavy precipitation, drainage systems may be overwhelmed and unable to properly dispel water. This regularly causes drain systems to overflow. There are many impacts to this vulnerability with the most common impact being roadway flooding. Widespread roadway flooding results in dangerous driving conditions for residents, staff, and students. In many instances, motorists will ignore barricades and warnings about driving into flooded roads causing them to become stranded in their vehicles. This puts emergency services at risk when responding due to dangerous weather and/or circumstances to help rescue them. Another aspect of this can be seen when bus routes become flooded which present the largest impact of flooding on school districts in the state. Following flooding events, students often will have to drive through flooded areas if schools are still in session. Options for schools experiencing flooding in their jurisdiction are to cancel school, which could lead to a loss of allotted closure days, or to move classes online which could ultimately impact parents who are not able to stay home with their children during their workday.

To help combat the vulnerability to flooding for jurisdictions throughout the state, it is recommended that counties enroll in the National Flood Insurance Program (NFIP). The NFIP makes access to flood insurance more accessible to residents and promotes the adoption and enforcement of floodplain management regulations within the county. Overall, the NFIP helps counties mitigate flooding effects. The Oklahoma Water Resource Board (OWRB) promotes community enrollment in the NFIP and advises the over 400 current participating communities on steps to ensure future participation. These participants include 6 tribal nations, 56 counties and 343 cities/towns. As of 2023, there have been $232 million in NFIP claims that have been paid since 1978. As of 7/31/2023, Oklahoma has 1,031 Repetitive Loss Structures and 258 Severe Repetitive Loss Structures through NFIP.

In addition, according to FEMA's National Risk Index for riverine flooding, Oklahoma experiences a wide range of risk to riverine flooding. Oklahoma county ranks the highest having a "relatively high" risk to riverine flooding and counties in the southeast part of that state having a "relatively moderate" risk to riverine flooding. Counties in the Oklahoma panhandle have a "very low" risk rating to riverine flooding.

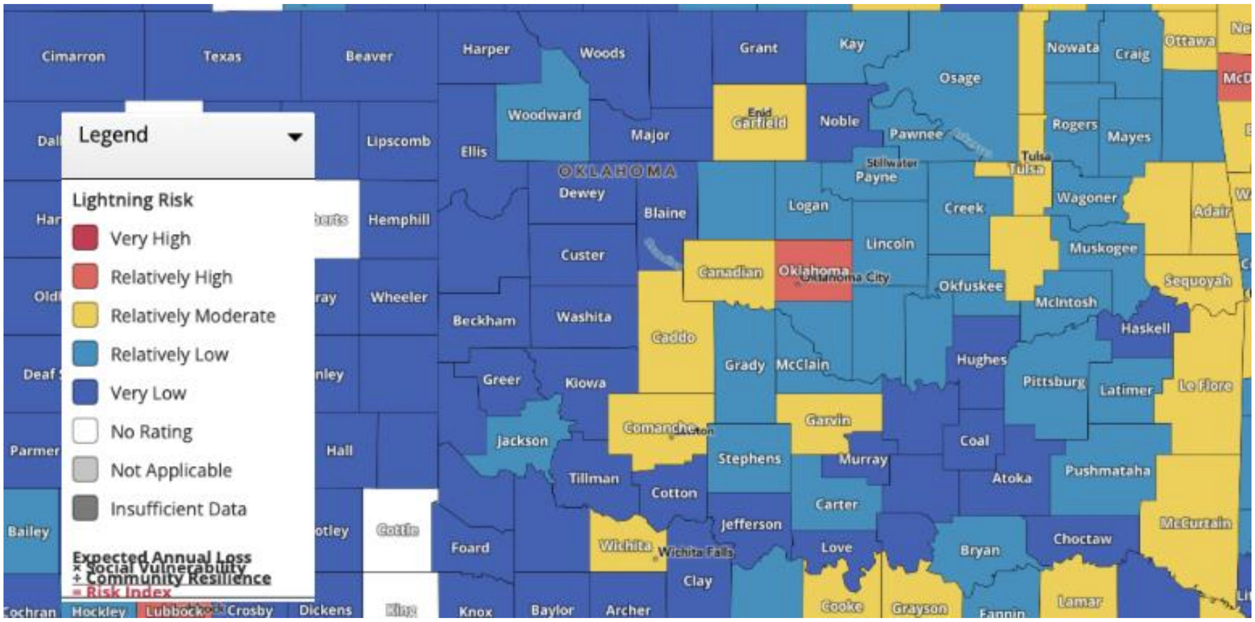


Figure 29: FEMA risk map for riverine flooding. Source: FEMA.

Effects of Climate Change

Heavy rainfall and flooding have always been part of Oklahoma's climate. Annual precipitation has increased over the vast majority of Oklahoma, with the highest change occurring in winter. According to Easterling et al. (2017), heavy rainfall (top 1% of annual events) increased by 12% between 1958 and 2016. Seasonally, rainfall is projected to increase in winter and spring and decrease in summer and fall by the end of the 21st century, but projected changes are small compared to natural variations. There is strong confidence that there will continue to be an increase in the frequency and intensity of heavy rainfall events over the 21st century (Easterling et al. 2017), which increases the chance of flooding. However, flooding is a locally complex phenomenon and can be exacerbated by human action (or inaction) as much as it can be caused by atmospheric conditions.

Mid-Century (2036-2065) Projections from South Central Climate Adaptations Center

- 1-Day Maximum Rainfall
  - Low Scenario: With a significant reduction in greenhouse gas emissions, we expect to experience a slight increase in the average 1-day maximum rainfall amount.

- High Scenario: Without a significant reduction in greenhouse gas emissions, we expect to experience an increase in the average 1-day maximum rainfall amount.

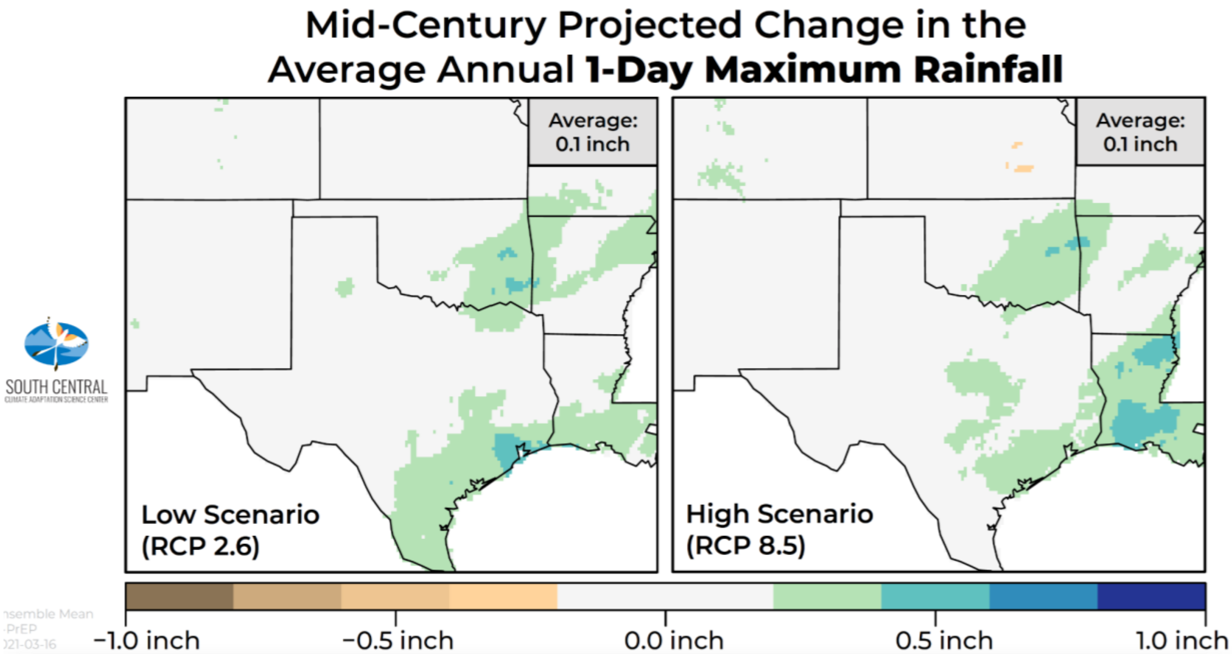


Figure 30: Projected Mid-century change in average annual 1-day maximum rainfall in Oklahoma. Source: South Central CASC.

- 5-Day Maximum Rainfall
    - Low Scenario: With a significant reduction in greenhouse gas emissions, we expect to experience a slight increase in the average 5-day maximum rainfall amount, particularly in eastern Oklahoma.
    - High Scenario: Without a significant reduction in greenhouse gas emissions, we expect to experience an increase in the average 5-day maximum rainfall amount.

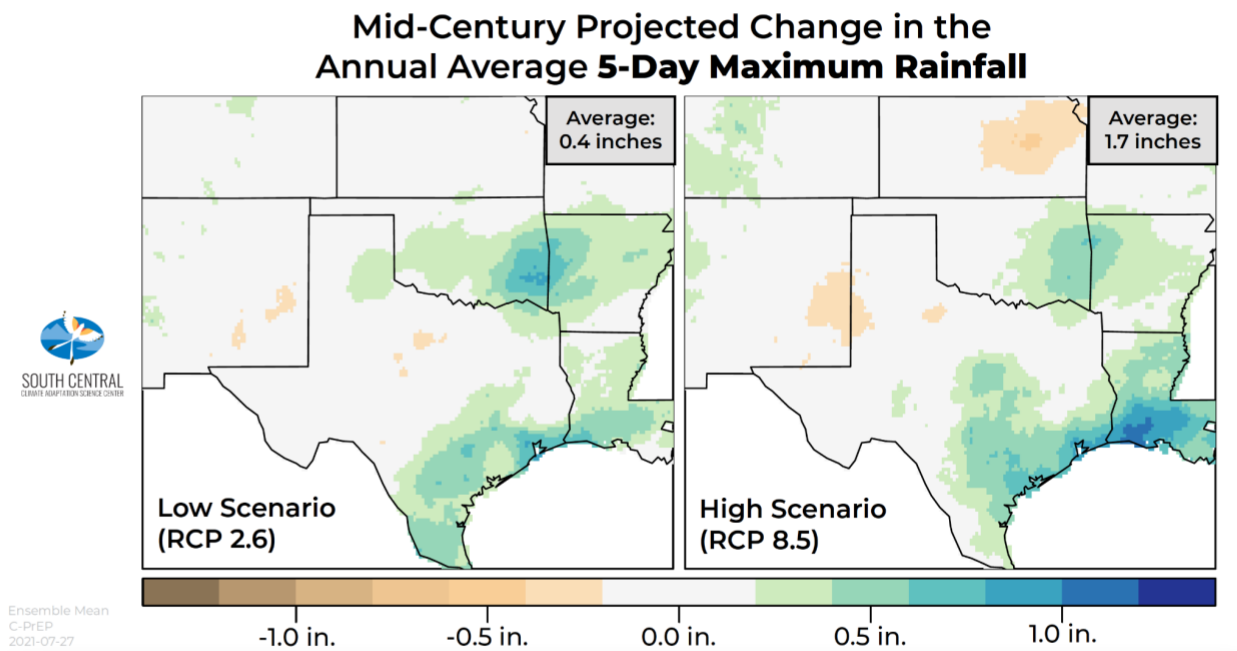


Figure 31: Projected Mid-century change in average annual 5-day maximum rainfall in Oklahoma. Source: South Central CASC.

3.4.5 HIGH WINDS

Description

Wind is defined as the movement of air relative to the earth's surface. High winds can result from thunderstorms, strong cold front passages, or gradient winds between high and low pressure moving across Oklahoma. High winds, sometimes referred to as "straight-line" winds, are speeds reaching 58 mph or greater, either sustaining or gusting.

High Wind:

- Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer or winds (sustained or gusts) of 50 knots (58 mph) for any duration (or otherwise locally/regionally defined), on a widespread or localized basis. In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively. The High Wind event name will not be used for severe local storms, tropical cyclones, or winter storm events.

Strong Wind:

- Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage. Consistent with regional guidelines, mountain states may have higher criteria. A peak wind gust (estimated or measured) or maximum sustained wind will be entered.

Thunderstorm Wind:

- Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Maximum sustained winds or wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) will always be entered. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a Storm Data event only if they result in fatalities, injuries, or serious property damage. Storm Data software permits only one event name for encoding severe and non-severe thunderstorm winds. The Storm Data software program requires the preparer to indicate whether the sustained wind or wind gust value was measured or estimated.

Derecho:

- A widespread, long-lived windstorm that is associated with a band of rapidly moving showers or thunderstorms. Although a derecho can produce destruction similar to the strength of tornadoes, the damage typically is directed in one direction along a relatively straight swath. As a result, the term "straight-line wind damage" sometimes is used to describe derecho damage. By definition, if the wind damage swath extends more than 240 miles (about 400 kilometers) and includes wind gusts of at least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho.

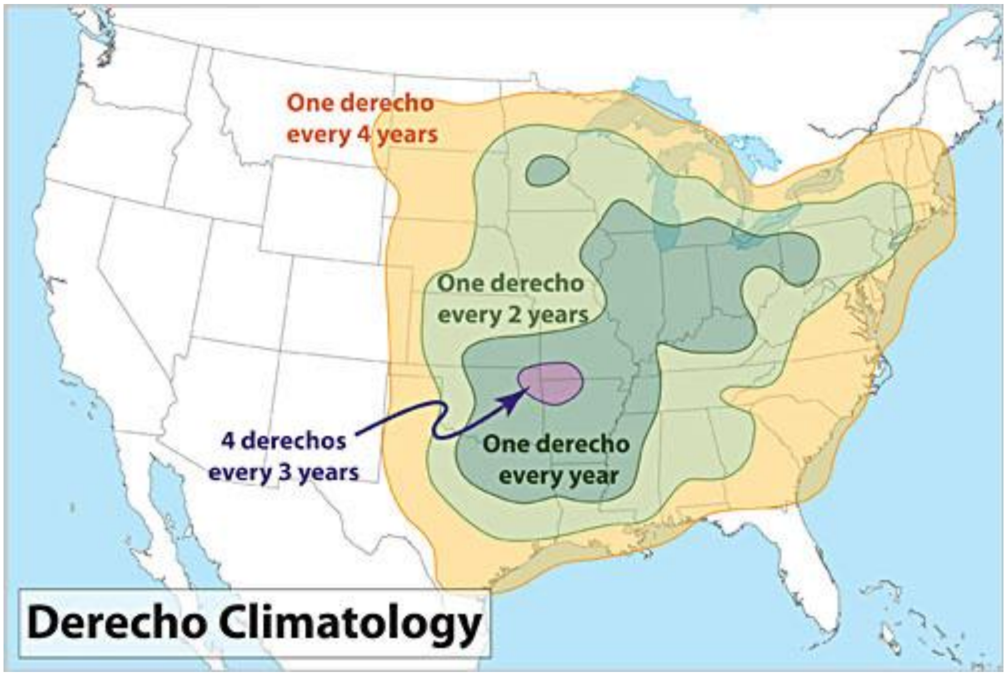


Figure 32: Derecho Climatology in the United States. Source: NWS.

Location

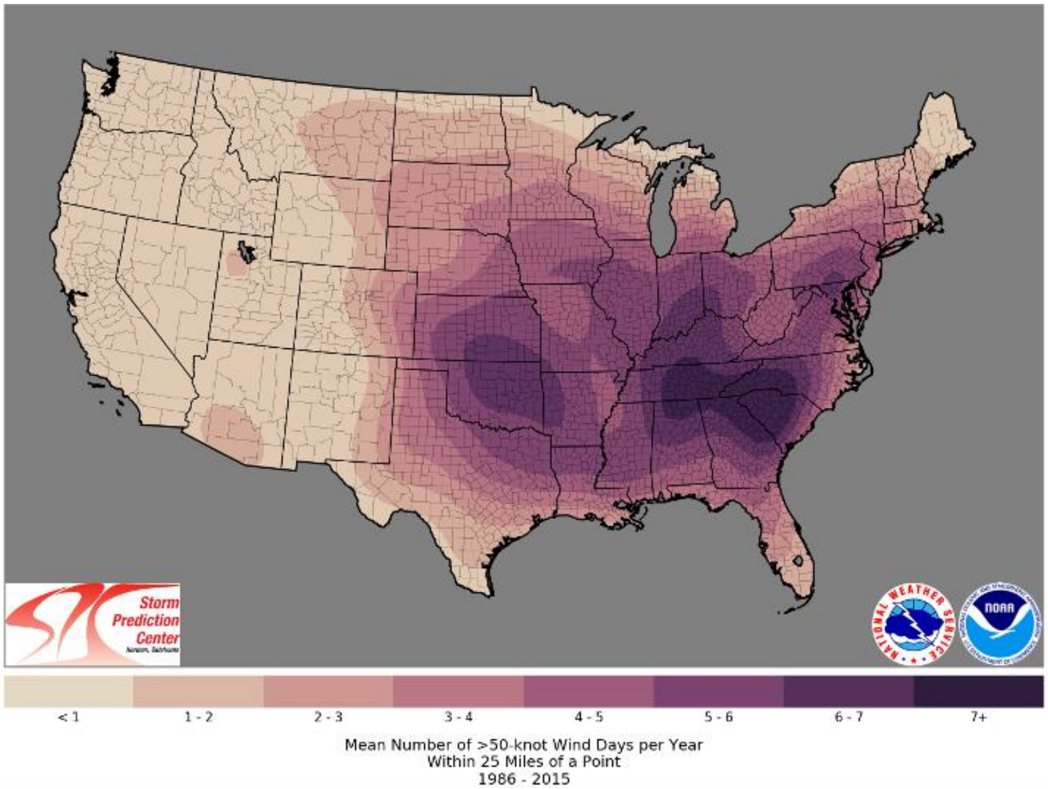


Figure 33: Mean Number of >50 knot wind days per year in the United States. Source: NOAA.

Oklahoma can experience any range on the Beaufort wind scale (as shown below) and can expert around 6-7 days per year with a mean number of greater than 50 knot wind day.

Beaufort Number	Wind Speed (miles/hour)	Wind Speed (km/hour)	Wind Speed (knots)	Description	Wind Effects on Land
0	< 1	< 1	< 1	Calm	Calm. Smoke rises vertically.
1	1-3	1-5	1-3	Light Air	Wind motion visible in smoke.
2	4-7	6-11	4-6	Light Breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	12-19	7-12	Gentle Breeze	Leaves and smaller twigs in constant motion.
4	13-18	20-28	11-16	Moderate Breeze	Dust and loose paper are raised. Small branches begin to move.
5	19-24	29-38	17-21	Fresh Breeze	Small trees begin to sway.
6	25-31	39-49	22-27	Strong Breeze	Large branches are in motion. Whistling is heard in overhead wires. Umbrella use is difficult.
7	32-38	50-61	28-33	Near Gale	Whole trees in motion. Some difficulty experienced walking into the wind.
8	39-46	62-74	34-40	Gale	Twigs and small branches break from trees. Cars veer on road.
9	47-54	75-88	41-47	Strong Gale	Larger branches break from trees. Light structural damage.
10	55-63	89-102	48-55	Storm	Trees broken and uprooted. Considerable structural damage.
11	64-72	103-117	56-63	Violent Storm	Widespread damage to structures and vegetation.
12	> 73	> 117	> 64	Hurricane	Considerable and widespread damage to structures and vegetation. Violence.

Figure 34: Beaufort Wind Scale. Source: NWS.

Previous Occurrence

The table below shows NCDC data recorded from 2012-2022.

Hazard	Number of Events	Number of Counties Affected	Number of Days with Event
High winds (50 kts or stronger)	447	54	119

Oklahoma ranks in the top 10 windiest states in the United States. This creates the opportunity for wind power, but also can lead to wind damage to occur across the state. As of September 2022, 11,714 MW of wind capacity was operating in Oklahoma, the third-most wind capacity of any U.S. state, following Texas (37,210 MW) and Iowa (12,195 MW). Wind turbines account for 38% of all of Oklahoma's electric-generating capacity, compared with 12% for the United States as a whole.

Significant Wind Events from 2012-2022

2013 Derecho Event

Severe thunderstorms developed during the late afternoon and evening hours of July 23rd over southern Kansas. The air mass was extremely hot and unstable south of these storms where afternoon heat indices reached 110 degrees. An upper-level disturbance moved southeastward during the evening and helped drive a complex of severe storms into eastern Oklahoma between 10pm and 3am.

The severe storms had a history of producing wind gusts to 80mph earlier in the evening in the Wichita area, and they continued to do the same as the complex moved into the Tulsa area. The Tulsa International Airport recorded a 76-mph wind gust as the storms rolled in, the highest ever recorded at the site.

Figure 35: 2013 Derecho damage. Source: NWS.

The damaging winds pushed across Tulsa and surrounding areas, causing widespread tree and power line damage leaving over 100,000 without power during the overnight and early morning hours. An EF-1 tornado developed along the leading edge of the bow west of Wagoner, snapping or uprooting several trees, and damaging some buildings and homes. The bow echo or derecho continued southward reaching Choctaw County shortly after 2am. Heavy rains also fell during the night, with some flooding reported in the Tahlequah and Miami areas. The heaviest rains fell along the Oklahoma-Arkansas border where between 3 to 5 inches fell.

April 2022 High Winds

April is Oklahoma's windiest calendar month climatologically, but April 2022 was exceptionally windy. Data from the Oklahoma Mesonet shows both the statewide average wind speed and maximum wind speed for this April were tops since Mesonet data began in 1994 at 12.2 mph and 22.9 mph, respectively. Previous top marks were held by 1996's 12 mph and 2011's 22.5 mph, again respectively. Those and other metrics point towards the month as the windiest April statewide in the Mesonet era. Fourteen of April's 30 days saw non-thunderstorm wind gusts of at least 50 mph somewhere in the state, and nine days with at least 60 mph. Tipton and Slapout shared the highest wind gusts at 74 mph on April 5 and 22, respectively.

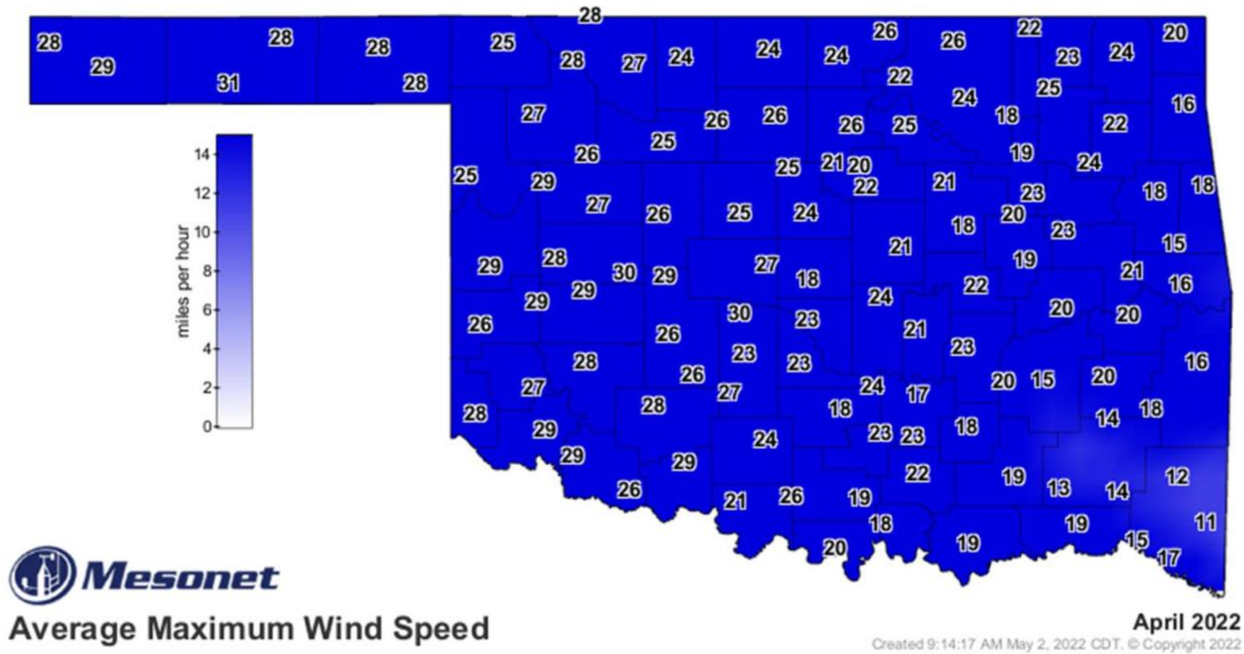


Figure 36: Average Maximum Wind Speed for April 2022. Source: Oklahoma Mesonet

Probability and Risk Calculation

The probability is *Possible*.

The CPRI for High Winds for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (1 x .30)	+ (3 x .15)	+ (2 x .10)	= 1.85

Vulnerability and Impact

Vulnerability to high winds is difficult to evaluate. High winds, when accompanied by thunderstorms, can occur at different levels of strength and at random locations. Due to the randomness of the location for such an event, the entire population of the state of Oklahoma remains vulnerable to possible injury and/or property damage from high winds. Damage to businesses, homes, fences, schools, public buildings, vehicles, trees, power lines, and outbuildings are commonly seen with high wind events. Members of the community who live in mobile homes, low-income residents, the elderly, and those with a language barrier are some of the most vulnerable populations to high winds.

All structures in the planning area are susceptible to high wind events. Buildings that fail under the effects of extreme winds often appear to have exploded, giving rise to the misconception that the damage is caused by unequal wind pressures inside and outside the building. This misconception has led to the myth that during an extreme wind event, a window or door in a building should be opened to equalize the pressure. Opening a window or door allows wind to enter a building and in turn increases the risk of building failure. In addition to structural issues, high winds can affect electrical and other utilities with service outages. Downed power poles can lead to the loss of power which could have a major impact on a community by affecting many residents and businesses, sometimes for a long period. If critical facilities such as hospitals were to be damaged by high wind or suffer from a power outage due to high winds, this would affect power to medical equipment, impacting patients at these facilities. In some events this could lead to an evacuation of the hospital which could take hours to days to find transportation and other medical facilities for patients to go. Storm debris can sometimes be seen scattered on roads and streets which can cause disruptions to the transportation system and delays to emergency response vehicles, or those transporting patients.

Those who reside in mobile/manufactured homes are more at risk to high winds (see tornado section to see specific statistics on mobile home risks). Over the past 50 years, storm-related casualties and injuries have decreased due to the improvements in radar and warning technologies (Boruff et al. 2003) and social media engagement (Ripberger et al. 2014), but socially vulnerable groups are still disproportionately affected by high winds and other hazardous events (Flanagan et al. 2011; Lim et al. 2017). Some of these vulnerabilities include lack of access to resources, rural populations, physically limited individuals, and non-English speaking minorities (Chaney et al. 2013; Lim et al. 2017).

(https://shareok.org/bitstream/handle/11244/324928/King_okstate_0664M_16473.pdf?sequence=1)

Other vulnerable locations include parks, (school) ball fields, outdoor recreation areas, outdoor tourist locations, and other locations where people are without warning devices or shelter. During warmer seasons or even during the school year, students, staff, and tourists can be seen watching sports events, hiking, or visiting a lake throughout the state of Oklahoma. Many of these areas may not be equipped with a warning device, or people may rely on outdoor warning sirens that may not reach all areas of the location. If students, staff, and parents are faced with a high wind event not accompanied by the typical thunderstorm, they may not see the tell-tale signs of lightning or hear thunder, in which they would know to seek shelter. These areas may also be in locations where there is a lack of cell phone service, which can also decrease their chances of receiving a warning, and in turn increasing their vulnerability to a high wind event. Damage and injuries to a high wind event can depend on wind speed and the nature of the objects in the path of the storm. Strong winds can turn debris and untethered objects into missiles, while falling limbs and trees can contribute to property damage and cause injuries. For those who are caught outside during a high wind event, they might find themselves in danger from flying debris around them.

For school districts, vulnerabilities not only lie in the outdoor sporting or school events, but also if there is a power outage. Many schools throughout the state may not have a backup generator or access to one, which could lead to canceling school. When school is canceled, this can take away the few days that are built into schedules to miss, or school can be moved online which can lead to issues for parents who have to work during the school day. For some students missing school can mean missing a meal, and along those lines, if a school is without power for an extended amount of time, this can lead to a loss of food in the cafeterias.

In addition, according to FEMA’s National Risk Index for strong winds, Oklahoma experiences nearly the entirety of the range of risk to high winds. Tulsa county ranks the highest having a “very high” risk to high winds and Cimarron, Grant, and Coal County having a “very low” risk to high winds. Much of the state is between relatively moderate and relatively high risk to high winds.

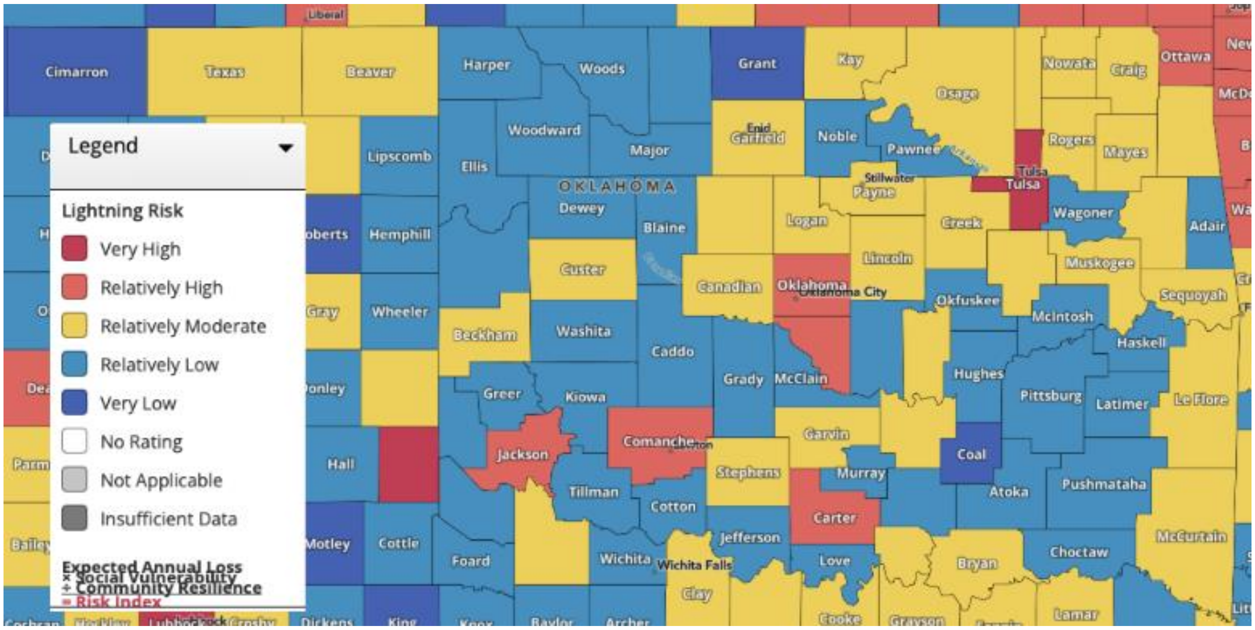


Figure 37: FEMA risk map for strong winds. Source: FEMA.

Effects of Climate Change

Damaging winds in Oklahoma are associated with severe thunderstorms and the passage of frontal boundaries. More favorable environments for severe thunderstorms are expected and increases in severe wind occurrences are projected. Climate models project an increase in the frequency and intensity of severe thunderstorms over the Southern Great Plains, especially during the peak storm season (March, April, May). Uncertainty remains, however, in the assumption that the favorable environments will reach their potential of producing damaging winds (Kossin et al. 2017).

3.4.6 SEVERE STORMS (HAIL AND LIGHTNING)

Description

Thunderstorms are common occurrences in the Midwest and Central United States. Each year, an estimated 100,000 thunderstorms occur in the United States. Of those, about 10 percent are classified as severe thunderstorms - those that produce hail at least three-quarters of an inch in diameter, have winds of 58 miles per hour or higher, or produce a tornado.

All thunderstorms are dangerous and can be associated with several hazards. Heavy rains can lead to flash flooding events – one of the primary causes of death associated with thunderstorms. Lightning, which is produced by every thunderstorm, causes an average of 43 fatalities and nearly 300 injuries each year according to the National Weather Service. Lightning can also start building fires, damage electrical equipment, electrocute humans and livestock. Every year people are killed by lightning strikes in Oklahoma. Statistics show that about 50 bolts of lightning strike less than a mile from someone each year in Oklahoma and statewide have 1 million strikes per year. High winds generated by thunderstorms can cause damage to homes, overturn vehicles, uproot or damage trees, or blow down utility poles causing widespread power outages. Hail causes billions of dollars in damage to crops and property each year and can injure people or animals left outdoors.

Hail is a form of solid precipitation that consists of balls or irregular lumps of ice, which are individually called hailstones. Large hailstones greater than an inch in diameter (quarter size), can result from a severe thunderstorm and require a very powerful updraft to form. Most large hail is the product of supercell thunderstorms, which have a sustained rotating updraft that moves growing hailstones a long distance through the height of the cloud before falling to the ground. Unlike ice pellets, hailstones are layered and can be irregular and clumped together. Hail is composed of transparent ice or alternating layers of transparent and translucent ice, which are deposited upon the hailstone by alternating wet or dry deposition processes as it travels upward through the cloud until it exits the updraft and falls to the ground.

Lightning is a natural phenomenon which develops when the upper atmosphere becomes unstable due to the convergence of a warm, solar heated, vertical air column on the cooler upper air mass. These rising air currents carry water vapor which, on meeting the cooler air, usually condenses, giving rise to convective storm activity. Pressure and temperature are such that the vertical air movement becomes self-sustaining, forming the basis of a cumulonimbus cloud formation with its center core capable of rising to more than 45,000 feet meters. To be capable of generating lightning, the cloud needs to be 3 to 4 km deep. The taller the cloud, the more frequent the lightning. The center column of the cumulonimbus can have updrafts exceeding 120 km/hr., creating intense turbulence with violent wind shears and consequential danger to aircraft. This same updraft gives rise to an electric charge separation which ultimately leads to the lightning flash distribution within a fully developed thunder cloud.

The entire state is susceptible to severe weather. The NWS classifies thunderstorms using the following categories:

- *Marginal:* Isolated severe thunderstorms, limited in duration and/or coverage and/or intensity
- *Slight:* Scattered severe storms possible, Short-lived and/or not widespread, isolated intense storms possible
- *Enhanced:* Numerous severe storms possible, more persistent and/or widespread, a few intense
- *Moderate:* Widespread severe storms likely, long-lived, widespread, and intense
- *High:* Widespread severe storms expected, long-lived, very widespread, and particularly intense

Oklahoma has seen severe weather events from all the categories listed above.

Location

All 77 Counties in Oklahoma can experience a range of Severe Thunderstorm watches from a minimum of 8 to greater than 15 a year. Many counties in central Oklahoma can experience 13 watches a year on average. The NWS definition of a Severe Thunderstorm watch is as follows.

Severe Thunderstorm Watch: A Severe Thunderstorm Watch is issued when severe thunderstorms are possible in and near an area. It does not mean that they will occur. It only means they are possible. Severe thunderstorms are defined as follows:
1) Winds of 58 mph or higher
AND/OR
2) Hail 1 inch in diameter or larger.

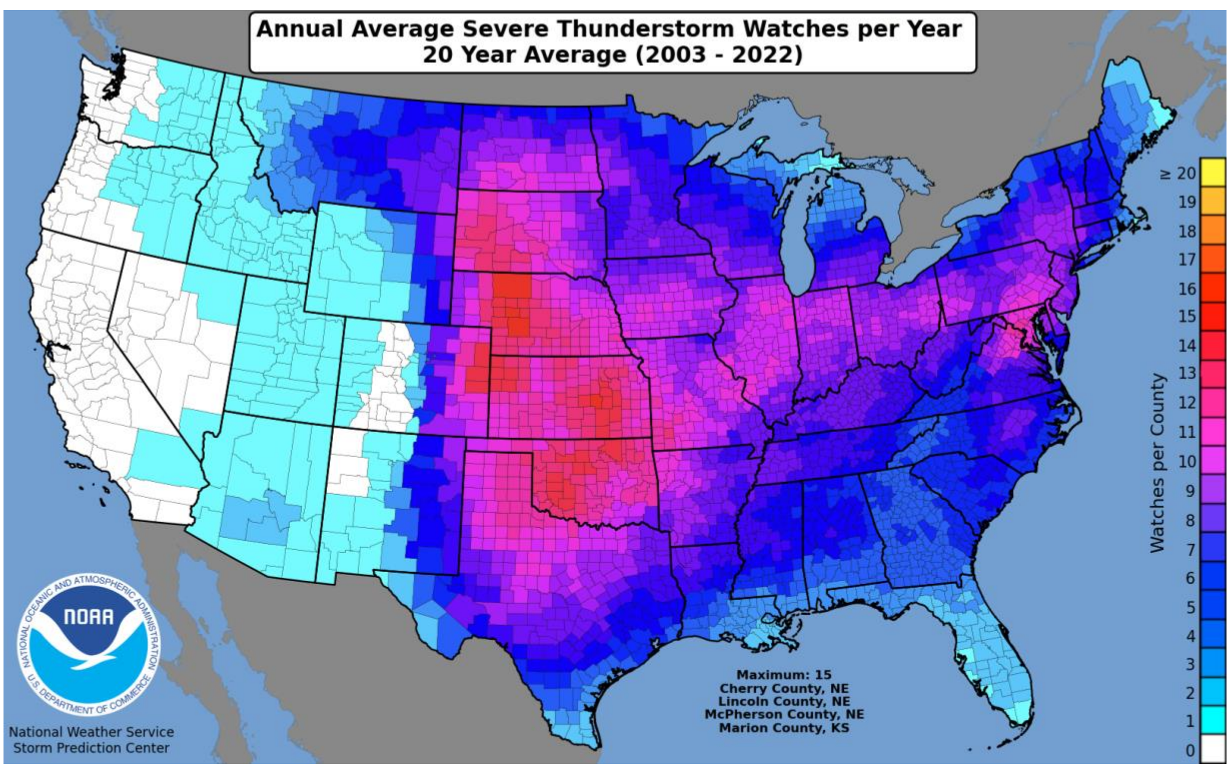


Figure 38: Annual Average Severe Thunderstorm Watches per year (20-year average, 2003-2022). Source: SPC.

Below are the Vaisala total lightning density per county maps for 2016-2021 and for 2022. Total lightning counts in Vaisala reports include both in-cloud lightning pulses and cloud-to-ground lightning strokes. Lightning Density is the number of lightning events per square kilometer. Lightning density is calculated by dividing the number of lightning events by the area. Each map below shows the total lightning density per county for the United States. From 2016-2021, Oklahoma saw anywhere from 12 to 128 lightning events per square kilometer per year. In 2022, Oklahoma saw anywhere from 12 to 256 lightning events per square kilometer per year. Based on the 2022 statistics, Oklahoma ranked at 4 for total lightning density in the United States, which was a step higher than the ranking of 5 in 2021.

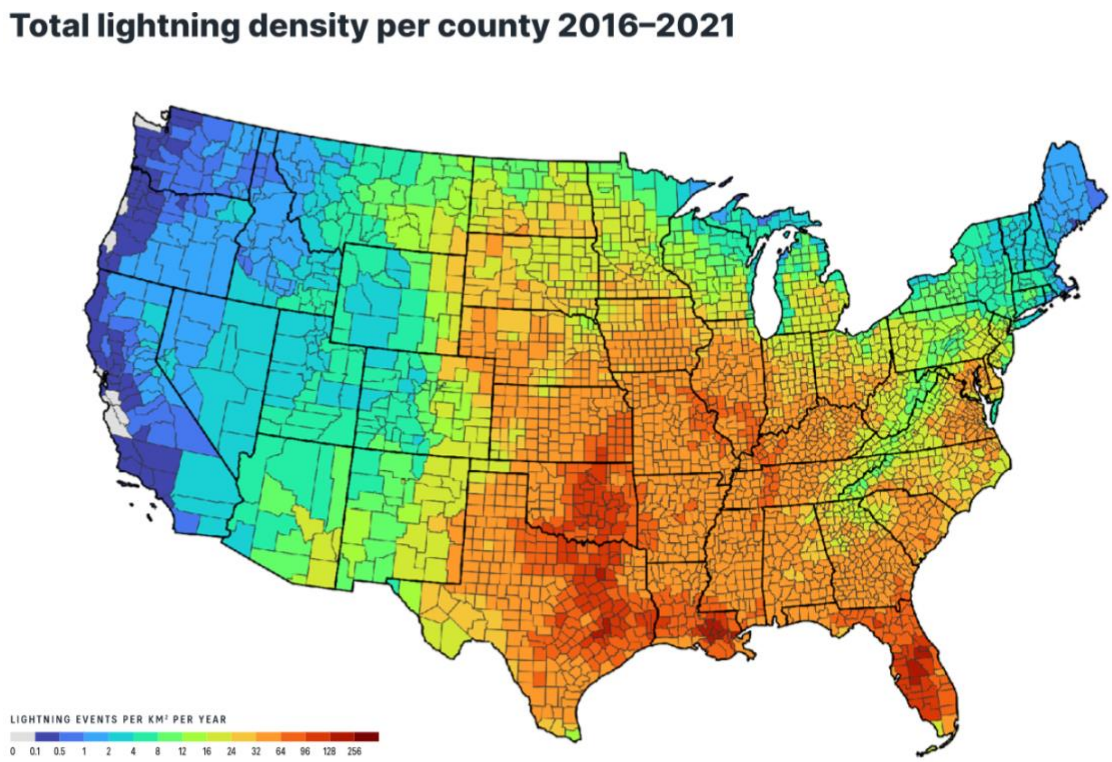


Figure 39: Total lightning density per county 2016-2021. Source: Vaisala.

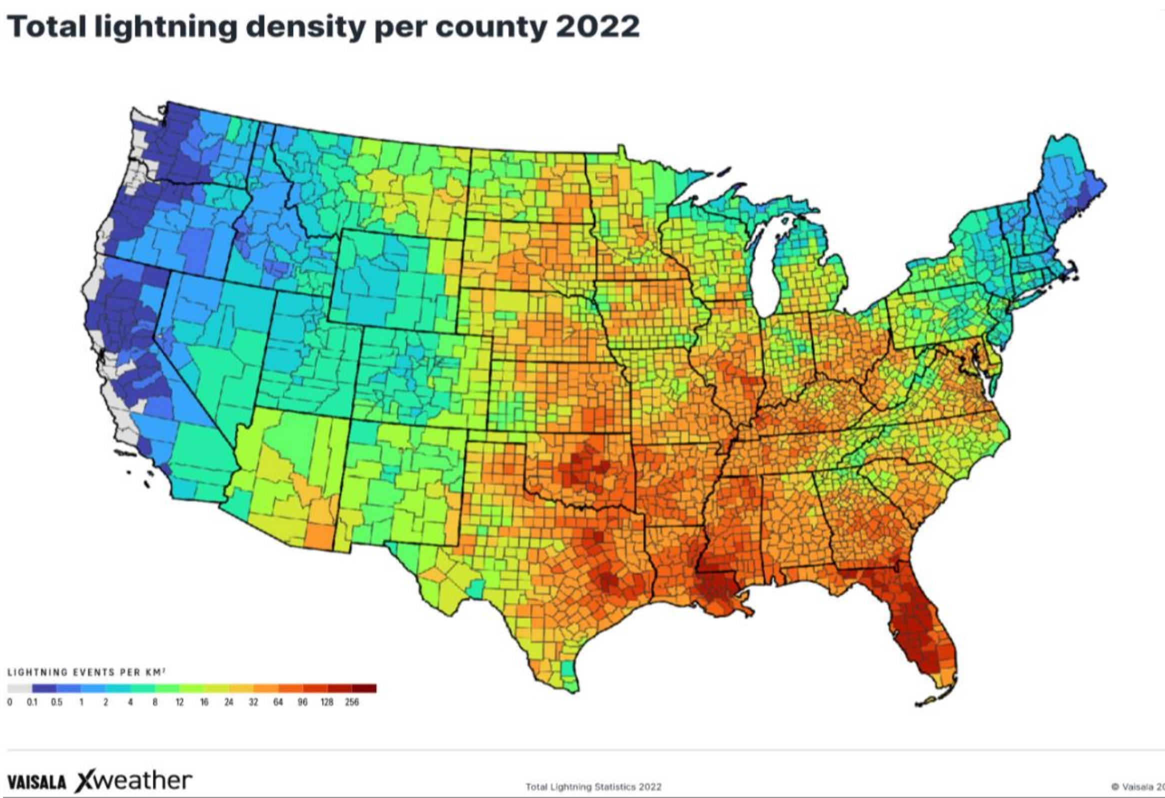


Figure 40: Total lightning density per county in 2022. Source: Vaisala.

Previous Occurrence

Below is the number of severe thunderstorm watches issued by the Storm Prediction Center (SPC) in Oklahoma from 2013-2022. Each year, Oklahoma has experienced over 40 severe thunderstorm watches.

Year	Severe Thunderstorm Watches Issued
2022	55
2021	41
2020	57
2019	61
2018	47

2017	58
2016	49
2015	44
2014	50
2013	68

As shown in the table below, and in accord with NWS criteria for severe thunderstorms, hail begins to be considered severe when it reaches one inch in diameter or larger. Hail is considered destructive when it reaches 1.6 inches in diameter, or approximately the size of a golf ball. Hail size for events in the state of Oklahoma can range anywhere between H0 – H10 categories on the combined NOAA/TORRO Hailstorm Intensity Scale.

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Small Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit & crops, damage to glass & plastic structures, paint & wood scored
H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented; brick walls pitted
H7	Very Destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very Destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball & up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Figure 41: Combined NOAA/Torro Scale. Source: NWS/NOAA.

In addition, the entire state of Oklahoma can experience the entire range of the Lightning Activity Level (LAL) at any time of the year.

Lightning Activity Level (LAL)
Is a scale which describes lightning activity. Values are labeled 1-6:

LAL 1	No thunderstorms
LAL 2	Isolated thunderstorms. Light rain will occasionally reach the ground. Lightning is very infrequent, 1 to 5 cloud to ground strikes in a five minute period.
LAL 3	Widely scattered thunderstorms. Light to moderate rain will reach the ground. Lightning is infrequent, 6 to 10 cloud to ground strikes in a 5 minute period.
LAL 4	Scattered thunderstorms. Moderate rain is commonly produced Lightning is frequent, 11 to 15 cloud to ground strikes in a 5 minute period.
LAL 5	Numerous thunderstorms. Rainfall is moderate to heavy. Lightning is frequent and intense, greater then 15 cloud to ground strikes in a 5 minute period.
LAL 6	Dry lightning (same as LAL 3 but without rain). This type of lightning has the potential for extreme fire activity and is normally highlighted in fire weather forecasts with a Red Flag Warning.

Figure 42: LAL scale. Source: NWS/NOAA.

Since 2013, Oklahoma has experienced the following federally declared disasters that have had severe storms as an element of the disaster:

Year of Declaration	Title of Declaration	Disaster Number
2013	OK Severe Storms and Tornadoes	DR-4117
2015	OK Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4222
2016	OK Severe Storms and Flooding	DR-4274
2017	OK Severe Storms, Tornadoes, and Flooding	DR-4315

2017	OK Severe Storms, Tornadoes, Line Winds, and Flooding	DR-4324
2019	OK Severe Storms, Straight-line Winds, Tornadoes, and Flooding	DR-4438
2019	OK Severe Storms, Straight-line Winds, Tornadoes, and Flooding	DR-4453
2019	Muscogee (Creek) Nation Severe Storms, Straight-line Winds, Tornadoes and Flooding	DR-4456
2022	OK Severe Storms, Tornadoes, and Flooding	DR-4657
2022	Muscogee (Creek) Nation Severe Storms, Tornadoes, and Flooding	DR-4670

Probability of Future Events and Risk Calculations

The probability is *Highly Likely*.

The CPRI for Severe Storms for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(4 x .45)	+ (2 x .30)	+ (3 x .15)	+ (2 x .10)	= 3.05

Vulnerability and Impact

All structures are exposed to hail and lightning during thunderstorms. Hail damages occur on an annual basis in the state of Oklahoma causing insured losses to residential and commercial properties as well as automobiles. Hail can cause bruises, punctures, and leaks on roofing systems. The amount of damage can depend on the size of the hail, the age, and the material of the structure at the time of the event. In worst cases, substantial hail damage may result in the need for an entirely new roofing system. Large hail driven by high winds can break through windows, doors, and skylights that were not built with impact resistant materials, allowing rainwater to enter buildings. Structures that have fallen into disrepair, like their roofs for example, make these structures more susceptible to hail events. When building a new home or replacing the roof, homeowners should consider using hail-resistant roofing products. According to the Verisk's latest report, *Hail: The Hidden Risk(1)*, Oklahoma had 55 percent of all buildings affected, with nearly 650,000 properties damaged in 2017. Also, there were 167 major hailstorms in 2018, according to the NOAA's Severe Storms database.

Top 10 States By Number Of Properties Experiencing Damaging Hail Events, 2017 (1)

Rank	State	Estimated number of properties affected	Percentage of properties affected
1	Texas	1,349,374	18%
2	Illinois	872,087	24
3	Missouri	832,525	46
4	Minnesota	737,375	44
5	**Oklahoma**	**644,803**	**55**
6	Kansas	513,941	57
7	Indiana	456,215	18
8	Virginia	400,529	16
9	North Carolina	400,248	10
10	Colorado	374,435	22

(1) Verisk considers hail to be damaging when the hailstones are greater than 1 inch in diameter. Source: ©2018 Insurance Services Office, Inc. (ISO) and Verisk. Reprinted with permission from ISO. Further reprint prohibited without permission from ISO.

Hailstorms can occur throughout the whole state of Oklahoma, and frequently occur in late spring and early summer. This period of elevated hail risk corresponds with the Midwest's peak agricultural seasons for multiple types of crops. Long-stemmed vegetation is especially vulnerable to damage from hail impacts and winds. Specifically, large metropolitan cities such as Oklahoma City, Tulsa, Lawton, and Woodward are more at risk to damage and potential losses due to hail. In these larger cities, hail can damage and destroy buildings, car dealerships, homes, vehicles, and other personal property causing millions of dollars in damage.

Populations who have a higher vulnerability to hailstorms include low-income populations who are less likely to be able to recover entirely from a destructive hailstorm if their home or car was damaged. Other populations include those with a language barrier who may not understand the risk of a thunderstorm warning and the risk of hail or may not know where or how to shelter. Those who are homeless or do not have a permanent home may find themselves with a higher risk to hail because they are most likely not able to receive warnings, therefore they may not be able to find shelter in time.

For homes, businesses, critical facilities, schools etc, who do not have covered parking for vehicles, damage is highly likely during a hailstorm. The amount of damage depends on the size of hail, but for critical facilities who house state-owned vehicles with no covering, they are likely to be damaged from hail which can result in a loss of vehicles while they are being repaired or replaced. Schools with no covering for buses could result in damage to the vehicles from hail which could result in a loss of resources for bus routes. Response vehicles in the open during a hail event would also face the same risk of damage during a hailstorm, most likely to windows and windshields.

Not as common as structure and vehicle damage, personal injury can be caused by large hail driven by high winds. Baseball sized hail can fall at 100 mph, which is extremely dangerous to those engaging in outdoor activities who may find themselves in a situation where adequate shelter is unavailable. All outdoor parks and recreation areas throughout the state should be equipped with warning sirens to ensure sufficient time to seek refuge from hailstorms.

One of the most common threats to school districts from hail is structural damage, especially to roofs. This can significantly shorten the lifespan of a roof, placing greater cost burdens on school districts. District vehicles are also quite vulnerable to hail damage. When not adequately sheltered, repair or replacement costs for hail damage to district vehicles represents a significant threat. Children in school districts are also vulnerable to injury or even death if caught outside during a hail event.

All critical facilities, structures, and buildings within the state of Oklahoma are also vulnerable to the impact of a lightning event. The most severe consequence of a lightning strike on infrastructure can be loss of electrical power and communications. Lightning has caused damage to transformers and downed lines in the past, resulting in outages in the service areas. Although surge protection may mitigate the effects of lightning, it cannot protect all electronic systems in the event of a direct lightning strike. Most buildings, including critical facilities, may not have backup generators in the event of a power outage caused by lightning.

Economic impacts from lightning can include loss of power, fire, and business interruption. The amount of impact on the economy depends on the length of time until electrical service restoration. Lightning can cause a loss of electrical power between a few hours to a few days. A fire caused by a lightning strike can have a longer-term impact. An intense lightning strike can cause a total loss of a structure, which could lead to relocating or rebuilding a business.

People who do not have access to lightning warnings or advanced alerts, especially while outside, are at higher risk simply due to exposure. This goes especially for spectators and participants who are at outdoor gatherings, such as at one of the many athletic fields across the state, whose focus may be more on the event than quickly changing weather conditions approaching. Lightning events could place park visitors in imminent danger, potentially calling for a park evacuation. Parks throughout the state should install lightning detection systems to keep park visitors safe from lightning when storms approach. Lightning can also spark structural and/or wildland fires, particularly during droughts or periods of high temperatures/low humidity. These fires can quickly spread and pose a threat to both people and property.

Areas of most concern are those with higher concentrations of people who do not have a way to receive severe weather alerts, especially low-income and non-English speaking populations. Additional mitigation measures, like lightning rods and surge protection, can reduce vulnerability to lightning by mitigating its impact. Lightning could cause any of the school districts to lose power, although unlikely, lack of power

causes schools to close or go virtually which can disrupt studies and may prevent students from getting lunch.
In Oklahoma, people experience many severe storms throughout the year. This can be emotionally distressing for some people, especially those who have survived a damaging storm, first responders, and friends and loved ones of survivors. According to the Substance Abuse and Mental Health Services Administration, symptoms of distress may appear before, during, and after a tornado or severe storm and may manifest in the hours, days, weeks, months, or even years after the storms occur. This can cause people to experience stress when severe storms are in the forecast causing them to not react to severe weather warnings to protect themselves, making them more vulnerable to severe storms.

In addition, according to FEMA's National Risk Index for hail, Oklahoma experiences nearly the entirety of the range of risk to hail. Oklahoma County ranks the highest having a "very high" risk to tornadoes and McCurtain County and others having a "very low" risk to hail.

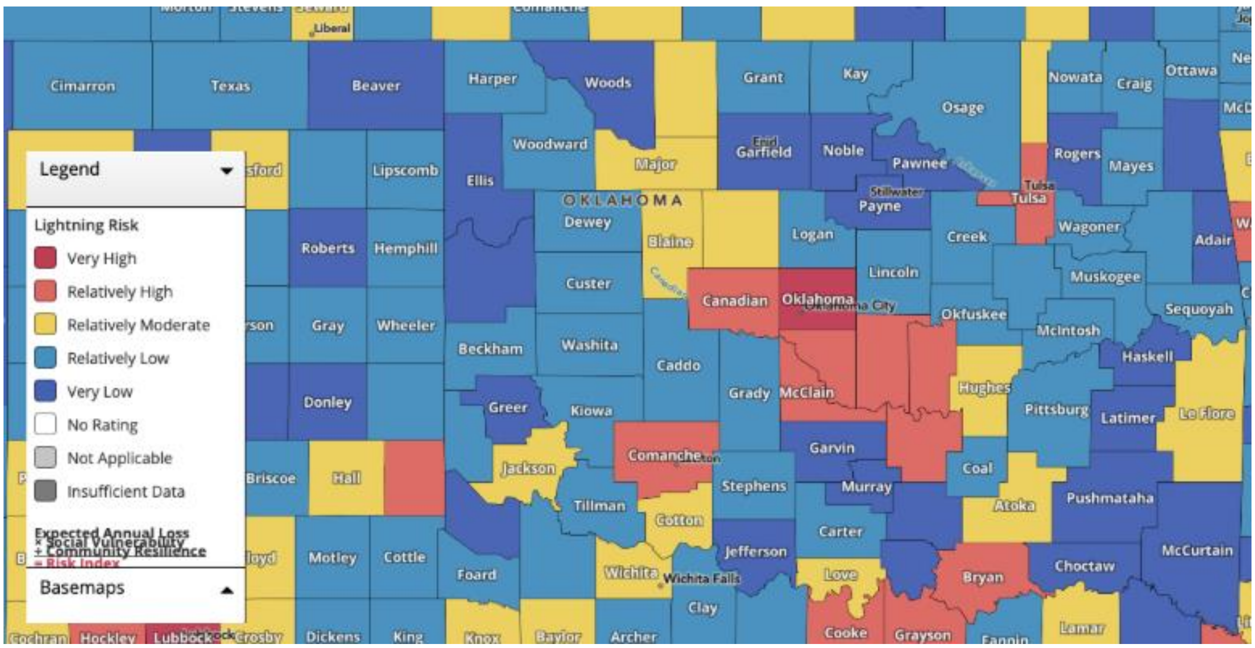


Figure 43: FEMA risk map for hail. Source: FEMA.

Effects of Climate Change

Lightning:

Lightning is associated with thunderstorms, so as more favorable environments for thunderstorms are expected across the United States, increases in lightning are also projected. Studies have shown an increase in lightning associated with severe storms (Schultz et al. 2011). Climate models project an increase in the frequency and intensity of *severe* thunderstorms (Kossin et al. 2017), therefore, lightning occurrences are likely to increase. Confidence in the projections is currently low, however, due to the isolated and sporadic nature of lightning events and limited comprehensive datasets which make it difficult to track long-term trends (Wuebbles et al. 2017a).

Hail:

Hail is commonly associated with severe thunderstorms. Climate models project an increase in the frequency and intensity of severe thunderstorms, and events with large hail are projected to increase (Kossin et al. 2017). At the same time, models project an overall decrease in the number of days with hail per year (Brimelow et al. 2017). Confidence in the projections is currently low, however, due to the isolated and sporadic nature of hail events and limited comprehensive datasets which make it difficult to track long-term trends (Wuebbles et al. 2017a).

3.4.7 SOIL HAZARDS – EARTHQUAKE, LANDSLIDES, EXPANSIVE SOILS/SOIL SUBSIDENCE

Description

Earthquake:

Earthquakes occur along fault zones throughout Oklahoma, as stress overcomes friction on faults that slip. The fault slip causes the ground to shake and the shaking leads to damage to infrastructure. Much of Oklahoma's earthquake activity since 2012 has been attributed to oil and gas production and disposal activity.

Landslides:

The term landslide refers to several forms of mass movement such as rockslides, mudflows, and debris flows. Landslides occur throughout the state of Oklahoma, particularly in mountainous regions of the Ozark, Ouachita, Arbuckle, and Wichita Mountains. Major factors that contribute to landslides in these mountains are the weathered and fractured bedrock lithology (i.e., shale and sandstone) and steep hillslope gradient. Major triggers are frequent intense precipitation and human-induced hillslope changes. OGS study shows many of the hillslopes with gentle to steep gradients in eastern Oklahoma (both in the Ozark and Ouachita Mountains) are highly susceptible to landslides, particularly small-sized shallow landslides, and soil creep.

Expansive Soils:

Expansive soil is a soil/clay (such as montmorillonite or bentonite) that is prone to expansion or shrinkage due directly to variation in water volume. Expansive soils swell when exposed to large amounts of water and shrink when the water evaporates. This continuous cycle of wet to dry soil keeps the soil in perpetual motion causing structures built on this soil to sink or rise unevenly, often requiring foundation repair. Expansive soils are composed primarily of minerals (incredibly fine particles) with little to no organic material and are thus incredibly viscous, proving difficult to drain.

Soil Subsidence:

Soil subsidence is sinking of the ground because of underground material movement. It is most often caused by the removal of water, oil, natural gas, or mineral resources out of the ground by pumping, fracking, or mining activities. Subsidence can also be caused by natural events such as earthquakes, soil compaction, glacial isostatic adjustment, erosion, sinkhole formation, and adding water to fine soils deposited by wind (a natural process known as loess deposits). Subsidence can happen over very large areas like whole states or provinces, or very small areas.

Location

The earthquake hazard is most present in the central and north-central portions of the state, near where large volume wastewater injection has occurred throughout the last decade. The Oklahoma Geological Survey (OGS) operates a real-time earthquake monitoring network that sends alerts about earthquake activity in partnership with the USGS.

The OGS also provides data to the Oklahoma Corporation Commission's Induced Seismicity Department (ISD) that is used to delineate areas where ISD may need to issue directives to mitigate the risk of induced seismicity related to oil and gas activity.

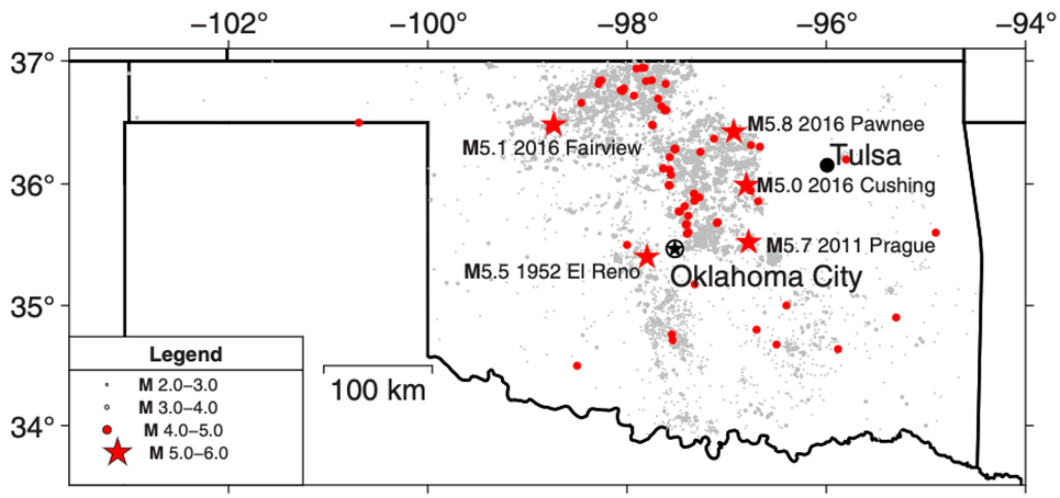


Figure 44: Earthquake activity in Oklahoma. Source: OGS.

OGS mapped more than 700 recent landslides in eastern Oklahoma. Most of these landslides are dominantly shallow and small sized, and a few of them were economically and socially disruptive. For example, a large landslide that occurred north of Red Oak in the Ouachita Mountains of Oklahoma severely damaged Oklahoma State Highway 82 and a forest road (Cerato et al., 2014). In June 2015, the I-35 Interstate was closed due to a rock fall that impacted the northbound lanes. Additionally, a landslide that occurred near Sallisaw in the southern Ozarks during a rainstorm of April 2020 damaged over 2,000 feet of water lines and left ~2,500 people without running water for a week (5NEWS, April 13, 2020).

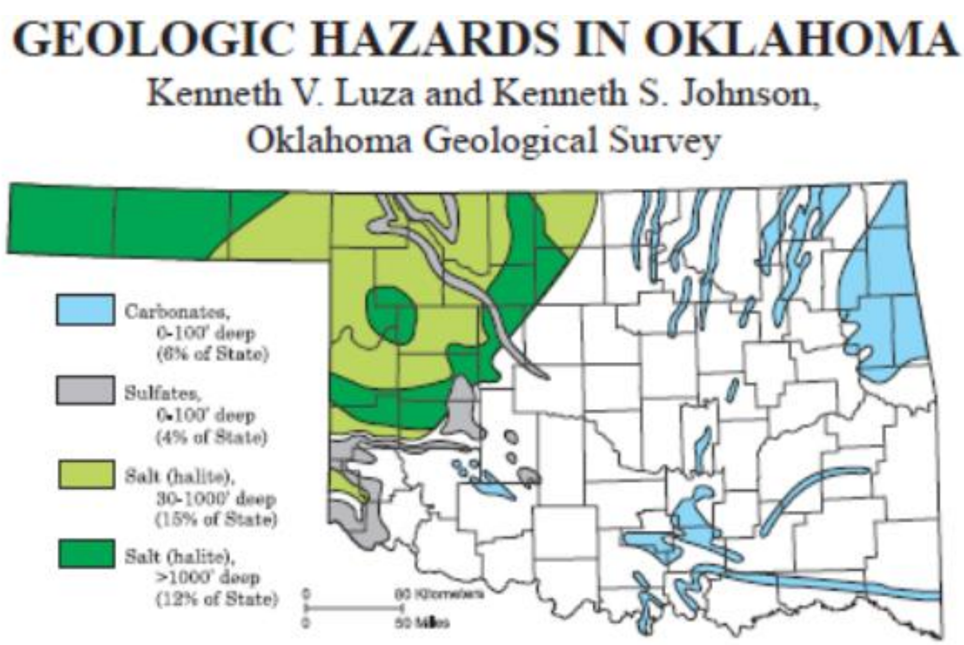


Figure 45: Geologic Hazards in Oklahoma. Source: OGS.

