

2021 Muscogee Nation Hazard Mitigation Plan Update

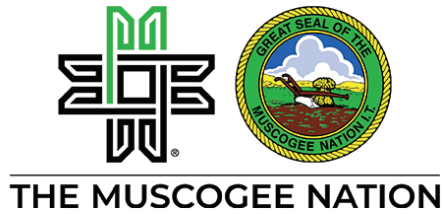


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Chapter 1 Introduction



1.1 Introduction

This document is the Multi-Hazard Mitigation Plan 2021 Update for the Muscogee Nation. The Muscogee Nation is the only jurisdiction covered in this plan; however, 11 different Oklahoma counties are completely or partially within the boundaries of the Nation (see Figure 1-1). Representatives from all 11 counties participated in the planning process (see Chapter 2). This Plan addresses natural and manmade hazards that can affect people and property in Muscogee Nation.

Oklahoma Counties Within the Geographic Boundaries of Muscogee Nation

- | | | | |
|----------|------------|------------|-----------|
| • Creek | • McIntosh | • Okmulgee | • Tulsa |
| • Hughes | • Muskogee | • Rogers | • Wagoner |
| • Mayes | • Okfuskee | • Seminole | |

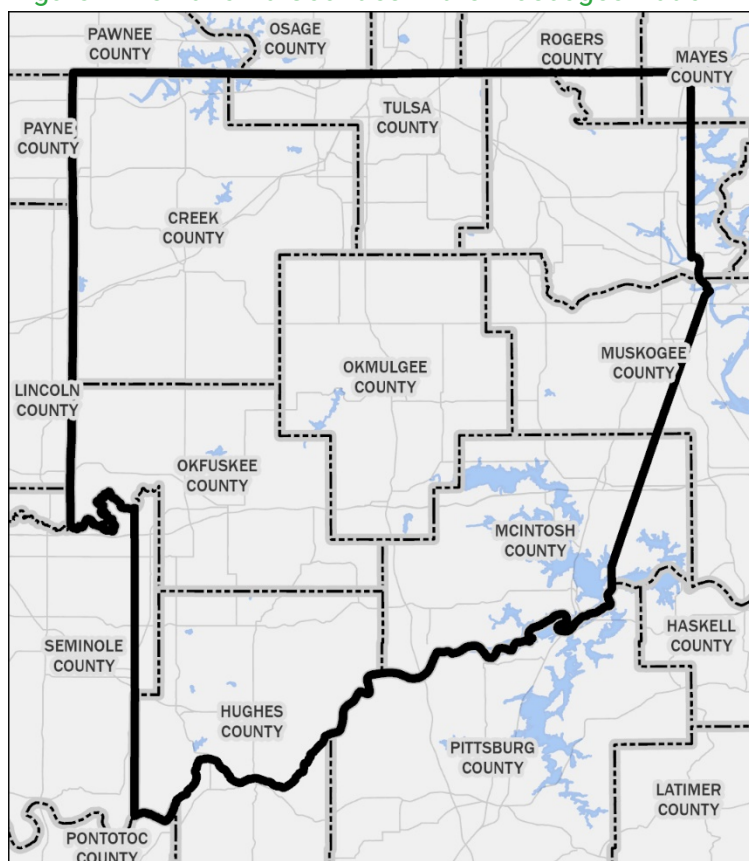
1.1.1 Purpose and Scope

Mitigation is most effective when it is based on a comprehensive, long-term plan that is developed before a disaster occurs. The purpose of mitigation planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. The objective of this plan is to guide mitigation activities for the next five years. It will ensure that Muscogee Nation implements hazard mitigation activities that are most effective and appropriate for the hazards that threaten the community. The plan addresses both short-term and long-term hazard mitigation opportunities beyond existing federal, state, and local funding programs.

In accordance with 44 CFR § 201.7(a)(1), a tribal government applying to FEMA as a grantee must have an approved tribal mitigation plan meeting the requirements in 44 CFR § 201.7 as a condition of receiving non-emergency Stafford Act assistance and FEMA mitigation grants, including the following programs:

- Public Assistance Categories C-G (PA C-G)
- Fire Management Assistance Grants (FMAG)
- Hazard Mitigation Grant Program (HMGP)

Figure 1-1 Oklahoma Counties in the Muscogee Nation



- Building Resilient Infrastructure and Communities
- Flood Mitigation Assistance (FMA)

Tribal mitigation plans must be submitted to FEMA for approval every five years to remain eligible for the programs listed above. Additional information regarding FEMA assistance programs that require a FEMA-approved mitigation plan as a condition of eligibility can be found in Appendix D: Mitigation Plans and Eligibility for FEMA Assistance.

The Sandy Recovery Improvement Act (SRIA) of 2013 amended the procedures for requesting disaster declarations. The amendment authorizes tribal governments to determine for themselves how they want to seek Stafford Act assistance. The Chief Executive of a tribal government may request a declaration specifically for the tribal government or elect to be considered as part of a state's declaration request. Previously, federally recognized tribes were treated as local governments and, thus, were not permitted to directly request disaster declarations from the Federal government. The SRIA amendments allow federally recognized tribes to directly request disaster declarations from the Federal government. This change provides federally recognized tribes with the option of applying for FEMA Hazard Mitigation Grant Program (HMGP) funds as either an Applicant or a sub-applicant.

For the purposes of this plan update, "Muscogee Nation," "MCN," "the Nation," "the tribe," and "planning area" will be used interchangeably (see "terms" section at the end of this chapter for more information).

1.1.2 Goal

The overall goal (or mission statement) of the Muscogee Nation Hazard Mitigation Plan is to create a disaster-resistant community by preserving the Muscogee Nation's culture and to improve the safety and well-being of the citizens of Muscogee Nation by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community. Specific goals and the process by which they were developed are included in Chapters 2 and 5 of this plan.

Hazard mitigation is most effective when it is based on a comprehensive, long-term planning that is developed before disasters. The purpose of mitigation planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. Considering the importance of mitigation, the Nation sees the development, application, and maintenance of this Hazard Mitigation Plan update as a key component to achieve that goal.

1.1.3 The Planning Process

Planning for the Muscogee Nation followed a ten-step process, based on guidance from FEMA.¹

- | | |
|---|-------------------------------------|
| 1. Organize to prepare the plan | 6. Set goals |
| 2. Involve the public | 7. Review possible activities |
| 3. Coordinate with other agencies and organizations | 8. Draft the action plan |
| 4. Assess the hazard | 9. Adopt the plan |
| 5. Assess the problem | 10. Implement, evaluate, and revise |

¹ <https://www.fema.gov/hazard-mitigation-planning-process>



1.1.4 Plan Organization

The plan and planning process build from the community and hazard assessments to create a specific and actionable mitigation strategy. The surveys, assessments, research, and analysis are organized into the following 6 chapters:

Chapter 1: Introduction

Chapter 2: The Planning Process

Chapter 3: Capability Assessment

Chapter 4: Hazard Identification and Risk Assessment

Chapter 5: Mitigation Strategy and Action Plan

Chapter 6: Implementation and Maintenance

1.2 Community Description

"The Mvskoke people looked at disasters as natural happenings for a reason and did not view them as disasters but part of nature."

"The Mvskoke people did not have plans for hazardous events. They used nature to divert and keep themselves safe from what was natural in the world. The plan was to have the things they used to keep themselves safe. During floods, my family would tell me the rains made the rivers deep so the large snakes and tvkwvnyav could move to other areas. My family had shells of a turtle to set out in the event of a tornado. This was believed to make the tornado go around. Turning the lights on in the house was to show you are a Mvskoke person that lived there because they believed that the tornado was a Mvskoke woman and a man. The fire, I was told was alive and had its own mind and to be careful around a grass fire because without your realizing what was happening it could surround you. During the heavy rains, they had a child throw out salt to make it stop, but that would cause extreme heat."

-Mvhayv Barnett

Muscogee Nation is a Native American tribe headquartered in the city of Okmulgee, Oklahoma. Their tribal jurisdictional area boundaries all or part of 11 counties in Oklahoma. Muscogee Nation is currently the 4th-most populous Nation in the United States, with approximately 86,000 citizens. Muscogee Nation is dedicated to keeping their legacy and cultural traditions alive by protecting their citizens, and especially, their elders (see Culture Section).

1.2.1 Governance

Muscogee Nation's current governmental structure is tripartite, with executive, legislative, and judicial arms. The executive and legislative arms are directly elected representatives, as tribal citizens who are 18 and older and registered to vote can vote in these elections. Recent U.S. Supreme Court decisions, including *McGirt v. Oklahoma*, have expanded the scope of powers vested to the Nation's government. Given the historical trajectory of these cases, it is expected that the scope of the Nation's governmental authority could continue to change.

The executive branch is composed of a Principal Chief, a Second Chief, and a cabinet with more than a dozen cabinet members. The Principal Chief and the Second Chief are determined through an election cycle of no more than 4 years, where the winner must capture a majority of the votes. As of the writing of this Plan, the Principal Chief is David Hill. The Principal Chief is responsible for appointing positions in the executive branch and preparing the annual budget, with advice and consent from the Nation's legislative body. The executive branch is supported by an Office of the Attorney General, which operates similarly to the federal office of the Attorney General.



Muscogee Nation's unicameral legislative body is the National Council. There are 16 representatives elected to the national Council for 4-year terms, with half of the Council representatives up for election every 2 years. Council members are elected from eight districts in these county areas—Creek, Hughes/Seminole, McIntosh, Muskogee, Okfuskee/Seminole, Okmulgee, Tulsa, and Wagoner/Rogers/Mayes—with 2 members elected from each district. The legislative process in the National Council is very similar to the passage of bills in the U.S. Congress. In addition, the Council reserves powers like the U.S. Congress, including the power to negotiate with other governments (within the United States), to borrow money, and to levy taxes.

The Muscogee Supreme Court is the highest Court in the Muscogee Nation. It is composed of 7 members, appointed by the Principal Chief, and confirmed by most of the National Council. Members serve 6-year terms. The Supreme Court has affirmed its juridical authority over the last several decades, using a combination of precedent from its previous decisions and from previous U.S. federal court decisions.

Muscogee Nation benefits from a range of interior affairs services, including Arbor Care, Fire Management, Cultural Center and Archives, Division of Agriculture and Natural Resources, Emergency Management, Environmental Services, Geospatial, Historic and Church Preservation, Planning and Grants Department, Storm Shelter Program, Transit, Tribal Construction, and Tribal Driveways. Several independent agencies augment governmental services. These agencies include child support, citizenship office, College of the Muscogee Nation, Conservation District, Election Board, Lighthorse Police, Muscogee Nation Business Enterprise, Mvskoke Media, Public Gaming, Tax Commission, and Veterans Affairs (see Chapter 3).²

Important extra-governmental figures, like religious leaders also hold authority in the Muscogee Nation. Some of the most prominent leaders are the Meeko, who are the custodians of the Nation's ceremonial grounds. Leaders like the Meeko exercise important influence, given their prominent position in the preservation and cultivation of the tribes' culture and religion.

Oklahoma's county and local governments within the Nation also can play a key role in mitigation. According to state law, each of these counties is governed by a three-member Board of Commissioners. The three districts are divided equally based on population, as determined by the decennial census. Each county also has an emergency management department, which has response and mitigation activities. Larger cities within the Nation, like Tulsa and Broken Arrow, have their own emergency management departments. Many of these emergency management departments, and several other key departments, are participating in the planning process for this Plan (see Chapter 2), which can strengthen the Plan's effectiveness and scope of impact.

1.2.2 Geography

Most of Muscogee Nation is located geographically in northeast Oklahoma. The Koppen climate classification lists the area as humid subtropical, which can be partially attributed to its proximity to the Gulf of Mexico. It has relatively high average temperatures compared due to its hotter summers and milder winters.

² "Articles I-VII," *Muscogee Constitution (Annotated)*; August 17, 1979; "Executive Branch," *Muscogee (Creek) Nation Website* (Accessed May 9, 2021) <https://www.muscogeenation.com/government/executive-branch/>; "How a Bill Becomes Law," *Muscogee (Creek) Nation Website* (Accessed May 10, 2021) <http://www.mcnncc.com/legislation/>; "Article VII (Judicial Branch): Annotations," November 7, 2009



Muscogee Nation is home to several ecoregions, including the Cherokee Plains, the lower Canadian Hills, and the Northern Cross Timbers. The Cherokee Plains ecoregion encompasses most of the Nation and is characterized by flat and irregular plains punctuated by low hills. Most of the region is composed of grasslands, farmlands, and floodplain forests, while most native woodlands are located on hills. Compared to the much of the rest of the state, the area encompassing the Nation is relatively low in elevation, averaging elevation under 1,000 feet above sea level. Nonetheless, the foothills of the Ouachita and Ozark Mountain ranges are located near the Nation's eastern and northeastern boundaries.

1.2.3 Climate

The area is known for its higher levels of precipitation, often averaging over 40 inches of rain annually. Like the rest of Oklahoma, surface water levels in the Nation are driven by precipitation levels. The Arkansas River is the main waterway in the area and serves as the drainage basin for most of the major rivers and other waterways in the Nation. Lake Eufaula and parts of the Canadian River system are located in the southern part of the Nation. Streams and rivers in the in the region are characterized by low gradients.

The combination of geography and climate exposes the Muscogee Nation to many natural hazards. Some of the most prominent hazards include flooding, tornadoes and other high wind events, severe winter storms, fire, and extreme heat. Flooding, tornadoes, and thunderstorms are most common in the spring and summer months. Extreme heat is most common in the summer months. Drought is linked to precipitation levels, given the region's dependence on precipitation for water. Winter storms tend to be less common than other hazards but can have a severe impact.³

1.2.4 History

Muscogee Nation has a dynamic history, which has shaped and been shaped by its geography, customs, languages, and interactions with other peoples. Some of the Nation's key characteristics have remained relatively constant throughout its recorded history, including the diversity of tribes composing the Nation, its cultural traditions, and its desire to exercise its sovereignty.

Some myths suggest that the tribes composing the present-day Muscogee Nation originated from the western regions of the present United States, but early surviving evidence traces the Muscogee Nation to the southeastern United States. The earliest records highlight the Nation's complexity and size. The Nation was composed of several tribes, which were added through conquest and negotiation. Many tribes spoke languages other than Muscogee (Mvskoke) and held differing practices and customs. For many centuries, many of the tribes of the Nation lived in or around flat-topped pyramids. These mounds were used as town centers and ceremonial grounds, depending on the time period of use and the region. Tribes were organized around these towns, with the creation of new towns allowing for the expansion of the Nation. The complexity and diversity of the Nation's peoples also can be explained, in part, by the size of the Muscogee Nation. At its height, the Nation stretched across much of what is currently the southeastern United States.

³ "Climate of Oklahoma," *Oklahoma Climatological Survey* (accessed May 12, 2021) https://climate.ok.gov/index.php/site/page/climate_of_oklahoma; "Ecoregions of Oklahoma," *Environmental Protection Agency* (accessed May 13, 2021) https://gaftp.epa.gov/EPADDataCommons/ORD/Ecoregions/ok/ok_front.pdf; Kenneth S. Johnson, "Topographic Map of Oklahoma," *Oklahoma Geological Survey*, 2008 (accessed May 12, 2021) http://www.ogs.ou.edu/pubsscanned/EP9_page2.pdf; Kenneth S. Johnson and Kenneth V. Luza, "Rivers, Streams, and Lakes of Oklahoma," *Oklahoma Geological Survey*, 2008 (accessed May 12, 2021) http://www.ogs.ou.edu/pubsscanned/EP9p12_14water.pdf



European colonialism accelerated the number of tribes that came under the banner of the Muscogee Nation, as some of the remnants of other tribes were absorbed into the Muscogee Nation's confederacy. Trade (including slaves), interaction, and intermarriage also shaped the Nation, especially the tribes living on the Chattahoochee and Flint rivers (which the Europeans called "Lower Creeks"). During this period, the differences between these tribes and the tribes living on the Coosa and Tallapoosa Rivers (Upper Creeks) widened, which was due in part to the Upper Creek's more limited contact with Europeans and Africans. This split in the Nation would impact where the tribes settled in the Oklahoma during their forced migration in the 19th century.

Although negotiation and conflict with Europeans predated the 19th century, the widespread forced migration of many of the tribes in Muscogee Nation to Oklahoma began in the early decades of the 19th century. The increasing consolidation of U.S. government and American jurisprudence, along with the aggressive expansion of settlers, sparked a series of legal, political, and violent battles between Muskogee tribes and the U.S. government. The conflict was accompanied by coerced assimilation of tribes to Euro-American culture. This period of conflict, negotiation, and ultimately forced migration culminated with the Trail of Tears in the late 1830s.

The displaced tribes of the Muscogee Nation began to rebuild around the North Fork, Deep Fork, and Canadian River Valleys in Oklahoma. The American Civil War, however, cut short tis growth. Muscogee lives, culture, and property were lost on both sides of the conflict. Following the War, the U.S. government took 3.2 million acres of allotted Muscogee land, further weakening their claims to sovereignty.

Muscogee Nation's desire for sovereignty, which had been expressed by the tribes since the issue had been first raised, surfaced in full force following the Civil War. In 1867, the Nation implemented a written Constitution that instituted a governmental structure based on executive leadership, legislative representation, and a justice system. Okmulgee was designated as the Capitol of the Nation. The Nation received U.S. federal designation as one of the 5 civilized tribes around this period.

Policies from the U.S. government continued to weaken the Nation's claims to sovereignty, however. The Dawes Act, in combination with Oklahoma's newfound statehood, began to further erode tribal claims to the lands that they had been promised earlier in the 19th century. By the middle of the 20th century, the Nation's unilateral control over its lands in Oklahoma had been nearly entirely eroded.

Although the Muscogee Nation's self-governance was threatened and significantly limited by the U.S. government during this period, its desire for an independent government was never extinguished. Chitto Harjo and other advocates became prominent during the end of the 19th century for their principled advocacy for Muscogee Nation's sovereignty and their opposition to the dissolution of the Muscogee government and the allotment of Muscogee lands to individual citizens. The passage of the Curtis Act, however, sought to unravel the Muskogee Nation's governmental structure. Legislative actions, which continued into the 20th century, significantly reduced the powers of the Muscogee government, but never fully dissolved the government.

The 1970s marked a resurgence of Muscogee sovereignty that continues into the present. The Muscogee people began to elect a Principal Chief without federal approval and passed a new Constitution that allowed for an executive, legislative, and, later, judicial authorities (see governance section). Court cases, beginning in the 1980s and continuing as of this writing, generally have continued to affirm the Muscogee Nation's sovereignty.



The Muscogee people and Muscogee Government have continued increase prosperity and impact in Oklahoma, which can be attributed to their resilience, creativity, and positive ethic. The Nation is the 4th largest nation in the U.S. in terms of population, with approximately 86,000 citizens. Its land area includes all, or part, of Creek, Hughes, Okfuskee, Okmulgee, Mayes, McIntosh, Muskogee, Rogers, Seminole, Tulsa, and Wagoner Counties. Today, the Muscogee Nation enjoys the benefits of a rich cultural diversity in terms of religion, language, customs, and ways of life. Despite these important differences, the Muscogee Nation is united in its desire to uplift its people and heritage and to safeguard the areas where they, and other residents, live.⁴

1.3 Community Assets

Community assets are defined broadly to include anything that is important to the character and function of a community and can be organized very generally in the following four categories: People, Economy, Culture, Built Environment, Natural Environment.

Although all assets may be affected by hazards, some assets are more vulnerable because of their physical characteristics or socioeconomic uses. This section describes assets in the Planning Area. School Districts have additional assessments in their subsections.

1.3.1 People

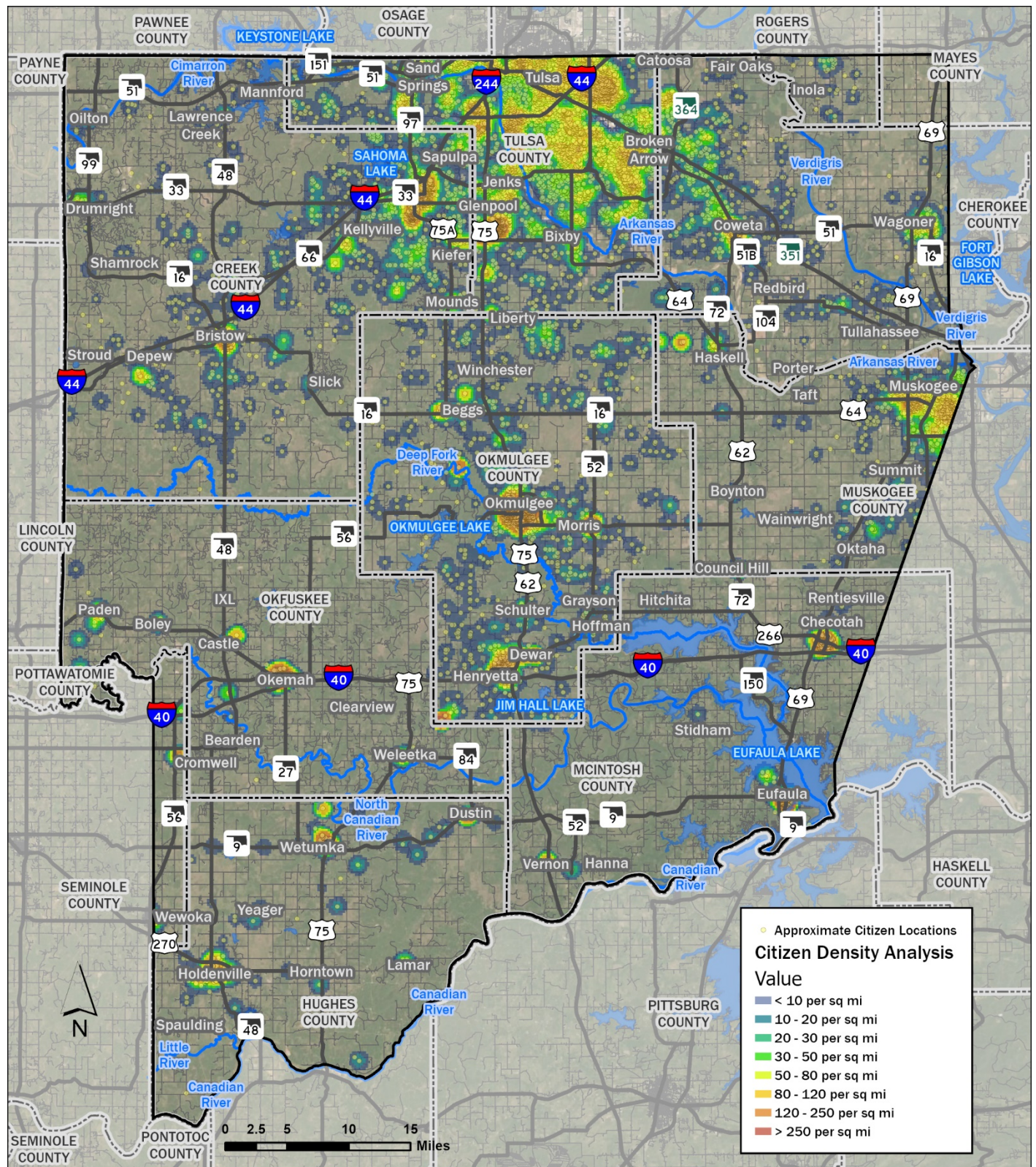
The term “people” refers to all people in the planning area, unless otherwise noted. The term “Muscogee Nation Citizens” or any iteration thereof, refers to the people in the planning area that are Citizens of Muscogee Nation. As of 2021, there are approximately 86,000 Citizens in the Muscogee Nation; approximately 48,000 of whom live within the geographic boundaries of the Nation (see geography section for the counties included in the Nation).

Tribal citizens are concentrated in many of the urban areas that overlap with many of the counties’ urban areas (see Figure 1-2). Although these Citizens are spread throughout the Nation, the North has more citizens and a higher concentration of Citizens than the South. The city of Okmulgee, which is the Nation’s capital, also has one of the highest numbers of tribal citizens as residents. Tulsa County has the highest number of tribal citizens, with most of these citizens residing in Sapulpa and Bixby. Other concentrated areas in the Northern part of the nation include Bristow (Creek County), Coweta and Wagoner (Wagoner County), and especially the City of Muskogee (Muskogee County).

⁴ Sources: “Muscogee (Creek) Nation History,” *Muscogee (Creek) Nation Website* (Accessed May 8, 2021) <https://www.muscogeenation.com/culturehistory/>; Theodore Isham and Blue Clark, “Creek (Mvskoke),” *The Encyclopedia of Oklahoma History and Culture* (accessed May 8, 2021) <https://www.okhistory.org/publications/enc/entry.php?entry=CR006>; Steven Hahn, *The Invention of the Creek Nation, 1670-1763* (Lincoln, N.E.: University of Nebraska Press, 2004), 12-32; Tim Alan Garrison, “Beyond Worcester: The Alabama Supreme Court and the Sovereignty of the Creek Nation,” *Journal of the Early Republic* 19, no. 3 (1999): 423-450; Robbie Ethridge, *Creek country: the Creek Indians and their world* (Chapel Hill, N.C.: UNC Press Books, 2004), 1-6.



Figure 1-2 Tribal Citizen Concentrations



Vulnerable Population Indicators

The southern part of the Nation also has areas of concentrations of Citizens, especially when compared to these areas' total populations. Some notable areas include Henryetta (Okmulgee County), Okemah (Okfuskee County), Wetumka and Holdenville (Hughes County), and Eufaula and Checotah (McIntosh County). Most of the towns in the south of the Nation also have concentrations of tribal citizens. Several areas in Hughes County, near the Canadian River and Lake Eufaula also have Citizens. The highest numbers of citizens outside the Nation's immediate boundaries can be found in Seminole County (to the southwest of the Nation) and Rogers County (northeast of the Nation), although many of the counties surrounding the Nation have tribal Citizens, especially the east and northeast.

All people within the geographical boundaries of the planning area are exposed to at least one of the hazards identified in this plan. Social and economic characteristics may limit peoples' abilities to understand their risk and respond to and recover from disasters. Six characteristics of populations are more at risk: poverty, speaking a language other than English at home, younger than 5 years old, older than 65 years old, not graduating from high school, and having a disability.

As of this writing, there is no comprehensive dataset that outlines these vulnerabilities for Citizens specifically. Instead, the only data available for the planning area includes all people within the Nation's geographical boundaries. Currently, Muscogee Nation collection demographic information on Citizens specifically through a program called Camphouse, which was developed initially for grant funding distribution. These demographic data collected should include information on the six vulnerability characteristics outlined below. In place of specific demographic data for Citizens in the Nation, the planning team used a combination of sources to understand how each of these vulnerability factors might impact the Nation.

1. Children under the age of 5

Young children have vulnerabilities to some hazards due to their psychological makeup, such as extreme temperatures or hazardous materials. In addition, they rely on caretakers to fulfill all their needs. Young children's higher levels of need, compounded by a lack of awareness to hazards, increase a family or community's vulnerability to hazards. More than one-quarter of Native Americans in the United States are living in poverty, and children and families are even more likely to live in poverty. The U.S. Census Bureau noted that 27% of Native American families with children live in poverty. For families with children under 5 years of age, 32% live below the poverty line.⁵ More research is needed to determine how many children under the age of 5 are Citizens and the relationship between young children and poverty in the Nation.

2. Elderly over the age of 65

People over age 65 are also vulnerable to hazards. They are more directly susceptible to extreme temperatures and may be less able to evacuate during or after extreme events. They are also more likely to be retired and on a fixed income, which could limit their ability to recover financially from home, vehicle, or other property damages. The Muscogee Nation Council noted the need to outreach and better protect their Elders since they are so vital to preserving their culture. It is additionally difficult to determine the number of elders in the Nation due to a general lack of technological literacy, lack of participation, and trust in census and other governmental bodies.

⁵ Sarche, M., & Spicer, P. (2008). Poverty and health disparities for American Indian and Alaska Native children: current knowledge and future prospects. *Annals of the New York Academy of Sciences*, 1136, 126–136. <https://doi.org/10.1196/annals.1425.017>



3. People who speak a language other than English

These residents may need outreach in another language to understand a hazard warning and how to respond. Additional study is needed to confirm which languages would be best for targeted outreach to these communities. The second language spoken most frequently throughout Muscogee Nation is Mvskoke. This language is mostly spoken by elders and some citizens, but the exact population is unknown until further research is conducted. Most Citizens who speak Mvskoke can also speak English.

4. People who did not graduate from high school

This population may have less income potential and more likely to be near or under the federal poverty line. As a result, their housing may be more at risk of hazard damages. This population also may be less able to use education or outreach materials. People living in the boundaries of Muscogee Nation have lower graduation rates than the Oklahoma and national average. According to the U.S. Department of Education, National Center for Education Statistics, Native Americans are the least likely to graduate high school compared to all other races in the United States and in Oklahoma.⁶

5. Disability

The census estimates the percentage of the population living with a disability through self-reported survey's. Individuals with different disabilities may need secondary methods of receiving warnings, assistance during isolation, a constant flow electricity to power life-sustaining apparati, or help evacuating. This definition of disability includes hearing, vision, ambulatory, cognitive, self-care, and independent living difficulties.⁷ According to the US Census, 24% of Native Americans have a disability compared to 19% of the general population. Many Native Americans are being unserved or underserved due to barriers limiting access, which include inadequate funding, personnel shortages, lack of coordination among agencies, lack of consultation with tribes, and problems identifying eligible Citizens for services.⁸

6. People who live below the poverty line

The planning area also has a slightly higher percentage of people living below the poverty line than the Oklahoma average. Low-income populations may be susceptible to damages from hazards, due to factors like poorer structural construction of their shelters, lack of access to resources, and shelter location. Lower-income populations also may take longer to recover financially from the impact of a hazard (more discussion in Chapter 3). According to an Impact Report prepared for Muscogee Nation, poverty rate for Citizens (14.7%) is similar the US rate of 14.6% and slightly less than the Oklahoma rate of 16.2% (as of 2017).⁹

1.3.2 Culture

Culture is an extremely important part of Muscogee Nation's identity (see History section in this chapter for more information). Cultural aspects can be impacted uniquely by hazards (see Chapter 4). Muscogee Nation families and society are typically organized matriarchally and matrilineally. Tribal Citizens are part of

⁶ U.S. Department of Education. (n.d.). *Public High School Graduation Rates*. Coe - Public High School graduation rates. Retrieved October 13, 2021, from <https://nces.ed.gov/programs/coe/indicator/coi>.

⁷ [American Community Survey and Puerto Rico Community Survey 2019 Subject Definitions \(census.gov\)](https://www.census.gov/popest/data/totals/2019/subject-definitions.html) pg 61

⁸ www.brownermedia.com, B. M.-. (n.d.). *Disabilities*. NCAI. Retrieved October 13, 2021, from <https://www.ncai.org/policyissues/education-health-humanservices/disabilities#:~:text=According%20to%20the%20US%20Census%2C%2024%20percent%20of,Nativ%20wit%20disabilities%20are%20either%20unserved%20or%20underserved>.

⁹ *Impact report - mcniimpact.com*. (n.d.). Retrieved October 14, 2021, from http://www.mcniimpact.com/wpcontent/uploads/2019/06/MCN_Impact_Report_June-26-2019.pdf.



an immediate family and a clan. The typical immediate family structure can include a mother and father, the mother's older relatives, their female children and husbands, unmarried sons, and grandchildren from female children. As part of the matriarchal family structure, men become part of their wives' families upon marriage. Clans are organized matrilineally by decedents of the same ancestral groups. Like the immediate family, clan affiliation is determined by the mother's side. Clan relations are treated similarly to the relations between the immediate family, with clan members often using relational descriptors like "brother" and "sister." Clan ties continue to shape marriages, economic and political choices, and friendships.

Tribal towns (*etul'wv*) and religious traditions also play a role in organizing tribal citizens and shaping their culture. Religious traditions also shape people of the Nation. The full variety of religious practices is outside the scope of this chapter, but pre-colonial and Christian (especially Baptist and Methodist) practices feature strongly for many of the Nation's citizens. Religious and symbolic sites also serve as communal and spiritual nexuses, as well as spaces for distributing essential goods. Currently, there are 93 listed churches within the Nation. Cemeteries and ceremonial sites also play a key role in shaping the nation's cultural life.¹⁰

Language and the dissemination of customs and traditions are also essential to Muscogee Culture. The exchange of the language, customs, and traditions can occur more informally, through family or clan networks for instance, or more formally, through educational institutions and formal ceremonies. In addition, the development of cultural centers can serve as places for dissemination of culture. A cultural center is currently under new development by the Historic and Cultural Preservation Department to ensure the protection and preservation of valued historic and cultural resources for future generations; these include multiple artifacts and library archives, etc.

1.3.3 Economy

After a disaster, economic resiliency drives recovery. Muscogee Nation has specific economic drivers that are important to understand when planning to reduce the impacts of hazards and disasters to the local economy. Muscogee Nation's major industries are River Spirit casino, agriculture, manufacturing, retail, and gaming. The financial capabilities of the Muscogee Nation are fully profiled in Chapter 3, the Capability Assessment.

1.3.4 Built Environment

The built environment includes existing structures, infrastructure systems, and cultural resources within the planning area. Critical facilities and lifelines are discussed in Chapter 4, given their importance to understanding direct risk.

¹⁰ Sources: "Muscogee (Creek) Nation History," *Muscogee (Creek) Nation Website* (Accessed May 8, 2021) <https://www.muscogeenation.com/culturehistory/>; Theodore Isham and Blue Clark, "Creek (Mvskoke)," *The Encyclopedia of Oklahoma History and Culture* (accessed May 8, 2021). <https://www.okhistory.org/publications/enc/entry.php?entry=CR006>; Steven Hahn, *The Invention of the Creek Nation, 1670-1763* (Lincoln, N.E.: University of Nebraska Press, 2004), 12-32; Tim Alan Garrison, "Beyond Worcester: The Alabama Supreme Court and the Sovereignty of the Creek Nation," *Journal of the Early Republic* 19, no. 3 (1999): 423-450; Robbie Ethridge, *Creek country: the Creek Indians and their world* (Chapel Hill, N.C.: UNC Press Books, 2004), 1-6; "Mvskoke (Creek) Customs and Traditions," provided by Muscogee Creek Nation personnel.



Existing Structures

All structures are exposed to risk. Certain buildings or concentrations of buildings may be more vulnerable because of their location, age, construction type, condition, or use (see Chapters 3 and 4 for more information).

Infrastructure

Infrastructure systems are critical for life safety and economic viability and include transportation, power, communication, and water and wastewater systems. Many critical facilities depend on infrastructure to function. For example, hospitals need electricity, water, and sewer to continue helping patients. The continued operations of infrastructure systems during and following a disaster are key factors in the severity of impacts and the speed of recovery. Hospitals and medical facilities are included on the list of critical facilities in Appendix A. It is also important to note, however, that Muscogee Nation does not own and operate most of the infrastructure that it and its Citizens rely on to fulfil basic services (see Chapters 3 and 4)

Utilities

Various utilities service Muscogee Nation and its citizens. The tribal Nation itself utilizes the Tribal Energy Program which provides assistance to all eligible Muscogee citizens. The Tribal Energy Program is not an emergency assistance program. Citizens receive their water from several various locations throughout the rural districts depending on where they reside. Muscogee Nation is looking at future projects of obtaining a rural water district of their own and providing their citizens with backup water sources from newly developed water towers.