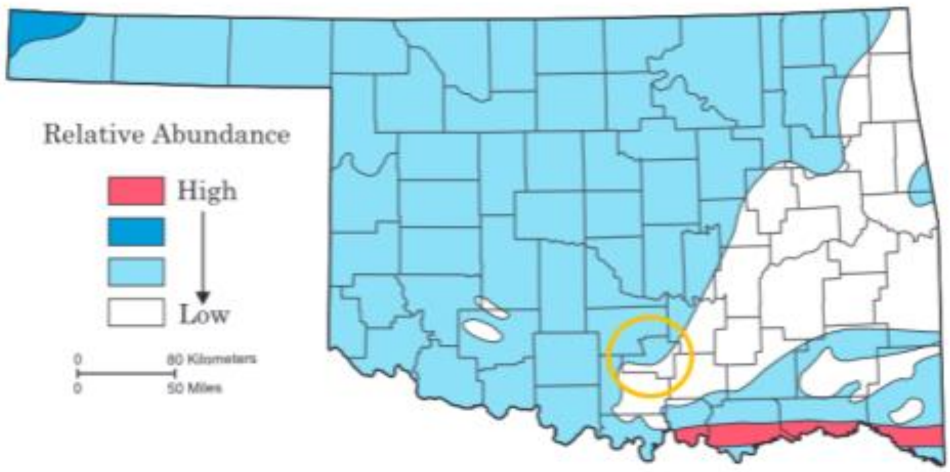


Figure 46: Relative abundance of expansive soils in Oklahoma. Source: OGS.

Previous Occurrences

Felt earthquakes: Several of the largest earthquakes in Oklahoma recorded history have occurred since 2009, including the November 2011 Mw 5.7 Prague earthquake, the February 2016 Mw 5.1 Fairview earthquake, the September 2016 Mw 5.8 Pawnee earthquake, and the November 2016 Mw 5.0 Cushing earthquake. Severe damage to several buildings during the Prague, Pawnee, and Cushing earthquakes were reported with some buildings condemned. Approximately 1,200 years ago, an earthquake ruptured along the Meers Fault, near Meers, OK. Geologists determined this through detailed field studies and the fault trace was noticed because it 1 of 2 surface-visible fault traces east of the Rocky Mountains. The field investigations suggest the fault ruptured a sufficient amount to produce approximately a magnitude 7 earthquake. The fault is likely still active though it has a very long recurrence time. Oklahoma can experience up to magnitude 7 earthquake based on previous occurrences, but normally can expect a range of magnitude 2-4.

The Modified Mercalli Scale with Richter Magnitude Approximations			
Magnitude	Mercalli	Description	Earthquake Effects
2	I	Instrumental	Not felt except by a very few under especially favorable conditions.
	II	Feeble	Felt only by a few persons at rest, especially on upper floors of buildings.
3	III	Slight	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
	IV	Moderate	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
4	V	Rather Strong	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5	VI	Strong	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
	VII	Very Strong	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6	VIII	Destructive	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
7	IX	Ruinous	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
	X	Disastrous	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
8	XI	Very Disastrous	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
	XII	Catastrophic	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Figure 47: Modified Mercalli Scale. Source: USGS.

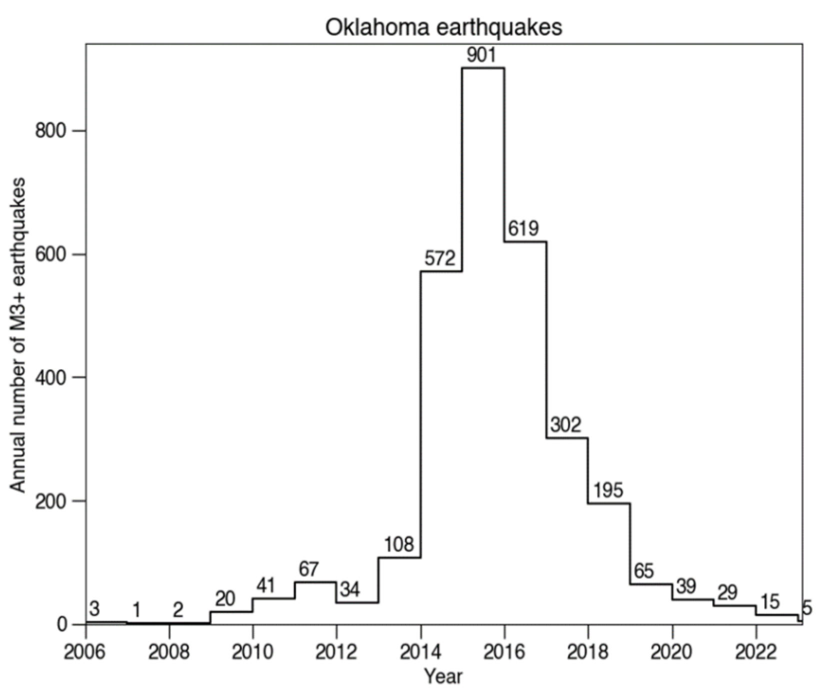


Figure 48: Annual values for statewide earthquakes (M3.0 and greater). Source: OGS.

Top 10 Largest Earthquakes in Oklahoma Recorded History

Date	Name	Magnitude	County
September 3, 2016	Pawnee Earthquake	5.8	PAWNEE
November 6, 2011	Prague Earthquake	5.7	LINCOLN
April 9, 1952	El Reno Earthquake	5.5	CANADIAN
February 13, 2016	Fairview Earthquake	5.1	WOODS
November 7, 2016	Cushing Earthquake	5.0	PAYNE
October 22, 1882	Choctaw Nation Earthquake	4.8	
November 5, 2011	Prague foreshock	4.8	LINCOLN
January 7, 2016	Fairview foreshock	4.8	WOODS
November 8, 2011	Prague aftershock	4.8	LINCOLN
November 19, 2015	Alfalfa County Earthquake	4.7	ALFALFA

Landslides: Locations of landslides were mapped from aerial photographs acquired since 1995. KS: Kansas; OK: Oklahoma; TX: Texas; AR: Arkansas; and MO: Missouri.

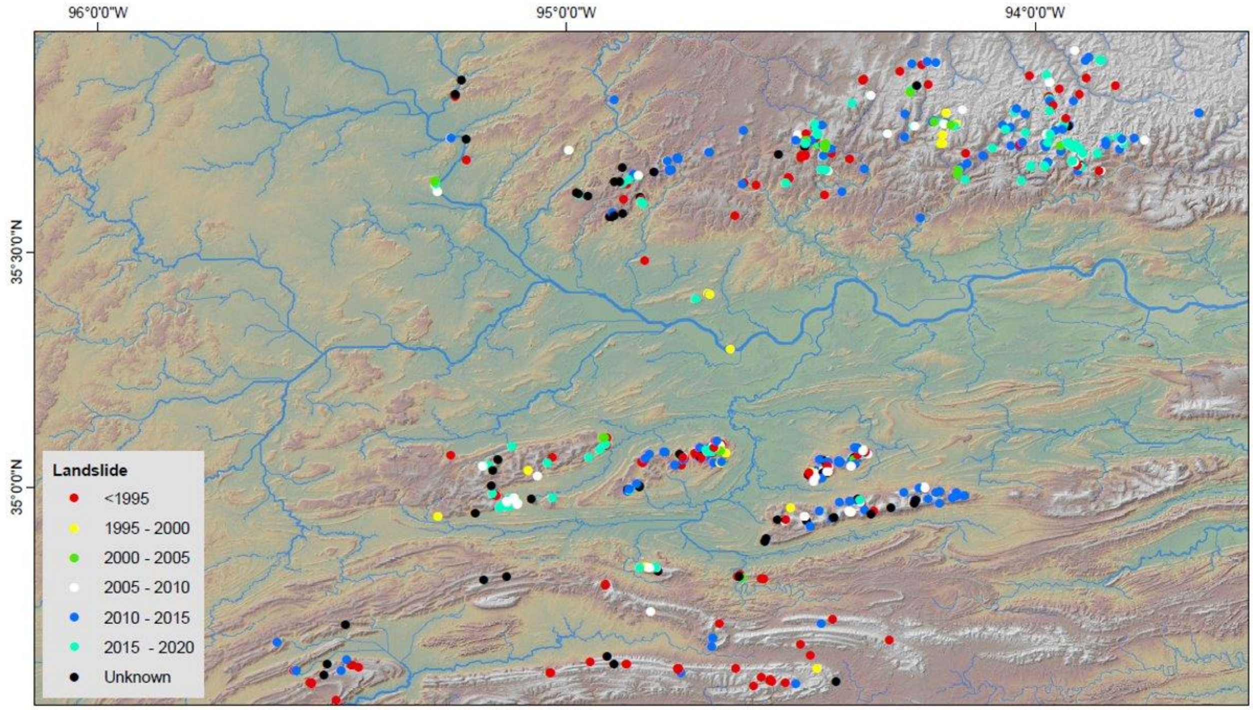


Figure 49: Mapped landslides in Oklahoma. Source: OGS.

Expansive Soils: Oklahoma does not have disaster information on Expansive Soils because a catastrophic event has not been declared. No history is available because there are no reported losses that identify the presence of expansive soils as the direct cause. In addition, a lack of datasets and previous studies relating the role of expansive soils in Oklahoma does not exist. This hazard develops gradually and is difficult to attribute dollar amounts to. Expansive soil can play a major role in landslides and subsidence which have been known to occur in Oklahoma (see landslide map above).

Probability of Future Events and Risk Calculation

The probability is *Possible*.

The CPRI for Earthquakes for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (1 x .30)	+ (4 x .15)	+ (1 x .10)	= 1.9

The USGS indicates that the chance for damage in an earthquake is low to moderate in the north-central portion of the state experiencing earthquakes, and thus a low to moderate likelihood of damage occurring.

The potential of future naturally occurring Earthquake events in most of Oklahoma is low because of slow geological movement. The most likely areas are in the counties shown on the map above. The danger of additional earthquakes in Oklahoma is Possible.

OGS study suggests that upland hillslopes in eastern Oklahoma are highly susceptible to shallow landslides. These mountains are also susceptible to damage causing large landslides, like the one near Red Oak, under extreme triggering events (i.e., extreme rainfall, high magnitude earthquakes, and slope modifications). Thus, the likelihood of future landslides in this area can be considered moderate to high.

Expansive Soils: The potential for expansive soil events in Oklahoma is possible under the right soil and weather conditions. In Oklahoma, numerous foundation failures and pipeline breaks resulted from soil shrinkage during hot and dry summers (1998, 2005-2006 and 2011). The drought period between 2005-2006 led to water main and sewer pipe breaks and leaks in many Oklahoma cities including Ada, Holdenville, Okmulgee, and Muskogee due to soil shrinkage.

Vulnerability and Impact:

Earthquakes: Those areas experiencing increased seismic activity and magnitudes of earthquakes in Oklahoma have been in areas predominantly from the central area north extending to the northwest, as indicated in the preceding location map. Within this area of concentration, the vulnerabilities are many fold. The cities of Oklahoma City, Edmond, Guthrie, Stillwater, and Enid are located within these areas, and the earthquake effects on an urban environment would be experienced. The three major interstates of I-40, I-35, and I-44 have a common junction in Oklahoma City and impacts to those transportation routes would have regional and national impacts. Metro areas of Oklahoma City and Tulsa are most vulnerable to the earthquake hazard due to the larger number of structures and built environment. Since the seismic risk to the built environment is associated with the underlying seismic hazard, the OGS has identified soils statewide that may be susceptible to stronger shaking relative to other areas (OGS GM-41). In that study, they specifically identify which areas within these major metropolitan zones may be more susceptible to stronger shaking and subsequent damage. Further urban mapping would be required to better understand the soil structures that would be susceptible to strong shaking.

The Oklahoma Corporation Commission’s Induced Seismicity Department has instituted numerous directives aimed at oil and gas wastewater disposal and well completion activities to mitigate the risk of felt seismicity that could be related to these activities. These directives have been credited by seismologists with being a key factor in the 90-plus reduction rate in 3.0 and larger magnitude earthquakes since the peak in 2007.

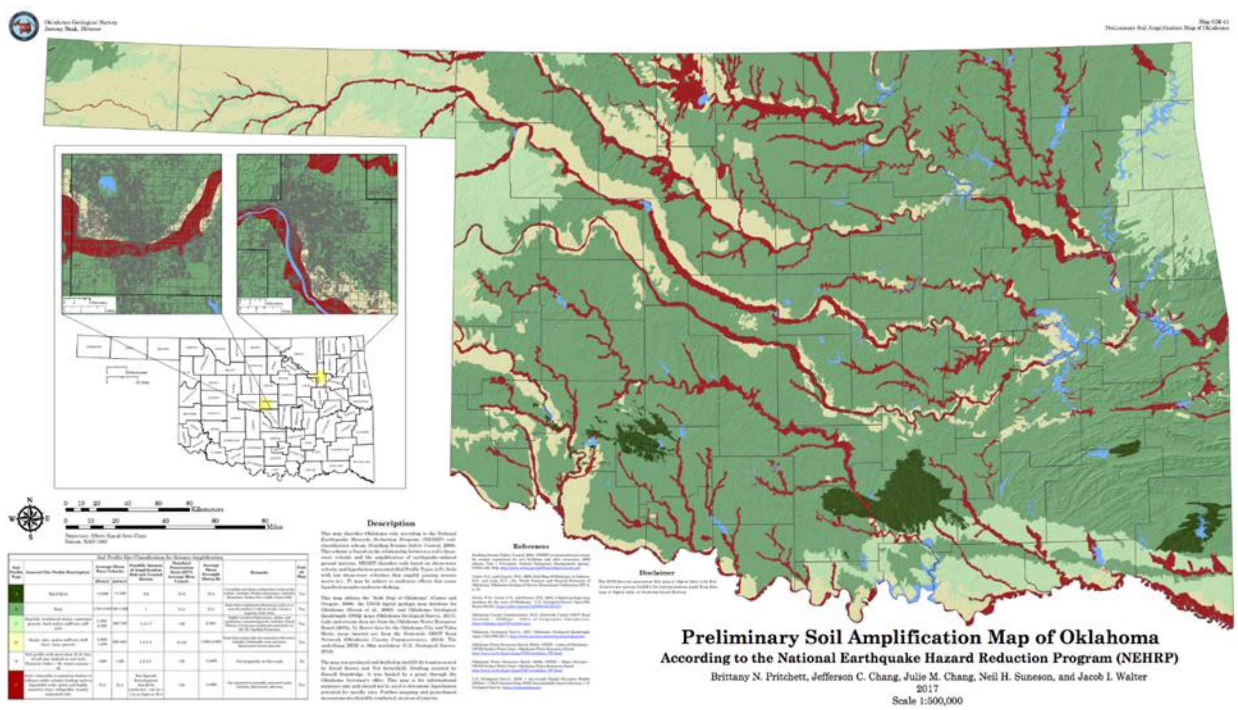


Figure 50: Geologic Map (GM) 41 depicting soil classification for possible amplification during strong earthquake shaking. Source: OGS

In addition, according to FEMA's National Risk Index for earthquakes, Oklahoma experiences an overall uniform range of risk to earthquakes. Oklahoma county ranks the highest having a "relatively moderate" risk to earthquakes while the rest of the state has a "relatively low" to "very low" risk.

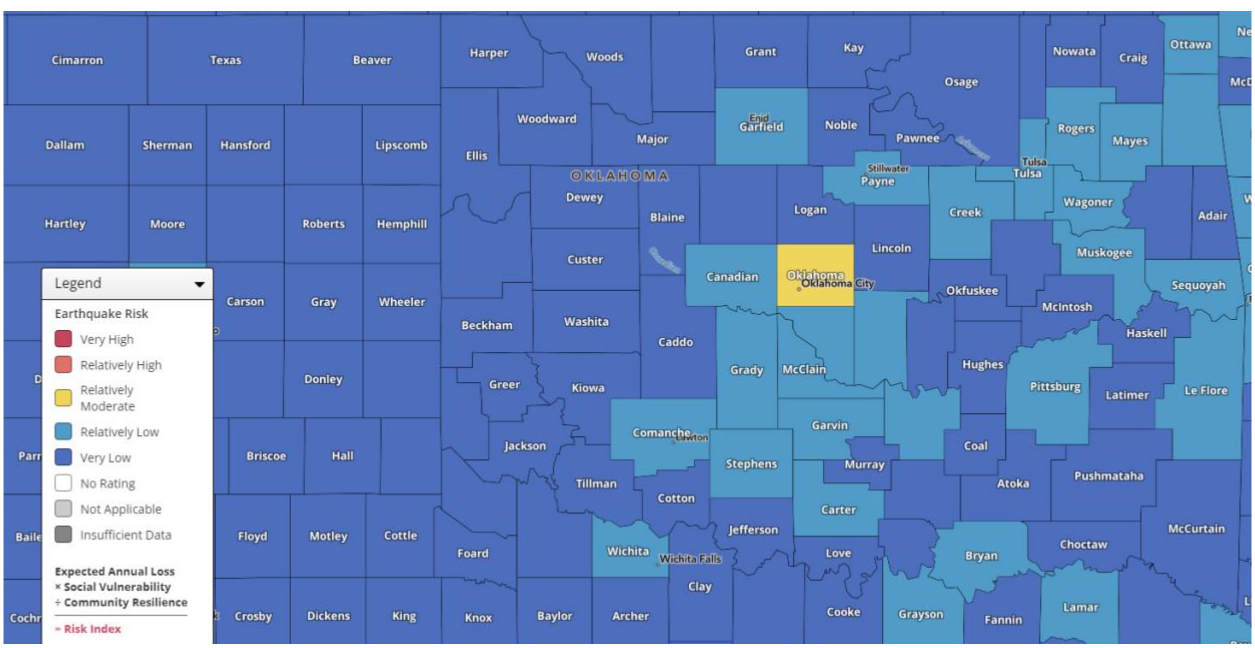


Figure 51: Risk map for earthquakes in Oklahoma. Source: FEMA

Landslides: Landslide hazards in the State of Oklahoma have been located in specific areas and are dependent on geological formations and influenced by weather related factors such as periodicity of precipitation. These locations primarily occur in Eastern Oklahoma, which has many of the requisite factors such as precipitation, slope instability and geological formations that are factors in a landslide event.

Areas experiencing frequent landslides in Oklahoma are the Ozark and Ouachita Mountains of Eastern Oklahoma. OGS maps the largest occurrence of landslides in Cavanal Hill and Sugarloaf Mountain of LeFlore County. Upland slopes in its neighboring counties, such as Sequoyah and Adair in the Ozark and McCurtain and Pushmataha in the Ouachita, are also highly susceptible. These mountains have some potential to generate economically and socially disruptive landslides. This area is a very popular tourist destination in Oklahoma, and if a landslide were to occur, it could impact tourists as well as those who live in this area. Tourists might not be aware of the risk associated with these areas, and thus would be more vulnerable to a landslide.

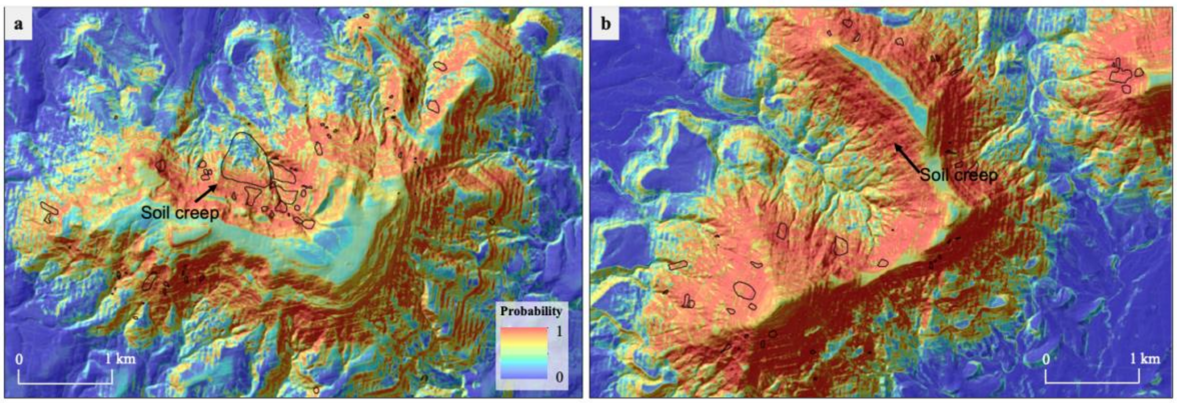


Figure 52: Landslide probability in Cavanal Hill (a) and Sugarloaf Mountain (b). Polygons are the historical rapid landslides and arrows show the areas of landslides and soil creep examples. Soil creep dominates the landscape. Source: OGS

According to FEMA's National Risk Index for landslides, Oklahoma also experiences a uniform risk to landslides. Tulsa, Murray, and Pushmataha County rank the highest having a "relatively moderate" risk to landslides while the rest of the state has a "relatively low" to "very low" risk.

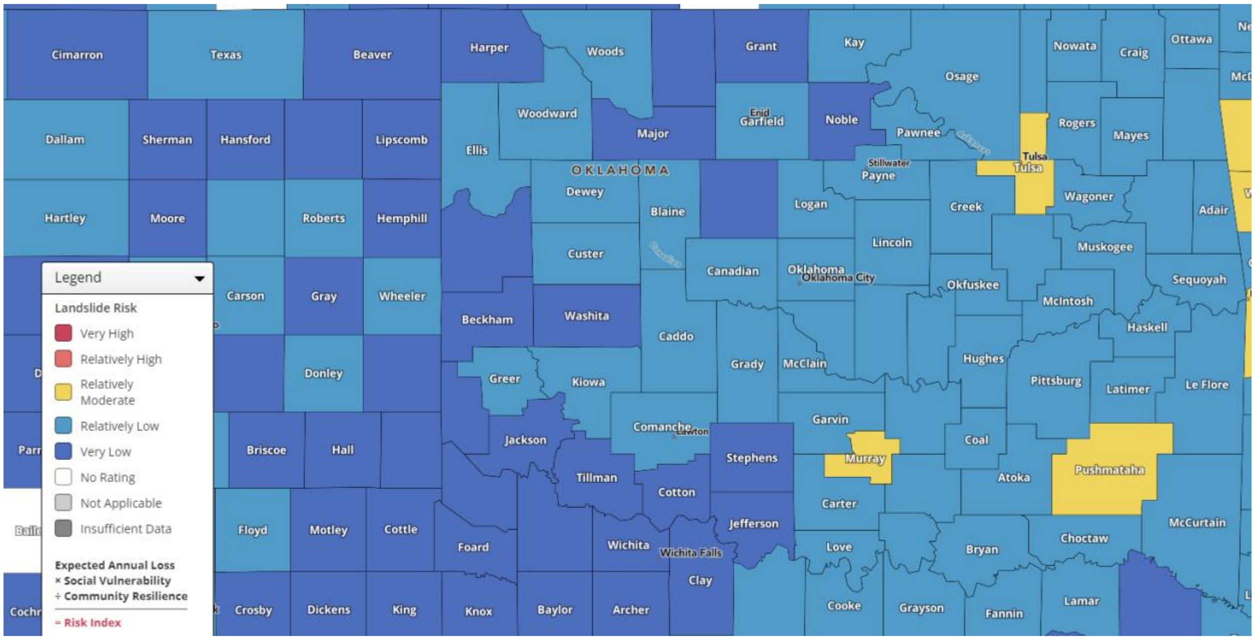


Figure 53: Risk map for landslides in Oklahoma. Source: FEMA

Expansive Soils: In Southeast Oklahoma, the soil is abundant with clay of high swelling potential while most of the state's soil is underlain by clay of moderate swelling potential. Areas of high swelling potential pose threats to life or personal injury. This has not generally been documented for expansive soils. Indirect threats to populations throughout the state can include economic damages to structures such as homes, businesses, schools, etc. Public health concerns can arise from this hazard when the shrinking and swelling of soils cause water or sewer lines to break, which can often occur during periods of extreme heat and drought. The increase in soil volume can cause damage to foundations. The most obvious manifestations of damage to buildings are sticking doors, uneven floors, and cracked foundations, floors, walls, etc. If damage is severe the cost of repair may exceed the value of the building, as it does not take much soil movement to damage buildings. The counties of McCurtain, Choctaw, Pushmataha, Bryan, Atoka, Marshall, Johnston, Love and Carter are the most susceptible to severe Expansive Soils while other counties could have isolated areas that may experience soil subsidence.

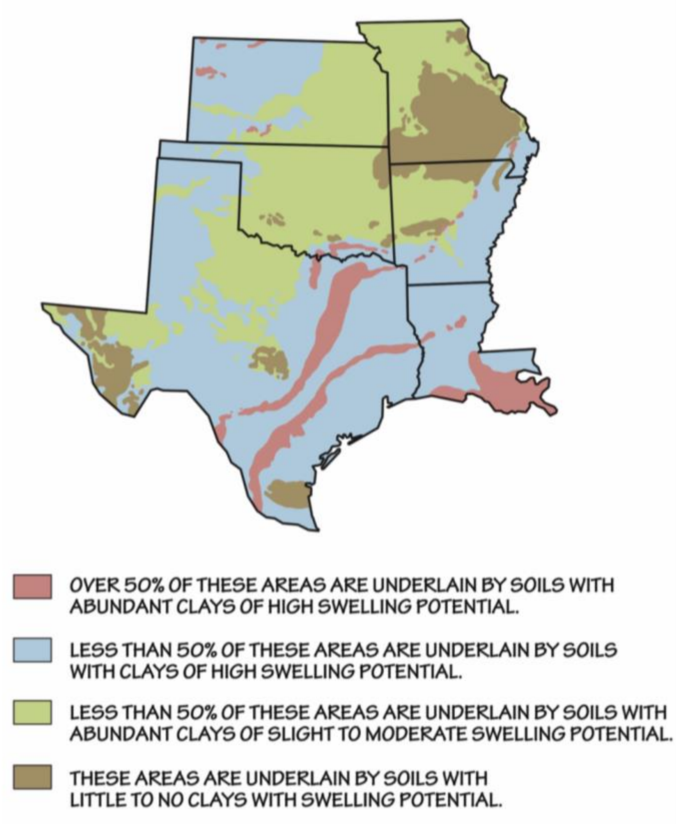


Figure 54: Approximate distribution of expansive soils in the South Central US. This map is based on the distribution of types of bedrock, which are the origin of soils produced in place. Source: OGS.

Effects of Climate Change:

Earthquakes do not have a direct relationship to climate and thus are not affected by a changing climate. However, man-made issues have caused an increase of earthquakes in Oklahoma.

Risk due to landslides, soil subsidence, and expansive soils are projected to evolve and potentially increase due to shifts in precipitation patterns, temperature extremes, and increased weather variability. Higher temperatures and changing rainfall patterns can exacerbate soil expansion and contraction, potentially increasing the occurrence of soil-related damage to structures and infrastructure. Landslide researchers are warning that climate change may make landslides more likely, and that we are not prepared for this growing risk.

3.4.8 TORNADO

Description

A tornado is defined as a violently rotating column of air that reaches from the bottom of a cumulonimbus cloud to the ground. Tornadoes are found in severe thunderstorms, but not all severe thunderstorms will contain tornadoes. Tornadoes can appear in a variety of shapes and sizes ranging from thin ropelike circulations to large wedge shapes greater than one mile in width. However, a tornado's size is not necessarily related to its wind speed. The strongest tornadoes can have wind speeds in excess of 200 mph. While tornadoes normally strike in the midafternoon to early evening, tornadoes can strike at any time during the day. Spring is the peak season for Oklahoma tornadoes, but they can form during any season when the necessary atmospheric conditions of wind shear, lift, instability, and moisture are present.

The Fujita (F) Scale was originally developed by Dr. Tetsuya Theodore Fujita to estimate tornado wind speeds based on damage left behind by a tornado. An Enhanced Fujita (EF) Scale, developed by a forum of nationally renowned meteorologists and wind engineers, makes improvements to the original F scale. This EF Scale has replaced the original F scale, which has been used to assign tornado ratings since 1971.

The original F scale had limitations, such as a lack of damage indicators, no account for construction quality and variability, and no definitive correlation between damage and wind speed. These limitations may have led to some tornadoes being rated in an inconsistent manner and, in some cases, an overestimate of tornado wind speeds.

The EF Scale considers more variables than the original F Scale did when assigning a wind speed rating to a tornado. The EF Scale incorporates 28 damage indicators (DIs) such as building type, structures, and trees. For each damage indicator, there are 8 degrees of damage (DOD) ranging from the beginning of visible damage to complete destruction of the damage indicator. The original F Scale did not take these details into account.

For example, with the EF Scale, an EF3 tornado will have estimated wind speeds between 136 and 165 mph (218 and 266 kph), whereas with the original F Scale, an F3 tornado has winds estimated between 162-209 mph (254-332 kph). The wind speeds necessary to cause "F3" damage are not as high as once thought and this may have led to an overestimation of some tornado wind speeds.

Fujita Scale 3-Second Gust (mph)		**Damage Levels**	**Enhanced Fujita Scale 3-Second Gust (mph)**	
F-0	45-78	Light - tree branches down	**EF-0**	65-85
F-1	79-117	Moderate - roof damage	**EF-1**	86-110
F-2	118-161	Considerable - houses damaged	**EF-2**	111-135

F-3	162-209	Severe - buildings damaged	**EF-3**	136-165
F-4	210-261	Devastating - Structures leveled	**EF-4**	166-200
F-5	262-317	Incredible - Whole houses destroyed	**EF-5**	Over 200

Source: https://www.spc.noaa.gov/faq/tornado/ef-scale.html

Location

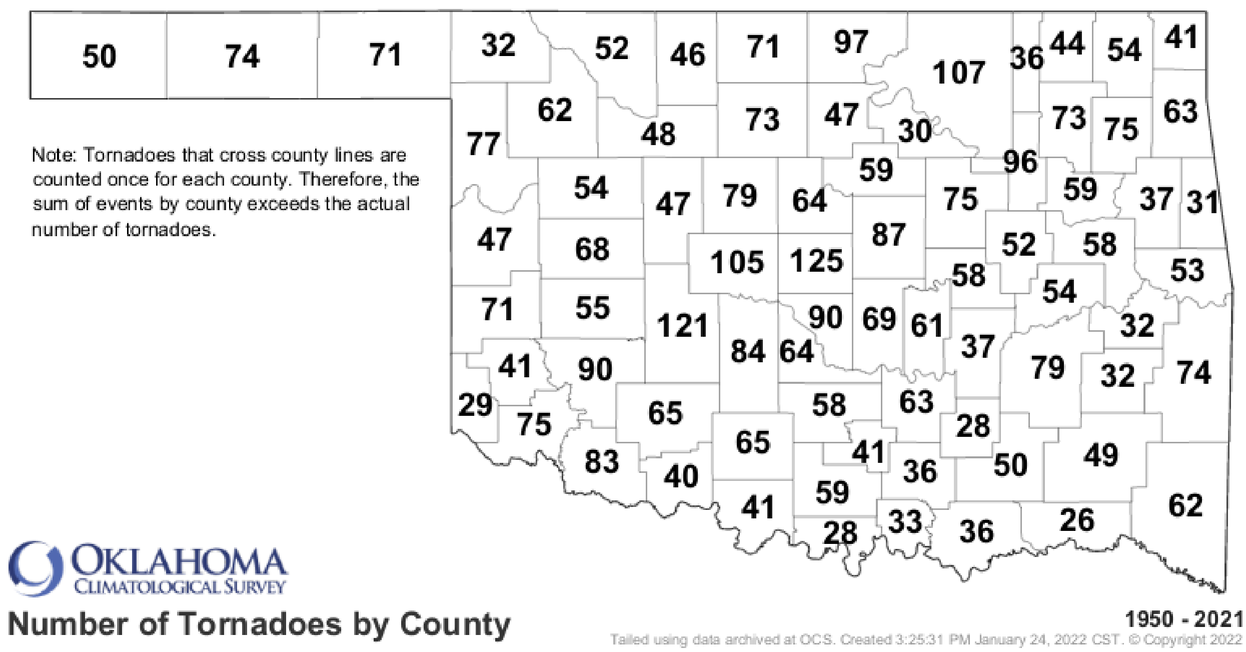


Figure 55: Number of tornadoes by county in Oklahoma from 1950-2021. Source: OCS.

The entire State of Oklahoma is at risk for tornadoes, with a range of Choctaw Co observing 26 tornadic events to Oklahoma Co observing 125 tornadic events. In addition, Oklahoma has experienced and can expect to continue to experience the entire range of the Enhanced Fujita Scale (EF-0 – EF-5).

Previous Occurrences:

Since 2013, Oklahoma has experienced 8 federally declared disasters that have had tornadic events as an element of the disaster.

Additionally, there have been 85 Tornadic events of an EF2 or greater reported between 01/01/2012 and 12/31/2022 according to the National Weather Service.

Year	EF 0	EF 1	EF 2	EF 3	EF 4	EF 5
2012	45	23	1	2	0	0
2013	43	40	7	3	2	1
2014	12	3	1	0	0	0
2015	64	48	13	4	0	0
2016	17	32	8	3	1	0
2017	21	38	7	0	0	0
2018	24	23	3	0	0	0
2019	54	65	13	4	0	0
2020	11	20	3	0	0	0
2021	18	24	1	0	0	0
2022	21	24	7	0	1	0

Since 2013, Oklahoma has experienced the following federally declared disasters that have had tornado as an element of the disaster:

Year of Declaration	Title of Declaration	Disaster Number
2013	OK Severe Storms and Tornadoes	DR-4117
2015	Ok Severe Storms, Tornadoes, Straight-line Winds, and Flooding	DR-4222
2017	OK Severe Storms, Tornadoes, and Flooding	DR-4315
2017	OK Severe Storms, Tornadoes, Line Winds, and Flooding	DR-4324

2019	OK Severe Storms, Straight-line Winds, Tornadoes, and Flooding	DR-4438
2019	OK Severe Storms, Tornadoes, Straight-line Winds and Flooding	DR-4453
2022	Ok Severe Storms, Tornadoes, and Flooding	DR-4657
2022	Muscogee (Creek) Nation Severe Storms, Tornadoes, and Flooding	DR-4670

Significant Tornadoes from 2012-2022

Woodward Tornado - 2012:

The tornado developed approximately 2 miles northeast of Arnett at 11:50 pm CDT on April 14, 2012, and moved northeast. Six structures were damaged as the tornado moved toward the Woodward County line. Only minor damage, downed trees and power poles/lines was seen as the tornado moved over mainly rural portions of Woodward County. The tornado then struck two mobile homes 5 miles southwest of Woodward. The damage here was determined to be EF-2 in intensity and resulted in 3 fatalities.

Figure 56: Tornado damage from Woodward Tornado. Source: NWS Norman.

The heaviest damage, rated EF-3, was reported as the tornado entered the southwest sides of Woodward around 12:18 am CDT. Several homes and businesses were heavily damaged as the tornado continued northeast. Several more mobile homes were destroyed by the tornado on the north side of Woodward and resulted in 3 additional fatalities. The tornado finally exited the city of Woodward at approximately 12:23 am CDT, eventually dissipating approximately 4 miles north of Woodward at 12:27 am CDT. (Image Source: Woodward News).

Newcastle-OKC-Moore Tornado - 2013:

A tornado outbreak occurred during the afternoon and evening hours of May 20, 2013, and was the last day of a three-day stretch of significant severe weather from May 18-20, 2013. This event also produced the most deadly and devastating tornado of the year for Oklahoma and the United States.

Several supercell thunderstorms developed during the early afternoon of May 20th along a dryline in central Oklahoma. One of these storms developed near Chickasha and rapidly intensified, producing a tornado which touched down at 2:56 PM CDT on the west side of Newcastle. The tornado became violent within minutes, then tracked east northeastward across the city of Moore and parts of south Oklahoma City for about 40 minutes before finally dissipating near Lake Stanley Draper. The tornado caused catastrophic damage in these areas and was given a maximum rating of EF-5. The tornado claimed 24 lives, injured scores of people, and caused billions of dollars in damage. The tornado also destroyed much of Briarwood Elementary School, where the NWS storm survey team rated damage as EF-5. Despite the destruction of this elementary school during school hours, no fatalities occurred at the school.

Figure 57: Newcastle-OKC-Moore Tornado Damage. Source: NWS Norman.

Later, the tornado moved through more suburban neighborhoods and toward Plaza Towers Elementary School. Damage to the school was extensive and seven children were killed when a wall collapsed at the school. Nine other people were killed in eight different neighborhood homes within one-quarter mile of Plaza Towers Elementary, most occurring just south of the school.

El Reno Tornado - 2013:

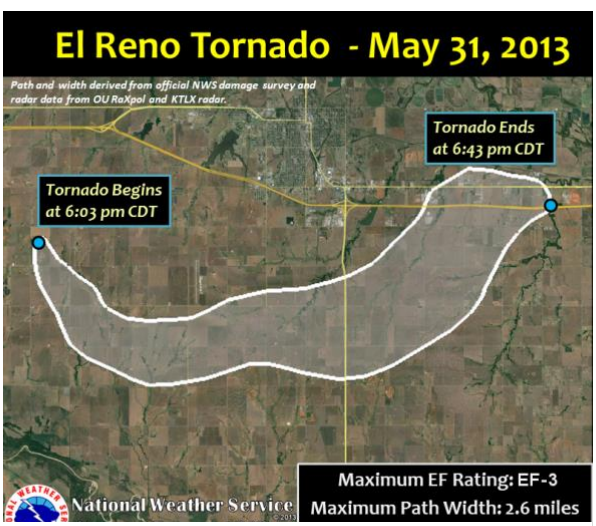


Figure 58: El Reno Tornado Path. Source: NWS Norman.

On May 31, 2013, an intense, long-track tornado formed southwest of El Reno. This exceptionally wide tornado took a complex path, rapidly changing in both speed and direction. The tornado spared El Reno and its airport from a direct hit, tracking just south of those locations. The tornado damaged numerous homes along with a few businesses near El Reno. Additionally, intense sub-vortices destroyed crops in numerous fields in the area.

The tornado developed at 5:03 PM CST (6:03 PM CDT) just northeast of the intersection of Heaston and Reuter roads. The tornado continued to expand in size just southwest of the El Reno Municipal Airpark, where its speed increased to 30 to 40 mph. As the tornado passed just south of the airport, two satellite tornadoes formed briefly on the west side of the tornado.

Eight people were killed in the tornado, all in vehicles. This included three severe storm researchers who were killed east of U.S. Highway 81 as the tornado overtook their position. Additionally, several other people were killed while attempting to escape the tornado near U.S. Highway 81. Finally, two people were killed along I-40 while waiting for the storm to pass.

The monetary damages were estimated. This tornado was well sampled by two separate mobile research radar teams – the University of Oklahoma RaXPol radar, and the Center for Severe Weather Research's Doppler on Wheels. Both radars measured winds in the tornado of more than 200 mph. The RaXPol radar data shows winds of at least 295 mph very close to the surface. These intense winds were present in very small sub-vortices within the larger tornado circulation. An analysis of the high-resolution radar data combined with the results of the ground damage survey indicates that none of these intense sub-vortices impacted any structures in rural Canadian County. So despite the measured wind speeds, surveyors could not find any damage that would support a rating higher than EF-3 based solely on the damage indicators used with the EF scale.

The maximum tornado width was 2.6 miles. However, the damaging wind swath was much larger, as non-tornadic downdraft winds extended for at least a mile south of the tornado. Given the difficulty of separating this damage from tornado damage, the OU RaXPol radar was used to help determine the width.

Katie/Wynnewood Tornado - 2016

A tornado developed 1.25 miles south of the community of Katie, Oklahoma, or about 3.4 miles north of Hennepin in Garvin County. Initially damage was confined to trees until the tornado crossed county road 1690 where a home was destroyed where only interior walls remained standing. To the east of this house, two mobile homes were damaged on the southern periphery of the tornado path. The tornado moved east-northeast damaging another mobile home, then east removing the roof from a home on Indian Meridian Road.

Figure 59: Katie/Wynnewood Tornado Damage. Source: NWS Norman.

The tornado varied in movement between northeast and southeast as it approached and crossed county road 1680. A home was destroyed near county road 1680 and Indian Meridian Road where an EF4 rating was applied. Further east, a fatality occurred when the tornado destroyed a modular home. After destroying another home, the tornado moved northeast and dissipated near Interstate 35.

Probability and Risk Calculation

The probability is *Possible*.

The CPRI for Tornadoes for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (2 x .30)	+ (3 x .15)	+ (2 x .10)	= 2.15

In addition, according to FEMA's National Risk Index for tornadoes, Oklahoma experiences nearly the entirety of the range of risk to tornadoes. Oklahoma county ranks the highest having a "very high" risk to tornadoes and Cimarron County having a "very low" risk to tornadoes.

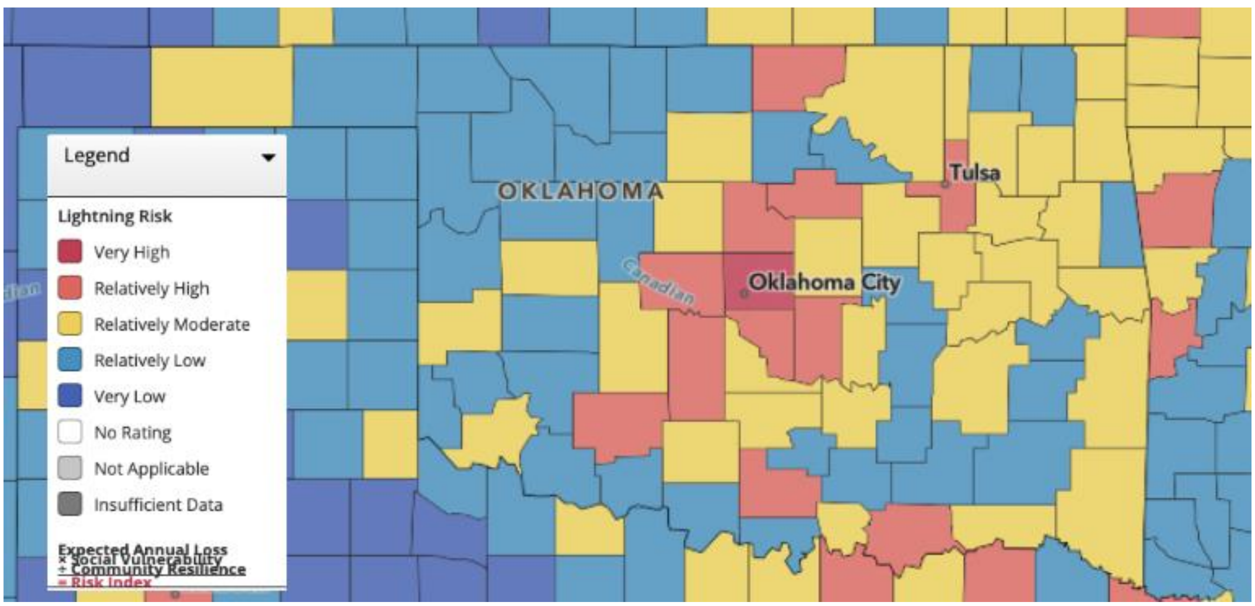


Figure 60: Risk map for tornadoes. Source: FEMA.

Vulnerability and Impact

According to a 2017 American Community Survey by the U.S Census Bureau, Oklahoma has nearly 166,000 mobile homes which represents 10% of the total housing stock in the state. Mobile and manufactured homes are extremely dangerous places to be during a tornado. In fact, about 54% of fatalities that occur in a home during a tornado happen in mobile and manufactured homes. With this many people living in mobile and manufactured homes, these people are more than 15-20 times more likely to be killed in their homes during a tornado compared to residents living in permanent housing. This makes those people extremely vulnerable to tornadoes.

The Department of Housing and Urban Development outlines areas prone to experience different strengths and frequencies of high winds though their Wind Zone Map. Anchoring systems that are designed to protect the homes from high winds vary depending on the Wind Zone the mobile home is located in. Wind Zone I (the lowest level) makes up most of the United States, including Oklahoma. This means mobile and manufactured homes in Oklahoma are made and anchored based on the intensity of winds in Zone I (approximately 97 mph). By comparison, homes made for Wind Zone III are built to withstand wind gusts of around 130 mph and Wind Zone II up to 120 mph. Residents living in mobile or manufactured homes can make their home more structurally sound during a tornado by doing the following:

- Buy a Wind Zone II or Wind Zone III home and place it in a Zone I area.
- Install anchors in concrete slabs, a concrete footer, or a concrete perimeter around the home.
- Talk directly to your installers to ensure they install the anchors you request.

Alternatively, homeowners can Install an above ground or below ground storm shelter outside of the home to ensure safety from tornadoes.

Figure 61: Wind Zones in the US. Source: Department of Housing and Urban Development.

The entire state of Oklahoma is at risk to tornadoes. Adequate warning systems are essential to public safety during tornado events. Though the purpose of outdoor warning sirens is to provide a warning for people participating in outdoor activities, many residents rely on them as their primary notification indoors. Education should continue to be done to help residents understand that these devices are meant for outdoor warning. Those with an increased vulnerability to this hazard and the level of resilience post-event include those with language barriers, those with no accessible safe shelters, those in older or manufactured homes, and those with lower income levels. While many counties within the state utilize the state standard for building codes, many smaller towns and jurisdictions do not have an established set of building codes, making them more susceptible to the effects of strong winds during a tornado event.

People without access to safe rooms or other shelter options are at direct risk of injury or death, even from lower end of the scale tornadoes. One concern regarding safe rooms is the need to inform the Oklahoma residents that not all safe rooms are created equal. Lack of adequate safe room design and where it is located can cause the shelter to fail, which could result in injury or even death if a tornado were to occur. Check with your county or jurisdictional Emergency Manager to see if there is a storm shelter rebate program where you live.

All critical facilities in Oklahoma are exposed to tornadoes, especially buildings that do not meet 2018 codes, which have been adopted by the Oklahoma Uniform Building Code Commission. Some critical facilities in the state have adequate backup generation while others do not. Loss of functioning to a critical facility such as a hospital, nursing home, water treatment plant, etc. could lead to the disruption in key emergency and basic services. A medical system such as a hospital or ambulance could be strained or compromised by a tornado that results in a mass casualty incident, especially if the incident also damages key infrastructure or critical facilities. If a hospital were to be hit by a tornado, damage could render the hospital unusable which could delay emergency services in providing care for patients who need hospital care immediately. This could also cause all patients inside the hospital to have to be transported elsewhere during a time where resources and hospital beds nearby are already running thin. Medical services would have to be sent in to help with the transporting of patients as well as the emergency services searching through the destruction of the tornado.

All school district buildings in the state of Oklahoma are also at risk of tornadoes. There are some factors which can reduce school buildings' risk to these types of events. Three of the most prominent factors include saferooms, more advanced building codes (which have standards for structures to withstand higher wind speeds), and shatter-proof glass or other forms of window protection. Many schools throughout the state of Oklahoma do not have saferooms, and some schools who do, must leave the school to access the shelter. Leaving the school to access the shelter presents an added risk to students and staff as they are now out in the elements where they can be hit by flying debris and so on. Along with this risk, for some schools it can take 5-10 minutes to walk to reach the shelter, or longer if they must be bussed there. During tornado events, time is of essence, so requiring students and staff to take precious time needed to shelter before the storm hits, can lead to injury or even death if they are not able to reach the shelter in time. For schools such as this, it must be required to have emergency action plans in place to ensure students and staff are leaving the school building in time to reach the shelter before the impending danger hits their area. For some school districts, saferooms are not big enough to house all students and staff, as well as some saferooms may need to be updated to ensure safety guidelines are met. It should also be noted that for some school districts, outdoor sirens currently in place around their jurisdiction are not equally distributed across the school district, or they may not have any sirens in or near the school districts. All these vulnerabilities present a heightened risk for students and staff while they are at school.

Effects of Climate Change

According to the Environmental Protection Agency, although summer droughts are likely to become more severe, floods may also intensify. During the last 50 years, the amount of rain falling during the wettest four days of the year has increased about 15 percent in the Great Plains. Over the next several decades, the amount of rainfall during the wettest days of the year is likely to continue to increase, which would increase flooding. Scientists do not know how the frequency and severity of tornadoes will change. Rising concentrations of greenhouse gasses tend to increase humidity, and thus atmospheric instability, which would encourage tornadoes. But wind shear is likely to decrease, which would discourage tornadoes. Research is ongoing to learn whether tornadoes will be frequent in the future. Because Oklahoma experiences about 60 tornadoes a year, such research is closely followed by meteorologists in the state.

3.4.9 WILDFIRE

Description

Wildfire is generally defined as any uncontrolled, outdoor fire occurring in natural fuels. Wildfires often pose a threat to values-at-risk including residences, outbuildings, road and utility infrastructure, business/industry, and agricultural infrastructure. Oklahoma is home to many different wildland fuel types ranging from dense timber to open grassland to areas of decadent brush. Each of these fuel types exhibit the potential for extreme fire behavior including rapid rates of spread, extreme fireline intensity, long-range spotting, and crown fire. Wildfires occur year-round in Oklahoma with two pronounced periods of increased wildfire occurrence: 1) February - April - Dormant season transition to growing season, and 2) September-November – Growing season transition to dormant season. Increased wildfire occurrence and severity are inherent during periods of enhanced drought, La Nina ENSO cycle, and frequent fire-effective weather patterns regardless of seasonality.

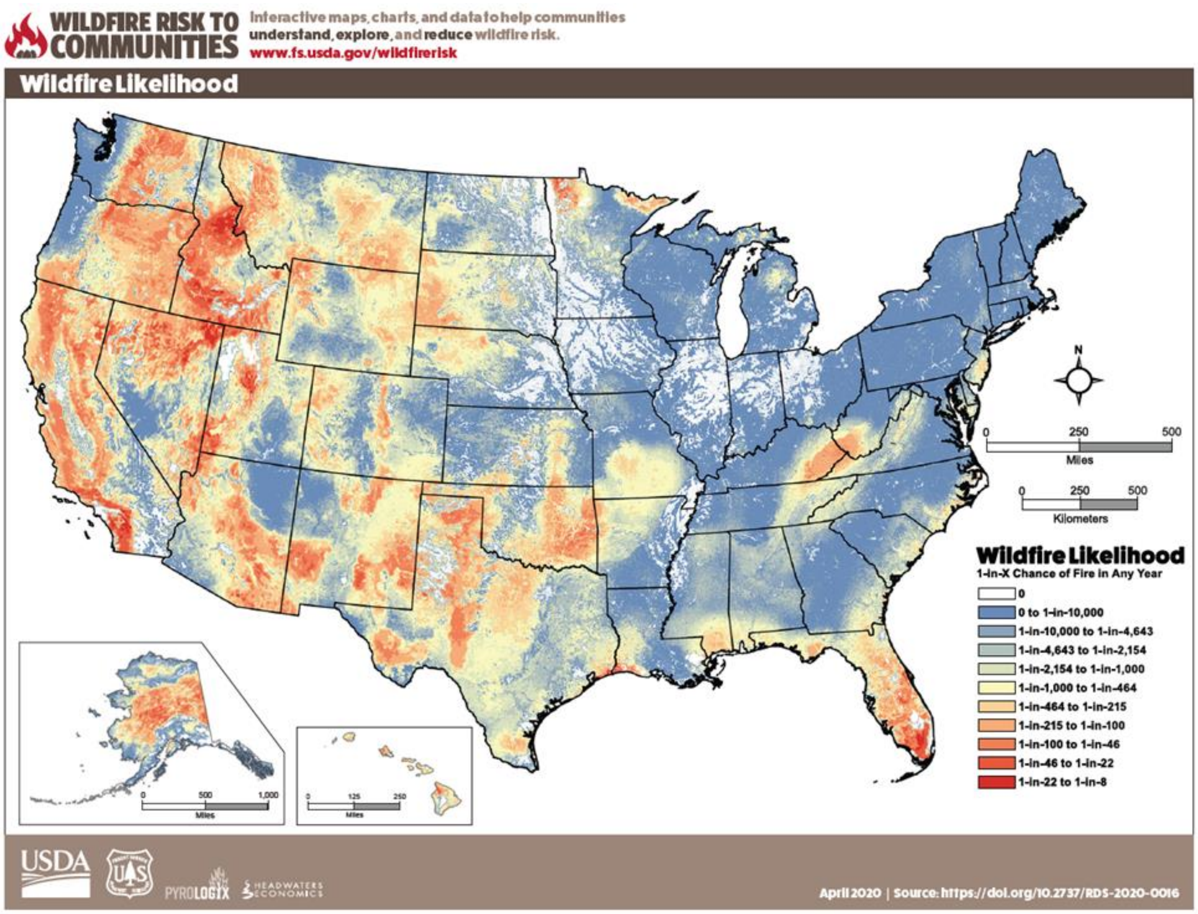


Figure 62: Wildfire Likelihood in the United States. Source: USDA

Oklahoma experienced an increase in the number of "Large Fires" in the last decade. For statistical purposes, large fires are classified as any wildfire larger than 100 acres in timber or over 300 acres in grass/brush. Not only are these fires challenging from a complexity standpoint, but frequently require additional firefighting resources and extended operational periods to achieve containment. Wildfires of this magnitude become a drain on Oklahoma's fire service over the course of a fire season, often leading to an increased number of near misses, accidents, and overall responder fatigue.

Improper, or lack of, land management practices in many parts of Oklahoma, coupled with the suppression of fire for nearly 100 years have allowed for significant accumulation of wildland fuels which contributes to wildfire severity. State and Federal agencies which suppress wildland fire also spend funds to introduce fire on the landscape under proper conditions for the benefit that fire has on native vegetative communities and to reduce the hazard present.

Furthermore, wildfire complexity has increased with population growth, especially within the Wildland Urban Interface (WUI) where an increasing number of structures in rural areas continues to complicate fire suppression activities. Oklahoma's history of severe weather and drought as well as the effects of climate variations have increased the chances of catastrophic wildfires.

Figure 63: 2022 Large Fire Occurrences in the United States. Source: ODAFF

States At High to Extreme Wildfire Risk, 2021

Rank	State	Estimated number of properties at risk	Rank	State	Percent of properties at risk
1	California	2,040,600	1	Montana	29%
2	Texas	717,800	2	Idaho	26%
3	Colorado	373,900	3	Colorado	17%
4	Arizona	242,200	4	California	15%
5	Idaho	175,000	5	New Mexico	15%
6	Washington	155,500	6	Utah	14%
7	***Oklahoma***	***153,400***	7	Wyoming	14%
8	Oregon	147,500	8	Arizona	9%
9	Montana	137,800	***9***	***Oklahoma***	***9%***
10	Utah	136,000	10	Oregon	9%

(1) As of October 2021. Source: Verisk Wildfire Risk Analytics used data from FireLine®, Verisk's wildfire risk management tool.

As a response to this trend, Oklahoma has adopted the National Cohesive Wildland Fire Management Strategy to work collaboratively among stakeholders to address three goals:

1. Resilient Landscapes
2. Fire Adapted Communities
3. Safe and Effective Wildfire Response

This strategy has focused natural resource agencies efforts and attention on implementing programs proven successful at achieving these goals. Due to the implementation of this strategy, state wildfire agencies have seen an increase in federal funding resulting in improved wildfire management capacity and more hazardous fuel treatments across the landscape.

Hazardous Fuels Mitigation: Mitigation involves the manipulation or removal of fuels to reduce the likelihood of ignition, to lessen potential damage from a wildfire and to enhance firefighting efforts. Common practices used to achieve desired results include prescribed burning, chemical treatments and use of mechanical equipment to address identified threats.

Although this is a relatively new concept to Oklahomans, these practices have been implemented throughout the country for decades and proven very effective. Not only do these actions help to lessen the fire effects from potentially catastrophic wildfires but they also provide a safer working environment for responders and help to limit damages to values-at-risk.

Oklahoma is not immune to the impacts from hazardous wildland fuels. Historic wildfire events have caused catastrophic damages throughout communities resulting in loss of life, significant structure loss and damages to natural resources. Recently an emphasis has been placed on key Communities at Risk (CAR) to encourage planning and mitigation efforts for future wildfire events. This is being facilitated through development of Community Wildfire Protection Plans and extensive outreach efforts at the local and county level. Currently Oklahoma City, Bartlesville and Tulsa have ongoing or planned mitigation projects based upon identified threats to the community. These efforts will continue for years to come helping to fortify these CARs and serving as the catalyst for expansion and inclusion of new projects throughout the state.

MITIGATION SUPPORT PROGRAMS:

Community Wildfire Protection Plans (CWPP) - A CWPP identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment on Federal and non-Federal land that will protect one or more at-risk communities and essential infrastructure and recommends measures to reduce structural ignitability throughout the at-risk community. A CWPP may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection - or all the above. Currently Oklahoma has the following CWPPs in place: fifty-one (51) municipal/fire department plans, two (2) fire protection district plans, three (3) county level plans and one (1) tribal nation plan. For more information on developing a CWPP, visit:

https://www.usfa.fema.gov/downloads/pdf/publications/creating_a_cwpp.pdf

or contact Oklahoma Forestry Services at www.forestry.ok.gov.

Community Wildfire Defense Grants (CWDG) - The Community Wildfire Defense Grant program provides grants to at-risk communities to develop or revise a CWPP and to carry out projects described in a CWPP that is less than 10 years old. CWDG is authorized through the Infrastructure, Investment, and Jobs Act (IIJA) and provides $1 billion for this program over a five-year period (fiscal years 2022 through 2026). CWDG prioritizes at-risk communities that are in an area identified as having high or very high wildfire hazard potential, are low-income, and/or have been impacted by a severe disaster. For more information on participation in the CWDG program, visit https://www.fs.usda.gov/managing-land/fire/grants or contact Oklahoma Forestry Services' CWDG Coordinator at www.forestry.ok.gov.

Firewise USA® - The national Firewise USA® recognition program provides a collaborative framework to help neighbors in a geographic area get organized, find direction, and take action to increase the ignition resistance of their homes and community and to reduce wildfire risks at the local level. Any community that meets a set of voluntary criteria on an annual basis and retains an "In Good Standing Status" may identify itself as being a Firewise® Site. The Firewise USA® program is administered by NFPA® and is co-sponsored by the USDA Forest Service and the National Association of State Foresters. While the

NFPA® administers this program, individuals and communities participate on a voluntary basis. For more information on becoming a Firewise® Site, visit https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA/Become-a-Firewise-USA-site or contact the Oklahoma Forestry Services' State Liaison at www.forestry.ok.gov.

Location

Wildfire is a regular occurrence across Oklahoma with year-round potential. Wildfire impacts and outcomes, including threat to life and property, range widely based on exposure and the severity of the burning conditions. One methodology for addressing locations of increased concern is an evaluation of exposure to wildland vegetation in populated areas (where homes and businesses are present). The graphic below illustrates the populated areas in Oklahoma predominantly exposed to wildfire from direct sources such as adjacent flammable vegetation. Forty-one percent of homes in Oklahoma are directly exposed to adjacent wildland vegetation and susceptible to wind-blown embers or home-to-home ignition. Additionally, another 32% are indirectly exposed, meaning that those structures are susceptible to wind-blown embers from a wildfire and/or home-to-home ignition.

Wildfire Exposure to Populated Areas

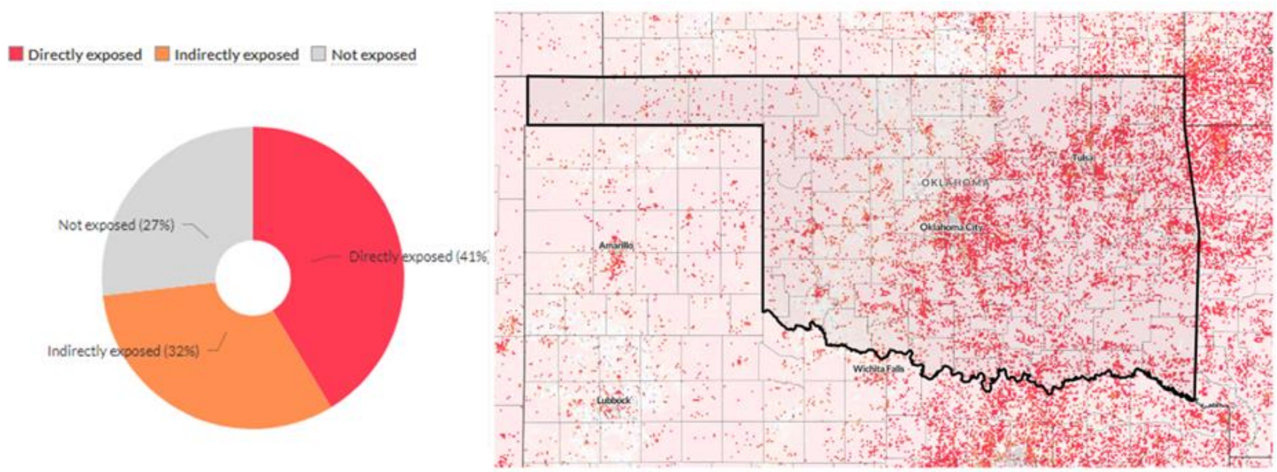


Figure 64: Wildfire Exposure to Populated Areas in Oklahoma. Source: US Forestry Service

FIRE MANAGEMENT REGIONS: Oklahoma has a wide range of ecosystems with multiple wildland fuel types spanning across the state. Oklahoma is where the humid east meets the arid west resulting in variable fire regimes. For planning purposes, the Fire Management Regions below simply divide the state into quadrants which is in line with many organizational divisions across state and local government.

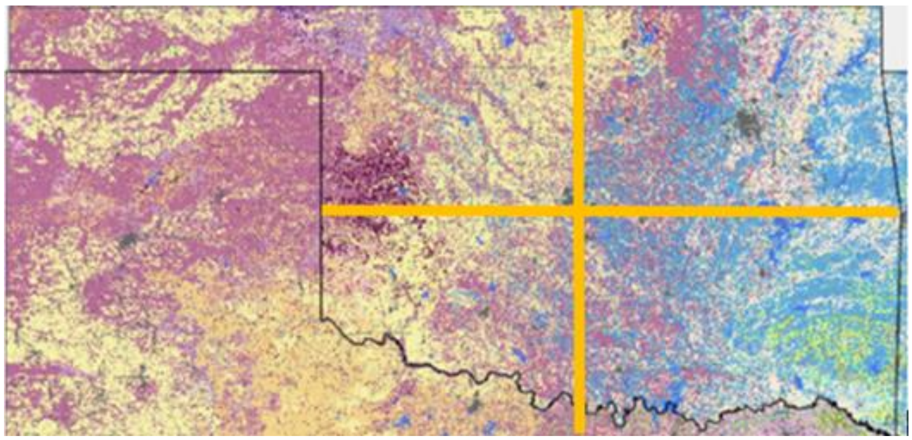


Figure 65: Fire Management Regions. Source: ODAFF.

Grass/Brush →→→→ Timber

Panhandle and Northwest

The panhandle and northwest counties, generally north of I-40 and west of I-35, incorporate the High Plains, Southwestern Tablelands and Central Great Plains ecoregions with an overall dry-subhumid to semi-arid climate. As such, vegetation varies from grasslands to mixed grass/brush complexes and areas of agricultural utilization such as wheat production. These rangeland fuels occur over rolling topography punctuated with canyons, escarpments, and broken plains where moderately coarse grass averaging two feet in depth supports potential for rapid to extreme rates of fire spread with moderate to high flame length. The dormant season occurring through winter and early spring presents the highest likelihood of wildfire occurrence and severity. During this season, the frequency of fire-effective weather including dryline intrusion and dry-frontal passage contribute to a fire environment encouraging significant wildfire potential (>5,000 acres). This area is also drought prone, and a pronounced period of wildfire activity is not uncommon during the summer months when both herbaceous soil moisture is low during low soil moisture conditions.

Overall population density is less than 25 people per square mile with the larger population centers (Woodward, Guymon, Enid, Weatherford, and Clinton) having full-time fire protection while most of the area is served by volunteer departments. Given the rural dominance, wildfire occurrence regularly poses threat to small towns, communities, and associated infrastructure.

Southwest

The southwestern counties, generally south of I-40 and west of I-35, primarily fall within the Central Great Plains ecoregion with an area of Southwestern Tablelands in the far southwest corner and a finger of the Cross Timbers ecoregion adjacent to I-35 encompassing a transition from humid climate fuels to dry climate fuels. Rangeland vegetation dominates the landscape with grass to grass/brush complexes. Exception to this is the finger of Cross Timbers where timbered savannas and woodlands occur in the eastern part of this region and also the Wichita Mountains where rocky promontories poke through areas of dense brush and rangeland vegetation. Wildfire potential in this area is pronounced during the dormant season of winter and early spring and then again during the peak of summer heating. Any period where days since wetting rain exceed five to ten days translates into increasing rates of wildfire occurrence.

Canadian, Grady, Stephens, Comanche, and Jackson Counties have a population density greater than 25 people per square mile with the bulk of the people residing in or near the population centers of Chickasha, Duncan, Lawton/Fort Sill, Altus Anadarko and Elk City. Overall, the area is rural with wildfire activity regularly posing threat to small towns, communities, and associated infrastructure.

Southeast

The southeastern counties, generally south of I-40 and east of I-35 encompass a variety of ecoregion influences reflecting the transition from timber dominance in the east (Ouachita Mountains & Arkansas Valley) through the Cross Timbers and into the South-Central Plains. Average annual rainfall in far eastern Oklahoma registers approximately 50 inches while 35 inches is the expectation along I-35. Pine dominated forests of the south give way to mixed Pine-Hardwood progressing north into the Arkansas Valley while decadent timber stands in the east transition into the Cross Timbers in central Oklahoma. Wildfire occurrence is high across the area with a longstanding burning culture in place. Low mountains and hills transition toward rolling topography from east to west noting that the Arbuckle Mountains in south-central Oklahoma present some uniqueness on the landscape. Like other areas in Oklahoma, the dormant season presents the greatest frequency of wildfire occurrence and fire severity during this time of the year is largely dependent upon composite fuel moisture dryness and strength of fire weather. During the summer months, protracted dry periods coupled with above normal temperature often presents elevated fire severity concern with extreme fire behavior (crowing and torching) prevalent.

Many of the counties in southeastern Oklahoma register population densities above 25 people per square mile with the highest concentration of people along the I-35 corridor from Oklahoma City south to Ardmore. Additionally, communities such as Shawnee, Seminole, Ada, Durant, McAlester, Poteau, and Idabel are interspersed in the area while much of the land base is rural in nature supporting ranching. One note in this region is the rapid, tourist-based expansion centered around Hochatown in McCurtain County where transportation routes (including ingress and egress) are often clogged, and the number of cabins being constructed in adverse fuels and topography cause concern. In this area, the period of highest wildfire fire severity potential aligns with the seasonality of tourism.

Northeast

The northeastern counties, generally north of I-40 and east of I-35, transition from timber dominance in the east through the Cross Timber savannas and Flint Hills into the edge of the Central Plains. Timber in the eastern low mountains and hills transitions from oak-hickory-pine in the Arkansas Valley along I-40 to more defined oak-hickory hardwood stands in the Boston Mountains into the Ozark Highlands. Several popular recreation areas dot the landscape, but like other areas in Oklahoma livestock and other agricultural activities dominate the influence on the landscape. Wildfire occurrence is most frequent in the dormant season and with a more humid climate, growing season fire occurrence is less of a concern than in other regions of Oklahoma. The Flint Hills ecoregion encompassing Osage and Washington counties have a frequent fire return interval in large part due to a strong burning culture in the ranching community prevalent in this ecoregion.

Tulsa is the largest metropolitan area with other communities such as Ponca City, Stillwater and Muskogee serving as population centers. While the region is greater than 25 people per square mile in density, those persons primarily inhabit the aforementioned areas giving a strong rural feel to the region.

Previous Occurrences

Wildfire is an issue throughout Oklahoma. The issues associated with wildfire are troublesome in that fire has many benefits when applied properly but can have destructive consequences when left unchecked. Wildfires often cause economic damage to forestlands, endanger firefighters and threaten public safety and property. State and federal natural resource agencies expend a considerable amount of their annual budgets on wildfire suppression to prevent these unwanted consequences.

Since 2013, Oklahoma has been on the top fifteen list for either the highest number of wildfires or the highest number of acres burned in the United States according to the National Interagency Fire Center (NIFC). Listed below are some of the key years for wildfire occurrence in Oklahoma where federal assistance was received:

> ***2000*** *- Three (3) wildfire incidents with FMAG declaration. Total amount of public assistance: $1,326, 871.*
>
> ***2005*** *– Seven (7) wildfire incidents with FMAG declaration. Total amount of public assistance: $381,143.*
>
> ***2006*** *– Twenty-three (23) wildfire incidents with FMAG declaration. Total amount of public assistance: $9,888,667.*
>
> ***2009*** *– Seven (7) wildfire incidents with FMAG declaration. Total amount of public assistance: $3,037,658.*
>
> ***2011*** *– Twenty-five (25) wildfire incidents with FMAG declaration. Total amount of public assistance: $2,762,732.*
>
> ***2012*** *– Eight (8) wildfire incidents with FMAG declaration. Total amount of public assistance: $8,866,569.*
>
> ***2016*** *– Three (3) wildfire incidents with FMAG declaration. Total amount of public assistance: $1,102,989.*
>
> ***2017*** *– Three (3) wildfire incidents with FMAG declaration. Total amount of public assistance: $740,221. Total amount of FMAG - Hazard Mitigation Funds - $2,674,731*
>
> ***2018*** *– Four (4) wildfire incidents with FMAG declaration. Total amount of public assistance: $9,668,207. Total amount of FMAG - Hazard Mitigation Funds - $758,059*

2019 *– Two (2) wildfire incidents with FMAG declaration. Did not meet the state threshold for public assistance.*

2020 *– One (1) wildfire incident with FMAG declaration. Did not meet the state threshold for public assistance.*

2021 *– One (1) wildfire incident with FMAG declaration. Total amount of public assistance: $8,866,569. Total amount of FMAG - Hazard Mitigation Funds – $786,552.*

**Before 2018 FMAG did not qualify for hazard mitigation funds*.

Since 2010, Oklahoma has responded to 21,176 fires totaling 3,578,996 acres statewide. These fire suppression efforts have saved over 9,000 structures with a value of approximately 275 million dollars. Due to data limitations and lack of adequate fire reporting, the above statistics only include a fraction of the actual wildfires that have occurred in Oklahoma.

Since 2013, Oklahoma has experienced the following FMAG Fires throughout the state:

Year of Declaration	Declaration Title	Disaster Number
2012	OK Fair Grounds Fire Complex	FM-2997
2012	OK Luther Fire	FM-5001
2012	OK Freedom Fire	FM-5000
2012	OK Noble Fire	FM-2999
2012	OK Geary Fire	FM-2998
2012	OK Glencoe Fire	FM-5002
2012	OK Drumwright Fire	FM-5003
2014	OK Guthrie Fire	FM-5052
2015	OK Dld Fire Complex	FM-5117
2016	OK Oak Grove Fire	FM-5118

2016	OK Pawnee Cove Fire	FM-5119
2016	OK 350 Fire Complex	FM-5122
2017	OK Okc Fire Complex	FM-5168
2017	OK 141st Fire	FM-5169
2017	OK NW Oklahoma Wildfire Outbreak Complex	FM-5177
2018	OK Shumach Fire Complex	FM-5230
2018	OK Rhea Fire Complex	FM-5232
2018	OK 34 Fire Complex	FM-5231
2019	OK Gauge Fire	FM-5305
2019	OK Highway 50 Fire	FM-5304
2020	OK 412 Fire Complex	FM-5306
2021	OK Cobb Fire	FM-5421

Probability and Risk Calculation:

The probability is *Possible*.

The CPRI for Wildfire for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (1 x .30)	+ (4 x .15)	+ (3 x .10)	= 2.1

Probability and potential risk is best captured by assessing multiple relevant data sets to generate a matrix or gridded assessment. The nationally consistent evaluation of all lands populated in Oklahoma reveals that, on average, populated areas in Oklahoma have a greater wildfire likelihood than 96% of the states in the United States eclipsed by only Idaho and California.

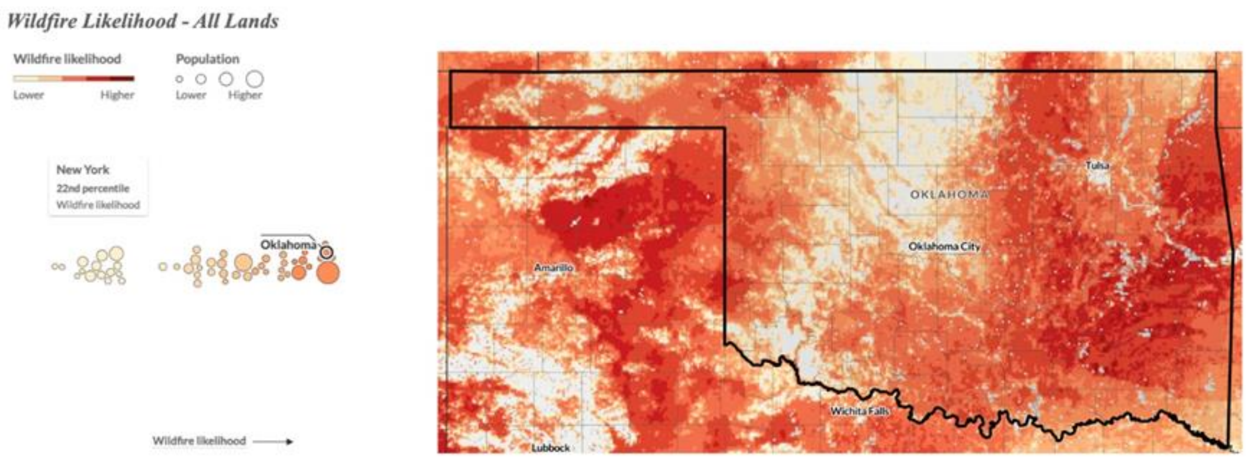


Figure 66: Wildfire Likelihood in Oklahoma. Source: Oklahoma Department of Forestry.

The 'Wildfire Likelihood' graphic above is generated from the suite of LANDFIRE data sets (fuel, vegetation, fire activity, fire management), USGS topography, NWS historical weather patterns, USDA Forest Service long-term simulations and community data from the US Census Bureau and Department of Energy.

Another source that can be used to help determine forest fire potential, is the Keetch-Byram Drought Index (KBDI). According to the United States Forestry Service (USFS), this index is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers and is a continuous index relating to the flammability of organic material in the ground. The inputs for KBDI are weather station latitude, mean annual precipitation, maximum dry bulb temperature, and the last 24 hours of rainfall. The index increases for each day without rain (the amount of increase depends on the daily high temperature) and decreases when it rains. The scale ranges from 0, no drought, to 800, severe drought. The state of Oklahoma can see the entire range of this scale. The KBDI is utilized by Oklahoma Forestry Services to trigger the Governor's burn ban during dry seasons in the state to monitor fire danger and severity.

Keetch-Byram Drought Index (KBDI)	
0 – 200	Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.
200 – 400	Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night.
400 – 600	Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.
600 – 800	Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn thorough the night and heavier fuels will actively burn and contribute to fire intensity.
Source: http://www.wfas.us/content/view/32/49/	

Vulnerability and Impact:

The entire state of Oklahoma is susceptible to wildfires. Although the vulnerability and impacts of a wildfire differs across the state, during drought-like conditions, wildfires can be easily started anywhere in the state and can be extremely dangerous. Strong winds, heavy fuel supply, and low humidity can all set the stage for a severe wildfire event. An out-of-control wildfire has the potential to become a wildland urban interface fire if it were to move into vegetated areas of a town or city sparking structure fires that can cause damage to homes, farms, pastures, livestock, businesses, schools, government buildings, emergency services buildings, and other critical facilities such as hospitals. Loss of crops, grasslands, livestock, homes, businesses, critical facilities, etc. can cause major damage to a city, town or even county within the state.

Wildfires can put people in life threatening danger from smoke inhalation and burn wounds and can also lead to residential structural fires. These incidents can occur at night, putting people sleeping at a very high risk of injury or death. Wildfires moving into residential areas or along roadways can threaten individuals and could call for evacuation of schools or other facilities such as nursing homes and hospitals. Firefighters are at risk of injury and health problems related to smoke inhalation and high temperatures while responding to wildfires.

Modern buildings are designed to minimize the probability of catastrophic fires. Nonetheless, all buildings have some risk of wildfire, which can lead to structure fire and could result in light damage to complete destruction. Many existing structures throughout the state were built to older building codes or standards and may lack resilient construction techniques. One of the most likely threats to infrastructure from wildfire is due to power outages from poles or lines damaged by fire. Some infrastructure could be impacted by wildfires directly, leading to interruption of electrical, water, gas, or sewage treatment services. Gas supply lines near fires can create extremely dangerous situations if they are impacted. Many incorporated areas have abandoned buildings near the edges of town. This can exacerbate the dangers of wildfire risk, especially in the Wildland Urban Interface (WUI), for surrounding structures in these incorporated areas.

Most fire departments and other emergency response units share mutual aid agreements with local neighboring fire departments, some of which can cross county lines. This can lead to areas with limited resources to rely on help from neighboring jurisdictions to fight wildfires in their jurisdiction. This can lead to an exacerbation of resources the neighboring jurisdictions may end up needing for their own jurisdiction. Or it could be the other way around, where a neighboring jurisdiction may be asking for help from a jurisdiction with limited resources, which means they may have to look for help from farther away, which can lead to the wildfire spreading further in the meantime.

Those with a higher vulnerability to wildfire are those who live within a WUI, those who live further from a fire department, those who live nearby vacant buildings or areas with uncontrolled brush such as cedar trees, and those who are in areas experiencing extreme drought. Some populations at a greater risk are the elderly, disabled, or those with mobility issues that would make it harder for them to be able to evacuate if a wildfire were nearby. Critical facilities such as nursing homes and hospitals have protocols, they must follow to evacuate. This includes finding a location to transport each patient to when they evacuate. This procedure can take several hours to complete, which can limit the decision-making time on when to start evacuating and can put some workers and patients in danger if they are not able to evacuate as quickly as needed. Other populations at a greater risk to wildfire are those with a language barrier as they may not be able to understand the situation and when and where to evacuate.

All schools in the state are vulnerable to fire; however, schools in the WUI zone, schools that are located further from fire departments, and schools that have nearby vacant buildings or uncontrolled brush are at a greater risk. The proximity of school districts to emergency response units, especially fire departments, affects a school districts' vulnerability, as longer response distances (and times) can limit response units' abilities to manage the wildfire. If jurisdictions were to lose power or even evacuate, this could lead to school cancellation which can put students behind or even extend the school year.

Integrating both wildfire likelihood and average intensity of wildfire in each area provides both a generalized risk to the structures and potential impacts relevant to fireline intensity. Below is a graphic that categorizes the risk to homes in populated areas that reveals Oklahoma is in the 90th percentile of all US states with only five states having greater risk to homes (Nevada, Utah, California, Idaho, and Hawaii).

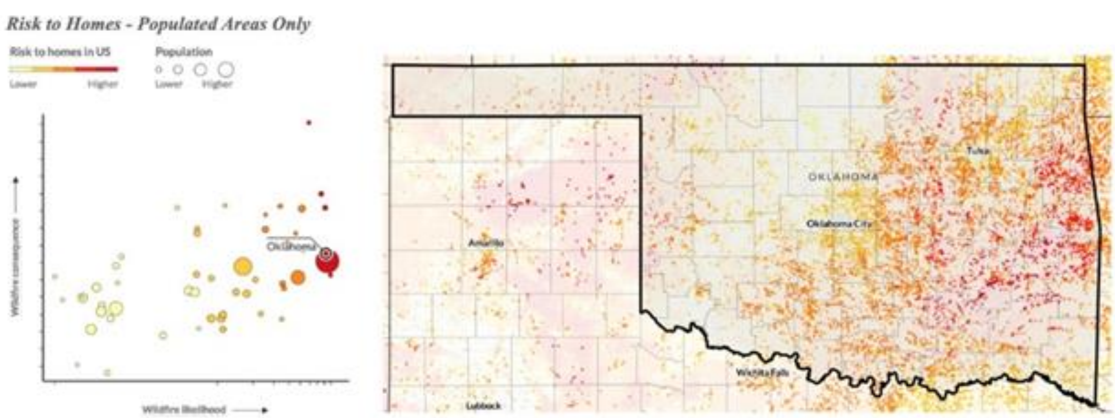


Figure 67: Wildfire risk to homes in Oklahoma. Source: Oklahoma Department of Forestry.

Oklahoma's Top 25 Communities at Risk with a population over 5000

Ranking	City	Population	County
1	Moore	62,633	Cleveland
2	Elk City	11,743	Beckham
3	Owasso	37,559	Rogers / Tulsa
4	Holdenville	5,753	Hughes

5	Claremore	19,173	Rogers
6	Tahlequah	16,213	Cherokee
7	Stillwater	48,055	Payne
8	Anadarko	6,182	Caddo
9	Jenks	25,210	Tulsa
10	Cushing	8,201	Payne
11	Broken Arrow	112,751	Tulsa
12	McAlester	18,225	Pittsburg
13	Hugo	5,146	Choctaw
14	Henryetta	5,667	Okmulgee
15	Coweta	9,696	Wagoner
16	Verdigris	5,189	Rogers
17	Collinsville	7,765	Rogers / Tulsa
18	Vinita	5,250	Craig
19	Guymon	12,804	Texas
20	Bartlesville	37,074	Washington / Osage
21	Glenpool	13,446	Tulsa
22	Harrah	6,155	Oklahoma

23	Wagoner	7,694	Wagoner
24	Catoosa	7,821	Rogers / Wagoner
25	Sapulpa	21,853	Creek / Tulsa

Communities were ranked using the Southern Wildfire Risk Assessment Portal provided by the Southern Group of State Foresters. Criteria used in the rankings includes the Wildland Urban Interface Risk Index, percentage of Community Protection Zones and Burn Probability. This list will be used to target future mitigation and prevention efforts with the intent of limiting impacts to a community in the event of a wildfire.

Medical Marijuana farming and processing facilities pose specific vulnerabilities for Wildfire hazard events. As reported in previous hazard profiles, there are 6,781 marijuana grow facilities across Oklahoma, as of March 2023.

Whether grown in outdoor or indoor settings, marijuana is cultivated in a more dense-packed manner than other traditional crops. If a Wildfire were to occur, it has the potential to decimate a high number of marijuana crops in a short amount of time. This could pose a sudden economic loss to surrounding municipalities who might be dependent on the revenues from these farming operations. According to the Oklahoma Medical Marijuana Authority, the historical tax revenue for January - April 2023 is as follows:

MONTH	SQ788 TAX	STATE & LOCAL SALES TAX
January 2023	$4,489,921	$5,998,955
February 2023	$4,287,641	$5,417,973
March 2023	$4,083,860	$5,525,169
April 2023	$4,396,662	$5,725,332

Indoor marijuana grow and storage facilities have enhanced flammability potential, which can be a concern during times of high Wildfire potential. Grown rooms are often filled with carbon dioxide (CO2) to help the plants grow faster and more robustly, but compressed CO2 systems pose a serious fire risk. Marijuana processors use CO2 and solvents to create cannabis extractions. Even with closed-loop extraction systems, the release of gaseous fumes occurs every time the system is opened to retrieve the extracted material. In addition, marijuana fumigation uses sulfur dioxide to abate powdery mildew on the plant. Sulfur dioxide can be corrosive when present with water vapor and humidity, which can damage CO2 detection systems and other fire suppressant equipment. The enhanced flammability of these facilities increases the vulnerability of a structure fire, which could quickly spread into a Wildfire if the environmental conditions are conducive.

Whether a wildfire involving an outdoor or indoor grow setting occurs, marijuana smoke contains carcinogenic combustion byproducts which include benzopyrene, benzanthracene, phenols, vinyl chlorides, nitrosamines, and other reactive oxygen chemical species*. During Wildfire events, these chemicals pose a threat to grow facility employees, emergency personnel, and neighboring residential and business areas. This could result in a cascading hazardous material secondary event because it has the potential to necessitate the evacuation of businesses, schools, and residential areas. In addition, marijuana requires more water than traditional commodity crops. In areas where there are a high number of grow facilities, water resources may become taxed and depleted. During times of drought, when Wildfire risks are at their peak, a reduction in available water may impede emergency personnel from getting the wildfire under control in a timely manner.

Finally, according to FEMA's National Risk Index for wildfire, Oklahoma experiences a wide range of risk to wildfires. Much of the eastern part of the state ranks the highest with a "relatively moderate" risk to wildfire while the rest of the state ranks from "very low" to "relatively low".

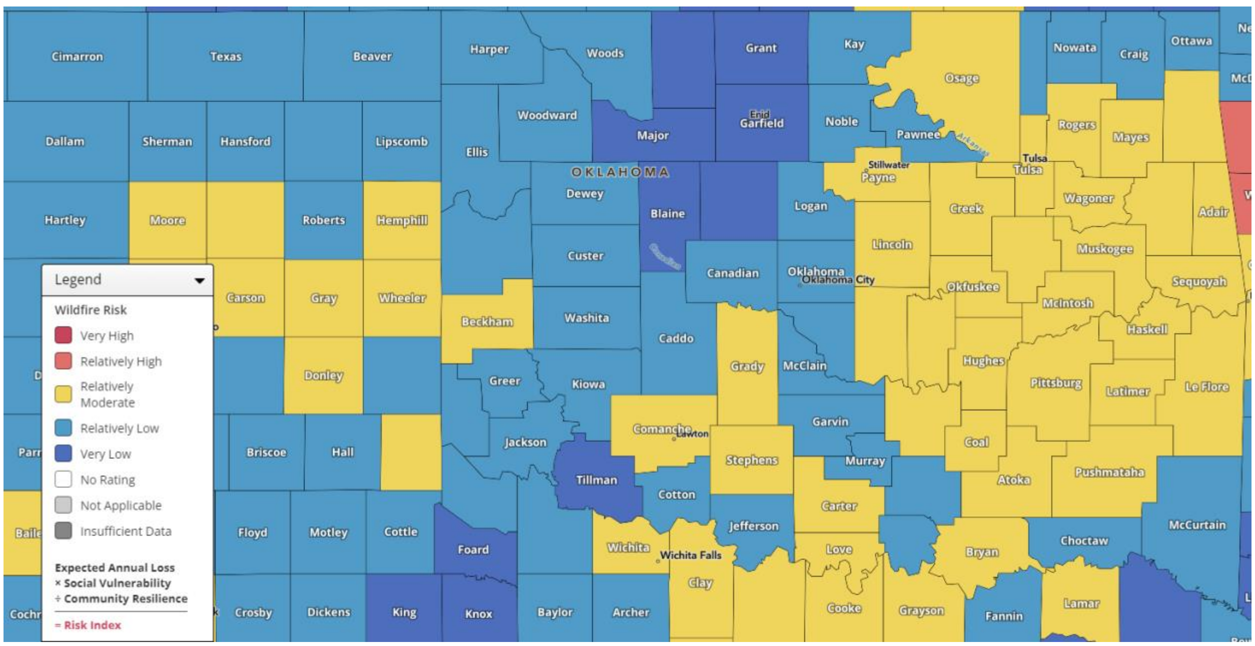


Figure 68: Risk map for wildfires. Source: FEMA.

* Source: "Letter From the Director." *National Institute on Drug Abuse*, 27 May. 2020, https://nida.nih.gov/publications/research-reports/marijuana/letter-director Accessed 15 Jun. 2023.

Effects of Climate Change

Climate variation is an ever-present factor in Oklahoma with a recent trend of longer duration warm/dry periods and protracted wet periods. The result has been increased production of herbaceous species (wildland fuels) followed by extended dry periods where both wildfire occurrence and severity increase. There is a pattern of recognition in Oklahoma that is utilized to track the build-up of a particular period of wildfire concern that incorporates the following inputs:

1. Growing season rainfall encouraging effective herbaceous growth.
2. Onset or occurrence of the La Nina phase of ENSO.
3. Subsequent persistence of dryness.
4. Transition toward severe (D2) drought intensity or greater.
5. Periods of accelerated drying of wildland fuels.
6. Increasing wildland fire occurrence.
7. Frequency of fire-effective weather patterns.

Onset of this pattern has served as a key indicator of increasing fire occurrence and severity of impacts related to wildland fires.

As related to that pattern, future projections of rainfall and temperature seem to indicate the proclivity for increased wildfire danger in Oklahoma through at least the mid-21st Century (2036-2065). The number of days with rain across Oklahoma is expected to decrease by 3-5 days, or an average of 3.2 days, which would result in more drying days of wildland fuels. (High Scenario, Fig. 66, Dixon K.W., A.M. Wootten, M.J. Nath, J. Lanzante, D.J. Adams-Smith, C.E. Whitlock, C.F. Gaitán, R.A. McPherson, 2020: South Central Climate Projections Evaluation Project (C-PrEP), South Central Climate Adaptation Science Center, Norman, Oklahoma, USA. DOI: https://doi.org/10.21429/12gk-dh47).

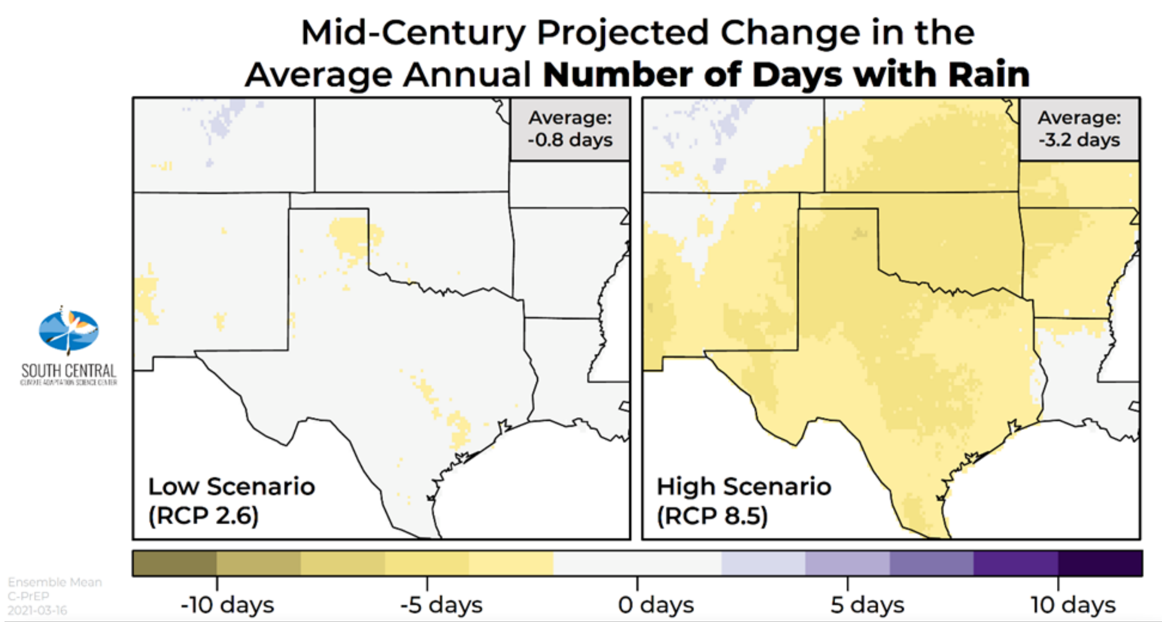


Figure 69: Projected Mid-century change in average annual number of days with rain. Source: South Central CASC.

This is further emphasized by the expected increase of the average annual longest dry spell length. In the high emission scenario, that increase is expected to average 1.2 days across Oklahoma, but 2-4 days across western Oklahoma (*Fig. 69*, previous citation).

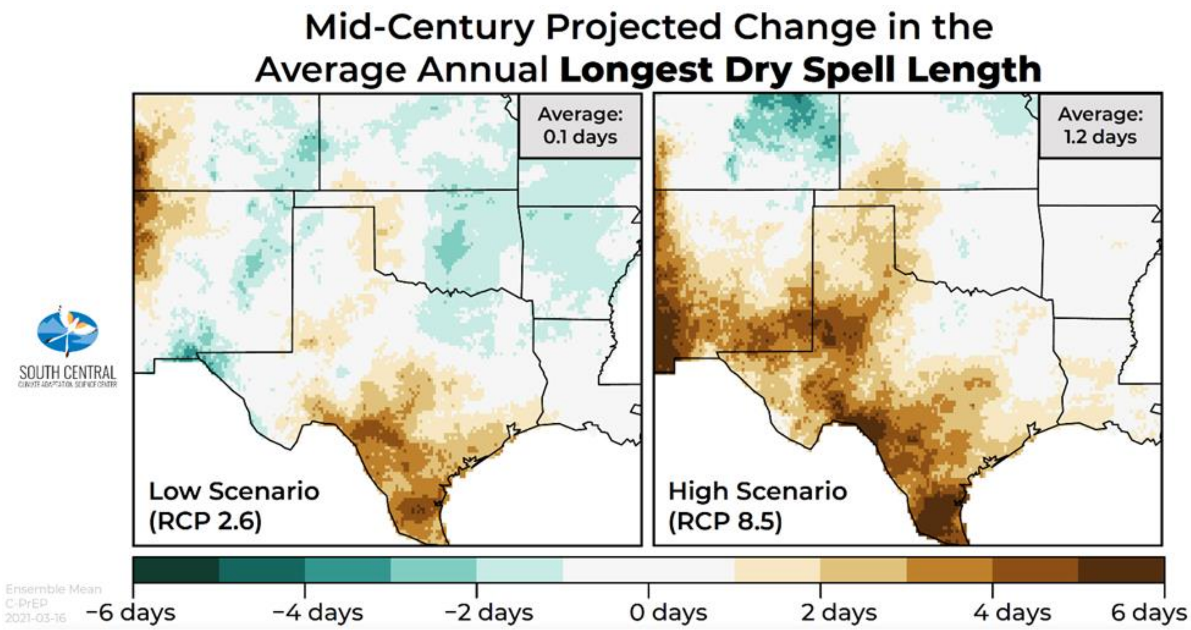


Figure 70: Projected Mid-century change in average annual longest dry spell length in Oklahoma. Source: South Central CASC.

Expected temperature changes will enhance drying of wildfire fuels looking through the mid-21st Century (*Fig. 70,* High Emission). In addition, those temperature changes are expected to help increase the severity of droughts going forward. Further, even if annual precipitation amounts do not change much, higher temperatures will increase evaporation from lakes, soils, and plants, stressing agricultural and natural systems (SCIPP Simple Planning Tool, pg. 8).

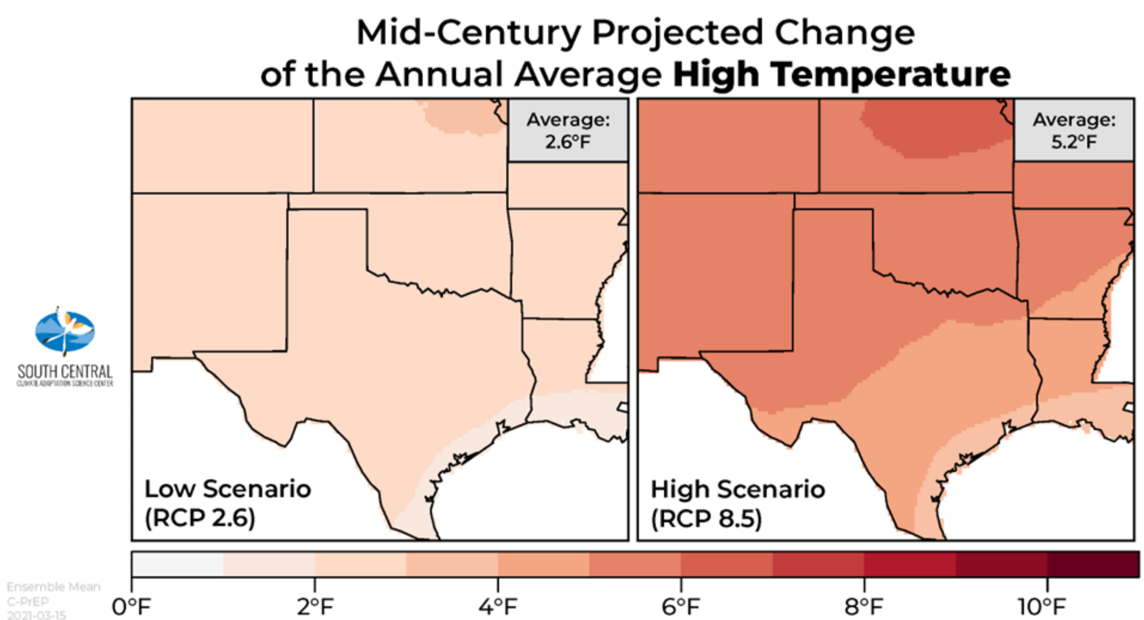


Figure 71: Projected Mid-century change in average annual high temperature in Oklahoma. Source: South Central CASC.

Extreme heat is also expected to increase through the mid-century, with the number of days with high temperatures greater than 100°F increasing by an average of 24.3 days across Oklahoma by 2063 (*Fig. 71*, previous citation).

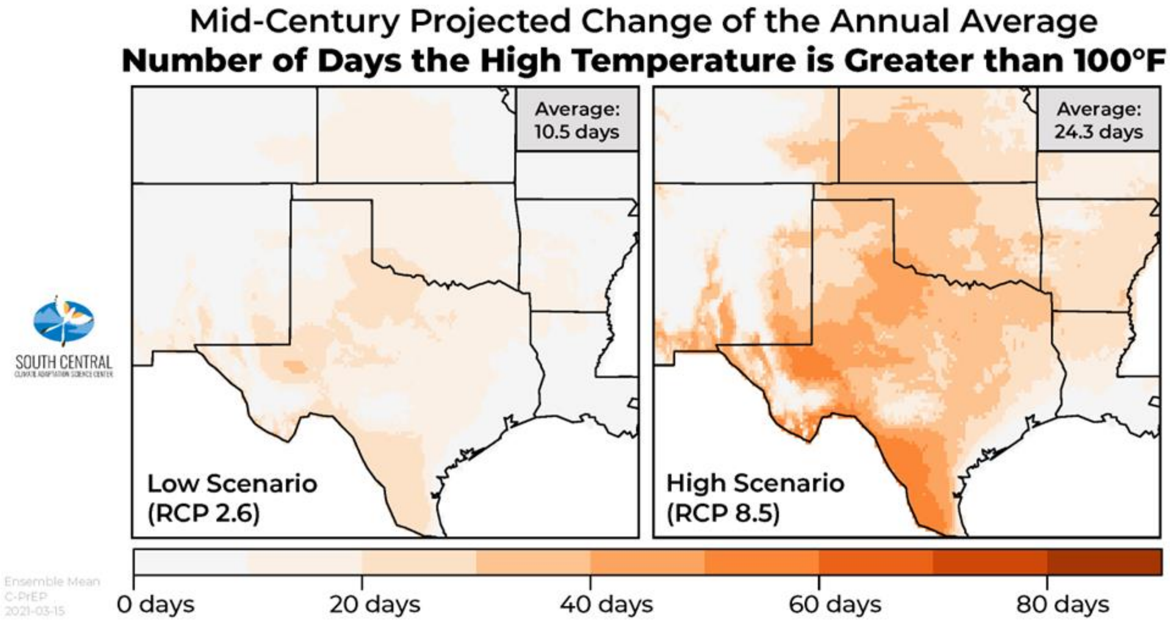


Figure 72: Projected Mid-century change in annual average number of days of greater than 100-degree temperatures in Oklahoma. Source: South Central CASC.

3.4.10 WINTER STORMS (ICE, FREEZING RAIN, SNOW)

Description

A severe winter storm can range from freezing rain or sleet to moderate snow over a few hours to blizzard conditions and extremely cold temperatures that lasts several days. Below are important definitions for the type of winter storms Oklahoma can experience.

Winter Storm can refer to a combination of winter precipitation, including snow, sleet and freezing rain.

Severe Winter Storm is one that drops 4 or more inches of snow during a 12–hour period, or 6 or more inches during a 24- hour span.

Blowing Snow is wind-driven snow that reduces visibility and causes significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground and picked up by the wind.

Blizzards occur when falling and blowing snow combine with high winds of 35 mph or greater reducing visibility to near zero.

Freezing Rain is rain that falls as liquid onto a surface with a temperature below freezing. This causes the drops to freeze on contact onto surfaces like trees, utility lines, cars, and roads, forming a coating or glaze of ice. Even small accumulations of ice can cause a significant hazard. SLEET is frozen precipitation that has melted by falling through a warm layer of the atmosphere and then refreezes into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not immediately stick to objects. However, it can accumulate like snow and cause a hazard to motorists.

Ice Storms are extended freezing rain events, lasting several hours to sometimes days, when the freezing rain accumulates a thick enough glaze on surfaces to damage trees, utility lines, and cause major travel hazards. Ice storms can result in a heavy glaze an inch thick or more, but even a quarter inch ice accumulation can cause problems under windy conditions.

Wind Chill is used to describe the relative discomfort and danger to people from the combination of cold temperatures and wind. The wind chill chart below from the National Weather Service shows the apparent temperature derived from both wind speed and temperature.

Location

The entire state of Oklahoma is at risk for experiencing winter storms, with a range of Cimarron Co. observing around 32 inches of annual snowfall and 140 days per year with low temperatures below 32 degrees, to McCurtain Co. observing 1-4 inches annual snowfall and only 66 days per year with temperatures below 32 degrees.

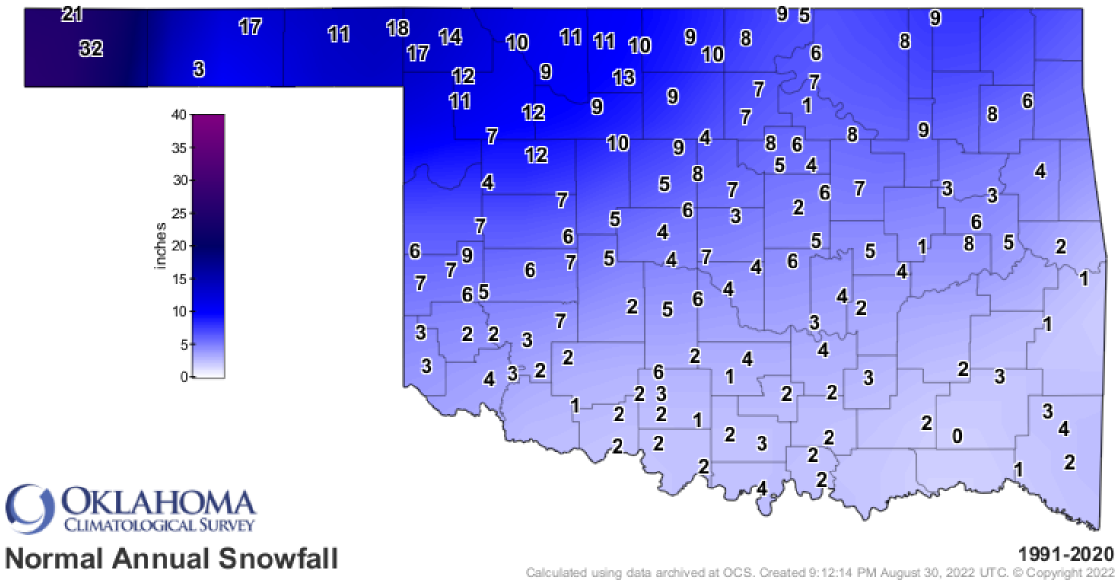


Figure 73: The normal annual snowfall for a 30-year period using observations from the National Weather Service cooperative observer network. Data are quality assured by the National Climatic Data Center. Source: OCS.

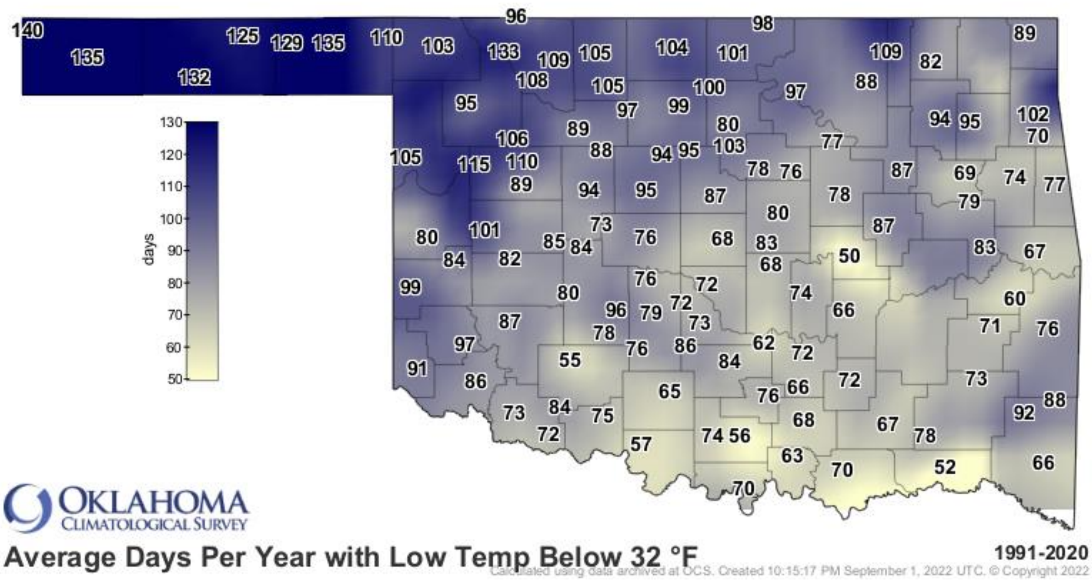


Figure 74: The average number of days per year when the low temperature is 32 degrees Fahrenheit or colder. Source: OCS.

Wind chill is also a dangerous component of winter weather events. Wind chill is the combination of wind and temperature that serves as an estimate of how cold it feels to exposed human skin. Wind chill values below -19 degrees Fahrenheit are considered extremely dangerous to the population of the State of Oklahoma, although hypothermia can still occur at higher temperatures and cause deaths. Parts of the Oklahoma Panhandle sometimes experience wind chills of -19 degrees several times per year.

Wind Chill Chart

Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes / 10 minutes / 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F) V = Wind Speed (mph)

Effective 11/01/01

Figure 75: Wind Chill Chart. Source: NWS.

The Sperry-Piltz Ice Accumulation Index or SPIA Index is ice accumulation and ice damage prediction index that uses an algorithm of researched parameters that, when combined with National Weather Service forecast data, predicts the projected footprint, total ice accumulation, and resulting potential damage from approaching ice storms. It is a tool to be used for risk management and/or winter weather preparedness. Oklahoma previously has and will likely experience the whole range on the SPIA Index.

The Sperry-Piltz Ice Accumulation Index, or "SPIA Index" – Copyright, February, 2009

ICE DAMAGE INDEX	DAMAGE AND IMPACT DESCRIPTIONS
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
2	Scattered utility interruptions expected, typically lasting 12 to 24 hours. Roads and travel conditions may be extremely hazardous due to ice accumulation.
3	Numerous utility interruptions with some damage to main feeder lines and equipment expected. Tree limb damage is excessive. Outages lasting 1 – 5 days.
4	Prolonged & widespread utility interruptions with extensive damage to main distribution feeder lines & some high voltage transmission lines/structures. Outages lasting 5 – 10 days.
5	Catastrophic damage to entire exposed utility systems, including both distribution and transmission networks. Outages could last several weeks in some areas. Shelters needed.

(Categories of damage are based upon combinations of precipitation totals, temperatures and wind speeds/directions.)

Figure 76: Sperry-Piltz Ice Accumulation Index. Source: NWS.

Previous Occurrences

The table below shows NCDC data recorded from 2012-2022.

Hazard	Number of Events	Number of Counties Affected	Number of Days with Event
Heavy Snow	246	50	33
Blizzard	21	16	5
Ice Storm	168	68	11
Cold/Wind Chill	146	52	29
Frost/Freeze	13	3	5
Winter Storm	377	75	37

Significant Winter Storm Events from 2012-2022:

December 26-28, 2015:

According to the Oklahoma Mesonet, a powerful winter storm at the end of 2015 left portions of eastern Oklahoma flooded and portions of western Oklahoma covered in snow. The event took place from December 26 through the 28th, prompting winter storm, ice storm and blizzard warnings for western Oklahoma while causing flood-related emergencies for the eastern half of the state. High wind was also another factor to this storm as the Oklahoma Mesonet reported 984 wind gusts of at least 50 mph, with some gusts reaching up to 70 mph, from 10 p.m. on Dec. 26th through 4:15 a.m. on Dec. 28th. High wind combined with freezing rain and ice left more than 200,000 without power and caused five deaths and 104 storm-related injuries. Along with this, Oklahoma Highway Patrol (OHP) reported 955 weather-related collisions, including 137 injury collisions. OHP provided 39 motorist assists, including water rescues, while the Stranded Motorist Assistance Recovery Teams assisted approximately 170 motorists. The eastern half of Oklahoma saw anywhere from 6 to 12 inches of rain from the 3-day event period. Catastrophic damage was reported along the Illinois River basin where the river reached record flood levels, as floodwaters from dams in the northeast part of the state also led to evacuation warnings. Near Tahlequah, the Illinoi River basin crested at 30.69 feet, beating the record of 27.94 feet on May 10, 1950, for that location.

Daily maximum rainfall records were broken in areas such as McAlester (2.98 in.), Tulsa (2.92 in.), and Oklahoma City (1.6 in.) on the 26th, and McAlester (4.68 in.) and Tulsa (2.76 in.) on the 27th. Counties that reported flooding during this period were Cleveland, Cherokee, Muskogee, and Wagoner County on the 26th; Cherokee, Delaware, Haskell, Latimer, Le Flore, Mayes, McCurtain, Muskogee, Nowata, Okfuskee, Okmulgee, Ottawa, Pittsburg, Pushmataha, Tulsa, and Wagoner County on the 27th; Cherokee, Haskell, Latimer, Le Flore, Mayes, Muskogee, Nowata, Okfuskee, Ottawa, Pittsburg, Pushmataha, Sequoyah, Tulsa, and Wagoner County on the 28th; Le Flore, Mayes, Muskogee, Ottawa, Pushmataha, and Sequoyah County on the 29th; and Cherokee, Choctaw, Haskell, Le Flore, Mayes, Nowata, Okmulgee, Ottawa, and Sequoyah County on the 30th. Rain and snow weren't the only hazards the state faced during this event though, as large hail was reported along with numerous tornado warnings that were also issued in central and eastern Oklahoma on Dec. 26th. One EF0 tornado was also reported on Dec. 26th in McClain County.

https://www.enidnews.com/multimedia/photos/ice-storm-2015-a-photo-slideshow/collection_891d8c80-978c-11e5-ac71-df090019da39.html

https://stormreadyblog.wordpress.com/

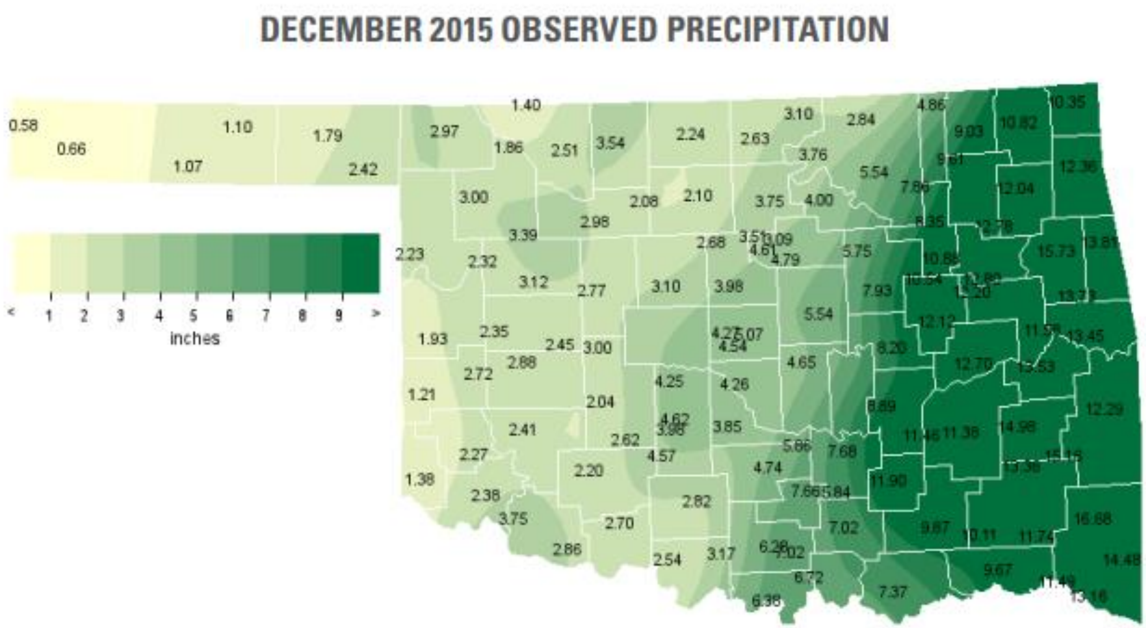


Figure 77: Observed Precipitation totals for Oklahoma in December 2015. Source: OCS.

Oklahoma's Historic 2015 Weather Ends With A Bang | Mesonet

MCS_December_2015.pdf (ok.gov)

Ice Storm of Oct. 26-29, 2020:

According to the National Weather Service in Norman, a powerful early season ice storm began on the morning of October 26, 2020, and occurred over a 3-day period across most of Oklahoma. Central and western Oklahoma reported mainly freezing rain and sleet while some snow was reported across far northwestern Oklahoma. There were reports of at least 1.5 inches of extreme freezing rain accumulations in west-central and central Oklahoma, and greater than 0.5-inch totals reported over a large area from

Lawton to Clinton to Oklahoma City to Ponca City. Extensive tree and powerline damage was reported across much of the region, and by 4pm on October 27th, 314,103 outages were reported within the state.

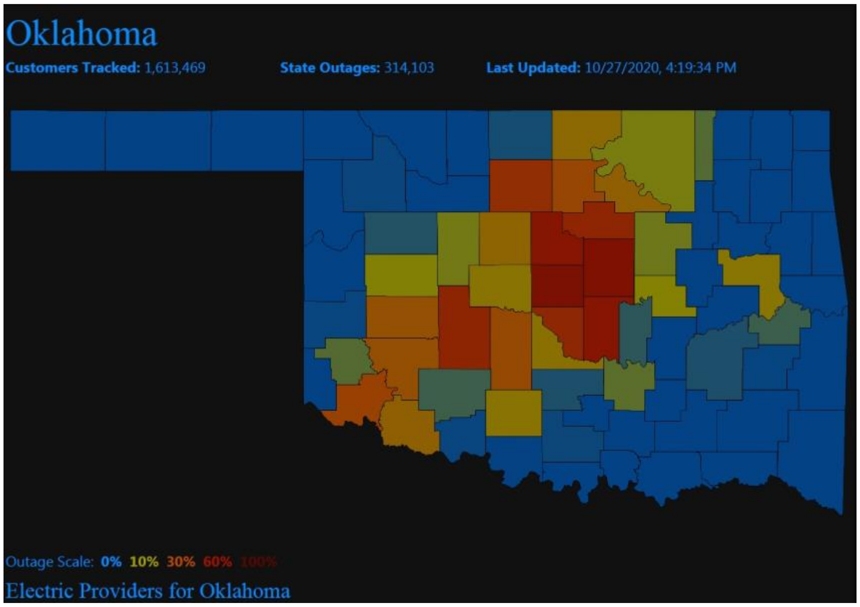


Figure 78: Outage Map. Source: TWC.

According to The Weather Channel, as long as days after the event, more than 40,000 homes and businesses were still without power. Reported by OG&E, there were more than 1,300 power poles, 1,050 crossarms, and 194 transformers that were damaged or destroyed from this storm. Some were left without power for as long as 11 days after the storm.

the storm. At the height of the storms' impacts, OG&E reported more than 400,000 outages, which is the highest number of storm-related outages they have ever experienced.

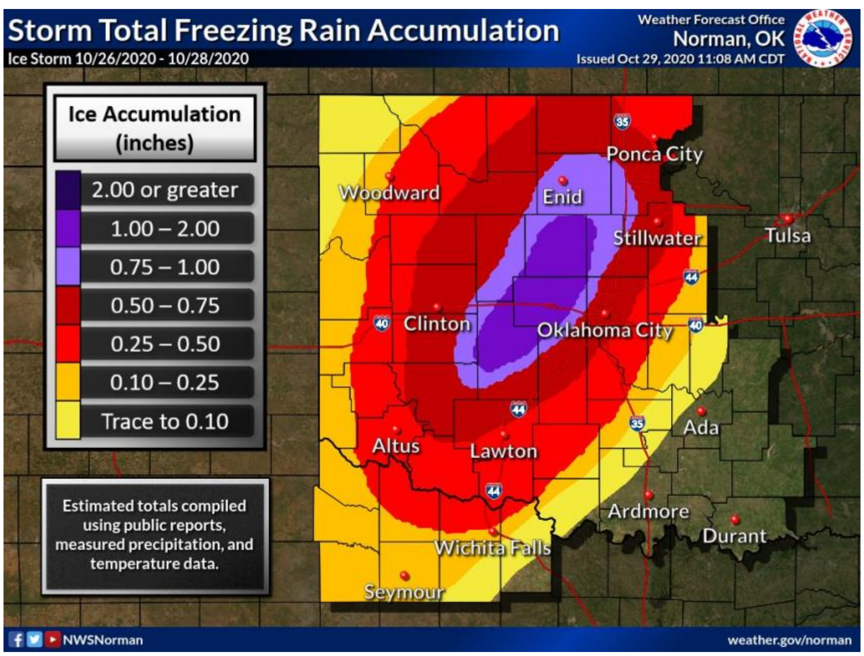


Figure 79: Total Freezing Rain Accumulation according to the National Weather Service office in Norman, OK.

[More Than 40,000 Still Without Power 10 Days After Oklahoma Ice Storm | The Weather Channel]

[The Ice Storm of October 26-29, 2020 (weather.gov)]

Snowfall Event in Western and Central OK on Nov. 14, 2022:

According to the National Weather Service in Norman, OK, an accumulating snowfall event occurred from the late morning through early evening of November 14th across portions of west, central, northern, and central Oklahoma, with the highest snowfall totals occurring along the U.S. Interstate Highway I-40 corridor across western Oklahoma. Accumulations of snowfall from 4-7 inches were seen roughly from Texola to Clinton, OK, while the Oklahoma City metro saw the trace to 2-inch range. Warm temperatures just above the surface kept most of the precipitation in south central Oklahoma confined to rain as this area experienced periods of heavy precipitation.

Figure 80: Snowfall Accumulation from November 14, 2022. Source: NWS Norman.

[The November 14, 2022 Snowfall Event in Western and Central Oklahoma (weather.gov)]

Since 2013, Oklahoma has experienced the following federally declared disasters that have had winter storm as an element of the disaster:

Year of Declaration	Title of Declaration	Disaster Number
2013	OK Severe Winter Storm and Snowstorm	DR-4109
2013	OK Severe Winter Storm	DR-4164

2015	OK Severe Winter Storms and Flooding	DR-4247
2016	OK Severe Winter Storms and Flooding	DR-4256
2017	OK Severe Winter Storm	DR-4299
2020	OK Severe Winter Storm	DR-4575
2021	OK Severe Winter Storm	EM-3555
2021	OK Severe Winter Storm	DR-4587

Probability and Risk Calculation

The probability is *Possible*.

The CPRI for Winter Storms for the State of Oklahoma is:				
Probability	+Impact	+ Warning Time	+ Duration	= CPRI
(2 x .45)	+ (2 x .30)	+ (1 x .15)	+ (3 x .10)	= 1.95

Vulnerability and Impact

Winter storms can occur anywhere in the state of Oklahoma, leaving behind a vast range of impacts all throughout the state. Winter storms can range from accumulating snow and/or ice over just a few hours to blizzard conditions with blinding, wind-driven snow lasting several days. The entire state of Oklahoma is susceptible to winter storms, and although the vulnerabilities and impacts can vary throughout the state, the aftermath from a damaging winter storm can continue to affect an area for weeks and even months no matter where you are.

Hypothermia is one of the most prominent threats to health when it comes to winter weather. Children and the elderly are at increased physiological risk. Additionally, lower-income residents may not have access to housing, or their housing may be poorly insulated from cold temperatures. Additionally, they have a greater risk of not having access to electricity during winter weather events. They may seek alternate methods for heating such as using space heaters or even using ovens as a last resort to heat their homes.

These methods can lead to carbon monoxide poisoning and/or pose a serious fire risk, along with other harmful side effects. Populations exposed to cold remain vulnerable for several reasons, including:

- There may not be a warming station nearby.
- The warming station may not be large enough to accommodate everyone.
- The station may not have backup generation.
- Residents may not seek shelter, despite a need.
- Residents may not know about the station or how to access it.

All structures are at risk of damage associated with winter storms, due to snow and ice (including frozen pipes). Water lines, both interior and exterior, are at threat to freezing and bursting. Gas lines, including gas pipelines, are also at risk of freezing. Like vulnerable populations who may need a constant, reliable supply of water, there are those who rely on a constant supply of gas to heat their homes. This is especially true for the elderly. Threats to the electrical infrastructure from winter weather primarily stem from ice and snow accumulation on power lines and roofs causing damage and destruction. Loss of a constant supply of electricity to vulnerable populations is another risk that can present a threat to life, health, or well-being, especially for those who are disabled and need electricity to run their medical equipment. Most homes and even some critical facilities may not have backup generators, which presents a vulnerability if the power were to go out during a winter storm. There is also a lack of education and outreach to individuals on the do's and don'ts of how to warm your home when the power is out, which can lead to injury or worse.

Ice-covered and snow-packed roadways represent a threat to individuals who venture upon them, whether they be first responders or citizens ignoring advice to avoid them. The state of Oklahoma typically sees an ice and/or snowstorm or two during the winter season but is typically nothing like the eastern parts of the United States experience. Because of this difference in occurrence, most drivers in the state of Oklahoma have a lack of knowledge on how to drive on roads when winter weather occurs. Other parts of the country who experience winter weather more frequently than Oklahoma, for the most part, also have the knowledge and experience on how to prepare the roads before winter weather occurs and how to clean roads after it occurs. The state of Oklahoma has their own methods on preparation and cleaning up after winter weather, but it can also be said that there is a lack in knowledge on the best ways to do so due in part because of the lack in experience with these events. If drivers decide not to heed warnings on driving during winter weather, they may face road conditions that they are not able to handle. This can cause drivers to get stuck on the road, slide along the road, or get in a wreck. An additional threat to roadways can be considered more of a long-term one. Surface materials used to pave roadways can expand and contract due to annual extreme temperature differences. Additionally, water freezing on these roadways, then melting and seeping into any existing cracks can cause further deterioration in the quality of roads in Oklahoma.

Several vulnerabilities to school districts relating to winter weather exist, primarily stemming from effects on roadways and infrastructure. Roadways that are affected by winter weather can affect transportation to and from school, including bus routes, which can lead to school cancellations or moving to virtual instruction. School districts typically plan for a set number of days for cancellations due to the weather, if these allotted days are exceeded, it can result in an extension of the school year. Other threats to schools also include a lack of backup generation of the power were to go out. This could also lead to school cancellation and even damage to school facilities if pipes were to freeze, food were to go bad, or even if tree branches were to freeze and break off and fall on school property.

In addition, according to FEMA's National Risk Index for winter weather, Oklahoma experiences nearly the entirety of the range of risk to winter weather. Tulsa and Muscogee county rank the highest with a "very high" risk to winter weather, while counties such as Woods, Ellis, Okfuskee, and Coal have a "very low" risk to winter weather.

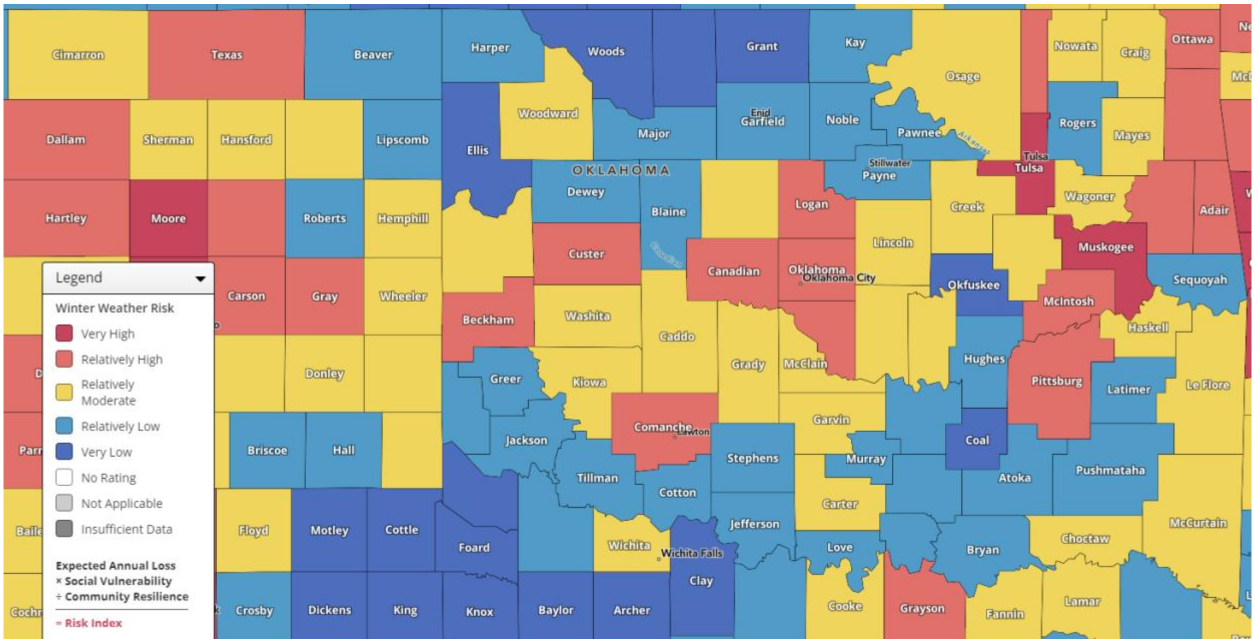


Figure 81: Risk map for winter storms. Source: FEMA.

Effects of Climate Change

According to the National Climate Assessment, winter storms have increased in frequency and intensity since the 1950's. It is believed that heavy snowstorms have increased in number during the last century in the northern and eastern parts of the United States but have been less frequent since 2000. In southern and some western areas, total seasonal snowfall has generally decreased, while the northern Great Plains and Great Lakes region has increased. They believe that overall snow cover has decreased in the Northern Hemisphere, due to higher temperatures that shorten the time snow spends on the ground. In a warmer climate we will see more extreme high temperatures and fewer extreme cold temperatures, extreme cold events can and will still occur, but will just be less frequent.

[Changes in Storms | National Climate Assessment (globalchange.gov)]

3.5 Risk Assessment of State Facilities, Estimated Potential Losses, and Vulnerability of Jurisdictions

For the purpose of this plan *critical facilities* means: State owned assets which are vital to health, safety and well-being of Oklahomans during a time of Natural Disaster.

The State of Oklahoma owns just over 9,000 buildings structures and appendages with a total building value in excess of **1.3** billion dollars with contents over 14 million dollars.

The buildings in the State of Oklahoma are as vulnerable to natural disaster just as any other building, public or private. This includes the most critical state facilities where public health and safety functions are performed or coordinated:

- National Guard facilities
- Emergency Operations Center
- Highway Patrol HQ and district patrol headquarters
- Communications and computer systems
- Specific government agencies/offices
- State Penitentiary
- State Medical Examiner

This plan emphasizes the MOST critical state owned and operated facilities. The exclusion of a building from the list does not mean that it houses an unimportant function; it just means the Planning Team chose to use the most critical facilities based on the activities and functions carried out at the locations profiled. It should also be noted that some critical facilities such as most of the electric and gas utility providers are privately owned, not government owned. These private facilities are not profiled as a part of this plan.

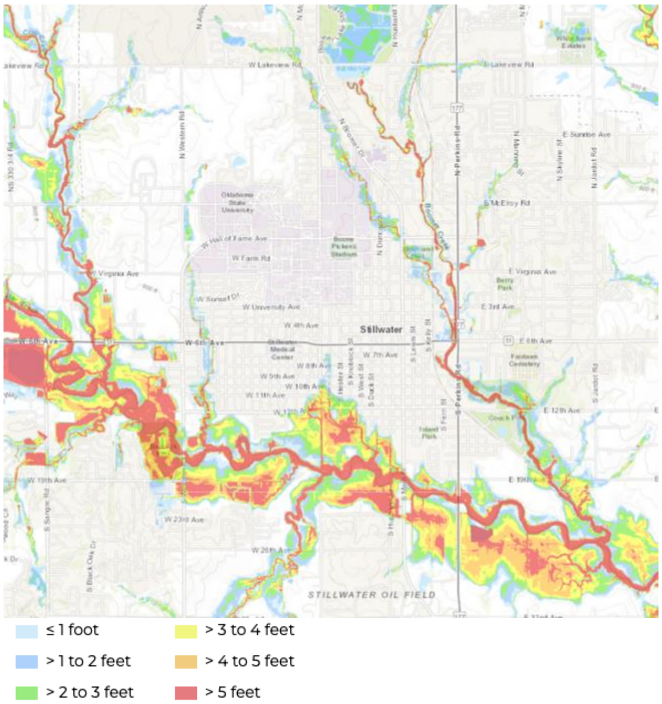
Methodology:

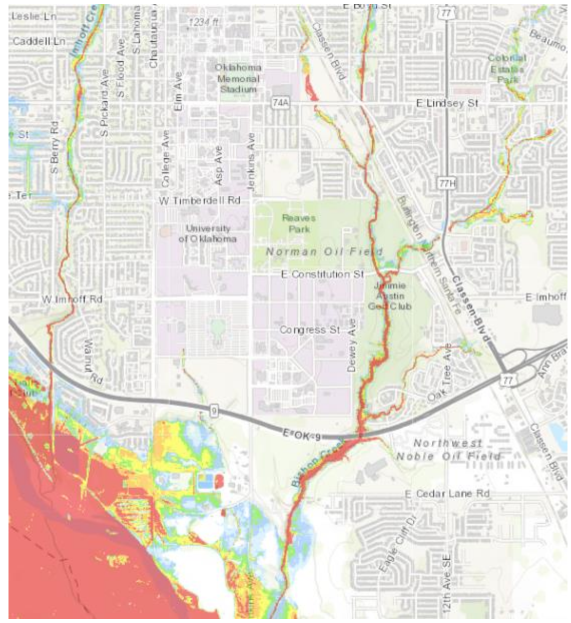
These facilities can range from the Oklahoma State Capitol Complex in Oklahoma City to a local office in a county providing state services. These facilities are hubs for everything from administrative activities to public safety functions and every conceivable role in between. Should these facilities be rendered inoperable by a natural hazard, the public will lose a vital link between them and their government and the services the government provides.