Transportation

Roadways provide the primary means of transportation throughout the planning area. Muscogee Nation provides a transit service within the 11 Muscogee Nation tribal jurisdictional boundaries. The service is available to anyone in the communities and are not limited to tribal citizens. Other options are through partnerships such as trolley routes and with Ki Bios Area Transit System (KATS) to service citizens with the MCN Transit System is unavailable.

1.3.5 Natural Environment

Environmental assets and natural resources are important to Muscogee Nation's identity and quality of life. They support their cultural legacy and economy through agriculture, tourism and recreation, and a variety of other ecosystem services, such as clean air and water. The natural environment also provides protective functions that reduce hazard impacts and increase resiliency. For instance, wetlands and riparian areas help absorb flood waters, soils and landscaping contribute to stormwater management, and vegetation provides erosion control and reduces runoff. Conservation of environmental assets may present opportunities to meet mitigation and other community objectives, such as protecting sensitive habitat, developing parks and trails, or contributing to the economy.

1.3.6 Recent and Future Development

An effective way to reduce future losses is to avoid development in known hazard areas and enforce safe structures in other areas. In other words, keep people, businesses, and buildings out of harm's way from the beginning. Muscogee Nation is actively developing an app to warn its citizens of hazards, natural disasters, and broadband connectivity. The Nation is actively working on a new Cultural Center, constructing the building up to ICC 2021 standards, and hardening it to protect their cultural items best. The Nation also



hopes to obtain a rural water district and water towers for a backup water source for their citizens in times of drought. The Nation recently completed a Master Plan for the Tribal Complex. This plan will be completed in three Phases at the exact location of the existing Tribal Complex and includes risk reduction measures such as stormwater management.



Chapter 2 The Planning Process

The planning process for Muscogee Nation followed a ten-step process, based on the guidance and requirements of the FEMA Enhanced Tribal Mitigation Plan Requirements in accordance with 44 CFR Part 201. The Tribal Mitigation Plan Review Guide, Tribal Mitigation Planning Handbook, and the Enhanced Tribal Mitigation Plan Requirements were used to ensure Tribal Mitigation Planning requirements were met in this process.

2.1 Step One: Organize to Prepare the Plan

As outlined in Chapter 1, there is one participating jurisdiction in this plan: Muscogee Nation. The Nation does interact with several other partners in the community however, these include the 11 encompassing Counties within the tribal boundaries, participating critical facilities and emergency services and other public and private stakeholders. Bobby Howard served as the representative for the Muscogee Nation and also as part of the core planning team. As of this writing, Mr. Howard is the Emergency Manager of Muscogee Nation.

Muscogee Nation secured funding for this update through the Pre-Disaster Mitigation (PDM) program. The planning process was formally created by the Muscogee Nation on April 27, 2021. The resolution designated the stakeholder working group to oversee the planning effort (see Section, Coordinate with Other Agencies). The Core Planning team led the Stakeholder working group. The Core Planning Team was composed of members of the Tribal government and other key stakeholders. Membership for the core planning team was selected by tribal leadership in conjunction with the Muscogee Nation Emergency Management Director. The Core Planning Team is also referred to as “the planning team” throughout this Plan. The core planning team was assisted by Meshek and Associates, and was composed of the following members:

Core Planning Team

First Name	Last Name	Occupational Affiliation
Bobby	Howard	Muscogee Nation Emergency Manager
Annie	Vest	Meshek & Associates
Janet	Meshek	Meshek & Associates
Jonah	Vasquez	Meshek & Associates
Frank	Harjo	Muscogee Nation Geospatial Department
Audrey	Southwick	Muscogee Nation Geospatial Department
Tracie	Revis	Muscogee Nation Chief of Staff
James	Williams	Muscogee Nation Environmental Department
Jesse	Allen	Muscogee Nation Secretary of Interior
Kami	Willis	Muscogee Nation Department of Health
Phil	Booker	Muscogee Nation Risk Management
Prag	Mahajan	Muscogee Nation Tribal Construction Services
Rae-Lynn	Butler	Muscogee Nation Cultural Preservation



Terra	Branson	Muscogee Nation Secretary of the Nation and Commerce
Miranda	Carman	Muscogee Nation Secretary of Community and Human Services
Jason	Salsman	Muscogee Nation Press Secretary
Nick	Smallwood	Muscogee Nation Department of Health

During the first stages of the planning process, the planning team met weekly and monthly at River Spirit to review preventative measures, property protection, natural resource protection, emergency services, structural flood control projects and public information. This review led to the development of the plan and recommend goals and objectives, mitigation measures, and priorities for mitigation actions. During the planning process, the committee reviewed progress, identified issues, received task assignments, and advised the consultants. Meeting dates and locations were posted by the Muscogee Nation Emergency Manager. The meeting dates of the 6 planning team meetings can be seen in Table 2-1.

Table 2-1 Core Planning Team Meetings

Meeting	Date	Purpose
Core Meeting 1	May 5, 2021	Stakeholder #1 Workshop overview, hazard identification, capability assessment identification, and public survey review
Core Meeting 2	May 19, 2021	Geographic Information Systems integration into the planning process, public survey results review, and capability assessment continued
Core Meeting 3	June 1, 2021	Flood and dam hazard identification, public health emergencies and the Muscogee Nation, discussion of Stakeholder Meeting #2.
Core Meeting 4	June 16, 2021	Focused meet with Environmental Services Department, Department of Community and Human Services, and the Cultural Preservation Department regarding capabilities and possible mitigation actions for plan integration.
Core Meeting 5	July 14, 2021	Focused meet with Department of Community and Human Services, Council House and Muscogee Nation Language office regarding additional capabilities and mitigation action.

2.2 Step Two: Involve the Public

As outlined in Chapter 1, the “public” refers to “Citizens” of the Muscogee Nation. All Stakeholder Committee Meetings were open to the public and posted on the Muscogee Nation Emergency Management social media outlets (see next section). The public also was given the opportunity to comment generally on hazards, capabilities, or other aspects of the planning process through a survey. Draft action items and the draft plan also were made available for review prior to submittal to the FEMA Region VI for review.



Feedback from public stakeholder meetings and the public survey were incorporated into the capability and risk assessments.

An online survey was made available to the public via social media posts and remains live on the Muscogee Nation website to solicit feedback from the Muscogee Nation's citizens. This became an opportunity for the Muscogee Nation Emergency Manager to share information about hazards faced and gather information about the public's perceived risk, while gathering feedback on potential ways to reduce the risk presented. The survey generated 144 responses and was considered by the committee for incorporation into the final action plan. The survey also was used to determine continuing needs for educating the public on various hazard information.

2.3 Step Three: Coordinate with Other Agencies and Organizations

The Planning team contacted approximately 45 entities, including representatives from various departments within the Muscogee Nation, neighboring communities, tribes, local, state and federal agencies, businesses and other private and non-profit organizations, hereafter referred to as Stakeholders, by email, letter, or phone. Stakeholders were personally interviewed to review their existing studies, reports and technical information and their needs, goals and plans for the area.

Four workshops were held throughout the planning process. At the first three workshops, attending Stakeholders reviewed the existing Muscogee Nation Hazard Mitigation Plan and determined what was still relevant, assessed the identified hazards and resulting problems associated with each hazard, determined/developed appropriate mitigation measures and drafted an action plan. At the fifth workshop, attending Stakeholders reviewed the draft Hazard Mitigation Plan and provided final comments and recommendations prior to adoption of the 2021 Muscogee Nation Hazard Mitigation Plan. A representative or designee for each of these Stakeholders attended one or more of these workshops. Other representatives provided input through emails. A private website was created where the draft plan was maintained so participating agencies and organizations could review and provide feedback as the plan was developed.

Stakeholder Meeting Participants

First Name	Last Name	Title
Clay	Darnell	Muscogee Nation Controller
Covey	Murray	Creek County Emergency Manager
David	Hill	Principal Chief of the Muscogee Nation
David	Williams	Chief Hydrologist, USACE, Tulsa District
Del	Beaver	Second Chief of the Muscogee Nation
Diana	Billie	Muscogee Nation Community Resource and Development
Frank	Harjo	Muscogee Nation GIS Manager
Gary	McCormick	City of Tulsa, Senior Special Projects Engineer
Heath	Underwood	Wagoner County Emergency Management Director



James	Jackson	Muscogee Nation Floodplain Management/GIS
James	Williams	Muscogee Nation Environmental Services Director
Jeff	Smith	Muscogee County Emergency Management Director
Jesse	Allen	Muscogee Nation Secretary of Interior
Jim	Copeland	Okfuskee County Emergency Management Director
Joe	Farney	River Spirit Casino
Johnny	Janzen	Mayes County Emergency Management Director
Joseph	Kralicek	City of Tulsa/Tulsa County Emergency Management Director
Kami	Willis	Muscogee Nation Department of Health
Kevin	Kloesel	Director, Oklahoma Climatological Survey
Michael	Dockrey	Hughes County Emergency Management Director
Miranda	Carman	Muscogee Nation Secretary of Community & Human Services
Nadie	Badie	Muscogee Nation Secretary of Housing
Paige	Nutter	Choctaw Nation Emergency Management
Paul	Zachary	City of Tulsa Director of Engineering Services
Phil	Booker	Muscogee Nation Risk Management
Prag	Mahajan	Muscogee Nation Construction Services
Rachel	Nutter	FEMA Region VI, FIT Liaison
Rae-Lynn	Butler	Muscogee Nation Cultural Preservation
Richard	Cole	River Spirit Casino
Richard	Philips	Lighthorse Police Chief
Roger	Wiley	Muscogee Nation Attorney General
Scotty	Stokes	Rogers County Emergency Management Director
Shane	Holuby	Muscogee Nation Government Services Administration
Shawn	Terry	Muscogee Nation Secretary of Health
Steve	Emerson	Muscogee Nation Director Tribal Construction
Steve	Palladino	Director of Operations, Oklahoma Department of Emergency Management
Susan	Whittle	McIntosh County Emergency Management Director
Sylvia	Tulsa	Muscogee Nation Risk Management
Terra	Branson	Muscogee Nation Secretary of the Nation and Commerce
Tim	Craighton	Okmulgee County Emergency Management Director
Tracie	Revis	Muscogee Nation Chief of Staff
William	Smiley	Chief Emergency Management and Homeland Security, USACE Tulsa District.



Public and stakeholder meetings provided critical information on the vulnerability of the Nation to each hazard, which assisted creating the risk assessment. Input also facilitated creating and prioritizing mitigation strategies into the Action Plan. Public meetings are summarized in Table 2-1.

Table 2-2 Stakeholder Meetings

Meeting	Date	Purpose
Stakeholder Workshop 1	April 27, 2021	Introduction to plan process and organization. Collect information on Muscogee Nation's existing mitigation practices and capabilities.
Stakeholder Workshop 2	June 29, 2021	Present on hazards and specific information around the hazards. Conduct a risk assessment for the Nation for each natural hazard.
Stakeholder Workshop 3	August 13, 2021	Discuss possible hazard mitigation actions/solutions for the identified natural hazards and criteria for an action plan.
Stakeholder Workshop 4	October 12, 2021	Final discussion on mitigation actions and comments for draft Hazard Mitigation Plan.

2.4 Step Four: Assess the Hazard

The planning team collected data on the hazards from available sources, the 2016 Muscogee Nation Hazard Mitigation Plan. The Hazard Identification and Risk Assessment, Chapter 4, includes a description of the type, location, and extent of natural hazards that can affect Muscogee Nation within the tribal territory. The Plan includes information on previous occurrences of hazard events and the probability of future events. Chapter 4 describes the hazard selection process and assesses each hazard's risks to the planning area. Data from several sources was used to assess the hazards, including the Simple Planning Tool for Oklahoma Climate Hazards, the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, the National Weather Service, among other federal and state sources. These sources were used throughout Chapter 4.¹¹ The planning team also reviewed documents developed by Muscogee Nation, including floodplain ordinances, master drainage plans, capital improvements plans, comprehensive plans, and emergency operations plans. In addition to these sources, hazards were assessed, prioritized, and verified with key stakeholders at meetings 2 and 3 (see step 3, above).

2.5 Step Five: Assess the Problem

The hazard data was analyzed considering its impact on public safety, health, buildings, transportation, infrastructure, critical facilities, the natural environment, endangered species, and the economy. Each hazard's previous occurrences, location, and extent were considered in the assessment. Communities' specific vulnerabilities were also considered. Hazard risks were discussed at a public meeting, where members of the Planning Committee contributed to the analysis.

¹¹ The simple planning tool for hazards is produced by the Southern Climate Impacts Planning Program, one of 11 NOAA Regional Integrated Sciences Assessments Teams.



Building footprints and problem areas were used to estimate potential losses from flood and wildfire hazard areas identified in Chapter 4, and a standalone web viewer developed by Meshek & Associates, LLC. Building footprint polygons within the planning area were selected from computer-generated building footprints covering all 50 US states.¹² Additional GIS data from previous studies, such as the master drainage plan, and other collected information was used in this analysis. Property damage estimates were not calculated for the general area hazards. Building footprint polygons that intersected spatially with flood and wildfire hazard areas were identified. This was used to estimate the number of buildings at risk to those hazards. Specific problem statements, or observations, are included for each hazard in Chapter 4.

2.6 Step Six: Set Goals

Project and community hazard mitigation goals and objectives for Muscogee Nation were developed by the Core Working Group to guide the development of the plan. The hazard mitigation goals are listed in Chapter 5.

2.7 Step Seven: Review Possible Activities

There were 22 mitigation actions identified in the 2016 mitigation plan. An annual report is prepared by Engineering Services under the direction of the Planning Committee on the status of existing Hazard Mitigation Plan mitigation actions and presented to the governing body of Muscogee Nation. This report includes the status of each mitigation action, whether the action is achieving expectations, and if not if it should be modified. A review of the 2016 mitigation actions along with the latest annual report was completed by the planning team. Actions were evaluated with the intent of carrying over any not started, or continuous for the next five years. Actions with the same intent were combined into a general action item. Specific observations and problem statements, resulting in the actions listed in Chapter 5, are included at the end of each hazard section in Hazards, Chapter 4. Wide varieties of measures that can affect hazards or the damage from hazards were examined. A more detailed description of each category is located in *Chapter 5: Mitigation Strategy*.

2.8 Step Eight: Draft an Action Plan

The planning team reviewed observations from the risk assessment and results of the capability assessment when considering different actions. The planning team evaluated and prioritized the most suitable mitigation actions for Muscogee Nation to implement. The mitigation strategy analyzes actions and projects considered to reduce the impacts of hazards identified in the risk assessment and identifies the actions and/or projects that Muscogee Nation intends to implement.

2.9 Step Nine: Adopt the Plan

The Draft *Muscogee Nation Multi-Hazard Mitigation Plan Update 2021* was submitted to FEMA Region VI for review and approval. The plan was approved and adopted by the Muscogee Nation.

¹² Microsoft 2021 data



2.10 Step Ten: Implement, Evaluate, and Revise

Adoption of the *Multi-Hazard Mitigation Plan* is only the beginning of this effort. Community offices, other agencies, and private partners will proceed with implementation. The planning team and other stakeholder continue to meet on a regular basis to monitor progress, evaluate the activities, and periodically recommend revisions to the Plan and Mitigation Action Items. These findings and recommendations will be included in the annual report prepared under the direction of the Muscogee Nation Emergency Management Director. The plan will be formally updated a minimum of every five years, as required by FEMA.



Chapter 3 Capability Assessment

The Muscogee Nation has taken a broad encompassing approach to ensure its Citizens are well looked after at all times. The sections within this chapter survey the regulations, plans and infrastructure that the Muscogee Nation has in place for avoiding or mitigating the impacts of natural hazards. This survey is based on step 4 of FEMA's Tribal Mitigation Planning Handbook and assesses the Muscogee Nation's existing authorities, policies, programs, and resources available to accomplish mitigation.

The Muscogee Nation holds a set of capabilities that are extremely unique to one specific entity. Acting as its own sovereign government, the Muscogee Nation bears the authorities, policies, programs, staff, funding, and other resources available to accomplish mitigation efforts and to reduce long-term vulnerability to hazards that may arise in the future. The planning team reviewed existing capabilities within the Muscogee Nation and its comprised boundary areas and identified capabilities that currently reduce disaster losses or could be used to reduce losses should a hazard event arise. Capabilities that may unknowingly increase risks within the community were also examined. The planning team used the Capability Assessment Worksheet from the *Tribal Mitigation Planning Handbook* to review the Muscogee Nation's existing capabilities and gain a wholistic understanding of all relevant programs, regulations, resources, and practices across different departments within the tribal government.

For this update, the planning team reviewed the information provided in Chapter 4: Capabilities Assessment of the 2016 Plan and updated information, as appropriate, to reflect current developments. The planning team also reviewed relevant community plans, reports, and technical documents already instituted by the Muscogee Nation during the evaluation and planning phases of the Multi-Hazard Mitigation Plan development.

Citizenship data was used to determine Muscogee Nation citizen concentrations based on tribal boundaries. Growth patterns and future development were also examined. Capital Improvements planning engagement with the Muscogee Nation Secretary of the Interior was used to determine priorities of public infrastructure improvements and timing of potential future development. These informal plans were used to identify areas of future growth and development so that hazardous areas could be identified and evaluated with the intent to plan appropriate mitigation measures for them.

The Planning Team involved numerous stakeholders from neighboring communities, counties, non-governmental organizations to determine if studies, plans or other relevant information pertinent to floodplain management and other present hazards were available that would support the Muscogee Nation's Hazard Mitigation Plan (see Chapter 2 for list of these stakeholders). The planning team organized critical capabilities into four assessment sections. These assessment data were divided into three parts, which are described below.

Assessment Sections

1. **Planning and Regulatory**
2. **Administrative and Technical**
3. **Financial**
4. **Education and Outreach**



Section Parts

All sections, except for the Education and Outreach Sections, are organized into three parts:

Overview Assessment

The Overview Assessment provides a high-level summary of the capabilities that these jurisdictions have at their disposal.

Qualitative Assessment

Qualitative Assessment describes the capabilities listed in the overview assessment, focuses on their strengths or deficiencies, and includes any information or suggestions for their future utility.

Observations and Recommendations

Capability gaps, along with observations and recommendations derived from the qualitative sections of this assessment, are a driving force and to inform the suggested actions in Chapter 4 and mitigation actions in Chapter 5.



3.1 Planning and Regulatory

Planning and regulatory capabilities refer to the ordinances, policies, laws, plans, and programs that Muscogee Nation uses to guide physical development and growth on Tribal lands. There are many kinds of mitigation capabilities that are expressed through plans, processes, and programs, such as building codes, land use plans, economic development strategies, and natural resource preservation programs.

3.1.1 Overview Assessment

Key

Addressed specifically and is current, with minor room for improvement	✓
Addressed/included indirectly	—
No not addressed or included	✗

Plans and Regulations

Hazard Mitigation Plan	✓
Comprehensive (Master) Plan	✓
Emergency Operations Plan	✓
Continuity of Operations Plan	✓
Capital Improvements Plan	✓
Housing Plan	✓
Building Codes	✓*
Zoning, Subdivision, and Landscape	✓
Structural Assessment and Enhancement Programs	—
Economic Development Plan	✓
Transportation Plan	✓
Debris Management Plan	—
Tribal Resilience Plan	✗
FEMA Public Assistance and Hazard Mitigation Assistance Admin Plan(s)	✓

*Vulnerable Structures are analyzed separately



3.1.2 Qualitative Assessment

Hazard Mitigation Plan

Muscogee Nation mitigation planning is overseen by the nation's Emergency Management Department through a group of representatives from various departments within the Muscogee Nation, referred to as the Core Group, or the "planning team." The Core Group is comprised of leaders from several departments that are crucial to the Nation's functioning, especially in terms of hazard risk reduction. Members from Environmental Services, Geospatial, Historic and Cultural Preservation, Planning and Grants, Tribal Construction and Tribal Housing have been integral in the planning process and have been active participants in the Core Group.

This Hazard Mitigation Plan is coordinated with numerous additional internal and external stakeholders. The Hazard Mitigation Plan allows the Nation to remain eligible for FEMA's Hazard Mitigation Assistance programs and request a Presidential or emergency declaration directly to FEMA. The Sandy Recovery Improvement Act of 2013 (SRIA) amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended, 42 U.S.C. §§ 5121 et seq. (Stafford Act), to provide federally recognized Indian tribal governments (tribal governments) the option to request a Presidential emergency or major disaster declaration. Since the previous plan was adopted, the Tribe has requested two Presidential disaster declarations and continues to make mitigation a priority (see Chapter 4).

The Nation will continue to improve this plan as technology advances and as better hazard data becomes available. The Nation will follow the plan maintenance strategy outlined in Chapter 6.

Comprehensive (Master) Plan

The Muscogee Nation's comprehensive Tribal Master Plan is a centered approach to long-term development within the 5–7-mile radius that surrounds the Tribal Capitol Complex in Okmulgee, Oklahoma. The 3 phase plan centers around 4 key sites inside the Nation's boundaries. The Tribal Capital Complex, Omniplex/Agriplex/Hotel-Casino site, 40 acres of land with public service emphasis, and a proposed Cultural Center site are strategic areas for development. Preliminary site assessments were completed for locations within the plan and beyond to determine best use and areas of focus. Infrastructure was evaluated and possible challenges identified before selecting final locations for improvement. The Nation explicitly includes the most recent building codes and drainage criteria in the Tribal Complex Master Plan. In addition, Muscogee Nation plans to harden some of the new buildings planned in the 3 phases. The Tribe plans to seek FEMA Hazard Mitigation funds to include disaster resistant construction best practices into plans for the new Cultural Center. It hopes to use funds to protect its most sacred artifacts and archives from all hazards, including extreme heat and cold

Emergency Operations Plan (EOP)

The purpose of the Muscogee Nation Emergency Operation Plan is to provide the management structure, key responsibility, emergency assignments, and general procedure to follow in preparing for, responding to, and recovering from emergency situations. This plan should enable the Muscogee Nation to respond to all hazards (small or large) and incorporates operating procedure from the Incident Command System (ICS) and the National Incident Management System (NIMS), for handling emergencies which could disrupt normal business operations. The plan is updated on as needed bases, as requested by the Principal Chief. A "state of emergency," activates the plan. Only the Principal Chief or the individual directly authorized by the Principal Chief has the authority to declare a state of emergency. The Emergency Operations Plan for the

Muscogee Nation needs updated and exercised. During this planning process members of the planning team were asked if they were aware of their individual responsibilities during a disaster event. Most answered with neutral responses. The Nation intends to update the EOP and complete position specific training for various Emergency Support Functions. The EOP does not note evacuation routes within high hazard areas. Evacuation planning is the responsibility of municipal and county emergency managers. Muscogee Nation Emergency Management and the Lighthorse Police would act in a support role during any evacuation planning or operations.

Continuity of Operations Plan (COOP)

The currently adopted 2018 Continuity of Operations Plan of the Muscogee Nation ensures that the many key programs and functions provided by the tribal government for its Citizens are not interrupted due to unpredictable incidences such as emergencies, accidents, and natural or man-made hazards that may occur within its boundaries. In addition to describing each department's role during natural hazard, outlined within document is a clear set of identified facilities for use, leadership roles and succession guidelines should key figureheads be unavailable to complete the duties usually under their care. Facilities highlighted in the document for continuity use were identified and measured using a completed risk assessment that considered vulnerability to all hazards, cost to make the facility available for use during critical times, sufficient distance from the normal operating facilities that may be interrupted, and a formal analysis of acceptable risk when making the move to an alternative facility.

Plans and procedures exist and are discussed in the COOP Plan that detail when daily operations shift into an all-hazards situation and when normal functions may be altered. Additionally, the plan is segmented into four phases: readiness and preparedness, activation, continuity of actual operations, and a return to normal operations and function. Implementation of the actual plan occurs in the three phases of: activation and relocation, alternate facility operations, and reconstitution to normal function. Each department that provides any service to a Muscogee Nation citizen is covered within the plan. As changes are made to the plan and as implementation methods are reviewed, a plan maintenance record exists within the document to track changes and showcase best practices.

Overall, the plan is an encompassing view of the Muscogee Nation and the services it provides to its citizens and shows how to keep those services functioning during a times of disruption. Recommended sections for expansion in the future would be to the Business Recovery Plan for Muscogee Nation casino operations. As a vital component of the economic framework for the Nation, individual roles during disruption should be expanded upon for employees not on the specified response teams highlighted. It is expected that the plan will be updated due to recent disruptions of service in 2019 following severe flooding in the planning area.

Energy and Conservation Strategy

In 2011 the Muscogee Nation received Energy Efficiency and Conservation Block Grant funding to develop an Energy Efficiency and Conservation Strategy (EECS). The provide a framework for the Muscogee Nation's future energy security and independence and to reduce the impacts of energy consumption. Although the EECS was written to guide the Nation in its energy project decisions from 2012-2016, the plan ultimately is intended to be a living document to guide decisions beyond 2016. The plan includes many programs that rely on the Nation developing a Tribal Utility Authority. As of the writing of this plan, legislation creating the Tribal Utility Authority was under review by Tribal leadership in hopes of approval by the National Council in 2022.



Capital Improvements Plan (CIP)

The Muscogee Nation has a vast and focused goal for constant improvement and progress. Working as a collaborative effort, Muscogee Nation Interior Affairs identifies areas of need and potential development and often works in tandem with the Planning and Grants Department (Department of Commerce) to pinpoint funding mechanisms that facilitate Capital improvements. Identified capital Improvement projects are distinguished based upon cost, available funding, and importance to tribal Citizens. In-depth grant procedures and protocols are followed when seeking additional funding. These regulatory procedures include developing a grant concept, drafting a grant application, receiving National Council approval once awarded, as well as reporting activities throughout the life of the project. Capital improvement projects within the Muscogee Nation can range from property acquisition to widespread broadband installation.

An overall capital improvement plan is present in the Tribal Master Plan that outlines priorities and an implementation strategy. Many mitigation-related structure and infrastructure projects are included in the plan such as reducing flooding at the Glenpool Community Center or plans to construct water towers and encourage adequate water supply at Tribal facilities.

Research and Studies

The Nation also conducts studies to develop new projects or determine their efficacy. The results of these studies also have been used to develop or enhance planning and regulatory operations, including ordinances and policies. The Nation is currently in the process of completing three drainage studies, those studies will be incorporated into the next plan update and provide better information on the flood risk in Muscogee Nation.

Housing Plan

The Muscogee Nation Department of Housing was established in 1965 with the mission to provide eligible Citizens with safe, efficient, and affordable housing. The Nation strives to meet those needs by providing housing opportunities through home ownership, emergency home repair, and rental programs. Through collective efforts with the United States Department of Housing and Urban Development (HUD) the Muscogee Nation provides opportunities for Citizens to prosper, gain self-sufficiency and participate in home ownership. A housing strategy is submitted to HUD to remain compliant with funding requirements. To continue our mission of enhancing the overall quality of life of the Muscogee people, the Nation is committed to providing quality housing programs and services to meet a variety of needs.

The Nation does not currently have a complete list of Citizens in need of housing, and the planning team suggested a homelessness study be completed as an action item of this mitigation plan. Without a true assessment of housing need, it will be difficult to assess the housing status after a disaster event. Additionally, there is no housing recovery plan in place. Muscogee Nation can expand this capability by completing a pre-disaster housing analysis and recovery plan. An assessment of Tribal housing located in hazard areas is included in Chapter 4. The Nation is a member of the NFIP and receives Federal housing funds, both prevent the tribe from constructing housing in the floodplain. The Tribe also purchases existing structures because it is less expensive at times than new construction. The Tribe can expand this capability and help reduce future flood risk, by implementing a policy requiring housing staff to check the location of structures before acquisition or construction, in proximity to any FEMA mapped floodplains, including Base Level Engineering Data and regulatory floodplains within the City of Tulsa.



Building Codes

The Muscogee National Council has adopted the 2021 Existing International Building Code under Muscogee Nation law under Title 28, Chapter 8, and adopted codes include:

- The International Residential Code
- 2021 International Fire Code
- 2021 International Mechanical Code
- 2021 International Plumbing Code
- 2021 International Dual Gas Code
- 2020 International Electric Code (NFPA 70)

The IBC contains provisions that meet or exceed the minimum flood-resistant design and construction requirements of the NFIP for buildings and structures. In order to assure compliance with all current construction guidelines, the Muscogee Nation has employed the use of a building inspector and code enforcer that acts as a code official for all construction work occurring on Tribal Trust property.

Although the Muscogee Nation institutes the IBC for its current and most recent construction projects, in some instances, previously purchased structures may comply with County building codes based on their location, or no building guidelines at all if not instituted in the County for which the structure is located. Currently, environmental assessments are completed before purchases of existing properties, facilities and new construction projects take place.

Vulnerable Residential Structures

Structures that fall outside IBC regulation, either due to the time at which they were constructed, or their location in a County with a lack of regulations are at heightened risk. This is particularly concerning for homes purchased by citizens that are more vulnerable to hazard events, especially high wind and tornadoes, but also including severe winter storm, extreme heat, and earthquakes. Mobile homes and some prefabricated and modular homes are more at risk to high wind and earthquake events due to their construction than other residential homes. Compared to other homes in the planning area, these homes are often constructed with materials that cannot withstand high wind events and are often not anchored securely to the ground. Increased vulnerability also can result from a lack of sufficient insulation. Officials in the Muscogee Nation have proposed to increase the resilience of the housing structures that the Nation purchases for Citizens by retrofitting these structures with proper insulation. Bringing these structures up to the adopted code will be important to decrease their vulnerability.

National Floodplain Insurance Program

The National Flood Insurance Program (NFIP) allows homeowners, business owners, and other entities to purchase federally backed flood insurance policies. Communities must participate in the NFIP to allow these entities to purchase insurance, however. Participation in the NFIP requires that communities maintain baseline standards of mapping, permitting, regulating, and related activities. Communities can reduce the premiums available to some of their residents by participating the Community Rating System (CRS; see the section below for more information).

Managed and overseen by the Tribal Construction Department, the Muscogee Nation joined the National Flood Insurance Program in 2021. All Citizens of the Muscogee Nation are eligible to purchase federal flood insurance. As the tribe's participation in the NFIP program progresses, increased community involvement and participation will be sought in order to attain NFIP Community Rating System (CRS) credit in the future.



Floodplain administration and other NFIP compliance is covered under Title 28, Lands and Minerals, of Muscogee Nation Code of Law. The Nation currently has 2 Floodplain Administrators on staff with Certified Floodplain Management credentials.

The NFIP Community Rating System is a voluntary incentive program that recognizes and encourages community floodplain management practices that exceed the minimum requirements of the National Flood Insurance Program. Seeking this CRS credit will strengthen community involvement within the tribe as well as make flood insurance within the territory more affordable for Citizens, adding value to their already instituted flood mitigation efforts. The Muscogee Nation will continue to meet minimum NFIP requirements and exceed those requirements by enforcing local regulatory floodplain ordinances.

Zoning, Subdivision, and Landscape

The Tribal Construction Division of the Muscogee Nation ensures that all new and rehabilitative construction considers flood risk as well as other hazards that may be present within the tribal area. When considering construction in flood prone areas, there are several types of flood mitigation techniques that are instituted by the Muscogee Nation. New buildings are constructed with the finished floor elevation one foot above the Base Flood Elevation (BFE) to mitigate flooding

Hazard-Specific Ordinances or Practices

The Tribal Construction Division designs stormwater detention to mitigate increases in runoff. The Nation also provides erosion control for all new and rehabilitative construction projects that disturb over an acre of earth.

Land for Open Space and Public Use

As of July 2021, 165 Citizens have access to over 2,500 acres of MCN land for hunting, fishing, and gathering. The Nation is working towards the donation of another 1,300 acres on Tiger Mountain for wildlife use. Citizens can apply for permits online or come in for assistance and apply for permits in person. The Wildlife Program Coordinator has been busy preparing properties for hunting seasons and evaluating habitat and wildlife populations, as well as planning food plot mixes. They have also deployed electronic traps with camera systems that allow for the efficient removal of feral swine, while limiting the unintended capture and harm of other wildlife species. The Nation has submitted a USFWS Tribal Wildlife grant to study and restore wild turkey populations on the reservation. There are not currently plans in place to acquire land for the purposes of open space to prevent flood impacts. The Nation understands the benefit of such activities and has include them as potential action items in the five-year mitigation strategy.

Structural Assessment and Enhancement Programs

BCEGS

Insurance services office (ISO) is an independent body that rates the effectiveness of certain community capabilities, including fire capabilities and building codes. It provides an assessment of a community's building codes, called the Building Code Effectiveness Grading Schedule (BCEGS) rating. This rating focuses on a codes' mitigation capabilities and vulnerabilities to hazard events, which can give communities deeper insight into their mitigation strengths and weaknesses. Like ISO's other rating systems, BCEGS is rated from 1 to 10, with 1 being the best rating and 10 as not meeting ISO's standards. In addition to increased resilience, communities are assigned credit ratings based on ranges of BCEGS classifications (1-3, 4-7, 8-9, and 10). As of this writing, Muscogee Nation has not pursued a BCEGS rating. Muscogee Nation should pursue a BCEGS rating in order to enhance building resilience, as described above, and to make the Nation more competitive on certain federal grants projects.



IBHS

In addition, future development throughout the planning area could be less vulnerable to high wind events if higher building standards are implemented. In 2018, insurance companies began offering discounts on insurance premiums for homes constructed to the Insurance Institute for Business and Home Safety's (IBHS) fortified home standards. Homes constructed to this structural capacity can withstand winds up to 130 mph, which includes 95% of tornadoes. Although building to IBHS can reduce structural vulnerability to many hazards, they seem most impactful at reducing vulnerability to Tornado/ High Wind, Hail, Fire, and Earthquake events. Muscogee Nation should offer IBHS practices or partner with an entity already doing so throughout the planning area (see Chapter 4 for more information).

Economic Development Plan

In 2012 the Muscogee Nation National Council amended Title 17, Chapter 7, of the Code of Laws of the Muskogee (Creek) Nation, establishing the Muscogee Nation Economic Development Committee. Section 7-104 establishes the Economic Development Committee. The committee focuses on oversight and direction to the Muscogee Nation on business and economic development-related issues. The largest economic impacts are outlined in Chapter 4.

Transportation Plan

The Muscogee Nation complies with 25 CFR Part 170 to administer the Tribal Transportation Program (TTP). The Tribal Transportation Program is a program enacted to address the surface transportation needs of Tribes. The TTP is authorized as part of the Federal Lands Highway Program under Chapter 2 of Title 23. The program is jointly administered by the Bureau of Indian Affairs (BIA) and FHWA Office of Federal Lands Highway (FLH). The TTP is managed under a memorandum of agreement between FHWA and BIA that was established in 1983 and amended in 1992. No current plans for active transportation that identify evacuation routes or areas to avoid during a hazard are available at this time. The Nation plans to expand on this capability thorough continued partnerships with the Oklahoma Department of Transportation, and units of local government located within the Muscogee Nation to ensure transportation infrastructure is maintained, repaired, upgraded, and enhanced as needed.

Debris Management Plan

With integral programs like Arbor Care dealing with debris management following natural hazards that include components such as ice and high wind, the Muscogee Nation is proficient in taking a focused and coordinated approach towards removal and disposal of debris. While Arbor Care removes limbs and branches following natural hazards, the program also provides management on a regulatory basis, monitoring any limbs or branches that could damage property or utilities preemptively. The Nation applies this approach to all 11 counties within its boundaries. While a formalized debris management plan is not in place, it has been identified that building partnerships with individual county governing bodies is essential for future debris management efforts, as programs like Arbor Care only service tribal citizens or tribal land. Combining forces on many fronts will ensure that a duplication of efforts does not occur. This ultimately acts as a cost saving measure for the tribe and possibly the counties to which its citizens reside, while also safeguarding human health, minimizing the disposal footprint, and limiting environmental impacts. Additionally, a formalized debris management plan would assist the Muscogee Nation manage and properly dispose of debris following Flooding, Severe Winter Storm, Tornado/High Winds, Hail, or Earthquake that may not be tree related.

Infrastructure Resilience Plan

Tribal Resilience within the framework of the United States Department of Interior Affairs refers to resiliency in regard to adaption to science-based climate needs. No current plan addressing resilience to climate needs currently exists within the Muscogee Nation. During the planning process, Muscogee Nation officials made clear the importance of this type of resilience especially as it related to the effects of natural hazards on infrastructure.

While the current adaption of the Nation's Hazard Mitigation Plan addresses risk and supplies mitigation actions for decreased risk to life and property in regard to effects of hazardous climate, in-depth analysis of the Nation's services and assets in relation to natural hazards should be address in a formalized planning process.

FEMA Public Assistance and Hazard Mitigation Grant Program Administrative Plans

Tribal governments must develop a disaster-specific Public Assistance (PA) Administrative Plan and separate Hazard Mitigation Grant Program Administrative Plan, after the President declares an emergency or major disaster authorizing PA for the tribal government. While the Nation's Emergency Operations Plan establishes procedures for response to emergency and disaster events, the Administrative Plans required by FEMA ensure the Nation's capacity to act as the recipient and establish procedures for administering FEMA's disaster assistance programs. The Muscogee Nation has an approved Public Assistance Administrative Plan that designates the Muscogee Nation Department of Emergency Management as the tribal agency acting as the recipient of funds on behalf of the Nation. In addition, the plan describes the following:

- Describes the staffing plan, including management and oversight responsibilities;
- Detail procedures for processing project appeal requests and requests for time extensions; and
- Describe procedures to comply with the administrative requirements of 44 C.F.R. § 206.207(b) and 2 C.F.R. part 200.

The Muscogee Nation must submit an updated Public Assistance administrative plan to the FEMA Regional office every year and a disaster specific administrative plan for each new declaration.

The Nation's Hazard Mitigation Grant Program (HMGP) Administrative Plan for FEMA DR 4456 was approved, but the Nation did not use the FEMA Mitigation funding. Funding for HMGP did not become available in FEMA DR-4587. Since 2019, and DR-4456, the Nation has made significant strides and investment in its emergency management program. Resources and contractual support are available to assist the Nation in identifying projects and utilizing all mitigation dollars when they become available post disaster. Additionally, the Nation has gained practical experience implementing the PA program and hopes to continue to seek Federal Disaster Assistance as a direct Recipient to FEMA moving forward.

The HMGP Administrative Plan is reviewed and updated annually and designates the Muscogee Nation Emergency Management Director or their designee as the Tribal Hazard Mitigation Officer. The Muscogee Nation Grants Department assists the nation with financial management of mitigation programs following a disaster. If necessary, the Nation can seek contract support to augment staffing capabilities and administer the Public Assistance and Hazard Mitigation Grant Program's. The Muscogee Nation HMGP Administrative Plan describes procedures to comply with the administrative requirements of 44 C.F.R. § 206.437 and 2 C.F.R. part 200



3.2 Administrative and Technical Capabilities

Administrative and technical capabilities refer to the Tribal government's staff, skills, and tools that can be used for mitigation planning and to implement specific mitigation actions. It also includes the ability to access, coordinate, and implement these resources effectively. Staffing levels at Muscogee Nation well exceed the capabilities of many Tribal Nations. As of the third quarter of FY 2021, the Muscogee Nation employs 1,092 full-time employees.

The sections below describe several departments and their capacity and capability to support mitigation activities. The Nation has staff capacity and the capability and training to implement mitigation. The Tribe offers training internally and plans to request several FEMA courses in partnership with FEMA Region VI. Until additional training is received and the Tribe gains experience in FEMA's programs, they will continue to seek outside expertise and resources to implement more technical, programmatic requirements, such as the Benefit-Cost Analysis. The Nation retains several external consultants to assist in implementing programs to provide technical support as needed, such as FEMA subject matter expertise, Planning, and H&H services.

Muscogee Nation possesses a range of capabilities that are directly and indirectly related to hazard mitigation activities. These capabilities are organized by department to high the structure of authorities responsible for the execution of these capabilities. Currently, most of these capabilities can be found within the Department of Interior Affairs. Although the Nation is very capable, the overview assessment emphasizes the importance for interdepartmental and intradepartmental collaboration. Comprehensive mitigation efforts often will require many of these departments. Collaboration will become increasingly important as the Nation expands its capability offerings, such as the Tribal Utility Authority, and increases the scope of its mitigation activities.

3.2.1 Overview Assessment

Departments

Name	Specific Capabilities Profiled	
Emergency Management Department	-	
Department of Administration	<ul style="list-style-type: none"> Information Technology Fleet Management 	<ul style="list-style-type: none"> General Services Administration Facilities
Department of Commerce	<ul style="list-style-type: none"> Planning and Grants Department 	<ul style="list-style-type: none"> Muscogee Nation Tribal Utility Authority
Department of Interior Affairs	<ul style="list-style-type: none"> Arbor Care Division of Agriculture and Natural resources Environmental Services Water Resource Management 	<ul style="list-style-type: none"> Storm Shelter Program Geospatial Department (GIS) Historical and Cultural Preservation Tribal Transportation Program Tribal Construction Department
Department of Health	<ul style="list-style-type: none"> Muscogee Health Care System 	<ul style="list-style-type: none"> Public Health
Department of Community and Human Services	<ul style="list-style-type: none"> Hazard Mitigation and Response Activities 	



Department of Education Employment and Training	-
Department of Housing	-

Other independent agencies

Other Capabilities

Response Network

Warning Systems/Services

3.2.2 Qualitative Assessment

Emergency Management

The Muscogee Nation Emergency Management Department was previously under the Department of Interior Affairs but is now under the direct authority of the Principal Chief, per legislation passed in 2020 (NCA 20-023). The Department is tasked with all four phases of emergency management: mitigation, preparedness, response, and recovery. The overarching goal of the department is to minimize the effects of technological and natural disasters for the citizens of the Muscogee Nation. This is primarily done through executing and exercising preparedness plans, assisting counties within the Tribal boundary and governing bodies with training and mitigation efforts, and coordinating disaster response and recovery operations.

With a significant and crucial workload assigned to the Emergency Manager, the Emergency Management Department is currently a department of one full-time employee, who holds several other capacities such as a Floodplain Administration for the Nation. Based on a deficient of staffing, it is recommended that additional supplemental administrative staff should be allocated. Current operating budgets could support this recommendation and seeking additional staff may increase focus on public education regarding hazards with the Muscogee Nation, as well as the mitigation actions outlined within this document in Chapter 5. In addition, with increased staff and, in relation to all the services the Emergency Management Department provides during recovery and response activities, a more formalized and outfitted Emergency Operations Center may be required.

Department of Administration

The Department of Administration consists of several departments including, Human Resources, Information Technology, Fleet Management, General Services Administration, and Facilities. These departments provide services, support, and information to (MCN) employees and Tribal Citizens. The MCN IT staff provides quality technology-based services, in the most cost-effective manner to facilitate MCN services. MCN IT has a staff of thirteen (13) employees and offers support for all MCN locations on campus and remote offices. MCN-IT provides desktop and network support to 980 employees inclusive of multiple custom-built applications. MCN IT supports 14 remote network (MPLS) locations, community centers and remote Tribal programs. Fleet Management provides maintenance for approximately 716 vehicles. Fleet completed 818 work orders, and 355 vehicle reservations were made through Fleet Management Software. The Fleet Management Department also provides preventive maintenance for Muscogee Nation Citizens and employees.



Department of Commerce

The mission of the Department of Commerce is to foster, promote, and develop the foreign and domestic commerce of the Muscogee Nation, and to foster, serve, and promote the Nation's economic development and technological advancement. The Department of Commerce contains of the following departments/programs: Self-Governance, Mvskoke Loan Fund, Planning and Grants Department, and Contract & Employment Services. As of this writing, the Muscogee Nation is intending to create a Tribal Utility authority, which will fall under this Department.

Planning and Grants Department

The Nation relies on several Federal grant programs and has in-house expertise applying for and managing federal funds. The Grants Department provides consultation and compliance assistance to various Muscogee Nation departments. Consistent funding streams for the Tribe include grants through the Department of Housing and Urban Development, Environmental Protection Agency, the Indian Health Services, United States Department of Health and Human Services Administration, and FEMA. The Nation seeks funding as needed provide services to its Citizens.

Tribal Utility Authority

Legislation creating the Tribal Utility Authority was under review by Tribal leadership in hopes of approval by the National Council in 2022 during the time of this plan creation. With tribal citizens present in all 11 counties, and no tangible control or ability to mitigate disruptions in utility service during hazards, the need for a more active role utilizing a Tribal Utility Authority to guide decisions and build partnerships is apparent.

Department of Interior Affairs

The Muscogee Nation Department of Interior Affairs is tasked with the implementation and management of numerous tribal resources including transportation, land and natural resource management, and tribal construction. The following divisions fall under the Department of Interior Affairs and directly support mitigation activities in Muscogee Nation.

Arbor Care

The Arbor Care Service Department works throughout the Muscogee Nation jurisdictional boundary mitigating its properties and the properties of Citizens from trees, tree branches and tree limbs that could destroy or do damage to living structures, utilities or obstruct emergency services or aid to an individual's home. The goal of this service department is to provide Muscogee Citizens, Tribal entities, and Tribal Departments, arbor care services with no out-of-pocket expenses to the citizen.

This department takes individual call-ins, Churches, Ceremonial grounds, and tribal government properties and responds to them in a timely manner. The Housing administration supplies the Arbor Care Department with a list of homes categorized by county, then by city within each of these counties. The supervisor surveys the needs of each of these sights and schedules homes as needed. Wood that can be used for heating is left at each site if client wishes or it is taken by the crew for further distribution to tribal Citizens. In the case of emergency this department is on 24-hour call out for tree branch, tree limb and tree removal from homes, driveways, and entrances for emergency access/egress only.

Division of Agriculture and Natural Resources

The Division of Agriculture and Natural Resources stewards the Nation's natural resources manages the agribusiness operations and fosters leadership training and personal development opportunities for



Muscogee youth. Programs include Fencing, Looped Square Ranch and Meat Company, Storm Shelters Ag Youth and Wildlife.

Environmental Services

Muscogee Nation Environmental Services provides oversight and services for many federal programs and regulatory duties are referenced below:

Native American Housing and Self Determination Act (NAHASDA)

- HUD funded to: Provide Environmental Reviews and Assessments for Native American Housing Programs
- FEMA Floodplain Review
- Archaeological Surveys
- Indoor Air Quality and Mold Investigations
- Lead-based Paint Testing
- Asbestos Inspections
- Methamphetamine Investigation and Testing
- Community Awareness and Educational Outreach
- Water Quality Sampling and Stream Assessments

Illegal Dumping Investigations

- Recycling
- General Environmental Support
- Water Resource Management

Water Resource Management

The capabilities of the Environmental Services Department provide immediate benefit in the Nation's efforts to reduce the risk of climate change and natural hazard impacts. Additionally, the services offered, such as environmental surveys and archeological reviews, can be used as in-kind when the Nation seeks funds for Federal construction projects. The Nation will continue to expand on the existing capabilities of this department as they move towards energy sovereignty efforts and stand up a Tribal Utility Authority.

Storm Shelter Program

The Muscogee Nation's Storm Shelter Program was created through MCN National Council legislation in February 2017, with a limited budget being appropriated for the program. The program allows for the purchase and installation of storm shelters for eligible Muscogee Citizens. To qualify for this program, you must be an enrolled Muscogee homeowner living within the MCN jurisdictional boundaries. There are no income limitations. Because of the limited budget, the Nation plans to expand this program by applying for FEMA Hazard Mitigation Assistance funds annually through BRIC.

Geospatial Department (GIS)

The Geospatial (GIS) Department of the Muscogee Nation is charged with mapping and documenting the resources of the Muscogee Nation within the Reservation. The GIS Department provides GIS information to better protect and preserve the historical and current resources of the Muscogee Nation. The department utilizes GIS software for planning and decision-making purposes. In addition to overseeing GIS solutions for the Nation, the GIS Department employee three Certified Floodplain Managers and is actively involved in the Tribes participation in the National Flood Insurance Program.



Virtual Connectivity: With internet resources becoming more and more important in receiving and delivering information, this data provides an idea for how valuable an internet presence or mobile applications can play in reaching a large proportion of the population before, during, or after a disaster. In addition, relationships between emergency management and social programs that reach access and needs populations (experiencing homelessness, elders, etc.) can help to better identify needs and prepare those populations to withstand and recover from events. Realizing this ever-growing need for technology and connectivity, the Muscogee Nation most recently partnered with counties within its boundaries to provide computers as well as improved internet access to eligible citizen students requiring remote education during the Covid-19 pandemic. Additionally, the Nation is seeking funding from the Tribal Broadband Connectivity Program in order to finalize design plans and implement broadband connectivity in critical areas throughout its entire boundaries.

Historic and Cultural Preservation

The purpose of the Historic and Cultural Preservation Department is to ensure the protection and preservation of valued historic and cultural resources for future generations. The Historic Preservation Office serves as the contact for statutory and regulatory compliance consultation regarding Federal Historic and Cultural Preservation Laws.

Tribal Transportation Program

Tribal Transportation provides transit services within the Muscogee Reservation. These services are available to anyone in the communities and are not limited to tribal Citizens. Muscogee Nation Transit partners with Ki Bois Area Transit (KATS) to service areas where the Muscogee transit system is not available. It is possible this program could be used during emergency and disaster declarations to provide transportation out of areas at risk of impact or impacted.

Tribal Construction Department (Engineering/Building Codes)

The Tribal Construction Department plans, designs and field-inspects tribal renovation projects, as well newly developed capital improvement projects that benefit the tribe and its Citizens. The Tribal Construction Division provides engineering Services, administers planning, and construction quality assurance services for projects involving stormwater management, transportation, and other infrastructure. The components of the department consist of a Director, Assistant Director, project managers, engineers, survey technicians, CAD technicians, engineers, and assistants. The department is tasked with enforcing and following the 2021 International Building Codes and ensuring compliance.

The Tribal Construction Department consists of a Tribal Construction Director, Assistant Director, Senior Project Manager, Project Manager, Civil Engineer, CAD Technician, and Survey Technician. The overarching goal of this personnel is to deliver projects from all milestones of design and through construction. All staff hold a workable knowledge of engineering practices, and the current Assistant Director and Civil Engineer positions hold engineering specific education or certifications. Having engineers and engineering versed employees on staff undoubtedly leverages the Muscogee Nations ability to design and construct projects at a reduced cost compared to soliciting and selecting a qualified engineering firm to perform the work. While many projects primarily utilize the Tribal Construction Department for engineering services, larger projects may be consulted out to qualified vendors depending on size and scope of work. During the adaption of this plan, the Civil Engineer position was vacated and due to the extreme importance of the position it is suggested that the position be filled as soon as possible if not already done so by the adoption of this plan.



Department of Health

The Muscogee Nation Department of Health (MCNDH) was first established in 1977. In 2002, MCN compacted with the United States government under the Indian Self Determination and Education Assistance Act of 1975 (ISDEAA) to provide comprehensive health care services to eligible American Indians/Alaskan Natives (AI/AN), who primarily reside in the Muscogee Nation jurisdictional boundaries as well as serving the needs of other community residents. The MCN operates one of the largest tribal health care systems in the state, providing more than 120,000 patient visits and more than \$37 million annually in care to both Indian and Non-Indian populations. Muscogee Nation provides services that include primary care, urgent care, dental, optometry, behavioral health services and ancillary services such as laboratory, radiology, pharmacy. The MCNDH also offers specialty services such as pediatrics, wound care, physical therapy, diabetes management, and tobacco cessation. As a comprehensive health facility providing services to all generations, MCN has complementary services to assist in taking care of the whole person; contract health services (with approval) provide tertiary care for patients who require care not available in Muscogee Nation facilities and community health representatives provide outreach and health promotion/disease prevention services to the community.

In June 2021, the Nation acquired the former Cancer Treatment Centers of America. This acquisition will increase treatment capacity in the area for high-demand situations like the Covid-19 pandemic and increase access to patients for additional specialty care services. One advantage of the hospital being located in Tulsa is allowing MCNDH to have closer access to physicians in Tulsa which will enhance patient care. Outpatient services will open around the end of July and inpatient services will open in early 2022. MCNDH will add 100 or more employees within the next year, with more jobs to come as services grow. Additionally, the hospital has 153 hotel rooms that will accommodate family members and patients. The opportunity to provide higher level of care for our patients along with lodging provisions for family is a huge advantage for the tribe. MCNDH will have the ability to address any future pandemics or future services in general during a crisis. Initial phase of construction has begun for the Okmulgee Behavioral Health building including concrete work, road demo, hanging steel structure and fence installation. A specialty clinic is being planned to be housed in the Pine Building. The suite is currently being renovated.

Public Health

Compared to other health science disciplines, public health addresses peoples' health by placing more emphasis on the impact of communal, organizational, and societal aspects in determining health. Given the variety across these aspects, public health emergencies can range in type and degree.

The Muscogee Nation Department of Health employs several full-time staff dedicated to emergency management and preparedness for public health emergencies. During this plan update process, the Nation had an opportunity to discuss how Public Health preparedness can be expanded beyond the responsibilities of staff employed by the Department of Health. Building a public health infrastructure, whether that be a department or coordinator/liaison can help ensure that sufficient resources are devoted to public health efforts. The Nation discussed ensuring that the Nation's overall health and its Citizens, beyond the scope of the Department of Health, be addressed.

The Nation will expand its public health capabilities by adding a public health planner to the Muscogee Nation Department of Emergency Management staff. This position will be responsible for broader public health planning and response. In addition, the Nation is considering the development of a continuity of operation plan for the Department specifically, which considers the main hospitals and clinics in the Nation and public health emergencies as well. It is likely that these efforts also will result in data collection and



analysis that will help health officials understand the public health needs of vulnerable communities, in particular.

Department of Community & Human Services

The Department of Community & Human Services (C&HS) encompasses ten client-based social service programs committed to providing services, which promote self-sufficiency through effective program delivery while maintaining compliance with Tribal and Federal regulations. Maintaining positive relationships with Tribal, State, and Federal entities is necessary to ensure a comprehensive range of services are available to the youngest Citizens through the oldest.

Hazard Mitigation and Response Activities

C&HS provides elders with air conditioners through a program to help alleviate the impacts of heat. This program was established under Title 20, Chapter 4 of the Muscogee Nation's Elderly Services code. The Muscogee Nation provides shelter assistance and utility costs to Muscogee Citizens who have experienced a Natural Disaster. Assistance includes replacing necessary items such as clothing, personal hygiene, groceries, furniture, housing, and/or emergency shelter and utility costs. Applicants must apply concurrently for other resources, including Red Cross. The maximum benefit per event is up to \$5,000. Muscogee Nation discussed conducting an annual review of the maximum disaster benefit to ensure the amount is adequate during the plan update.

Department of Education, Employment, and Training

The Department of Education and Training provides oversight of comprehensive programs that result in quality educational opportunities for Muscogee people from early childhood through college. To help better serve the students, the Nation partners with several local and surrounding universities and colleges.

Department of Housing

The Department of Housing was established in 1965 with in order to provide Muscogee Nation citizens access to safe, efficient, and affordable housing. The department accomplishes this by providing housing opportunities for home ownership, rental assistance, and emergency home repair options. There are outlined application criteria and guidelines for each provided program of assistance. Programs and criteria are fully outlined in Title 24, Housing of Muscogee Nation statutes. In addition to assisting with grants for closing costs and lease with the option to buy Programs for emergency home repair and the Affordable Housing and Elderly Housing Programs specifically target tribal citizens that are included in low-income and elderly vulnerable populations.

Independent Agencies

In addition to the agencies and capabilities listed above, the Muscogee Nation has a range of independent agencies, all of which can be vulnerable to hazards in differing ways (see Chapter 4). Several are listed below:

Independent Agencies

- Lighthorse Administration
- Office of Tax Commission
- Office of Public Gaming
- Muscogee Nation Business Enterprise
- Office of Veterans Affairs



- Mvskoke Media
- Natural Resource Conservation District

Independent Constitutional Executive Agencies

- Citizenship Board
- Election Board
- College of the Muscogee Nation Board of Regents

Response Network

Muscogee Nation benefits from a network of partnerships from local, state, and federal partners, along with a number of partners. This summary provides an overview of Muscogee Nation's response network and mutual aid agreements and should not be seen as a comprehensive list.

Muscogee Nation lacks a firefighting service. In addition, its existing units cannot cover response across the entire planning area. This makes partnerships with other entities crucial to the Nation's response effort. Most fire departments and other emergency response units in the planning area share mutual aid agreements with local neighboring fire departments, some of which can cross county lines. In terms of fire management. The Nation interfaces directly with the Bureau of Indian Affairs (BIA) branch of Wildland Fire Management to conduct fire suppression activities in the Nation (see Chapter 4 for more information)

Warning Systems/Services

Electronic Communication Systems

For more information and more frequent alerts, Muscogee Nation is looking into obtaining their own app that Citizens can opt in or out of, such as CivicReady, which can send notifications if a disaster strikes or if there is a warning. The app has multilingual capabilities and be used for educational and outreach purposes as well as emergency notifications.

Sirens

Muscogee Nation does not operate sirens within the planning area. These are the purview of local authorities in the area, strengthening case for partnerships with these entities.



3.3 Financial Capabilities

This section includes the financial leverage the planning area has accessed, can access, and could access for mitigation actions. For specific plans and authorities that procure, authorize, or enable access to some of these financial capabilities, see the Planning and Regulatory section and the Administrative and Technical Section.

3.3.1 Overview Assessment

A 2017 economic impact study showed the Muscogee Nation had an \$866 million economic impact in Oklahoma.¹³ The Executive Branch submits a financial report to the National Council quarterly. At the end of the third quarter FY 2021, the Nation had 140 federal grants/contracts. At the end of the second quarter, the permanent fund had \$506,639,000, which increased from the first quarter's \$478,242,000. Gaming distributions are received by the 15th of each month and reserved for future fiscal years operating costs. The Nation's financial capabilities allow them to provide critical services to Citizens and sought-after jobs and education opportunities across Oklahoma and the United States. In 2019 the Nation spent \$50,500,701 on capital projects. Capital projects include facilities construction, upgrades, or other improvements that require a large one-time expenditure.

3.3.2 Qualitative Assessment

Muscogee Nation is both highly financially capable and vulnerable to hazards (see Chapter 4 for vulnerability), given the size and scope of financial activities and resources in the planning area. The assessment below highlights 4 of the main revenue drivers in the Nation that can be used to fund mitigation activities directly and indirectly.

Muscogee Nation Gaming Operations

Gaming within the tribe is governed by Title 21, Gaming, of current Muscogee Nation code. The Muscogee Nation owns and facilitates the operation of 9 casinos within its tribal boundaries. Collectively, the gaming operations totaled \$17,582,335.01 in revenue for fiscal year 2019 and \$42,357,844.33 for fiscal year 2020 respectively. These numbers represent a vast 141% increase due to Casinos being closed following severe flooding in 2019 and then reopening in the next fiscal year. The higher revenue amount is most typical based upon prior reporting years. Unlike the other revenue streams listed in this assessment, the gaming institutions provide a large portion of jobs among the counties they reside in. Most notably River Spirit Casino, located in Tulsa County, Oklahoma employs approximately 2,200 workers that contribute to that county's local economy as well. The same effect is present at the remaining 8 casino operations.

COVID-19 Relief, United States Department of the Treasury

As a result of the COVID-19 pandemic, the Nation received over \$282 Million Coronavirus aid, Relief and Economic Security Act (CARES Act) funds from the United States Department of the Treasury to Establish the Muscogee Nation Coronavirus Relief Fund Program. In 2021 the Nation received \$424,351,068 in federal American Rescue Plan Act (ARPA) funds. The tremendous volume of funds received from the Department of the Treasury allowed the Nation to provide critical recovery resources to its Citizens. In addition, the Nation plans to use a portion of the ARPA funding for broadband infrastructure.

¹³ http://www.mcnimpact.com/wp-content/uploads/2019/06/MCN_Impact_Report_June-26-2019.pdf



FEMA Disaster and Hazard Mitigation Assistance

In 2019 the Muscogee Nation requested a Presidential Disaster Declaration for the first time since the authority was given by the Sandy Recovery Improvement Act (SRIA). The Nation completed damage assessments and managed funds received in Public Assistance Categories A and B and C-G. The Nation did not use the small amount of HMGP funding available as a result of the event. It is working to build capability in the Department of Emergency Management and the Planning and Grants Department. The Muscogee Nation applied for and received FEMA Hazard Mitigation Assistance in FY19. The Nation received a Pre-Disaster Mitigation (PDM) award to fund a drainage analysis on the Tribal Complex and a separate award to fund the Tribal Hazard Mitigation Plan update. The Tribe intends to apply for FEMA's non-disaster assistance on an annual basis. In FY2021, the Nation will seek funding to expand its storm shelter program. The Nation plans to expand their use of FEMA funding in future years and continue to request emergency and disaster declarations directly to the United States Government. As of the writing of this plan, Muscogee Nation has not received requested or received a Fire Management Assistance Grant (FMAG)

Muscogee Nation Tax Code, Title 36: Taxation and Revenue

Pursuant to Title 36, Chapter 1 of the Muscogee Nation Code Annotated, the Tax Commission was created for the orderly development, administration, regulation of taxation and collection of all the following taxes: Motor Vehicle Registration Tax, Tobacco Tax, Motor Fuel Tax, Sales Tax, Liquor and Beverage Tax, and Oil and Gas Severance Tax. It is the purpose and intent of this Act to provide revenues for essential governmental services of the Muscogee Nation.



3.4 Educational and Outreach Activities

This section refers to preventative educational activities—i.e. activities that occur before a disaster. For outreach capabilities during a disaster, see mutual aid agreements. The Muscogee Nation has a strong outreach program that has been used for other projects and can be leveraged to communicate the Tribe's risk assessment and mitigation strategy. For example, the Muscogee Nation Community Centers maintain information boards and can be used to educate members on hazards and mitigation.

During the planning process, a survey was distributed to generate feedback from the general population. Survey results indicated Muscogee Citizens would benefit from more outreach regarding risks they face and how to prepare for disasters. Of the Citizens that participated in the survey, several commented requesting better communication from the Nation about hazards and disasters. At the third Stakeholder Workshop, members of the planning team suggested staffing Muscogee Nation employees at the community centers to help Citizens access an online risk assessment portal and other information disseminated by the Tribe. Staffing community centers under the jurisdiction of the Muscogee Nation will additionally increase access to information at the base level, as currently, community centers remain closed until a member of the tribal staff determines they need to be opened. Staffing the centers provides a means for tribal citizens to access information during determined hours of operation and in a more consistent manner.



Chapter 4 Risk Assessment

The risk assessment helps communicate vulnerabilities, develop priorities, and inform decision-making for the hazard mitigation plan and for other emergency management efforts. This plan was completed with hours of input from stakeholders in Muscogee Nation and across Oklahoma. The 2021 risk assessment provides the basis for developing a mitigation strategy for the Muscogee Nation.

The Risk Assessment integrates data collected from the Nation's Emergency Operations Plan, Housing Plan, Tribal Master Plan. Data from Oklahoma Climatological Survey was used to assess previous occurrences and the probability of future hazard events. Hazards from the State Hazard Mitigation Plan were reviewed and integrated into this plan when appropriate. Input from the Emergency Management Directors within the Muscogee Nation's municipal and county entities provided copies of local hazard mitigation plans and drainage studies. This information was used to understand flood problem areas and areas of risk for other hazards when available. The Oklahoma Water Resources Board provided data on the condition of High Hazard Dams within the Nation's boundaries. This information was integrated into the plan to profile the flood, dam, and drought hazards. The Nation's transportation plan and Tribal Master Plan were integrated into Future Development sections of each hazard profiled.

During the planning process, the Nation had several conversations on how to incorporate actions of this plan into implementing its Tribal Complex Master Plan. Based on these discussions, the Nation seeks to build the new Cultural Center using hazard resistant construction techniques to protect the Tribes most valuable asset, its culture. While there are no formal plans for sacred sites, the Muscogee Nation Department of Historic and Cultural Resources contributed countless hours of guidance and many data sets to assess locations of cultural resources in hazard areas.

4.1 Introduction: The 2021 Risk Assessment

This assessment integrates an assets-based approach with an analysis of individual hazards to provide a deeper understanding of specific hazards and their impact on the planning area. An assets-based approach, which aligns with the most current FEMA guidance, allows communities to identify assets that are critical to their stability and that are most exposed to hazards. For hazard mitigation planning, this approach allows communities to drive mitigation actions more effectively. Beyond the scope of this mitigation plan, results from the risk assessment should be integrated into future emergency management planning, recovery planning, and development efforts.¹⁴

Compared to the 2016 hazard mitigation plan, the risk assessment was updated and enhanced to provide the most current and robust data and information for quantifying the cost-effectiveness of potential hazard mitigation projects. A GIS analysis was conducted to include any new/modified/updated information (including hazard, land use, and development trends), findings, research, and risk data. New, readily available, credible technical data was incorporated into the analysis as appropriate.

The introductory section is divided into four parts, the first two of which relate to a high-level assessment of hazards throughout the planning area, one that highlights some key vulnerabilities in the planning area broadly, and the final part, which combines development from the previous 3 parts, along with FEMA

¹⁴ A web-based version of the risk assessment may be found online at [Muscogee Nation Hazard Mitigation Portal \(arcgis.com\)](https://arcgis.com)



guidance, to implement an assessment tool that informs the risk assessment. The four parts of this introduction are listed below:

1. Hazard Identification
2. Disaster Declaration History
3. Critical Lifelines and Facilities
4. Definitions for Risk Classification

4.1.1 Hazard Identification

Muscogee Nation considered a full range of hazards that could affect the planning area for the 2021 HMP Update. The process included a review of the 2016 HMP, a review of the state hazard mitigation plan, a review of previous events and losses. In addition, information on the frequency, magnitude, and costs associated with hazards that could affect the planning area were included. Extensive outreach was conducted to subject-matter experts to ensure the appropriate elements of each hazard were included and best-available data was used for the risk assessment.

Hazards of Concern

The organization and evaluation of hazards in the risk assessment has changed somewhat since the development of the 2016 Hazard Mitigation Plan. High wind and tornado events were combined in this plan due to their similar impacts. The 2016 Plan included thunderstorms as a hazard, which included winds, hail, and lightning. The planning team combined the impacts of wind from thunderstorms in the tornadoes and high wind profile for the same reason that high wind and tornado events were combined. Hail and lightning events were profiled separately, given their differing impacts on the planning area.

Hazardous material incidents were considered and discussed by the planning team, but ultimately were not profiled as a separate hazard. Hazardous materials present a threat across the entire planning area from several different sources, including Tier II facilities, transportation systems and hubs (roadways, rail, and air), along with pipelines.¹⁵ In particular, the planning team noted several concerns about how a significant hazardous materials event could affect tribal facilities, especially in Tulsa and Okmulgee counties. The planning team may wish to profile these incidents as a separate hazard in future Plan updates.

Public Health Emergency was considered as a hazard and discussed by the planning team, given the impact of the Covid-19 pandemic, and the threat of other public health emergencies, especially those with a biological or ecological basis. Public health emergencies are best mitigated holistically, especially to protect vulnerable populations. Public health emergency response should be continuous and include a range of medical, infrastructural, and communication components to ensure that mitigation and response remain holistic.¹⁶ For these reasons, a public health subsection was included in the vulnerability section for nearly every hazard. In addition, public health components were incorporated into guidance for Chapter 3.

¹⁵ To facilitate community planning for hazardous material events, the Emergency Planning and Community Right-to-Know Act (EPCRA) requires Tier II reporting on the storage, use, and release of hazardous substances. Facilities that use or store chemicals over EPA thresholds must submit Tier II reports to ODEQ on an annual basis; these facilities can be known as Tier II facilities. The LEPC and fire departments use this information create response plans.

¹⁶ These efforts can, and should, include: environmental hazard identification, epidemiological services, health and medical needs assessment, identification of affected individuals, contamination control, health surveillance, laboratory specimen collection and analysis, infectious disease control, quarantine/isolation, public health information, risk communication, responder safety and health, medical equipment safety and availability, health-related volunteer and donation coordination, in-hospital care and evacuation measures.



In addition, some of the metrics used to evaluate the hazards have changed since the last plan update. For example, the 2021 plan differed from the 2016 plan by adding wet-bulb globe index as a more accurate measurement of extreme heat effects on the body and heat index to determine outside temperature.

The 10 hazards of concern evaluated for the 2021 HMP update are presented below in alphabetical order:

- Dam and Levee
- Drought
- Earthquake
- Extreme Heat
- Fire
- Flooding
- Hail
- Lightning
- Tornado/High Wind
- Severe Winter Storm

4.1.2 Disaster Declaration History

Muscogee Nation has received 3 disaster declarations since 2019, which was enabled by the passage of *The Sandy Recovery Improvement Act* (SRIA) (see Chapter 1 for more information). Nonetheless, federal disaster declarations in the geographic boundaries Nation predate the passage of SRIA. The 11 counties in the geographic Nation have received disaster declarations since 1970, which has tangentially benefitted the Nation and its Citizens. All these counties have received several declarations since 1970. For this reason, the planning team included both the FEMA disasters for Muscogee Nation in Table 1-1 and declarations for the relevant counties in Table 1-2 to provide a better understanding of the severity of the hazards that merited disaster declarations and the government assistance to Muscogee Nation directly and tangentially.