All state owned/operated facilities are potentially vulnerable to damage and impacts caused by the hazards found below. These hazards have the potential to affect facilities statewide. Although, the effect of these hazards on the facilities may not be location specific, their location does have an impact on the frequency that these facilities may be exposed to these hazards.

Severe Storms, Tornadoes and Wind Hazard: Storms and tornadoes can damage or destroy state facilities in a jurisdiction, thus cutting off vital state government services to the citizens in that area. State facilities would have comparable vulnerability to severe storms and tornadoes as all facilities located within a said county.

Flood Hazard: State owned facilities are not usually located in floodplains although certain segments of state property may be in flood prone areas that can be subjected to occasional flooding. Impacts on these facilities has the potential to pose a problem to the surrounding community as impacts reach beyond the flooding of the facility. For example, both the University of Oklahoma and Oklahoma State University are located near areas where more than 5 feet flood depths can occur according to base flood engineering (BFE) maps *(see maps below).* If a flood were to occur it would impact both campus facilities and roads leading into campus. In addition, the 2019 City of Tulsa Hazard Mitigation Plan has identified 26 critical facilities that are touched by or adjacent to the city's floodplains.



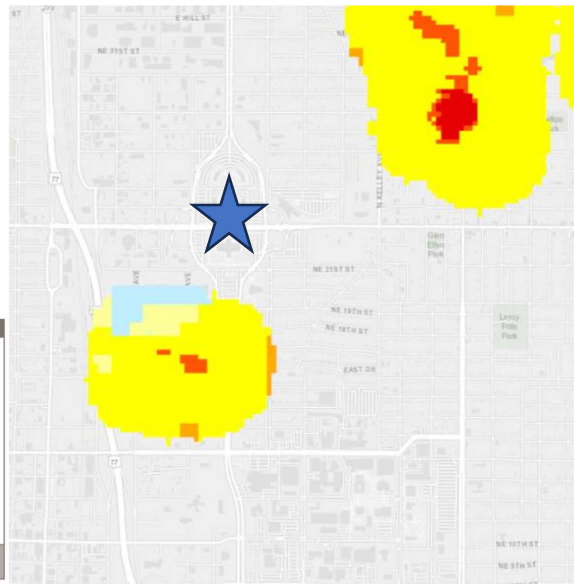


Winter Storms/Snow and Ice: Oklahoma winter storms are seldom severe enough to cause extensive damage to state owned facilities however ice or heavy buildups of snow do occasionally cause roofs to collapse. Other impacts to state owned facilities due to winter storms/snow and ice could include power outages, loss of communication systems, and damage to state owned vehicles.

Earthquake: Earthquakes in Oklahoma are seldom severe enough to damage structures such as our state facilities. In a worst-case scenario however, severe damage could occur to most of the facilities because most Oklahoma buildings are not constructed for earthquakes.

Wildfire: Wildfires risk would be highest in those state facilities located in the Wildland Urban Interface and those located in rural areas. For example, the Oklahoma State Capitol Complex *(pictured below)* is located near the outlined Wildland Urban Interface (WUI). In addition, just south of the Complex is rated moderate (-2) to high (-7) on the WUI Risk Index. The WUI Risk Index range of values is from -1 to -9, with -1 representing minor impacts and -9 representing a major impact.

Class	Acres	Percent
-9 Major Impacts	14	0.00%
-8	804	0.40%
-7	9,783	5.30%
-6	8,094	4.40%
-5 Moderate	25,643	14.00%
-4	14,453	7.90%
-3	27,648	15.10%
-2	87,683	47.80%
-1 Minor Impacts	9,230	5.00%
Total	183,353	100.00%



Roads, Highways and Bridges:
The transportation corridors such as roads, highways and bridges in the State of Oklahoma are critical not only to the motoring public but to economic development, and emergency response following disasters.

The major towns of Oklahoma are connected by state and national highways. The northern and the southern part of Oklahoma are joined by Interstate Highway 35. The eastern end of Oklahoma is connected to the western end of the state by Interstate Highways 40. I-44 runs through Oklahoma City and Tulsa from the northeastern corner of the state to the southwestern portion of the state where it exits to Texas at Wichita Falls. I-40 and I44 are primary travel arteries connecting the eastern and western United States.

The other prominent route is I-35 which makes the cities north and south of Oklahoma easily accessible. Some of the more important US Highways of the state are 81, 70, 283, 69, 259 and 77. Historic U.S. Highway 66 also follows a route through Oklahoma from east to west.

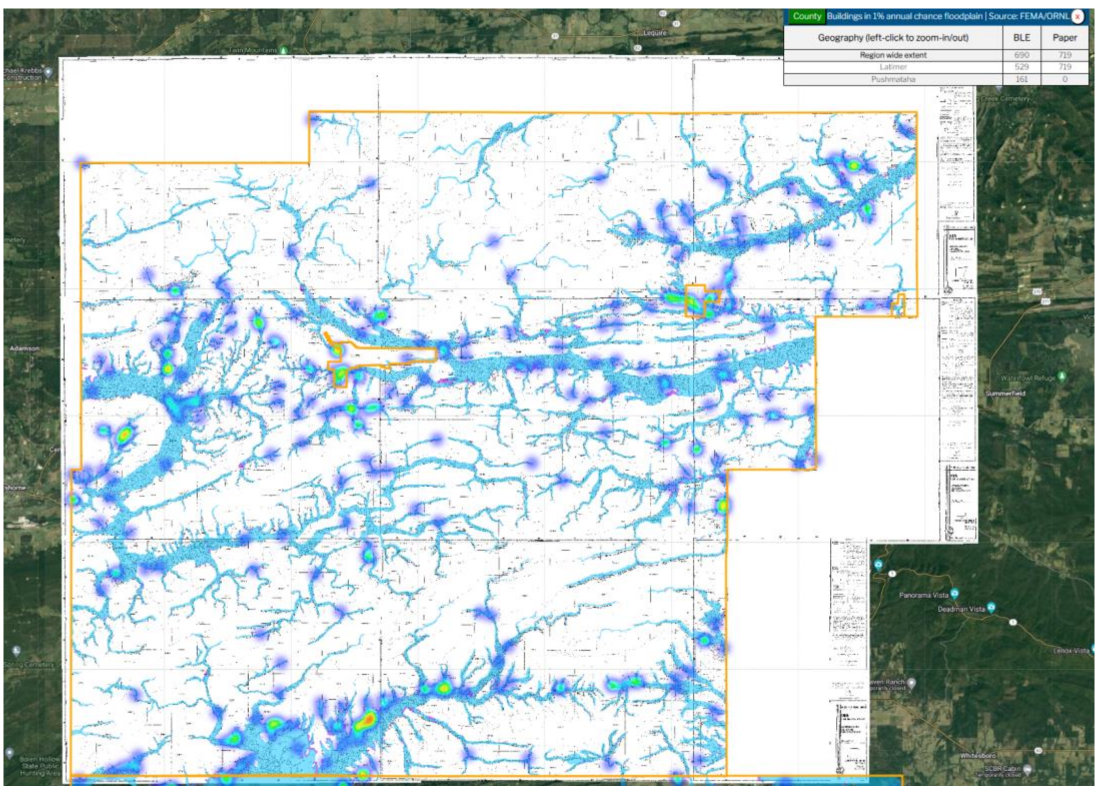
The roads and bridges in Oklahoma are subject to natural hazards as are buildings in Oklahoma. Roads and bridges flood and when the floodwaters go down, the roads are missing either in part or in whole. Entire bridges washout and cause roads that may not have been designed for heavy traffic to be used as detours. Tornado's also cause road damage in areas with damage to overlay and directional signs.

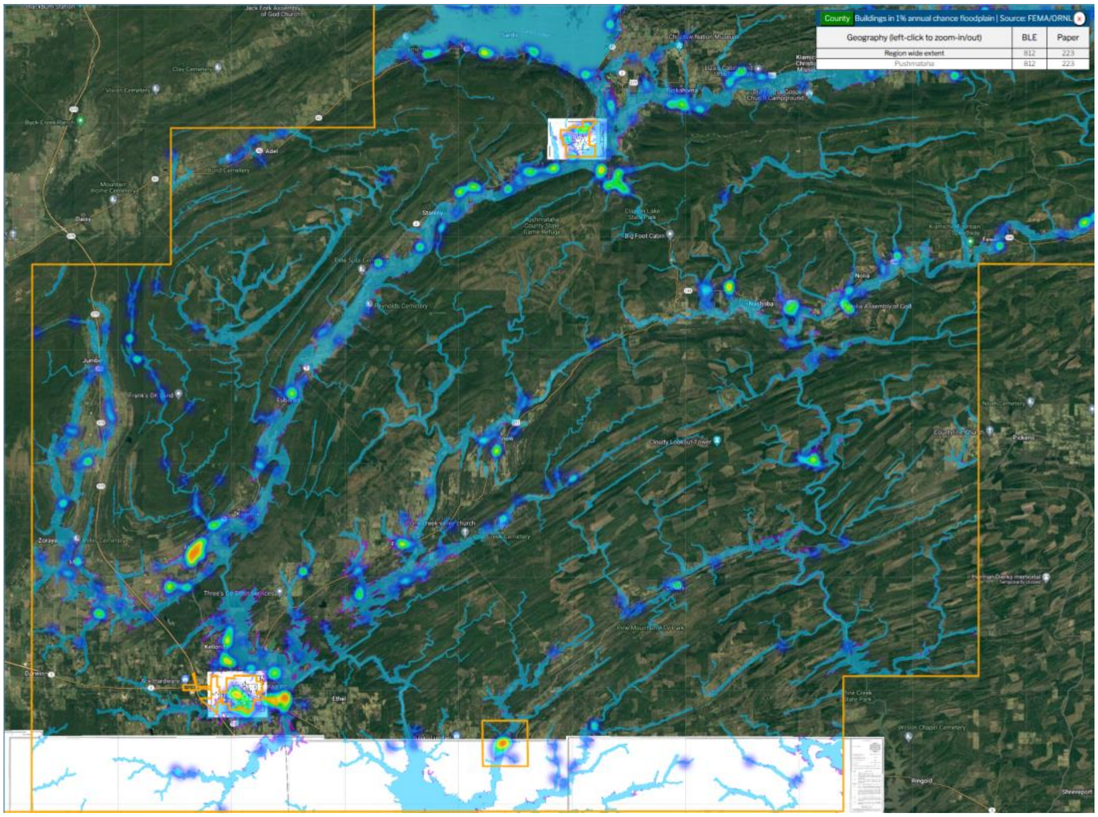
Drought and wildfire heat causes damage to roadways, again leaving cracked, broken and otherwise damaged roadways. Winter Storms have the same effect. Earthquakes, though minor sometimes damage roads and highways in Oklahoma. Losses vary widely by pre-disaster condition, quality, construction materials used, roadbed preparation and other considerations of road strength. Highways, Interstates and turnpikes all fair better during natural hazards because they are well constructed with heavy vehicle traffic being a primary consideration. County roads and state highways usually have less stringent design standards and are more susceptible to hazards.

Local Loss Estimates Discussion

There is no data for local loss estimates in local hazard mitigation plans because it is not a required element for local hazard mitigation planning. We have made assumptions based on the state facilities located in *Appendix A* regarding local loss estimates for communities throughout Oklahoma.

As mentioned in Chapter 1, Hochatown Oklahoma is extremely vulnerable to wildfires. With increased development and population increase, Hochatown would see an increase in local dollar losses if a wildfire occurred. Another example of an area vulnerable to potential local losses would be the Sardis Lake area in Pushmataha and Latimer County. This area is vulnerable to flooding due to a lack of required flood ordinances, not participating in the NFIP, and a large increase in development around the lake. Based on data provided through the *BLE to FIRM effort (https://femar6.github.io/ble_firm/)* from FEMA, a high risk for flooding is noted in these counties but there are still no required flood ordinances *(see figures below)*. This effort provides the precedent for stricter building codes and ordinances which could help limit the local economic loss after a flood occurs. This risk was not previously as clear with simple paper maps and BLE maps. In the event of a flood, both Latimer and Pushmataha counties would be vulnerable to high dollar losses to local structures and would see an increase dollar amount needed for emergency response. In addition, there is an overall lack of awareness of flooding risk in this area, making the residents more vulnerable to flooding.




County
Buildings in 1% annual chance floodplain | Source: FEMA/ORNL
Geography (left-click to zoom-in/out)
BLE
Paper
Region wide extent
812
223
Pushmataha
812
223

SECTION 4: MITIGATION STRATEGIES AND PRIORITIES

4.1 Goals to Reduce/Avoid Long-Term Vulnerabilities from Identified Hazards

In 2003, Oklahoma Governor Brad Henry recognized the resilience of Oklahomans when he stated: "Our fellow citizens deserve opportunity, safety, and security -- no matter where they reside within the borders of our state. We Oklahomans are known for our ability to weather any storm. The pioneers who settled this land were strong in spirit and determination. We are rightly renowned around the world for our compassion and the way in which we band together in the face of challenges. Tragedy brings out the best of the Oklahoma character. We know all too well the potential dangers of springtime and tornado season. Oklahomans came to the aid of their friends and neighbors hit hard by the May 3, 1999, tornadoes. Nature can be cruel, but Oklahomans are a resilient people, and face crises with strength and resolve."

Governor Henry's ambitious 2004 initiative included forging "Partnerships for a safer future through a process of coordination between the private sector, volunteer organizations, individuals and families, and all levels of government." Governor Henry's comments contributed to the formulation of the goals expressed in the 2022 State of Oklahoma Hazard Mitigation Plan which were intended to be applicable over a long period of time. They were:

1. To protect life
2. To protect property
3. To protect the environment
4. To increase public preparedness for disasters

In the 20 years since Governor Henry's remarks, Oklahoma has faced a series of natural disasters that have tested the State's capacity to mitigate, prepare, respond, and recover. The original goals however, as reviewed by the State Hazard Mitigation Team and OEM's HM planning review staff for this update, were determined to be valid, and further support the State's initiative to unite pre-disaster and post-disaster hazard mitigation, rather than as two separate efforts.

The goals were also evaluated considering the occurrences of hazards and improvements in technology, but the basic goals of the Plan remain the same. Further detail of the goals follows.

The State of Oklahoma Hazard Mitigation Team has identified ten natural hazards that threaten life and property (see Chapter Three). The threat each poses to human life varies, depending on factors such as knowledge of the hazard, locations of areas most at risk, frequency of hazard event occurrence, population density within the hazard zone, the availability of warning systems, and whether first responders have necessary training and equipment.

1. To protect life
2. To protect property
3. To protect the environment
4. To increase public preparedness for disasters

4.2 Process Used to Prioritize Mitigation Actions

4.2.1 S.T.A.P.L.E.E. - Prioritization and Review Criteria for State

Evaluation Category	Sources of Information and Considerations
Social	Over 30 state, federal, local, and non-profit agencies were contacted and had input throughout the planning process. While many were team members, others participated by identifying potentially vulnerable facilities, resources they were able to contribute, and efforts each agency is making to integrate mitigation in their operations. Approved local natural hazard mitigation plans were incorporated wherever possible. The selected mitigation actions/projects were considered to do the most good for the largest amount of people without adversely affecting any significant section of the population.
Technical	The following persons/agencies were consulted as to the technical feasibility of the various projects: FEMA, NWS, USACE, US Fish & Wildlife, USGS, HUD, BIA, US Bureau of Reclamation, American Red Cross, OKACCO, ODAFF, OCS, ODOC, OK Cons. Comm., OK Corp. Comm., OEMA, ODEQ, OFMA, OGS, OK Dept. of Health, SHPO, OK Dept. of Human Services, OK Ins Comm., OML, ODOT, OWRB, State NFIP Coordinator, State Dam Safety Cord., ODWC. The mitigation actions/projects implemented were also based upon the judgments of these experts and existing literature/studies regarding the hazards and technically feasible mitigation actions for repetitive loss properties. It was felt the selected actions/projects would provide the best long-term solutions and have minimal secondary impacts.
Administrative	Based upon available funding, capability assessment and organizational responsibilities, staffing for implementation of the state plan will rely on existing personnel in OEM and members of the SHMPC.
Political	Representatives from state, federal, local, and non-profit agencies attended the SHMPC meetings and were consulted on all aspects of the plan and mitigation actions/projects and provided input.
Legal	The State Natural Hazard Mitigation Plan was made available to all state agencies, governing bodies, and promulgation authorities. In their opinion, no significant legal issues were involved in the state mitigation strategies/actions that were selected.
Economic	Economic issues were discussed by all involved. It was felt that based upon the state's benefit-cost analysis methodology, economic impact assessment, priorities, and funding capabilities the mitigation actions/projects selected would do the best at eliminating or reducing loss of life, repetitive loss properties and other property, help break the cycle of damage, reconstruction,

Evaluation Category	Sources of Information and Considerations
	and repeated damage and have the most benefits. Each project is subjected to a cost benefit review.
Environmental	All environmental concerns are addressed through their respective state agencies before any mitigation actions/projects are undertaken at the state or local level. Coordination with state and federal resource agencies during the formation of the plan and before any mitigation actions/projects are implemented ensures compliance with all relevant statutes and regulations.

4.2.2 Mitigation Project Selection

Eligible Applicants

- State and local governments.
- Private non-profit organizations and institutions that own or operate a private nonprofit facility as defined in 44 CFR Part 206.221(e).
- Indian tribes or authorized tribal organizations

Sub-recipients must have a FEMA approved Hazard Mitigation Plan at the time of award as outlined in 44 CFR 201.6.

Identification and Notification of Potential Applicants

Information on the Hazard Mitigation Grant Program is widely disseminated through multiple sources such as by phone, e-mail, internet, and press releases.

Potential applicants will be directed to the OEM website at www.oem.ok.gov for information on available Hazard Mitigation Assistance programs and pre-application and application deadlines.

The OEM Area Coordinators, who are the local points of contact for emergency management activities, will also disseminate information on the program. Local Emergency Managers and Floodplain Administrators will be emailed the details on the program briefings and application announcements.

Mitigation staff will attend OEM area meetings to discuss hazard mitigation issues and new opportunities for funding. In addition, coordination with the Association of County Commissioners of Oklahoma and the Oklahoma Municipal League will serve to notify county and city personnel on the availability of mitigation funds.

Eligible Projects

Projects may be of any nature that will result in meeting the mitigation goals of the local Hazard Mitigation plan and the overall State Mitigation Goals. These projects are developed from the goals and mitigation actions that form the basis of local hazard mitigation plans. During the development and update of a local hazard mitigation plan, local communities identify those hazards that have the highest risk potential. This hazard analysis identifies benchmark events in those planning areas that have the greatest impact. For example, the 2013 Moore Oklahoma Tornadic event that effected an elementary school, the 2015 Statewide Flooding the significantly impacted southern counties of Oklahoma, 2018 Wildfires in Northwestern Oklahoma and the 2019 Flooding event that impacted the NE part of the State. These events are used to update the local hazard mitigation plan, and to assist OEM in conducting mitigation outreach and project development. Local communities are encouraged to follow the mitigation actions that will best meet their stated goals for their community, with the collective goals of these actions building to a local and state resiliency.

Identification of Projects

Projects identified in Local Hazard Mitigation Plans will be the initial source for identifying potential projects. All mitigation projects must be identified or support goals and objectives in federally approved local mitigation Plans. Hazard Mitigation Planners will review all FEMA approved Plans to identify mitigation projects. Information acquired during the Preliminary Damage Assessment (PDA) in response to a disaster event is another source for identification of mitigation issues and potential projects. PDA teams will be briefed as to the availability and requirements of the Hazard Mitigation Grant Program so potential projects can be identified for follow-up by the State Hazard Mitigation Staff.

Review, Priorities, and Ranking of NOIs/ Applications

Projects that have been submitted to OEM and are currently waiting for funding at the time of a disaster declaration are the highest priority for the State of Oklahoma. Applicants are responsible for prioritizing projects by urgency of the need with the disaster being mitigated, financial impact to the jurisdiction, human losses, and timeframe for completion. The State is responsible for prioritizing each project application with respect to how much and when State assistance is available.

General Review Criteria

Applications for funding under the Hazard Mitigation Grant Program received by the State Hazard Mitigation Section will be reviewed for the following criteria (from 44 CFR 206.434). The following must be provided prior to submitting applications in NEMIS:

- Be in conformance with the State Mitigation Plan and Local Mitigation Plan approved under 44 CFR Part 201;
- Have a beneficial impact upon the designated disaster area, whether or not located in the designated area;

- Be in conformance with 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and 44 CFR Part 10, Environmental Considerations;

- Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project will be completed. Projects that merely identify or analyze hazards or problems are not eligible;

- Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster. The sub-recipient must demonstrate this by documenting that the project:

  - Addresses a problem that has been repetitive, or a problem that poses a significant risk to public health and safety if left unsolved.
  - Will not cost more than the anticipated value of the reduction in both direct damages and subsequent negative impacts to the area if future disasters were to occur.
  - Has been determined to be the most practical, effective, and environmentally sound alternative after consideration of a range of options.

- Contributes, to the extent practicable, to a long-term solution to the problem it is intended to address.

- Considers long-term changes to the areas and entities it protects and has manageable future maintenance and modification requirements.

Statewide Hazard Mitigation Programs

The State may submit applications for Hazard Mitigation Assistance funding as the recipient and sub-recipient. Historically, OEM has applied for and received funds for 27 phases of the SoonerSafe Safe Room Rebate Program. OEM is responsible for administering the SoonerSafe Program. The SoonerSafe program provides homeowners with a rebate of 75% towards the cost of a safe room and installation, not to exceed $2,000. SoonerSafe is contingent on the availability of Federal funds.

OEM may, at its discretion, act as sub-recipient for other project types such as, but not limited to: Hazard Mitigation Planning Initiatives, Public Information and Outreach, Mapping Activities, and other mitigation activities.

SOONERSAFE STATS							
PHASE	GRANT #	APPROVAL DATE	POP Date or Closeout Date	Federal Amount Approved	Federal Amount Spent	# OF ISR'S GRANT APPROVED FOR	TOTAL # INSTALLED AT END OF GRANT
PHASE 01	1917	2/1/12	1/1/16	$1,000,000.00	$996,367.79	500	506
PHASE 02	1926	2/29/12	10/30/12	$22,001.00	$21,875.00	11	11
PHASE 03	1970	7/3/12	5/7/13	$12,000.00	$11,802.39	6	6
PHASE 04	1988	8/8/12	1/1/16	$58,000.00	$57,860.00	29	29
PHASE 05	1988	9/9/12	3/20/13	$6,000.00	$6,000.00	3	3
PHASE 06	1985	8/31/12	12/1/13	$6,000.00	$6,000.00	3	3
PHASE 07	1989	10/1/12	10/1/16	$116,000.00	$90,436.32	58	46
PHASE 08	1970	10/17/12	10/1/16	$144,616.00	$94,557.64	54	48
PHASE 09	PDM 2012	1/1/13	4/18/16	$1,075,000.00	$970,804.75	538	493
PHASE 10	4064	7/3/13	3/26/15	$24,000.00	$23,664.91	12	12
PHASE 11	4078	6/26/13	1/21/15	$20,000.00	$19,945.00	10	10
PHASE 12	4078	1/9/14	11/4/14	$2,000.00	$2,000.00	1	1
PHASE 13	PDM 2014	4/1/15	9/1/17	$1,000,000.00	$919,506.87	500	466
PHASE 14	4109	11/25/14	5/1/18	$466,000.00	$408,030.48	233	210
PHASE 15	4117	1/14/16	7/1/18	$545,081.00	$407,378.00	273	209
PHASE 16	PDM2015	4/1/16	9/30/17	$1,000,000.00	$770,851.10	500	392
PHASE 17	PDM2016	4/16/2017	10/1/2019	$1,000,000.00	$739,965.24	500	378
PHASE 18	4222	4/1/17	2/22/2021	$600,000.00	$466,928.10	300	240
PHASE 19	FMAG 5117	7/17/19	2/1/2020	$106,000.00	$92,459.80	53	47
PHASE 20	4247	1/10/18	3/31/2021	$21,300.13	$21,300.13	10	11
PHASE 21	4274	11/10/18	7/20/2021	$105,425.00	$61,041.25	53	31
PHASE 22	4315	6/27/2019	11/22/2021	$21,942.50	$21,942.50	10	11
PHASE 23	4324	8/23/19	1/21/2023	$210,000.00	$138,818.08	105	70
PHASE 24	PDM2018	9/24/19	9/22/2022	$766,000.00	$279,041.58	288	140
PHASE 25	PDM2019	4/10/20	11/22/2023	$764,205.20	STILL OPEN	288	59 as of today
PHASE 26	4453	7/16/21	1/8/2024	$104,000.00	STILL OPEN	52	30 as of today
PHASE 27	BRIC 2021	12/3/22	12/2/2025	$533,166.00	STILL OPEN	267	79 as of today
			TOTALS	$9,728,736.83	$6,628,576.93		3,541

Five Percent Set-Aside

Sub-applicants will not be awarded more than one grant in the five percent initiative-funding category. The only exception to this is when the State has funded at least one sub-applicant to all jurisdictions in line for funding or there is funding available at the conclusion of the application period. Additionally, for siren and generator projects, funding will may be limited dependent on the number and size of project applications that have been submitted. Should OEM initiate a cap on Initiative funds, caps may be instituted at the following amounts: maximum federal share available for generators funded under the five percent initiative will be $50,000. Maximum federal share available for sirens funded under the five percent initiative will be $60,000. These caps may be waived upon request of the jurisdiction and approval of OEM.

7-Percent Planning Grants

Grants are available to municipalities with a population greater than 25,000. Counties of any population size are eligible for Planning funds. OEM encourages all Counties to work with their respective local jurisdictions including local communities and schools to be incorporated into the Planning process. Counties may apply to roll single jurisdictions into the county Plan as time permits.

Hazard Mitigation Planning Grant Funding

Community Type	Population	Maximum Award (Total Project)
Rural County Multi-Jurisdictional	Less than 25,000/	$50,000
Midsize County Multi-Jurisdictional	25,000-200,000/	$80,000
Midsize City Single-Jurisdictional	25,000-200,000/	$80,000
Urbanized County, **Metropolitan Area**, **Large City, or Regional Plan (multi-county)**	Greater than 200,000/	$200,000

Hazard Mitigation Planning Grants must be based on actual needs of the jurisdiction. Factors affecting the range of costs:

- Technical sophistication of scope of work
- Number and size of participating jurisdictions
- Number of significant hazards affecting Planning area
- Variance of hazards/risk across Planning area
- Update or new Plan (costs of first round updates may be similar to new Plans depending on quality of original Plan; second round updates should start significantly decreasing)
- Post disaster (more to analyze – higher cost)

Fire Management Assistance Grants (FMAG)

• OEM will prioritize HMGP Post Fire assistance to Wildfire Mitigation projects first within the first 90 days of the application period. Following the 90-day initial period, HMGP eligible projects will be made available to eligible sub-applicants statewide. OEM will coordinate with OEM regional Representatives and through the State Hazard Mitigation Team to announce funding. Deadlines for applications will be within the guidance set by the FMAG-HMGP requirements.

4.3 State Mitigation Actions

The strategies identified below in the Hazard Mitigation Initiatives are activities and programs are those that OEM and partner agencies are currently engaged with to facilitate mitigation actions throughout the state. The table below uses a strategy and action basis to provide pathway to meeting the mitigation goals.

Hazard Mitigation Initiatives to Protect Life					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Every public school should have a tornado shelter or designated safe room	Develop an inventory of public schools with safe rooms or shelters, and those that lack any sheltering facilities.	Ongoing	HMGP, BRIC	By identifying schools that lack shelters, efforts can be initiated in communities to raise awareness and funding for shelter construction or retrofitting of existing buildings.	Use of tornado shelters prevents injuries and saves lives.
Provide a reliable state-wide emergency communications method	Plan and implement user training sessions and tests of **WebEOC** simulating various disaster scenarios.	Ongoing	Existing State and local resources	Communities rely on the **WebEOC** network to coordinate emergency response activities.	**WebEOC** enables real-time information sharing which is vital in the deployment of regional resources during emergencies and disaster events to save lives and property.

Hazard Mitigation Initiatives to Protect Life					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Promote increased awareness of, and participation in NFIP	Sponsor and conduct annual NFIP courses for floodplain professionals	Ongoing	CAP-SSSE	Educate community stakeholders on the importance of floodplain management, NFIP regulatory and administrative requirements, and the benefits of NFIP participation.	Education of the public along with local enforcement of NFIP regulations ultimately reduces the risk of exposing residents to flood-prone areas.
Provide site-specific emergency preparedness instruction for school administrators	Continue the all-hazard All Hazard Emergency Preparedness for Public Education program.	Ongoing	Oklahoma Schools Security Institute-DPS	State schools do not have a standard protocol for ensuring safety of students and staff in the event of natural disasters, school violence, or need for campus lock-downs.	Having plans, and conducting drills so that teachers and staff know exactly how to move school building occupants to safety and work with first responders, will reduce injuries and save lives.

Hazard Mitigation Initiatives to Protect Life					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Promote enforcement of State and local building codes	Promote enforcement of existing building codes by State and local governments.	Ongoing	State and local resources, HMGP-PF, BRIC	Oklahoma has adopted stringent building codes, but enforcement is the responsibility of local government.	Conformance to minimum construction standards ensures stronger, safer buildings which, in turn, contribute to the safety of the public.

Hazard Mitigation Initiatives to Protect Property					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Protect critical State-owned assets	Prioritize structural and non-structural retrofits for critical State-owned facilities based on their vulnerability to natural hazards.	Ongoing	Capital budget funds, HMGP	Prioritizing the facilities will provide direction for timely upgrades pending availability of funding.	Retrofitting facilities will preserve State buildings, as well as protect their contents and occupants from hazard events.

Hazard Mitigation Initiatives to Protect Property					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Identify vulnerabilities of transportation infrastructure	Examine the vulnerability of transportation infrastructure and develop contingencies for alternate operations.	Ongoing	Existing and future State resources- Oklahoma Dept. of Transportatio n	By studying past events and known vulnerabilities and projecting this data to future events, contingency plans can be developed for overcoming failures in transportation infrastructure.	Identifying potential infrastructure weaknesses enables stakeholders to plan solutions before the failures occur, and to allocate resources proactively.
Inform citizens of need for flood insurance	Encourage renters, homeowners, and business owners to purchase flood insurance even if their property is not located within high flood risk areas.	Ongoing	Existing and future State resources- Oklahoma Water Resources Board (OWRB)	Many people do not realize that most homeowners and business insurance policies do not cover flood losses; also renters may not realize that they are eligible to purchase flood insurance through NFIP.	While having insurance doesn't mitigate the flooding event, having flood insurance helps deter catastrophic financial losses and reduces the possibility of blighted, abandoned properties which erodes the property value of adjacent areas.

Hazard Mitigation Initiatives to Protect Property					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Implement measures that reduce wildfire vulnerable structures	Implement defensible space for State facilities. Encourage homeowners to create defensible space around their properties.	After FMAG declaration	HMGP-PF, Oklahoma Department of Forestry	The state has identified state owned and local facilities that are vulnerable to wildfires. In addition, protecting agriculture land and economic impacts near grow houses for medical marijuana facilities.	This would mitigate against wildfire for both state owned facilities and local facilities.

Hazard Mitigation Initiatives to Protect the Environment					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Bury electric transmission lines	Work with electric utilities to explore development of underground lines in high-risk areas, including fire interface areas.	Ongoing	Existing resources, HMGP-PF	Electric transmission lines protected in underground conduits are not susceptible to damage from fire, fallen trees or snow loads.	Buried electric lines can't create sparks that can cause fires, nor are they vulnerable to damage from wildfires.
Establish Firewise Communities	Promote establishment of Firewise Communities Program throughout State	Ongoing	Oklahoma Department of Forestry	The mission of the Firewise Communities Program is to protect people and property in communities at risk for wildfires.	By educating residents about the hazards of wildfires and how they can make their property fire-resistant, this program has a proven record of success in protecting lives, property, and the environment.
Utilize fire resistant vegetation	Eradicate red cedar trees and promote the use of fire resistant vegetation.	After FMAG declaration, as funding becomes available	HMGP-PF, Oklahoma Department of Forestry	This would protect wildlife feeding sources and habitats. In addition, it would help mitigate the effects of wildfire for individuals and structures in the WUI.	Utilizing fire resistant vegetation mitigates against wildfire for the natural environment as well as individuals living in the WUI.

Hazard Mitigation Initiatives to Increase Public Preparedness					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
Increase stakeholder knowledge of Hazard Mitigation Planning	Encourage local jurisdictions to prepare local Hazard Mitigation plans for FEMA approval.	Ongoing	Existing resources, State Mitigation Programs	Preparing and maintaining local plans leads to increased awareness of Hazard Mitigation issues through public forums and continued dialog.	Improving knowledge of the State's hazards and the risks they pose will lead to development of better policies and improved funding for hazard reduction strategies.
Improve public knowledge of hazards and protective measures so individuals appropriately respond during hazard events	Assess the State's public school education program on emergency preparedness and disaster resistance to determine its effectiveness and establish a baseline for future education efforts.	Ongoing	Existing program resources, State mitigation programs	There is no standardized awareness program to make school officials aware of potential hazards and how to respond to them.	Educating school officials about potential hazards and how to respond before, during, and after events will lead to effective preparedness programs.
Educate the public about the risks of wildfires in urban areas that abut undeveloped areas	Develop and maintain a comprehensive public education program that increases awareness of the wildland interface fire risk and promotes	Ongoing	Existing resources, Oklahoma Dept. of Forestry	Development in interface areas is increasing but property developers and residents need to be aware that the risk for wildfires is not limited to undeveloped, rural areas.	Increasing the knowledge of the public, property developers and local planners of the wildland fire risk and mitigating that risk will improve

Hazard Mitigation Initiatives to Increase Public Preparedness					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
	actions that reduce the risk of fire to life and property.				public safety in interface areas.
Improve hazard information including databases and maps	Develop and maintain an inventory of existing geographical databases for natural hazards.	Ongoing	Existing and additional resources	Many land-use planners and emergency managers do not know where to turn for geographical (GIS) databases for hazards or whether such a database exists.	Maintaining a centralized library of hazard databases will improve their accessibility and expand their use by land-use planners and emergency managers, resulting in better plans and mitigation initiatives.
Create a GIS database of areas within the state that are prone to natural hazards for fast and easy access	Accelerate mapping of natural hazard areas, including floods, and develop GIS-compatible database products for them.	Ongoing	Dependent on continued funding	Few GIS databases for natural hazards exist.	Availability of GIS databases for natural hazards would greatly improve mitigation initiatives and consequent land-use planning.
Create a GIS database of state critical assests required to meet	Data collection of state critical assests and natural hazard areas, including floods, and	Ongoing	Dependent on continued funding	Initial dataset of assets is available, ESF partners would provide a ranking of those	Availability of GIS databases for critical assets of ESF partners would greatly improve

Hazard Mitigation Initiatives to Increase Public Preparedness					
Strategy	Action	Projected Timeline	Projected Resources	Rationale for Action	How Action Contributes to Mitigation Strategy
ESF functions within the state that are prone to natural hazards for fast and easy access	develop GIS-compatible database products for them.			assets required to meet their ESF support function.	mitigation initiatives and consequent land-use planning.

4.4 Hazard Mitigation Actions Funding Sources

Note: One new funding source, Building Resilient Infrastructure and Communities (BRIC) was introduced in August 2020, to replace Pre-Disaster Mitigation (PDM Funding). Other Funding sources have remained the same throughout this planning period.

The State of Oklahoma has a variety of programs available to assist with funding for hazard mitigation projects. They include but are not limited to the following:

Hazard Mitigation Grant Program (HMGP)

The Hazard Mitigation Grant Program (HMGP) was created in 1988 by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended. This program is activated during Presidential Disaster Declarations to assist in identifying mitigation projects, and funding these projects on a 75% Federal / 25% non-Federal cost share basis. The program is administered at the State level; in Oklahoma, through Emergency Management. Note: In Oklahoma, the 25% share is normally absorbed by the local, city or county government.

- Objectives of this program include: Prevent future loss of lives and property due to disasters; implement State or local hazard mitigation plans; enable mitigation measures to be implemented during the immediate recovery of a disaster; and, provide funding for previously identified mitigation measures that benefit the disaster area.
- Eligible applicants for the HMGP are: State and local governments; certain non-profit organizations; and Indian tribes.

The HMGP is designed to reduce the State's or local government's vulnerability to risk through a thoroughly coordinated all-hazards approach to mitigation activities, with a heavy emphasis on planning. This focus on planning includes updating plans; implementing the measures identified in all-hazard mitigation plans; developing local mitigation plans; developing State legislation; or adopting local ordinances. The key is the coordination and implementation of an all-hazards approach using a strong partnership at the State and local level.

Hazard Mitigation Grant Program Post Fire (HMGP-PF)

Hazard Mitigation Grant Program for Post fire is mitigation funding that has been made available to the state as a result of Fire Management Assistance Grant declarations in fiscal years 2017 and 2018 as authorized in Section 20602 of the Bipartisan Budget Act of 2018.

HMGP Post Fire utilizes existing HMA Guidance with the following exceptions:
• A Fire Management Assistance declaration rather than a Presidential major disaster declaration activates HMGP assistance.

• OEM will prioritize HMGP Post Fire assistance to Wildfire Mitigation projects first, then those HMGP eligible projects will be made available to eligible sub-applicants statewide. OEM will coordinate with

OEM regional Representatives and through the State Hazard Mitigation Team to announce funding. Deadlines for applications will be within the guidance set by the FMAG-HMGP requirements and the State Admin plan for HMGP.

• The HMGP funding amounts are based on a national aggregate for each Fire Management Assistance declaration and HMGP assistance shall be aggregated under the first Fire Management Assistance declaration. The total amount available for HMGP for states and tribal applicants is determined by FEMA headquarters on an annual basis based on data from past years.

• The application period is 6 months from the date of applicant (state, territory, or federally recognized tribe) funding notification and extensions may be requested.

Building Resilient Infrastructure and Communities (BRIC) Program

In August of 2020, the BRIC Program was introduced. It is a yearly competitive program; it is open to local communities and tribal nations. The NOFO is typically released each year around late August/early September, and the deadline is usually the end of January. Each year the NOFO is a little different, depending on FEMA's focus for that year. The usual 75%/25% match also applies to BRIC projects.

Along with the competitive program, each State receives a certain amount of money for projects. The amount of money changes each year.

The Building Resilient Infrastructure and Communities grant program gives states, local communities, tribes and territories funding to address future risks to natural disasters, including ones involving wildfires, drought, hurricanes, earthquakes, extreme heat, and flooding. Addressing these risks helps make communities more resilient.

The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.

Pre-Disaster Mitigation (PDM) Program (Sunsetting after BRIC was introduced)

FEMA has long been promoting disaster resistant construction and retrofit of facilities that are vulnerable to hazards to reduce potential damages due to a hazard event. The goal is to reduce loss of life, human suffering, economic disruption, and disaster costs to the Federal taxpayer. This has been, and continues to be, accomplished through a variety of programs and grant funds.

Although the overall intent is to reduce vulnerability before the next disaster threatens, the bulk of the funding for such projects actually has been delivered through a "post-disaster" funding mechanism, the Hazard Mitigation Grant Program (HMGP). This program has successfully addressed the many hazard mitigation opportunities uniquely available following a disaster. However, funding of projects "pre-disaster" has been more difficult, particularly in States that have not experienced major disasters in the past decade. In an effort to address "pre-disaster mitigation," FEMA piloted a program from 1997-2001 entitled “Project Impact” that was community based and multi-hazard oriented. In Oklahoma, there were four “Project Impact” named cities: Tulsa, Miami, Durant and Lawton.

Through the Disaster Mitigation Act of 2000, Congress approved creation of a national Pre-disaster Hazard Mitigation program to provide a funding mechanism that is not dependent on a Presidential disaster declaration. This authorization is in Section 203 of the Stafford Act, 42 USC 5121-5206, as amended by Section 102 of the Disaster Mitigation Act of 2000. For FY2002, $25 million was appropriated for the new grant program entitled the Pre-Disaster Mitigation Program (PDM). This new program builds on the experience gained from Project Impact, the HMGP, and other mitigation initiatives. There is a one-time grant each year for the State for this program.

The high points of the PDM program are:

(1) The program will be administered by each State.

Eligible projects include:

- State and local hazard mitigation planning
- Technical assistance (e.g. risk assessments, project development)
- Mitigation Projects
- Acquisition or relocation of vulnerable properties
- Hazard retrofits
- Minor structural hazard control or protection projects
- Community outreach and education (up to 10% of State allocation)

(2) The emphasis for FY2002, the first year of the program, was on mitigation planning, to help localities meet the new planning requirements of DMA 2000.

Each State establishes grant selection criteria and priorities based on:

- The State Hazard Mitigation Plan
- The degree of commitment of the community to hazard mitigation
- The cost effectiveness of the proposed project
- The type and degree of hazard being addressed

(3) For project grants, “good standing” of the community in the National Flood Insurance Program (NFIP)

(4) The funding is 75% Federal share, 25% non-Federal, except as noted below.

- The non-federal match can be fully in-kind or cash, or a combination
- The grant performance periods will be 18 months for planning grants, and 24 months for mitigation project grants
- The PDM program is available to regional agencies and Indian tribes

(5) Special accommodation will be made for "small and impoverished communities," that will be eligible for 90% Federal share, 10% non-Federal.

Flood Mitigation Assistance (FMA) program

The Flood Mitigation Assistance grant program is a competitive program that provides funding to states, local communities, federally recognized tribes and territories. Funds can be used for projects that reduce or eliminate the risk of repetitive flood damage to buildings insured by the National Flood Insurance Program. FMA provides assistance to States and communities for flood mitigation planning and activities to fund cost-effective measures that reduce or eliminate the long-term risk of damage to buildings, manufactured home, and other NFIP-insurable structures in some cases by providing funds for acquisitions and removal or Repetitive loss and Severe Repetitive loss properties, and it is not disaster dependent. Note: In Oklahoma, the 25% local share will be absorbed by the local, city or county government, and one-half of the 25% (or 12.5% of the total grant) share must be a "hard match."

(1) FMA is part of the National Flood Insurance Act of 1968, Sections 1366 and 1367 as amended by Sections 553 and 554 of the National Flood Insurance Reform Act (NFIRA) of 1994.

(2) Goals of the program include: Reduce the number of repetitively damaged structures and associated claims against the National Flood Insurance Fund; and encourage long-term comprehensive mitigation planning.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program, enacted in 1968, made federally subsidized flood insurance available to property owners located in communities participating in the flood program. Communities wanting to participate in the National Flood Insurance Program must establish minimum floodplain management regulations in their special flood hazard areas and enforce these regulations.

(1) In 1973, Congress passed the Flood Disaster Protection Act. This law required the purchase of flood insurance as a condition for Federal or Federally-related loans or other Federal financial assistance for property located in identified floodplain areas. This provided the incentive for participation in the Program.

(2) Most counties in the State of Oklahoma lacked proper authority concerning land use regulation necessary to participate in the Flood Insurance Program. In 1980, the legislature passed the Oklahoma Floodplain Management Act to allow citizens that desired to participate in this Program to procure flood insurance. This legislation enables any county or community in the State to form a Floodplain Board and enact floodplain regulations to allow participation in the Program.

(3) The National Flood Insurance Program requires communities to adopt and enforce a minimum amount of floodplain management criteria. These criteria includes such items as: Requiring permits for construction within designated floodplains; reviewing development plans and

subdivision proposals to determine if proposed building sites will be reasonably safe from flooding; requiring protection of water supply and sanitary sewage systems to minimize infiltration of flood water and discharges from the system into the flood waters; obtaining, reviewing, and utilizing all available base flood elevation data; and assuring the maintenance of flood carrying capacities within all water courses.

(4) A current list of Oklahoma communities participating in the Program, consists of counties (unincorporated areas), tribes and municipalities, is provided in **Appendix B** of this plan.

Community Rating System

The Community Rating System (CRS) is an element of the NFIP. This program is designed to promote the availability of flood insurance, reduce future flood damages and insure the accurate rating of flood insurance policies. Participating communities may receive credit for proven mitigation measures, thus reducing the cost of flood insurance within their communities. In 2021, the City of Tulsa moved up to a Class 1 in the CRS program the highest possible ranking. They are one of two programs in the nation to have a received a Class 1 designation.

Disaster Housing Program

The Disaster Housing Program is available to provide disaster hazard mitigation measures in the form of home repair grants to eligible homeowners following a federally declared disaster. If the home repair costs exceed the Disaster Housing Grant, the applicant can be referred to the Individual and Family Grant Program for additional grants not to exceed the maximum grant limitations of the Individual and Family Grant Program.

CAP-SSSE (Community Assistance Program-State Support Services Element)

The State administers the CAP-SSSE Grant available through FEMA. The grant provides funds for assistance to communities participating in the National Flood Insurance Program. This assistance is directed at the administration of each community's floodplain development permit system to insure compliance with flood loss reduction guidelines.

Summary

Changes to FEMA hazard mitigation grant program since the last Plan Update include the elimination of the Severe Repetitive and Repetitive Loss Claim and Repetitive Flood Claim grant programs. To encourage efforts by states and local jurisdictions to reduce repetitive loss damages, FEMA has reduced the cost share requirement for HMA grant funding if the action directly reduces repetitive losses. Another change was elimination of the PDM program and introducing the competitive BRIC program.

4.5 Mitigation Action Items Completed Since 2019 State HM Plan

Since the last update, OEM has focused on mitigation actions and projects that are identified and conducted by local jurisdictions and are site-specific programs and projects.

State Hazard Mitigation Action Projects/Programs (Past and Present):

In recent years, the Hazard Mitigation Division of OEM has changed its focus from State-sponsored efforts to the support of local governments in developing site-specific programs and projects. The table below is overview of State Mitigation Projects that have been completed and on-going

Description	Associated Hazards	Lead Agency	Schedule / Completion Date
State 911 PSAP Facility Mapping The State is currently using its Emergency Management network to systematically verify each location of State owned and operated facilities.	Dam Failure Earthquake Flooding Tornado Wildfire	Oklahoma Emergency Management (OEM)	OEM-USACE Silver Jackets FY 2018-2019
Local Jurisdiction Hazard Mitigation Projects Reverse 911, GIS Mapping, 911 Training, School Safe Rooms, Shelter Models, Acquisitions, Natural Hazard Mitigation Plans, etc.	Dam Failure, Drought, Earthquake, Severe Thunderstorms / Hail / Lightning, Expansive Soils, Extreme Temperatures Heat/ Cold, Flooding, High Winds, Landslides, Tornadoes, Wildfires, Winter Storms/ Icy Hazards	OEM (funding source only)	Multiple completion dates ranging from one to three years; Ongoing
Tornado Shelter Seminars Oklahoma Emergency Management presents free seminars across the State specifically discussing community and school shelters.	Tornadoes High Winds	OEM	Various Conferences Annually
Hazard Mitigation Planning Workshops Conducts informational sessions throughout the State explaining the	Dam Failure, Drought, Earthquake, Expansive Soils, Extreme Temperatures	OEM	Ongoing, conducted quarterly through OEM Regions

Description	Associated Hazards	Lead Agency	Schedule / Completion Date
value and need for Local HM Plans, why they are important, and options on how to create them.	Heat/Cold, Flooding, High Winds, Landslides, Severe Thunderstorms/Hail/ Lightning, Tornadoes, Wildfires, Winter Storms/Icy Hazards		
March is "Flood Insurance Month" This annual State campaign spreads the word about the availability of FEMA's affordable NFIP flood insurance.	Flooding	OWRB	Every March
May is "Flood Awareness Month" This annual State campaign reminds citizens of the dangers of flash flooding.	Flooding	OWRB	Every May
Oklahoma Red Flag Fire Alert This notification program limits the use of outdoor burning during periods of high risk.	Wildfires	Oklahoma Forestry Service	Ongoing
Dam Safety Program This program ensures that the 4,500 dams in the State are inventoried, inspected and properly maintained.	Dam Failure Flooding	OWRB	Ongoing
OK-FIRST Program This communications system has been recognized internationally for its innovative approach in providing instant access to vital weather data for fire, police, and emergency management agencies.	High Winds Thunderstorms Tornadoes Winter Storms	Oklahoma Climatological Survey	Ongoing
Resolve data deficiencies	Tornado, Winter Storms, Sinkholes, Mine	OEM	Ongoing

Description	Associated Hazards	Lead Agency	Schedule / Completion Date
Work with local jurisdictions to assist them in identifying and gathering data that is missing from their plans prior to submission to FEMA.	Subsidence, Flooding, Wildfires, High Winds, Drought, Hail, Lightning, Extreme Heat, Earthquake, Dam Failure, Landslides, Expansive Soils, Special Events		
Flood Risk Resiliency Projects- Identification of communities that are high risk for flooding, or have been experienced significant damage due to flooding. These are funded through the USACE Silver Jackets Program.	Flooding, Dam Breach	USACE, OEM	2-3 communities selected annually.

SECTION 5:
STATE MITIGATION CAPABILITIES

5.1 State Agency Capabilities for Hazard Mitigation

5.1.1 Oklahoma Department of Emergency Management and Homeland Security

The Oklahoma Department of Emergency Management and Homeland Security (ODEMHS) is statutorily required to prepare for, respond to, recover from, and mitigate against any natural or manmade disaster which can affect the state of Oklahoma. The agency maintains and exercises the State Emergency Operations Plan and the coordinates disaster response from state agencies.

The agency now also includes the Office of Homeland Security and the state 9-1-1 program. The Oklahoma Office of Homeland Security was founded in 2004 and placed under ODEMHS by Executive Order 2020-25 effective September 1, 2020.

The Department also procures and administers other funds for emergency management research and construction projects. ODEMHS provides professional assistance, and maintains liaison with all state agencies, various federal agencies, local governments, industry, and the general public in the event of a natural, technological, or man-made disaster. As the Grantee for FEMA, ODEMHS partners with FEMA to receive guidance and assistance in managing federal disasters, adhering to all regulations contained in the Stafford Act, as well as FEMA policies and guidelines. The ODEMHS director is the *Governor's Authorized Representative* empowered by the Governor of Oklahoma to execute all necessary documents for disaster assistance.

ODEMHS is more than 90 percent federally funded through federal grant programs for emergency management and disaster preparedness, response, recovery, and mitigation.

5.1.2 Oklahoma Department of Agriculture-Forestry Division

The Forestry Services Division of the Oklahoma Department of Agriculture, Food and Forestry serves the public, private landowners, forest industry, cities and towns, and other agencies and organizations through a wide variety of programs. These services include protection, management, improvement and use of Oklahoma's forests and natural resources and their associated benefits. Oklahoma has an estimated 7.5 to 10 million acres of forestland. Professional foresters provide assistance in all 77 counties, contribute to the economy, and improve the quality of life of all Oklahomans.

Forestry helps maintain forest health by minimizing damage from destructive wildfires, insects, and diseases and by helping improve the productivity of the state's forests. These services are provided through the Forestry Services Division:

- Rural Fire Defense Program
- Community Wildfire Preparedness Program
- Statewide Wildfire Control and Management
- Wildland firefighting training to Oklahoma's career and volunteer fire departments
- Develop and maintain criteria for Fire Weather Watches and Red Flag Warnings

- Provide wildfire mitigation information and technical advice to landowners and communities
- Forest Stewardship Program Utilization and Marketing advice to the forest industry
- Forestry education through the Forest Heritage Center and direct contact with schools, communities and civic groups
- Project Learning Tree programs
- Urban and Community Forestry Program
- Forest Water Quality Management Program
- Forest Regeneration and Forest Tree Improvement Centers

5.1.3 Oklahoma Climatological Survey

The Oklahoma Climatological Survey (http://www.climate.ok.gov) was established in 1980 to provide climatological services to the citizens of Oklahoma, conduct research on the impacts of climate on human activities, and serve as a support facility for the State Climatologist. OCS has a legislative mandate to acquire, process, and disseminate climate and weather data and information for use by the state's citizens. The Survey maintains an extensive array of climatological information; operates the Oklahoma Mesonet, the nation’s premier environmental monitoring network, and hosts a wide variety of educational outreach and scientific research projects. The OCS is a research unit of the College of Atmospheric and Geographic Sciences at the University of Oklahoma.

OCS historical information includes documenting tornado occurrences in the state, assessing the likelihood of severe weather, and documenting recent events that resulted in Federal disaster declarations in the state. Products on the OCS website include historical averages and extremes, available at a county or sub-county level, a weather timeline, and synthesized information for monitoring drought, heavy rainfall, and other weather hazards.

OCS also operates several outreach programs that provide training, products, and decision-support systems tailored to the needs of different groups. Groups served by OCS outreach programs include K-16 education, emergency management, wildfire manages, and agricultural producers. Additional information about these programs is on the OCS website under the Outreach tab.

A staff of climatologists at OCS is available to assist local decision-makers. OCS climatologists are adept at tailoring Oklahoma’s climate records to provide information that can improve decision-making, whether in real-time or longer-term risk analysis. Data archives allow staff to provide from the ‘big picture’ overview of Oklahoma climate to local historical probabilities and occurrences of significant weather events. OCS programs include the following:

- The Oklahoma Mesonet
  This is a statewide network of 120 automated weather stations, with at least one station located in each county in Oklahoma. The network was developed through the cooperation of Oklahoma State University and The University of Oklahoma and established in 1994. The Mesonet reports observations of temperature, rainfall, winds,

humidity, pressure, solar radiation, and soil temperature and moisture at 5-minute increments, around-the-clock. Mesonet data serve as the backbone of several public-safety oriented products provided by OCS.

- OK-First Program
  OK-First serves Oklahoma's emergency management and public safety communities, including meeting many of the requirements for the National Weather Service's *Storm Ready* community certification. Participants attend workshops where they learn how to access and interpret radar and other weather data sources, improve coordination of storm spotter activities with state and federal officials, and interact with colleagues and mentors from the state's meteorology community. Refresher workshops are offered every 18 months to provide the latest technology and weather information.

- Southern Climate Impacts Planning Program (SCIPP)
  The Southern Climate Impacts Planning Program (http://www.southernclimate.org) is a climate hazards preparedness program focused on the South-Central United States, which aims to bridge the gap between climate science and local and state hazard planning processes. Focusing on the six-state region of Oklahoma, Texas, Louisiana, Arkansas, Tennessee, and Mississippi, SCIPP investigates major climate hazards of the region and actively engages community-level decision makers to determine hazard planning and climate data gaps; collaboratively develop assessment and decision support tools; and provide education and outreach. Major climate hazards of interest of SCIPP include droughts, floods, hurricanes, and severe storms.

5.1.4 U.S. Army Corps of Engineers, Tulsa District

The United States Army Corps of Engineers (USACE) has authority under Public Law 84-99 to assist public agencies in responding to flood emergencies. Assistance can be in the form of technical assistance, direct assistance, or rehabilitation of federal and certain non-federal flood control works, damaged or destroyed by floods. The USACE develops and implements flood control plans, and has authority for emergency operations, stream bank protection, permit administration, and technical assistance. In Oklahoma, activities of the USACE include:

- Feasibility Studies and Projects
- Continuing Authorities to implement certain types of water resource projects without specific Congressional authority.
- Emergency Operations to respond to flood emergencies.
- Permit Authority to issue Section 10 permits to cover construction, excavation, and other related work in or over navigable waterways; and Section 404 permits covering the discharge of dredged or fill material in all waters of the United States, to include adjacent wetlands.
- Disaster Response to coordinate with and support all FEMA response activities. Following the 1995 bombing of the Murrah Building, the USACE established a Disaster Field Office in Oklahoma City to coordinate public works and engineering in accordance with the Federal Response Plan.

- Flood Control for controlling floodwater releases from all USACE lakes.
- Dam Safety to include mandatory annual training for personnel on dam safety, and all dams are inspected every four years for safety standards and the integrity of the dams.
- Silver Jackets is an interagency team that facilitate collaborative solutions to state flood risk priorities.

5.1.5 Oklahoma Department of Commerce

The Oklahoma Department of Commerce is the primary economic development arm of the State of Oklahoma. The Department's goals are to stimulate the creation, expansion, and retention of jobs and growth of investment in all parts of Oklahoma. The Department's Community Development Programs provide grants and loans in cases of hazard mitigation as they relate to wastewater treatment facilities, drainage, and other infrastructure needs, primarily in rural areas.

5.1.6 Oklahoma Conservation Commission

The Oklahoma Conservation Commission's (OCC) mission is to conserve, protect and restore Oklahoma's natural resources, working in collaboration with the conservation districts and other partners, on behalf of the citizens of Oklahoma. OCC provides assistance to Oklahoma's 84 conservation districts and the public to foster a sense of stewardship and conservation management of Oklahoma's renewable natural resources. OCC's divisions and areas of responsibility include:

- District Services Division, which serves as a liaison between the Oklahoma Conservation Commission and the state's conservation districts.
- Conservation Programs Division, which provide Oklahoma's 84 conservation districts with the resources and assistance they need to protect our state's soil and water. This division oversees four areas: Flood Control Program, Locally Led Cost Share Program, Flood Control Rehabilitation, and Small Watershed Upstream Flood Control.
- Water Quality Division which is responsible for protecting the state's waters from nonpoint source pollution, which is pollution that comes from land management practices.
- Land Management Division, which is dedicated to assisting landowners across Oklahoma with resource concerns that have an impact on our state's soil, water, and safety.
- Office of Geographic Information and Technical Services Division, which is responsible for housing the State Office of Geographic Information and the State GIS Coordinator as well as maintaining Oklahoma Conservation Commission's geographic information systems (GIS) operations and database.

5.1.7 Oklahoma Corporation Commission

The Oklahoma Corporation Commission (OCC) was established in 1907 by the Oklahoma Constitution. The OCC has regulatory authority over aspects of oil and natural gas exploration and production activities, including seismic activity linked to oil and gas activity, trucking, fueling facilities, electric and natural gas utilities, railroads, interstate pipelines, towing companies, telephone companies, passenger carriers, and transportation network providers (e.g., Uber, Lyft).

The OCC supports the State's hazard mitigation by and enforcing all state and federal regulations and developing rules regarding oil and gas exploration and production, transportation, storage, and disposal of crude, natural gas, refined petroleum products and oil and gas waste. The Commission has judicial, legislative, and administrative authority to carry out its mission.

5.1.8 Oklahoma Department of Environmental Quality

The Oklahoma Environmental Quality Act, passed in 1992, provides the regulatory framework to ensure the environmental regulatory concerns of industry and the public are addressed in an expedient manner, improve the way citizen complaints are tracked and resolved, better utilize state financial resources for environmental regulatory services, and coordinate environmental activities of state environmental agencies.

The Oklahoma Department of Environmental Quality (DEQ) was created to meet those legislative requirements within its jurisdictional area of environmental responsibility. As outlined, DEQ has jurisdictional responsibility for the following:

- Point Source and non-Point-Source discharges of pollutants;
- Storm water discharge from all facilities, except those where specific authority has been designated to either the Department of Agriculture or the Oklahoma Corporation Commission;
- Surface and groundwater water quality standards;
- Sole environmental jurisdiction to regulate air emissions from all facilities and sources subject to requirements of Title V of the Federal Clean Air Act;
- Superfund responsibilities of the state under CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) and amendments thereto;
- Radioactive waste and all regulatory activities for the use of atomic energy, except for diagnostic x ray facilities; public and private water, and wastewater supply or treatment systems;
- Solid waste and hazardous substances; environmental regulation of any entity or activity;
- Prevention, control, and abatement of any pollution, not subject to the specific statutory authority of another state environmental agency.

5.1.9 Oklahoma Geological Survey

The Oklahoma Geological Survey (OGS) is chartered in the State's constitution with the mission of investigating the land, water, mineral, and energy resources of the State, and disseminating the results of those investigations to promote the wise use of Oklahoma's natural resources consistent with sound environmental practices. Programs at the OGS involve fossil fuels, earth science education, geologic mapping, industrial minerals, and earthquakes.

The OGS conducts geologic mapping of the State, including identifying potential hazards such as landslides, rock falls, and sinkholes. The OGS provides data for the mineral mining industry in Oklahoma, which was 30th in the nation in total non-fuel mineral production value in 2021, accounting for 1% of the U.S. total. The OGS monitors seismicity in Oklahoma using a network of seismometers located throughout the state. This effort began with the Leonard Geophysical Observatory in the 1970s and continues to this day in Norman, OK. Originally comprised of only a few seismic stations, the OGS seismic network has evolved rapidly in the last decade to encompass 100+ seismometers that deliver real-time data to the central data hub in Norman. Analysts in Norman process the seismic data and deliver updated earthquake locations, magnitudes, and other scientific data that are freely available through the OGS website (http://ogs.ou.edu/).

5.1.10 Oklahoma Department of Human Services

To promote the general welfare of the people of the State of Oklahoma, DHS can provide temporary assistance to victims of disasters and emergencies. When a major or lesser disaster is declared in Oklahoma, DHS notifies its Family Support Services Division (FSSD) staff in the declared counties. At that time the FSSD readies its SNAP (Supplemental Nutrition Assistance Program) staff to expedite issuance of food vouchers. Other assistance may be in the form of providing bulk food and diapers to public shelters. DHS is also involved in disaster planning with area aging services to make sure elderly populations are adequately provided for in emergency situations.

5.1.11 Oklahoma Department of Health

The State Department of Health has statutory responsibility for the public health of the people of Oklahoma (63 OS §1- 101). Special Health Services is responsible for food protection service and occupational licensing. Public health and medical systems were identified as critical infrastructure and vital support functions in the event of disasters and emergencies. In 2002, the Oklahoma State Department of Health formed the Bioterrorism Preparedness Division, which later evolved to the Emergency Preparedness and Response Service, to address the public health and medical implications of a large-scale disaster affecting the state’s population.

5.1.12 Oklahoma Insurance Department

The elective office of State Insurance Commissioner oversees the approval of the organization of domestic insurance companies of every authorized type, approval of all applications by foreign and alien insurers seeking admission into the State of Oklahoma for the purpose of transacting any insurance business, and approval of certain life, accident, and health insurance policy forms before such contract can be lawfully offered for sale within the State. The State insurance Commissioner provides counsel to the State Hazard Mitigation Team regarding insurance issues as such pertains to acquisition of repetitive loss properties.

5.1.13 Oklahoma Department of Transportation

The Oklahoma State Department of Transportation (ODOT), operating under rules, regulations and policies prescribed by the State Transportation Commission, is charged with the planning, construction, operation, maintenance, and coordination of designated multi-modal transportation systems designed to meet present and future transportation needs of the State. ODOT also provides professional assistance to ODEMHS and FEMA regarding repair and replacement of disaster-damaged infrastructure.

5.1.14 Oklahoma Water Resources Board

The Oklahoma Water Resources Board (OWRB) is assigned the statutory responsibility of coordinating the National Flood Insurance Program Statewide, regulating dam safety, administering the water laws of the State, and planning and developing water resources to ensure water supplies are adequate to fulfill the present and future needs of Oklahoma. The OWRB currently coordinates with various local, State, and Federal agencies regarding NFIP activities. OWRB divisions and programs include:

- Floodplain Management Program - Responds to Oklahoma's frequent flooding incidents by coordinating with other State and Federal agencies and local governments to mitigate the catastrophic effects of these natural disasters. Members of the Division, as well as OWRB Field Office personnel, routinely serve on the State Hazard Mitigation Team.
- National Flood Insurance Program - Mitigates flood disasters through flood damage prevention and the control of development in designated hazard areas. Eligible communities must establish a floodplain board and recognize floodplain boundaries and regulate development in those areas. Division staff provides guidance to communities in adopting these measures and visits with community.
- Dam Safety Program - An integral part of the Board's role in hazard mitigation relative to ensuring the safety of more than 4,700 non-federal dams 25 feet or more in height and/or impounding 50 acre-feet or more of water. Program staff maintains a current inventory of these dams. To check on the safety of these dams, the agency requires and/or conducts regular inspections to verify dam maintenance and integrity. If problems are discovered, the OWRB requires the dam owner or operator to make timely repairs. Agency staff coordinates dam inspection training seminars

to ensure that interested private engineers are qualified to conduct professional examinations of nonfederal dams in the State.