Table 4-1 FEMA Disaster Declarations in Muscogee Nation

Year of Declaration	Declaration Title	Disaster Number
2019	SEVERE STORMS, STRAIGHT-LINE WINDS, TORNADOES, AND FLOODING	DR-4456-OK
2020	COVID-19	EM-3502
2021	OKLAHOMA SEVERE WINTER STORMS	DR-4587-OK

Although declarations in Muscogee Nation are very recent, declarations to the counties in the planning area can provide additional information to understand hazards in the planning area. Since 1970, the 11 counties have received 86 total declarations, of which 53 were major disaster declarations (DR), 10 were emergency management declarations (EM), and 23 were fire management assistance declarations (FM). Table 1-2 outlines these declarations.

Table 4-2 FEMA Disaster Declarations for 11 Counties Within the Boundaries of Muscogee Nation

Year of Declaration	Declaration Title	Declared County Area	Disaster Number
1970	HEAVY RAINS, TORNADOES & FLOODING	SEMINOLE	DR-297-OK
1971	HEAVY RAINS & FLOODS	CREEK, OKMULGEE, TULSA, WAGONER	DR-314-OK
1972	SEVERE STORMS & FLOODING	TULSA, WAGONER	DR-317-OK



1973	SEVERE STORMS, FLOODING, & TORNADOES	MAYES, MCINTOSH, MUSKOGEE, TULSA	DR-392-OK
1973	SEVERE STORMS & FLOODING	HUGHES, SEMINOLE	DR-409-OK
1974	HEAVY RAINS & FLOODING	ROGERS, TULSA	DR-419-OK
1974	SEVERE STORMS & FLOODING	CREEK, MAYES, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-441-OK
1974	SEVERE STORMS & FLOODING	CREEK, TULSA	DR-453-OK
1975	SEVERE STORMS, FLOODING & TORNADOES	MAYES	DR-474-OK
1975	SEVERE STORMS & TORNADOES	TULSA	DR-491-OK
1976	SEVERE STORMS & FLOODING	TULSA, WAGONER	DR-504-OK
1982	SEVERE STORMS & FLOODING	OKFUSKEE	DR-662-OK
1983	SEVERE STORMS AND FLOODING	HUGHES	DR-685-OK
1983	SEVERE STORMS & FLOODING	OKFUSKEE	DR-693-OK
1984	SEVERE STORMS & TORNADOES	CREEK, OKMULGEE, TULSA, WAGONER	DR-704-OK
1984	SEVERE STORMS & FLOODING	ROGERS, TULSA, WAGONER	DR-709-OK
1986	SEVERE STORMS & FLOODING	CREEK, MAYES, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, TULSA, WAGONER	DR-778-OK
1990	SEVERE STORMS, TORNADOES & FLOODING	HUGHES, MCINTOSH, OKMULGEE, SEMINOLE	DR-866-OK
1991	SEVERE STORMS & TORNADOES	ROGERS	DR-905-OK
1993	SEVERE STORMS & TORNADOES	MAYES, ROGERS, TULSA, WAGONER	DR-987-OK
1993	SEVERE STORMS, TORNADOES & FLOODING	CREEK, OKFUSKEE, OKMULGEE, TULSA, WAGONER	DR-991-OK
1995	TORNADOES, SEVERE STORMS AND FLOODING	CREEK, SEMINOLE	DR-1058-OK
1996	EXTREME FIRE HAZARD	TULSA	EM-3118-OK
1999	OK, TORNADOES 5/3/99	CREEK, OKMULGEE TULSA	DR-1272-OK
2000	OK-BRISTOW FIRE COMPLEX-9/18/00	CREEK	FS-2342-OK
2000	SEVERE WINTER AND ICE STORM	CREEK, HUGHES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, SEMINOLE, TULSA, WAGONER	EM-3158-OK
2001	SEVERE WINTER ICE STORM	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-1355-OK
2001	SEVERE STORMS, FLOODING, AND TORNADOES	OKMULGEE, MUSKOGEE, OKFUSKEE	DR-1384-OK



2002	SEVERE WINTER ICE STORM	CREEK, ROGERS, TULSA	DR-1401-OK
2003	SEVERE STORMS AND TORNADOES	CREEK, MUSKOGEE, OKFUSKEE, OKMULGEE, SEMINOLE	DR-1465-OK
2005	HURRICANE KATRINA EVACUATION	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, SEMINOLE, ROGERS, TULSA, WAGONER	EM-3219-OK
2005	FLAT ROCK FIRE COMPLEX	MAYES	FM-2587-OK
2005	TEXANNA ROAD FIRE	MCINTOSH	FM-2590-OK
2005	HUGHES COUNTY FIRE COMPLEX	SEMINOLE	FM-2592-OK
2006	DEPEW FIRE COMPLEX	CREEK	FM-2597-OK
2006	WAINWRIGHT FIRE COMPLEX	MUSKOGEE	FM-2599-OK
2006	SHAMROCK FIRE COMPLEX	CREEK	FM-2601-OK
2006	SAPULPA FIRE COMPLEX	CREEK	FM-2605-OK
2006	PRAGUE FIRE	OKFUSKEE	FM-2606-OK
2006	EUFAULA FIRE	MCINTOSH	FM-2608-OK
2006	MCNALLY FLATS FIRE	MCINTOSH	FM-2615-OK
2006	HENRYETTA FIRE	MCINTOSH, OKMULGEE	FM-2616-OK
2006	EXTREME WILDFIRE THREAT	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-1623-OK
2007	SEVERE WINTER STORMS AND FLOODING	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	EM-3272-OK
2006	KIEFER FIRE	CREEK	FM-2625-OK
2006	SPERRY FIRE	TULSA	FM-2628-OK
2007	SEVERE WINTER STORMS	HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-1678-OK
2007	SEVERE STORMS, TORNADOES AND FLOODING	HUGHES, MCINTOSH, OKFUSKEE, SEMINOLE	DR-1707-OK
2007	SEVERE STORMS, FLOODING, AND TORNADOES	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, WAGONER	DR-1712-OK
2007	SEVERE STORMS, TORNADOES, AND FLOODING	OKFUSKEE, OKMULGEE, SEMINOLE	DR-1718-OK
2007	SEVERE STORMS, FLOODING, AND TORNADOES	SEMINOLE	DR-1723-OK
2007	SEVERE WINTER STORMS	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE,	EM-3280-OK



2007	SEVERE WINTER STORMS	OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER CREEK, MAYES, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-1735-OK
2008	SEVERE STORMS, TORNADOES, AND FLOODING	HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE	DR-1752-OK
2008	SEVERE STORMS, TORNADOES, AND FLOODING	HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, ROGERS, SEMINOLE, WAGONER	DR-1754-OK
2008	SEVERE STORMS AND FLOODING	OKFUSKEE, ROGERS	DR-1775-OK
2009	SEVERE WINTER STORM	HUGHES, MCINTOSH, MUSKOGEE, OKFUSKEE	DR-1823-OK
2010	SEVERE WINTER STORM	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	EM-3308-OK
2010	SEVERE WINTER STORM	CREEK, HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-1876-OK
2010	SEVERE WINTER STORM	CREEK, HUGHES, MAYES, MUSKOGEE, OKFUSKEE, OKMULGEE, ROGERS, SEMINOLE, WAGONER	DR-1883-OK
2010	SEVERE STORMS, TORNADOES, AND STRAIGHT-LINE WINDS	CREEK, MCINTOSH, OKFUSKEE, OKMULGEE, SEMINOLE	DR-1917-OK
2011	SEVERE WINTER STORM AND SNOWSTORM	CREEK, MAYES, OKMULGEE, ROGERS, TULSA, WAGONER	DR-1985-OK
2011	SEVERE STORMS AND FLOODING	MCINTOSH, MUSKOGEE, OKMULGEE	DR-1988-OK
2011	FRANKHOMA 81-FIRE	CREEK	FM-2940-OK
2011	REGENCY FIRE	CREEK	FM-2943-OK
2011	TURLEY FIRE	TULSA	FM-2944-OK
2011	265TH WEST FIRE	TULSA	FM-2946-OK
2011	CLEVELAND-MANNFORD FIRE COMPLEX	CREEK	FM-2947-OK
2011	SEVERE WINTER STORM	CREEK, HUGHES, MAYES, MCINTOSH, OKFUSKEE, OKMULGEE, MUSKOGEE, ROGERS, SEMINOLE, TULSA, WAGONER	EM-3316-OK
2012	FREEDOM FIRE	CREEK	FM-5000-OK
2012	DRUMRIGHT FIRE	CREEK	FM-5003-OK
2012	FREEDOM AND NOBLE WILDFIRES	CREEK	DR-4078-OK



2013	SEVERE STORMS, TORNADOES, AND FLOODING	HUGHES, MCINTOSH, OKFUSKEE, OKMULGEE, SEMINOLE CREEK, HUGHES, MAYES	DR-4117-OK
2015	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	MCINTOSH, OKFUSKEE, OKMULGEE, MUSKOGEE, ROGERS, SEMINOLE, TULSA, WAGONER	DR-4222-OK
2016	OAK GROVE FIRE	CREEK	FM-5118-OK
2016	SEVERE WINTER STORMS AND FLOODING	HUGHES, MAYES, MCINTOSH, MUSKOGEE, OKFUSKEE, OKMULGEE	DR-4256-OK
2017	141ST FIRE	WAGONER	FM-5169-OK
2017	SEVERE STORMS, TORNADOES, AND FLOODING	MUSKOGEE, MAYES, ROGERS	DR-4315-OK
2017	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	OKFUSKEE, OKMULGEE, MUSKOGEE	DR-4324-OK
2019	FLOODING	MUSKOGEE, TULSA, WAGONER	EM-3411-OK
2019	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	MAYES, MUSKOGEE, TULSA, ROGERS, WAGONER, CREEK, OKFUSKEE, OKMULGEE	DR-4438-OK
2019	SEVERE STORMS, TORNADOES, STRAIGHT-LINE WINDS, AND FLOODING	OKMULGEE, OKFUSKEE	DR-4453-OK
2020	COVID-19	CREEK, MCINTOSH, MUSKOGEE, OKMULGEE, MAYES, OKFUSKEE, HUGHES, ROGERS, SEMINOLE, TULSA, WAGONER	EM-3462-OK
2020	COVID-19 PANDEMIC	CREEK, MCINTOSH, MUSKOGEE, OKMULGEE, MAYES, OKFUSKEE, HUGHES, ROGERS, SEMINOLE, TULSA, WAGONER	DR-4530-OK
2021	SEVERE WINTER STORM	CREEK, MCINTOSH, MUSKOGEE, OKMULGEE, MAYES, OKFUSKEE, HUGHES, ROGERS, SEMINOLE, TULSA, WAGONER	EM-3555-OK
2021	SEVERE WINTER STORMS	CREEK, MCINTOSH, MUSKOGEE, OKMULGEE, MAYES, OKFUSKEE, HUGHES, ROGERS, SEMINOLE, TULSA, WAGONER	DR-4587-OK

4.1.3 Critical Facilities and Lifelines

This section describes critical facilities and FEMA lifelines, given their importance to maintain the continuity of basic and life-sustaining services in the planning area.¹⁷ Critical facilities are identified as being crucial to the basic functioning of communities in the planning area. The planning team has identified critical facilities

¹⁷ These are not the only crucial components in the planning area. For example, commentary on cultural components is notably absent. For a more comprehensive commentary, see the vulnerability sections for each hazard profile.



that are exposed to increased flooding risk, which is the baseline standard for FEMA. The planning team expanded their study to identify critical facilities that are at risk for any of the identified hazards across the entire planning area, when possible. A map of critical facilities can be found Figure 1-1. Most critical facilities are concentrated in the City of Tulsa greater metropolitan area and the City of Okmulgee.

Given the number and variety of facilities owned by the Muscogee Nation, the planning team mapped critical facilities based on three overlapping factors: the facilities' role in maintaining the basic and immediate community functioning, the facilities' relationship to FEMA lifelines, and the facilities' outsized role as an economic driver/employer. Four categories of structures were selected as "critical" under this metric:

- Tribal Government Buildings (includes departments located at the Tribal Complex in Okmulgee)
- Health Care - Medical Buildings
- Community Centers
- Casinos

Other cultural structures and sites of significant importance to the Nation are considered critical, including Churches, cemeteries, and sacred grounds. None of these cultural structures and sites are mapped, however, to protect the confidentiality of their locations. All other facilities that do not fall into any of the categories above are mapped in yellow to show the distribution of Muscogee Nation's facilities throughout the planning area.

Critical facilities can impact one or more community lifelines. Lifelines, however, provide officials and residents a system-wide approach to mitigation.¹⁸ FEMA's community lifelines are *systems* that are essential a community's basic functioning by supporting key government, business, and other essential functions. Lifelines can be composed of chains of critical facilities and other assets.

Critical facilities and Lifelines are found in the vulnerability sections of each profiled hazard. Within this section, the planning team included a commentary on critical facilities in the built environment section, under critical facilities. Commentary on lifelines throughout the planning area are included throughout the vulnerability parts of each hazard but are concentrated in the infrastructure subsection within the built environment section. FEMA's seven lifelines are listed below:

¹⁸ <https://www.fema.gov/emergency-managers/practitioners/lifelines>



FEMA Community Lifeline List



Safety and Security - Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety



Food, Water, Shelter - Food, Water, Shelter, Agriculture



Health and Medical - Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management



Energy - Power Grid, Fuel



Communications - Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch

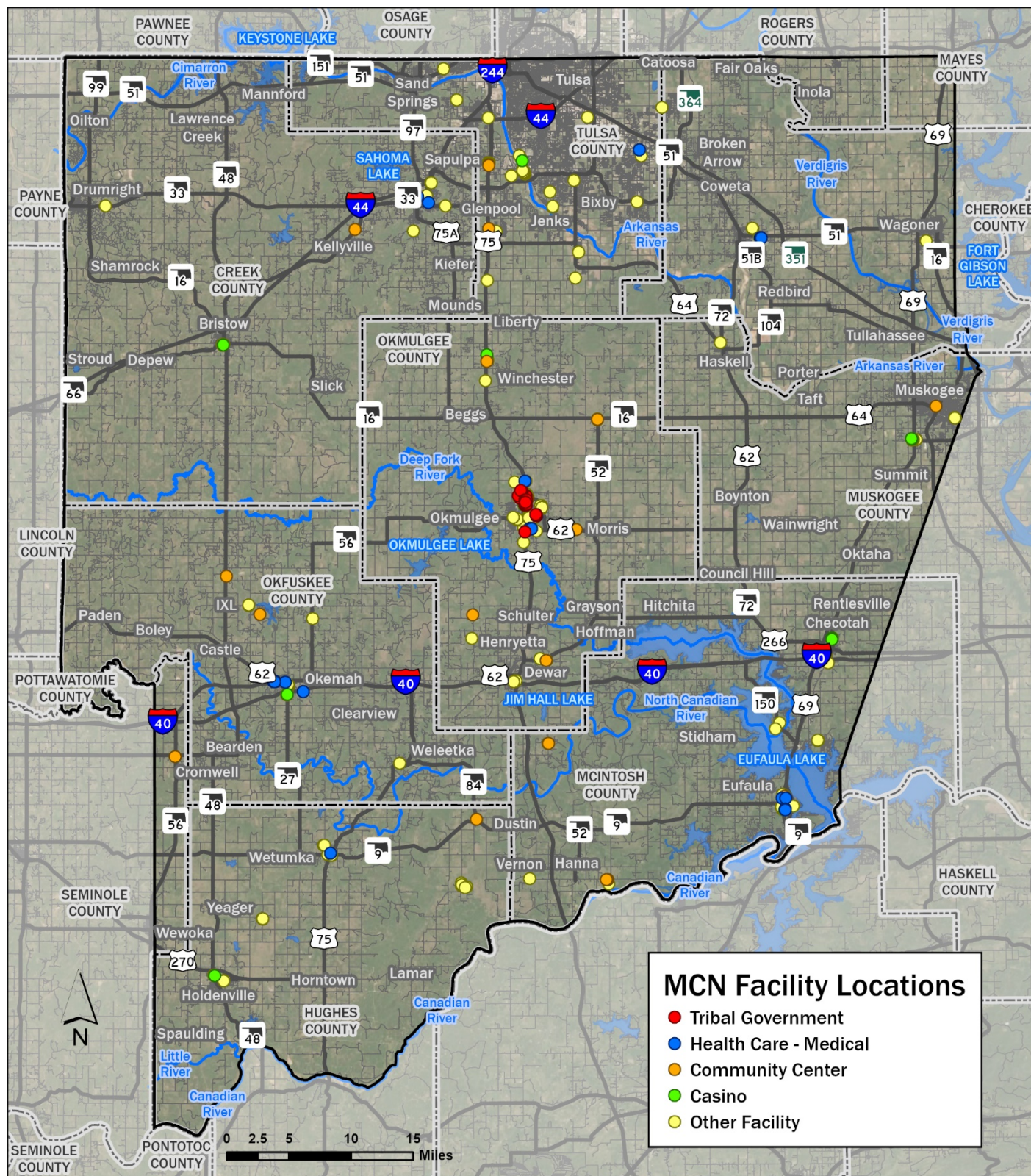


Transportation - Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime



Hazardous Material - Facilities, HAZMAT, Pollutants, Contaminants

Figure 1-1 Facilities and Critical Facilities in Muscogee Nation



4.1.4 Definitions for Risk Classifications

The hazards assessed throughout this risk assessment follow guidance and precedent from planning processes in FEMA Region VI and the state of Oklahoma. Hazards are organized by a description section, a vulnerability and risk assessment section, and a summary of observations and recommendations section.

The classifications for probability and overall significance, as defined on Worksheet 5.1 in the *FEMA Tribal Mitigation Planning Handbook*, met Muscogee Nation's needs and methods, and were used in the 2021 risk assessment. Through the National Mitigation Planning Program, FEMA provides guidance, training, and technical assistance to support Indian tribal governments (tribal governments) in developing and implementing mitigation plans. The tribal mitigation planning requirements under 44 CFR § 201.7(a)(4) specifically allow tribal governments to participate in multi-jurisdictional mitigation plans (see Chapter 1 for more information).

Probability of Future Events

The planning team used different probability metrics for the 2021 Plan compared to the 2016 Plan. The 2016 plan used the similar metrics—"Unlikely," "Possible," "Likely," and "Highly Likely"—as this assessment but assigned these metrics different probability values.¹⁹ The planning team decided to use different metrics in the 2021 Plan because they aligned more closely with standard practices in the State of Oklahoma and FEMA Region VI. Given the larger size of the planning area compared to other planning areas in Oklahoma, none of the hazards addressed met the criterion for "likely" under this matrix. This should assist readers in comparing and integrating the 2021 Plan with surrounding communities, enhancing potential mitigation planning and response actions. These metrics were included in Table 1-3 and in the description section of each hazard profiled.

Unlikely: Less than 1 percent probability of occurrence in the next year or a recurrence interval of greater than every 100 years.

Occasional: 1 to 10 percent probability of occurrence in the next year or a recurrence interval of 11 to 100 years.

Likely: 10 to 90 percent probability of occurrence in the next year or a recurrence interval of 1 to 10 years.

Highly Likely: 90 to 100 percent probability of occurrence in the next year or a recurrence interval of less than 1 year.

Overall Significance

The 2016 HMP did not include an overall significance classification statement but did include a vulnerability assessment. The overall significance statements for each hazard are included in Table 1-3 and in the vulnerability section of each hazard profiled.

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

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

¹⁹ "Highly likely" was classified by a 100% < probability of occurrence in the next year (event has a one in one years' chance of occurring). "Likely" was classified by a 33% < 100% probability of occurrence in the next year (event has a one in three years' chance of occurring). "Occasional" referred to 20% < 33% probability of occurrence in the next year (event has a one in five years' chance of occurring). "Unlikely" referred to < 10% probability of occurrence in the next year (event has a one in ten years' chance of occurring).



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

Table 4-3: Summary of Hazard Probability and Overall Significance

Hazard	Probability	Overall Significance
Flooding	Highly Likely	High
Severe Winter Storm	Highly Likely	High
High Wind & Tornado	Highly Likely	High
Dam & Levee Failure	Likely (Dam) Occasional (Levee)	High
Extreme Heat	Highly Likely	Medium
Fire	Highly Likely	Medium
Hail	Highly Likely	Medium
Drought	Highly Likely	Low
Lightning	Highly Likely	Low
Earthquake	Unlikely	Low



4.2 Flooding (Ue-lvoke)

4.2.1 Hazard Description

A flood is the partial or complete inundation of water over normally dry land. Common impacts of flooding include damage to personal property, buildings, and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities. There are three common types of flooding in Muscogee Nation: riverine flooding, flash flooding, and urban flooding.

Riverine flooding: occurs from excessive rainfall in upstream areas that forces rivers and streams to rise and overflow their banks, inundating the adjacent floodplains. Riverine flooding is usually a gradual process, with several hours to several days of warning time for downstream communities. This type of event usually remains in flood for a longer period than flash or urban flooding, and often causes more damage due to the length of time structures are inundated, the velocity and depth of water, and floating debris.

Flash flooding: is associated with large convective thunderstorms that frequent the region and can drop between 1 and 5 inches of rain in an hour. When the soil is already saturated, rainfall from such storms can converge in creeks and streams suddenly, with little warning. Flash floods can reach peak flows within a few minutes. Waters from flash floods move with great force and velocity and can tear out trees, carry away houses and outbuildings, and destroy roads and bridges. These walls of water often carry large amounts of debris, sewage, and pollutants. Although potentially hazardous to life and destructive of property, flash flooding usually lasts only a matter of hours.

Urban flooding: occurs when heavy rainfall runs off structures, parking lots, and streets, converging in culverts and drainage ways often clogged with debris. This causes streets to flood and storm sewers to back up.

Location

The nearly 5,000 square miles of Muscogee Nation's geographic area includes hundreds of miles of waterways, ranging from some of the largest rivers in the United States to small streams. To better understand flood patterns in an area of this size and scope, flooding in Muscogee Nation can be segmented into several categories:

- Floods along major waterways with very large drainage basins, most prominently:
 - Arkansas River
 - Verdigris River
 - Polecat Creek
 - Deep Fork River
 - North Canadian River
 - Canadian River
- Flash floods along tributaries that ultimately drain into major waterways (listed above)
- Floods that impact streets and county transportation systems
- Localized drainage problems from inadequate infrastructure

Given the size and scope of the Nation's flooding problems, along with differences in data collection throughout the Nation, this section will outline several data sources and collection methods that the planning team used to determine flooding location throughout the planning area. This assessment begins with a discussion and analysis of FEMA's digital floodplain mapping in the planning area, given its scope of mapping. In order to compliment this area-wide analysis, the planning team included FEMA base-level engineering (BLE) maps for areas that lack more detailed data. The planning team also notes the importance of additional mapping that some incorporated areas in Muscogee Nation have completed,

which has enhanced the detail of the flood and drainage mapping in these areas. To highlight some of the areas of greatest risk in the planning area, this flooding location section culminates with a list of the most significant flooding “problem areas.” These problem areas will drive information in the extent and vulnerability sections of this assessment.

FEMA Floodplain Mapping

As a part of its regulatory function, the National Flood Insurance Program (NFIP) has established zones that are used in Flood Insurance Rate Maps (FIRM)s. FEMA uses these zones to map floodplains. Flood location in Muscogee Nation is characterized by two types of FEMA floodplain zones in particular (all zones are described in more detail in the extent section). These mapped zones are:

- Zone A, or 1% Annual Chance (100-year) flood zones. These zones are also called special flood hazard areas (SFHA)s. For the sake of clarity, this plan will refer to these zones as 1% (100-year) flood zones. There are six A zones. FEMA maps for the planning area outline two of them; the approximate A zone (A) and the A zone (AE).
- Zone C, 0.2% (500-year) flood zones. These flood zones are determined to have a 0.2% chance of flooding annually. For the sake of clarity, this plan will refer to these zones as 0.2% (500-year) flood zones.

Figure 1-2 includes FEMA floodplains mapped within Muscogee Nation’s boundary. It is important to note that while FEMA digital flood data is recognized as best available data for planning purposes, it does not always reflect the most accurate and up-to-date flood risk. Flooding and flood related losses often occur outside of delineated SFHAs.

Base Level Engineering (BLE) Mapping

FEMA also has prepared Base Level Engineering (BLE) maps in Oklahoma. BLE maps combine high-resolution ground elevation data, and modeling technology advancements to create engineering models and flood hazard data on a large scale. The BLE data, as shown in Figure 1-3, are generally equivalent to Zone A (approximate flood zones) mapping and can be adopted as such for areas without Zone A floodplains. They cannot be used to replace Zone AE (detailed flood zones) mapping.

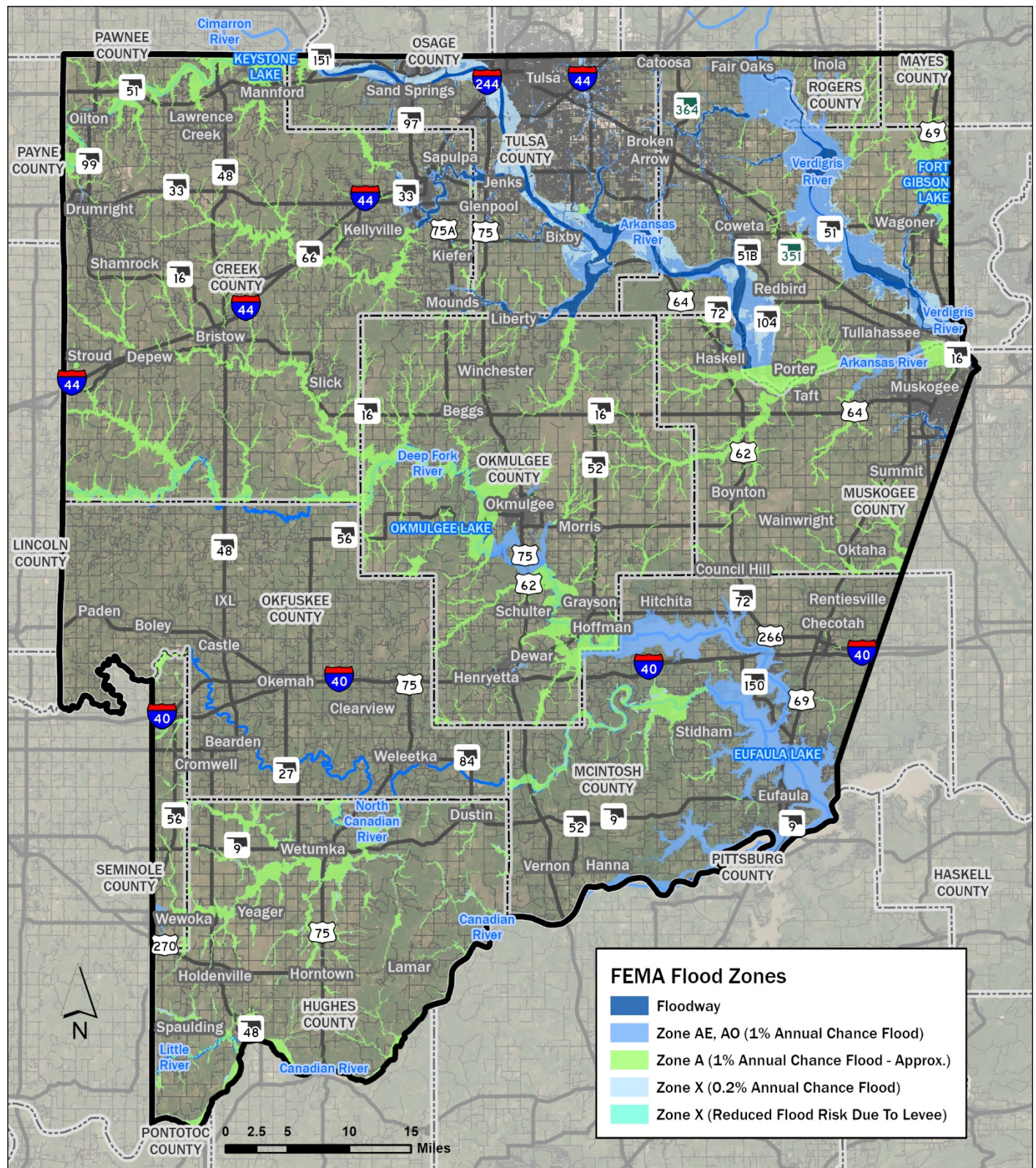
Additional Mapped Areas

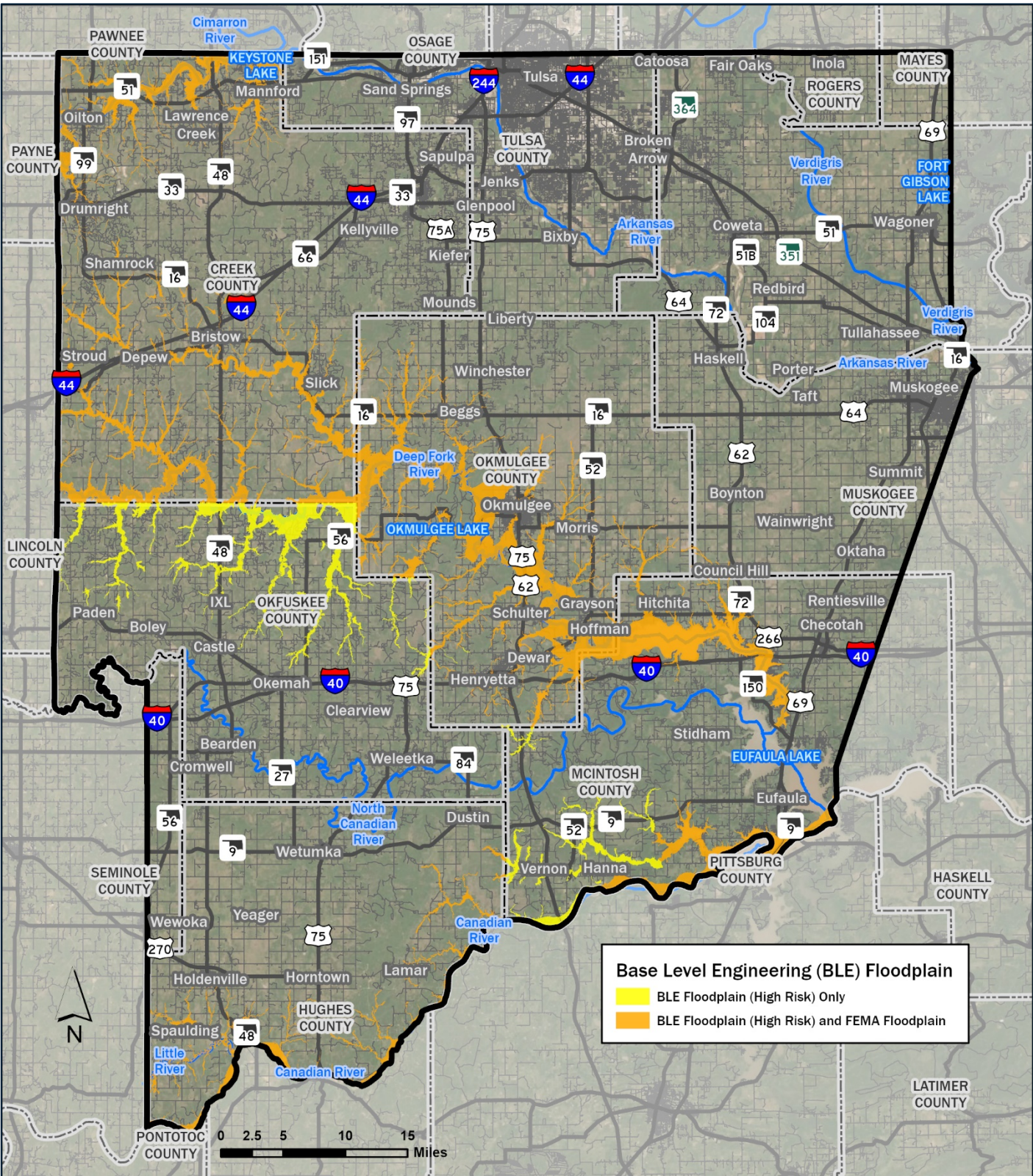
In addition to FEMA mapping data, portions of the Nation that fall within Sand Springs, Tulsa, Sapulpa, and Okmulgee have identified additional floodplain areas based on the local master drainage plans that they have conducted. These floodplains are extended upstream in the drainage basin to a point where there is approximately 40 acres of drainage. These floodplain models can be compared to Special Flood Hazard Area (SFHA) models, which only extend to a point where there is approximately one square mile of drainage area (see extent section for more information).²⁰ Some of the incorporated areas in Muscogee Nation, especially many of the larger urban areas, have adopted floodplain ordinances based on these data and plans.

²⁰ Citywide or localized floodplain maps are not shown in this assessment.



Figure 1-2 Muscogee Nation FEMA Floodplain Maps





Problem areas

Given the size and scope of flooding issues in boundaries of Muscogee Nation, the planning team found it important to focus on mitigating flood risk in recurring problem areas, which impact streets and transportation systems and have localized drainage and nuisance flooding problems. These specific problem areas were selected by the planning team and were discussed in several stakeholder meetings. The problem areas were identified because their importance to the Nation and vulnerability to flood hazards, which can be seen in Table 1-4 and on the preceding figures.

Table 4-4 Muscogee Nation Problem Areas

Area	Source	Location	Description
1	Arkansas River	River Spirit Casino, Tulsa, OK	This facility was flooded in 2019. Later analysis of the 2019 flood showed that it was approximately the same as the flood with a 1% probability.
2	Okmulgee Creek and local drainage	Muscogee Nation Tribal Facilities in Okmulgee, OK	This area, including the current Lighthorse police station, flooded during an extraordinary flood on June 7, 2021.
3	Local Drainage	Okemah Low Rent Housing, Okemah, OK	This area floods due to adjacent development. Water gets into some of the buildings,
4	Coal Creek (tributary of Pole Cat Creek)	Glenpool Community Center, Glenpool, OK	The building is lower than the BFE for Coal Creek by more than one foot and flooded June 26, 2015 (Flood Insurance claim of \$58,698.74).
5	Local Drainage	Holdenville Child Development Center (CDC) and Community Center (Nutrition Center).	The CDC building flooded June 19, 2015, from heavy rains (Flood Insurance claim of \$23,705.50). The Community Nutrition Center flooded June 29, 2015 (Flood Insurance claim of \$10,653.62).
6	Canadian River	South and East of Dustin and Hannah, Oklahoma	Flooding from the Canadian River and its tributaries have caused flooding and erosion on the Ranch.
7	Snake Creek	Tulsa County south and east of Bixby, OK	Bixby Bottom Road (171 St. So.) is approximately an annual flooding problem. Snake Creek south of Highway 64 and the area between Mingo Rd. and Garnett Ro. floods nearly every year, cutting off access from the south. During a 10% storm, the roadway near 181st St. South and Garnett Road will have flooding 4 feet deep.
8	Verdigris River	305 th E. Ave. in Wagoner County between 11 th Street and 41 st St..	County Roads overtop frequently. When the Verdigris River gets up during the 1% annual chance flood, 305 th E. Ave. floods as much as 5 feet deep on the roadway.
9	Arkansas River	From the Arkansas River south to approximately 19 th St. between 145 th W. Ave and 155 th W. Ave. in Tulsa County	Town & County Subdivision flooded during the 2019 flood by as much as 4 feet in some residences. Tribal Citizens live in this subdivision.



Figure 1-4 Muscogee Nation Problem Areas (1-9)

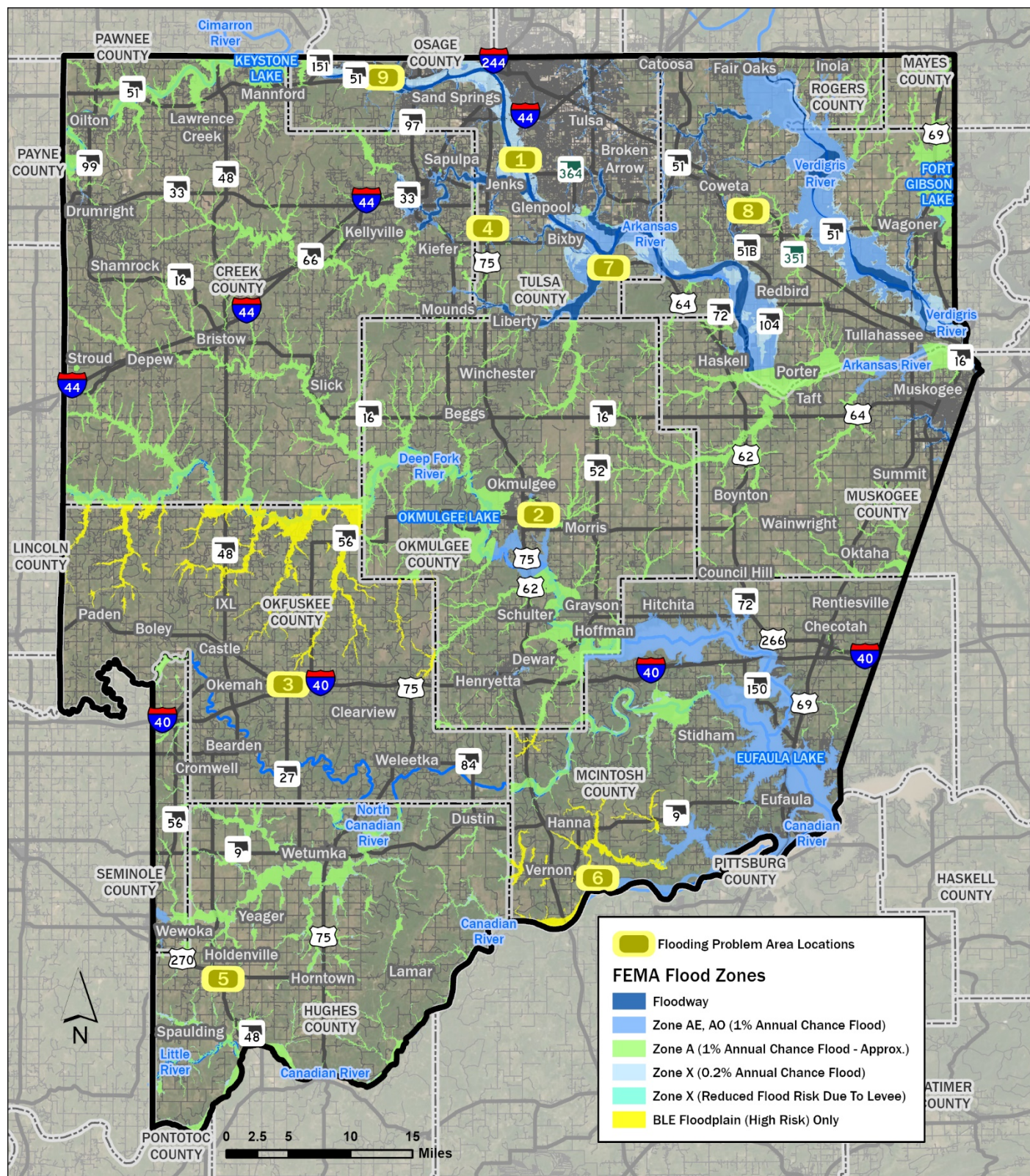


Figure 1-6 Problem Area 1: River Spirit Casino

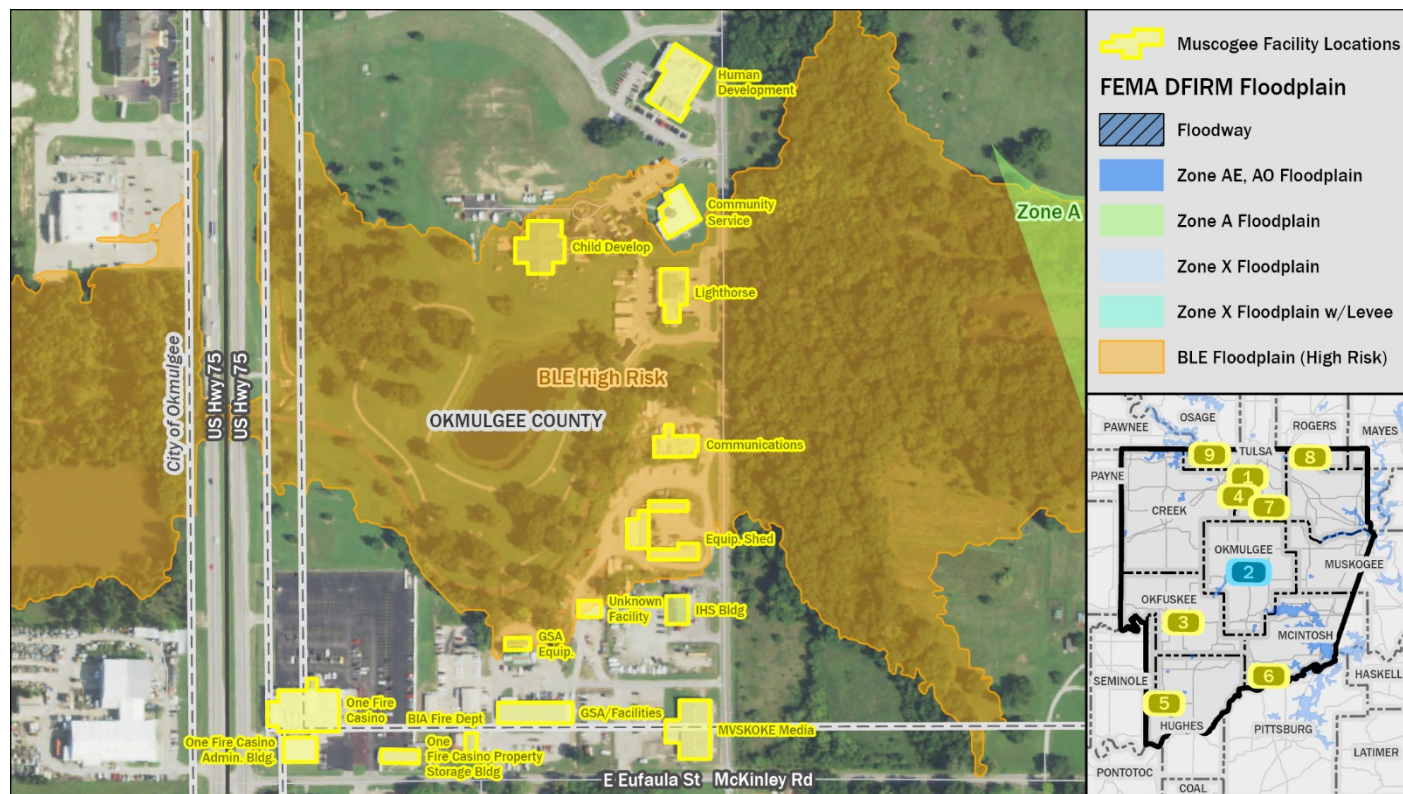


Figure 1-5 Problem Area 2: Muscogee Nation Tribal Facilities

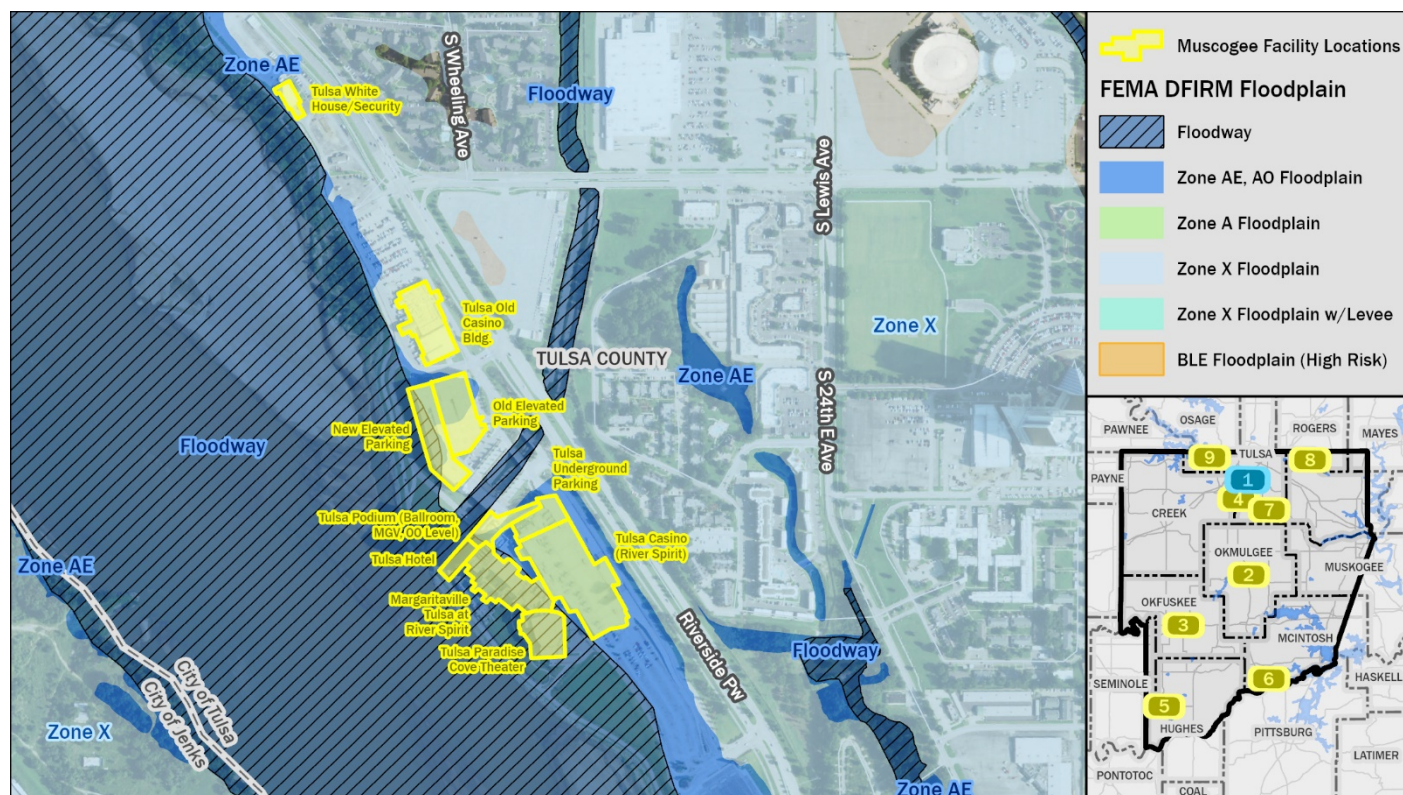


Figure 1-8 Problem Area 3: Okemah Low Rent Housing

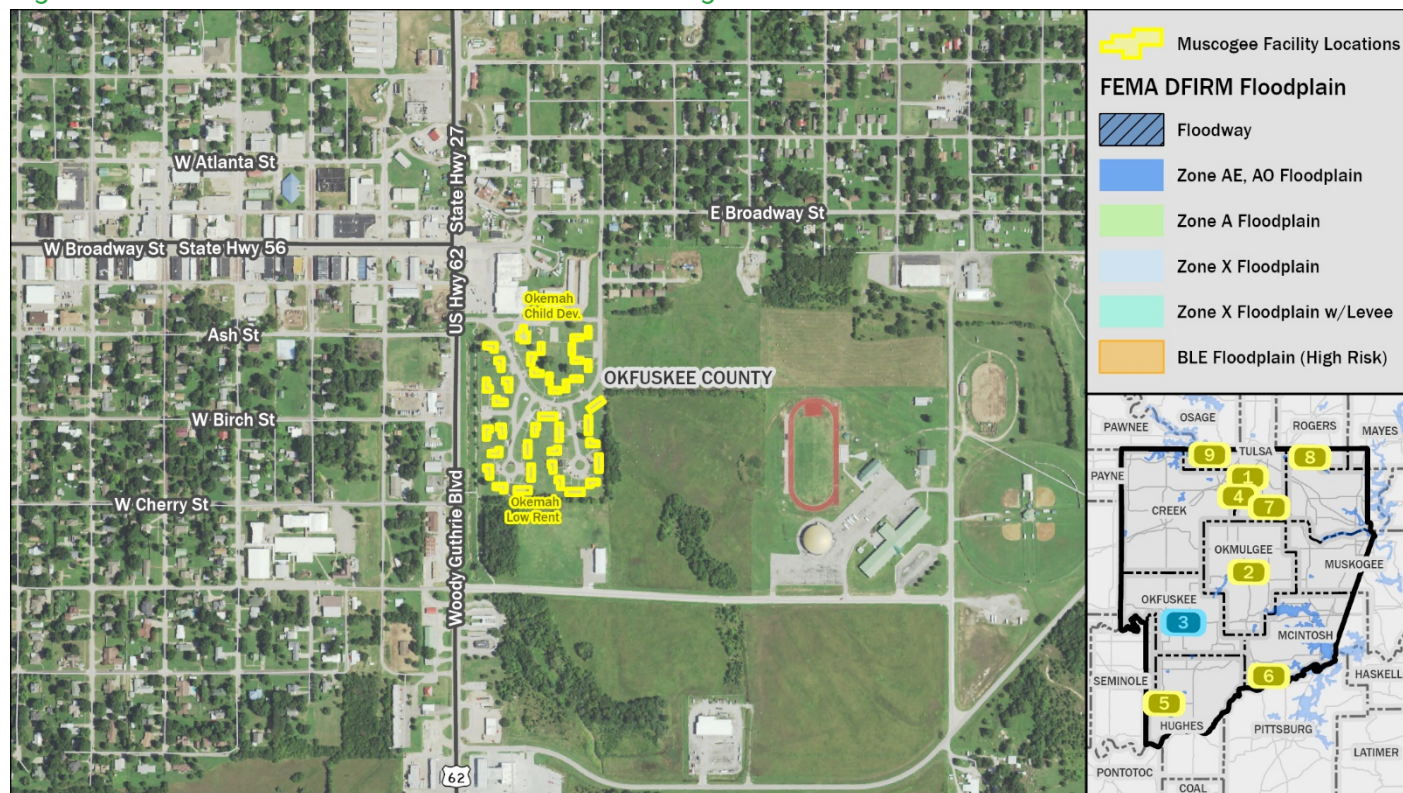


Figure 1-7 Problem Area 4: Glenpool Community Center

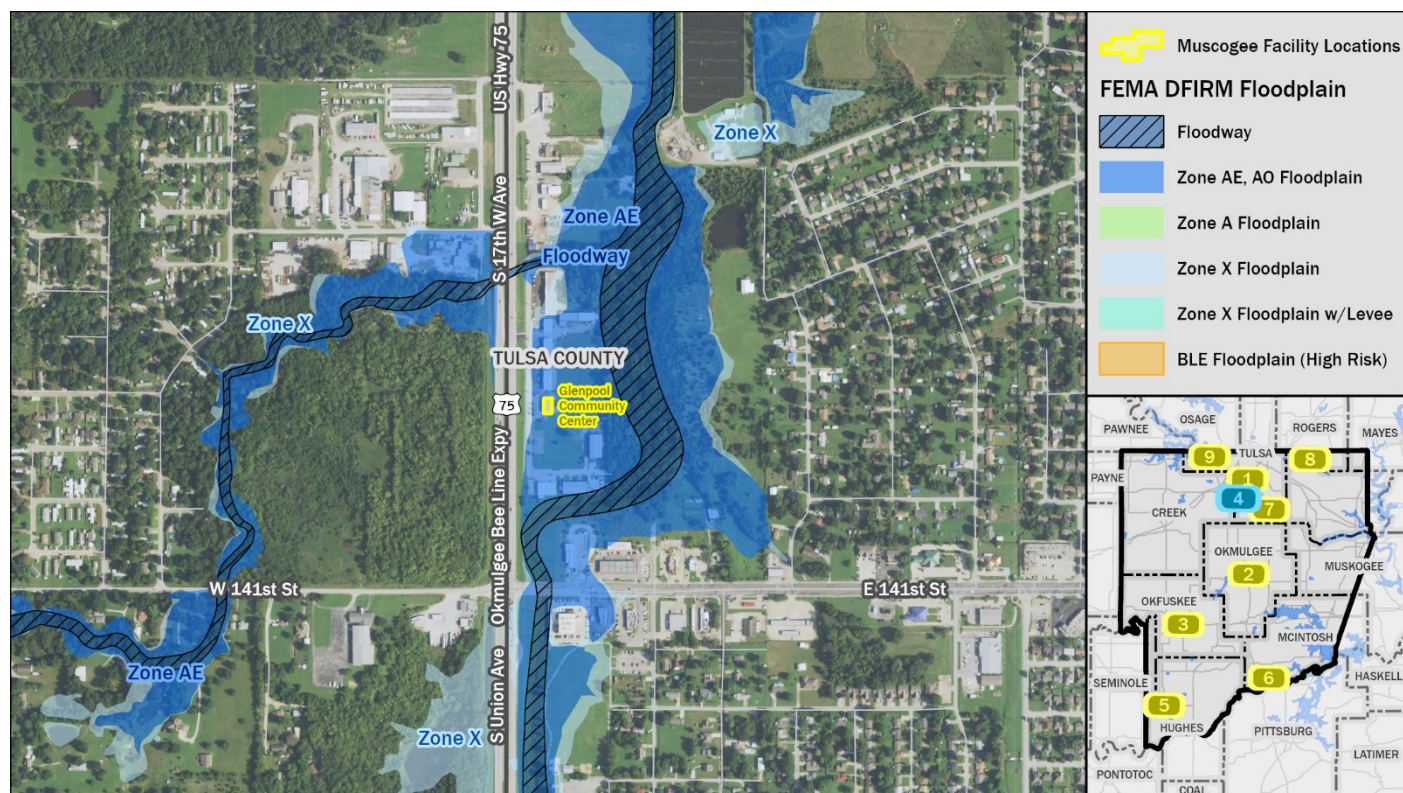


Figure 1-9 Problem Area 5: Holdenville Child Development Center and Community Center

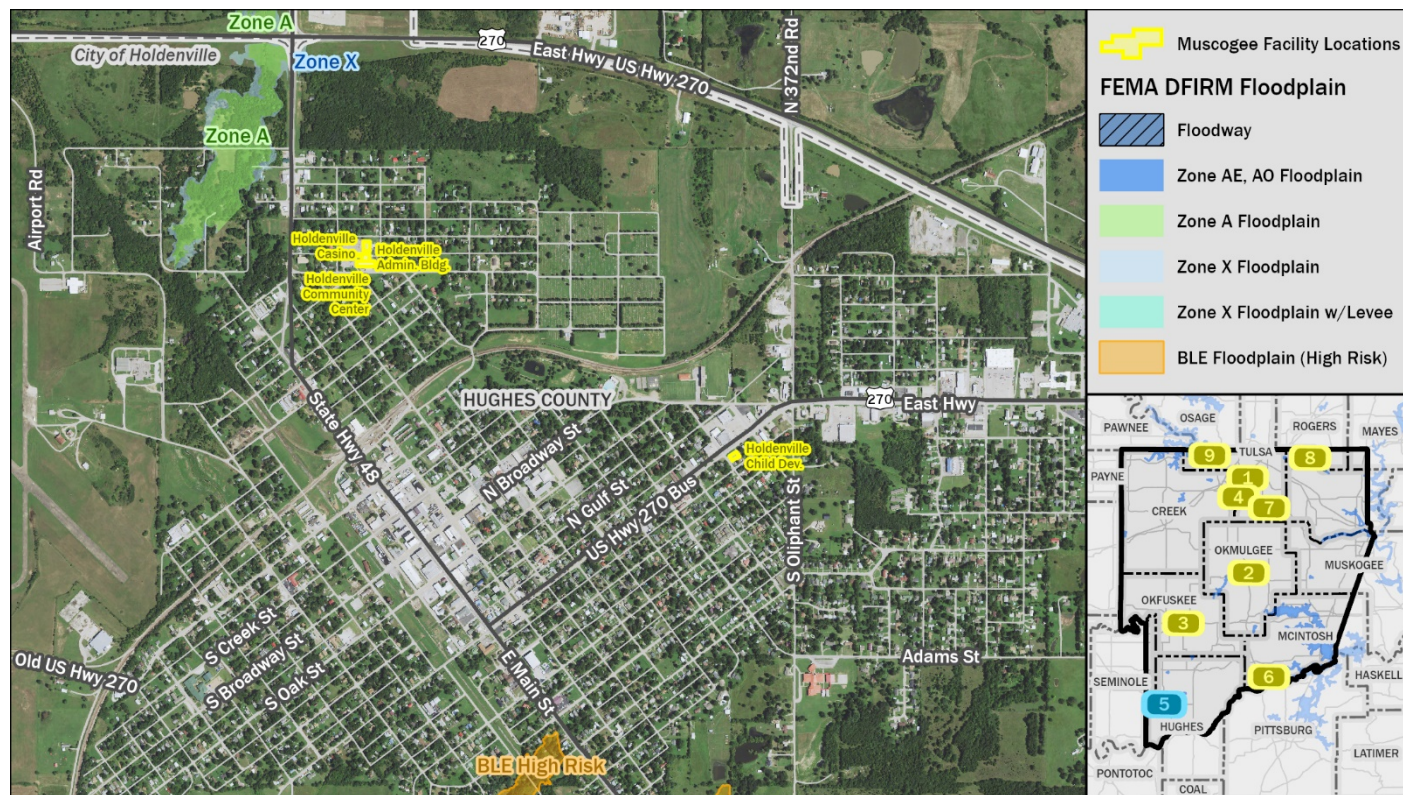
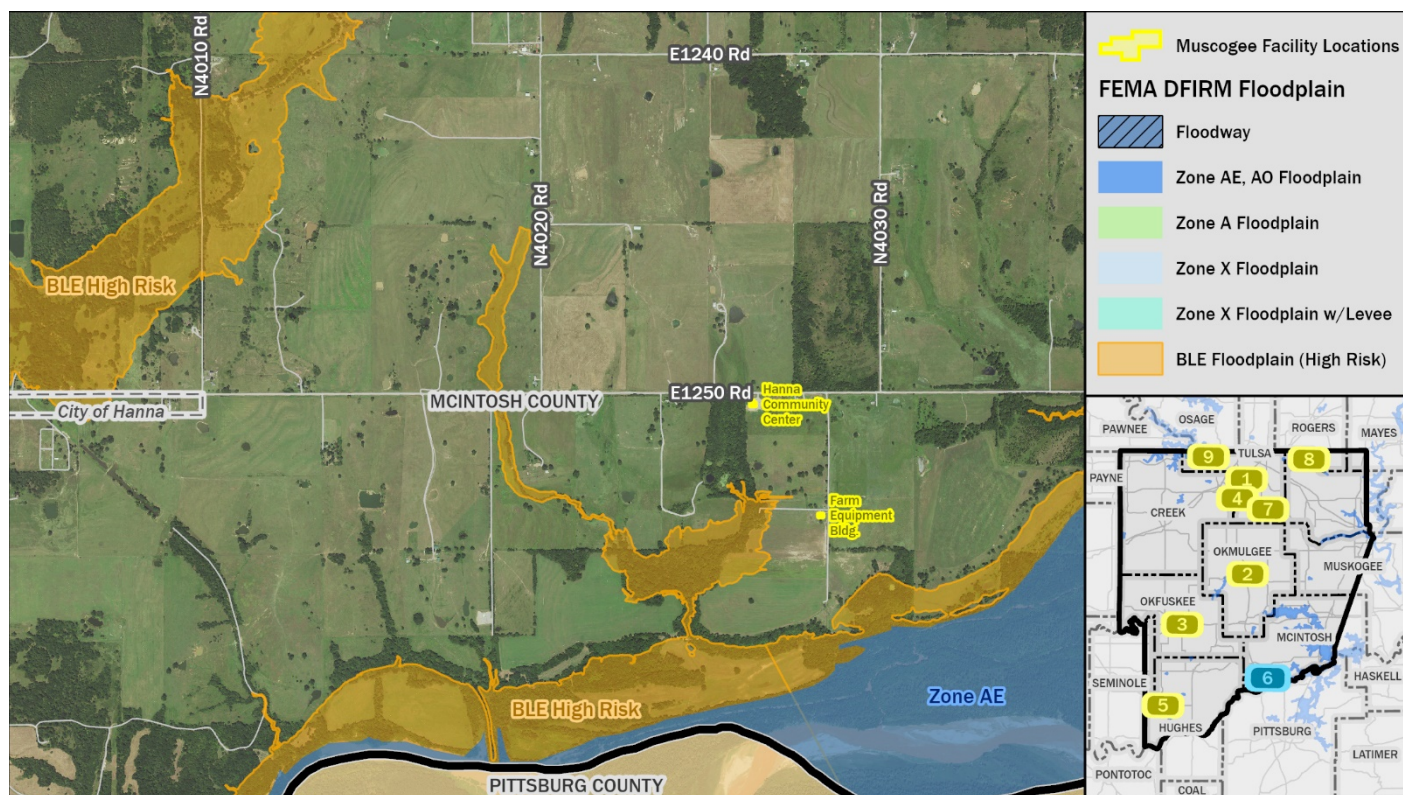


Figure 1-10 Problem Area 6: Unincorporated McIntosh County, South and East of Dustin and Hannah



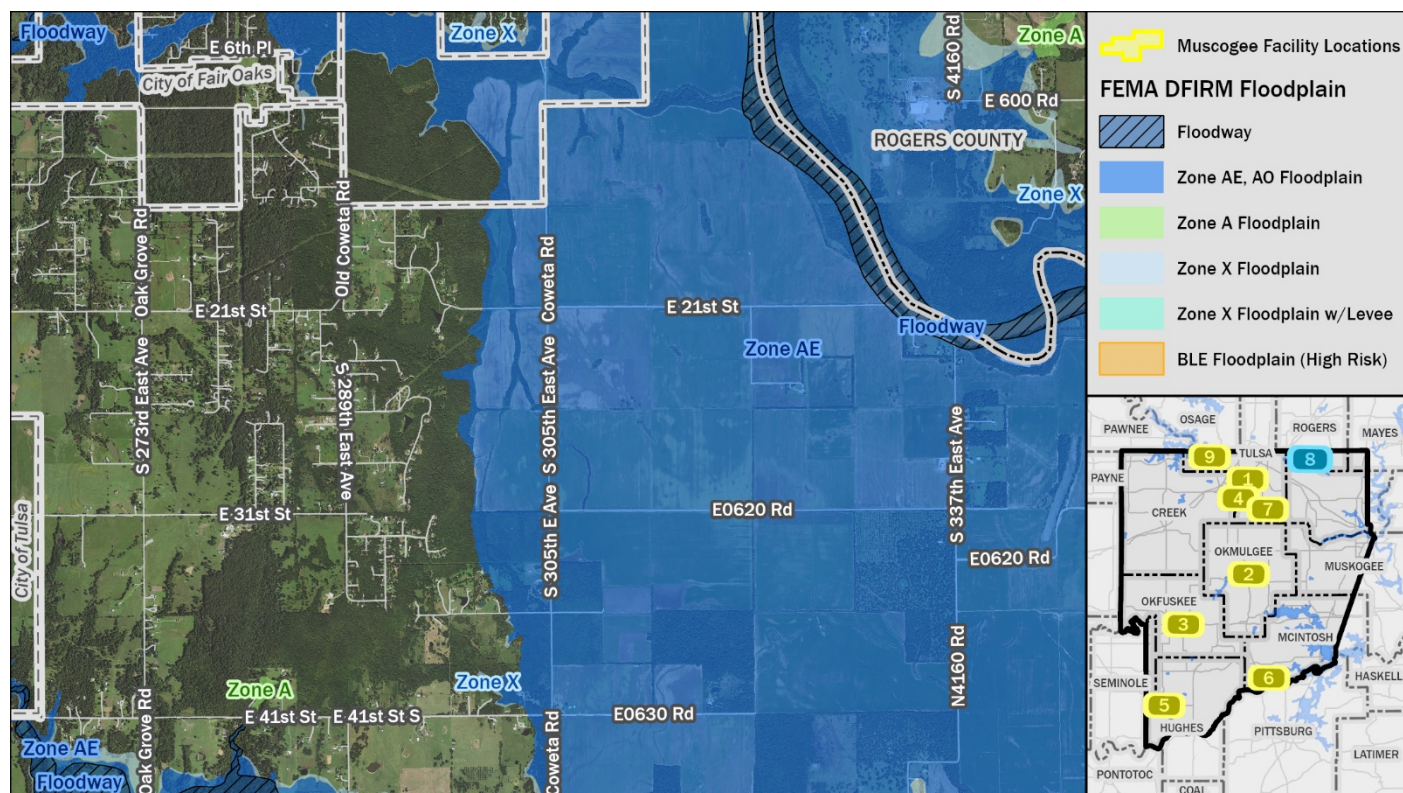
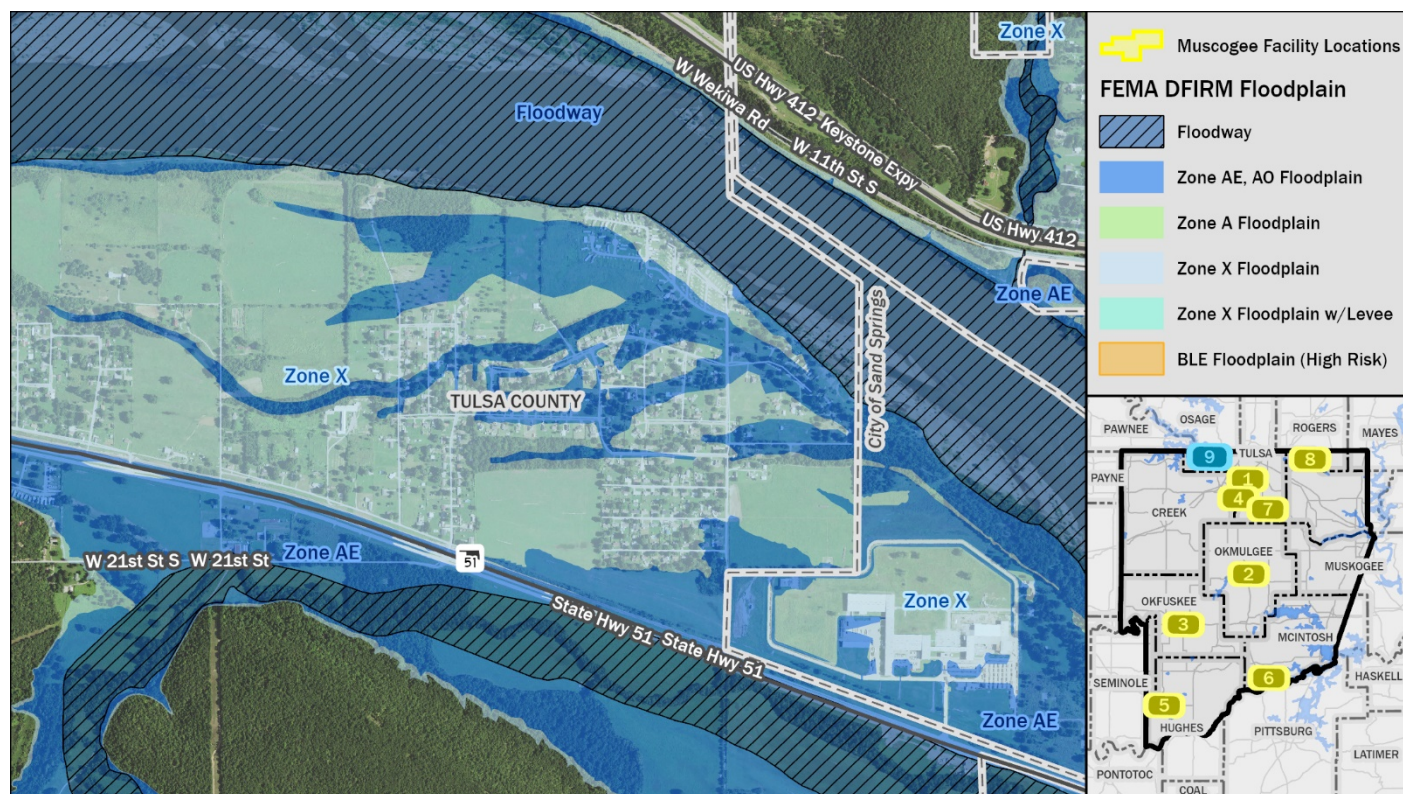


Figure 4-13 Problem Area 9: Unincorporated Tulsa County, the Town and Country Subdivision



Extent

As discussed in the flood location section, FEMA develops maps based on several floodplain zones. Flood extent in Muscogee Nation is characterized by two floodplain zones in particular, which affects the extent of flooding in these areas. They are:

- Zone A, or 1% Annual Chance (100-year) flood zones.
- Zone C, 0.2% (500-year) flood zones.

Table 1-5 lists the FIRM zones identified for use in regulating construction in the floodplain and for determining insurance rates for properties located in the floodplain. It is estimated that the average structure in the SFHA will experience 2 feet of flooding, which will result in 25% damage to the structure and 25% damage to contents.

Table 4-5 FEMA Flood Insurance Rate Map (FIRM) Zones

FIRM Zones		
Zone A	The 1% Annual Chance (100-year) or Base Floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs, are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).

	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFE's are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
	AR	The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone V and VE	V	The coastal area subject to velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and the 500-year floods. B zones are also used to designate base floodplains or lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than one square mile.	
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depiction FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.	
Zone D	Area of undetermined but possible flood hazards.	

One of the current shortcomings of much of the available detailed floodplain data (Zone AE) is that it was prepared many years ago with much cruder topography and rainfall depths that are smaller than current standards. Any detailed modeling should be updated in areas where Muscogee Nation is considering development. Extent for the problem areas is discussed in Table 1-4 (the location section).