- The Financial Assistance Division - Administers loan and grant programs especially for the financing and implementation of sewer and water facilities. The Division makes long-term, low interest loans backed by the Statewide Water Development Revolving Fund. They also provide loans through the safeguarding tomorrow revolving loan fund (STORM Act) while ODEMHS runs the programmatic side of the program. It also makes emergency grants to smaller communities facing infrastructure crises that could threaten life, health, or property.

5.1.15 Oklahoma Department of Wildlife Conservation

The mission of the Oklahoma Department of Wildlife Conservation (ODWC) is the management, protection, and enhancement of wildlife resources and habitat for the scientific, educational, recreational, aesthetic, and economic benefits to present and future generations of citizens and visitors to Oklahoma. ODWC does not receive general state tax appropriations. License sales and federal Wildlife and Sportfish Restoration Program grant revenues are the main funding sources. Every license dollar spent by sportsmen in Oklahoma is used to fund ODWC's user pay/public benefit conservation efforts. The Oklahoma Department of Wildlife Conservation (ODWC) with its 350 employees are responsible for managing Oklahoma's fish and wildlife resources and habitat.

5.1.16 State Historic Preservation Office

The State Historic Preservation Office (SHPO) is a division of the Oklahoma Historical Society, a State agency. The SHPO is responsible for administering the Federal historic preservation programs in Oklahoma. The National Historic Preservation Act (NHPA) established these programs and provides the framework for the preservation of the nation's heritage. Section 106 of the NHPA requires that Federal agencies or their designees must consider the effect of their undertakings on archeological and historic resources listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation (Council), a Federal agency, has established the regulations (36 CFR Part 800) that govern the Section 106 process and provides guidance to Federal agencies and the SHPO.

During disaster recovery efforts, SHPO is an invaluable advisor to FEMA in ensuring that repairs and reconstruction meet all NHPA regulations. Archeological sites, buildings, districts, objects, structures, landscapes, and Traditional Cultural Properties must be identified and evaluated prior to any federally funded undertakings. The purpose of the Section 106 consultation is to find ways to avoid, minimize, or mitigate any adverse effects on these historic properties. To streamline the Section 106 review process, FEMA, SHPO and the Oklahoma Archeological Survey (OAS) entered into a programmatic agreement (PA) in 2015 in order to more effectively and efficiently conduct the review of FEMA undertakings. However, if an undertaking does not qualify as a programmatic allowance under Appendix B of the PA and if an adverse effect finding is made and cannot be avoided or minimized, the Memorandum of Agreement (MOA) will set forth the mitigation plan (such as documentation of a building or structure that must be demolished, excavation of an archeological site that will be destroyed, etc.).

5.1.17 Oklahoma Floodplain Managers Association

The Oklahoma Floodplain Management Association (OFMA) was officially organized in November 1990 with the intent of bringing together those individuals who have a common interest in floodplain management. In the first year of its existence, membership more than tripled. In September 1999 the name was changed to Oklahoma Floodplain Managers Association. The OFMA objectives are to:

- Promote interest in flood damage abatement;
- Improve cooperation among various related local, state and federal agencies;
- Encourage innovative approaches to managing the nation's floodplain OFMA issues a quarterly newsletter to broaden public awareness of Oklahoma's flood hazards. They also provide training to elected officials, floodplain managers, surveyors, engineers, lenders, and real estate agents and promote a Certified Floodplain Manager (CFM) program. OFMA holds an annual conference with guest speakers who discuss pertinent floodplain management issues. Interacting with other members provides opportunities for exchanging ideas and networking among agencies and companies to build cooperation. The association brings together those individuals who are experiencing similar problems with those who may have solutions. OFMA is a non-profit organization and has the ability to communicate a uniform position on current concerns, rule changes, local programs and other issues impacting floodplain management.

5.1.18 Oklahoma Municipal League

The Oklahoma Municipal League is non-profit organization that serves as the source for information, training, and resources on effective local government for member organizations. The League is recognized as the respected voice of Oklahoma municipal governments in interactions at both the state and national levels. The League provides services and programs to its members to assist them in better serving their citizens and communities and acts as a clearinghouse to offer services which individual cities and towns do not have the time, money, or expertise to provide alone. The League provides guidance to existing and newly elected mayors, and city managers and their staff through workshops, an inquiry assistance service, a weekly newsletter, and legislative bulletins. Additionally, every newly elected municipal official in the State participates in the Leagues New Official's Institute. The League provides an Emergency Response Program whereby the League facilitates training for municipal officials and staff in collaboration with Oklahoma Emergency Management.

5.1.19 Association of County Commissioners of Oklahoma

In Oklahoma, each county has three districts, and each district has one commissioner. These county commissioners exercise the administrative powers given to them by the Oklahoma Statutes and the Oklahoma Constitution. Made up of the commissioners from the 77 counties in Oklahoma, ACCO is a non-profit association that provides orientation training and assistance to assist the commissioners in conducting their duties. ACCO's staff provides workshops, written study materials, technical support, and legal advice.

5.1.20 Oklahoma Cooperative Extension Service (OCES)

Educational materials are provided through state universities to farmers, ranchers, and others on what they can do to protect themselves and their property against hazards associated with disasters. This may also include technical advice on cleanup of damaged property; sanitation precautions; insect control; food preparation in an emergency; recovery actions on damaged farms; and renovation of damaged equipment and property.

5.1.21 Oklahoma Emergency Management Association

Oklahoma Emergency Management Association (OEMA) is a non-profit association whose goal is to assist local, state, tribal and federal agencies in the establishment and maintenance of effective emergency management organizations. Through research, legislative review, information exchange and education programs, OEMA strives to advance the professional standards of persons engaged in these activities.

Local emergency managers coordinate and direct the planning, organization, control, and implementation of local emergency management activities. Such activities may include the development of a severe storm spotter network designed to provide advanced/early warning of impending severe weather threats to the community. Oklahoma local emergency managers manage, operate, and maintain Emergency Operations Centers, and coordinate, develop and implement the Emergency Operations Plan (EOP) for their jurisdiction and update it annually. They coordinate with community officials and with ODEMHS as necessary to ensure the effective administration of the emergency management program. They prepare and distribute disaster preparedness material to the citizens of their jurisdiction, with the intent of offering an appropriate means of educating the community as to how they may prepare for and protect themselves from the consequences of potentially dangerous disasters.

5.2 How the State Supports Jurisdictions in HM Efforts

5.2.1 Development of the Oklahoma State Hazard Mitigation Plan

The State Hazard Mitigation Plan is a helpful tool to jurisdictions as they identify and analyze their community risks and vulnerabilities to natural hazards. The state plan serves as an informational resource and guide. The State Hazard Mitigation Plan identifies

Oklahoma's hazards, risks, vulnerabilities, goals, objectives, priorities, and strategies to enable effective mitigation planning.

This plan is developed by the Hazard Mitigation Plans Office, Oklahoma Department of Emergency Management and Homeland Security (ODEMHS), in partnership with a variety of state agencies and community stakeholders. This partnership of organizations provided valuable data for this plan, as well as the planning and execution of many current and future HM projects throughout the State. This partner relationship is codified and exercised through the State Hazard Mitigation Team (SHMT). The SHMT was established by state law in 1999, (63 O.S. §683.6). It receives no direct funding support and is under the coordination of the State Hazard Mitigation Officer.

The State Hazard Mitigation Team is a consortium of Oklahoma government agencies formed to plan and prioritize state mitigation activities. The team meets about four times a year to update the current plan for Oklahoma. Additionally, agencies can coordinate their activities with other team members. According to the 2021 Oklahoma Statute, §63-683.6, the SMHT is composed of the following agencies:

- Oklahoma Department of Emergency Management, Team Coordinator
- Oklahoma Water Resources Board
- Oklahoma Climatological Survey
- Oklahoma Conservation Commission
- Oklahoma Corporation Commission
- Oklahoma Department of Commerce
- Department of Environmental Quality
- Department of Human Services
- State Department of Health
- Department of Transportation
- Oklahoma Department of Agriculture, Food, and Forestry or the Secretary of Agriculture
- Department of Wildlife Conservation
- Oklahoma Historical Society
- Oklahoma Insurance Department
- Association of County Commissioners of Oklahoma
- Oklahoma Municipal League
- State Fire Marshal
- Department of Labor
- A local Emergency Management Director as determined by the President of the Oklahoma Emergency Management Association
- State Chancellor or his or her representative for The Oklahoma State System of Higher Education
- State Director or his or her representative for the Oklahoma Department of Career and Technology Education.
- The Team Coordinator Oklahoma (Department of Emergency Management) may request participation of the heads of any other state agencies as deemed appropriate.

- The Team Coordinator shall also request that a representative of the United States Army Corps of Engineers be appointed by the administrative head of the Tulsa District to participate on the Team.
- The Team Coordinator shall also request a representative of the U.S. Department of Housing and Urban Development be appointed by the administrative head of the Oklahoma City office to participate on the team.

5.2.2 Development of Jurisdictional Hazard Mitigation Plans

The ODEMHS Hazard Mitigation Plans Office provides a variety of mechanisms to help jurisdictions develop their own Hazard Mitigation Plans.

Training
The State offers a several different options when it comes to training local emergency managers on their hazard mitigation plans. ODEMHS provides active notification to jurisdictions on upcoming FEMA 318 class (Mitigation Planning for Local and Tribal Communities) opportunities on how to write their hazard mitigation plan. Additional training opportunities such as the FEMA L-276 BCA Fundamentals course are conducted periodically. ODEMHS routinely encourages local jurisdictions to attend FEMA EMI training courses and opportunities such as the Hazard Mitigation Assistance Workshop. New Emergency Managers are required to attend the ODEMHS New Emergency Manager Orientation within 1 year of their appointment, which has a mitigation component. The training includes an overview of mitigation focusing on the planning process and the benefits of having a mitigation plan, as well as a quick overview of HM projects, including the ODEMHS Notice of Intent process.

Technical Assistance and Guidance Education
ODEMHS is very active in engaging local emergency managers in providing technical assistance on plan guidance and requirements and offers in-person or remote options. This assistance ranges from broad overviews of the hazard mitigation planning process as a whole, or very detailed guidance on how to draft/edit jurisdictional plans. ODEMHS has the capability to schedule area technical visits where several counties can come together, or the Hazard Mitigation Plans Office staff can schedule one on one time with local emergency managers that need assistance with their plan.

Plan Funding
ODEMHS's ability to provide financial assistance is entirely dependent on the availability of post-disaster funding from FEMA. When the President declares a disaster for the State of Oklahoma and FEMA determines the cost of the disaster, additional funding is provided to the State exclusively for HM efforts. This is referred to as HMGP, or "404 funding," as provided under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Approval of the State's 2023 Hazard Mitigation Update will continue Oklahoma's eligibility for FEMA disaster assistance and HMGP funding for State agencies, but it does not substitute for the requirement of local governments to have a FEMA-approved plan to be eligible for local hazard mitigation grants. Local jurisdictions are free to use any funding available to them for this purpose. Local

jurisdictions with limited resources are encouraged to consider joining with a larger or even several jurisdictions in the development or update of a multi-jurisdictional plan.
The State of Oklahoma has 77 counties. As of April 2023, the State has 67 local plans approved, which includes 44 county plans, 16 city plans, 1 town plan, 2 school district only plans, and 4 tribal plans.

5.2.3 Barriers to Development of Jurisdictional Hazard Mitigation Plans

Overall, ODEMHS has made significant improvements in the number, and product quality, of jurisdictional hazard plans since 2019. However, there are some continued barriers to the effective development of jurisdictional hazard mitigation plans, and opportunities for improvement:

- Barrier: Many jurisdictions lack the understanding on how to integrate mitigation measures into other local plans and initiatives. Also, local coordination with individual communities is sometimes lacking once a plan is approved, thus missing opportunities to move mitigation actions forward.

  Solution: ODEMHS will establish procedures to provide continuing education on this topic.

- Barrier: ODEMHS does not have established procedure for reaching out to jurisdictions before their plan has expired. ODEMHS often does this informally, but not consistently.

  Solution: Establish procedures on relevant jurisdictional contact at 18 mos., 12 mos., and 6 mos. prior to plan expiration.

- Barrier: There is a continued need for jurisdictional advisement before planners apply for a planning grant and/or begin the planning process. Some jurisdictions need additional education on their roles and responsibilities to the planning process when they utilize a contract planner, and some jurisdictions lack an understanding of the level of specificity of information that is obtained during the planning process. Sometimes the ODEMHS HM Plans Office's first contact with a planning jurisdiction is when their plan is submitted for review and the planning process is over. This sometimes results in plans that need extensive edits before they are ready for FEMA submittal.

  Solution: ODEMHS could improve this process by establishing procedures for proactively reaching out to jurisdictions before the planning process begins, contacting the jurisdiction during the plan writing phase, and providing information to jurisdiction who might be having difficulty with contract planners. In addition, ODEMHS could also establish continuing education procedures to provide information on a rotating lists of individual plan requirements, which can be distributed out via monthly email to emergency managers and planners.

- Barrier: There is a continued, but getting rarer, issue with jurisdictions who receive inferior plan products from contractors. In addition, some plans are submitted close to the grant expiration date, which leaves little time for editing. This puts a strain on the jurisdiction and ODEMHS as they work to ensure the plan meets FEMA requirements in a timely fashion.

  Solution: ODEMHS should identify planning process grant timeline milestones, and advocate more for the jurisdictions when they encounter a contractor who does not abide by these milestones. They should also counsel jurisdictions on effective grant management procedures, so jurisdictions are better able to oversee their plan project.

5.3 State Laws, Regulations, Policies, and Programs that Improve Hazard Mitigation Resilience

Emergency Management Act of 2003, Statute Title 63 § 683:
The purpose of the Oklahoma Emergency Management Act of 2003 is to ensure that all emergency management and hazard mitigation functions of this state be coordinated to the maximum extent with the comparable functions of the federal government. This includes the various departments and agencies of other states and localities, and the private agencies of every type, so the most effective preparation and use of all agencies can result in well-coordinated disaster and hazard mitigation.

The Oklahoma Floodplain Management Act, Statute Title 82 §1601-1618:
This act was passed by the State Legislature in 1980 and revised several times. In approving the Act, the Legislature recognized the need for a united effort between local and state government to combat recurrent flood damages. The Act establishes a state and local partnership to reduce flood damages through sound floodplain management. It authorizes communities (i.e., cities, towns, and counties) to develop floodplain regulations, designate flood hazard areas, and establish floodplain boards. An amendment in 2004 called for community floodplain administrators to become accredited through the Oklahoma Water Resource Board (OWRB), ensuring that officials are properly trained to effectively administer local floodplain regulations.

State accreditation requirements for Floodplain Administrators can be found in this statute:
§82-1620.1. Accreditation standards for floodplain administrators. This Oklahoma statute defines accreditation standards and considerations for floodplain administrators.

Oklahoma Corporation Commission Regional Directives:
Beginning in 2009, Oklahoma experienced a surge in seismicity. It is estimated that some earthquakes have been induced by oil and gas related process, and few were induced by fracking. As a result of this increase, the OK Corporation Commission continues to issue directives to curb the frequency of earthquakes in Oklahoma. Directives issued from 2015-2022:

March 25, 2015 - Directive for 347 wells in the Arbuckle to check depth. Operators must prove that the disposal interval is not in communication with basement rock, or a plug-back operation must be completed to raise the bottom of the well at least 100 feet or more above the base of the Arbuckle group.

July 17, 2015 - Directive for 211 disposal wells in the Arbuckle to check depth. Operators must prove that the disposal interval is not in communication with basement rock, or a plug-back operation must be completed to raise the bottom of the well at least 100 feet or more above the base of the Arbuckle group.

Note: The July 17 and March 25 directives have resulted in 227 wells plugging back (i.e., reducing depth). An additional 44 wells have terminated their UIC authorization to inject or have re-completed to a different disposal interval above the Arbuckle Group.

February 16, 2016 Oklahoma Western Reduction Area. Directive to reduce volumes in an area that includes portions of northern, northwestern, and central Oklahoma. Affected wells were in the following counties: Alfalfa, Canadian, Cleveland, Kay, Kingfisher, Garfield, Grant, Major, Oklahoma, Woods, and Woodward.

March 7, 2016 - Oklahoma Central Reduction Area. Directive to reduce volumes in an area that includes portions of northcentral, central, and east-central Oklahoma. Affected wells were located in the following counties: Creek, Garfield, Kay, Lincoln, Logan, Noble, Oklahoma, Pawnee, and Payne.

February 24th, 2017 - AOI Volume Cap Directive. All active Arbuckle disposal wells within the AOI for induced seismicity will have allotments equal to their last 30 volume averages which contribute to operators' total allowable disposal volumes within the AOI.

October 2, 2018 - Four county expansion of reporting requirements for Arbuckle UIC wells. Directive expanded reporting area for daily Arbuckle volume reports to Oil and Gas Conservation District (OGCD). 107 Wells added to reporting.

February 9, 2021 - Covington, OK: February 9th, 2021 - 4.2 Mw earthquake; 5 wells with-in 0-3 miles of epicenter shut-in by Directive, and 11 wells within 3-10 miles reduced by 50% by March 10th, 2021.

February 19, 2021 - Manchester, OK: February 19th, 2021 - 4.2 Mw earthquake; 5 wells with-in 0-3 miles of epicenter shut-in by Directive, and 16 wells within 3-10 miles reduced by 50% by March 22nd, 2021.

January 31, 2022 – Seven wells within 0-6 miles of Clyde, OK epicenter shut-in by Directive, and five wells within 6-10 miles reduced by 50% by February 28th, 2022.

Wildfire: 2021 International Wildland-Urban Interface Code (IWUIC).
This code contains provisions addressing fire spread, accessibility, defensible space, water supply and more for buildings constructed near wildland areas. This code is adopted by jurisdictions, not the state.

The 2021 IWUIC does the following:
- Establishes regulations to safeguard life and property from the intrusion of wildland fire and to prevent structure fires from spreading to wildland fuels.
- Regulates defensible spaces and provides ignition-resistant construction requirements to protect against fire exposure and resist ignition by burning embers.
- Provides standards for emergency access, water supply, and fire protection.
- Provides requirements for automatic fire suppression and safe storage practices.
- Is fully compatible with all of ICC's International Codes.
- Is founded on data collected from tests and fire incidents, technical reports, and mitigation strategies from around the world.

State Plans and Programs

Plan/Program	Description	Applicability	Effectiveness
Emergency Operation Plan (EOP)	State Statute (OS 63 § 683.2) requires the State to maintain and update a written Emergency Operations Plan (EOP) which assigns responsibilities and actions to be taken any time the State Emergency Operations Center (EOC) is activated. State Statute (OS 63 § 683.11) requires all incorporated jurisdictions to also have an EOP, or else enter into agreement with their county government to manage their emergencies.	Based on *the National Incident Management System* (NIMS), the State EOP clearly defines the roles of state departments, agencies, commissions, and volunteer organizations. Communities and counties are free to adapt the State EOC as a framework for local EOCs.	The State EOP has proven highly effective any time the EOC has been activated, including 36 Federally declared disasters, 7 state emergency declarations, and 39 Fire Management Assistance Grants. All EOPs are reviewed and revised annually. Community and county EOPs are based on *local* risk analyses.
State Hazard Mitigation Plan	DMA 2000 (Public Law 106- 200) encourages and rewards local and State pre- disaster planning and is intended to integrate State and local planning and implementation efforts.	Developing and maintaining a Hazard Mitigation Plan enables the State, and local jurisdictions to articulate specific mitigation needs, resulting in faster	As of April 2023, Oklahoma has 67 FEMA-approved local plans.

		allocation of funding for effective risk reduction.	
Continuity of Operations Plans (COOP)	State agencies and local governments should develop an emergency operating plan to be followed in the event of emergency situations, to ensure continued operation of the department or agency.	Due to Oklahoma's risks for extreme weather, it is vital that each state agency have a written plan to assure seamless delivery of services to the public.	State agency COOPS are routinely updated to reflect changes in technology that serve to increase agency capabilities.
Capital Improvements Plans (CIP)	CIPs identify where major public expenditures will be made over the next 5 to 10 years.	CIPs can secure hazard- prone areas for low-risk uses; identify roads or utilities that need strengthening, replacement, or realignment; and prescribe standards for the design and construction of new facilities.	CIPs allow more efficient use of public funds. During this update, there is increased interest statewide to include community tornado shelters and safe rooms in local CIPs.
StormReady Communities Program	This voluntary program, developed by the National Weather Service's Tulsa forecast office, provides clear- cut advice to communities regarding weather warnings.	In order to achieve *StormReady* status, a community must establish a 24-hour warning point and EOC; have more than one way to receive weather forecasts and warnings and to alert the public; create a system that monitors local weather conditions; promote the importance of public readiness; develop a formal hazardous weather plan to include the training of weather spotters and holding emergency exercises.	As of April 2023, Oklahoma had 32 counties, 57 communities, 11 universities, 1 Indian Nation, and 1 Commercial participants.

Firewise Communities Program	The Oklahoma Department of Agriculture, Food and Forestry, in cooperation with the USDA Forestry Service, provides cost share funds to communities for the purpose of reducing wildfire risks.	To be eligible for fire grants, applicants must first be *Firewise Community USA Certified*. The focus of the funding is to support new initiatives that would not occur without grant funds.	As of April 2023, there are 67 Firewise communities (active and archived status). There are also 56 developed Community Wildfire Protection Plans (CWPP) on file with the Oklahoma Department of Agriculture Food and Forestry; 51 Municipal/Fire Department, 2 Fire Protection Districts, 3 County, and 1 Tribal Nation.
Local Hazardous Materials Response Program (LEPC)	The *Oklahoma Emergency Response Act* (27A OS §4-2- 102) requires that each community have a local emergency planning committee for the purpose of developing plans to address hazardous material spills	Oklahoma is the crossroads of the nation's interstate transport industry. Every day, shipments of agricultural products, manufactured goods and bulk industrial materials share the roadways. Accidental release of hazmat cargo can have life- threatening results if not remediated properly. Local emergency planning committees comprised of volunteers such as emergency responders and industry representatives provide guidance for hazmat emergency planning and response to meet the requirements of these unfunded mandates.	All events involving accidental release of chemicals are called in to the National Response Center (NRC) where data is compiled, and results can be queried on- line. Additionally, the OK Department of Environmental Quality licenses all companies that perform clean-up of hazardous materials spills on State highways, and the OK Corporation Commission is alerted when incidents involve pipelines.
SoonerSafe Residential Safe Room Program	The *SoonerSafe - Safe Room Rebate Program* was developed in 2011 by ODEMHS to provide a rebate for purchase and installation of safe rooms	Homeowners may qualify for up to 75% of their installation costs not to exceed $2000 per safe room.	This program, initiated in 1999, has been renewed as federal funding becomes available.

	for Oklahoma homeowners. This State-administered program utilizes FEMA funds to rebate homeowners for installation of safe rooms built to FEMA- approved designs.		From the period of 2012-2022, over $9,700,000 in federal grant money has been allotted to the SoonerSafe Program, and there have been 4,659 Individual Saferoom grant applications approved.
Emergency Management Accreditation Program (EMAP)	EMAP, an independent, non- profit organization, offers a standard-based assessment and peer review accreditation process for government programs responsible for coordinating all aspects of disaster management, including hazard mitigation.	EMAP is currently the only accreditation process for emergency management programs.	Oklahoma Emergency Management was approved for EMAP certification in 2018. *Hazard Mitigation* is one of the 64 standards that were evaluated as part of the accreditation process.
404/406 Mitigation Programs	This State-administered program utilizes FEMA Public Assistance funds to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities.	The 404 funding, or Hazard Mitigation Grant Program funding, (HMGP) is used to provide protection to undamaged parts of a facility or to prevent or reduce damages caused by future disasters. The entire state - not just residentially declared counties - may qualify for 404 mitigation projects. The 406 grant, Public Assistance (PA), is managed by the State under funding provided for in the Stafford Act. The 406 mitigation funding provides discretionary authority to fund mitigation measures in	Due to Oklahoma's frequency of natural hazard occurrence, ODEMHS oversees the management of multiple 404/406 Mitigation Projects annually.

		conjunction with the repair of the disaster-damaged facilities, so is limited to declared counties and eligible damaged facilities.	
Oklahoma Comprehensive Water Plan (OCWP)	The Oklahoma Comprehensive Water Plan (OCWP) fulfills a state legislative mandate for the OWRB to provide a general analysis of water supply availability across the state with guidelines for meeting Oklahoma's future water supply needs.	The OCWP serves as an indispensable resource for water professionals, state and local officials, and many others to make long-range decisions regarding water planning and investment.	The Water Policy Recommendations section presents suggested measures to address Oklahoma's key water issues. This plan also includes information on Floodplain Management Issues and Recommendations.
OK-First Program	OK-First serves Oklahoma's emergency management and public safety communities, including meeting many of the requirements for the National Weather Service's *Storm Ready* community certification. Participation in OK-First is limited to Oklahoma agencies with jurisdictional responsibility and authority in maintaining public safety.	OK-First classes cover a variety of meteorological topics including basic meteorology, radar, National Weather Service products, severe thunderstorms, lightning, flash flooding, fire weather, and winter weather. Through a mix of presentations and hands-on lab exercises, participants learn how to properly interpret weather information and get experience with the tools for viewing that information.	Members of the program are provided with password-protected access to innovative data visualization tools built and maintained by Oklahoma Mesonet staff, including an interactive weather data website and interactive radar software.
Southern Climate Impacts Planning Program (SCIPP)	SCIPP is a collaborative research effort between the Oklahoma Climatological Survey at the University of Oklahoma and the Department of Anthropology and Geography/Southern	Focusing on the six-state region of Oklahoma, Texas, Louisiana, Arkansas, Tennessee, and Mississippi, SCIPP investigates major climate hazards of the region and actively engages community-	Since 2008, SCIPP has been dedicated to helping communities navigate their unique weather and climate risks and challenges.

	Regional Climate Center at Louisiana State University. SCIPP (http://www.southernclimate.org) is a climate hazards preparedness program focused on the South Central United States, which aims to bridge the gap between climate science and local and state hazard planning processes.	level decision makers to determine hazard planning and climate data gaps; collaboratively develop assessment and decision support tools; and provide education and outreach.	
Oklahoma Silver Jackets Team	Support comprehensive and sustainable actions that reduce risks from flooding and other hazards to provide risk reduction benefits through greater protection of life and property. This state-led team works in partnership with the USACE.	The team's goals are to: - Provide technical assistance to reduce vulnerability and consequences of flooding and other hazards. - Collaborate with key partners to develop risk reduction strategies. - Jointly develop risk assessments and other hazards risk identification for impacted communities. - Complete educational opportunities such as exercises, workshops, training course, and classes. - Support engagement with all partners and stakeholders to communicate risk of hazards.	Team activities: - Eastern Shawnee Tribe Flash Flood Study - Choctaw Tribe Infrastructure Assessment Miami Oklahoma Flooding Assessment Community Resilience Project - Lake Tenkiller Community Resilience Project Broken Bow Catastrophic Flood Resilience and Response Exercise Oklahoma City Oklahoma Catastrophic Flood Resilience and Response Exercise Wichita Levee, Wichita KS.
Flood Control Program	An Oklahoma Conservation Commission program dedicated to protecting Oklahoma's upstream flood control dams and reducing flooding our Flood Control	The Flood Control Program's primary strategy is to build small flood control dams on tributaries upstream from rivers or large streams. The	Altogether, the flood control dams provide the following benefits: • Protecting 2,756 county and highway bridges

	Programs assist conservation districts with the construction of upstream dams, as well as the operation and maintenance of existing dams. With 2,107 flood control dams in 61 counties, Oklahoma leads the nation in protecting citizens and property from the devastation of floods.	series of dams in a watershed help trap runoff water during heavy rainstorms, which can then be slowly released over time through a pipe in the dam. In this way, the dams prevent excess water from reaching the river all at once, reducing flooding.	• Providing a reduction in flooding for 41,744 farms and ranches • Trapping 19 million tons of sediment each year, which would otherwise end up in major streams and lakes • Creating or enhancing 90,979 acres of wetlands.
Locally-Led Cost Share Program	An Oklahoma Conservation Commission program, authorized by the Oklahoma Legislature in 1998, the Oklahoma Cost-Share Program allocates funds to conservation districts to help landowners implement conservation practices on their land to reduce soil erosion and improve water quality.	The program allocates funds to conservation districts based on appropriations from the Oklahoma Legislature. The conservation districts then administer the program to meet their local needs by selecting conservation practices to offer to landowners, establishing cost-share rates, overseeing the landowner application process and assisting the landowners throughout their involvement with the program.	Only practices that have been approved by the Conservation Commission and placed on the state list and offered by the conservation district list are available for cost-share assistance. Examples of conservation practices that may be available include: - Brush Management - Water Wells, - Pipelines - Grass planting - Cover Crop - Pond - Herbaceous weed control
Great Central U.S. Shakeout	Although regional/ federal program, Oklahoma is an active participant. The Great Central U.S. ShakeOut is a multi-state drill spanning much of the central United States.	The purpose of the ShakeOut is to help people and organizations better prepared for Earthquake response, so they in turn can mitigate the vulnerabilities and risks of these events.	ODEMHS facilitates Oklahoma's participation in this program. Participants by year: 2017: 84,980 2018: 74,609 2019: 81,227 2020: 38,492 2021: 36,495 2022: 55,603

5.4 State Laws, Regulations, Policies, and Programs that Impede Hazard Mitigation Resilience

Drought and Wildfire:
In 2018, Oklahoma voters authorized the state's medical marijuana program with State Question 788. This created Oklahoma Medical Marijuana Authority (OMMA) and the state laws that started the industry. Title 63 Public Health and Safety, Chapter 15 Narcotic Drugs, Section 422, item D (Commercial Grower License) states the following:
D. There shall be no limits on how much marijuana a licensed commercial grower can grow.
https://www.oscn.net/applications/oscn/DeliverDocument.asp?CiteID=483201

Having the ability for unlimited medical Marijuana grow has resulted in significant number of Marijuana-related businesses across Oklahoma. According to OMMA data as of March 2023, the state of Oklahoma has:

- 6,782 Marijuana grow farms across the state.
- 1,817 Marijuana processors
- 2,883 Dispensaries
- 11 Waste Disposal Facilities

Marijuana is a plant that requires more water than typical commodity crops, which can exacerbate and deplete water usage during times of drought. Drought is a natural hazard that routinely affects all jurisdictions across the state. In addition, communities residing near outdoor Marijuana grow farms are at increased risk for a Hazardous Materials (HAZMAT) event, should a wildfire occur. This a particular concern for any nearby residential areas.

Climatological Impact
Another method for farming Marijuana is to grow it in indoor settings. However, these operations produce greater carbon emissions, and require a substantial amount of energy. This can have a negative environmental impact and a strain on community energy resources with a high number of growers in their area. This issue requires further study to determine the long-range climate impact.

The following link outlines ongoing legislative efforts that pertain to medical Marijuana grow laws, and the maps below show the quantity of facilities related to medical marijuana businesses, current as of April 2023:

Source: https://oklahoma.gov/omma/rules-and-legislation/legislative-updates.html

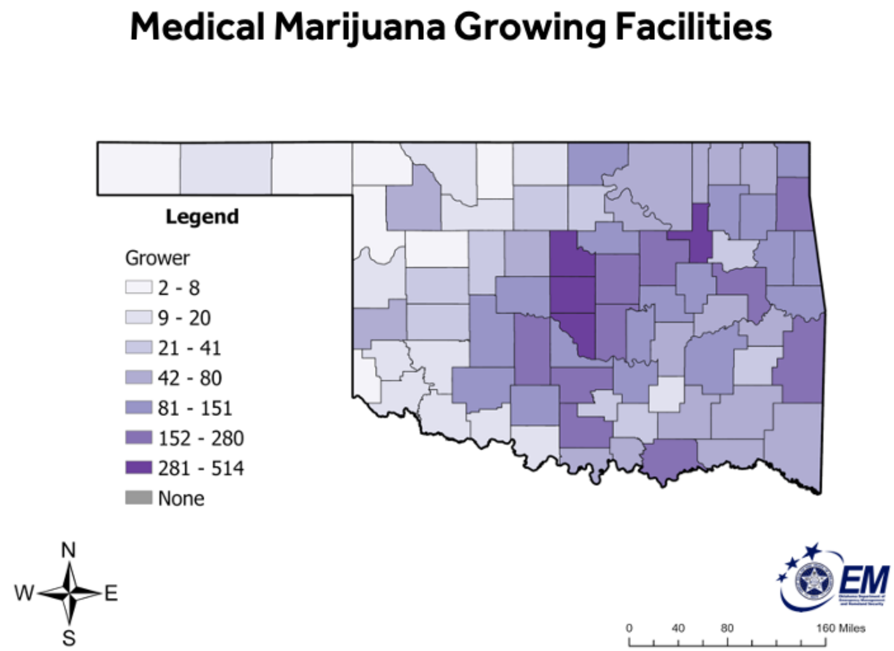


Figure 1: Medical Marijuana Growing Facilities in Oklahoma. Source: ODEMHS.

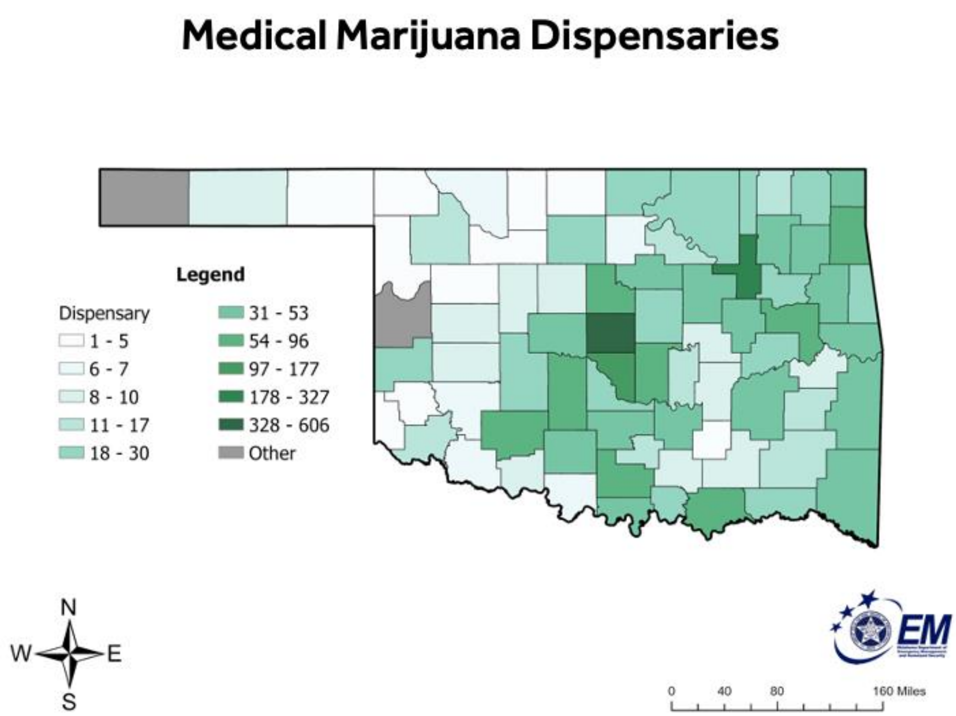


Figure 2: Medical Marijuana Dispensaries in Oklahoma. Source: ODEMHS.

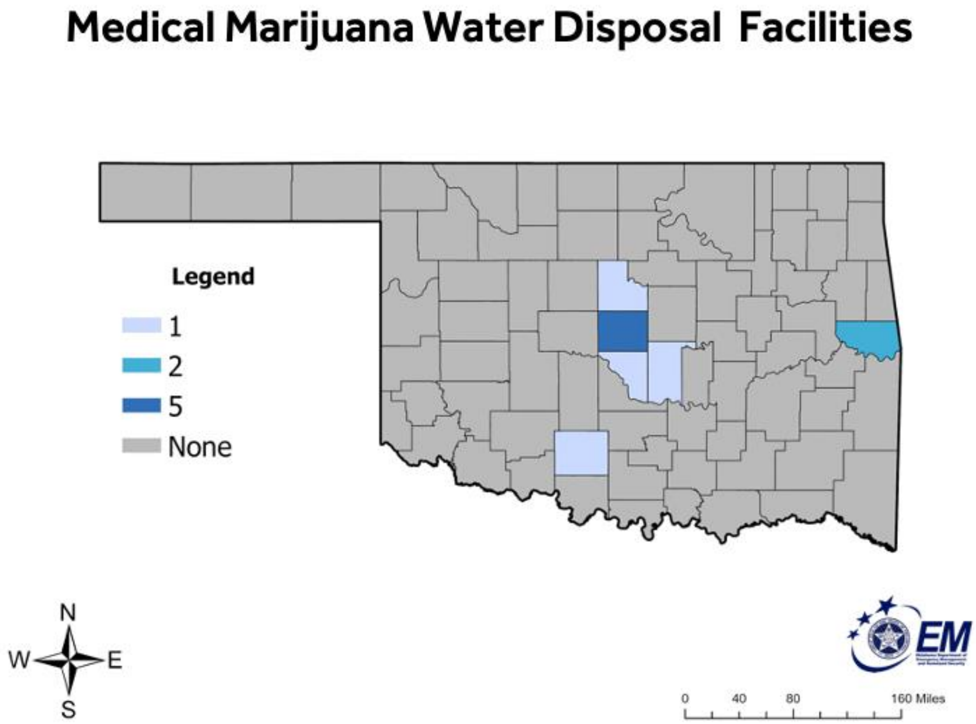


Figure 3: Medical Marijuana Water Disposal Facilities in Oklahoma. Source: ODEMHS.

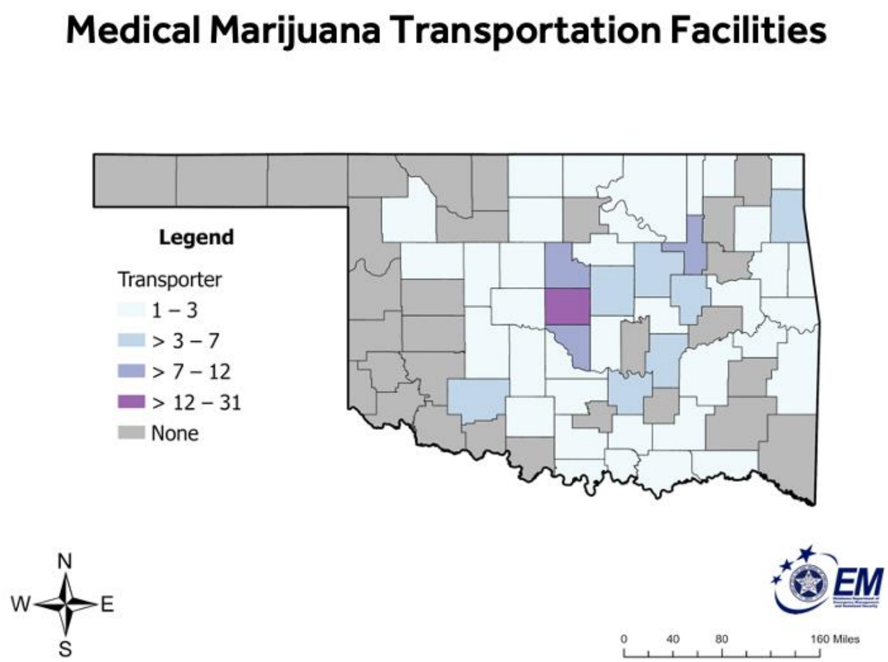


Figure 4: Medical Marijuana Transportation Facilities in Oklahoma. Source: ODEMHS.

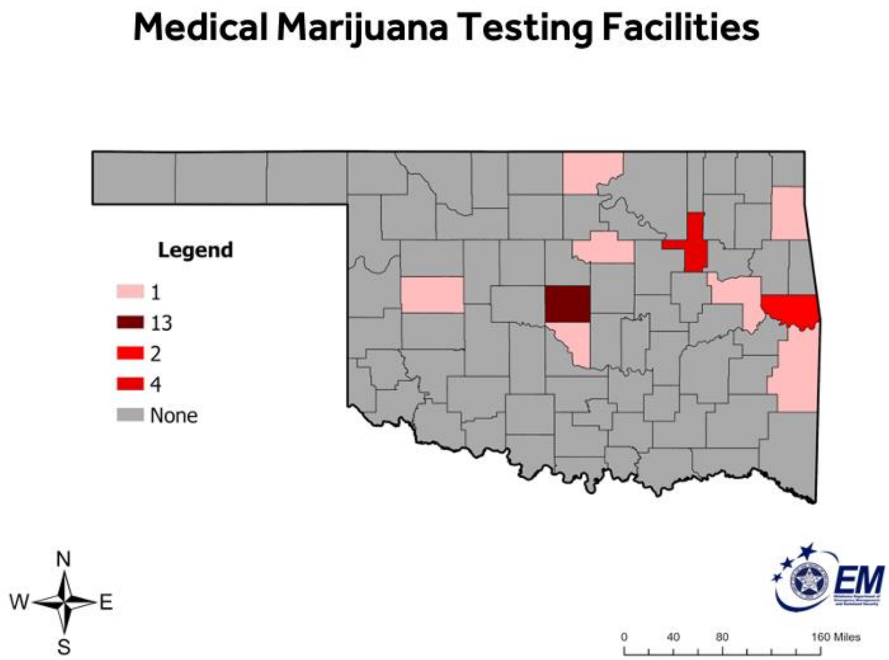


Figure 5: Medical Marijuana Testing Facilities in Oklahoma. Source: ODEMHS.

5.5 State Land Use Laws, Enabling Legislation, Plans, and Authorities that may be Delegated to Local Governments by State Law

Laws, Legislation Plans, and Authorities	Description
The Oklahoma Emergency Management Act of 2003, § 683.11.	This statue provides guidance to political subdivisions on the requirement for local emergency management personnel and programs. The purpose of the local plan is to identify hazards that are specific to those local jurisdiction(s) area, determine a prioritized list of hazard mitigation measures, and implement an action plan for those mitigation actions. For this reason, has a staff of plan reviewers who coordinate plan submissions to FEMA (in compliance with 44 CFR 201.6(d) (1)).
The Oklahoma Floodplain Management Act	Passed in 1980, authorizes communities (cities, towns, and counties) to develop and enforce floodplain regulations in designated flood hazard areas. An amendment in 2004 calls for community floodplain administrators to become accredited through the OWRB, ensuring that these officials are properly trained to effectively administer local floodplain regulations.
Senate Bill 1269	In 2020 Oklahoma legislature passed Senate Bill 1269 to create Oklahoma's first statewide flood planning initiative. The Oklahoma Flood Plan, integrated with the Oklahoma Comprehensive Water

	Plan (OCWP), raises awareness and motivates action to reduce flood risk. At the community level, the plan identifies mitigation projects and provide a foundational structure for initiating and coordinating successful floodplain management programs.

5.6 State Laws Governing Building Code Adoption and Enforcement

Oklahoma's Uniform Building Code

The State of Oklahoma adopted statewide building construction codes in 2009, through the passage of the Oklahoma Uniform Building Code Act, Oklahoma Statute, Title 59 Sections 1000.20 through 1000.29. As a result, the Oklahoma Uniform Building Code Commission (OUBCC) was created for the purpose of reviewing and adopting minimum building codes for residential and commercial construction to be used by all entities within the state.

The OUBCC consists of technical committees, comprised of individuals in the respective trades, to review the codes and make recommendations to the commission. The OUBCC has adopted nationally recognized base-model codes with modifications through the state's rulemaking process. The OUBCC has the following authorities:

- To review and adopt all building codes for residential and commercial construction to be used by all entities within this state. Codes and standards adopted by the Commission shall be the minimum standards for residential and commercial construction in this state.
- To establish a training and certification process for all residential and commercial building code inspectors.

All jurisdictions in the state of Oklahoma have the ability to adopt these minimum codes for their area. These jurisdictions may also adopt codes that are more restrictive. These codes ensure that a minimum standard is provided for all construction in the state that promotes building safety for citizens and visitors to the State of Oklahoma.

Changes made by a single-subject technical committee looking at Storm Shelter requirements for both residential and commercial construction were added to the 2015 adoptions of the IBC, IEBC and IRC. Further changes were made in the adoptions of the 2018 IBC, IEBC, and IRC.

The following is a listing of adopted building codes relevant to hazard mitigation:

International Residential Code (IRC) Adoptions

IRC Adoption Amendments	Effective Date	Date Superseded	Adoption Action
2011 07 15 IRC 2009 Permanent Rule	July 15, 2011	November 1, 2016	Adoption of the 2009 Edition of the IRC

2016 11 01 IRC 2015 Permanent Rule	November 1, 2016	September 15, 2017	Adoption of the 2015 Edition of the IRC
2017 09 15 IRC 2015 Permanent Rule	September 15, 2017	September 17, 2018	Amendments to the 2015 IRC adoption to correct Scrivener's errors
2018 09 17 IRC 2015 Permanent Rule	September 17, 2018	September 14, 2021	Amendments to the 2015 IRC adoption related to storm shelter requirements
2021 09 14 IRC 2015 Permanent Rule	September 14, 2021	September 14, 2022	Amendments to the 2015 IRC Adoption to correct Scrivener's errors and update referenced standards
2022 09 14 IRC 2018 Permanent Rule	September 14, 2022	N/A	Adoption for the 2018 Edition of the IRC

Hazard resistant provisions of 2022 09 14 IRC:
This code includes an appendix that provides prescriptive-based requirements for construction of a residential garage door meeting or exceeding a 135-mph wind event corresponding to an EF-2 tornado rating, to mitigate the risks associated with high wind and tornado events. This 2018 change recognizes that the single most important objective in protecting a structure against high wind is achieving a continuous load path from the roof to the foundation. This appendix includes a group of eleven building practices, based on the findings of studies and failures associated with various construction types as it relates to wind event mitigation. The appendix is a recognition of best practice but is not a mandatory part of the code.

International Building Code (IBC) Adoptions

IBC Adoption Amendments	Effective Date	Date Superseded	Adoption Action
2012 11 01 IBC 2009 Permanent Rule	November 1, 2012	November 1, 2015	Adoption of the 2009 Edition of the IBC
2015 11 01 IBC 2015 Permanent Rule	November 1, 2015	September 15, 2017	Adoption of the 2015 Edition of the IBC
2017 09 15 IBC 2015 Permanent Rule	September 15, 2017	September 17, 2018	Amendments to the 2015 IBC adoption related to alternative fuel fueling stations and repair garages
2018 09 17 IBC 2015 Permanent Rule	September 17, 2018	September 14, 2021	Amendments to the 2015 IBC adoption related to storm shelter requirements
2020 08 03 IBC 2015 Emergency Rule	August 3, 2020	September 14, 2021	Emergency amendments related to the growing and processing of plant material

2021 09 14 IBC 2018 Permanent Rule	September 14, 2021	N/A	Adoption of the 2018 Edition of the IBC

Hazard resistant provisions of 2021 09 14 IBC:
The 2018 amendment to this code includes the following measures intended to mitigate the risks of high wind and tornado events, and to ensure the safety and well-being of storm shelter occupants:

- Limit the nonresidential portion of the live/work unit to not greater than 2,500 square feet.
- Clarify that any room or structure, as may be used as a place of refuge during a severe wind storm event, shall not be defined as a storm shelter unless specifically designed to the requirements as listed in Section 423.
- Require that critical emergency operations, buildings that contain 911 call stations, emergency operation centers, and fire, rescue, ambulance and police stations comply with Table 1604.5 as a Risk Category IV structure and shall be provided with a storm shelter constructed in accordance with ICC 500®.
- Require designated Group E occupancies with an occupant load over 200 to have a storm shelter constructed in accordance with ICC 500®.
- Clarify occupancy capacity for buildings on site as it relates to population of facility.
- Require that storm shelter construction documents be maintained within shelter facility.
- Clarify storm shelter entrance requirements.
- Clarify roof live loads may not be reduced, as allowed in Section 1607.13.2.1.
- Require that the minimum design wind speed for all storm shelters in the State of Oklahoma shall be set at 250 miles per hour.
- Clarify useable floor space requirements of shelter.
- Clarify egress requirements for shelter doors, and the operability of doors and shutters designed to protect windows, temporary sanitation facilities in storm shelters.
- Outline the height of storm shelter to clarify ventilation requirements.
- Clarify requirements for temporary sanitation facilities.
- Specify that first aid kits for community shelters shall be required to be ANSI rated for the number of occupants in the shelter.

International Existing Building Code (IEBC) Adoptions

IEBC Adoption Amendments	Effective Date	Date Superseded	Adoption Action
2012 11 01 IEBC 2009 Permanent Rule	November 1, 2011	November 1, 2015	Adoption of the 2009 Edition of the IEBC
2015 11 01 IEBC 2015 Permanent Rule	November 1, 2015	November 15, 2017	Adoption of the 2015 Edition of the IEBC
2017 09 15 IEBC 2015 Permanent Rule	November 15, 2017	September 14, 2021	Amendments to the 2015 IEBC adoption related to storm shelter requirements

2021 09 14 IEBC 2018 Permanent Rule	September 14, 2021	N/A	Adoption of the 2018 Edition of the IEBC

Hazard resistant provisions of 2021 09 14 IEBC:
The 2020 amendment to this code includes the following measures intended to mitigate the risks of high wind and tornado events, and define storm shelter occupancy requirements:

- Require all 911 call stations, emergency operations centers and normally occupied fire, ambulance, and police stations shall have a storm shelter constructed in accordance with ICC 500® and Section 423.
- Requires that Group E storm shelter occupancies be capable of housing the occupant load of the classrooms and administrative areas in the new building or addition containing the Group E occupancy, with certain exceptions for Group E day care facilities, Group E occupancies accessory to places of religious worship, and entire buildings meeting the requirements for storm shelter design in ICC 500® and Section 423.

International Fire Code (IFC) Adoptions

IFC Adoption Amendments	Effective Date	Date Superseded	Adoption Action
2012 11 01 IFC 2009 Permanent Rule	November 1, 2012	November 1, 2015	Adoption of the 2009 Edition of the IFC
2015 11 01 IFC 2015 Permanent Rule	November 1, 2015	September 15, 2017	Adoption of the 2015 Edition of the IFC
2017 09 15 IFC 2015 Permanent Rule	September 15, 2017	September 14, 2021	Amendments to the 2015 IFC adoption related to alternative fuel fueling stations and repair garages
2020 08 03 IFC 2015 Emergency Rule	August 3, 2020	September 14, 2021	Emergency amendments related to the growing and processing of plant materials
2021 09 14 IFC 2018 Permanent Rule	September 14, 2021		Adoption of the 2018 Edition of the IFC

Hazard resistant provisions of 2021 09 14 IFC:
The 2020 amendment to this code includes the following measures intended to mitigate the risks of natural hazard events which can result in a loss of power, such as tornados, severe winter storm, high wind, hail, extreme heat events. These amendments were deemed necessary as more marijuana growing and processing facilities were utilizing home refrigerators for product storage during the extraction of marijuana oil phase. When the facilities experienced a power outage, the products in the household refrigerators would off-gas chemicals and were at risk of combustion.

The 2020 amendment addressed many safety concerns with growing and processing facilities, to include the requirement that extraction room ventilation and lighting systems be provided with emergency power for extraction processes utilizing hydrocarbon gases or liquids as solvents, in accordance with Section 2702 of the International Building Code®.

5.6.1 Challenges to Implementing and Enforcing Hazard-Resistant Building Codes

The three biggest challenges are:

- The cost for construction: For residential construction, increased costs have the capacity to price first-time homeowners out of being able to afford a home. This is one of the main reasons home builders are reluctant to add in optional hazard-resistant mitigation code options. Although each option might only be hundreds or a few thousand dollars of added cost, the overall cost of the home can increase significantly when multiple options are added. With the current housing shortage in Oklahoma, that is a significant issue.
- Inconsistent enforcement of the codes: Oklahoma is primarily rural in nature, and there are a lot of areas where enforcement of residential structures doesn't happen, or the person inspecting the structure hasn't been properly trained. For commercial structures in rural areas where there is no jurisdiction exercising the authority to enforce the codes, enforcement is handled by the State Fire Marshal (SFM). The SFM is primarily looking at the fire and life-safety aspects of the construction of a structure, and not necessarily everything that should be inspected.
- The OUBCC is tasked with providing education on the adopted codes to building inspectors, but OUBCC is not authorized to provide this same training to other groups in the construction industry.

5.6.2 Strategies for Overcoming Challenges to Implementing and Enforcing Hazard-Related Building Codes

The OUBCC is working on statewide building code education, however the agency has limited capability on who they are allowed to train, per current legislative restraints. The OUBCC is trying to address this issue so they can collaborate more effectively with contractors, architects, engineers, building inspectors, and other construction industry personnel. The goal of this collaboration is to educate all stakeholders on the same material, so that all aspects of building code implementation, from the design of a structure to construction and inspection, can be more cohesive.

5.7 How State Agencies Administer the NFIP

The National Flood Insurance Program (NFIP) was created by Congress in 1968, offering nonstructural approaches to reduce flood damage. The NFIP is a federal initiative that provides communities with a mechanism for implementing sound floodplain management techniques. This effective approach to floodplain management makes affordable flood insurance available for citizens in participating communities that enact and adhere to sound regulations that guide development in floodplains. In return, the NFIP requires the community to adopt a floodplain management ordinance containing certain minimum requirements intended to reduce future flood losses.

For more than 50 years, the OWRB has been the coordinating state agency for the National Flood Insurance Program (NFIP) in Oklahoma. As the NFIP State Coordinator, the Water Board partners with other state and federal agencies and local governments to prevent and mitigate the catastrophic effects of flooding disasters in Oklahoma.

The OWRB promotes community enrollment in the NFIP and advises the over 400 current participating communities on steps to ensure future participation. These participants include 6 tribal nations, 56 counties and 343 cities/towns. As of 2023, there have been $232 million in NFIP claims have been paid since 1978.

The OWRB has identified a need to improve their outreach to non-participating NFIP communities.

5.7.1 Pre-Disaster

The Oklahoma Floodplain Management Act, passed in 1980, authorizes communities (cities, towns, and counties) to develop and enforce floodplain regulations in designated flood hazard areas. An amendment in 2004 calls for community floodplain administrators to become accredited through the OWRB, ensuring that these officials are properly trained to effectively administer local floodplain regulations.

The Act provides for the following:

- Authorizes the establishment of floodplain boards.
- Provides for appointment and organization of floodplain boards.
- Authorizes floodplain boards to adopt floodplain regulations and the procedure for such adoption.
- Directs the Oklahoma Water Resources Board to develop and publish criteria for the establishment of floodplains and floodplain regulations; Provides for cooperative agreements.
- Provides for redefinition of floodplains.
- Prohibits certain construction and development.
- Provides for the exemption of the use of usual farm buildings for agricultural purposes, the planting of crops or the construction of farm ponds.
- Provides for issuance of permits for construction in the floodplain (development permit).
- Provides exceptions for certain pre-existing uses of floodplains.
- Provides for variances.
- Provides for fees.
- Provides penalties for acts.
- Provides for the needs of industry or agriculture located within a floodplain.
- Provides for appeals.
- Preserves boards and regulations already in existence.

- Provides that floodplain boards designate a floodplain administrator accredited by the Oklahoma Water Resources Board.

If a community wishes to join the NFIP, the OWRB can meet with each municipality to educate them on the requirements of the program. These communities, through their governing bodies, will meet and adopt a resolution to:

- Create the Floodplain
- Board Appoint members
- Set duties of Floodplain Board

In addition to the NFIP, the OWRB assists in pre-disaster flood mitigation efforts through a variety of additional methods, to include monthly Floodplain Management training opportunities, the Cooperating Technical Partners Program (CTP) and the Community Assistance Program – State Support Services Element (CAP-SSSE).

Floodplain Management Training

The OWRB Floodplain Management Section (FPM) provides workshops annually to train community Floodplain Administrators (FPA) on floodplain management topics. The OWRB also distributes floodplain management information to NFIP participating communities via their list serve. A list of current community FPAs and contact information is maintained and updated annually. The FPM also maintains information on the OWRB website regarding floodplain management information, and current topics and training opportunities. The calendar of training opportunities can be seen here: https://www.owrb.ok.gov/floodplain/calendar.php

Cooperating Technical Partners Program

This program involves collaboration between federal, state, local, and other stakeholders to maintain up-to-date flood hazard maps and other flood hazard information. The program's objectives are:

- Prioritize the development of flood risk information for unmapped and under-mapped communities utilizing Base Level Engineering (BLE) and other available resources.
- Increase outreach by targeting communities with completed Base Level Engineering (BLE) studies. Use opportunity to develop project plans – including map adoption, future studies and mitigation actions.
- Expand Model Backed Mapping to all NFIP participating communities. Leverage completed BLE's to identify high risk of flooding.

Community Assistance Program – State Support Services Element

This program helps states proactively identify, prevent, and resolve floodplain management issues in participating communities before a flood event even occurs. The CAP-SSSE program goals detailed below align directly to the national Floodplain Management Program multi-year plan. Annual, the state of Oklahoma is expected to develop and meet performance commitments for funded activities and community outcomes that align to the achievement of the CAP-SSSE program goals:

Goal 1: Grow local capacity and capability to improve resiliency through floodplain management.
Goal 2: Build state floodplain management capability and promote strong state inter-agency coordination and collaboration.
Goal 3: Promote the benefits and drive demand for strong floodplain management development standards and insurance.

Under the CAP-SSSE Program, the OWRB conducts the following assistance to local jurisdictions:

- Community Assistance Visit
- Community Assistance Contact
- Ordinance assistance
- Outreach workshops and other training
- General Technical Assistance
- Enrollment of communities
- Community Rating System (CRS) support
- Coordination with other state and federal agencies

OWRB CAP-SSSE Assistance from 2018-2022

Assistance Type Provided to Oklahoma Communities	Number of Events 2018-2022
Community Assistance Visit	60
Community Assistance Contact	200
General Technical Assistance	500

Of note, FEMA is currently redesigning the Community Assistance Visit and Community Assistance Contact processes into the new NFIP Compliance Audit process. OWRB will be expected to attend webinars and other events to increase their understanding of the new process and provide input into the design of an initial pilot project.

In addition, FEMA has also established the CAP-SSSE Tiered State Framework (TSF) in response to feedback from state partners highlighting a need for clarity on the goals and performance standards of CAP-SSSE. Feedback from regular engagements every year since 2018 via surveys, workshops, and in-person meetings with State NFIP Coordinators, Regional Community Assistance Program (CAP) Coordinators, and FEMA Regional Floodplain Management and Insurance Leadership (Branch Chiefs) has helped to develop and improve the TSF. The TSF helps FEMA recognize, invest in, and incentivize state efforts to develop and maintain the capabilities necessary to carry out the duties of a State NFIP Coordinating Agency as defined in 44 CFR § 60.25(b). The TSF and the aligned program funding methodology allow FEMA to:

- Increase transparency around state floodplain management activities and best practices,

- Enable a performance-based program that can fairly and consistently evaluate State NFIP Coordinating Agency strengths and areas of improvement, and
- Establish a level playing field for CAP-SSSE to make judgements about the resources that states may require to deliver upon the goals of the program.

5.7.2 Post-Disaster

When a flood disaster occurs, or is imminent, the OWRB's list of Floodplain Managers is utilized to alert communities and provide specific information and remind communities of substantial damage regulations and their responsibility to make damage determinations and enforce the requirements. Information is also be posted to the OWRB website and through other media platforms, such as Facebook and Twitter. Once the impacted areas are identified, specific messaging is delivered to the affected communities by email, phone calls, or site visits.

5.7.3 Changes in Participation, Insurance Coverage, and Trends

Since the previous plan update, there have been changes in NFIP participation, insurance coverage, and trends.

Regarding NFIP participation, the communities of Haskell County, Johnston County, Murray County, Marshall County, and the Muskogee Creek Tribal Nation have joined the program. The town of Stonewall, OK has also joined. Cole County is currently in the process of joining. The town of Moffitt, OK has been suspended as a participant by FEMA due to non-compliance.

Regarding insurance coverage, there is a downward trend in the number of active NFIP insurance policies nationally, and this is also reflective in Oklahoma's data. Since the previous plan update, Oklahoma has seen the number of policies drop by 17%, going, from approximately 12,000 active policies to approximately 10,000. The following may be contributing factors to this downward trend:

- People who take FEMA Individual Assistance after a disaster are required to be enrolled in NFIP coverage, and that requirement expires after three years. In 2019 there were three disaster declarations for flooding in Oklahoma (DR4438, DR4453, 4456) and there were two disaster declarations in 2022, (DR4657, DR4670). Those individuals who received Individual Assistance in 2019 are no longer required to maintain active coverage.
- In Oct 1, 2021 FEMA enacted new updates to its risk rating methodology and premium pricing calculation through its Risk Rating 2.0 Program. This methodology has the capability and tools to address rating disparities by incorporating more flood risk variables, to include flood frequency, multiple flood types, and distance to a water source along with property characteristics such as elevation and the cost to rebuild. While premiums across Oklahoma have generally fared better under this new methodology, the average rate for premiums is still

approximately $700 annually. This can be a deterrent for some individuals, particularly those who have not experienced a recent flood event.

5.7.4 Description of Substantial Damage Administration

After a presidentially declared disaster, local officials inspect homes damaged by flood waters to determine whether a structure was damaged to the extent that it will have to meet current building codes and floodplain management regulations when it is repaired. A determination of “substantial damage” applies to a severely damaged home or other structure in a Special Flood Hazard Area, regardless of the cause of damage, where the community participates in the National Flood Insurance Program.

FEMA does not make substantial damage determinations; the determination is made by a local building official or floodplain manager. If the cost of repairing the structure is 50 percent or more of its market value before the disaster, it is considered substantially damaged. Land value is not a consideration; the determination is based strictly on the value of the damaged structure. Rebuilding a substantially damaged structure in a floodplain requires a permit for the property to be brought into compliance with local floodplain management regulations.

The OWRB provides administrational guidance on substantial damage assessment procedures through the publication of the State of Oklahoma State Substantial Damage Plan, dated November 1, 2022. The purpose of this plan is to establish procedures for training and assistance to communities on National Flood Insurance Program (NFIP) requirements regarding substantial damage and substantial improvement. The Plan provides a framework to:

- Ensure compliance with FEMA regulations found in 44CFR 60.3 regarding substantial damage and substantial improvement for residential and commercial structures.
- Establish a statewide education and support plan to train local community officials on substantial damage requirements and provide post-flood support to assist with substantial damage assessments.
- Ensure residential and commercial structures are mitigated to reduce the risk of flood damage.

The OWRB provides workshops annually to train community Flood Plain Administrators on floodplain management topics. These workshops include a brief overview of the Substantial Damage requirements. At least one additional workshop specific to the topic of substantial damage and the FEMA Substantial Damage Tool is provided annually. The FPM Section participates in quarterly meetings with the Oklahoma Department of Emergency Management and Homeland Security (OEMHS) and the State Hazard Mitigation Officer (SHMO).

5.7.5 State Support for Communities Participating/Interested in the Community Rating System (CRS).

The Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the NFIP. Over 1,500 communities participate nationwide. In CRS communities, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community's efforts that address the three goals of the program:

- Reduce and avoid flood damage to insurable property.
- Strengthen and support the insurance aspects of the National Flood Insurance Program.
- Foster comprehensive floodplain management

Activities in the Community Rating System are organized in four main categories: public information, mapping and regulations, flood damage reduction, and warning and response. Stormwater management, drainage system maintenance and floodplain development regulations all contribute to CRS ratings, which stay in effect for a three-year cycle.

The table below shows the credit points earned, classification awarded and premium reductions:

CRS Credit Points	CRS Class	CRS Discount (Premium Reduction)
4,500+	1	45%
4,000 – 4,499	2	40%
3,500 – 3,999	3	35%
3,000 – 3,499	4	30%
2,500 – 2,999	5	25%
2,000 – 2,499	6	20%
1,500 – 1,999	7	15%
1,000 – 1,499	8	10%
500 – 999	9	5%
0 – 499	10	0

CRS communities are audited every 3 years, except for those who have a "1" rating. These communities are audited annually.

In 2021, Tulsa, Oklahoma achieved a Class 1 CRS rating, which is the highest possible ranking in the NFIP's Community Rating System. Tulsa is one of only two communities nationwide to achieve a Class 1 rating. With Tulsa's Class 1 rating, NFIP policies issued or renewed in the city limits are now eligible for a 45-percent discount.

The OWRB supports communities interested in, or participating in, the CRS Program through their partnerships with state and local floodplain managers. The OWRB is currently working on preparing workshops for CRS training topics, and they are establishing a partnership with the Oklahoma Floodplain Managers Association to teach advanced flood mitigation topics to local floodplain managers.

When a community is interested in participating in the CRS Program, they apply directly to FEMA. However, the OWRB serves as a technical guide to assist them in their flood hazard mitigation efforts.

CRS Communities in Oklahoma (as of April 2023)

City/Town	CRS Entry Date	CRS Effective Date	Status Current/Rescinded	CRS Rating	% Discount
Norman	10/1/2011	10/1/2022	C	6	20
Tulsa	10/1/1991	4/1/2022	C	1	45
Edmond	10/1/1993	10/1/2021	C	6	20
Oklahoma City	5/1/2014	10/1/2021	C	9	5
Broken Arrow	10/1/1993	4/1/2021	C	8	10
Sand Springs	10/1/1991	5/1/2018	C	7	15
Del City	5/1/2017	5/1/2017	C	6	20
Stillwater	10/1/1991	5/1/2017	C	7	15
Enid	10/1/1993	5/1/2016	C	9	5
Ponca City	5/1/2010	5/1/2014	C	5	25
Lawton	10/1/1991	5/1/2009	C	6	20
Bartlesville	10/1/1992	10/1/2002	C	17	15
Dewey	10/1/1992	5/1/2019	R	10	N/A
Blackwell	10/1/1991	10/1/2014	R	10	N/A
Chickasha	10/1/1992	10/1/2014	R	10	N/A
Bixby	10/1/1993	10/1/1998	R	10	N/A
Lindsay	10/1/1992	10/1/1993	R	10	N/A
Sapulpa	10/1/1992	10/1/1993	R	10	N/A

C = Current, R = Rescinded

Source: https://www.fema.gov/sites/default/files/documents/fema-crs-eligible-communities_apr-2022.pdf

5.7.6 Summary of Structures at High Risk of Flooding and Mitigation Actions

The mitigation of structures that are a high risk of flooding starts at a local level. The majority of mitigation efforts of high-risk structures has been property buyouts. This has been the targeted strategy for communities such as Kingfisher, Oklahoma City, and Tulsa.

The OWRB is currently working on the Oklahoma Flood Plan to develop an inventory of high-risk structure flood mitigation projects. Currently, FEMA maintains an active list of these projects.

Structures at High Risk for Flooding in Oklahoma

Number of Repetitive Loss Properties	Number of Severe Repetitive Loss Properties	How OWRB coordinates with local Floodplain Administrators (FPA) to Reduce the Number of These Structures
1,312	258	With an information sharing agreement in place, OWRB provides jurisdictions with information on flood insurance claims filed in their communities so the FPA may provide site-specific mitigation techniques aimed at preventing certain future losses. For those structures deemed RLP/SRL, OWRB provides referral guidance and information regarding mitigation options and resources so each jurisdiction can reduce the number of these structures.

5.7.7 NFIP challenges identified during regular coordination between the state and FEMA

There are no particular challenges identified regarding the communication between the state and FEMA. However, one challenges between the state and each local community is the high turnover rate of Floodplain Administrators (FPA). The FPA position can be an additional duty for some communities, and not a full-time position, and building competency is a challenge. The role of FPA requires ongoing training before a level of proficiency is realized. When there is a high turnover rate of FPAs, it is difficult to reach an adequate level of technical competency needed for the role. Most FPAs do not stay in the position long enough to reach full competency, and those individuals who attain full accreditation often move into other positions.

5.8 Discussion of the state's participation in, and capabilities related to, FEMA's flood hazard mapping program, (i.e., Risk MAP)

5.8.1 Risk MAP Program Background

In 1997, FEMA issued a seven-year strategic plan introduced as the Flood Map Modernization Initiative (FMMI). The FMMI set out long-term plans for digital flood hazard map production and management of inventory to support federal flood insurance coverage decisions. The strategic plan indicated that FEMA would convert more than 100,000 paper FIRMs to digital data format, and all new flood maps and those in need of revision (updating) would be produced as DFIRMs, if possible. The goal of this program was to transform flood maps into more reliable, easier-to-use, and readily available products. The Map Modernization Program has evolved to become FEMA's Risk MAP Program.

5.8.2 Risk MAP Program

Risk Mapping, Assessment, and Planning (Risk MAP) is the FEMA program that provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens. Through more precise flood mapping products, risk assessment tools, and planning and outreach support, Risk MAP strengthens local ability to make informed decisions about reducing risk. Through collaboration with state, tribal, and local entities, Risk MAP delivers quality data that increases public awareness and leads to action that reduces risk to life and property. Risk MAP focuses on products and services beyond the traditional Flood Insurance Rate Map (FIRM) and works with officials to help put flood risk data and assessment tools to use, effectively communicating risk to citizens, and enabling communities to enhance their mitigation plans and actions.

The multi-year Risk Map Program has five main goals:

- Address gaps in flood hazard data
- Measurably increase public's awareness & understanding
- Lead effective engagement in Mitigation Planning
- Provide an enhanced digital platform
- Align Risk Analysis programs and develop synergies

FEMA and OKDEMHS address flood risks with a topographical watershed approach, instead of by individual counties, as previously studied. As of 2022, Oklahoma has performed discovery on 10 watersheds. Discovery is the procedure where FEMA, OKDEMHS, and OWRB solicit comments related to any risk within their community. Comments are collected and evaluated to produce a report regarding their flood risk. This report collates recommendations on what projects to undertake to reduce the watershed and jurisdiction's flood risk.

Base Level Engineering (BLE) is a watershed-wide engineering map modeling method that uses high resolution ground elevation, automated model building techniques, and manual model review to prepare broad and accurate flood risk information for FEMA to assess its current flood hazard inventory.

BLE prepares flood risk information with scalable engineering models at minimal cost, allowing FEMA to assess and update its current flood hazard inventory more efficiently while increasing our operational transparency. Each mile of stream shown on a FIRM is required to be validated each five years. The flood hazard information is reviewed to determine if the built environment or expected flood flows have changed since the previous study was performed. A large portion of the regional flood hazard inventory of stream miles is currently unknown or unverified.

BLE provides modeling and floodplain extents to assess these unknown and unverified mileage. Additionally, BLE results have been prepared to meet all technical, engineering and mapping standards so that it may be used to update FIRMs in the case that the current inventory is not able to be validated.

Figure 6: Statewide OCWP Watershed Planning Region and Basin Delineation.

5.8.3 How the State Shares Flood Risk Data for Mitigation Planning and Action

The OWRB shares flood risk data with jurisdictions for use in mitigation and community planning, and mitigation action development, in a variety of ways. One way is through Cooperating Technical Partners (CTP) Program. The CTP Program mission is to strengthen the effectiveness of the NFIP and support federal mitigation objectives. The CTP Program leverages partnerships to deliver high-quality hazard identification and risk assessment products and provides outreach support and empower communities to take action to reduce risk based on informed, multi hazard-based data and resources. This is in support of FEMA's Risk Mapping, Assessment and Planning (Risk MAP) Program.

Through the CTP Program and in consultation with FEMA Region 6, the State of Oklahoma developed processes and procedures, and deployed teams, to collect High Watermark (HWM) data. FEMA Region 6 provided geospatial data analysis support for the HWM data collected. FEMA, the U.S. Army Corps of Engineers, and the OWRB CTP worked together to document more than 980 HWM signs across several Oklahoma counties. HWM coordinates, site photographs, and field notes were collected using Mobile Information Collection Application software, and then analyzed to produce map books by watershed and stream name. An interactive map viewer, depth grids (in conjunction with Interferometric Synthetic Aperture Radar inundation maps, and project summaries by county were also produced.

Another way the OWRB shares flood risk data is by providing water-related information through web-based, interactive maps and applications published through an Esri ArcGIS Enterprise installation at the University of Oklahoma's Center for Spatial Analysis and hosted on Esri's ArcGIS Online platform. The OWRB General Viewer is a compilation of data layers produced by the agency. There are also printable maps available on its website.

The OWRB also shares flood risk data information by providing regular continuing education training opportunities to Floodplain Administrators.

https://www.owrb.ok.gov/floodplain/calendar.php

5.8.4 How the State Identifies Risk MAP Areas of Study

The OWRB identifies areas that need to be studied and/or restudied, with local communities through effective and available communication with all Oklahoma jurisdictions. In addition to the continually access communities have to OWRB guidance and technical advisement, the OWRB also provides continual outreach to Floodplain Administrators. Current information and technical guidance are shared through regular email distribution, and the OWRB does a newsletter twice a year.

The OWRB also identifies areas to be studied and restudied by annually reviewing FIRM data and seeing where there are any data deficiencies in mapping, or where paper-only mapping exists.

As required by FEMA, the OWRB also performs annual Community Assistance Contact with each participating NFIP community. In addition, there is a new FEMA initiative which requires NFIP program audits of each state every three years. This audit evaluates states using a tiered framework, and subsequent funding amounts are largely tied to the proactive flood mitigation activity that a state undertakes. Oklahoma underwent this audit in 2023 and will be eligible for another audit in 2026. This audit deemed Oklahoma as proficient, and close to advanced, in its mitigation efforts.

5.8.5 How the State Builds Risk MAP Partnerships

OWRB builds Risk MAP partnerships primarily though the CTP Program. The program's goal is to build partnerships in order to deliver high-quality hazard identification and risk assessment products. The goal is also to provide outreach support and empower communities to take action to reduce risk, based on informed, multi hazard-based data and resources.

5.9 Funding Capabilities for Hazard Mitigation Actions/Projects

The State of Oklahoma has a network of public and private entities to help further the mission of Hazard Mitigation Statewide. The Oklahoma Department of Emergency Management has several working partnerships with various State agencies, and organizations to assist in implementing mitigation measures throughout the State. New relationships with various State agencies and organizations are always encouraged, to help foster various mitigation across the State to become more disaster resilient.

These mitigation efforts are funded through a variety of funding capabilities, which are primarily federal.

5.9.1 Federally Funded Mitigation Resources

Federal Hazard Mitigation Grant Resources

Grant	Agency	Description
Emergency Management Performance Grants	Federal Emergency Management Agency, Department of Homeland Security	The purpose of the Emergency Management Performance Grant (EMPG) Program is to provide federal funds to states to assist state, local, territorial, and tribal governments in preparing for all hazards. Title VI of the Stafford Act authorizes the Federal Emergency Management Agency (FEMA) to make grants for providing a system of emergency preparedness for the protection of life and property in the United States from hazards. It vests responsibility for emergency preparedness jointly in the federal government, states, and their political subdivisions. The federal government, through the EMPG Program, provides the necessary direction, coordination, guidance, and assistance to support a comprehensive all-hazards emergency preparedness system. The EMPG Program will provide federal funds to assist state, local, tribal, and territorial emergency management agencies to obtain the resources required to support the National

		Preparedness Goal's associated mission areas and core capabilities.
Flood Mitigation Assistance Program	Federal Emergency Management Agency, Department of Homeland Security	The goal of FEMA's Flood Mitigation Assistance (FMA) Program is to reduce or eliminate claims under the National Flood Insurance Program (NFIP). FMA provides funding to states, territories, federally recognized tribes, and local communities for projects and planning that reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP. FMA funding is also available for management costs. Funding is appropriated by Congress annually.
Hazard Mitigation Grant Program (405 Program Funding)	Federal Emergency Management Agency, Department of Homeland Security	The purpose of the Hazard Mitigation Grant Program (HMGP) is to help communities implement hazard mitigation measures following a Presidential Major Disaster Declaration in the areas of the state, tribe, or territory requested by the Governor or Tribal Executive. The key purpose of this grant program is to enact mitigation measures that reduce the risk of loss of life and property from future disasters. The primary guidance document for this program is the Hazard Mitigation Assistance Guidance. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.
Pre-Disaster Mitigation Program (Superseded in 2020)	Federal Emergency Management Agency, Department of Homeland Security	Through the Disaster Mitigation Act of 2000, Congress approved creation of Pre-Disaster Mitigation Program (PDM), a national hazard mitigation program to provide a funding mechanism that is not dependent on a Presidential disaster declaration. This authorization is in Section 203 of the Stafford Act, 42 USC 5121-5206, as amended by Section 102 of the Disaster Mitigation Act of 2000.
Building Resilient Infrastructure and Communities (BRIC) (Supersedes the PDM Program)	Federal Emergency Management Agency, Department of Homeland Security	BRIC supports states, local communities, tribes, and territories in pre-disaster mitigation projects to reduce long-term risk from natural hazards. The BRIC program's guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency. BRIC is a new FEMA pre-disaster hazard mitigation program that replaces the Pre-Disaster Mitigation (PDM) program and is a result of amendments made to Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) by Section 1234 of the Disaster Recovery Reform Act of 2018 (DRRA).
High Hazard Dam Potential Grant Program	Federal Emergency Management Agency	The High Hazard Potential Dams (HHPD) Grant Awards provide technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams. A state or territory with an enacted dam safety

		program, the State Administrative Agency or an equivalent state agency is eligible for the grant.
Public Assistance (406 Program Funding)	Federal Emergency Management Agency, Department of Homeland Security	The FEMA Public Assistance (PA) program provides grants to state, territorial, tribal, and local governments, and certain types of private non-profit (PNP) organizations, so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. Through the program, FEMA provides supplemental federal disaster grant assistance for debris removal; life-saving emergency protective measures; and the repair, replacement, or restoration of disaster- damaged publicly owned facilities, and the facilities of certain PNP organizations. The PA program also encourages protection of these damaged facilities from future events by providing assistance for cost- effective hazard mitigation measures during the recovery process.
National Dam Safety Program	Federal Emergency Management Agency, Department of Homeland Security	For 30 years, the federal government has used the National Dam Safety Program (NDSP) to protect Americans from dam failure. The NDSP is a partnership of states, federal agencies, and other stakeholders that encourages and promotes the establishment and maintenance of effective federal and state dam safety programs to reduce the risks to human life, property, and the environment from dam- related hazards.
Community Assistance Program-State Support Services Element (CAP-SSSE)	Federal Emergency Management Agency	The Community Assistance Program – State Support Services Element (CAP-SSSE) helps states proactively identify, prevent and resolve floodplain management issues in participating communities before a flood event even occurs. In this way, CAP-SSSE helps to: ▪ Ensure that the flood loss reduction goals of the NFIP are met, ▪ Build state and community floodplain management expertise and capability and ▪ Leverage state knowledge and expertise in working with their communities. The State administers the Community Assistance Program-State Support Services Element Grant (CAP-SSSE) available through FEMA. CAP-SSSE funds are to be used by States to provide technical assistance to NFIP communities, to evaluate community implementation/performance of NFIP floodplain management activities, and to build State and community floodplain management expertise and capacity.
Community Development Block Grant -	Department of Housing and	The Community Development Block Grant Mitigation (CDBG-MIT) Program funds pose a unique opportunity for eligible grantees to use this assistance in areas impacted by recent

Mitigation (CDBG -MIT)	Urban Development	disasters to carry out strategic and high-impact activities to mitigate disaster risks and reduce future losses.
Community Development Block Grant - Disaster Recovery (CDBG-DR)	Department of Housing and Urban Development	These grants help cities, counties, and states recover from Presidentially declared disasters, especially in low-income areas, subject to availability of supplemental appropriations. The primary focus of the CDBG-DR program is on long-term recovery efforts for housing, infrastructure, and economic development. Though grantees can, and often do, have mitigation activities/components in their CDBG-DR Action Plan, increasing resilience for future disasters is not the primary focus of CDBG-DR.
Conservation Reserve Program (CRP)	Farm Service Agency, United States Department of Agriculture	The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners to receive rental payments when they convert marginal farmlands to vegetated cover. Participants enroll in CRP contracts for 10 to 15 years. This reduces soil erosion, supports farmers, reduces sedimentation and pollution in water sources, and establishes wildlife habitat. The wetland enhancement, shoreline protection, and riparian buffer practices enhance resilience by reducing downstream flooding during storm events. One effort of the CRP is the Floodplain Wetlands Initiative, which restores the functions and values of wetland ecosystems that had been devoted to agricultural use. Wetland restoration reverses the degradation of the wetland areas on what is often marginal soil. For farmers and landowners facing crop damage from flooding, restoring wetlands to receive floodwaters can also increase flood storage capacity – while significantly reducing farming risks.
Conservation Stewardship Program (CSP)	Natural Resources Conservation Service, United States Department of Agriculture	The Conservation Stewardship Program (CSP) helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resource concerns. CSP pays participants for conservation performance— the higher the performance, the higher the payment. Many conservation practices (riparian forest buffers, cover crops, etc.) reduce runoff and erosion, reducing flooding downstream.
Emergency Watershed Protection Program (EWPP)	Natural Resources Conservation Service, United States Department of Agriculture	Congress established the Emergency Watershed Protection (EWP) program to respond to emergencies created by natural disasters. The EWP program offers technical and financial assistance to help local communities mitigate imminent hazards to life and property caused by floods, fires, windstorms, and other natural occurrences that impair a watershed. The Natural Resources Conservation Service (NRCS) administers the EWP

		program, which consists of two options: EWP – Recovery, and EWP – Floodplain Easement (FPE). NRCS offers financial and technical assistance for various activities under EWP – Recovery, including: • Removing debris from stream channels, road culverts, and bridges. • Reshaping and protecting eroded streambanks. • Correcting damaged or destroyed drainage facilities. • Establishing vegetative cover on critically eroding lands. • Repairing levees and structures. • Repairing conservation practices. In addition to recovery projects, NRCS may purchase EWP floodplain easements instead of trying to recover damaged floodplain lands if it proves to be more cost-effective than recovery.
Environmental Quality Incentives Program (EQIP)	Natural Resources Conservation Service, United States Department of Agriculture	The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation, or improved or created wildlife habitat. While not designed to be an emergency response or hazard mitigation program, EQIP can play a vital role in helping producers prevent the worst impacts of and recover from natural disasters like floods, hurricanes, wildfires, and drought. Through EQIP, NRCS provides financial assistance to repair and prevent the excessive soil erosion caused or affected by natural disasters. These practices include activities like stream bank restoration, grassed waterways, and buffers. NRCS-funded conservation practices protect land from erosion, support disaster recovery and repair, and can help mitigate loss from future natural disasters.
Housing Preservation Grants	Rural Development, United States Department of Agriculture	The Housing Preservation Grant (HPG) program provides grants to sponsoring organizations for the repair or rehabilitation of low- and very low-income housing. The grants are competitive and are made available in areas where there is a concentration of need. Very low income is defined as below 50% of the area median income (AMI); low income is between 50 and 80% of AMI. Eligible homeowners can apply for funding to repair damages caused by natural hazards or to harden their structures against future hazard events.
USDA Disaster Assistance Programs	Farm Service Agency, United States	The Farm Service Agency provides several disaster assistance programs. These include the Emergency Conservation Program, Emergency Forest Restoration Program, Emergency Loan Program, and Tree Assistance Program, as well as a mix of

	Department of Agriculture	other programs aimed at specific agricultural sectors. While focused on recovery, many of these programs provide funding for conservation practices that enhance resilience.
Water and Environmental Programs	Rural Development, United States Department of Agriculture	The USDA's Rural Development Water and Environmental Programs (WEP) provide technical assistance, loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and cities and towns of 10,000 or less. WEP also makes grants to non-profit organizations to provide technical assistance and training to help rural communities with their water, wastewater, and solid waste problems. Water quality projects often meet flood mitigation goals and vice versa. WEP includes Emergency Community Water Assistance Grants, Grants for Rural and Native Alaskan Villages, Water & Waste Disposal Loans & Grants, and more.
EDA Disaster Recovery	Economic Development Administration, Department of Commerce	The Economic Development Administration (EDA) has a long history of successfully supporting disaster recovery and resiliency efforts. EDA's role in disaster recovery is to facilitate the timely and effective delivery of federal economic development assistance to support long-term community economic recovery planning and project implementation, redevelopment, and resiliency. EDA is uniquely positioned to coordinate regional disaster recovery efforts in partnership with its extensive network of Economic Development Districts (EDDs), University Centers, institutions of higher education, and other partners in designated impact areas.
EDA Disaster Supplemental Funding	Economic Development Administration, Department of Commerce	Congress often appropriates supplemental funds for economic recovery after significant disasters. Between Fiscal Years 2018 and 2019, EDA received $1.2 billion in supplemental disaster appropriations ($600 million each year) from Congress to help regions recover from the economic harm and distress resulting from natural disasters in 2017-2019. With the support of these funds, American regions and communities hard hit by major disasters are rebuilding stronger, more resilient economies.
Brownfields Program Grant Funding	Environmental Protection Agency	The EPA's Brownfields Program provides direct funding for brownfields assessment, cleanup, revolving loans, and environmental job training, and it provides technical information on brownfields financing matters. Separate grant programs are available for assessment, cleanup, environmental job training, and more. While not envisioned as a mitigation program, brownfield cleanup can prevent toxic materials from spreading during a hazard event.
Nonpoint Source Water Quality (Section 319) Grants	Environmental Protection Agency	Clean Water Act Section 319(h) funds are provided only to designated state and tribal agencies to implement their approved nonpoint source management programs. State and tribal nonpoint source programs include a variety of components, including technical assistance, financial assistance, education,

		training, technology transfer, demonstration projects, and regulatory programs. Water quality projects often meet flood mitigation goals and vice versa. Each year, EPA awards Section 319(h) funds to states in accordance with a state-by-state allocation formula that EPA developed in consultation with the states. Tribal funding is also available under Clean Water Act Section 319(h).
Smart Growth Support	Office of Sustainable Communities, Environmental Protection Agency	The Environmental Protection Agency's (EPA) Office of Community Revitalization works on smart growth issues by: • Conducting research. • Producing reports and other publications. • Providing examples of outstanding smart growth communities and projects. • Working with tribes, states, regions, and communities through grants and technical assistance. Smart growth can incorporate elements of green infrastructure and/or land preservation and can create more resilient communities.
Wetlands Protection Program Development Grants	Environmental Protection Agency	Wetlands Protection Development Grants (WPDGs) provide eligible applicants an opportunity to conduct projects to strengthen wetland protection programs. Eligible projects promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. Wetland protection is an important type of natural resource protection hazard mitigation project.
Disaster Recovery Grants	National Park Service, Department of Interior	Congress responds to some major disasters by appropriating Emergency Supplemental funding from the Historic Preservation Fund (ESHPF) for recovery, allowing state and tribal Historic Preservation Offices to work on various recovery projects, including compliance activities, survey and inventory of historic resources in areas impacted by the disaster, recovery and repair of historic properties damaged during the disaster, and other activities related to disaster recovery, as approved by the National Park Service (NPS). All funded repair work must substantially mitigate the threat and include steps to mitigate future damages.
Housing Improvement Program	Bureau of Indian Affairs, Department of Interior	The Housing Improvement Program (HIP) is a home repair, renovation, replacement and new housing grant program administered by the Bureau of Indian Affairs (BIA) and by federally recognized tribes. It is aimed at American Indians and Alaska Native (AI/AN) individuals and families who have no

		immediate resources for standard housing. Repairs can include those required as part of recovery or to reinforce the structure.
North American Wetland Conservation Fund	Fish and Wildlife Service, Department of Interior	The North American Wetland Conservation Fund Program provides matching grants to wetlands conservation projects in the United States, Canada, and Mexico. It includes a Standard Program and a Small Grants Program. Wetland conservation is an important type of natural resource protection hazard mitigation project.
Tribal Resilience Program	Bureau of Indian Affairs, Department of Interior	The BIA's Tribal Resilience Program (TRP) provides grants to tribes to build capacity and resilience for tribally designed resilience training, adaptation planning, vulnerability assessments, supplemental monitoring, capacity building, and youth engagement.
WaterSMART Programs	Bureau of Reclamation, Department of Interior	Through WaterSMART, the Bureau of Reclamation will continue to work with states, tribes, and local entities as they plan for and implement actions to increase their water supply through investments to modernize existing infrastructure and attention to local water conflicts. WaterSMART is an umbrella for a variety of programs, including water and energy efficiency grants, drought planning grants, and watershed management planning grants.
Five Star and Urban Waters Restoration Grant Program	National Fish and Wildlife Foundation	The Five Star and Urban Waters Restoration Program seeks to develop nationwide-community stewardship of local natural resources, preserving these resources for future generations and enhancing habitat for local wildlife. Projects seek to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development.
Resilient Communities Program	National Fish and Wildlife Foundation	The program focuses on water quality and quantity declines, forest health concerns, and sea level rise. The program will emphasize community inclusion and assistance to traditionally underserved populations in vulnerable areas.
Emergency Relief Program	Federal Highway Administration, Department of Transportation	The Federal Highway Administration's (FHWA) Emergency Relief (ER) Program provides grants for the repair or reconstruction of federal-aid highways and roads on federal lands that have suffered serious damage as a result of either natural disasters or catastrophic failures from an external cause. The program supplements the commitment of resources by states, their political subdivisions, or other federal agencies to help pay for unusually heavy expenses resulting from extraordinary conditions. The applicability of the ER program to a natural disaster is based on the extent and intensity of the disaster. Damage to highways must be severe, occur over a wide area, and result in unusually high expenses to the highway agency. Applicability of ER to a catastrophic failure due to an external cause is based on the criteria that the failure was not the

		result of an inherent flaw in the facility, but was sudden, caused a disastrous impact on transportation services, and resulted in unusually high expenses to the highway agency.
Climate Adaptation Fund	Wildlife Conservation Society	The Wildlife Conservation Society's (WCS) Climate Adaptation Fund provides grant awards to conservation non-profits across the United States to catalyze innovative, science-driven projects responding to the impacts of climate change on wildlife and people.

Federal Hazard Mitigation Loan Resources

Loan	Agency	Description
Disaster Loan Assistance	Small Business Administration, Department of Commerce	The Small Business Administration (SBA) provides low-interest disaster loans to businesses of all sizes, private non-profit organizations, homeowners, and renters. SBA disaster loans can be used to repair or replace the following items damaged or destroyed in a declared disaster: real estate, personal property, machinery and equipment, and inventory and business assets.
Clean Water State Revolving Loan Fund	Environmental Protection Agency	The EPA's Clean Water State Revolving Fund (CWSRF) program is a federal-state partnership that provides communities a permanent, independent source of low-cost financing for a wide range of water quality infrastructure projects. CWSRF can fund a wide variety of water quality protection efforts. The program’s flexibility and broad range of project eligibilities enable states to target CWSRF funds to their specific water quality priorities. Water quality projects often meet flood mitigation goals and vice versa. States are responsible for the operation of their CWSRF program. Under the CWSRF, states may provide various types of assistance, including loans, refinancing, purchasing, or guaranteeing local debt and purchasing bond insurance. States may also set specific loan terms, including interest rates from 0% to market rate and repayment periods of up to 30 years. States have the flexibility to target financial resources to their specific community and environmental needs.
Drinking Water State Revolving Fund	Environmental Protection Agency	Under the Drinking Water State Revolving Fund (DWSRF), the EPA provides grants to all 50 states plus Puerto Rico to capitalize state DWSRF loan programs. The states contribute an additional 20% to match the federal grants. The program also provides direct grant funding for the District of Columbia, U.S. Virgin Islands, American Samoa, Guam, and the Commonwealth of Northern Marianas. Water quality projects often meet flood mitigation goals and vice versa. The 51 DWSRF programs function like infrastructure banks by providing low-interest loans to eligible recipients for drinking

		water infrastructure projects. As money is paid back into the state's revolving loan fund, the state makes new loans to other recipients. These recycled repayments of loan principal and interest earnings allow the state's DWSRF to "revolve" over time.
Section 108 Loan Guarantee Program	Department of Housing and Urban Development	The Section 108 Loan Guarantee Program (Housing and Community Development Act of 1974) provides communities with financing for economic development, housing rehabilitation, public facilities, and other physical development projects, including improvements to increase their resilience against natural disasters. The flexibility of the program makes it one of the most important public investment tools that HUD offers to state and local governments. Section 108 offers state and local governments the ability to transform a small portion of their CDBG funds into federally guaranteed loans large enough to pursue physical and economic revitalization projects capable of revitalizing entire neighborhoods.
Emergency Farm Loans	U.S. Department of Agriculture	If the county is declared by the President or Secretary of Agriculture to be a disaster area, When a tornado, flood, or drought strikes, or a quarantine is imposed by the Secretary of Agriculture, or when other natural disasters occur, the Farm Service Agency, U.S. Department of Agriculture Emergency Farm Loans Program is there to help eligible farmers and ranchers rebuild and recover from sustained losses. The Emergency Farm Loans Program is triggered when a natural disaster is designated by the Secretary of Agriculture or a natural disaster or emergency is declared by the President under the Stafford Act. These loans help producers who suffer qualifying farm related losses directly caused by the disaster in a county declared or designated as a primary disaster or quarantine area. Also, farmers located in counties that are contiguous to the declared, designated, or quarantined area may qualify for Emergency loans. These low-interest loans can be used to repair or replace buildings or other structures, purchase livestock and equipment, and pay essential living expenses. For production losses, a 30% reduction in a primary crop in a designated or contiguous county is required. Crop loss quality, such as receiving a 30% reduced price for flood damaged crops, may be eligible for assistance as well.
The Rural Utility Service (RUS)	U.S. Department of Agriculture	USDA's Rural Utilities Service provides much-needed infrastructure or infrastructure improvements to rural communities. These include water and waste treatment, electric power and telecommunications services. All of these services help to expand economic opportunities and improve the quality of life for rural residents. This agency may provide electric and

		telephone cooperatives with low-interest loans and technical assistance to repair infrastructure and implement mitigation measures following a natural disaster.

5.9.2 State Funded Mitigation Resources

State Hazard Mitigation Grant Resources

Grant	Agency	Description
Locally Led Conservation Cost-Share Program	Conservation Programs Division, Oklahoma Conservation Commission	This program provides financial assistance to local landowners who to stabilize erosion and improve water quality throughout the state. Grant funds are provided to conservation districts, who solicit local applicants and evaluate them based on local priorities.
Priority Watershed Cost-Share Program	Conservation Programs Division, Oklahoma Conservation Commission	The Priority Watershed Projects provides funding for clean water projects. These projects focus on removing pollutants from water and reduce sources from non-point sources. Projects that reduce water pollution often have benefits for flooding and erosion.
80/20 Reimbursement Grant	Oklahoma Department of Agriculture, Food, and Forestry	This program provides funding to fire departments in rural areas, specifically communities that have fewer than 10,000 residents. These grants provide reimbursement of 80% of the total project cost. Fire departments may be interested in education and outreach around fire prevention and land management.
Community Wildfire Preparedness Planning Grant	Oklahoma Forestry Service, Oklahoma Department of Agriculture, Food, and Forestry	The Forest Service offers assistance and funding to communities who are developing wildfire protection plans or are trying to gain standing in the Firewise program.
Oklahoma Water Resources Board Financial Assistance	Oklahoma Water Resources Board	The Oklahoma Water Resources Board provides a range of grants to assist communities in their efforts to protect Oklahoma's water resources. Eligible projects include brownfield remediation and urban stormwater activities. Additional flood mitigation projects may be eligible as well.
State Wildlife Grants	Oklahoma Department of Wildlife Conservation	This grant program helps to provide additional assistance for the conservation of rare or at-risk animal species. While not focused on hazard mitigation, these projects may have implications for flood, drought, heat, and other hazards. It may also provide opportunities to partner with local organizations.

State Hazard Mitigation Loan Resource

Grant	Agency	Description
Oklahoma Water Resources Board Financial Assistance	Oklahoma Water Resources Board	The Oklahoma Water Resources Board provides a range of grants to assist communities in their efforts to protect Oklahoma's water resources. Eligible projects include brownfield remediation and urban stormwater activities. Additional flood mitigation projects may be eligible as well.

5.10 How the State has Used its Funds & Other State Resources for Mitigation

ODEMHS does not currently receive any state funding for direct mitigation projects. However, there are limited funds available through the Oklahoma Department of Commerce:

5.10.1 Oklahoma Disaster Mitigation and Recovery Matching Fund Act

This fund was created by the passage of HB3819 which was signed into law on May 26, 2022, and the goal is to help jurisdictions meet their fund match for federal mitigation grant projects. The law is intentionally structured off existing Rural Economic Action Plan (REAP) grants which are trusted funding opportunities for locals, and one of the most utilized in rural Oklahoma. This program is still being crafted, but the following fund details include:

- The fund is a continuing fund not subject to fiscal year limitations.
- $5M in the initial year, will be administered by the Oklahoma Department of Commerce to the state’s eleven Council of Governments (COGs).
- The act establishes separate accounts for nine of the eleven COGs. One account will be divided equally into two subaccounts. Based on the language in the legislation, all COGs in Oklahoma will receive $500,000 except for the Association of Central Oklahoma Governments (ACOG) and the Indian Nations Council of Governments (INCOG). They will split an account and receive $250,000 each for distribution to any city or town within the respective jurisdiction of the entity or for the benefit of an unincorporated area.
- The governing board of the COGs must develop a plan for the use of available funds for providing matching amounts.
- As of May 2023, the Oklahoma Department of Commerce is working on the details of how this fund program will be managed.

5.10.2 The Oklahoma Emergency Fund

This fund, outlined in Title 62. Public Finance, §62-139.42, has primarily been used to fund the following activities:

- 12.5% of the Local Match requirement of Public Assistance Category A-H
- State Gubernatorial Declarations
- Operational costs of Emergency Management Assistance Compact and OK State National Guard Assistance Requests.
- These costs are coordinated through ODEMHS, Oklahoma Office of Management and Enterprise Services, and the State Governors Office and State Legislature.

5.11 How the State has Used FEMA Mitigation Programs & Funding Sources

The state of Oklahoma serves as a pass-through agency for FEMA mitigation funding. The state facilitates grant funding by disaster and project type, and project funding is awarded to sub-recipient jurisdictional entities while state agencies oversee grant execution. The following information highlights how the state of Oklahoma has used FEMA Mitigation Programs and Fundings Sources:

Oklahoma Disaster Declarations by Year, 2017-2022

YEAR	Declared Disasters (DR)	Emergency Declaration (EM)	Fire Management Assistance Declaration (FM)
2017	4299, 4315, 4324	N/A	5168, 5169, 5177
2018	4373	N/A	5230, 5231, 5232
2019	4438, 4453, 4456	3411	5304, 5305
2020	4530, 4575	3494, 3514, 3578, 3495, 3511, 3679, 3486	5306
2021	4587	N/A	5421
2022	4657, 4670	N/A	N/A

5.11.1 Hazard Mitigation Grant Program (HMGP)/404 Grant Funding

HMGP Funding since the previous plan update was used for a variety of mitigation projects, primarily related to mitigated planning. Projects include hazard mitigation plan development, flood master drainage plan development, dam breach studies, and fire mitigation planning.

HMGP/404 Funding to Oklahoma, 2017-2022

YEAR	DR #	FEMA-Obligated HMGP Funding
2017	4324, 4315, 4299	$22,304,148.80
2018	4373	$758,059.44
2019	4456, 4453, 4438	$16,588,922.10
2020	4575, 4530	5,864,451.18
2021	4587	$936,597.95
2022	4670, 4657	Pending

5.11.2 Public Assistance (PA) 406 Grant Funding

Public Assistance (406) Funding to Oklahoma, 2017-2021

Year	PA Funding	Number of PA Projects with Mitigation	% of Projects with Mitigation
2017	$284,465,501.56	15	5.64%
2018	$6,086,384.39	1	7.14%
2019	$85,248,320.68	126	13.86%
2020	$36,774,984.02	0	0.00%
2021	$1,549,214.75	0	0.00%

5.11.3 Flood Mitigation Assistance Grant Program (FMA)

Oklahoma FMA Projects "Identified for Further Review" by FEMA, 2017-2021

Year	Sub-Applicant	Federal Share Requested/Eligible
2018	15720 N Western Oklahoma City Acquisition	$ 230,548.00

Source: https://www.fema.gov/grants/mitigation/floods/previous-fiscal-year-subapplication-statusesflood-mitigation-assistance-fy2018-subapplication-status

Note: Sub-applications "Identified for Further Review" contain sufficient information for a preliminary determination of cost-effectiveness and feasibility. In certain instances, FEMA may work with applicants to confirm cost-effectiveness and feasibility. Identification for further review is not a notification of award.

5.11.4 Pre-Disaster Mitigation Program (PDM)

(Superseded in 2020)

Oklahoma PDM Projects "Identified for Further Review" by FEMA, 2017-2020

Year	Sub-Applicant	Federal Share Amount
2018	City of Tulsa Fulton Creek Flood Control - Advanced Assistance	$ 150,000.00
2018	OEM SoonerSafe ISR Phase 24	$ 574,500.00
2018	PDM FFY 2018 SMC	$ 14,796.00
2018	Quapaw Tribe of Oklahoma 2018 PDM M&A	$ 67,676.00
2018	Quapaw Tribe of Oklahoma OLC Safe Room	$ 573,187.00
2018	Quapaw Tribe of Oklahoma Advance Assistance - Safe Room Planning	$ 115,843.00
2018	Tonkawa Tribe Planning Project Advance Assistance	$ 81,750.00
2019	Cherokee Nation Immersion Storm Safe Shelter	$227,167.50
2019	Cherokee Nation, Hulbert Community Storm Safe Shelter	$227,167.50
2019	Cherokee Nation Community Shelters M & A	$37,647.96
2019	Choctaw Nation Mitigation Project Storm Shelter Rebates	$571,875.00
2019	Choctaw Nation Advanced Assistance Wind Feasibility Study	$150,000.00
2019	Otoe-Missouria Tribe of Indians Blue Meadows SR	$73,211.25
2019	Otoe-Missouria Tribe generator project TDLC/Pipestem	$57,975.00
2019	Otoe-Missouria Tribe Safe Room TDLC Project	$134,855.00
2019	City of Stillwater Master Drainage Plan: Boomer, East Boomer, West Boomer Creek	$375,220.00
2019	River West Phase I Community Safe Room Tulsa	$222,711.75
2019	SoonerSafe ISR Phase 25	$574,500.00
2019	OEM PDM 2019 SMC	$38,017.50

Source: https://www.fema.gov/grants/mitigation/pre-disaster

5.11.5 Building Resilient Infrastructure and Communities (BRIC)

(Supersedes the PDM Program)

Oklahoma Projects "Identified for Further Review" by FEMA, 2020-2021

Year	Sub-Applicant	Federal Share Requested/Eligible	Total Project Cost
2020	State Management Costs	$6,816,286.89	$6,816,286.89

2020	State Management Costs	$15,813.00	$21,084.00
2020	Oklahoma Water Resources Board Statewide Flood Plan	$300,000.00	$851,000.00
2020	Project Scoping for Midway Drive Flood Mitigation	$112,500.00	$150,000.00
2020	Norman - Flood Warning System Development	$75,000.00	$100,000.00
2020	Southmoore High School Detention Pond and Storm Sewer Project	$112,500.00	$150,000.00
2020	BRIC Tsa-La-Gi Shelter	$261,502.50	$348,670.00
2020	Osage Nation Mitigation Plan Update	$25,875.00	$34,500.00
2020	Tribal Mitigation Planning	$158,130.00	$210,840.00
2020	Choctaw Nation Storm Shelter Project	$571,875.00	$762,500.00
2021	Muscogee (Creek) Nation Residential Safe Room Program	$1,066,666.67	Not Available
2021	Oklahoma Management Costs	$100,000.00	Not Available
2021	SoonerSafe Phase 27	$533,166.00	Not Available
2021	Oklahoma County Wilshire Rd. Resilient Infrastructure Scoping	$311,465.72	Not Available
2021	State Management Costs	$2,742,015.85	Not Available
2021	City of Tulsa 2023 Hazard Mitigation Plan Update	$149,958.00	Not Available
2021	Choctaw Nation Mitigation Voucher Project	$750,000.00	Not Available
2021	Fulton Creek Drainage Basin Urban Flood and Heat Reduction Project	$19,578,851.87	Not Available

Source: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/after-apply/fy-2021-subapplication-status#status

2022 BRIC Grant Information:
The project application period was open from Sept 30, 2022 to Jan 27, 2023. As of April 2023, project selection has not been announced. Changes in BRIC funding from 2021-2022 include:

- Increased total available funding, more than doubling BRIC levels from $1 billion in FY 2021 to $2.295 billion in FY 2022.
- State/Territory Allocation subtotal increased from $1million to $2million, which includes an increase to hazard mitigation planning and planning-related activities to $1 million per applicant.
- Increased the Tribal Set-Aside from $25 million to $50 million. Raised the combined cost of an applicant’s Capability- and Capacity-Building activities to $2 million.

5.11.6 Community Assistance Program-State Support Services Element (CAP-SSSE)

From 2017-2022, the Oklahoma Water Resource Board has used CAP-SSSE funds to accomplish the following:

- Completed 15 Community Assistance Visits (CAV)
- Completed 50 Community Assistance Contacts (CAC)
- Completed 250 General Technical Assistances (GTA)
- Provided 8 Workshops
- Provided 1 FEMA L-273Floodplain Management Classes

5.11.7 National Dam Safety Program

National Dam Safety State Assistance Grant Funding

Year	Federal Funding Award to Oklahoma
2019	$377,919
2020	$341,591
2021	$323,097
2022	$606,912

Source: https://www.fema.gov/emergency-managers/risk-management/dam-safety/grants#:~:text=The%20primary%20purpose%20of%20the,safety%20training%20for%20state%20personnel

5.11.8 High Hazard Potential Dams Grant (HHPD)

High Hazard Potential Dams Grant Funding

Year	Federal Funding Award to Oklahoma	Number of Oklahoma Dam Mitigation Projects Approved
2019	$277,019	2 Planning and Design Projects
2020	$204,939	2 Planning and Design Projects
2021	$949,058	5 Planning and Design Projects
2022	$1,593,723	1 Planning and Design Projects (pending approval)

Source: https://www.fema.gov/emergency-managers/risk-management/dam-safety/rehabilitation-high-hazard-potential-dams/awards

5.11.9 Community Development Block Grant – Mitigation

Since the last plan update, there have been no CDBG-MIT funding allocations for Oklahoma.

5.11.10 Community Development Block Grant – Disaster Recovery

The Oklahoma Department of Commerce (ODOC) currently has one active CDBG Disaster Recovery program related to the severe storms, tornadoes, and flooding events that occurred in May-June of 2019. Funds applied towards mitigation include the following:

- ODOC has allocated $16.7M towards a Voluntary Buyout Program (VBP) from the 100-year floodplain, which is detailed in the 2019 CDBG-DR Action Plan. There have been no expenditures to date for the VBP, but expenditures are anticipated.
- ODOC has allocated $1.5M towards a statewide floodplan, which is also detailed in the 2019 CDBG-DR Action Plan. As of May 2023, approximately $39,000.00 has been spent developing the plan.

CDBG – DR Proposed Non-Substantial Amendment #3 Budget Allocation			
STATE OF OKLAHOMA: CDBG-DR Allocation (PL 116-20)		`	
	Non-Substantial Amendment #3 Amount	**Proposed Non-Substantial Amendment #4 Amount**	**Proposed Change by Activity**
Housing Programs			
Voluntary Buyout Program	$16,750,000.00	$16,750,000.00	No change
Single-Family Reconstruction and Rehabilitation Program (owner occupied)	$4,500,000.00	$4,500,000.00	No change
Housing Programs Total	$21,250,000.00	$21,250,000.00	No change
Infrastructure	$11,694,760.00	$11,694,760.00	No change
Planning	$1,590,590.00	$1,590,590.00	No change
Administration	$1,817,650.00	$1,817,650.00	No change
GRAND TOTAL:	$36,353,000.00	$36,353,000.00	No change

Source: 2019 CDBG-DR Action Plan, page 18

5.11.11 SoonerSafe - Safe Room Rebate Program

SoonerSafe Grant, 2017-2022

PHASE	GRANT #	APPROVAL DATE	Federal Amount Approved	Federal Amount Spent	# OF ISR'S GRANT APPROVED FOR	TOTAL # INSTALLED AT END OF GRANT
17	PDM2016	4/16/2017	$1,000,000.00	$739,965.24	500	378
18	HMGP, DR4222	4/1/17	$600,000.00	$466,928.10	300	240
19	FMAG 5117	7/17/19	$106,000.00	$92,459.80	53	47
20	HMGP, DR4247	1/10/18	$21,300.13	$21,300.13	11	11
21	HMGP, DR4274	11/10/18	$105,425.00	$61,041.25	53	31
22	HMGP, DR4315	6/27/2019	$21,942.50	$21,942.50	11	11
23	HMGP, DR4324	8/23/19	$210,000.00	$138,818.08	105	70
24	PDM2018	9/24/19	$766,000.00	$279,041.58	288	140
25	PDM2019	4/10/20	$764,205.20	STILL OPEN	288	35 as of May 2023
26	HMGP, DR4453	7/16/21	$104,000.00	STILL OPEN	52	30 as of May 2023
27	BRIC 2021	12/3/22	$533,166.00	STILL OPEN	267	55 as of May 2023

5.12 Obstacles, Challenges, and Proposed Solutions Related to any State Capabilities

In general, the state has been successful in utilizing our capabilities for hazard mitigation. However, there are some challenges to address:

- There is a high turnover of local Floodplain Administrators (FPA). The FPA position can be an additional duty for some communities, and not a full-time position, and building competency is a challenge. The role of FPA requires ongoing training before a level of proficiency is realized. When there is a high turnover rate of FPAs, it is difficult to reach an adequate level of technical competency needed for the role. Most FPAs do not stay in the position long enough to reach full competency, and those individuals who attain full accreditation often move into other positions. There is also high turnover of state FPAs and NFIP Coordinators. One way OWRB continues to remedy this situation is to continue board accreditation and annual recertification of local FPA. This is currently a required training in Oklahoma. This requirement is fairly unique among other states and it aids Oklahoma in our FPA education efforts.

- The number of statewide participants in The Great Shakeout Earthquake education and preparedness program has decreased since 2020 and has not fully recovered to pre-COVID levels. Some of this may be due to the negative impact that COVID had on participation in community educational programs. Another factor can be the decrease in earthquakes across Oklahoma after drilling restrictions were enacted, and this decrease in events can lead to complacency among local communities to educate and prepare for earthquake events. In addition to this, ODEMHS has decided not to participate in the Great Shakeout Program in 2023. A possible solution would be for ODEMHS to continue to seek future opportunities to provide earthquake mitigation and safety education to community stakeholders. ODEMHS has already taken steps forward in this effort, as detailed in their educational video to schools, which is detailed further in Section 5.13.
- Although many jurisdictions have made efforts to have an approved hazard mitigation plan, there are some jurisdictions who do not have a current plan and they are not eligible for federal mitigation funding. This issue, and proposed solutions, are discussed at length in Section 5.2.3 of this plan.

5.13 Capability Changes since Previous Plan Approval

Since the previous state hazard mitigation plan approval, there have been changes in our capabilities:

- **Increased capability:** The ODEMHS Hazard Mitigation Plans office updated the way it reviews plans in 2020. The new method establishes a protocols for two independent reviews of a submitted plans, establishes a system to reconcile any review differences, and made the review process more efficient. As a result, the plans office has seen great improvement in the quality and quantity of jurisdictional hazard mitigation plans submitted to FEMA. In addition, it has allowed us to tailor our support to jurisdictions who might be having difficulty finalizing their plan.
- **Increased capability:** The Oklahoma Uniform Building Code Commission identified the need to provide more education on current building codes to statewide stakeholders. Currently, they are limited on who they are allowed to train, per current legislation, and are working to seek legislative solutions to this issue.
- **Decreased capability:** In 2023, ODEMHS opted out of the ShakeOut Earthquake Grant and decided not to coordinate participation across the state.
- **Increased capability:** In 2022 ODEMHS partnered with the Oklahoma Geological Survey (OGS) and University of Oklahoma to develop three educational videos and one Public Service Announcement for use in school programs. These videos were made through OGS's already-established program in which they develop educational products to use in OGS's school training program, which is also distributed to science teachers for use in their respective teaching programs. Approximately $64,000 was utilized to develop these videos, which have received positive feedback from officials at the Central United Stated Earthquake Consortium (CUSEC) and our FEMA Region VI partners.

- **Increased capability:** Since 2020, the federal funding amount for the High Hazard Dam Potential Grant award to Oklahoma has increased significantly. This enables Oklahoma to mitigate issues with the most at-risk dams across the state.
- **Increased capability:** The Oklahoma Disaster Mitigation and Recovery Matching Fund Act became law in 2022. This fund aids jurisdictions in their efforts to meet their cost share requirement for federal mitigation grant eligibility. This is detailed further in Section 5.10.
- **Increased/decreased capability:** In 2018, ODEMHS began phasing in EM Grants as a grant tracking system, which is intended to provide cradle to grave electronic grant tracking. This system provides better reporting capability for grants overall, but the system is not as flexible as it could be for the grant management user. The system has difficulty categorizing grant payments which are not simply the awarded 75/25 split, as in the case where project retainage payments are a factor or adjustments need to be incorporated. Another issue with the system is that it can be difficult for the sub-recipient to use. ODEMHS grants staff provides an EM Grants user guide to the sub-recipient, but sub-recipient user who do not frequently use this system still experience user-interface issues. In some cases, this results in ODEMHS having to input the grant data on behalf of the sub-recipient. One addition issue is that some records have gone missing within the system, although this has occurred on rare occasions. One of the positive aspects of EM Grants is that records, documents, and reports are available electronically, and subrecipients can track their reimbursement requests.
- **Increased capability:** In November 2021, the Infrastructure Investment and Jobs Act (IIJA) was signed into law. This Act contained significant increases in funding for several dam safety programs, including the National Dam Safety Program Grant (NDSP) and the High Hazard Potential Dam Program Grant. For FY21 the total amount in the NDSP grant nationally was $5.815 million, and this was increased to $10.854 million in FY22. This increase in funding capability enables the OWRB's to do more dam safety mitigation activities. Some examples include, hiring additional staff, providing more in-depth technical assistance to dam owners, and updating software and publications.

SECTION 6: LOCAL COORDINATION AND MITIGATION CAPABILITIES

6.1 Summary of Local Policies to Accomplish Hazard Mitigation

The purpose of the local plan is to identify hazards that are specific to those local jurisdiction(s) area, determine a prioritized list of hazard mitigation measures, and implement an action plan for those mitigation actions. For this reason, OEM has a staff of plan reviewers who coordinate plan submissions to FEMA (in compliance with 44 CFR 201.6(d) (1)), and maintain detailed records for tracking, approval, and renewal purposes.

Local governments desiring to develop a hazard mitigation plan currently have two choices: formulate an independent plan or participate in a multi-jurisdictional planning process. In 2014, OEM adopted the following funding matrix to maximize HMGP Plan funds for local jurisdictions.

Planning Grants are available to municipalities with a population greater than 25,000. Counties of any population size are eligible for Planning funds. OEM encourages all Counties to work with their respective local jurisdictions including local communities and schools to be incorporated into the Planning process. Counties may apply to roll single jurisdictions into the county Plan as time permits.

Hazard Mitigation Planning Grant Funding

Community Type	**Population**	**Maximum Award (Total Project)**
Rural County Multi-Jurisdictional	Less than 25,000/	$50,000
Midsize County Multi-Jurisdictional	25,000-200,000/	$80,000
Midsize City Single-Jurisdictional	25,000-200,000/	$80,000
Urbanized County, **Metropolitan Area**, **Large City, or Regional Plan (multi-county)**	Greater than 200,000/	$200,000

Hazard Mitigation Planning Grants must be based on actual needs of the jurisdiction. Factors affecting the range of costs:

- Technical sophistication of scope of work
- Number and size of participating jurisdictions
- Number of significant hazards affecting Planning area
- Variance of hazards/risk across Planning area
- Update or new Plan (costs of first round updates may be like new Plans depending on quality of original Plan; second round updates should start significantly decreasing)
- Post disaster (more to analyze – higher cost)

Both single- and multiple-jurisdiction plans require review and approval every five years. Local plans may also include the incorporated and unincorporated areas within the county. Regardless of the option selected, all participating jurisdictions must meet the requirements of 44 CFR §201.6:

- The risk assessment must assess each jurisdiction's risks where they may vary from the risks facing the entire area. (44 CRF §201.6(c)(2)(iii))
- There must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan. (44 CRF §201.6(c)(3)(iv))
- Each jurisdiction requesting approval of the plan must document that it has been formally adopted. (44 CRF §201.6(c)(5))

6.2 Summary of Local Programs to Accomplish Hazard Mitigation

The State Hazard Mitigation Plan identifies Oklahoma's hazards, risks, vulnerabilities, goals, objectives, priorities, and strategies to enable effective mitigation planning. In addition to working with FEMA in all aspects of hazard mitigation projects and plans, OEM has established partnerships with a variety of agencies for the purpose of exchanging information. This dialog has provided valuable data for the planning and execution of many HM projects throughout the State, as well as those that will be carried out in the future as funding becomes available. This relationship is codified and exercised through the State Hazard Mitigation Team.

Some of these partnerships are ongoing, while others are formed to solicit expert advice on specific projects. Contributors include trade associations such as the ***Oklahoma Home Builders Association***, ***Oklahoma Portland Cement Association***, and the ***Oklahoma Lumbermen's Association***. Academic advisors include University of Oklahoma Geological Survey which provided input and advice regarding Earthquake Hazard profile. ***The University of Oklahoma through the Southern Climate Impact Planning Program*** provides current data on climate and meteorological hazard profiles and risk analysis.

The ***Oklahoma Water Resource Board*** is the State agency that administers the Oklahoma Floodplain Management Act, serves as the State Coordinator for the National Flood Insurance Program [NFIP] and is the lead agency for the FEMA RiskMAP program. The ***Oklahoma Insurance Commissioner*** is an excellent advocate for flood and earthquake insurance, and the ***Oklahoma Conservation Commission*** works with OEM on flood buyouts, hazardous material planning, earthquake mitigation and dam safety issues. The ***Oklahoma Department of Transportation*** [ODOT], the ***U.S. Department of Transportation*** and the ***Federal Highway Administration*** [FHWA] work with OEM on flood buyouts, open space restriction, earthquake planning, and bridge retrofits. Additionally, the ***U.S. Geological Survey***, the ***Central U.S. Earthquake Consortium*** [USEC], the ***American Institute of Architects*** [AIA/OK], the ***American Society of Civil Engineers*** [ASCE], the ***Oklahoma Society of Professional Engineers*** [OSPE], Oklahoma Association of Electrical Cooperatives [OAEC], Oklahoma Municipal Power Authority [OMPA], Oklahoma City Foundation, Regional Chamber of Commerce, and private businesses support HM initiatives.

The ***National Weather Service*** [NWS] has enhanced its program offerings, as they are integral tools for hazard mitigation and emergency response. NWS has upgraded its weather radio transmitter system and incorporated enhanced weather radar products to monitor and deliver hazard information more effectively.

Local jurisdictions have established Individual Safe Room registration programs to provide a critical response after a significant weather event. This information has contributed to outreach in areas of communities that have al lower density of safe room installations.

In an effort to better establish the effective warning areas and use of mitigation funds, several jurisdictions have begun to assess their current early warning sirens locations. These jurisdictions have and are developing multi-year plans to invest in modernized warning systems, while retiring those systems that are limited in effectiveness.

6.3 Summary of Local Capabilities to Accomplish Hazard Mitigation

The State of Oklahoma has a strong network of public, and private entities to help further the mission of Hazard Mitigation Statewide. The Oklahoma Department of Emergency Management has several working partnerships with various State agencies, and organizations to assist in implementing mitigation measures throughout the State. New relationships with various State agencies and organizations are always being investigated, to help foster various mitigation across the State to become more disaster resilient.

6.4 Challenges to Implementing Local Mitigation Policies, Programs, and Capabilities

- Local Hazard Mitigation Plan upon approval is valid for five years, and in the interim, there is no requirement to document maintenance. In the interim, the local planning team no longer meets, so there is a loss of strategy and knowledge.
- Many jurisdictions reconstitute their local planning teams until just before the local hazard mitigation plan is about to expire, thus starting anew.
- Many jurisdictions lack the understanding on how to integrate mitigation measures into other local plans and initiatives, thus missing opportunities to move mitigation actions forward.

- Local Hazard Mitigation Plan is generally not useful for local, is often found to be cumbersome and unhelpful.
- Local coordination with individual communities is lacking once plan is approved, and hazard mitigation conversation is isolated at a local level.
- State does not generally send reminders to communities letting them know their plan is 18 mos., 12 mos., 6 mos., away from expiration.
- Lack of capacity at the local level to update and maintain a local hazard mitigation plan, and at the state level, limited capacity to assist with update.
- Local and state funding priorities have reduced investment on Mitigation resources, with priority shifting to project funding.
- Effects of climate change have not yet been noticed/experienced by local communities or statewide since impacts due to climate change are on a longer time scale. In addition, with Oklahoma being landlocked, sea level rise is not an identified risk statewide, which can lead to climate change factors not being prioritized or taken into consideration.
- A lack of resources for underserved communities and socially vulnerable populations. Programs tend to be prioritized on a national/statewide scale, and resources are typically only allocated at the time of a disaster.

6.5 Opportunities for Implementing Mitigation Actions through Local Capabilities

Gaining new partnerships across the State of Oklahoma can greatly benefit further mitigation measures Statewide. Technology will continue to improve and will be able to benefit agencies such as the National Weather Service to alert citizens quickly of various weather hazards. The Oklahoma Water Resources Board (OWRB) has deployed a FEMA FIRM Map and CTP Web viewer to communicate digital and spatial information to the public. City of Tulsa has invested in a Hazard Mitigation viewer that allows public and local officials to view and inform themselves regarding natural hazard effects on the City of Tulsa. OEM is actively developing a Mitigation database and subsequent viewer to allow jurisdiction to view local mitigation actions. As OEM and the State work with various State agencies and organizations, there is also the opportunity to learn about new ways to better further mitigation throughout the State.

6.6 How the State Supports Development/Update of Local FEMA-Approved HM Plans

Training-The State offers a several different options when it comes to training local emergency managers on their hazard mitigation plans. Annually, OEM intends to offer the FEMA 318 class, *Mitigation Planning for Local and Tribal Communities* on how to write their hazard mitigation plan. Additional training opportunities such as the FEMA L-276 BCA Fundamentals course are conducted periodically. OEM routinely encourages local jurisdictions to attend FEMA EMI training courses and opportunities such as HMA Workshop.

New Emergency Managers are required to attend, within 1 year of appointment, OEM New Emergency Manager Orientation, which has a Mitigation component.

Technical Assistance Visits - OEM is very active in engaging local emergency managers in technical assistance visits. These visits range from broad overviews of the hazard mitigation planning process, or a very detailed visit in walking through their plan section by section. OEM also schedules area technical visits where several counties can come together, and the hazard mitigation staff has one on one time with the local emergency managers that need assistance with their plan.

Funding - OEM's ability to provide financial assistance is entirely dependent on the availability of post-disaster funding from FEMA. When the President declares a disaster for the State of Oklahoma and FEMA determines the cost of the disaster, additional funding is provided to the State exclusively for HM efforts. This is referred to as HMGP, or "*404 funding,*" as provided under Section 404 of the *Robert T. Stafford Disaster Relief and Emergency Assistance Act.* Approval of the State's Hazard Mitigation Update will result in Oklahoma's eligibility for FEMA disaster assistance and HMGP funding for *State agencies*, but it does not substitute for the requirement of local governments to have a FEMA-approved plan to be eligible for local hazard mitigation grants.

Local jurisdictions are free to use any funding available to them for this purpose. Local jurisdictions with limited resources are encouraged to consider joining with a larger or even several jurisdictions in the development or update of a multi-jurisdictional plan.

6.7 Summary of Local FEMA-Approved Plans

The State of Oklahoma has 77 counties. As of August 2023, the State has 69 local plans approved, which includes 42 county plans. In addition, of the 37 federally recognized tribes in Oklahoma, 10 have approved plans. It should be noted that in some jurisdictions, the school system is included in the local plan, but in some instances, the Independent School System may be preparing their Hazard Mitigation Plan separately. After reviewing the above-referenced plans, as well as several draft plans submitted for state review, it has been determined that the goals and objectives of these local plans and the goals and objectives of this state plan closely track with one another. Further, the review indicated that based upon information provided by the state, local jurisdictions evaluated hazards and risks in a similar manner and came to similar conclusions as those found within this state plan.

6.8-6.9 Barriers and Approach to Developing/Updating, Adopting, and Implementing Local Plans

Within the process of developing or updating, adopting, and implementing FEMA-approved local hazard mitigation plans there may be barriers which hinder the local community from moving the process forward. A summary of potential barriers utilizing the STAPLEE framework and a summary of OEM Mitigation Section's approach to addressing and removing these barriers to advance local mitigation planning.

- **Social:** *Perceived importance and/or community acceptance of mitigation planning*
  - OEM promotes the requirements and benefits of local mitigation planning through multiple planning workshops across the State, post-disaster coordination activities, publication of mitigation success stories, and posting of outreach materials on the OEM website.

- **Technical:** *Lack of resources to develop risk assessments*
  - In 2018, OEM has proposed through the USACE Silver Jackets program, the development and delivery of a web-application for county wide hazard assessment. This information and web application would allow for local mitigation planners who are performing all the needed local Risk Assessments by providing default data developed for the State Plan to be accessed online.

- **Administrative:** *Lack of personnel to prepare the plan*
  - OEM provides the local planning community with training workshops; planning "toolbox" with meeting materials; a plan development outline with instructions; and a full-time Lead Planner to answer questions, provide instruction, and review plan documents. OEM does not provide personnel to directly prepare plans, numerous planning materials and technical assistance is provided to streamline the planning process for the local community.

- **Political:** *Lack of local champion to lead planning process, and local buy in of mitigation actions.*

- **Legal:** *Requirement for Mitigation Planning*
  - Legal precedence for local mitigation planning is addressed in the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended by the Disaster Mitigation Act of 2000, requiring local governments to develop and adopt FEMA-approved hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance.

- **Economic:** *Lack of available funding*
  - There are two primary sources of funds available to help local jurisdictions develop and update hazard mitigation plans, FEMA's HMGP and PDM. OEM provides information on all FEMA HMA grant programs, including eligibility, application needs, and deadlines on their website: https://www.ok.gov/OEM/Programs_&_Services/Mitigation/index.html
  - OEM encourages local governments to apply for FEMA planning grants, as well as, to participate in multi-jurisdictional plans to share the financial burden.
- **Environment**
  - Based on new guidance from FEMA, for this plan update OEM has addressed changing future conditions, including the effects of long-term changes in weather patterns and climate on the identified hazards. As local mitigation plans consider inclusion of

changing future conditions in their update processes, FEMA and the information provided within the State Plan update will support this effort.

6.10 The Criteria for Prioritizing Funding

Federal Disaster funds are contingent upon availability. Further, jurisdictions are competing for access to the same funding. OEM may prioritize funding requests based on whether the requesting jurisdiction has demonstrated the desire and ability to complete the project; however, this desire to comply with the initiatives in the local mitigation plan should not be dependent on the availability of State or Federal funds.

Oklahoma's local governments may apply for hazard mitigation grants through the on-line grants' portal, OEMGrants (accessible through the OEM website) OEM's Hazard Mitigation staff by direction of the SHMO then reviews the applications for completeness. To provide equitable distribution of mitigation funding, the following general guidelines were developed by OEM for the evaluation of local mitigation projects:

1. The jurisdiction must have a FEMA-approved Hazard Mitigation Plan, and the proposed project must be identified as an "*Action Item*" within the plan.
2. The jurisdiction must have the ability to provide the non-federal cost share.
3. OEM will consider the Benefit Cost Analysis [BCA] for each project, with projects with the most favorable BCA receiving the highest priority.
4. OEM may consider past experience in dealing with the applicant on other grants (such as disaster grants, mitigation projects, etc.).
5. OEM may contact other State and federal agencies as well as councils of government, to inquire as to past experiences with the applicant.
6. OEM may review the applicant's vulnerability to the natural or man-made hazard the project seeks to address. Consideration will be given to communities with the highest vulnerability including underserved communities and socially vulnerable populations.
7. OEM may review previous presidential disaster declarations, as well as non-declared events, to determine the number of times the applicant has been impacted by the events and the magnitude of damages resulting from the events. This review would consider the impact on infrastructure, as well as human suffering.
8. OEM will consider whether the applicant participates in the National Flood Insurance Program.
9. OEM will consider the number of insured, repetitive loss, and severe repetitive loss structures within the applicant's jurisdiction.
10. OEM may consider the applicant's status as a small or underserved community.
11. OEM may consider if the applicant has demonstrated ability to form effective disaster response and recovery partnerships.
12. OEM may offer special consideration to jurisdictions experiencing extreme growth as well as areas experiencing increasing development.
13. OEM may consider jurisdictions who seek to mitigate against the effects of climate change and who may be experiencing severe impacts from climate change.

Grant applications that meet these considerations, as determined by the SHMO, are then forwarded to FEMA region VI for approval.

Administration of the Pre-Disaster Mitigation (PDM) Program

OEM will administer the Pre-Disaster Mitigation Program based on the requirements and guidelines established by FEMA under the Disaster Mitigation Act of 2000. The Mitigation Division will have the primary responsibility for implementing this program within the State. All jurisdictions are potential candidates for the pre-disaster mitigation program. Ideally, all communities would participate in some form of pre-disaster mitigation; however, due to differences in local capabilities and priorities, the degree of participation will vary greatly from community to community.

The pre-disaster mitigation program is designed to provide technical and financial assistance to State and local governments to assist in the implementation of pre-disaster hazard mitigation measures that are:

1. Cost-effective
2. Designed to solve a problem to reduce injuries, loss of life, and damage or destruction of property (including damage to critical State or local government services and facilities); and
3. Complement current State and local mitigation goals and objectives. Technical assistance will be primarily with personnel from Oklahoma Emergency Management Agency (OEM) Mitigation division and funding assistance will be based on the availability of funds through the programs administered.