Previous Occurrences

Floods and flash floods are a frequent occurrence in Muscogee Nation and have accounted for many of most costly weather disasters within Nation. The National Center for Environmental Information (NCEI) is one of the most comprehensive databases for most natural hazards in the United States, which includes and applies to the geographical boundaries of Muscogee Nation. For this reason, the planning team will use NCEI information frequently throughout this risk assessment to determine previous hazard events and consequences.

In the more than 25 years between January 1996 and June 2021, NCEI has recorded nearly 260 separate flooding and flash flooding events in the 11 counties within the boundaries of the Muscogee Nation. It is important to note that the days with event by county will total more than 260 days, since many of these events occurred in counties simultaneously. It also is important to note that some of these data may apply just outside the Nation's boundaries, since only a fraction of some of these counties are contained within the Nation. A summary of these data can be found on Table 1-6.



Table 4-6 Flooding data from Counties within Muscogee Creek Nation 1996-2021

NCEI Estimates	Creek	Hughes	Mayes	McIntosh	Muskogee	Okfuskee	Okmulgee	Rogers	Seminole	Tulsa	Wagoner
Number of Days with Event:	56	9	44	39	72	35	76	47	16	126	54
Number of Days with Event and Death:	1	0	2	1	1	1	0	1	1	6	0
Number of Days with Event and Death or Injury:	1	0	2	1	1	1	0	1	1	6	1
Number of Days with Event and Property Damage:	11	2	9	9	22	8	11	8	6	30	15

In addition to the statistics in Table 1-6, the planning team included narratives of some of the most impactful flooding events in the Nation from the 1980s – 2021 to provide a more holistic understanding of the historical vulnerabilities caused by flooding (see the vulnerability section for more information on current flooding vulnerabilities in the Nation). The planning team extended the time frame from the late 1990s to the 1980s due to the impact of the 1984 and 1986 floods in the northern and central parts of Muscogee Nation. Overall, flooding throughout the Nation has caused nearly \$500 million and is responsible for several deaths and injuries during this period. These narratives are outlined in Table 1-7.

Table 4-7 Historic Flood Events in Muscogee Nation

Date	Event Narrative
May 26-27, 1984	The 1984 Memorial Day Flood affected the northern and central part of the planning area, making it the worst flood event in this part of the planning area as of this writing. It was caused by a 6"-15" deluge from a stalled cold front, affecting the Tulsa metropolitan area and centered near McClure Park. The entire Mingo Creek basin in Tulsa received at least 9" of rain during this event. There were 14 fatalities--6 of which were auto related--and 288 injuries. More than 5,500 buildings were damaged or destroyed, including more than 20 schools. 7,000 vehicles were destroyed or severely damaged, and many roads and bridges were also destroyed or heavily damaged. The damages were estimated to be \$180 million (\$406 million in 2013 dollars). Mingo Creek alone accounted for \$125 million of the damages. This event received a major-disaster declaration (DR-709).
September 26-October 15, 1986	This prolonged flooding event set new record high flood levels at 7 stream gage sites. Approximately 30,000 people had to be evacuated from about 25 towns in, and just outside, the Nation. All residents of Webbers Falls, Jenks, and Bixby were ordered to evacuate. Two lives were lost during this flood. A total of 509 residences were destroyed and 3,957 were damaged. Many roads and bridges were washed out, including two bridges on Interstate 35. A total of 52 of the 77 counties in Oklahoma suffered some type of flood damage. Damages were estimated at \$350 million (\$748 million in 2013), half of which was from agriculture (all damage figures are in 1986 dollars). This event received a major-disaster declaration (DR-778).



May 4, 2006	<p>More than 4 inches of rain fell in the Broken Arrow area and southeast Tulsa County. The rain flooded several streets causing some to be closed. Several water rescues were made for people whose cars were inundated by the flood waters. A few homes also received water damage and a retaining wall at the Bass Pro Shop collapsed. The NCEI database recorded over \$100,000 in property damages.</p>
June 1, 2013	<p>Severe thunderstorms produced several tornadoes during the evening hours across northeastern Oklahoma. From Weleetka to Clearview (Okfuskee County) numerous roads were flooded. Homes were evacuated in Weleetka from rising flood waters and roads and bridges were damaged by flooding in this area. A woman drowned inside her vehicle after driving into floodwaters along Alabama Creek south of Clearview. From Beggs to Dewar (Okmulgee County), many streets and roads were flooded and closed. A nursing home and about 25 residential homes were evacuated due to rising water in Henryetta. Approximately 50 homes were impacted by flooding in Dewar. NCEI reports an estimated \$350,000 in property damage. This event received a major-disaster declaration (DR-4117-OK).</p>
May 8-June 1, 2015	<p>A series of thunderstorms developed across eastern Oklahoma, resulting in widespread heavy rainfall and flash flooding. An isolated damaging wind event also occurred. Several county roads as well as Highway 75 and Highway 75A were flooded, becoming impassable. Bridges were washed out and vehicles were stranded in the flood water. Two men drowned on the Onapa Boat Ramp when the rising water of Lake Eufaula inundated their vehicle (the men were missing until June 7th when the lake receded enough for their vehicle to be found). Several homes were evacuated by boat near Park and Washington Streets in Sapulpa (Creek County). A man drowned in flood water near the intersection of S Hickory Road and W 186th Street South in Sapulpa. Property damages were significant; however, NCEI only reported \$115,000 in total. This event received a major-disaster declaration (DR-4222-OK).</p>
December 27-31, 2015	<p>Over 8-10 inches were reported across eastern Oklahoma up to one foot of rain. Several roads were closed due to flooding. A woman drove into flood waters on Mingo Road between 191st Street South and 201st Street South and was drowned. There was also major flooding of the Deep Fork River near Beggs causing severe agricultural flooding, road closures and home isolation. This event received a major-disaster declaration (DR-4256-OK).</p>
April 29, 2017	<p>Strong severe thunderstorms produced a strong tornado, hail up to baseball size, damaging wind and locally heavy rainfall. Multiple roads across the Nation were flooded, washed out and impassable. Some homes on the south end of Muskogee County were evacuated and property damages totaled \$175,000. This event received a major-disaster declaration (DR 4315-OK).</p>
May 21-31, 2019	<p>Six to sixteen inches of rain fell. During this period, six USACE Tulsa District flood control reservoirs set new pools of record in northeastern Oklahoma: Kaw, Keystone, Skiatook, Birch, Oologah, and Hudson Lakes. The Arkansas River near Tulsa rose more than 5 feet past its flood stage, making this the second highest crest on record. Severe flooding occurred along the Arkansas River in Tulsa County, with some homes in south Tulsa and Bixby flooded. Riverside Drive in Tulsa was closed in places. Two men drowned in the Tulsa area. Over \$300,000 in property damages were reported, several county claims were unaccounted for. This event received several disaster declarations (DR 4438-OK, DR 4456-OK, EM 3411-OK).</p>

Probability of Future Events

Based on the historical probability of flooding, it is **highly likely** that the Muscogee Nation will experience a flood each year. Based on the number of separate events over 25½ years from 1996 -2021, Muscogee Nation can expect to experience more than 10 separate flood events in somewhere in the Nation. Segmenting this data by location, the Nation should expect an average of as many as 5 minor flood events per year in the Tulsa County area to as few as 1 minor flood event every other year for the area of Hughes and Seminole Counties, with major flood events on a less frequent basis.

Future Conditions

In recent years, the planning area has experienced more short duration high intensity thunderstorms where rainfall intensity has exceeded the 1% storm intensities for brief time periods, such as the 2021 storm in Okmulgee. This has resulted in more street and localized flooding. This trend is expected to continue, and possibly accelerate, due to climate change. Scientific analysis used by the Southern Climate Impacts Planning Program (SCIIPP) indicate an increase in extreme storm events (top 1% of annual events) over the last 50 years.²¹ Most increases in rainfall are expected in winter and spring, while there may be a small decrease in rainfall frequency in fall and winter.²²

4.2.2 Vulnerability and Risk Assessment

The hazard has a high impact on the planning area and has a **high** overall significance based on the classifications in the introduction section.

People

Flooding is one of the most dangerous natural hazards to human life profiled in this plan. Driving through flooded areas accounts for most flood-related deaths, though residents trapped in their homes may be at risk of rising waters as well. More densely populated areas, like the greater Tulsa metropolitan area, the City of Muskogee, and the City of Okmulgee, possess a greater chance of having residents that could be stranded or drowned due to flooding due to higher average traffic volumes. In addition, busy roadways can become locations for accidents or drownings.

Certain groups of people are also more vulnerable to flooding. Among these groups are elderly people, young people, and lower-income people. Elderly people and younger people are more vulnerable to flooding for overlapping reasons. Among them can difficulties with using transportation independently and some difficulties/disinclination to use communication networks during emergency events.

Among the groups most impacted by flooding are lower-income Citizens, since lower income people are more likely to reside in areas with a higher frequency and/or extent of flooding. Some impoverished areas in Muscogee Nation have experienced flooding. Impoverished areas with higher numbers of Citizen residents include the northwest corner of Tulsa, the downtown area of Muskogee, and in the city of Eufaula. Eufaula and the northwest corner of Tulsa experience high levels of frequent flooding for both public and private property. In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

²¹ The planning team used SCIIPP for many hazard future assessments, given its nation reputation, connections with government agencies, and geographic focus on the region that includes Oklahoma.

²² <http://www.southernclimate.org/documents/SPTOK.pdf>



Public Health

There are also public health concerns due to flooding. According to the planning team's analysis, approximately 1800 Citizens live in a mapped floodplain. These Citizens are exposed to heightened public health risks to flooding. Flood waters can be contaminated with e-coli and fecal coliforms from sanitary sewer overflows and animal waste as well as hazardous chemicals which can cause immediate health problems. Contaminated flood waters can result in long term health and environmental impacts, and buildings inundated by flood waters may develop mold. There is long-term health risk from mold remaining in flooded structures. Flooding also can lead to evacuations, which carry their own physical and psychological risk to the people being evacuated.

Superfund sites in Muscogee Nation present a similar concern, especially those located near flood-prone zones. These sites include the Henryetta Iron and Metal site on West Main Street, the Sand Springs PetroChemical Complex, the Compass Industries Landfill in Sand Springs, the Wilcox site in Bristow (right next to a creek), and Drumright site within Creek County which will be online soon (for the effects of flooding on water and wastewater utilities, see the built environment section). To mitigate these risks, Muscogee Nation should partner with public and private entities that are working to remediate these sites. Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities.

Education and Outreach

Officials also noted the lack of consistent education and outreach on flooding hazards for developers, builders, realtors, and residents. This includes driving during a flood, understanding the limits of Muscogee Nation's health service. Officials also expressed interest in having an emergency management application to reach all residents to warn them about a flood. The emergency application could be expanded to provide educational materials as well, especially flood insurance, dangers building in a floodplain, health risks from flooding (e.g. mold), and other materials.

Culture

It is difficult to overemphasize the importance of culture to the Muscogee Nation, as Muscogee culture is interlinked and woven into the government and the Citizenry through shared values, history, and traditions (see Chapter 1). For this reason, it is difficult to separate cultural vulnerabilities into distinct parts. Nonetheless, the cultural resources in Muscogee Nation that are most vulnerable to flooding can be grouped into two categories. These categories overlap with other vulnerability sections, especially people and built environment. The first is the people of the Nation, particularly the elders. Muscogee Citizens contain, reflect, and transmit Muscogee culture through language, traditions, and stories. In addition to people, the second category of vulnerability, the built environment, can be divided into three subcomponents:

- Places and sites of deep cultural and religious significance. These spaces are culturally and intrinsically valuable. These include ceremonial sites, cemeteries, and churches. Some of these resources are shown in Table 1-8.
- Places and sites that contain cultural objects and articles of intrinsic significance to the Muscogee Nation. This can include the Muscogee Creek Nation Museum. Some of these resources are shown in Table 1-8.
- Places that serve as wellsprings of cultural knowledge and cultural transmission. These places include educational facilities. Some of these resources are shown in Table 1-8.

Some places may contain 2, or even all 3, of these components. It is also important to note that many of these cultural resources also apply to other sections of this vulnerability assessment.

Table 4-8 Cultural Resources (Built Environment) in the Floodplain

	Total	At Risk			Value ²³
		Zone A	Zone AE	BLE (High risk)	
Educational Institutions²⁴	3	-	-	-	Unknown
Community Centers	26	-	3	-	\$468,000
Ceremonial Grounds	16	1	0	4	Unknown
Churches	90	5	1	2	Unknown
Cemeteries	323	15	3	7	Unknown

To safeguard the confidentiality of these locations, this assessment will not disclose the specific location of ceremonial grounds, churches, or cemeteries, nor will any other hazard assessment disclose them. For similar reasons, the value, or approximate value, of these resources are not disclosed.

Economy

Flooding causes significant economic losses. Disruption to transportation networks causes business interruption. Flooding also can damage to business contents, vehicles, and business inputs (for example wood in lumber mills). Flooding of roads, and key transportation routes can have significant impacts on the economy. Prolonged disruption of supply chains in the planning area could cause an economic downturn in the sectors affected for months or even years.

Damage to large structures or structures with valuables can cause significant economic losses in building repairs. In addition, damage or closure to business that is revenue driver can lead to economic losses in terms of lost revenue. Damage to the River Spirit Casino from the May 2019 flooding event, for instance, caused the facility to close for an extended period, which cost millions while under repair. Reducing vulnerabilities to critical economic drivers in Muscogee Nation is crucial to reducing its economic vulnerability to flooding.

Built Environment

Existing Structures

All structures in Muscogee Nation are at risk of flooding. Not all structures share a uniform risk to flooding. To assess flood risk, a GIS-based analysis was used to estimate exposure to flood events using local tax assessor records in combination with building footprint data. The determination of assessed value at-risk (exposure) was calculated using GIS analysis by summing the improved values for parcels and structures that were confirmed to be located within an identified floodplain. Table 1-9 highlights some potential at-risk structures based on their relationship to mapped floodplains. It is estimated that the average structure will experience 2 feet of flooding, which will result in 25% damage to the structure and 25% damage to contents. Tribal Citizens were used as a proxy to determine an approximate number of homes owned by Citizens that

²³ Estimated values are not available due to limited parcel information throughout the study area.

²⁴ Includes centers for agricultural instruction.



touch, or are in, mapped floodplains. Muscogee Nation's data collection is likely to be enhanced in future efforts due to

Table 4-9 Structures and Parcels in Muscogee Nation located or proximate to Mapped Floodplains²⁵

	Total	More Vulnerable		
		Zone A	Zone AE	BLE
Tribal Citizens	48085	600	1029	192
Tribal Housing²⁶	160	-	-	-
Tribal Facilities²⁷	547	3	7	13
Critical Facilities²⁸	95	-	-	2

Muscogee Nation joined the NFIP in April 2021, so no NFIP claims data were available to the planning team as of this assessment. No Tribally owned property meet the definition of repetitive loss properties. For meeting FEMA's requirement to discuss the number and type of repetitive loss properties, there are none. People, citizens and non, in the planning area, however, have filed more than 1,000 NFIP claims, with more than 100 of these claims being repetitive losses. Most of these claims, especially the repetitive loss claims, are concentrated in the greater Tulsa metropolitan area. Most Citizens also live in the greater Tulsa metropolitan area.

Infrastructure

The planning team conducted an analysis of infrastructure based on 4 segments: electrical, gas, water/wastewater, and transportation. The planning team selected these 4 elements for further analysis based on the different ways that the hazards interact with these elements, in this case flooding. Most importantly, these 4 elements were selected because damage and disruptions to these elements can cause significant disruptions in the economic, cultural, and the basic people affected (see FEMA Lifelines in the introduction of this chapter). All hazards analyzed in this risk assessment include a commentary on some or all these infrastructure segments. The gas segment is not at specific or unique risk to flooding.

Electric: Flooding can cause and has caused power outages in the planning area. The most common causes and accentuations of power outages due to flooding include:

- Damage to electrical generation or distribution due to flooding
- Floodwaters make it unable for repair crews to reach points of generation or distribution to maintain or fix their operation (see transportation section)

Power outages can exacerbate conditions outlined the people and culture section. Muscogee Nation does not control the assets for electrical generation or distribution, nor does it have ownership or right-of-way to most electrical of the vulnerabilities in the Nation. The second part of the previous statement does not apply to the structures and land owned by Muscogee Nation. To limit the exposure to electrical outages and

²⁵ Estimated Values were not available due to limited parcel information throughout the study area

²⁶ Problem areas 3 and 9 in the location section relate to two specific housing areas that are affected by flooding. For a description of the vulnerability in these locations, see Table 1-4 in the location section.

²⁷ Facilities includes all critical and culturally critical facilities

²⁸ Critical facilities also include culturally critical facilities



given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

Water/wastewater: Water/wastewater facilities and water/wastewater distribution systems can be affected by floodwaters. Flooding can inundate facilities, which can halt operations. If prolonged, a cessation of operations can result in a crisis to provide potable water to citizens or cause a backup of wastewater, which can cause a sanitation and/or environmental crisis. Floodwater seepage into water lines and other distribution systems, although unlikely, could cause contamination and public health issues (see public health for more information).

To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. In terms of mitigation actions, Muscogee Nation could develop its own water treatment facilities, especially in areas that supply critical facilities. Muscogee Nation also could construct water towers or similar water holding facilities, although their limits during a drought.

Transportation: Road blockages and congestion can cut off access to homes and businesses. Closed bridges and roads can cause traffic accidents and other backups that can extend the flood impact well beyond the flooded area. These concerns result in missed work, extra transportation costs and reduced commerce. Flooding can result in hazardous driving conditions, which could cause loss of life, when vehicles are driven or swept into floodwaters. As little as 12 inches of standing water over roadways can stall many vehicles. Only 18 inches of flowing water can sweep most vehicles off roadways. In addition, problem areas 7 and 8 in the location section relate to specific transportation issues due to flooding. For a description of the vulnerability in these locations, see Table 1-4 in the location section.

Significant flooding can cause disruptions to railroad, waterway, and air distribution and travel networks. Major disruptions can lead to an economic downturn in the sectors affected (recreation, business sectors, etc.) and, in extreme cases, failure or difficulty to bring vital goods and services to Muscogee Citizens.

Critical Facilities

Many of the facilities in Muscogee Nation are touched by or adjacent to the floodplains and some critical facilities are in a floodplain. These critical facilities are highlighted in Table 1-9. Loss of a critical facility can delay response operations, government functioning, or other vital services that enable the daily functioning of businesses and Citizens in Muscogee Nation (for flooding impacts on infrastructure, see infrastructure above). Several cultural facilities may also be impacted by flooding (for cultural critical facilities that are affected by flooding, see the culture section). In addition, problem areas 1, 2, 4, 5, and 6 in the location section relate to specific critical facilities that are affected by flooding. For a description of the vulnerability in these locations, see Table 1-4 in the location section.

To best protect critical facilities, Muscogee Nation should ensure that it has functioning backup generation for all its critical facilities. Perhaps most importantly, however, the Nation should ensure that it follows the recommendations in the future development section, which focus on assessing risks of building in the floodplain.

Future Development

All future development in the planning area is vulnerable to flooding. This being said, as development in new areas and revitalization of existing ones continue, locations and building techniques should be closely examined. Development of new sites or redevelopment of existing sites that increases the impervious area



will further strain aging infrastructure. Muscogee Nation has adopted 2021 International Codes, which requires that all new residential and critical facilities be protected to the 0.2% or 500-year level of flooding.²⁹

Building in the floodplain should be avoided, if all possible. Adding structures to the River Spirit Casino complex over the Arkansas River should be reevaluated to assure risk of dangerous flooding is properly mitigated. The Nation recently built a new meat processing plant south of Duck Creek Casino on Highway 75, which is next to a wastewater lagoon. While the approximate Zone A floodplain does not appear to touch the buildings or lagoon, they plan to prepare a detailed floodplain analysis to confirm the risk to recommend flood mitigation measures that would protect the facility from flooding events up to the 0.2% (500-year) flood event, consistent with requirements for a critical facility.

Additional flood studies can provide data and solutions to reduce risk. Muscogee Nation is developing a master drainage plan for the Tribal Complex in Okmulgee. The plan is assessing the extent of the risk of future flooding and is preparing an alternative analysis of potential flood mitigation measures to recommend solutions that will reduce that risk. The Nation is also reviewing the Glenpool Indian Community Center, which is in the SFHA and is preparing a full floodplain analysis to identify the best solution for protecting the facility or moving the facility to a location out of the floodplain.

4.2.3 Summary of Observations and Recommendations

Table 4-10 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
Residents would benefit from an electronic flood alert system.	Develop an app specific to Muscogee Nation and their citizens to alert them of flood dangers in their area.	4
Floods have threatened and can threaten the electrical infrastructure (and all infrastructure) that supplies Muscogee Nation critical facilities, Citizens, businesses, and other residents in the planning area.	Strengthen partnerships with electrical providers throughout the planning area. Acquire and maintain adequate backup generation for all critical facilities. Invest in electrical infrastructure assets, including solar parks, electrical lines, and other elements of the microgrid. Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	11, 13, 14, 17, 28, 33
All current and future development would benefit from comprehensive studies on flood risk.	Prepare and implement master drainage plan from drainage studies for flood areas. Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical	7, 14, 15, 21, 23, 25

²⁹ Includes the international residential code, the international building code, the international existing building code, the international fire code, the international fuel gas code, the international mechanical code, the international plumbing code, the international energy conservation code, and the 2020 international electrical code.



	facilities and retrofit buildings to make them more disaster resistant. Prepare impact study of NRCS and municipal dam breaches to determine actions in potential inundation areas of current and proposed development. Establish construction management procedures compliant with FEMA Community Rating System (CRS) and join the CRS program. Develop and adopt stormwater engineering and development criteria to protect roadways and buildings from flooding damage.	
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation.	27, 31
The Nation experiences flood events on an annual basis. As development continues, and the frequency and severity of flooding increases, it is important for all Citizens to understand the benefits and costs of flood insurance and build new developments to fortified standards.	The Nation should continue annual floodplain notifications and educate the public on the importance of flood insurance. Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens.	1, 2, 3
A lack of consistent and current technologies in the planning area makes the area more vulnerable to flooding in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Water infrastructure is vulnerable to flooding, which could disrupt deliver to critical facilities in Muscogee Nation.	Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	16, 19, 34
Roadways can be damaged by floodwaters.	Partner with the Oklahoma Department of Transportation to mitigate roadways with repeated flooding events. Partner with neighboring jurisdictions to improve transportation abilities of Muscogee Nation citizens.	18, 30
Multiple jurisdictions have authority for response and	Develop a comprehensive recurrent loss analysis study to determine the most appropriate mitigation actions for these	10, 23



recovery during and after a flood event in the Arkansas River Corridor.	areas. Prepare impact study of dam breaches to determine actions in potential inundation areas of current and proposed development.	
River Spirit Casino is located next to the Arkansas River. In the past there has been major flood damage to the facility and there is a large risk of flooding in the future.	Work with USACE Tulsa District to complete Advance Measures Plan for River Spirit Casino. Determine long-term mitigation solutions to lessen the impact of future flood events at River Spirit Casino.	8, 9
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.3 Severe Winter Storm (Rvfo Rakke)

4.2.1 Hazard Description

Winter storm: is a winter weather event that produces significant and impactful accumulations of freezing rain/ice, sleet and/or snow. Winter storms usually occur in the planning area between November and March and are usually created by large low-pressure systems moving rapidly across the country. Ice storms are often a greater threat than blizzards. Moisture from the Gulf of Mexico moving over shallow cold air near the earth's surface can produce ice accumulations of two inches or greater.

Winter storms may include heavy snowfall, blowing and drifting snow, high winds, extreme cold or ice storms. Of the most extreme instances is a blizzard, which is defined as winds greater than 35 mph, visibility less than ¼ mile, and a duration of at least 3 hours. New snowfall is not necessary for a blizzard, since blowing snow can obscure visibility.

Ice Storm: In Muscogee Nation, ice storms may be a greater threat than blizzards. Access to moisture from the Gulf of Mexico falling over shallow cold air near the surface can produce ice accumulations of two inches or greater with tremendous damage to power distribution. Most significantly, ice storms can result in the rapid accumulation of ice on the built and natural environments. Winter storms are measured by snowfall accumulation or ice thickness.

Location

The risk of this hazard is uniform over the entire Muscogee Nation. Given the size of fronts that produce storms in northcentral Oklahoma, a winter storm can encompass most or all the planning area.

Extent

The extent of a storm is determined by its duration and severity. Severity reflects the general combination of a storm's temperature, wind speed, and precipitation levels (precipitation type is determined, in part, by temperature). The snowfall season usually runs from November to April. Total seasonal snowfall averages around 8 inches for the entire planning area. The greatest annual snowfall was 36.3 inches (Tulsa County). The greatest daily snowfall in the planning area was reported to be 15 inches (Okfuskee County). During the winter months, Muscogee Nation occasionally experiences snowfall combined with high winds, freezing rain or ice storms. Muscogee Nation has experienced ice accumulation of up to 3 inches thick in some areas during ice events. In addition, the coldest recorded temperature in the planning area was reported to be -21 degrees Fahrenheit.³⁰

The planning area has experienced ice accumulation during winter storms. The Sperry-Piltz Ice Accumulation (SPIA) Index, shown in Table 1-11 SPIA Index, can be used to predict the types of damages that may occur before the onset of a winter storm. The SPIA Index is used to predict the location, timing, and severity of ice storm impacts days in advance. The tool allows schools, power cooperatives, and other entities to better prepare for severe ice events. The planning area may experience an ice storm with greater than 3 inches of ice accumulation and a rating of 5 on the SPIA.

³⁰ https://climate.ok.gov/index.php/climate/county_climate planning team analysis



Table 4-11 SPIA Index

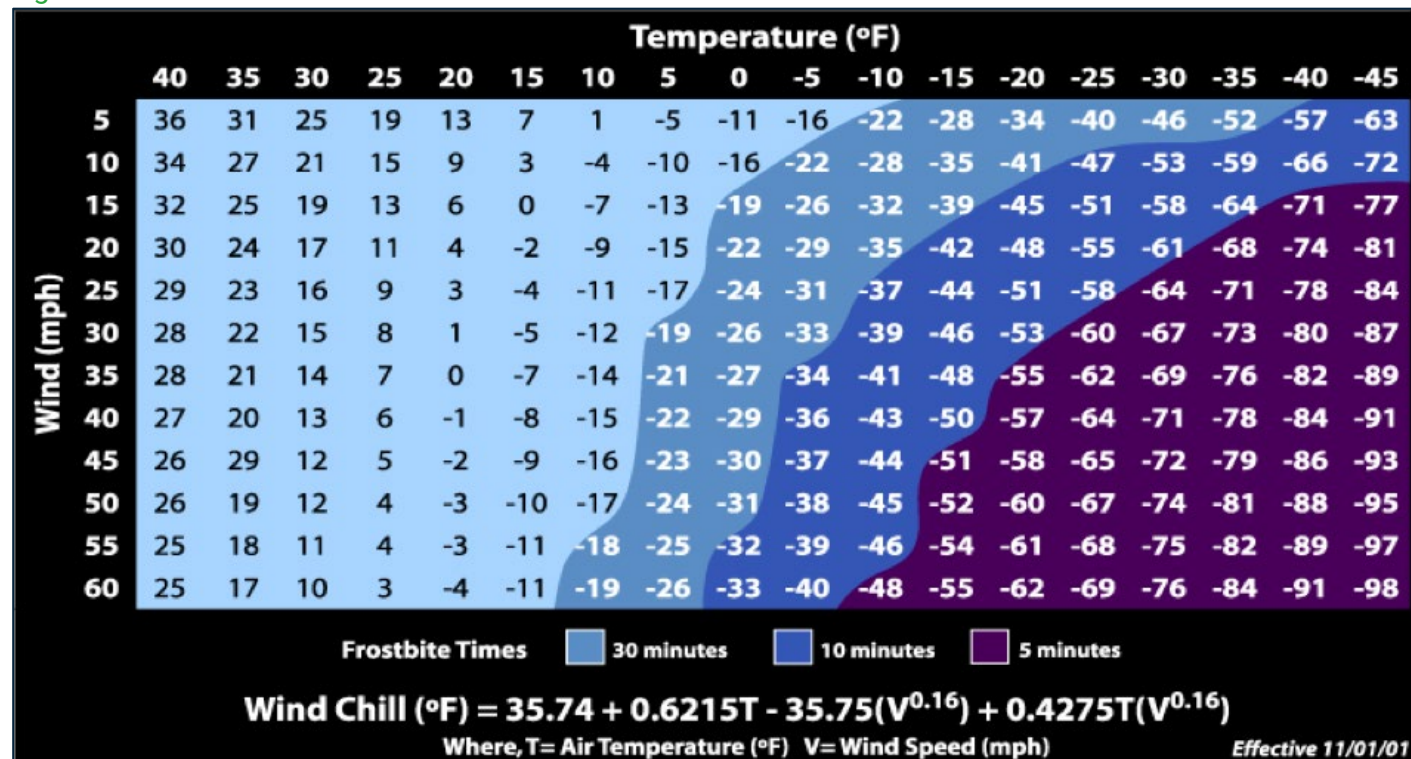
Ice Damage Index	Damage and Impact Descriptions
0	Minimal risk of damage to exposed utility systems; no alerts or advisories needed for crews, few outages.
1	Some isolated or localized utility interruptions are possible, typically lasting only a few hours. Roads and bridges may become slick and hazardous.
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.

In addition to ice, windchill (wind and temperature) has a significant impact on a winter storm's extent. The National Weather Service and the National Oceanic and Atmospheric Association created one of the most used windchill charts in the United States (Figure 1-14). This chart's primary use is to indicate immediate threat to human safety by listing approximate time periods for exposed skin to develop frostbite.

Rapid onset times for frostbite, although rare, are possible. Several days during the February 2021 event, for instance, the windchill factor approached the 30-minutes-to-frostbite zone in parts of Muscogee Nation. The planning area can expect the windchill factor to approach the 30-minutes-to-frostbite zone for extreme cold events.



Figure 4-14 NOAA/NWS Windchill Index



Previous Occurrences

Severe winter storms have been a frequent occurrence in Muscogee Nation. The NCEI database includes reports of 51 separate winter storm events between January 1996 – June 2021 that affected part, or all, of the planning area. In total, these events caused more than a dozen fatalities and caused more than \$400 million in damages. It is important to note, however, that some of these financial losses may have occurred just outside the planning area.

The most significant ice storm in Oklahoma as of this writing, which occurred in 2007, severely affected Muscogee Nation. This event outstripped the tolls for highest deaths and economic damages in the planning area by a considerable margin. In 2011, record snowfall shut down much of Muscogee Nation operations and small businesses within the planning area. Some of the most impactful events are summarized below in Table 1-12.

Table 4-12 Historic Winter Storm Events

Date	Event Narrative
December 8-10, 2007	An ice storm affected almost entire planning area, causing over \$400 million in damages, and damaging critical facilities and lifelines, especially electrical distribution. The storm caused several fatalities throughout the planning area due to automobile accidents, hypothermia, improper heating (carbon monoxide poisoning and fire), and a collapsed utility pole. This event received two declarations, DR-1735-OK and EM-3280-OK.
January 31-February 5, 2011	A heavy snow occurred across much of central and southern Oklahoma with 4.8 inches occurring across the state and effecting power lines within Muscogee Nation (EM-3316-OK).

Date	Event Narrative
February 24-26, 2013	Very heavy snowfall occurred over several days. Up to 18 inches were reported in multiple counties throughout Muscogee Nation and gusty winds up to 40 mph accompanied the snow which added another 7 inches (DR-4109-OK).
February 15 -16, 2015	Approximately 0.5 to 1 inches of sleet fell across portions of Muscogee Nation before changing into snow and the area received between 3-6 inches of snow, causing dangerous driving conditions.
December 26, 2015 - January 5th, 2016	Up to an inch of ice accumulation was reported. Power outages occurred and the damage estimates from the power company were \$38.429 million (DR-4256-OK).
October 26, 2020	An arctic cold front moved through eastern Oklahoma causing Muscogee Nation to have an ice storm. Ice accreted 0.30 to 0.75 inches across the county. Partial estimates reached \$285,000. The ice-covered roads led to dangerous driving conditions.
January 31 - February 5, 2021	Heavy snowfall and extremely cold temperatures occurred across much of central and southern Oklahoma with 4.8 inches occurring across the state and affecting the entire Nation. This event caused utility failure and substantial damages to some utility networks and other structures (EM-3316-OK).

Probability of Future Events

Based on previous occurrences, the likelihood of severe winter storms impacting the planning area is **highly likely**.

Future Conditions

In terms of future cold conditions due to climate changing, scientists supported by SCIPP have predicted that the planning area should expect to see fewer cold events.³¹ This analysis is supported by the Oklahoma Climatological Survey.³² Despite the decrease in number of severe winter storms, some observers predict an increase in winter precipitate and overall severity due to the increasing moisture in the atmosphere as the result of climate change. These assessments are contested, however, given the difficulty of modeling severe winter weather events. This is especially the case for ice storms.³³ Changing conditions would affect vulnerabilities in the planning area, which are outlined below. The way in which vulnerability could change remains contingent, in part, on changing dynamics of severe winter storm hazards.

4.3.1 Vulnerability and Risk Assessment

The overall risk assessment for the planning area was determined to be **high**, according to the classification table in the introduction section. Communities and individuals exposed to severe winter storms are at high risk of extended loss of utilities. Combined with dangerous travel conditions and possible structure damage, winter storms can put Muscogee Nation Citizens at high risk.

People

All Citizens in Muscogee Nation are exposed to severe winter storm events. Transportation accidents and cold-related injuries and fatalities present the largest concern to public safety. Ice accumulation on

³¹ <http://www.southernclimate.org/documents/SPTOK.pdf>

³² https://forestry.ok.gov/sites/g/files/gmc801/f/documents/2020/ok_climatological_survey_climate_statement.pdf

³³ <http://www.southernclimate.org/documents/SPTAR.pdf>



roadways immediately creates hazardous driving conditions. Roads on gradient and slick road surfaces increase the frequency and impact of traffic accidents for the general population, which can result in personal injuries and fatalities. Smaller, less maintained roads may be additionally damaged by ice or become more difficult to navigate. There have been recorded automobile-related fatalities due to winter storm conditions throughout the planning area (see previous occurrences section). In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on partnerships.

Public Health and Safety

Temperature related deaths and injuries have also been recorded in the planning area. These deaths and injuries primarily have been caused by two factors: the cold and warming attempts to alleviate the cold. Hypothermia is the most prominent cold-induced threat to human life. Extreme cold can cause animals and people, especially outdoor workforce exposed to winter elements, to suffer from frostbite and hypothermia – and when severe enough, death. Children and elderly Citizens are at increased physiological risk.

Homeless and lower-income populations also are vulnerable to the cold. They may not have access to housing, or their housing may have poor insulation or poor heating. These groups also are more likely resort to alternate methods of heat, such as space heaters or using the oven as a heat source, which can lead to carbon monoxide poisoning or other harmful side effects. Muscogee Nation offers sheltering programs for Citizens in need and can offer housing for the elders in the Nation (for more information on elders, see Culture section). In addition, other public and private entities can offer sheltering and housing assistance for Citizens in need. This being said, officials often noted difficulties with education and outreach, especially to lower-income and elderly groups. Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities (see Chapter 3).

Outreach and Education

Officials noted the lack of consistent outreach and education on severe winter storm for developers, builders, realtors, and residents. This can include information on proper warming techniques, location of shelters for warming, proper ways to conserve water, insulation best practices, and other information. It is also important to inform the public about severe winter weather, and how to best protect themselves and their family from the impacts. This can include information on proper warming techniques, location of shelters for warming, proper ways to conserve water, insulation best practices, and other information. Officials also noted the lack of consistent outreach and education on severe winter storm for developers, builders, realtors, and residents.

Outreach methods can include social media platforms, along with producing and distributing family emergency preparedness information about severe winter weather. Additionally, and perhaps most importantly for severe winter storm events, Muscogee Nation should continue to conduct outreach with its Citizens who are lower income and seek ways to strengthen these networks. The Nation should explore all options but enhancing its data collection efforts (see Camphouse in Chapter 1) and strengthening its partnerships with entities who also conduct outreach to these groups are likely to prove beneficial to these efforts.

Culture

Culture is extremely important to Muscogee Nation. The damage, destruction, or disruption of any cultural resources can result in a significant cultural loss to the Nation, in addition to the other benefits that these



resources can provide to Citizens. A severe winter storm event, especially if it is accompanied by extreme cold, could cause significant damages to some of these important resources. The cultural resources in Muscogee Nation that are most vulnerable to a severe winter storm event can be grouped into two categories. These categories overlap with other vulnerability sections, especially people and built environment.

The first of these is the people of the Nation, particularly the elders who live in low-income housing. These Citizens are vulnerable to these hazards, in large part, because the structures where they reside and work may not be as insulated or resistant to a severe winter weather. In addition to people, the second category of vulnerability, the built environment, can be divided into two subcomponents (which are overlapping):

- The places and sites of deep cultural and religious significance. Muscogee Nation's Churches, which due to the age and type of construction, are particularly vulnerable to a severe winter storm. During the 2021 event many churches experienced broken water lines due to cold.
- Places that serve as wellsprings of cultural knowledge and cultural transmission. See churches above. In addition, all Muscogee Citizens also can be at greater risk to severe winter storm when participating in outdoor festivals and ceremonies, especially for events that take place during the winter.

Economy

Extended power outages can put residents at economic risks by prevent businesses from opening or working remotely (see utilities). Many businesses and factories, including those in lifeline capabilities (see built environment) reported difficulty operating due to extreme cold like the 2021 winter event.

Extreme cold events also can threaten lower-income Citizens by dramatically increasing utility bills, especially to heat their homes. If prolonged, a severe winter storm event could cause ripple effects, leading to elevated prices for many basic goods and services. To mitigate against this hazard, Muscogee Nation has implemented several programs, including the Hardship Program and NAHASDA, which help with utility and housing expenses for Citizens that meet certain criteria. Although this could reduce some Citizens' risk to some rising utility bills, the assistance may not cover all expenses related to extreme cold events due to the size of the award.

Winter storms also affect the economy by disrupting transportation networks throughout the planning area, most prominently roads, but also rail roads and air travel. Prolonged closures can cause thousands of dollars in lost income, which can affect revenue and tax base in the long run. The prolonged or permanent closure of a revenue driver, such as a casino, due to a winter storm event will likely affect net revenues for Muscogee Nation.

Built Environment

Existing Structures

All structures in Muscogee Nation can be vulnerable to severe winter storms. A direct threat to structures from a severe winter event is excessive snow/ice accumulation onto flat or low-grade sloped roofing surfaces. This is especially true of older structures that were not constructed to withstand this type of stress. Commercial structures face the same impacts of winter weather as residential properties. More indirect threats to structures could result from power outages causing interruption to heating and refrigeration (loss of supplies, food, sensitive equipment), frozen water pipes (excessive flooding causing damage to interior and sensitive electronic equipment if pipes break), and fires (caused by power lines being torn away from structure or power surges as lost power is restored).

Infrastructure

Electric: The most severe consequence of a winter storm on infrastructure is damage to power lines caused by the added weight and surface area of ice accumulation, combined with the additional stress of wind. This can result in economic effects, if prolonged (see economy section). Among the biggest threats to a prolonged loss of power include water/wastewater utilities failures, communications and operations failures at critical facilities, and hospital system failures. The planning area experienced all these failures, to some degree or another, during the winter storm event in 2021.

Service companies throughout Muscogee Nation maintain routine tree trimming to ensure power line are protected and buildings and roads are clear. This has helped reduce power outages from downed power lines and other damages.

Gas: During winter events, gas providers in the planning area can experience a variety of challenges in meeting the needs of Citizens, including damage to gas meters from ice accumulation, inaccessibility to underground gas meters from falling debris, danger to field employees related to road conditions, and extreme temperatures. Several gas companies in the planning area noted difficulties maintaining their operations during the 2021 winter event because of extreme cold. Gas outages could render people affected unable to heat their homes without a backup source of power (see people section for effects) and could also cause water line breaks. Gas outages could also have severe impacts on the economy or transportation networks in the planning area.

Muscogee Nation does not own gas distribution systems in the planning area as of this writing. Developing and enhancing partnerships with private gas companies who own and operate these lines, along with local communities, counties, and the state of Oklahoma will be essential mitigating risk to the built environment and Citizens.

Water/Wastewater: Damages to water/wastewater processing or distribution infrastructure could strain water systems in the planning area and place the populations affected by the disruption at risk to degradations of water quantity and quality. Water systems throughout Muscogee Nation have been affected by winter storms in this way (see previous occurrences). To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. Muscogee Nation can enhance these capabilities and develop new ones (see suggested actions).

Transportation: Transportation networks are vulnerable to winter event in the planning area. Road closures due to ice/snow accumulation can result in loss of retail trade, wages, and tax revenue. The inability of public transportation (to function after a winter event can also contribute to increased risk to the population if it blocks normal emergency routes, access to other medical care, or access to safe shelter. Food insecurity is also a concern. Those who are without transportation or blocked by road conditions will be vulnerable to food shortages and need support systems in place.

Severe winter weather could result in the interruption of normal operations of rail systems and airport systems in the planning area. Significant ice or snow accumulations can impact runway safety and result in cancellation or major delays in regular flight schedules.

Muscogee Nation is not responsible for clearing snow, ice, and other debris from the road networks throughout the planning area. Instead, the Nation relies public and private entities across the planning area to clear road networks. Muscogee Nation's previous hazard mitigation plan noted the importance of proper debris management, which can be improved by debris management planning and education. Muscogee



Nation can reduce this vulnerability by supporting partners who provide education and debris management resources to the owners and operators of transportation networks in the planning area.

Critical Facilities

All critical facilities Muscogee Nation are susceptible to the potential impacts of a winter storm event. Among other things, power outages interrupt vital services, and snow/ice accumulation or debris from damaged trees result in inaccessibility due to road closures or blockages are among the most significant. This can hinder response efforts.

Future Development

All future development is exposed to winter storm events. Powerlines in areas of future development should be buried to avoid power loss. Generators should be installed at all critical facilities. Future development is assumed to be less vulnerable to high wind events because Muscogee Nation has committed to adopting the 2021 International Building Codes. Buildings constructed before the adoption of these codes, however, remain more vulnerable unless they are retrofitted or updated with more current standards. To this end, the New Cultural Center, which Muscogee Nation is constructing as of this writing, will be more vulnerable to this hazard if the building is not hardened with current approaches, materials, and technologies.

Natural Environment

The environment, especially large flora, is at risk of snow and ice accumulation. As little as ¼-to-½-inches of ice accumulations can break small branches and weak limbs, while ½-to-1-inch ice accumulations can cause larger branches to break.

4.3.2 Summary of Observations and Recommendations

Table 4-13 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
There is a large percentage of low-income and/or elders within the Muscogee Nation population who are unable to afford adequate heating during a winter event leading to hypothermia. Other Citizens are also at risk.	Educate the public on locations of shelters and energy assistance programs. Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens. Develop an emergency management app to send notifications to citizens about various hazards and emergency events throughout the tribal boundary.	1, 3, 4
A lack of consistent and current technologies in the planning area makes the area more vulnerable to severe winter storm events in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Water infrastructure is vulnerable to severe winter storms, which could	Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation	16, 19



disrupt deliver to critical facilities in Muscogee Nation.	Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	
Muscogee Nation wants to follow through with their last action plans of installing generators in critical facilities. In addition, critical facilities are vulnerable to other effects of severe winter storms.	Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant.	14, 15
Muscogee Nation relies on local jurisdictions to provide power to their residents.	Coordinate with private utilities and electric co-ops to harden electric utility infrastructure. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	11, 33
Muscogee Nation is vulnerable to winter storm damage and relies heavily on partnerships and collaboration between jurisdictions.	Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Recognizing interdependencies and interconnectedness of infrastructure, and critical infrastructure. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators.	13, 17
A severe winter storm can result in substantial amounts of debris, blocking roads and isolating areas of Muscogee Nation. In addition, trees pose a threat during winter storms, especially if around power lines causing outages.	Coordinate with surrounding communities to clear debris quickly after disaster events. Maintain tree-trimming capabilities around electrical lines to prevent fire and electrical outages.	29
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	27, 31, 34
Muscogee Nation is designing a cultural center to include historical artifacts and documents.	Attain an assessor to determine value of artifacts for a BCA and assure building is up to code, weather resistant and has a back-up generator. Protect the Muscogee	5

	Nation cultural center with weather-resistant infrastructure.	
Winter storms can damage buildings and critical facilities.	When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.	28
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.4 Tornado (Hotvle Rakko) and High Wind

4.4.1 Hazard Description

Tornado: is a violently rotating column of air, usually pendant to a cumulonimbus, with circulation reaching the ground. Tornadoes generally form from severe thunderstorms, mainly supercell thunderstorms – those that are isolated with the unimpeded inflow of moisture and enhanced by wind shear. Tornadoes may also develop along squall lines or in bands of storms associated with hurricanes. Tornadoes require moist air, instability (warm air rising), a source of lift such as a front, dryline, or heating, and wind shear (change in wind direction and speed with height). It is often difficult to separate windstorms and tornado damage when winds get above 73 mph.

High Wind: is the motion of air relative to the earth's surface. Extreme windstorm events are associated with cyclones, severe thunderstorms, and accompanying phenomena such as tornadoes and downbursts. High winds can result from thunderstorms, strong cold front passages, or gradient winds between high and low pressure. Damaging winds are often called "straight-line" winds to differentiate the damage they cause from tornado damage. Downdraft winds are a small-scale column of air that rapidly sinks toward the ground, usually accompanied by precipitation as in a shower or thunderstorm. A downburst is the result of a strong downdraft associated with a thunderstorm that causes damaging winds near the ground. Damaging winds can exceed 50-60 mph.

Location

Both high winds and tornados could affect any area within Muscogee Nation's boundaries. The location of this hazard is uniform over the planning area.

Extent

The planning team used Enhanced Fujita (EF) scale to classify the extent of tornadoes across Muscogee Nation. In terms of extent, it is often difficult to separate windstorms and tornado damage when winds get above 73 mph. The EF Scale was revised from the original Fujita Scale to better reflect the relationship between damage surveys and observed wind speeds. Tornadoes are classified according to the Enhanced Fujita (EF) scale, which became operational on February 1, 2007.

Table 4-14 EF Rating Scale

Rating	Wind Speed (3-Second Gust)
EF-0	65-85 MPH
EF-1	86-101 MPH
EF-2	111-135 MPH
EF-3	136-165 MPH
EF-4	166-200 MPH
EF-5	>200 MPH

The EF scale is used to classify tornadoes based on estimated wind speeds. As of this writing, the EF Scale, as shown on Table 1-14 is used by FEMA in its most recent guidance on saferooms for tornadoes.³⁴ Although all ratings on the EF scale can cause damage or injury, tornadoes of EF-3 and greater are most important in terms of their extent.

³⁴ FEMA P361, 4th edition, B3-16; https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf



FEMA and NOAA estimate that 85% of all fatalities resulted from tornadoes of EF-3 and greater.³⁵

Table 1-15 provides a description of typical damage to one- and two-family dwellings at certain windspeeds, which can apply to tornadoes and high winds. It is important to note, however, that these descriptions should be seen as a general estimate of damages, not a baseline estimate. As discussed in further detail in the vulnerability sections, structures like mobile and prefabricated home are likely to experience higher damage volumes than fixed residential structures.

Table 4-15 Residential Tornado Damage Descriptions

Wind Speed Ranges	General Description
63 – 97 MPH	Loss of roof covering material (<20%), gutters and/or awnings; loss of vinyl or metal siding.
79 – 116 MPH	Broken glass in doors and windows; uplift of roof deck and significant loss of roof covering (>20%); collapse of chimneys and garage doors.
103 – 142 MPH	Entire house shifts off foundation, and/or large sections of roof structure removed; most walls remain standing.
127 – 178 MPH	Most walls collapse except for small interior rooms.
142 – 198 MPH	All walls collapse.
165 – 220 MPH	Complete destruction of engineered and/or well-constructed residence. Foundation swept clean of structure.

The planning team used the ICC 500-2020 Map to determine extent of high winds and tornadoes in the planning area, given that both measures use wind speeds as a gauge. This map was used to measure extent because of recent guidance from FEMA.³⁶ Oklahoma and many surrounding states have the highest wind zones in the United States. According to ICC analysis, which can be seen in the Figure above, the entire planning area shares a uniform risk to winds up to 250 mph, or an EF5 tornado.³⁷ This assessment is supported by historical analysis, as the planning area experienced an EF-5 tornado in May 1960.

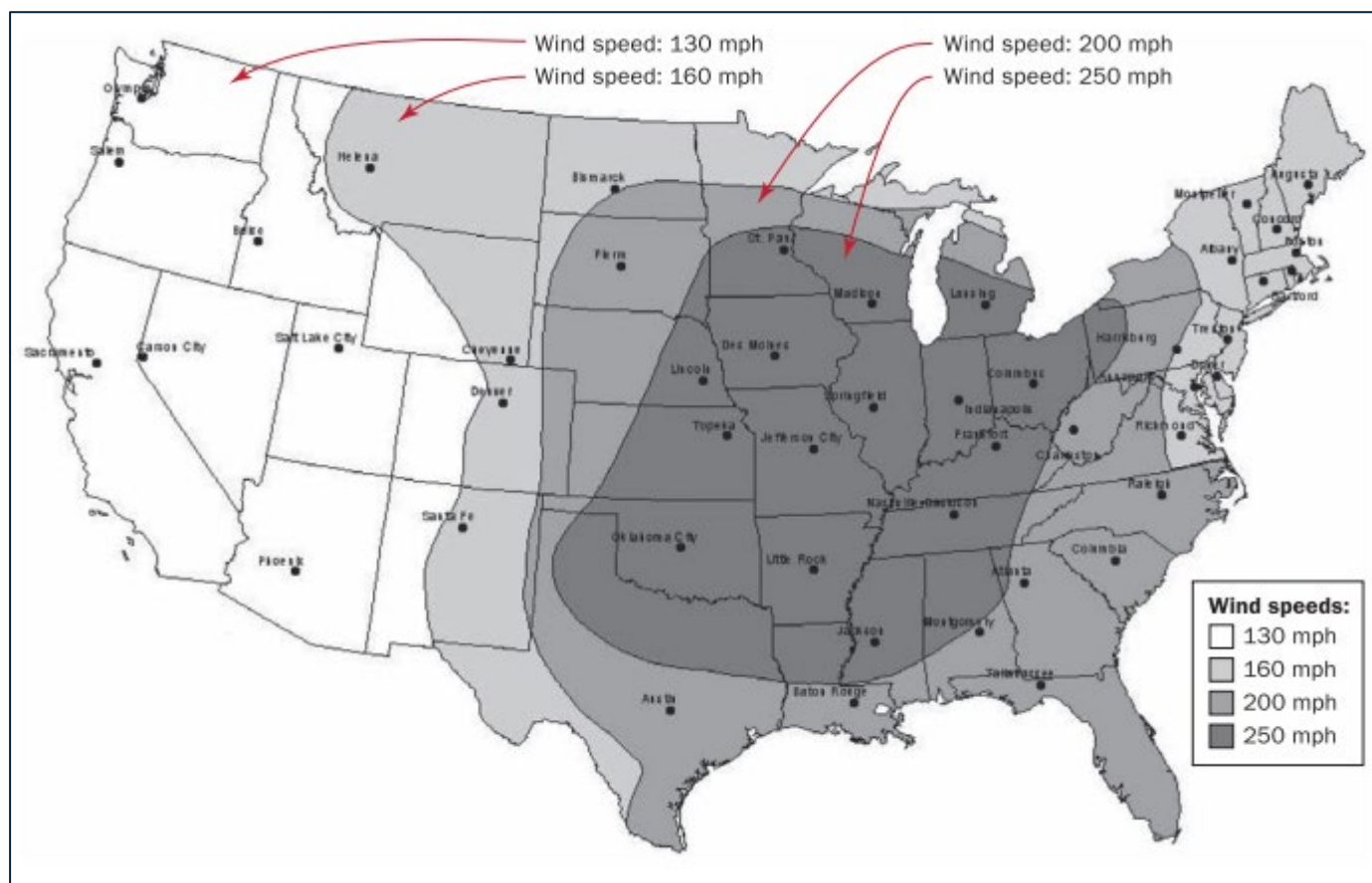
³⁵ Ibid., A2-2; https://www.fema.gov/sites/default/files/documents/fema_safe-rooms-for-tornadoes-and-hurricanes_p-361.pdf

³⁶ Ibid.

³⁷ https://www.fema.gov/media-library-data/20130726-1630-20490-8357/9_taking_shelter.pdf



Figure 1-15 ICC 500-2020 Wind Speed Zone Map



Previous Occurrences

High wind and tornado events occur frequently in Muscogee Nation. According to NOAA data, from 1955 - 2017, the Muscogee Nation and the areas just outside the Nation experienced more than 1,840 high wind events, or an average of nearly 30 events per year. According to NOAA data, from 1950 - 2017, the Muscogee Nation and the areas just outside the Nation experienced 314 tornadic events, about 4.7 tornado events per year.³⁸

The planning area has been impacted by 1 EF-5 tornado and 7 EF-4 tornadoes during this period. Most of the major tornadoes (in terms of wind speed) occurred on the western part of the planning area. In aggregate, tornadoes in the planning have caused millions of dollars in damages, killed dozens of people, and injured hundreds over the 66 years from 1995 - 2021. Summaries of damages associated with some of the most destructive tornadoes to the Nation are shown in Table 1-16 and a depiction of where those tornadoes occurred is seen in Figure 1-16.

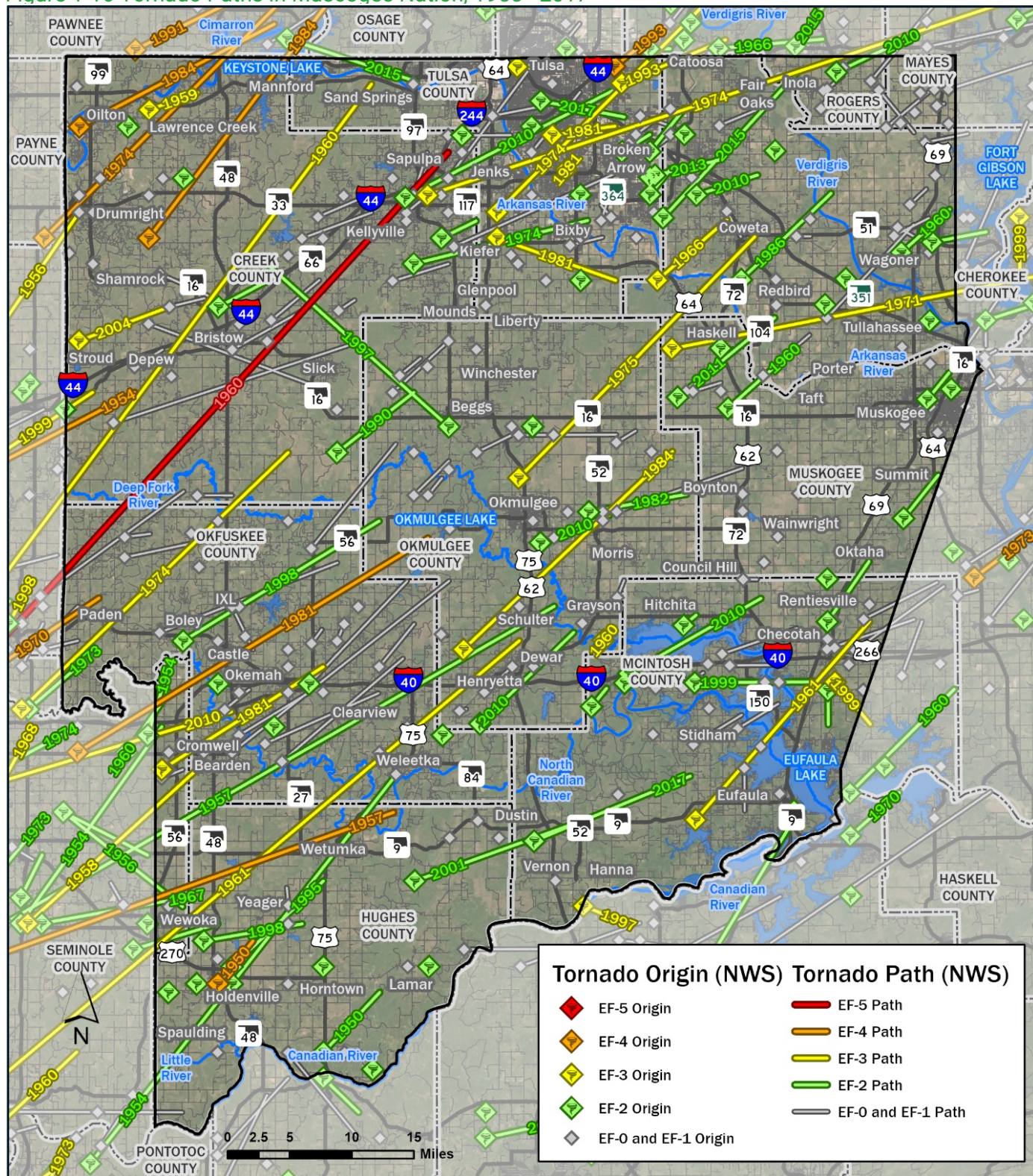
³⁸ These data are owned and maintained by the ESRI Federal User Community, who receive their data from NOAA.

Table 4-16 Historic Tornado/High Wind Events

Date	Event Narrative
May 5, 1960	As of this writing, this is the only EF-5 tornado recorded in the planning area. The tornado track was 71 miles long, running from Okfuskee County, through Creek County, and to Tulsa County. This tornado caused millions of dollars in damages and left 5 people dead and 81 injured. It is unclear whether any of these people were tribal Citizens.
April 19, 1981	An EF-3 tornado landed just south of Bixby, causing significant structural damages. The event left 5 people dead and 49 injuries. It is unclear whether any of these people were tribal Citizens.
April 26, 1984	An EF-3 tornado with a track of 22 miles occurred south of the City of Okmulgee. The tornado caused structural damages, killed 8 people, and injured 95 more. It is unclear whether any of these people were tribal Citizens.
April 24, 1993	An EF-4 ripped through Catoosa, just outside the Nation, and impacted the very Northern part of the nation. This event damaged thousands of homes, causing 7 fatalities and 100 injuries in total. It is unclear whether any of these people were tribal Citizens.



Figure 1-16 Tornado Paths in Muscogee Nation, 1955 - 2017



Probability of Future Events

The probability of Muscogee Nation experiencing a tornado or high wind event is **highly likely**. Due to the planning area's size and past events, there is a 90-100% probability of occurrence in the next year, or a recurrence interval of less than 1 year. Based on previous occurrences, Muscogee Nation should expect to experience damaging straight-line wind events on an annual basis. The probability of a tornado occurring within Muscogee Nation was derived using the Tornado Risk Assessment Tool from the Storm Prediction Center.³⁹ A historical analysis was run to determine the annual probability of a tornado striking any single point within the Nation. Muscogee Nation should expect to experience a tornado almost every year and expect them to occur near the months of April and May (the highest frequency of a tornado in any given month).

Future Conditions

Based on previous occurrences, Muscogee Nation should expect to experience damaging straight-line wind events annually. Muscogee Nation should expect to experience a tornado approximately once every few years and expect them to be in or near May (the highest frequency of a tornado in any given month). Scientists associated with SCIPP generally predict that the frequency of multiple tornadoes will increase, while the overall frequency of tornadoes will decrease. The link between climate change and tornado activity in the planning area has been understudied, however, making these predictions low-confidence assessments. Nonetheless, severe thunderstorm activity is expected to increase with climate change in the area, thereby increasing the likelihood of tornadoes as secondary hazards from thunderstorms.⁴⁰

4.4.2 Vulnerability and Risk Assessment

Based on the classifications in the introduction section, the overall significance of a high wind or damaging tornado event is **high**. Tornadoes and high winds threat people's lives and can cause injury. These events also can cause significant economic loss, especially through damages to the built environment.

People

All people in the planning area are vulnerable to tornadoes. People without access to saferooms are at direct risk of injury or death, even from small tornadoes or high wind events.⁴¹ The Muscogee Nation's Division of Agriculture and Natural Resources has an annual program where Citizens can apply for the purchase and installation of saferooms. Selections are made based on criteria established by the Division. Every year, approximately 60-120 Citizens receive funding for private saferooms. Following a disaster event, Muscogee Nation has 15 community centers that serve as shelters, along with other large buildings that can serve as shelters if needed.

More than 90% of tornado casualties are bodily injuries. Casualties are most frequently the result of structural collapse and flying objects. People are also at heightened risk while in transit. A compilation of tornado-related fatalities nationwide from 1985 through 1997 revealed that 38% of all fatalities occurred in

³⁹ Source: *Tornado Risk Assessment Tool*, Storm Prediction Center,

<https://www.spc.noaa.gov/climo/online/probs/?lat=35.6252&lon=-95.974&rad=50.6> Planning team analysis. Planning area set at 12,600 km². Center of planning area established in the City of Okmulgee.

⁴⁰ SCIPP, <http://www.southernclimate.org/documents/SPTOK.pdf>

⁴¹ One ongoing problem with Safe Rooms is the need for the public to understand not all safe rooms are created equal. Lack of adequate safe room design can cause the unit to fail. Communities in the planning area should consider applying for residential safe room funding through FEMA's Hazard Mitigation Assistance Programs.



mobile homes, 27% in permanent houses, and 11% in automobiles (see built environment for a commentary on vulnerable structures). In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Public Health

Muscogee Nation's health system 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. Delivery of other key services, such as a potable water and food could be disrupted by similar effects (see built environment for more information). Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities (see Chapter 3).

Education and Outreach

Adequate warning systems are essential to public safety during high wind and tornado events. Citizens should have access to an emergency notification app that would enable officials to send a message to people who have opted into the service. This program could provide a direct text link with residents to maximize their warning time.

In addition, Muscogee Nation could partner with entities that currently offer outreach and education efforts on tornado and high wind hazards for developers, builders, realtors, and residents. Going forward, it will also benefit structures owned by the Nation if design professionals involved in construction/retrofitting are educated to include wind mitigation during building design. To this end, Muscogee Nation additionally would benefit from an emergency mobile application, provided that the application could assist outreach and education efforts during response scenarios and blue skies.

Culture

Culture is extremely important to Muscogee Nation. The damage, destruction, or disruption of any cultural resources can result in a significant cultural loss to the Nation, in addition to the other benefits that these resources can provide to Citizens. A tornado and high wind event, particularly a severe event, could cause significant damages to some of these important resources. The cultural resources in Muscogee Nation that are most vulnerable to tornado and high wind can be grouped into two categories. These categories overlap with other vulnerability sections, especially people and built environment. The people of the Nation, particularly the elders who live in low-income housing are particularly vulnerable to tornadoes and high wind. These Citizens are vulnerable to these hazards, in large part, because the structures where they inhabit, and work are not as resistant as other structures (see built environment). In addition, certain spaces and sites in the built environment are culturally and intrinsically valuable are also at risk. These spaces and sites include some of Muscogee Nation's Churches, which due to the age and type of construction, are particularly vulnerable to these types of events.

Economy

While forecasting and early warning have decreased the number of fatalities associated with wind events, less has been done to address economic losses. Direct tornado damage is one of several factors contributing to economic loss after a tornado. Tornadoes and high winds in the planning area can cause extended and widespread losses of business services. Business service interruption can be due to either property destruction or disruption of utility services (see infrastructure section for more information on utility disruptions).



Built Environment

Existing Structures

All structures in Muscogee Nation are vulnerable to tornado and high wind events. Structures in the Nation differ their type of construction, age, and size. Despite this variance, mobile homes, homes with crawlspaces buildings with large spans, such as airplane hangars, gymnasiums, and factories are more vulnerable to high wind and tornadic events due to their construction. Even anchored mobile homes can be severely damaged when winds gust over 80 mph. Houses with crawl spaces are more susceptible to lift.

Although the planning team lacked complete data about the location of more vulnerable structures, officials noted that many of these types of structures were in the southern part of the Nation, in areas South of I-40 and those areas considered to be more rural. Additional studies are needed to determine the number and concentrations of more vulnerable types of homes.

In addition to structure type, older homes in the planning area are generally more vulnerable to high wind and tornado damage than more recently built homes constructed to meet higher wind standards. While the Nation has a housing plan that allows them to provide housing for its citizens using HUD funding, the Nation does not have a housing recovery plan. In addition to more studies on building stock in the planning area, the Nation should consider developing a post-disaster housing recovery and resilience strategy as an appendix to the Emergency Operations Plan.

Infrastructure

Electric: Loss of power and communication lines will require alternate methods of communication until cellular service or landlines can be restored. Prolonged outages can lead to the disruption of vital services. Disruptions in communication can hinder outreach to Citizens and other residents in the planning area. Like many of the infrastructure components in this assessment, Muscogee Nation does not control the assets for electrical generation or distribution. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

In addition, service companies throughout Muscogee Nation maintain routine tree trimming to ensure power line are protected and buildings and roads are clear. This has helped reduce power outages from downed power lines and other damages.

Water/wastewater: Destruction of water/wastewater processing or distribution infrastructure could strain water systems in the planning area and place the populations affected by the disruption at risk to degradations of water quantity and quality. To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. Muscogee Nation can enhance these capabilities and develop new ones (see suggested actions).

Transportation: Debris along roads can delay recovery and response operations. Loss of power and communication lines will require alternate methods of communication until cellular service or landlines can be restored. Muscogee Nation's previous hazard mitigation plan noted the importance of proper debris management, which can be improved by debris management planning and education. Muscogee Nation can reduce this vulnerability by supporting partners who provide education and debris management resources to the owners and operators of transportation networks in the planning area.

Critical Facilities

All critical facilities in Muscogee Nation are exposed to this hazard. Some cultural critical facilities face heightened risk to hazards (see Culture section). All critical facilities should consider retrofitting and other techniques to improve resilience to tornadoes and high wind events. Muscogee Nation determine the need for permanent or temporary backup generation for its critical facilities and should purchase additional equipment for backup generation when needed.

Future Development

All future development is also vulnerable to tornado and high wind events. Future development is assumed to be less vulnerable to high wind events because Muscogee Nation has committed to adopting the 2021 International Building Codes. The Nation could benefit from additional home protection measures, which could reduce insurance rates for buildings owned by the Nation. In 2018, insurance companies began offering discounts on homes built or retrofitted to certain tornado-resilient standards because a law went into effect April 1 requiring them. These improvements can be shared through a robust public outreach program. The Nation can support programs to train building officials as IBHS (Insurance Institute for Business and Home Safety) Home Evaluators. There is a shortage of evaluators in the planning area, which is driven by a need for homes to be evaluated, allowing homeowners may receive insurance discounts if their company offers them. Additionally, Muscogee Nation could partner with Oklahoma Insurance Department and similar entities to educate the public, building professionals, and insurance agents about these benefits.

Natural Environment

The effects of damaging wind from high wind events or tornadoes on the natural environment are not always obvious or immediately apparent. Debris from damaged or destroyed homes can result in asbestos being deposited. Hazardous household waste, such as cleaning and automotive products, becomes an issue to animals and plants in the area, and can also contaminate water and soil. During severe thunderstorm events in planning area, flash flooding is a common occurrence. Household and industrial waste can spread into animal habitats, stormwater, rivers, and lakes.

4.4.3 Summary of Observations and Recommendations

Table 4-17 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
Muscogee Nation provides between 28-30 storm shelters through an application process and covers the charges and construction for their citizens.	Improve and expand saferoom program.	6
Essential facilities in Muscogee Nation are threatened by power outages due to tornado and high wind events.	Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	14, 33
Muscogee Nation needs more planning and strategic studies to maintain utility delivery during hazard events.	Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Tribal utility authority, Counties, municipalities, HUD and infrastructure owners and operators within the Nation's boundaries. Conduct a utility inventory and	13, 17



	conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators.	
Water infrastructure is vulnerable to tornado/high wind events, which could disrupt deliver to critical facilities in Muscogee Nation.	Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	16, 19
A lack of consistent and current technologies in the planning area makes the area more vulnerable to tornado/high wind events in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Citizens, the general public, and even insurance agents, are unaware of the benefits associated with disaster resistant construction and discounts on insurance premiums.	Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens. Develop an emergency management app to send notifications to citizens about various hazards and emergency events throughout the tribal boundary.	1, 3, 4
The structure of critical facilities are at risk to tornado and high wind events.	Complete hazard evaluations of critical facilities and retrofit or remodel buildings to make them more disaster resistant. Complete wind feasibility study and cost effectiveness determination of building tribal housing and commercial facilities to Insurance Institute of Building and Home Safety (IBHS) FORTIFIED standards. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.	15, 20, 28
Utilities are threatened during tornado/high wind events.	Conduct a utility inventory and conditions assessment for the Nation. Coordinate with private utilities and electric co-ops to harden electric utility infrastructure.	11
Muscogee Nation is designing a cultural center to include historical artifacts and documents.	Protect the Muscogee Nation cultural center with weather-resistant infrastructure.	5
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the	27, 31, 34



	Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	
Trees pose a threat during tornado/high wind events, especially if around power lines causing outages.	Maintain tree-trimming capabilities around electrical lines to prevent fire and electrical outages.	29
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.5 Dam (Owv Sentvcke) and Levee Incidents

4.5.1 Hazard Description

Dam: “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,” according to FEMA. 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.⁴²

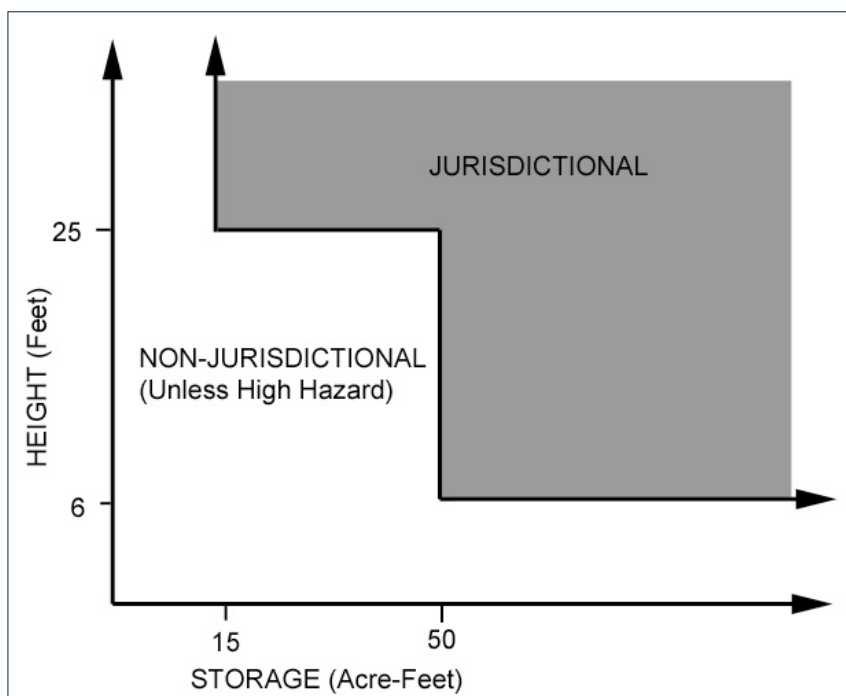
Dam Incident: a break in a dam can produce an extremely dangerous flood situation because of the high velocities and large volumes of water released during the incident. In the event of a dam failure, the potential energy of the water stored behind even a small dam can cause great property damage, as 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.