Financial assistance under PDM is provided with a federal cost share of up to 75% of the total cost of approved mitigation activities. Funds provided to communities shall be used principally to implement cost-effective pre-disaster mitigation measures.

They may also be used to:

- Support effective public-private natural disaster hazard mitigation partnerships.
- Improve the assessment of a community’s vulnerability to natural hazards; or
- Establish hazard mitigation priorities, and an appropriate hazard mitigation plan, for a community.

HMGP Funding

The State will use the criteria mentioned above to assist in determining which communities should receive technical and financial assistance under this program. In addition to those criteria, listed above the State **will also** consider the basic Criteria for Assistance Awards established in the Disaster Mitigation Act of 2000. Those criteria are as follows:

1. The jurisdiction must have a FEMA approved Hazard Mitigation Plan.
2. The extent and nature of the hazards to be mitigated.

3. The degree of commitment of the local government to reduce damages from future natural disasters.
4. The degree of commitment of the local government to support the hazard mitigation measures to be carried out using the technical and financial assistance.
5. The extent to which the hazard mitigation measures to be carried out using the technical and financial assistance contribute to established State/Local mitigation goals and priorities.
6. The extent to which prioritized, cost-effective mitigation activities that produce meaningful and definable outcomes are clearly identified,
7. If the local government has submitted a mitigation plan, the extent to which the activities identified under paragraph (5) above is consistent with the mitigation plan,
8. The opportunity to fund activities that maximize net benefits to society, and
9. The extent to which assistance will fund activities in small, impoverished communities.

Small and Impoverished Community Provisions

Small and impoverished communities means a community of 3,000 or fewer individuals that is identified by the State as a rural community, and is not a remote area within the corporate boundaries of a larger city; is economically disadvantaged, by having an average per capita annual income of residents not exceeding 80 percent of national, per capita income, based on best available data; the local unemployment rate exceeds by one percentage point or more, the most recently reported, average yearly national unemployment rate; and any other factors identified in the State Plan in which the community is located.

OEM has received assistance from the Oklahoma Department of Commerce in determining those communities that meet the criteria. These communities appear to meet the intent of the Disaster Mitigation Act of 2000’s definition of small and impoverished.

The President may increase the Federal cost share to 90% of the total cost of mitigation activities carried out by small impoverished communities. For non-planning grants, the FEMA funding programs, and the State require that projects be cost effective and consideration of the extent to which benefits are maximized is one of the criteria that must be met.

6.11 The Criteria for Prioritizing Funding for Repetitive Loss Properties and Severe Repetitive Loss Properties

The State of Oklahoma Repetitive Loss Strategy has been included as Appendix “B”

6.12 The Process and Timeframe Review, Coordinate, and "Link" Local HM Plans with the State HM Plan

Local / State Plan Integration

"The Oklahoma Emergency Management, Mitigation Division will play a key role relative to general oversight, reviewing goals and objectives, and developing a Pre-Disaster Mitigation implementation planning strategy. After reviewing approved plans as well as multiple drafts that were submitted for State approval, the State Hazard Mitigation Planning Team determined which goals and objectives of the local plans most closely tracked with the State goals and incorporated them into the State plan. This review also indicated that hazards and risks were evaluated in a similar manner and supported the findings found within this State plan. FEMA approved plans are reviewed within 30 days of approval and stored in the State of Oklahoma Plan Data Base where they are linked and coordinated with the State of Oklahoma Hazard Mitigation Plan.

The State Hazard Mitigation Planning Team has reviewed each risk assessments and mitigation strategies of approved local plans when preparing this edition of the State plan. Information in local plans that supplements and improves the accuracy and depth of the State plan have been added to the plan.

Such information may include, but not be limited to:

- Locations of hazard areas identified by the local jurisdiction.
- Information on populations and structures located in or near local hazard/critical areas.
- Information on projected growth in or near identified hazard/critical areas.
- Identify mitigation goals and strategies that require State attention through inclusion in the State plan.
- Consideration will be given to communities with the highest risks, repetitive loss properties, and most intense development pressures. For non-planning grants, a principal criterion for prioritizing grants shall be the extent to which benefits are maximized according to a Benefit Cost Analysis of proposed projects and their associated costs.

Historically, information contained in this *State Hazard Mitigation Plan* has been, and will continue to be, integrated into the planning documents of other state agencies, local governments, universities, businesses, and private associations. OEM invites all interested entities to freely use information provided in the State Plan in the development and management of their mitigation plans and programs. The *Oklahoma Hazard Mitigation Plan* is accessible through the OEM website.

OEM's Plan Review Procedure

Local plans submitted to OEM for review are evaluated on a first come, first served basis. Each plan is received at the State Recovery Office where it is date stamped and forwarded to the OEM's Hazard Mitigation Division which maintains a comprehensive log of the local plans which includes the sponsoring applicant, the sponsoring agent (e.g., contractor, planner, COG), the plan's participating jurisdictions, the date the plan was received, and the dates of internal review. This log also includes the date the plan was provided to FEMA, its disposition following FEMA review, and the status of the plan.

OEM's internal reviews take approximately 30-60 days from the date the reviewer begins the evaluation. OEM's review staff may suggest corrections or request additional information before the plan is transmitted to FEMA. If the plan is determined to be deficient, OEM provides an in-depth critique and remediation instructions. Depending upon the extent and scope of the remediation effort, the applicant is allowed one to two weeks to make the corrections and resubmit the plan. OEM's plan review objective is to have the plan acceptable to pass the State review and forwarded on to Region VI within 45 days of the original receipt of the plan. The following is the current process used by OEM to review both new and updated plans:

1. Draft of plan is submitted to OEM for review.
2. OEM's Plan Review Staff performs an internal review of the plan.
3. After all required revisions are completed, OEM transmits plan to FEMA Region VI.
4. FEMA approves plan and notifies OEM of its approval, pending adoption of the plan by the participating jurisdictions.
5. OEM notifies the sponsoring agent of pending approval.
6. The participating jurisdictions adopt the plan and send the resolutions to OEM.
7. The sponsoring agent provides two copies of the plan, and two CDs of the same, to OEM.
8. OEM retains one copy of the plan and CD and submits the other copy of the plan and CD to FEMA Region VI.
9. FEMA grants approval of the plan and sends a notification letter with the approval date, to OEM.
10. OEM notifies each participating jurisdiction, via certified mail, of the plan's approval.
11. Each Plan Update must be approved no later than five years after the initial approval date.

SECTION 7: PLAN REVIEW, EVALUATION, AND IMPLEMENTATION

7.1 The Method and Schedule for Monitoring, Evaluating, and Updating the Plan

Chapter Seven describes the formal process that will ensure that the State Hazard Mitigation Plan remains an active and relevant document available for reference and guidance to the public in mitigating the risks associated with natural hazards. The plan maintenance process includes annual evaluations, revisions and updates as required. The Plan will be resubmitted for FEMA review every five years.

- Proposed changes will be included in the agenda for regularly scheduled quarterly meetings of the State Hazard Mitigation Team (SHMT) to be discussed by the team.

- If the State Hazard Mitigation Officer (SHMO) determines the need for changes to be urgent, the SHMO can schedule a special session of the SHMT. Proposed legislative measures or changes in FEMA policies would be examples of exigent circumstances.

7.1.1 Plan Monitoring

ODEMHS's Hazard Mitigation staff will be responsible for monitoring the Plan on a quarterly basis and as disaster events occur. While each chapter of the Plan will be monitored for possible update requirements, Chapters Three (Risk Assessment) and Four (Goals and Objectives) will receive the closest attention due to the frequency of changes to "Previous Occurrences" and processing of "Action Items."

ODEMHS's plan review staff will respond to the State Hazard Mitigation Team's (SHMT) status requests regarding the Plan in the Team's quarterly meetings. Copies of the State Plan will be provided upon request and the Plan will be available on the ODEMHS website.

7.1.2 Plan Evaluating

OEM's Hazard Mitigation staff will be responsible for evaluating the Plan. The planning team will continuously evaluate the State Hazard Mitigation Plan to determine the effectiveness of the Plan's processes.

Plan evaluation will address the following:

- *Chapter 1 – About the Plan:*
    - Are there any changes in Scope, Funding, and or Strategy?
    - Are there any changes in the State's demographics & growth trends?

        - Maintain contact with local jurisdictions concerning major changes in populations or development.

- *Chapter 2 – The Planning Process*
    - Are the existing Plans / Programs still relevant to the maintenance and upkeep of the Plan?
        - Determine if there were any implementation problems, such as technical, political, legal, or coordination issued with other agencies.
        - Are contact lists being maintained to the responsible agency heads and resources?
        - Evaluate how other agencies and partners have participated.
- *Chapter 3 – Risk Assessment*
    - Are there any changes or updates required in the hazard risk assessment?
        - Evaluate magnitude of risk and determine if it has changed.
        - Incorporate New or revised Risk data as provided by those relevant data agencies.
- *Chapter 4 – Goals and Objectives*
    - Are there any changes in the goals and objectives of the plan?
        - Following a disaster in the state, whether declared or not, large, or small, ODEMHS's Hazard Mitigation staff will review the events in that disaster to evaluate their impact upon the Plan's Goals and Objectives.
        - Evaluate the Mitigation Action Items per the process outlined in Chapter Four.
- *Chapter 5 – Coordination of Local Mitigation Planning*
    - Are there any changes in Coordination processes with Sub-Grantees and other State Partners?
        - Maintain close contact with local jurisdictions regarding the status of their plans and mitigation projects.
        - Have changes in Plan development requirements been communicated to the Sub-Grantees by ODEMHS's Hazard Mitigation staff?
- *Chapter 6 – Plan Maintenance Process*
    - Are there any changes to the Plan Maintenance Process that will enhance or improve its effectiveness?
        - The State Hazard Mitigation Officer will evaluate the Plan Maintenance Process during each Update cycle.
        - Other changes as required by the State Hazard Mitigation Officer, the State Hazard Mitigation Team, and Federal/State Statutory Regulation Updates

Following evaluation review, the ODEMHS's plan review staff will recommend updates and changes to the Plan.

7.1.3 Plan Updating

ODEMHS's plan review staff, along with the SHMT, will be responsible for updating the Plan. The Plan will continue to be evaluated and updated annually during the five-year cycle process and any time there is a disaster. Beginning the fourth year, ODEMHS's staff will review all revisions to be finalized based on review of the evaluation data received and sent to FEMA six months before the end of the fifth year for the State of Oklahoma to maintain eligibility for federal disaster assistance programs. The Plan will be resubmitted for FEMA review every five years.

7.1.4 Plan Maintenance Process Effectiveness

Analyses by OEM Management of the Monitor, Evaluate and Update section of this plan revealed that these methods, schedules, and processes are proper, effective and will continue to be appropriate for use in the future.

7.2 The System for Tracking all Mitigation Action Items and Plan Goals

For any program to remain effective, the goals and objectives of that program must be reviewed and tracked periodically. The State Hazard Mitigation Officer is responsible for this review and tracking on an ongoing basis. That review and tracking process should address, as a minimum, the following issues:

1. Are the established goals and objectives realistic? Review will take into consideration available funding, staffing, and State/local capabilities, and the overall State mitigation strategy.
2. Has the State clearly explained the overall mitigation strategy to local governments?
3. Are proposed mitigation projects evaluated based on how they help the State and/or local government meet their overall mitigation goals and objectives?
4. How have approved mitigation projects complemented existing State and/or local government mitigation goals and objectives?
5. Have completed mitigation projects generated the anticipated cost avoidance or other disaster reduction result?

A thorough and realistic evaluation of the benefits of a mitigation project may be delayed until the area of the project is impacted by another disaster. The lack of realized benefits from a completed mitigation project may result in the disapproval or modification of similar projects in the future. At the same time, mitigation projects that have proven their worth may be repeated in other areas of the State.

Based on the results of the review/evaluation mentioned above, the State may need to adjust its goals and objectives to meet the current and future mitigation needs of the State and local governments. A formal mitigation status report, if requested or required, will be prepared by the SHMO on an annual basis. This report will be provided to the Oklahoma Emergency Management Director and Deputy Director for review and distribution, as needed. The report will address, as a minimum, the following items:

1. Completed mitigation projects:
    a. Affected jurisdiction
    b. Brief description of the project
    c. Source of funding
    d. Brief summary of any problem areas, with proposed solution
    e. Brief summary of effectiveness (cost-avoidance) of project, if available

2. Mitigation projects in progress:
    a. Affected jurisdiction
    b. Brief description of the project
    c. Source of funding
    d. Brief summary of project status
    e. Anticipated completion date

3. Pending (under review) mitigation projects
    a. Affected jurisdiction
    b. Brief description of the project
    c. Source of funding
    d. Brief summary of project status

Oklahoma Emergency Management has reviewed the mitigation actions and determined that they were implemented as planned when funds and personnel allowed. The action items were reviewed, and it was determined that each project contributed to meeting the States Goals and Objectives.

Monitoring Process of Mitigation Activities

ODEMHS is responsible for the monitoring and tracking of the progress of mitigation actions. The SHMO has been assigned to monitor and track the progress of mitigation measures by following-up with other agencies. In addition to the SHMO, the SHMT has been identified in the planning process section as the committee who will monitor the progress of state mitigation actions and will meet on a quarterly basis for the review.

ODEMHS mitigation staff tracks progress through quarterly reports from sub-grantees, and at the end of each quarter, a progress report is submitted to FEMA listing each project.

Once a year the SHMT will meet to report on the overall progress on achieving the Plan's goals, review any new information and make recommendations to the SHMO for updating the baseline data used in the risk analysis. This information is used to reassess project prioritization, as necessary.

- Project outcomes (successes/difficulties/what could have been done better) using the last Quarterly Report as the final evaluation
- Relevance of goals to changing situations
- New information learned from disasters, studies or reports
- Changes in State or federal policy
- Risk assessment updates

- Level of coordination among agencies in the State

Goals, objectives, and projects will be reviewed in the event of a disaster to determine whether they need to be modified to reflect the new conditions and the findings appended to the existing Plan. Based on the current conditions, the goals and projects will be reevaluated to determine if there is a need to modify the Plan. If necessary, the SHMO will update the Plan based on the recommendations of the SHMT. Each action will be reviewed by members of the planning committee, and updates such as contacts, prioritization, and fund names will be updated.

FEMA requires that all disasters be closed, and project activity terminated within five years of a disaster declaration. The SHMO will ensure that all grant projects are closed after all approved work has been completed or within two years of the date of project approval, whichever comes first. The SHMO will monitor all project files and fiscal issues and perform an annual site visit to ensure the community's compliance. The Project Manager is responsible for notifying the SHMO within 10 days of completion of the project. The SHMO will schedule a final site visit to review all program and fiscal records related to the project, and all unspent funds being held by the community must be returned.

A programmatic and fiscal closeout ensures that all claims and costs are eligible and in compliance with the Project Application and program requirements. At the time of the closeout, all files not previously reviewed or completed will be reviewed to ensure all necessary documents are included. If a file does not contain all required documentation, the Project Manager will be required to provide the information within 30 days of closeout. When all files are complete, the SHMO prepares a spreadsheet providing the total project costs and appropriate cost shares. IEMA and community will comply with the Single Audit Act, as amended, and maintain all project documentation for a period of three years following project or disaster closeouts.

The State mitigation staff will monitor, review, and evaluate the deadlines for each project and assess the status of the goals and activities throughout the year. Any recommendations regarding actions necessary to ensure a project's completion will be reported to the SHMO. The SHMO in coordination with the INHMPC and MCSC are responsible for monitoring and updating the plan. ODEMHS is currently developing separate Mitigation Planning and Grant Management toolboxes. These "toolboxes" provides templates and examples for developing successful applications for HMGP grant funds and planning documents, as well as examples of budgets, budget narratives, scope of work, cost match letters and procurement documentation.

ODEMHS HM will continue to solicit counties to update their hazard mitigation plan. There are many mitigation actions that can be completed by local jurisdictions with little to no funding required from the State or Federal governments, larger projects, which historically have the biggest impact on reducing the risks, are still required to maintain interest in mitigation planning. The State mitigation staff coordinates the review of these plans in the form of technical assistance and direct review before the plan is officially submitted to FEMA.

SECTION 8:
ADOPTION AND ASSURANCES

U.S. Department of Homeland Security
FEMA Region 6
800 N. Loop 288
Denton, TX 76209

FEMA

January 22, 2024

Annie Mack Vest, Director
Oklahoma Department of Emergency Management and Homeland Security
P.O. Box 53365
Oklahoma City, OK 73152-3365

Re: Approval of the State of Oklahoma Standard Multi-Hazard Mitigation Plan Update

Dear Director Vest:

We are pleased to inform you that the State of Oklahoma Standard Multi-Hazard Mitigation Plan Update has been reviewed and determined to be compliant with the standards set forth in the Disaster Mitigation Act of 2000, as contained in Title 44 of the Code of Federal Regulations § 201.4. The plan is hereby approved as a Standard State Plan for a period of five years from the date of this letter, expiring on January 21, 2029.

We commend the State for meeting the requirements and developing a solid, workable state plan that demonstrates a commitment to reducing risks from natural hazards. This plan should guide State mitigation activities over the coming years.

A formal update is required every five years. If the plan is amended or revised, it must be resubmitted to the Federal Emergency Management Agency Region 6 for review and approval. If the plan is not updated prior to the required five-year update, please ensure that a draft update is submitted by the State no later than six months prior to the expiration of this plan approval.

Approval of this plan ensures that the State will remain eligible to receive the following Stafford Act assistance and other grant programs:

- Public Assistance Categories C-G (PA C-G)
- Fire Management Assistance Grants (FMAG)
- Hazard Mitigation Grant Program (HMGP)
- Hazard Mitigation Grant Program – Post Fire (HMGP – Post Fire)
- Building Resilient Infrastructure and Communities (BRIC)
- Flood Mitigation Assistance (FMA)
- Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program

Thank you for your dedication to mitigation and for the close coordination and communication with our office in the review and approval of this plan update. If you have any questions, please contact Roosevelt Grant III, Mitigation Division Director, at (940) 898-5146.

Sincerely,

George A. Robinson
Regional Administrator

Enclosure: Oklahoma State Mitigation Plan Review Tool

cc: Kim Jenson, Oklahoma Interim State Hazard Mitigation Officer
Roosevelt Grant III, Region 6 Mitigation Division Director
Arsany Thomas, Region 6 Recovery Division Director
Brianne Schmidtke, Region 6 Hazard Mitigation Assistance Branch Chief
Ron Wanhanen, Region 6 Risk Analysis Branch Chief
Jennifer Burmester, MTD HQ

SECTION 9: REHABILITATION OF HIGH HAZARD POTENTIAL DAM (HHPD) GRANT PROGRAM

9.1 High Hazard Potential Dam Rehabilitation Program Overview

The Department of Homeland Security/FEMA's High Hazard Potential Dam Rehabilitation Program began offering grants to state applicants/jurisdictional sub-applicants in 2019. From 2019-2021 this program funded dam rehabilitation planning and design actions. In 2022, the program allowed for construction action funding.

The Oklahoma Water Resource (OWRB) Board oversees Oklahoma's participation in the Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program. OWRB serves as a pass-through agency for funding, and they manage the HHPD grants that are awarded to sub-applicants. After OWRB receives the annual eligibility program requirements they curate a list of eligible dams across Oklahoma and contact the dam owners to see if they have the capacity to apply to this grant. The grant is divided into a 65/35 split, and the dam owner is obligated to pay 35% in state and local funding.

The program eligibility requirements can change each year, and OWRB is anticipating the 2023 requirements to be posted in the fall of 2023. Once this is released they will curate a list of eligible dams across Oklahoma, prioritize them based off risk factors, and contact dam owners.

When FEMA publishes the HHPD Rehabilitation Program requirements, OWRB applies for funding as the grant applicant. FEMA will then award the annual funding total to OWRB, and then OWRB reaches out to dam owners to solicit sub-applicants. FEMA approves each sub-applicant proposal.

Across Oklahoma there are 116 dams classified as High Hazard. Of those, 25 dams meet the requirements for the 2022 HHPD Rehabilitation Program criteria.

How State Agencies and Stakeholders were Involved in the Planning Process

Oklahoma Statute, Title 82-110.1, cited as the "Oklahoma Dam Safety Act", established the dam safety program of the Oklahoma Water Resources Board (OWRB). As the administrator of the Oklahoma Dam Safety Program, the OWRB is charged with ensuring the safety of more than 4,700 across the State of Oklahoma.

The Oklahoma Dam Safety Program has participated in the planning process of this section of the State Hazard Mitigation Plan by contributing expertise, data, studies, and other information pertaining to HHPD in Oklahoma. Information supplied by the Oklahoma Dam Safety Program includes, but is not limited to, dam breach inundation mapping and downstream risk identification, technical information pertaining to the structural integrity of dams in Oklahoma, the relative seismicity at the locations of all HHPD, and the relative overtopping potential of all HHPD.

9.2 The Planning Process

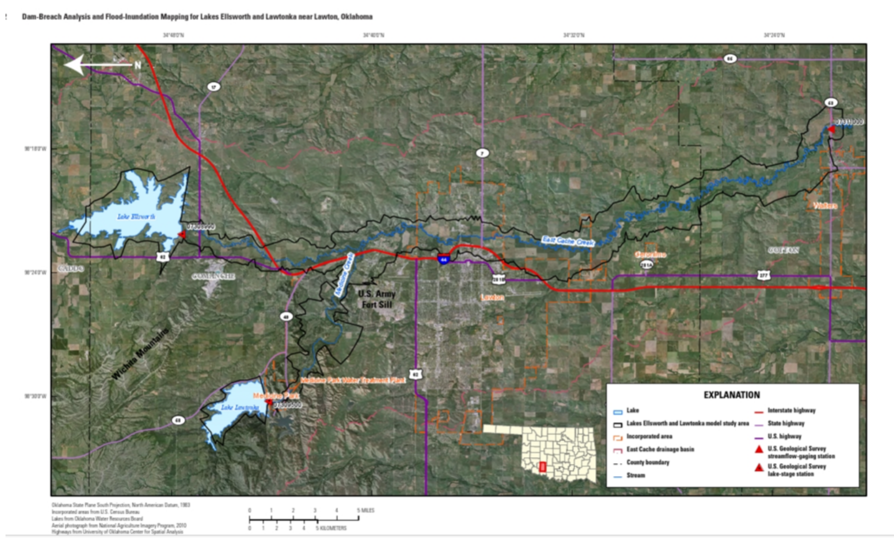
9.2.1 Data Which Contributed to the Planning Process

Dam Name	Population at Risk (PAR)	Has Inundation Mapping Y/N	Emergency Action Plan Y/N	Floodplain Management Plan Y/N	Software Used for Dam Breach Modeling HMS: Hydrologic Modeling System RAS: River Analysis System GIS: Geographic Information System
Ellsworth	5267	Y	Y, 2020	N, Will have in the future	RAS, GIS
Parthenia Lake	499	Y	Y, 2022	N	HMS, RAS, GIS
Sahoma Lake	471	Y	Y, 2021	N	HMS, RAS, GIS
Stigler Lake	533	Y	Y, 2019	N	RAS, GIS
Hominy Lake	560	Y	Y, 2020	N	HMS, RAS, GIS
Okmulgee Lake	475	Y	Y, 2021	N	Unknown
Lake Carl Blackwell	8993	Y	Y, 2022	N	RAS-GIS
Guthrie Lake	3	Y	Y,2021	N	Unknown
Carlton Lake	26	Y	Y	N	Unknown
Sportsmans Club	299	Y	Y,2022	N	HMS, RAS, GIS
Overholser	67945	Y	Y	N	RAS, GIS
Chickasha	7435	Y	Y	N	HMS, RAS, GIS
Weleetka	102	Y	Y	N	HMS, RAS, GIS
Jim Hall Lake	61	Y	Y	N	HMS, RAS, GIS
Lake Bar-Dew	258	Y	Y	N	HMS, RAS, GIS
Wewoka	227	Y	Y	N	HMS, RAS, GIS
Hobart	61	Y	Y	N	HMS, RAS, GIS
Cushing Lake	89	Y	Y	N	HMS, RAS, GIS
Waxhoma	67	Y	Y	N	HMS, RAS, GIS
Twin Lakes West	1074	Y	Y	N	HMS, RAS, GIS
Pines East	960	Y	Y	N	HMS, RAS, GIS
Shell Creek Lake Dam	97			N	Unknown
Lacy	243	Y	Y	N	HMS, RAS, GIS
Hunter	22	Y	Y	N	HMS, RAS, GIS
Shawnee City Lake No.1	1092	Y	Y	N	HMS, RAS, GIS

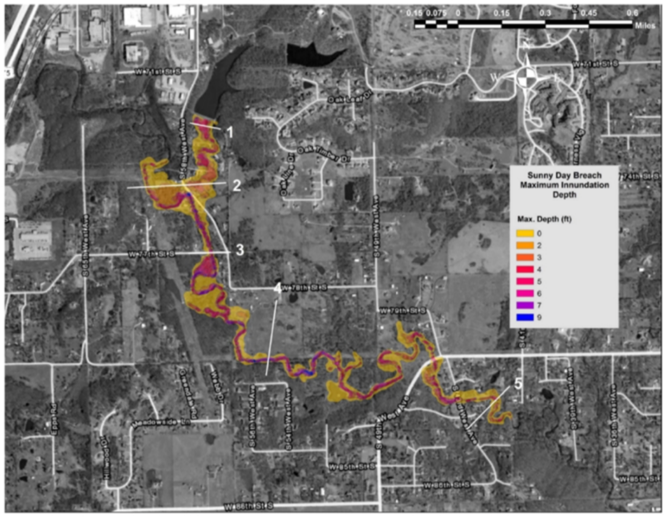
Dry Creek Detention Pond	245	Y	Y	N	RAS, GIS
New Beggs	57	Y	Y	N	RAS, HMS
Nichols Lake	1923	Y	Y	N	HMS, RAS, GIS
Templo de Alabanza	256	Y	Y	N	HMS, RAS, GIS
Masseys	41	Y	Y	N	HMS, RAS, GIS
Summit Lake	43	Y	Y	N	HMS, RAS, GIS
Blue River Dam	49	Y	Y	N	HMS, RAS, GIS
Clayton Lake	36	Y	Y	N	Unknown
Lawtonka	6805	Y	Y	N	RAS, GIS

Inundation Mapping

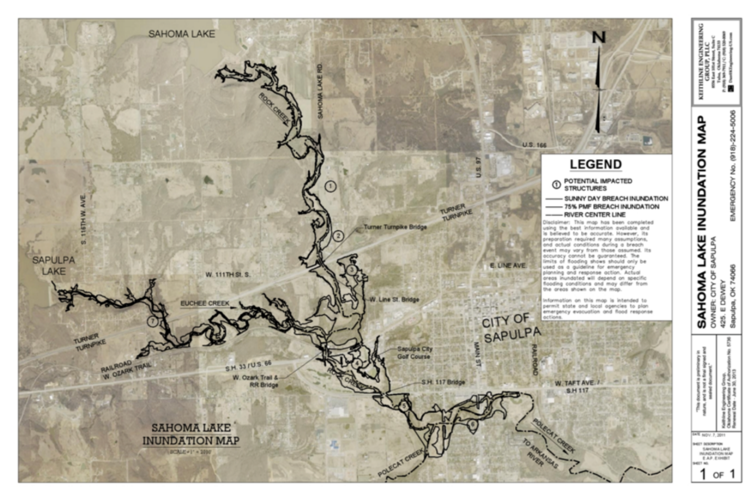
Ellsworth



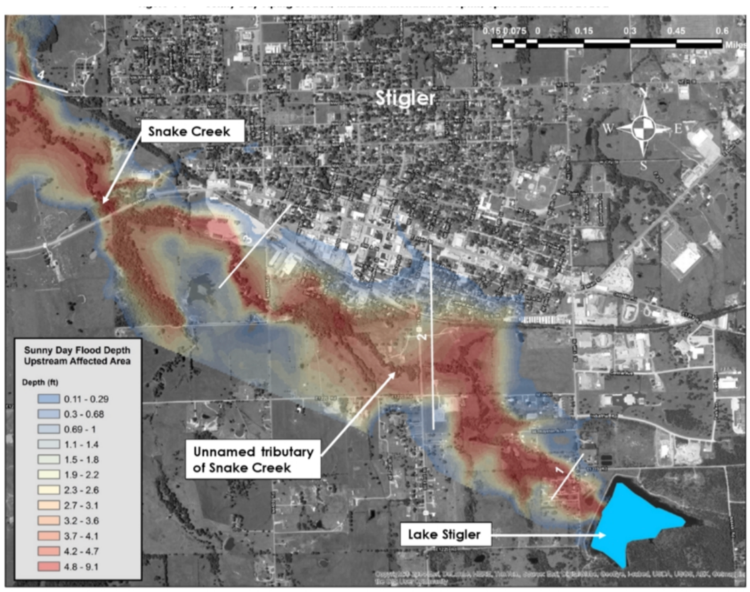
Parthenia Lake



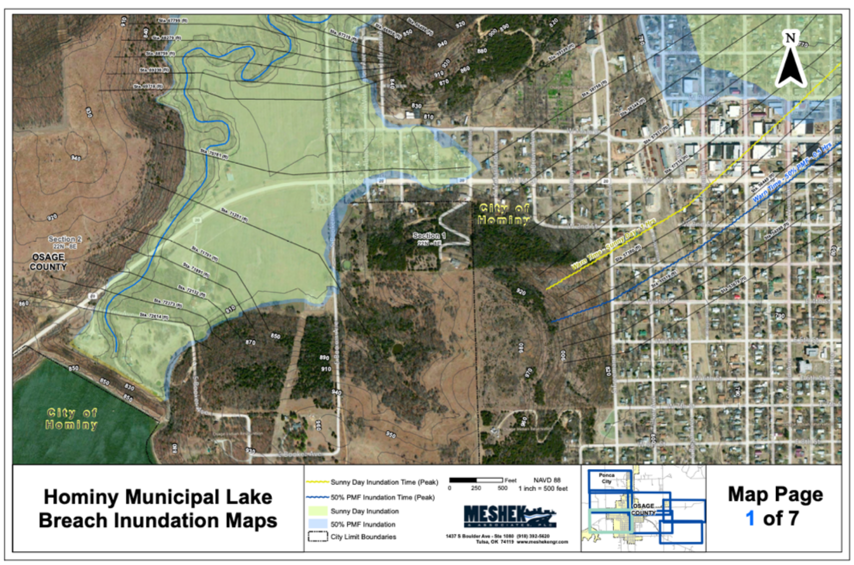
Sahoma Lake

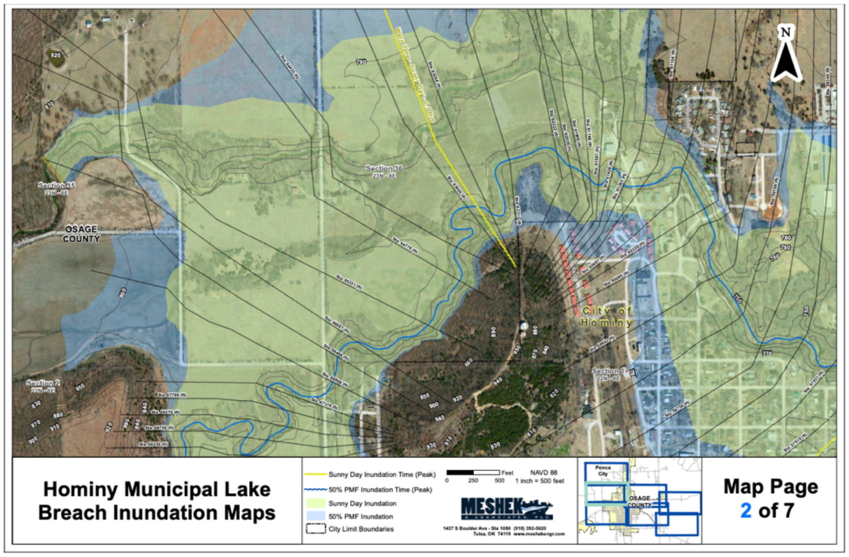


Stigler Lake



Hominy Lake




Hominy Municipal Lake
Breach Inundation Maps
Sunny Day Inundation Time (Peak)
50% PMF Inundation Time (Peak)
Sunny Day Inundation
50% PMF Inundation
City Limit Boundaries
MESHEK
Map Page
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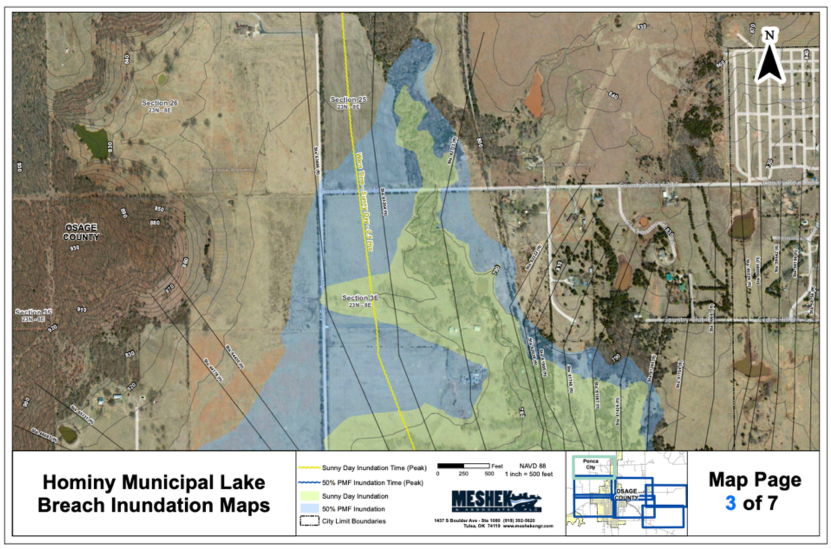
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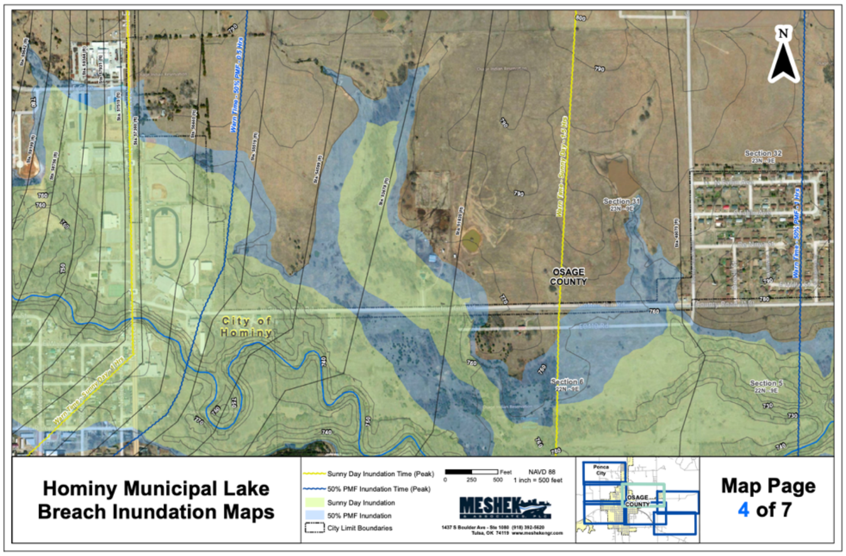
City of Hominy
OSAGE COUNTY
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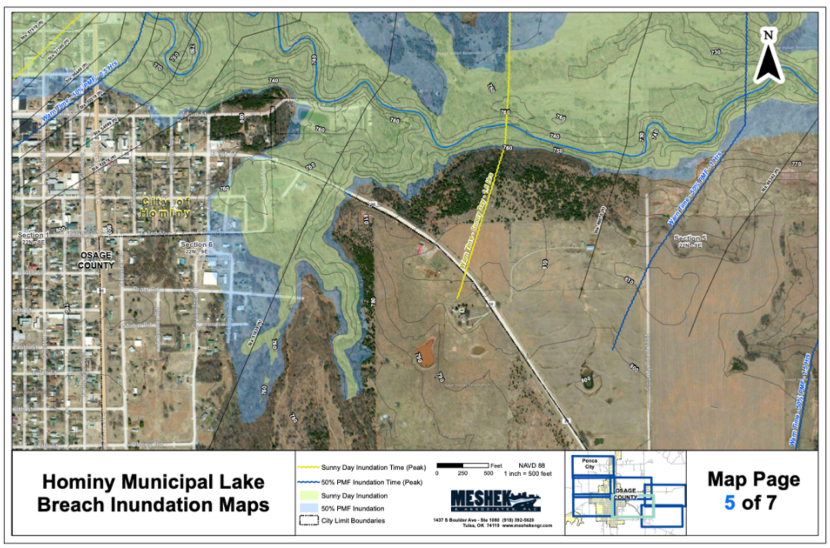
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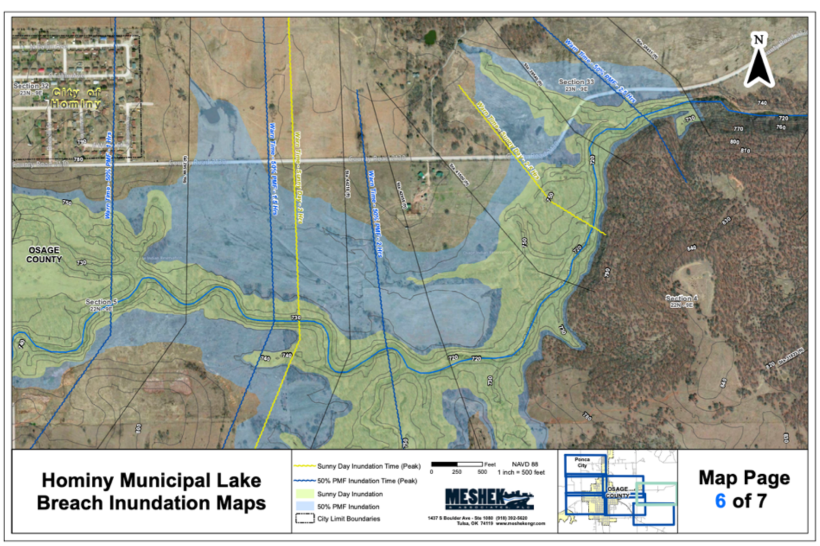
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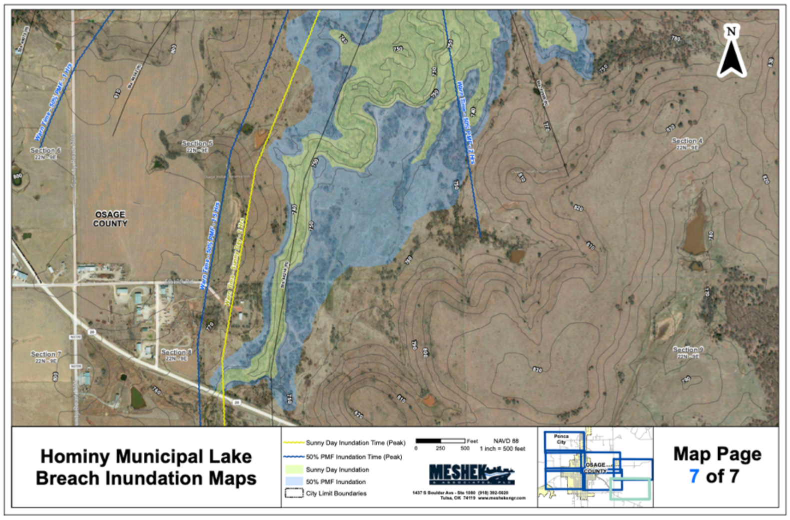
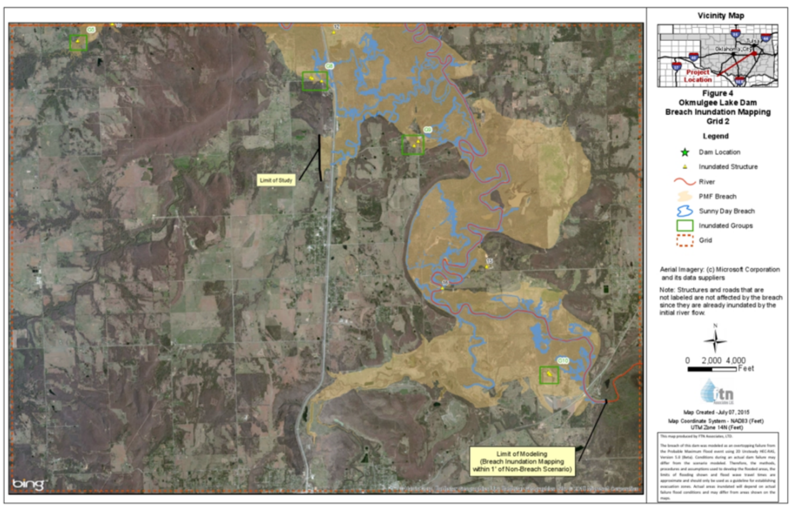
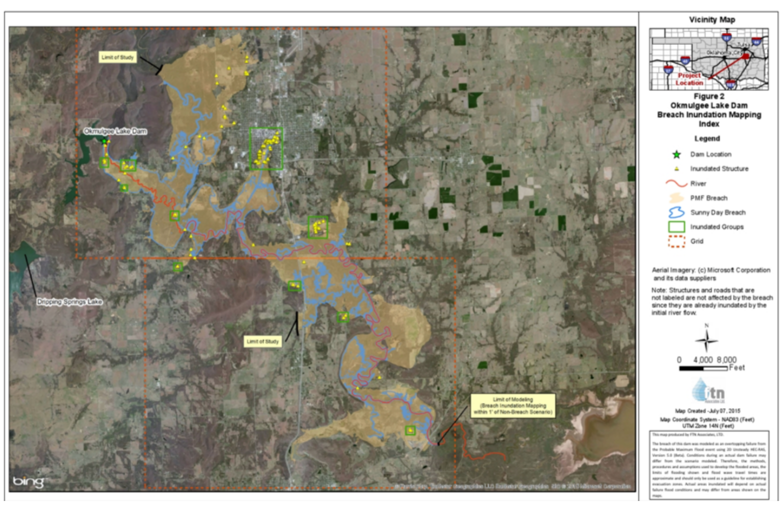
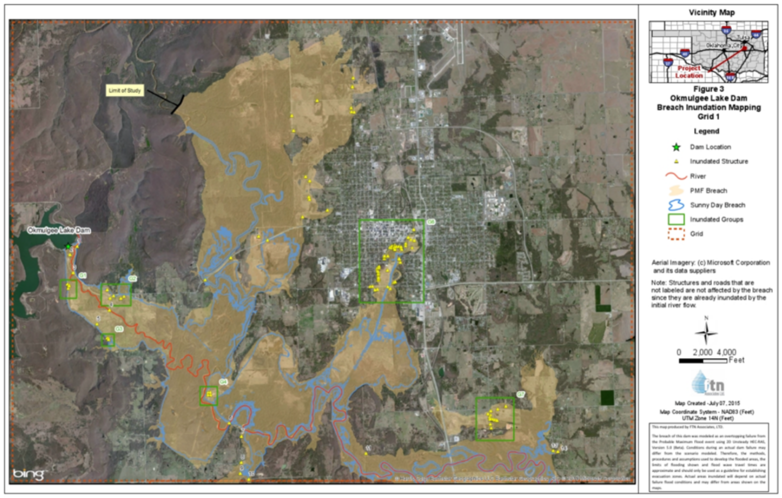


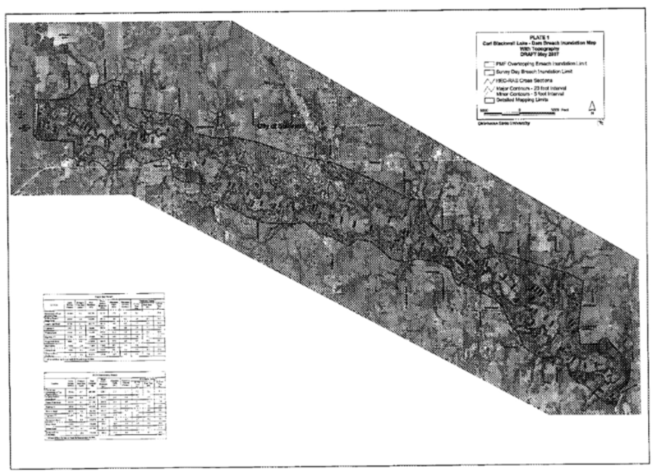
Okmulgee Lake

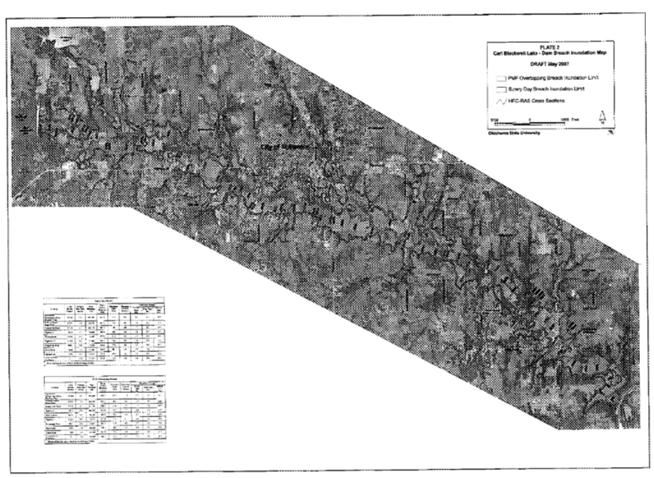




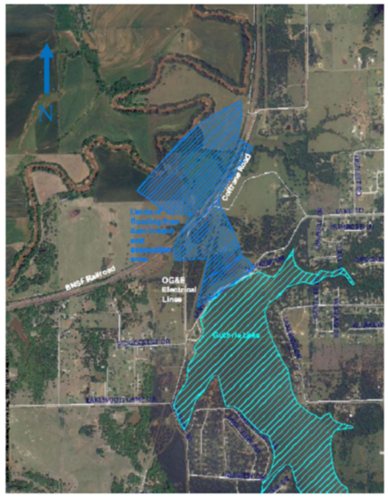


Lake Carl Blackwell

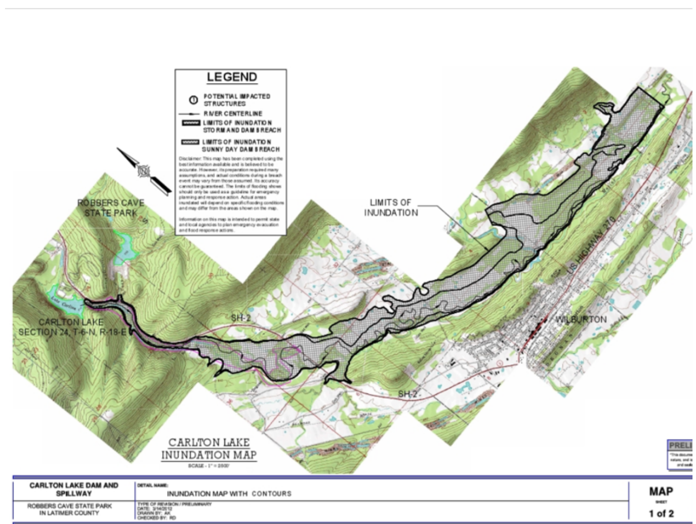


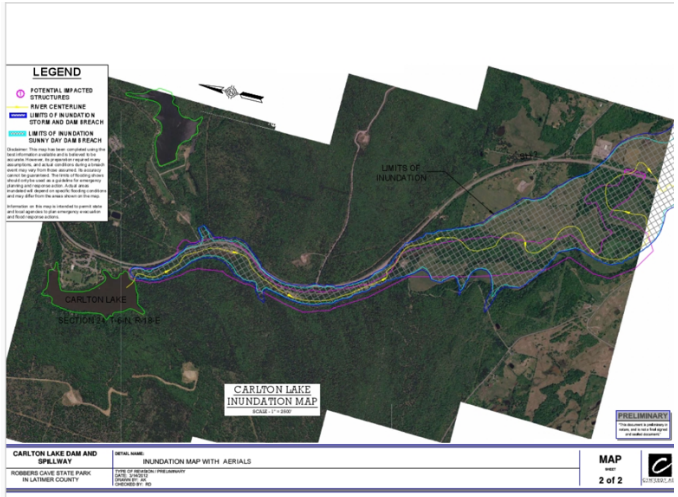


Guthrie Lake

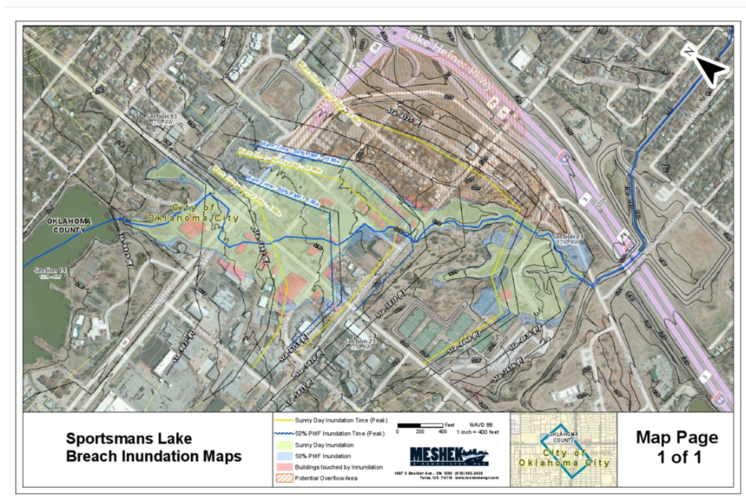


Carlton Lake

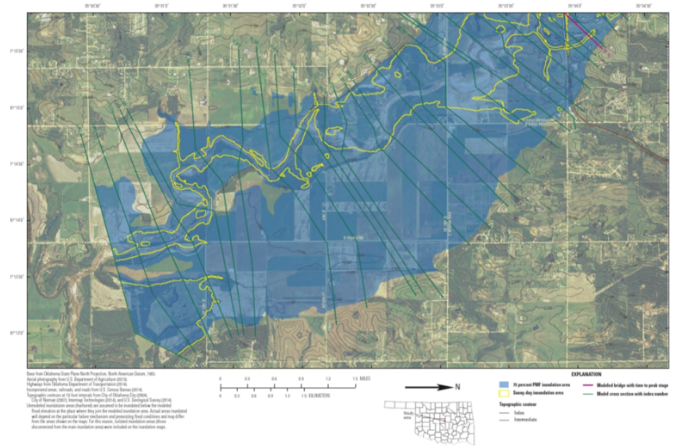


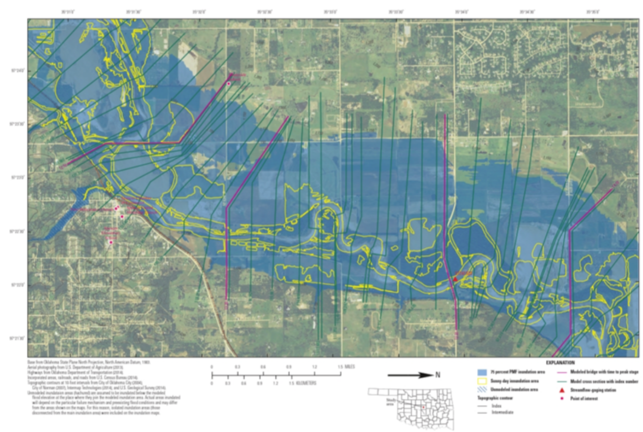


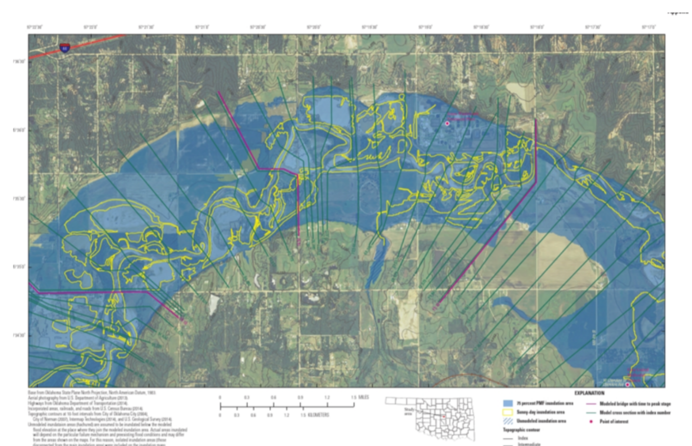
Sportsmans Club

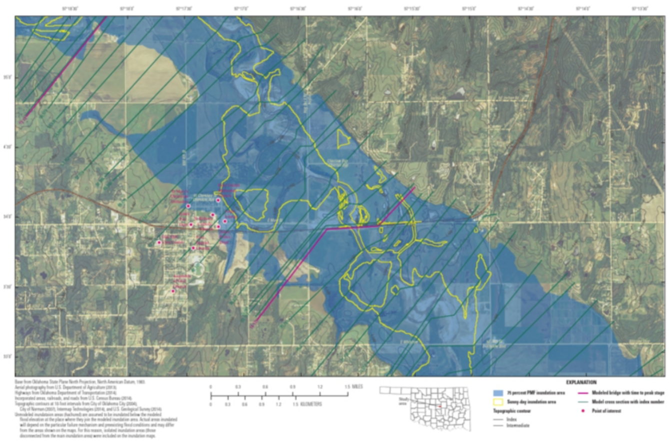


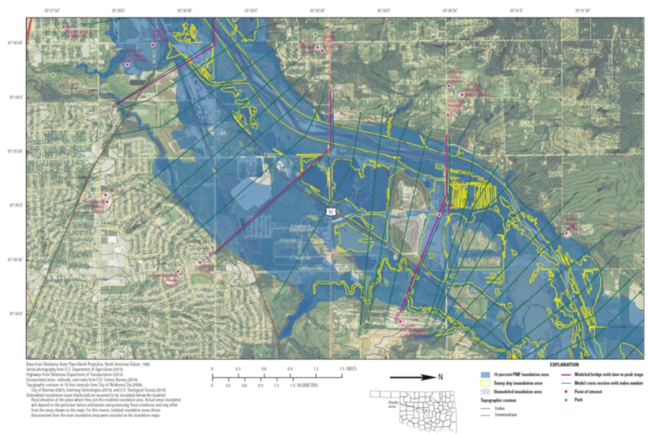
Overholser

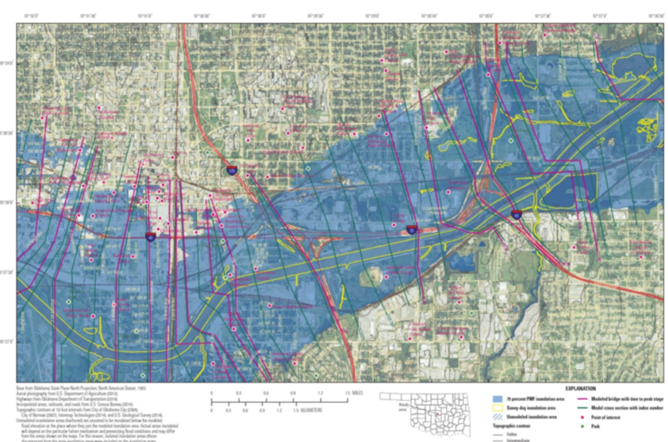


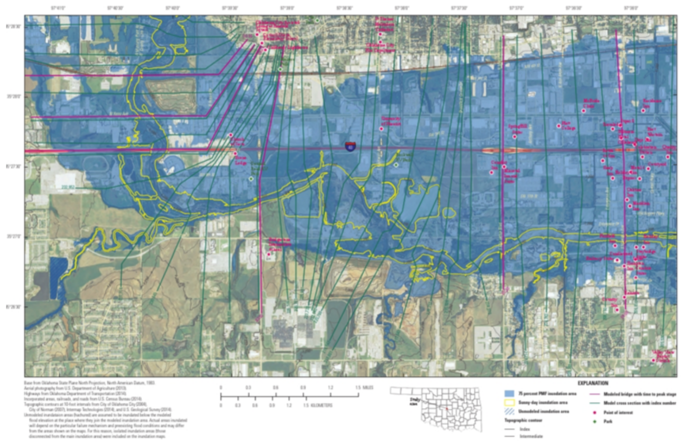


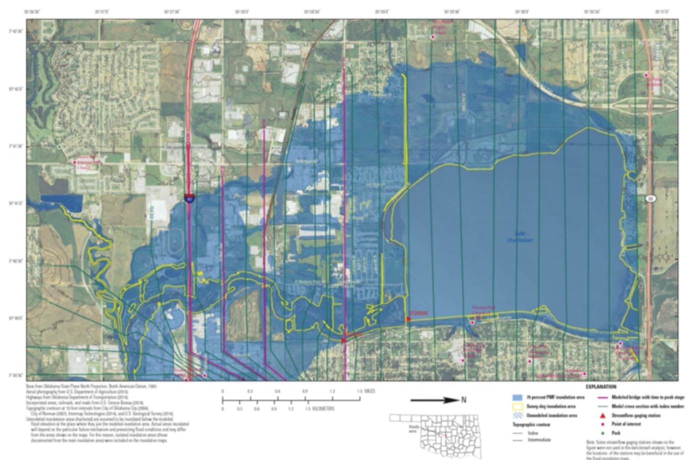


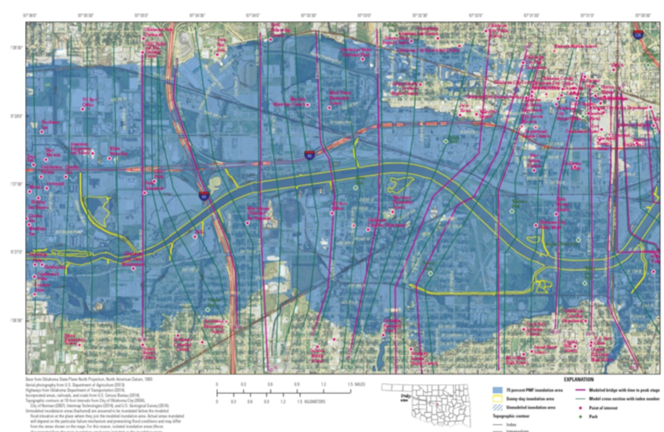




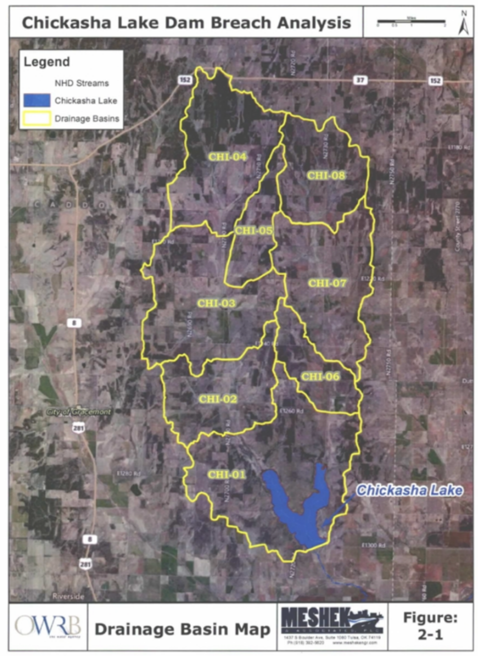




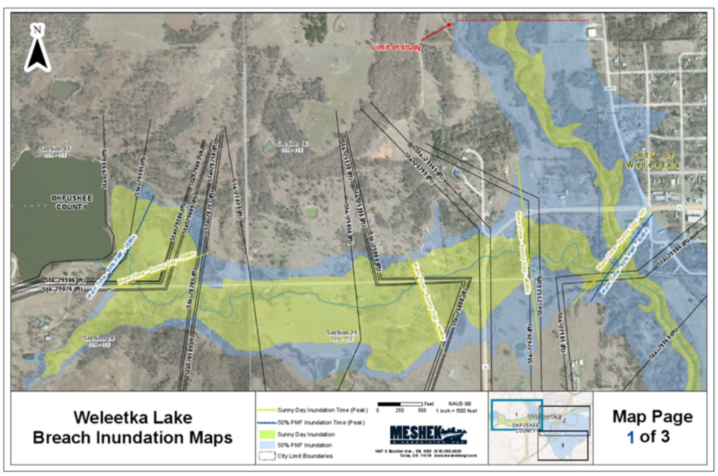


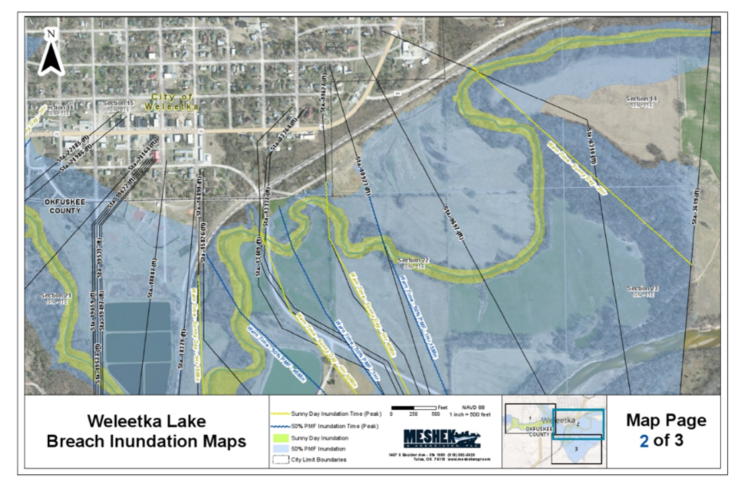


Chickasha



Weleetka




Weleetka Lake
Breach Inundation Maps
MESHEK
Map Page
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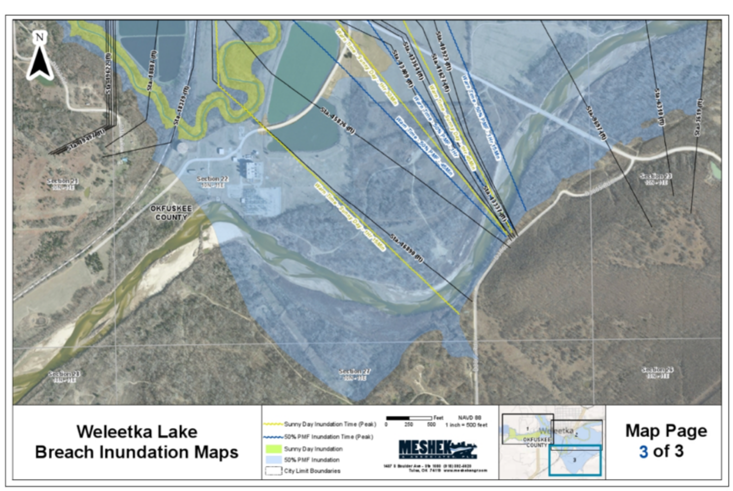
Weleetka Lake
Breach Inundation Maps
MESHEK
Map Page
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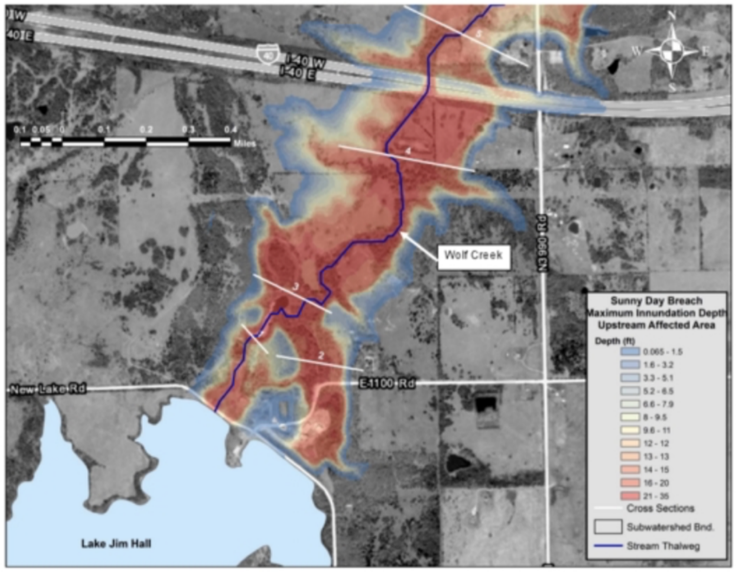
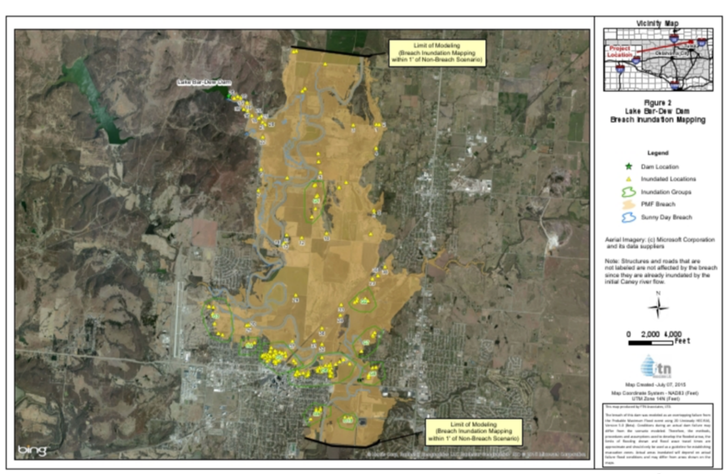
Jim Hall Lake

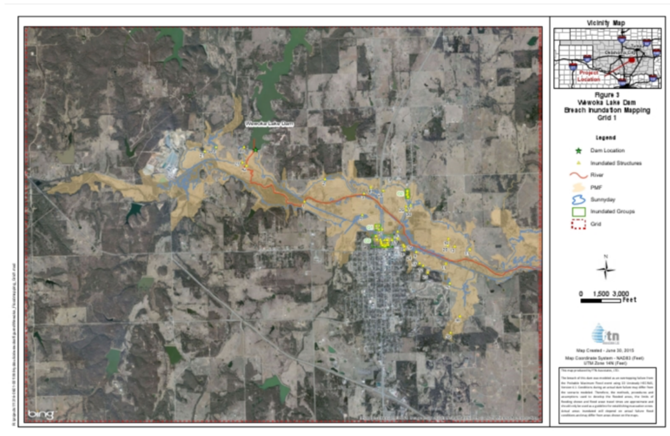
Figure 4-1 Sunny Day Piping Breach, Maximum Inundation Depths, Upstream Affected Area

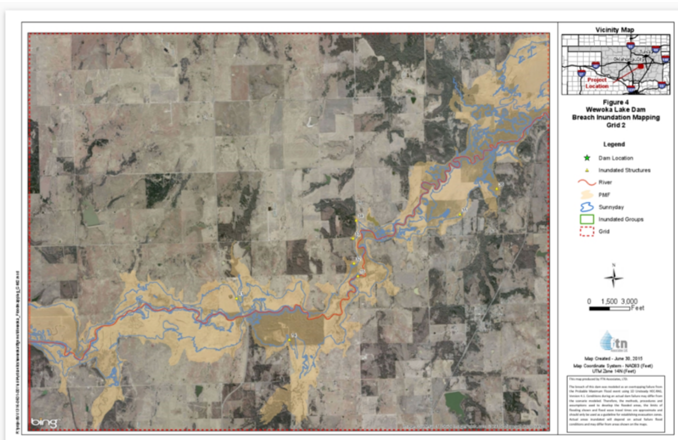


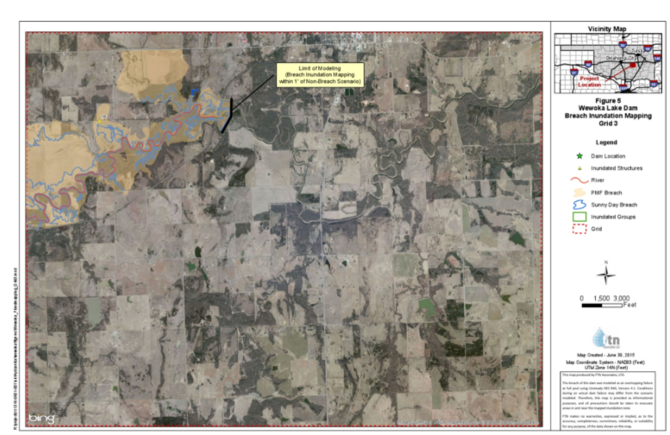
Lake Bar-Dew



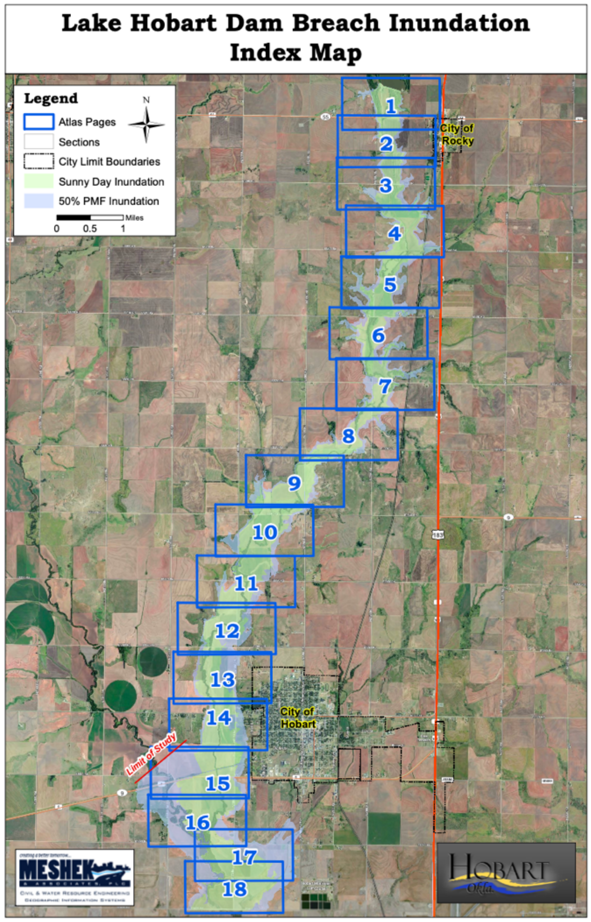
Wewoka


Vicinity Map
Project Location
Figure 3
Wewoka Lake Dam
Breach Inundation Mapping
Grid 1
Legend
Dam Location
Inundated Structures
River
PMF
Sunnyday
Inundated Groups
Grid
N
0 1,500 3,000
Feet

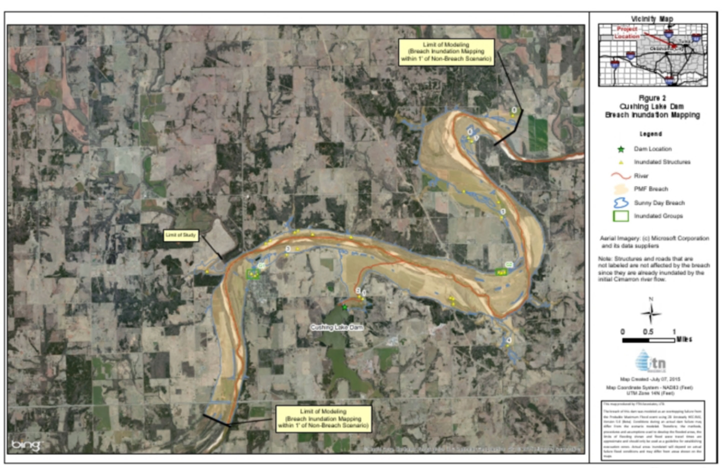

Vicinity Map
Project Location
Figure 4
Wewoka Lake Dam
Breach Inundation Mapping
Grid 2
Legend
Dam Location
Inundated Structures
River
PMF
Sunnyday
Inundated Groups
Grid
N
0 1,500 3,000
Feet


Limit of Modeling
Vicinity Map
Project Location
Figure 5
Wewoka Lake Dam
Breach Inundation Mapping
Grid 3
Legend
Dam Location
Inundated Structures
River
PMF Breach
Sunny Day Breach
Inundated Groups
Grid
N
0 1,500 3,000
Feet

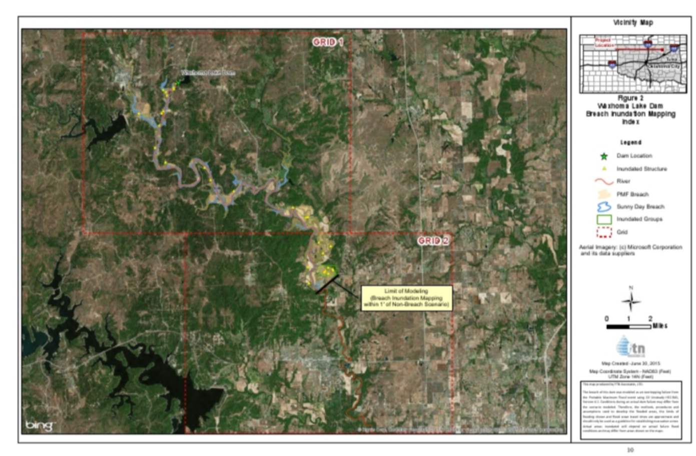
Hobart



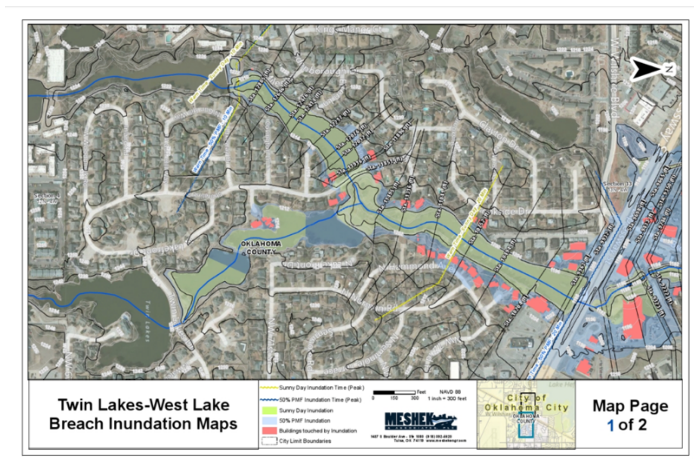
Cushing Lake

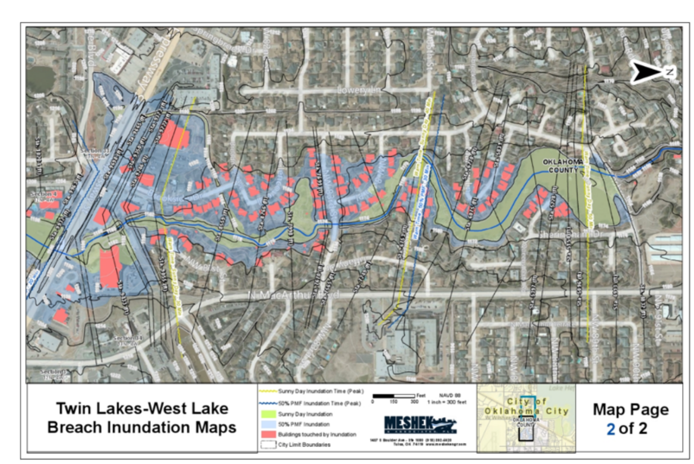


Waxhoma

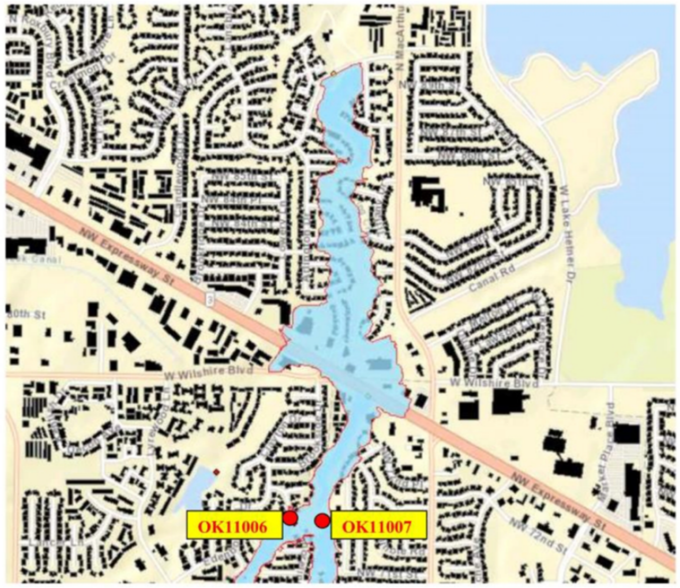


Twin Lakes West



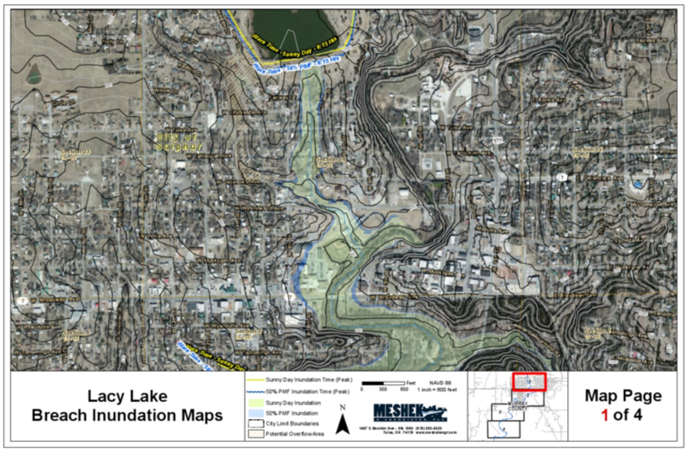


Pines East (OK11007)



Shell Creek Lake Dam

Lacy


Lacy Lake
Breach Inundation Maps
Map Page
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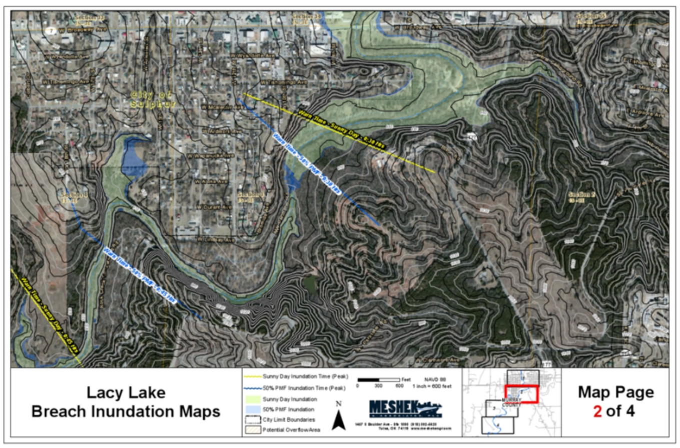
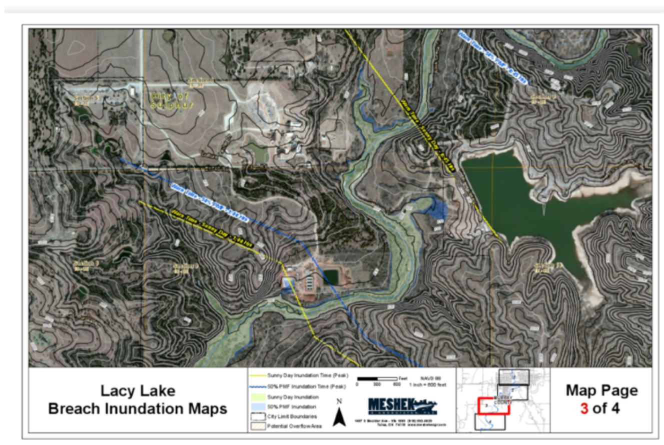

Lacy Lake
Breach Inundation Maps
Map Page
2 of 4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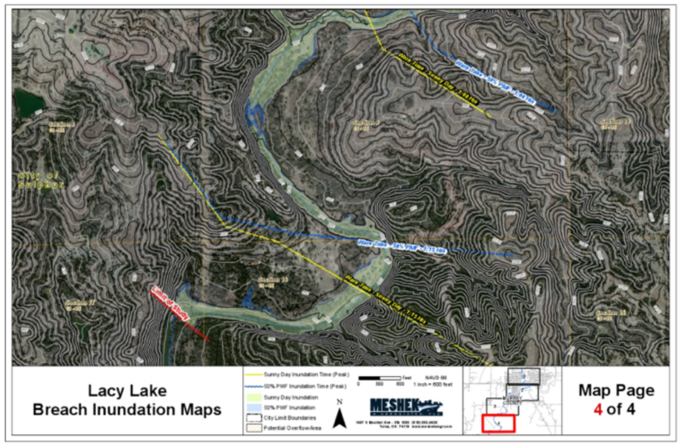
Lacy Lake
Breach Inundation Maps
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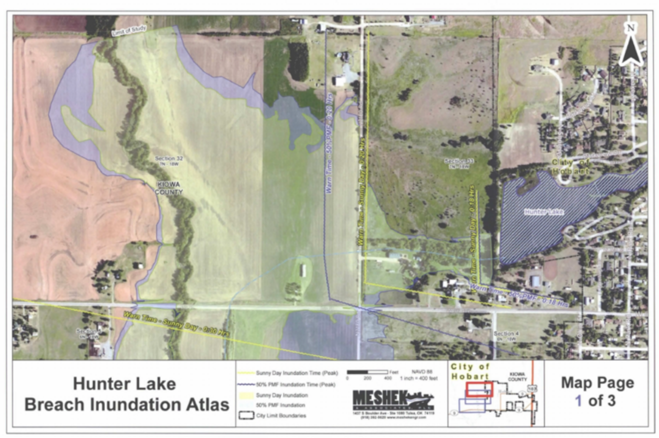
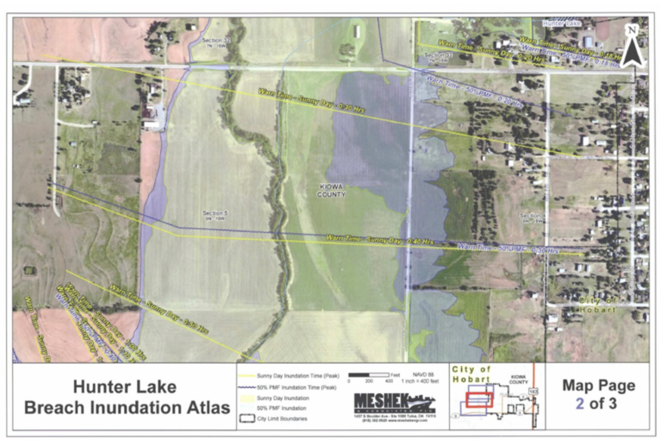
Hunter


Hunter Lake
Breach Inundation Atlas
City of Hobart
Map Page
1 of 3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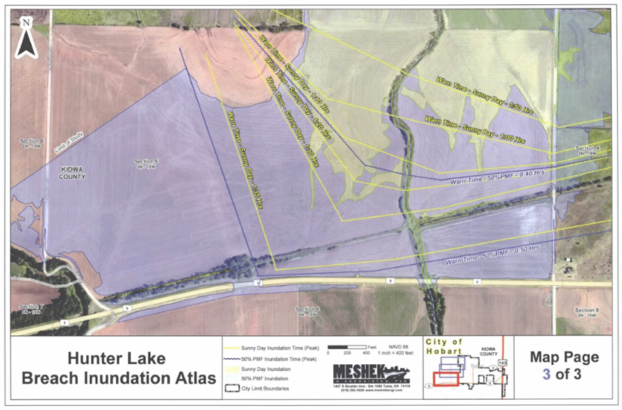
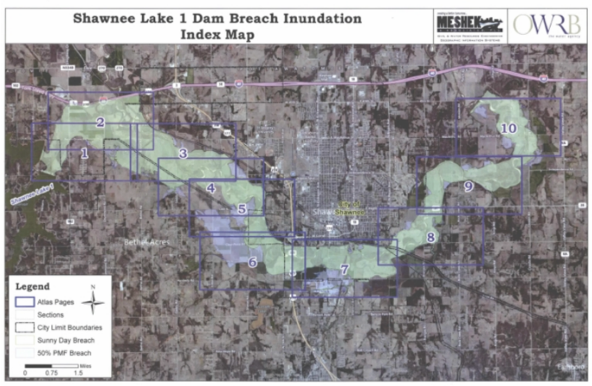
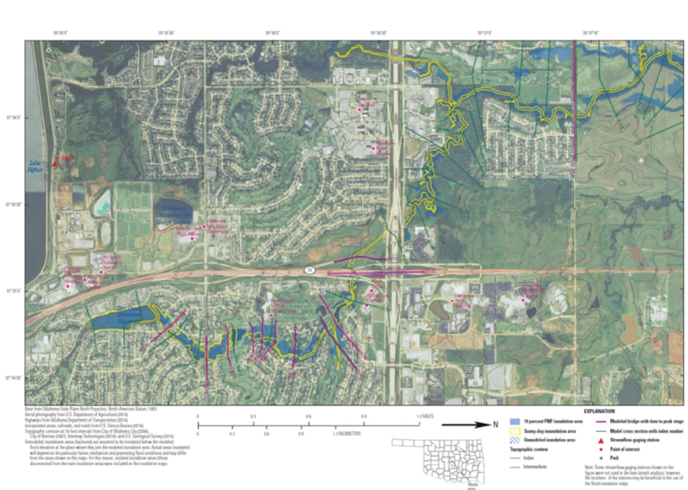
City of Hobart
Map Page
2 of 3



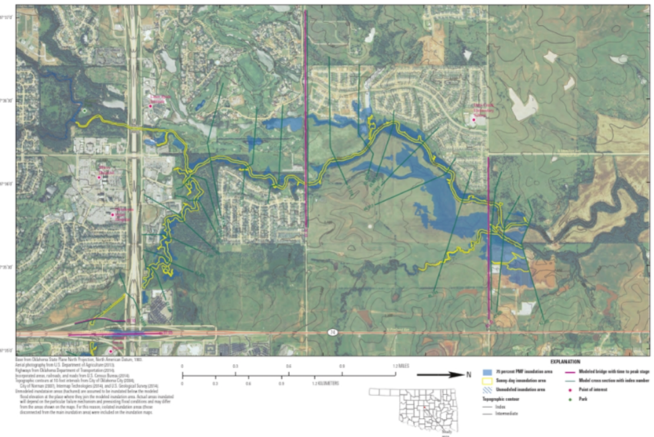
Shawnee City Lake No.1



Dry Creek Detention Pond

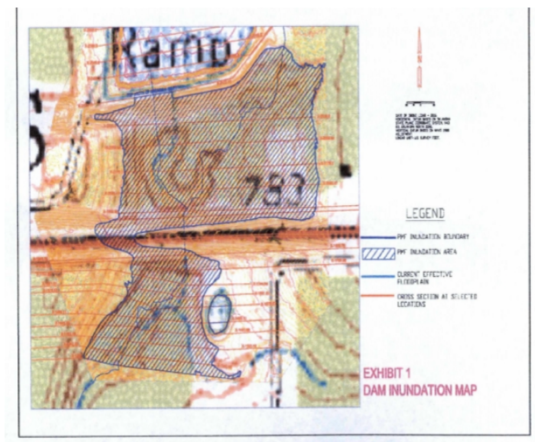


Appendix 4-1. Inundated areas for the 75-percent probable maximum flood (PMF) and sunny-day Dry Creek Detention Reservoir dam-breach model scenarios and time to peak stage for the 75-percent probable maximum flood.



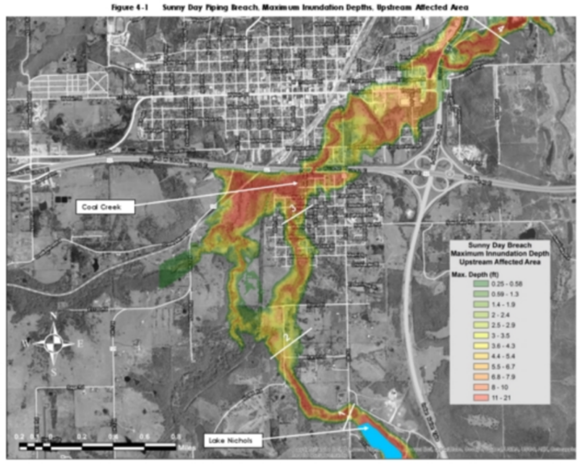
Appendix 4–2. Inundated areas for the 75-percent probable maximum flood (PMF) and sunny-day Dry Creek Detention Reservoir dam-breach model scenarios and time to peak stage for the 75-percent probable maximum flood.

New Beggs

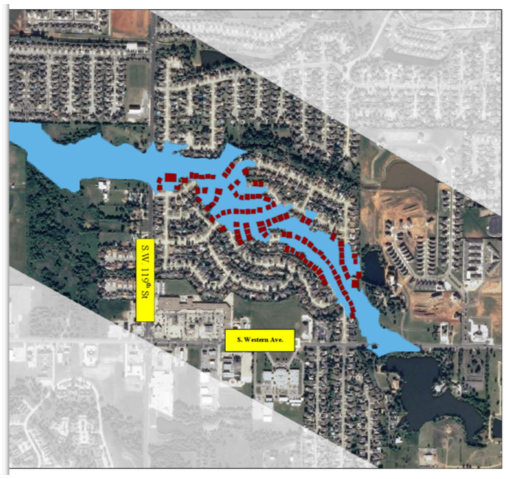


Nichols Lake

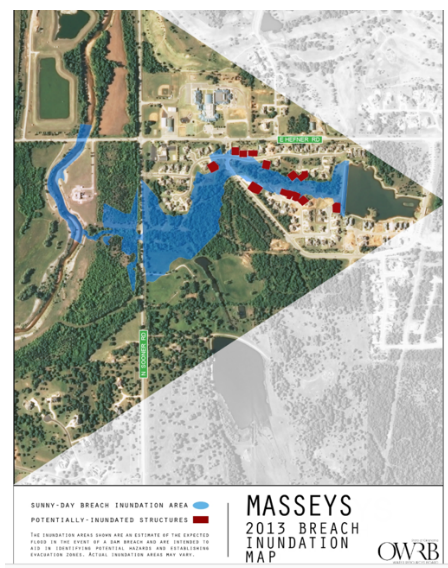
Figure 4-1 Sunny Day Piping Breach, Maximum Inundation Depths, Upstream Affected Area



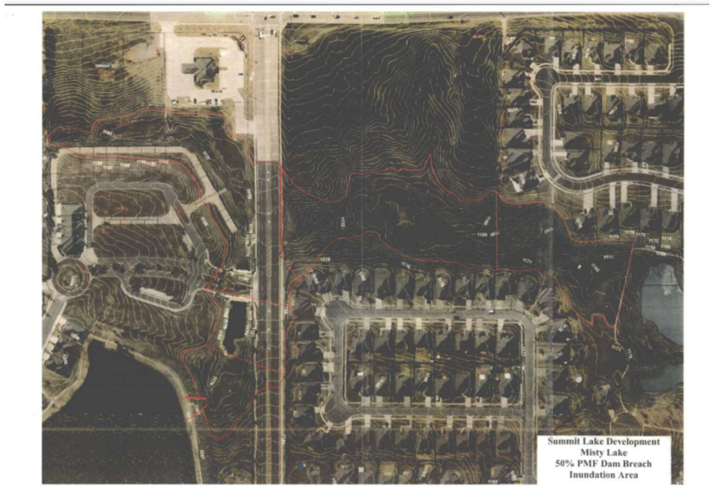
Templo de Alabanza



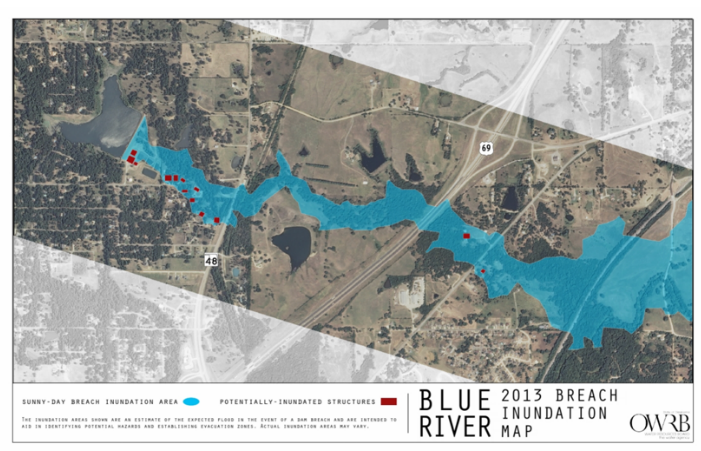
Masseys



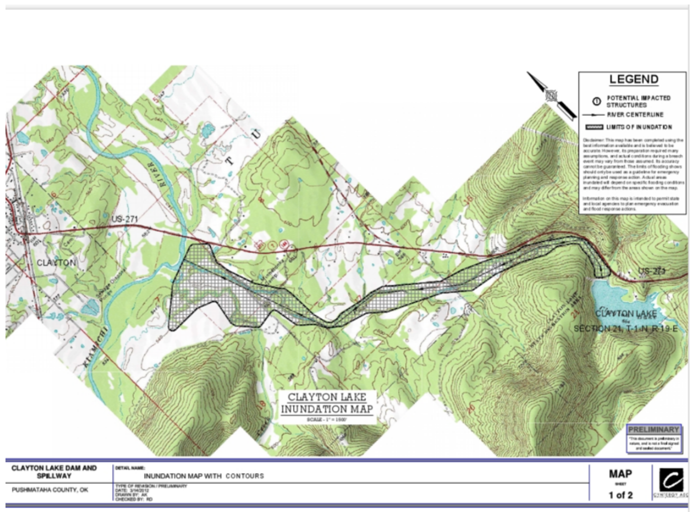
Summit Lake

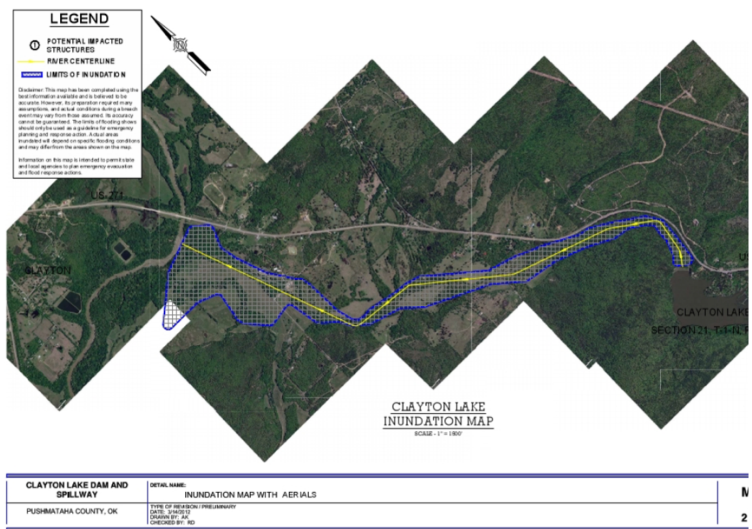


Blue River Dam

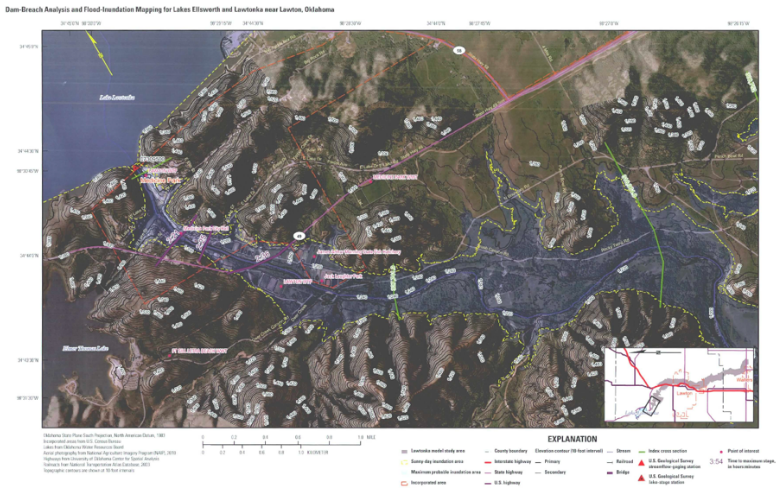


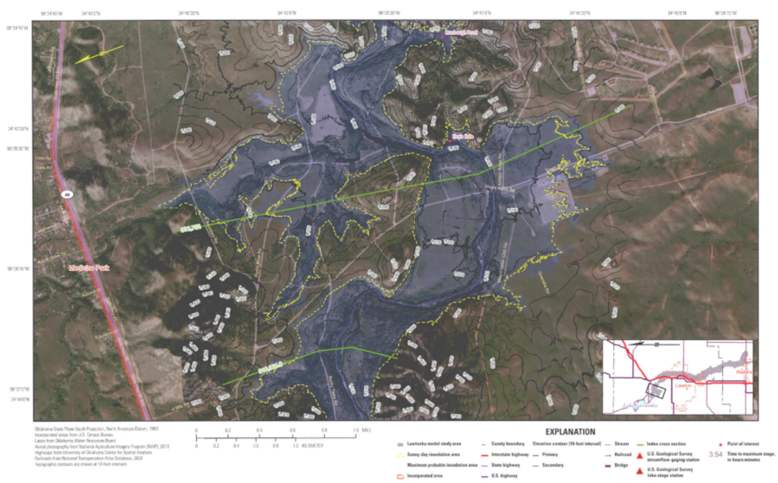
Clayton Lake

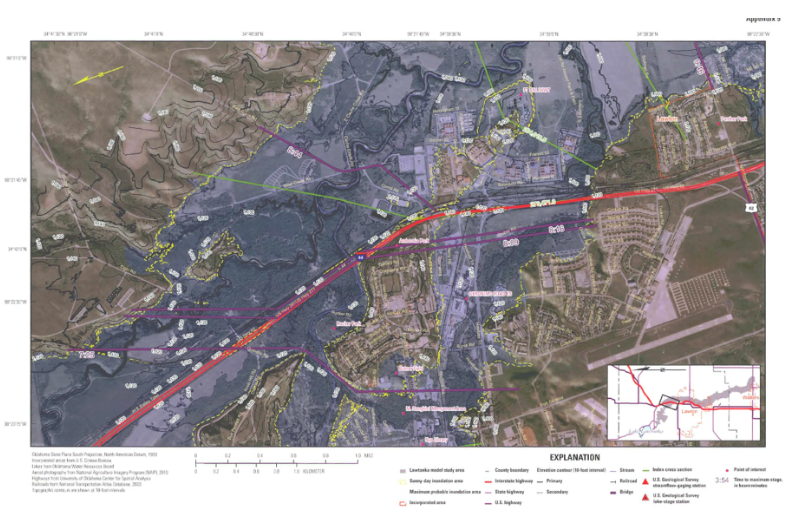




Lawtonka


Dam-Breach Analysis and Flood-Inundation Mapping for Lakes Ellsworth and Lawtonka near Lawton, Oklahoma
EXPLANATION


EXPLANATION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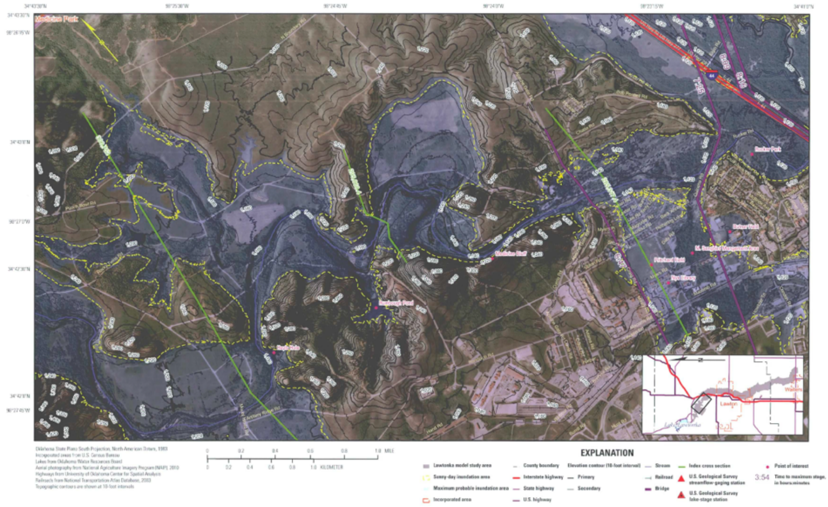
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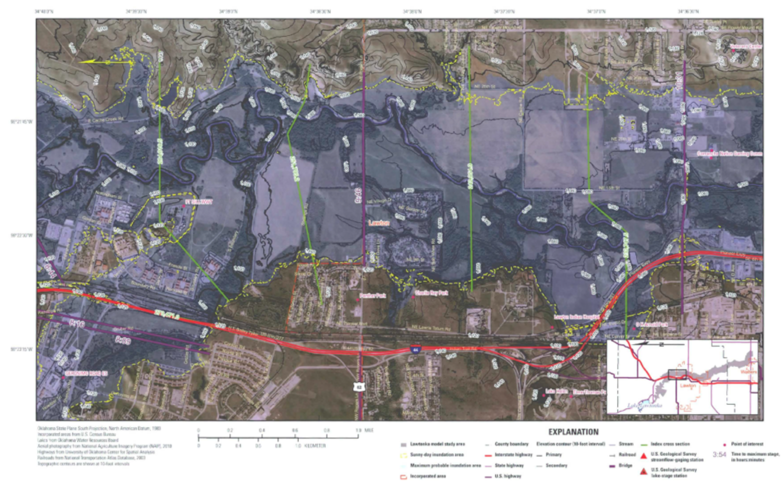
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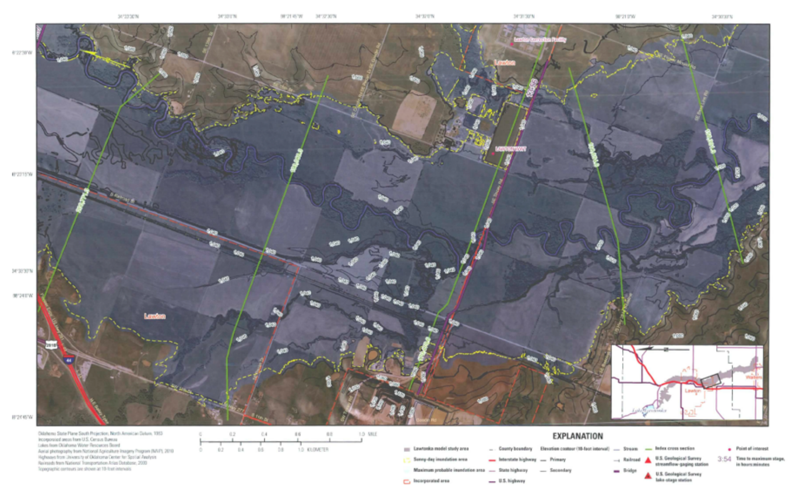
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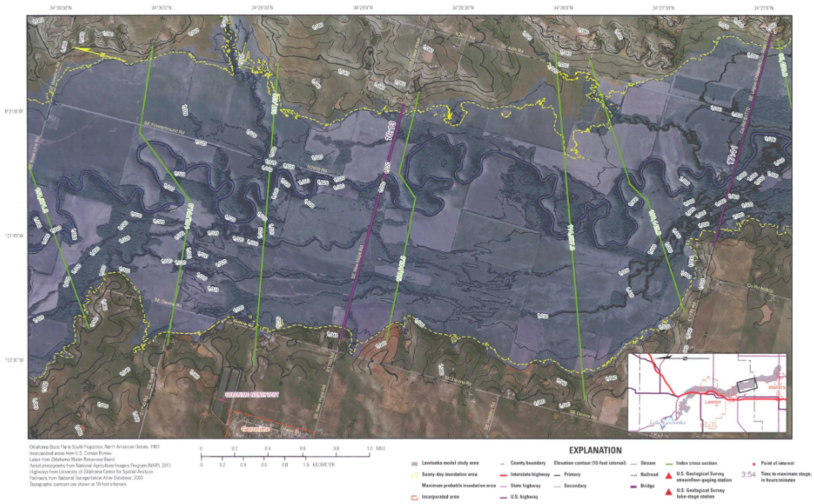
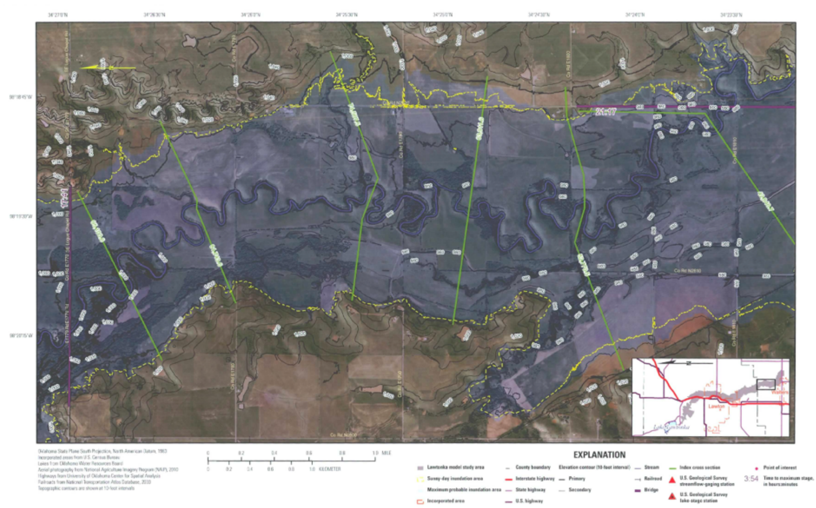

EXPLANATION
Lawtonka model study area
Sunny-day inundation area
Maximum probable inundation area
Incorporated area
County boundary
Interstate highway
State highway
U.S. highway
Elevation contour (10-foot interval)
Primary
Secondary
Stream
Railroad
Bridge
Index cross section
U.S. Geological Survey streamflow-gaging station
U.S. Geological Survey lake-stage station
Point of interest
3:54 Time to maximum stage, in hours:minutes
Lawton
Walters


EXPLANATION
Lawtonka model study area
Sunny-day inundation area
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Incorporated area
County boundary
Interstate highway
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U.S. highway
Elevation contour (10-foot interval)
Primary
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Stream
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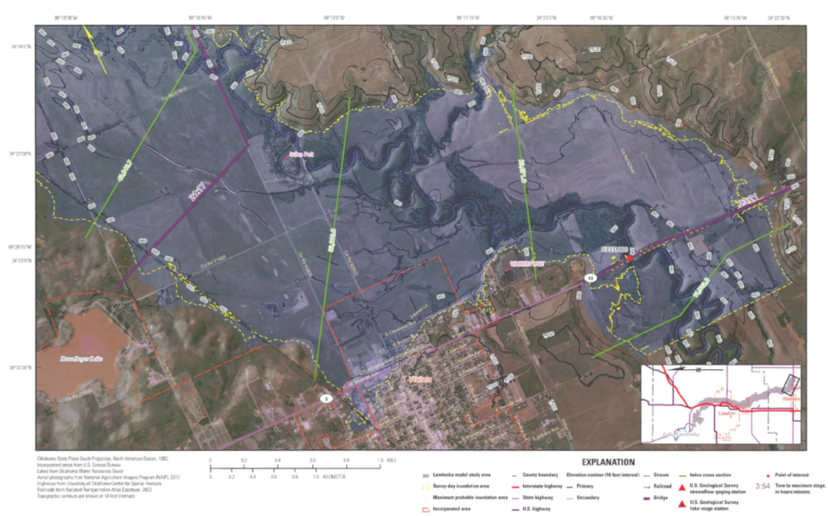
Bridge
Index cross section
U.S. Geological Survey streamflow-gaging station
U.S. Geological Survey lake-stage station
Point of interest
3:54 Time to maximum stage, in hours:minutes


EXPLANATION
Lawtonka model study area
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Bridge
Index cross section
U.S. Geological Survey streamflow-gaging station
U.S. Geological Survey lake-stage station
Point of interest
3:54 Time to maximum stage, in hours:minutes

9.2.2 Limitations during the Planning Process

During the Planning Process there were no limitations in coordination with state agencies, to include the OWRB. However, limitations in obtaining data were identified.

HHPD owners are responsible for maintaining dam evaluation, risk, and analysis data, and they provide this data to OWRB. Generally, HHPD owners with more financial resources often have data readily available to provide to OWRB. HHPD owners with less resources are more likely to have incomplete or outdated data. This can include older breach maps with poor resolution, or a lack of breach mapping altogether.

One main limitation is that the available dam inundation maps vary with age, with some of those maps being drafted in the 1980s to 2010s. Due to the wide range of dates, these maps utilize a variety of analysis methods and technical software. A significant limitation to getting all of the inundation mapping updated is funding availability.

One of the ways OWRB has worked to address these limitations is by identifying which dams lack critical data, and coordinating with the U.S. Army Corps of Engineers (USACE) so that agency can create breach mapping as needed. As of August 2023, USACE is fully funding 23 High Hazard Dams that need breach maps done/redone, and assisting to address identified data deficiencies.

Another limitation is that the eligibility requirements for evaluating HHPDs can change each year. This can result in some dams being ineligible one year, but eligible in subsequent years. These varying eligibility requirements means that different grant awards will be managed with an inconsistent set of metrics and standards from year to year.

9.3 Dam Risks from High Hazard Potential Dams Eligible for Potential Rehabilitation

9.3.1 High Hazard Potential Dams Identified for Rehabilitation by OWRB

The Oklahoma Dam Safety Program maintains a list of the downstream risks/consequences for each HHPD under both static failure conditions, (i.e., failure modes not associated with hydrologic events, also known as ‘sunny-day’ events). It also maintains a list of extreme hydrologic loading failure conditions, (i.e., failure modes associated with dam overtopping or other flood induced events), where available. Included in the summary of consequences are identified downstream critical structures, major roadways and bridges, the number of persons at risk due dam failure, and the jurisdictions in which the risks are located.

The Oklahoma Dam Safety Program publication “Dam Risk Prioritization Methodology” outlines the risk-based priority system used to identify high hazard-potential dams in Oklahoma. The risk-based priority system is used to evaluate HHPD based on the identified consequences of dam failure of each HHPD and the relative likelihood of identified dam failure modes.

Unacceptable Risk Dams Definition: Dams that pose an unacceptable risk to the public are those that are classified as high hazard-potential, are in other than satisfactory condition, and do not meet current state dam safety requirements. The OWRB maintains a list of dams that are considered to pose an unacceptable risk to the public.

These dams are required to be brought into compliance with state dam safety requirements, and increased mitigation actions must be taken to reduce vulnerabilities from dam failure until compliance has been achieved. Mitigation actions must be tailored to individual dams depending on the identified potential failure mode that is being mitigated. With guidance from the Oklahoma Dam Safety Program and dam owners' technical representatives, the owners of these dams are responsible for identifying and implementing temporary risk reduction measures.

Unacceptable Risk Dams Identification: Of the total high 116 hazard-potential dams in Oklahoma, 34 dams were identified as having an unacceptable amount of risk associated with them as determined by the condition assessment assigned to them in their most recent inspection reports, and the factors described above.

High Hazard Potential Dams Eligible for Rehabilitation (2022)

Dam Name	NID #	Jurisdictional Location	Breach Inundation Area	Owner Type
Ellsworth	OK00452	Comanche Co	Caddo Co, Comanche Co, Cotton Co, Elgin, Lawton, Walters	Local Govt.
Parthenia Lake	OK00563	Tulsa, Creek County	Tulsa, (Creek Co)	Non profit
Sahoma Lake	OK00566	Sapulpa, Creek Co	Creek Co, Salpupa	Local Govt.
Stigler Lake	OK00699	Stigler, Haskell Co	Haskell Co, Stigler	Local Govt.
Hominy Lake	OK01344	Osage Co	Osage Co, Hominy	Local Govt.
Okmulgee Lake	OK01362	Okmulgee, Okmulgee Co	Okmulgee, Okmulgee Co, Henryetta	Local Govt.
Lake Carl Blackwell	OK01388	Payne Co	Payne Co, Noble Co, Ripley, Stillwater	State
Guthrie Lake	OK02123	Guthrie, Logan Co	Logan Co, Guthrie	Local Govt.
Carlton Lake	OK02175	Latimer Co	Latimer Co, Wilburton	State
Sportsmans Club	OK02426	Oklahoma Co	Oklahoma Co, Oklahoma City	Private
Overholser	OK02537	OKC, Oklahoma Co	Bethany, Choctaw, Del City, Harrah, Jones, Midwest City, Oklahoma City, Oklahoma Co, Spencer	Local Govt.
Chickasha	OK02562	Caddo Co	Caddo Co	Local Govt.
Weleetka	OK10076	Okfuskee Co	Okfuskee Co, Weleetka	Local Govt.
Jim Hall Lake	OK10237	Okmulgee Co	Okmulgee Co	Local Govt.

Lake Bar-Dew	OK10411	Washington Co	Primarily Washington Co, and a small area of Osage Co	Private
Wewoka	OK10487	Seminole Co	Seminole Co, Wewoka, Hughes Co	Local Govt.
Hobart	OK10494	Washita Co	Washita Co, Hobart, Kiowa Co	Local Govt.
Cushing Lake	OK10642	Payne Co	Payne Co, Ripley	Local Govt.
Waxhoma	OK10731	Barnsdall, Osage Co	Avant, Barnsdall	Local Govt.
Twin Lakes West	OK11005	OKC (Oklahoma Co)	Oklahoma City, OK	Private
Pines East	OK11007	OKC (Oklahoma Co)	Oklahoma City, OK	Private
Shell Creek Lake Dam	OK11015	Sand Springs, Osage Co	Osage Co, Avant, Barnsdall, Skiatook, Tulsa Co, Washington Co	Local Govt.
Lacy	OK11016	Sulphur (Murray Co)	Sulpher, OK	Private
Hunter	OK11027	Hobart, Kiowa Co	Kiowa Co	Local Govt.
Shawnee City Lake No.1	OK11039	Shawnee, Pottawatomie Co	Pottawatomie Co, Bethel Acres, Earlsboro, McLoud, Shawnee	Local Gov
Dry Creek Detention Pond	OK11061	OKC, Oklahoma Co	Oklahoma City, OK	Local Govt.
New Beggs	OK11078	Beggs, Okmulgee Co	Okmulgee Co	Local Govt.
Nichols Lake	OK11079	Henryetta, Okmulgee Co	Okmulgee Co, Dewar, Henryetta, Schulter	Local Govt.
Templo de Alabanza	OK11089	Cleveland, Co	Oklahoma City, OK	Private
Masseys	OK12201	Oklahoma Co	Oklahoma City, OK	Private
Summit Lake	OK12578	Cleveland Co	Norman, OK	Private
Blue River Dam	OK21346	Bryan Co	Bryan Co, Durant	Local Govt.
Clayton Lake	OK21490	Pushmataha Co	Pushmataha Co, Clayton	State
Lawtonka	OK00450	Comanche Co	Comanche Co, Cotton Co, Lawton, Medicine Park, Walters	Local Govt.

Projects Partially funded through FEMA's HHPD Rehabilitation Program

Year	Selected Subrecipient	Dam Name	NIDID	Subrecipient Federal Award	Cost Share Contribution
FY19	Oklahoma State University	Lake Carl Blackwell	OK01388	$217,750.00	$117,250.00
	OK Dept. of Tourism	Carlton Lake	OK02175	$59,269.00	$31,914.08

FY20	City of Guthrie	Guthrie Lake	OK02123	$100,555.00	$35,194.25
	OK Dept. of Tourism	Clayton Lake	OK21490	$83,962.00	$29,386.70
FY21	Oklahoma City Water Utilities Trust	Overholser	OK02537	$552,500.00	$297,500.00
	City of Okmulgee	Okmulgee	OK01362	$44,362.00	$23,888.00
	City of Shawnee	Shawnee City Lake Dam No. 1	OK11039	$65,000.00	$35,000.00
	City of Lawton	Lawtonka	OK00450	$105,634.37	$56,882.74
	City of Lawton	Ellsworth	OK00452	$86,017.03	$46,316.87
FY22	Oklahoma City Water Utilities Trust	Overholser	OK02537	$509,100.00	$274,131.00
	City of Lawton	Ellsworth	OK00452	$925,251.00	$498,212.00

9.3.2 Statewide Vulnerabilities to/from High Hazard Potential Dams Eligible for Rehabilitation Program and Potential Consequences

1. Cascading Impacts:

In heavy rainfall or flooding, some dams are designed to hold back some of the water flowing downstream, protecting people and property downstream from higher water. This naturally results in higher water upstream of the dam, but auxiliary spillways are designed to pass excess floodwaters downstream. However, some dams are not designed to function as flood control structures. They are run-of-the-river dams designed to hold relatively stable water levels in the impoundment. Flood situations can sometimes exceed the capabilities of either type of dam, resulting in a failure, and a more drastic and sudden flooding of downstream property.

Earthquakes can result in damages or failures to dam structures. The total risk for dam structures mainly depends on the seismic hazard rating of dam site and the risk rating of the completed structure. Large dams must be designed with a capability of resisting severe earthquake motion, or fault movement, at the dam site without uncontrolled release of water stored in reservoir.

Landslide events can negatively impact dams. If sediments enter a dam or reservoir lake, it can compromise the integrity and functionality of the dam facility, putting additional stressors on its stability.

Wildfires change the conditions of a watershed, such as how fast water can move, and how vulnerable the land surface is to erosion. Heavy rains in a burned area can create:
- More and faster runoff from rainfall events, especially high-intensity storms.

- Large amounts of sediment, which may reduce storage capacity in the reservoir.
- Debris flows (mudslides) or downed timber, which may obstruct access to the dam.
- Debris flows from hill slopes near spillways, which may obstruct spillways.
- More floating debris (dead trees, branches, sticks) in the reservoir, which may obstruct spillways and damage the face of the dam.

2. Potential Impacts to Institutions /Critical Infrastructure/Community Lifelines:

Many HHPD owners and surrounding municipalities make an effort to limit critical infrastructure, institutions, and community lifelines downstream of a dam. In Oklahoma, the largest type of critical infrastructure downstream of HHPDs is roadways and transportation routes. However, the exception to this is the presence of municipal wastewater treatment plants. Having a wastewater treatment plant near a water source is helpful to facilitate water treatment logistics, but during a dam breach the wastewater treatment plant's sewage lagoons can become flooded and overflow to the surrounding areas.

In some jurisdictions the water retained by the dam is the community's and/or region's sole source of drinking water. Some are water sources for a rural water district. This represents a critical infrastructure for some communities/region, and a loss of that infrastructure has significant negative consequences. These are discussed below.

3. Potential Economic, Environmental, and Social/Multi-Jurisdictional Impacts:

If a downstream water treatment were to be damaged during a HHPD breach, it could have economic, environmental, and social/multi-jurisdictional impacts:

Economic:
As stated above, some HHPDs serve as the only source of water for a community and/or region. If a HHPD breach were to occur and disrupt this source, the communities affected would have to quickly find a backup water source. This often involves delivering trucked-in water to the community, which can be a costly option. Some communities, and particularly their residents, are not financial able to absorb these unexpected costs.

In addition, water and wastewaster treatment plants can be costly for municipalities to maintain and upgrade, and these types of projects are often considered significant investments, which would be costly to repair if damaged during an inundation event. Some municipalities have relied on federal funding sources, such as American Rescue Plan (ARPA), to accomplish needed upgrades to these operations. Should a dam breach occur and cause damage to a downstream facility, it would result in a loss of time, effort, and potentially replacement cost, of that capital investment project.

Environmental:
When a dam breach inundates a wastewater treatment facility's sewage lagoon, it can pose a threat to surrounding areas by introducing harmful bacteria into adjoining land spaces, and it can also alter nearby water areas. Sewage is particularly high in nitrogen and phosphorous, and the material from these lagoons can serve as a potent fertilizer source. If this nutrient material is introduced to a body of water nearby which is not acclimated, it can result is algae blooms, dead fish, and water plant die off.

Social/Multi-Jurisdictional:
As stated above, there are HHPDs which serve as the only source of water for some of Oklahoma's communities and/or region, and some HHPDs serve as a critical resource for a rural water district. If a dam breach were to occur and affect this water source, it has the potential to a cause widespread negative impacts for residents, socially-vulnerable communities, and critical service providers in those affected communities. In addition, if a HHPD breach damages a water or wastewater treatment facility, the facility might not be able to service the needs of a community. This could result in a disruption, or suspension, of daily functioning needs for residents, schools, municipalities, and critical service providers.

An addition impact to consider is that a dam inundation event might affect multiple jurisdictional areas. Each area may have different capabilities levels and approaches to incident response. Cooperation between multiple jurisdictions adds level of complexity to an inundation response event.

4. Methodology and/or Assumptions for Risk Data and Inundation Modeling:

In order to evaluate the consequences that could result from a breach event, breach inundation mapping is required to be done for all high hazard-potential dams in Oklahoma. Both static and hydrologic failure modes are modeled. Hydrologic and hydraulic guidelines were written by OWRB to establish a process to estimate dam breach inundation boundaries in a consistent way across the dam inventory, so that they are computed for the same failure scenarios and estimated in the same way for each dam in Oklahoma.

9.3.3 Limitations and Approach to Address Deficiencies

One of the main challenges to address deficiencies in HHPD rehabilitation is funding. Even if a grant funding source is used to absorb some of these costs, the grant share for some of Oklahoma's HHPD owners is beyond their financial capabilities. Even if some municipalities seek alternative funding through the Financial Assistance Loan Program, some will not qualify. To address this deficiency, OWRB regularly educates HHPD owners on potential sources for dam rehabilitation funding assistance.

Another limitation to address HHPD Rehabilitation is some owner's hesitancy to participate in the HHPD Rehabilitation Grant Program. To some HHPD owners, the paperwork and reporting requirements of this program are beyond their administrative capabilities, or they prefer not to accept some of the required conditions of receiving this federal funding.

Another challenge is that privately-owned dams are not eligible for most federal and/or state funding programs. It is possible for privately-owned dams to be eligible for HHPD funding, but they require a local government or non-profit project sponsor. Dam rehabilitation can also be difficult to coordinate with multiple owners such as homeowner's associations. The costs associated with these projects can be incredibly high, particularly in cases where there is only one private owner. In addition, some of the older, privately-owned dams have been inherited from a previous owner, and the costs associated with a rehabilitation project are not feasible.

9.4 Mitigation Goals to Reduce Vulnerabilities from High Hazard Potential Dams Eligible for Rehabilitation Grant Program

Oklahoma's mitigation goals to reduce vulnerabilities from high hazard potential dams are as follows:

1. Minimize the loss of life and property due to dam failure in the State of Oklahoma.
2. Enable the continuous operation of critical businesses and governmental functions.
3. Protect human health and safety.
4. Provide economic security. The following tasks are identified strategies and actions to achieve this goal.

9.5 Actions to Reduce Vulnerabilities to/from High Hazard Potential Dams Eligible for Rehabilitation Grant Program

The following tasks are identified strategies and actions to achieve the HHPD mitigation goals:

1. Emergency Action Planning
Develop and exercise a Dam Emergency Action Plan (EAP) for each High Hazard Dam. Owners of high hazard-potential dams are required by the Oklahoma Dam Safety Program to create and maintain an EAP that utilizes the recommendations, as determined by the OWRB, of the "Federal Guidelines for Dam Safety, Emergency Action Planning for Dams Owners," published July 2013 by the Federal Emergency Management Agency. Key features of the required EAP, listed below, are used to develop strategies to mitigate the consequence of dam failure or potential dam failure.

2. Risk Prioritization
Implement the OWRB dam risk assessments to select and prioritize those HHPD that require rehabilitation and/or temporary risk reduction measures and implement available funding mechanisms to assist the owners of these dams to achieve remedial actions.

3. Implement Temporary Risk Reduction Measures for Unacceptable Risk Dams
For dams that pose an unacceptable risk to the public, immediate actions need to be taken to reduce the risk as much as is practically possible until complete remediation of the deficiencies can be achieved. These temporary risk reduction/mitigation actions may include, but are not limited to, tasks such as lowering the water level in the reservoir, increased inspection frequency especially during and/or after heavy rainfall events, or installation of signage at critical roads and bridges. Possible temporary risk reduction measures should be identified for every HHPD in their Emergency Action Plans, typically as response to Emergency Level 1 scenarios. For dams that require substantial remedial work that cannot be practically achieved in the near term, semi-permanent risk reduction measures may need to be enacted such as the installation of remote monitoring devices, flood control devices, relief wells, etc. Risk reduction measures should be identified by the owner's technical representative with guidance from the Oklahoma Dam Safety Program.

4. Remediation and Rehabilitation of Dams
Work closely and proactively with the Oklahoma Water Resources Board with regards to High Hazard dams that are rated as unsatisfactory in their material condition and remediate the identified issues to bring them into compliance with state dam safety standards. The issues that cause HHPD that cause them to be rated as unsatisfactory are widely varied and each dam will need specific plans to address the cause of non-compliance with current safety standards.

5. Awareness Program
Establish a Dam Safety awareness program with both owners of high hazard-potential dams and residents that reside in dam breach inundation areas below high hazard-potential dams.

6. Zoning Ordinances
Develop and implement zoning ordinances to eliminate building structures below high hazard-potential dams. This action is difficult to implement.

9.6 Process to Evaluate/Prioritize HHPD Mitigation Actions

When FEMA publishes its annual HHPD Rehabilitation Program requirements, OWRB curates a list of High Hazard dams eligible for grant funding. OWRB prioritizes this list of potential dams based off the Population at Risk (PAR) and the condition of the dam. OWRB then contacts each dam owner, in order of higher to lower priority, and notifies them of this funding opportunity.

There are many other factors that are used to evaluate eligibility of projects. Whether or not the respective jurisdiction has an approved hazard mitigation plan is critical, and if they have the financial ability to fund their portion of the HHPD grant. Jurisdictions must also have a HHPD Annex, or HHPD data, included in their local mitigation plan. If a jurisdiction does not have HHPD data, they can file a letter for Extraordinary Circumstances (EC). If approved by FEMA, this enables the jurisdiction to have 12 months in which to document the HHPD Annex/data in their local mitigation plan. This allows the jurisdictional, grant sub-recipient the ability to move forward with their planned HHPD program actions as they complete the HHPD Annex/data.

9.7 Effectiveness of Local HHPD Mitigation Policies, Programs, and Capabilities

9.7.1 Summary of the Local Policies, Programs, and Capabilities for HHPD Mitigation

Since the Rehabilitation of High Hazard Potential Dams Grant (HHPD) Program was enacted, local jurisdictions have increased their knowledge of the potential for high hazard dam failure. Several jurisdictions have implemented measures to reduce the hazard, which include the following;

- Conducted a seismic retrofit study to ensure the dam spillway and parapet would be able to withstand a significant seismic event.
- Development of a breach inundation map that has been provided to homeowners for risk education.
- Risk reduction through maintaining a lower pool elevation of the lake, eliminating the inundation risk.
- Municipality-owned HHPD Dams have conducted Tabletop Response Exercises to ensure in the event of a failure, communities would be able to respond.

While some of these actions have begun to address the risk of a HHPD failure, a significant number of the jurisdictions in the state do not have current capabilities or policies directly related to HHPD.

9.7.2 Challenges to Local Mitigation Policies, Programs, and Capabilities Implementation

Despite the robust educational resources provided by OWRB, many jurisdictions lack the understanding, technical knowledge, capacity, and financial resources at the local level to integrate mitigation actions for HHPD. In order to meet federal and state dam safety requirements, the financial commitment for dam owners often precludes them from taking additional actions. At the state level, OWRB and other stakeholder agencies have limited capacity, financially and programmatically, to assist. In addition, local and state infrastructure priorities regularly compete for funding, and often dam rehabilitation projects far exceed the amount of funding that can be provided.

9.7.3 Local Capability Opportunities for Implementing HHPD Mitigation Actions

Gaining new partnerships across the State of Oklahoma can greatly benefit further mitigation measures statewide. With continued investment in Infrastructure occurring nationally and at a state level, opportunities such as HHPD Grants, Pre-Disaster Mitigation/ Building Resilient Infrastructure and Communities has the potential to provide mitigation funding that will reduce the risk from dam failure and flooding. As OEM and the state work with various state agencies and organizations, there is also the opportunity to learn about new ways to better further mitigation throughout the state.

9.8 Current/Potential Sources of Funding for HHPD-Eligible Mitigation Actions

The Rehabilitation of High Hazard Potential Dams (HHPD) grant program provides technical, planning, design, and construction assistance for eligible rehabilitation activities that reduce dam risk and increase community preparedness.

The Rehabilitation of HHPD Program is based off a 65/35 funding model, where FEMA funds 65% of the awarded grant and the dam owner funds 35% of the grant. Of the 35%, these funds need to come from state and/or local sources.

Some rehabilitation projects can be completed with awarded HHPD grant funding. However, some larger projects require more funding to complete. A dam owner can use any combination of federal funding sources as long as they meet their cost match/cost share requirements with state or local funds. Those cost shares cannot be sourced from other federal funds, and funds committed to a cost share cannot count toward the requirements for more than one federal funding source.

The following are additional resources that may be available to fund dam rehabilitation projects:

1. Oklahoma Water Resources Board – Clean Water State Revolving Fund (CWSRF).
   CWSRF is a low-interest loan program to assist communities with municipal wastewater/stormwater infrastructure construction projects and other pollution control projects.

2. Oklahoma Water Resources Board – Financial Assistance Program – Bond Loan
   The OWRB Financial Assistance Division assists communities in their efforts to protect and conserve Oklahoma's water resources for current and future generations through cost-effective loans.

3. FEMA Hazard Mitigation Assistance Programs (HMGP, FMA, PDM/BRIC)
   See *Chapter Four: Pre- And Post Disaster Hazard Management Policies, Programs, and Capabilities* for a description of these grant programs.

4. USDA, Natural Resources Conservation Services
   The Watershed Rehabilitation Program helps project sponsors rehabilitate aging dams that are reaching the end of their design life and/or no longer meet federal or state safety criteria or performance standards.

5. US Water Resources Development Act (WRDA)
   Passed by Congress in 2022, the Water Resources Development Act (WRDA) provides nearly $38 billion in funding for the Army Corps of Engineers. The WRDA is biennial legislation that provides the Corps with funding to address navigation, flood control, and ecosystem restoration.