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.

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) as shown in Figure 1-17.

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.⁴³

Figure 1-17 OWRB Jurisdictional Size of Dams



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

⁴² 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.

⁴³ 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.

economic damage that will occur downstream from a breach. Table 1-18 identifies the risk and required inspection frequency for these dams.⁴⁴

Table 4-18 OWRB Dam Classifications

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

All high hazard dams must have an Emergency Action Plan (EAP) and must have an accompanying breach inundation map. This describes the locations where a breach of the dam will inundate an area by at least one foot during a sunny day (non-storm event related) breach or by a breach resulting in water surface elevations at least one foot higher than the water surface elevations from the spillway design flood without a breach, whichever is larger in area. These maps are on file with OWRB. All the dams in the planning area have an approved EAP except Jim Hall Lake and Nichols Lake south of Henryetta. The EPAs on file for these two dams are listed as “*EAP Draft w Comments”.

Levee: “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,” according to FEMA. 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 Incident: Levee failures can cause catastrophic floods, releasing sudden walls of water that can sweep across lands thought to be protected by the structure. 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.

Location

Dams

This assessment will focus on high-hazard dams that impact the Nation, which can be located inside or outside the geographic boundaries of Muscogee Nation (see section above for description of high-hazard dams). Of these 35 dams listed as high hazard, the OWRB has indicated that 5 of the non-federal dams are in “poor” condition.⁴⁵ None of the federal dams are listed as being in poor condition. Table 1-19 shows the

⁴⁴ Oklahoma Water Resources Board, Dam Safety, <http://www.owrb.ok.gov/damsafety/index.php>

⁴⁵ USACE does not consider Chouteau Lock and Dam 17 and Newt Graham Lock and Dam 18 in Wagoner County to be high hazard because they are run-of-the-river facilities with very little conservation storage.



dams, ownership, flood operators and county location. The dams in “poor” condition are noted with an asterisk “*” and are mapped below with a sunny day breach, along with an overtop, PMF, or max breach.

Table 4-19 Dams that Impact Muscogee Nation

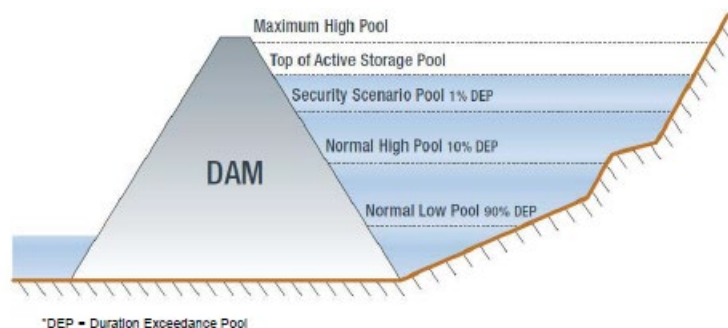
Dams	Owner	Counties Impacted
Federal Dams		
U.S. Army Corps of Engineers (USACE)		
Keystone	USACE	Tulsa
Heyburn	USACE	Creek
Oologah	USACE	Mayes
Skiatook	USACE	Osage
Grand River Dam Authority (GRDA)		
Pensacola	GRDA (operated by USACE during floods)	Mayes
Fort Gibson	GRDA (operated by USACE during floods)	Wagoner, Cherokee
National Resource Conservation Service (NRCS; formerly SCS) Constructed Dams		
SCS - Salt-Camp Creek Site 12	Creek County Conservation District	Creek
SCS - Little Deep Fork Creek Site 36	Creek County Conservation District	Creek
SCS - Little Deep Fork Creek Site 33	Creek County Conservation District	Creek
SCS - Okfuskee Tributaries Site H04	Okfuskee County Conservation District	Okfuskee
SCS - Cane Creek Site 05	Okmulgee County Conservation District	Okmulgee
SCS - Okmulgee Creek Site 1	Okmulgee County Conservation District	Okmulgee
SCS - Okmulgee Creek Site 2	Okmulgee County Conservation District	Okmulgee
SCS - Okfuskee Tributaries Site S1	Okmulgee County Conservation District	Okmulgee
SCS - Big Wewoka Creek Site 29	Seminole County Conservation District	Seminole
SCS - Big Wewoka Creek Site 31	Seminole County Conservation District	Seminole
SCS - Big Wewoka Creek Site 35	Hughes County Conservation District	Hughes
SCS - Big Wewoka Creek Site 30	Hughes County Conservation District	Hughes
SCS - Little Wewoka Creek Site 13	Hughes County Conservation District	Hughes
SCS - Cane Creek Site 22	Muskogee County Conservation District	Muskogee
Non-Federal Dams		
Holdenville City Lake	City of Holdenville	Hughes
Jim Hall Lake*	City of Henryetta	Okmulgee
New Beggs	City of Beggs	Okmulgee
Nichols Lake*	City of Henryetta	Okmulgee
Okemah Lake	City of Okemah	Okfuskee
Parthenia Lake	First Presbyterian Church of Tulsa	Creek
Sahoma Lake*	City of Sapulpa	Creek
Sapulpa Lake	City of Sapulpa	Creek



Okmulgee Lake*	City of Okmulgee	Okmulgee
Weleetka Lake*	Town of Weleetka	Okfuskee
Warrenton Lake	Warren Medical Center	Tulsa
Lake Massena	City of Bristow	Creek
R James Unruh Reservoir (Lynn Lane)	City of Tulsa	Tulsa
West Pre-sedimentation Basin - BA	City of Broken Arrow	Wagoner
East Pre-sedimentation Basin - BA	City of Broken Arrow	Wagoner

This assessment includes maps of USACE and GRDA federal dams, given the potential size of their impact (see vulnerability section for more information). This assessment also includes maps of non-federal dams that 1) impact Muscogee Nation Citizens, 2) were listed as in poor condition, 3) or both. These maps include the normal-high and maximum-high breaches for each dam, as long as data was available to do so.

Figure 1-18 USACE Dambreach Scenarios



The maps of the USACE dams display a normal-high and maximum high failure for dams in the planning area. The USACE determines dam failure scenarios based on those two conditions as shown in the Figure below. The Maximum High Pool includes the total storage space in the reservoir below the design water elevation. It includes surcharge, flood, conservation, inactive and dead storage. It is determined based on an elevation excluding any allowance for freeboard or wedge storage due to a sloping water surface. It establishes the upper limit of reservoir storage

capacity, downstream inundation, and potential consequences for the dam. Failure assumed during a maximum high pool assumed to occur due to overtopping.

The Normal High Pool (10% Duration Exceedance) is the maximum reservoir water surface elevation obtained when the reservoir is fully utilized for conservation purposes (e.g. municipal and industrial water supply, irrigation, hydroelectric power generation, navigation, etc.) excluding flood and surcharge storage. In this case failure is assumed to occur because of piping through the dam. While the Maximum High Pool provides the largest footprint and consequence from a dam breach, it is also quite unlikely. The Normal High Pool is seen as the reasonable lower limit to consider for dam breach and is the pool level with a 10% recurrence interval. Since this pool level occurs more frequently, the possibility of failure at this elevation would be more likely. The Normal High dam breach limits are mapped for consideration in the location and extent section.

In addition to complete or partial failure, the planning area also can be impacted by a high release event. A high release is an intentional release of water that exceeds normal release levels. A high release can occur in response to more runoff entering the reservoir than what is being released, causing the water surface to rise to the top of the flood pool while inflow is still occurring. Operating the gated spillway at that level requires that the outflow through the spillway must be equal to the inflow so that the water surface will not overtop the dam.

Figure 1-20 Keystone Dam (USACE) Location in the Muscogee Nation

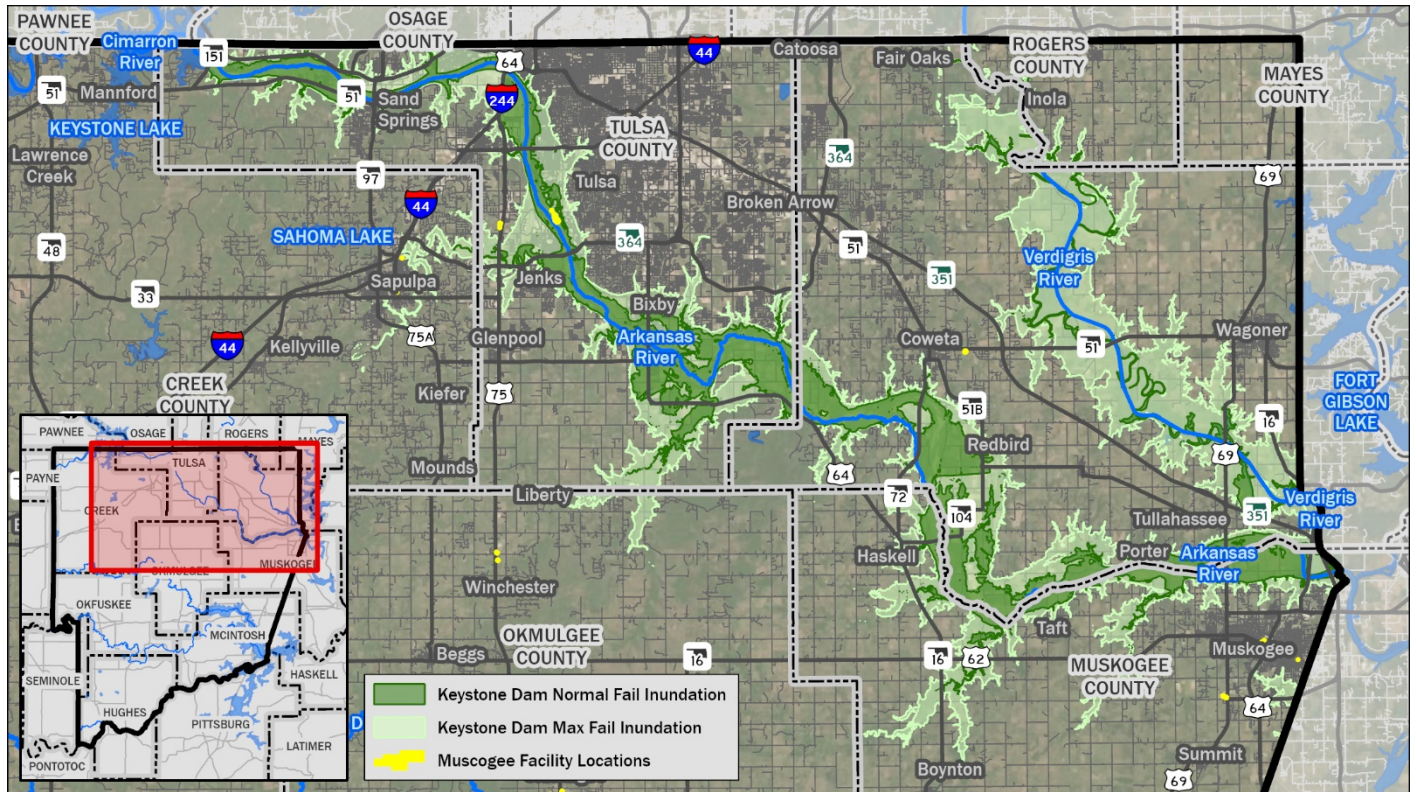


Figure 1-19 Heyburn Dam (USACE) Location in the Muscogee Nation

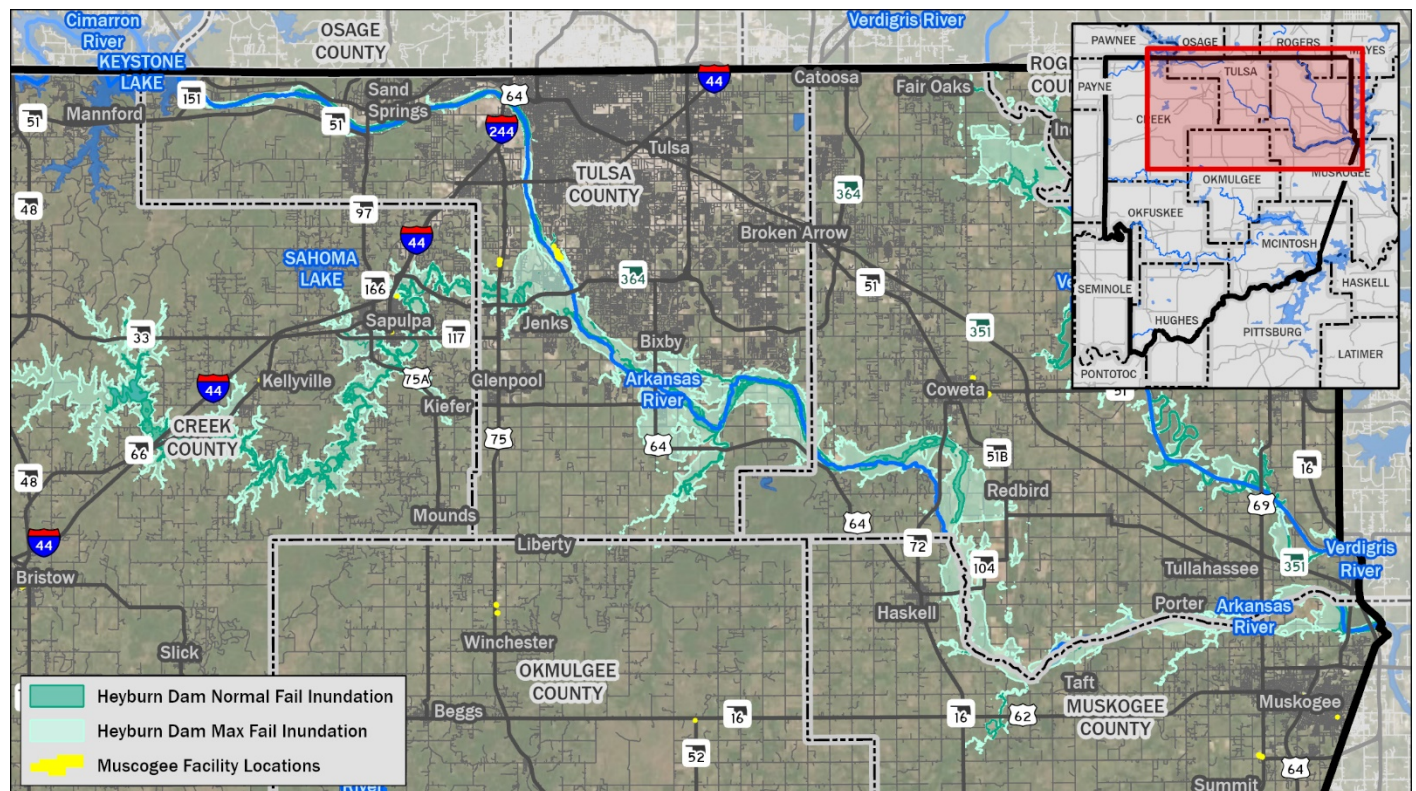


Figure 1-22 Oologah Dam (USACE) Location in the Muscogee Nation

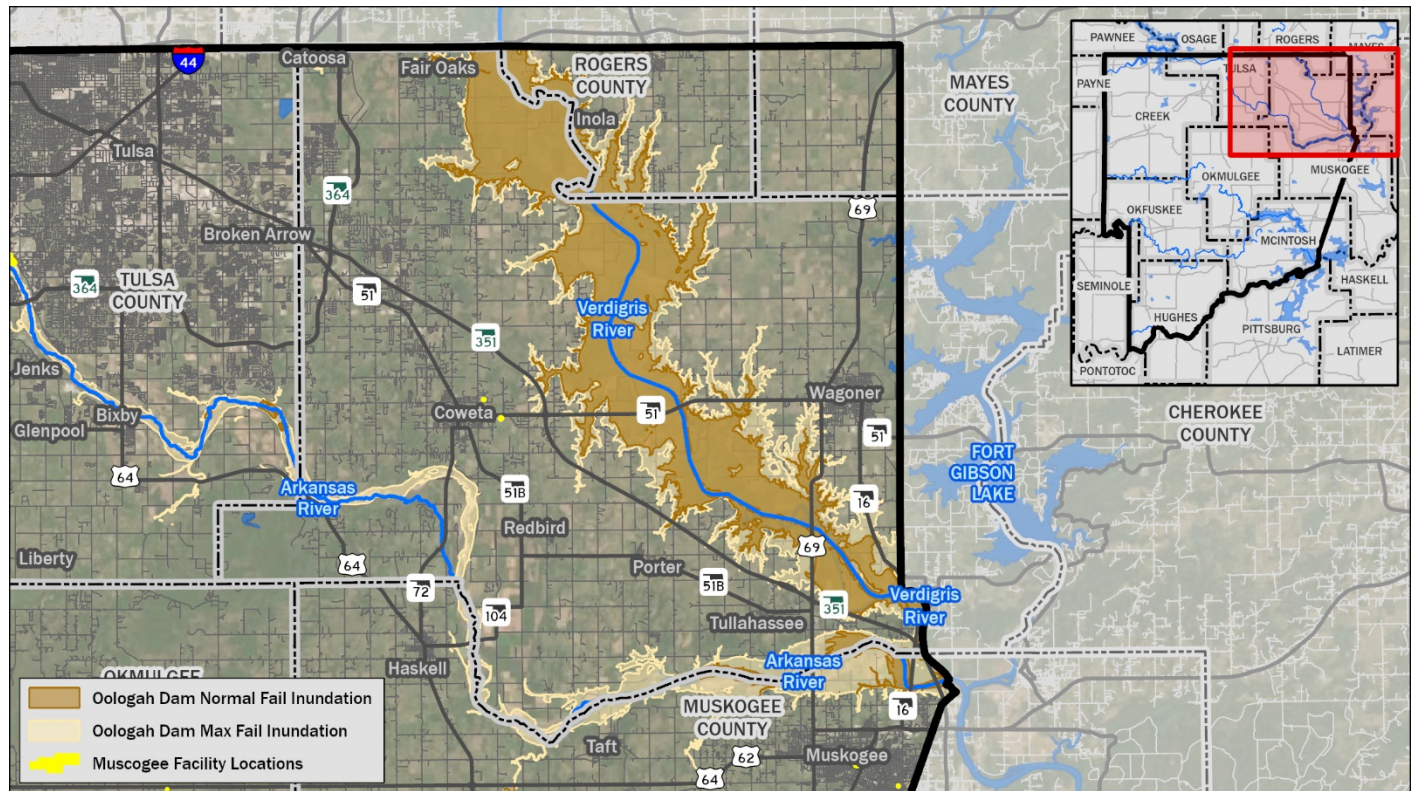


Figure 1-21 Skiatook Dam (USACE) Location in the Muscogee Nation (Max fail Inundation not available)

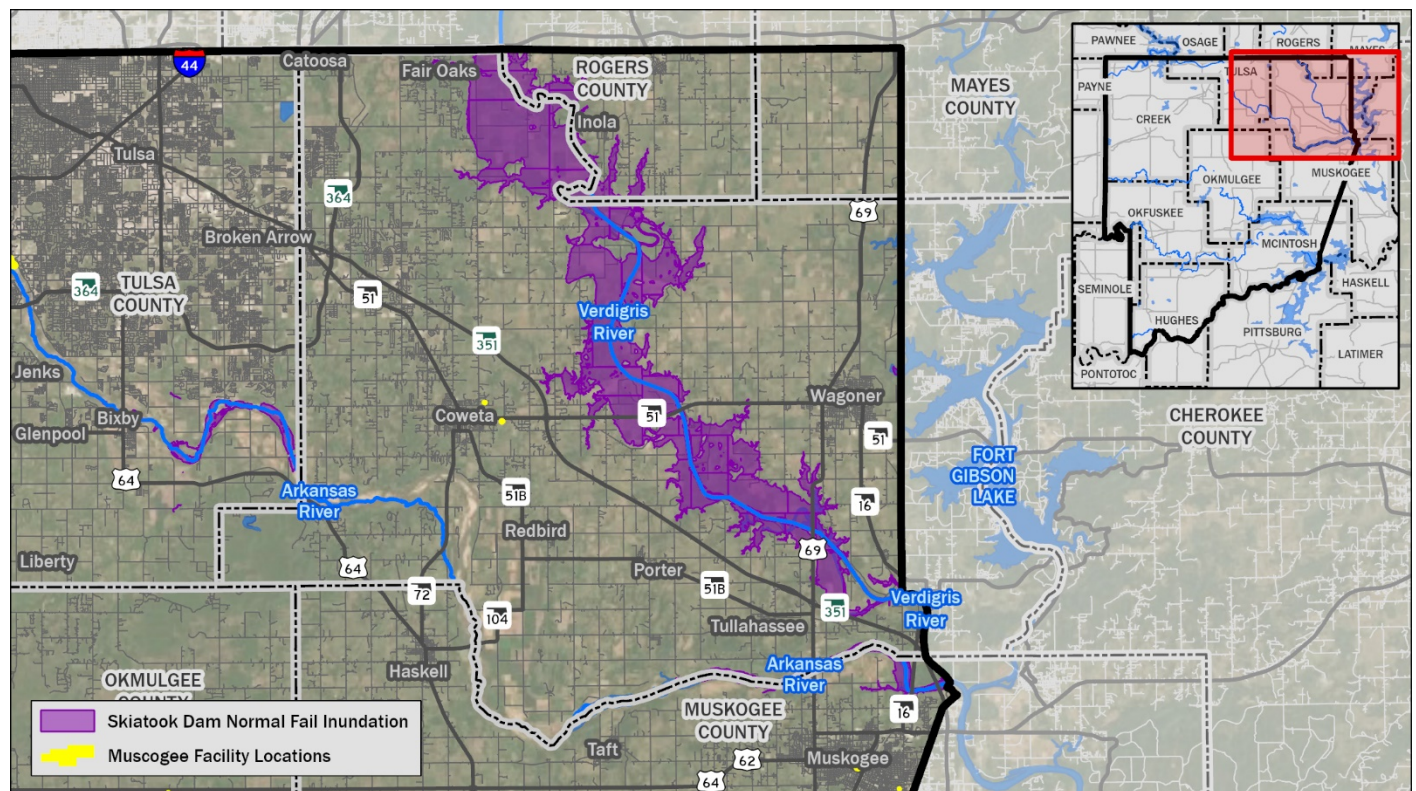


Figure 1-24 Pensacola Dam (USACE) Location in the Muscogee Nation

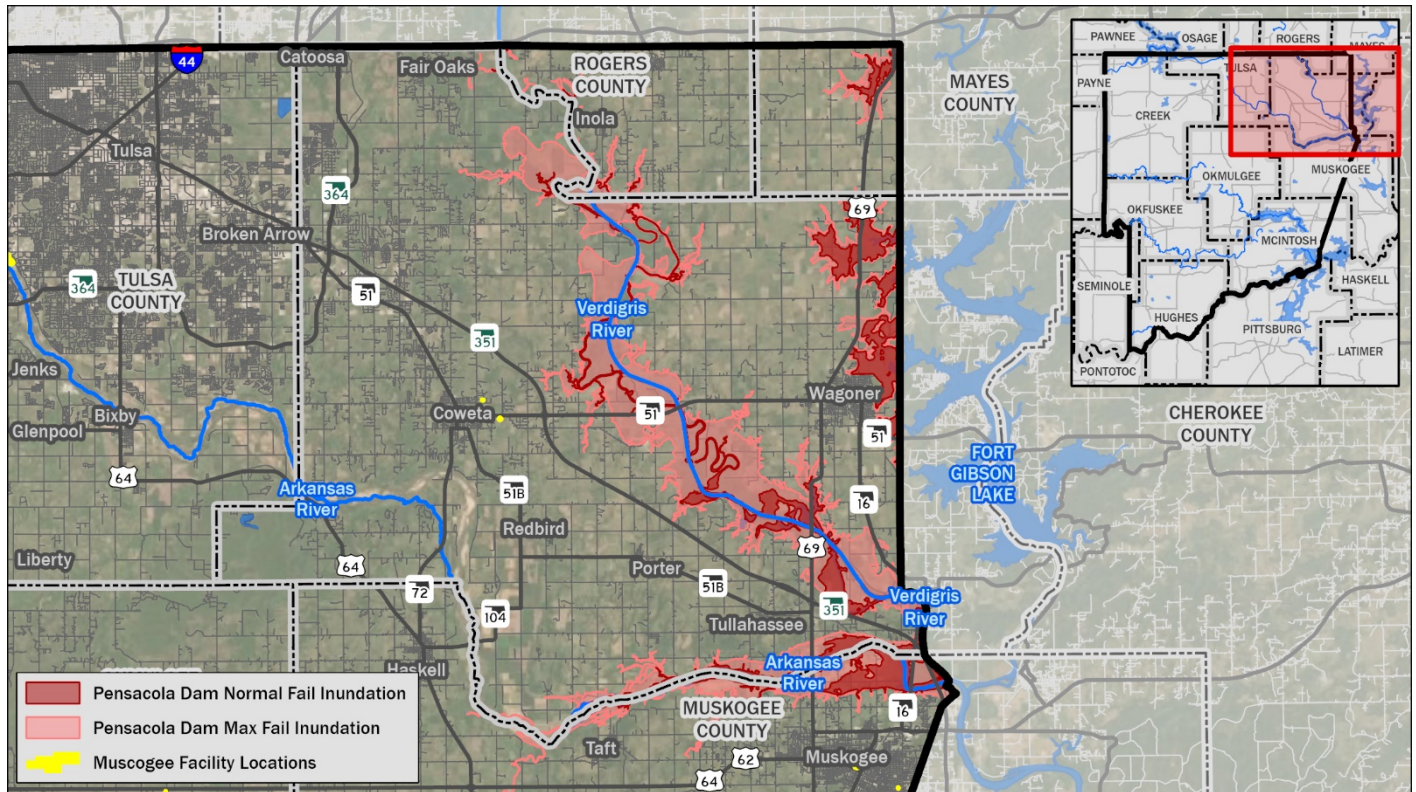


Figure 1-23 Fort Gibson Dam (USACE) Location in the Muscogee Nation

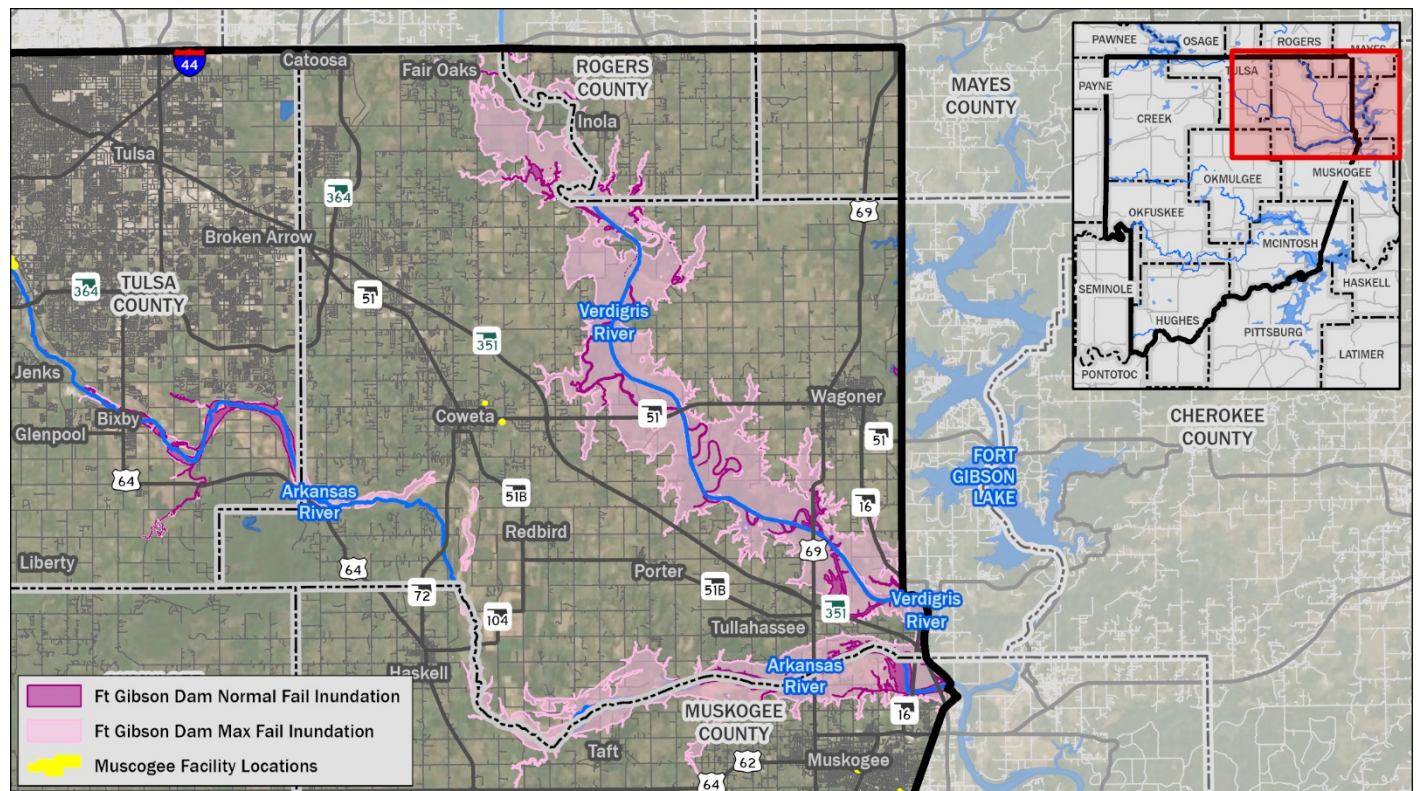


Figure 1-26 Sahoma Lake Dam (OWRB) Location in the Muscogee Nation

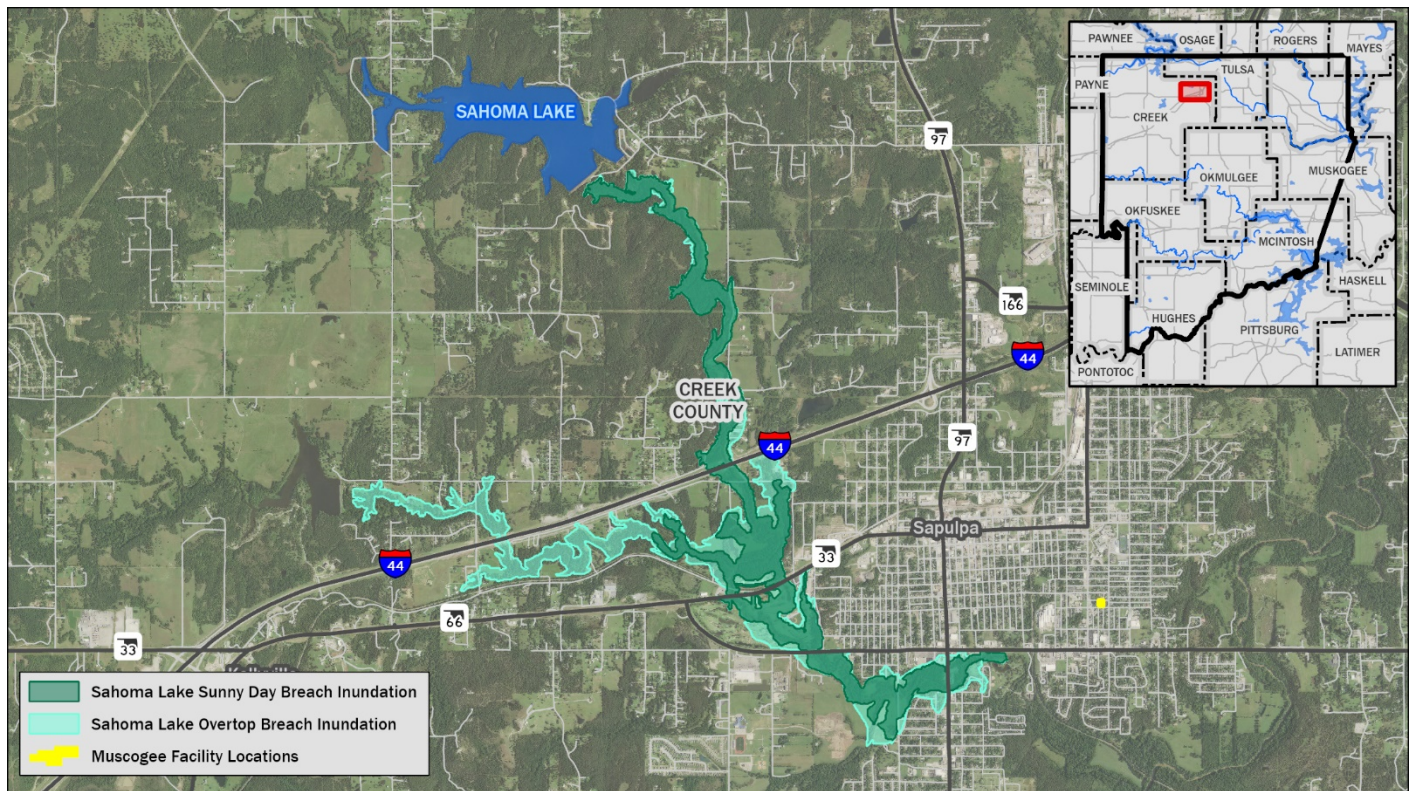


Figure 1-25 Jim Hall Lake Dam (OWRB) Location in the Muscogee Nation

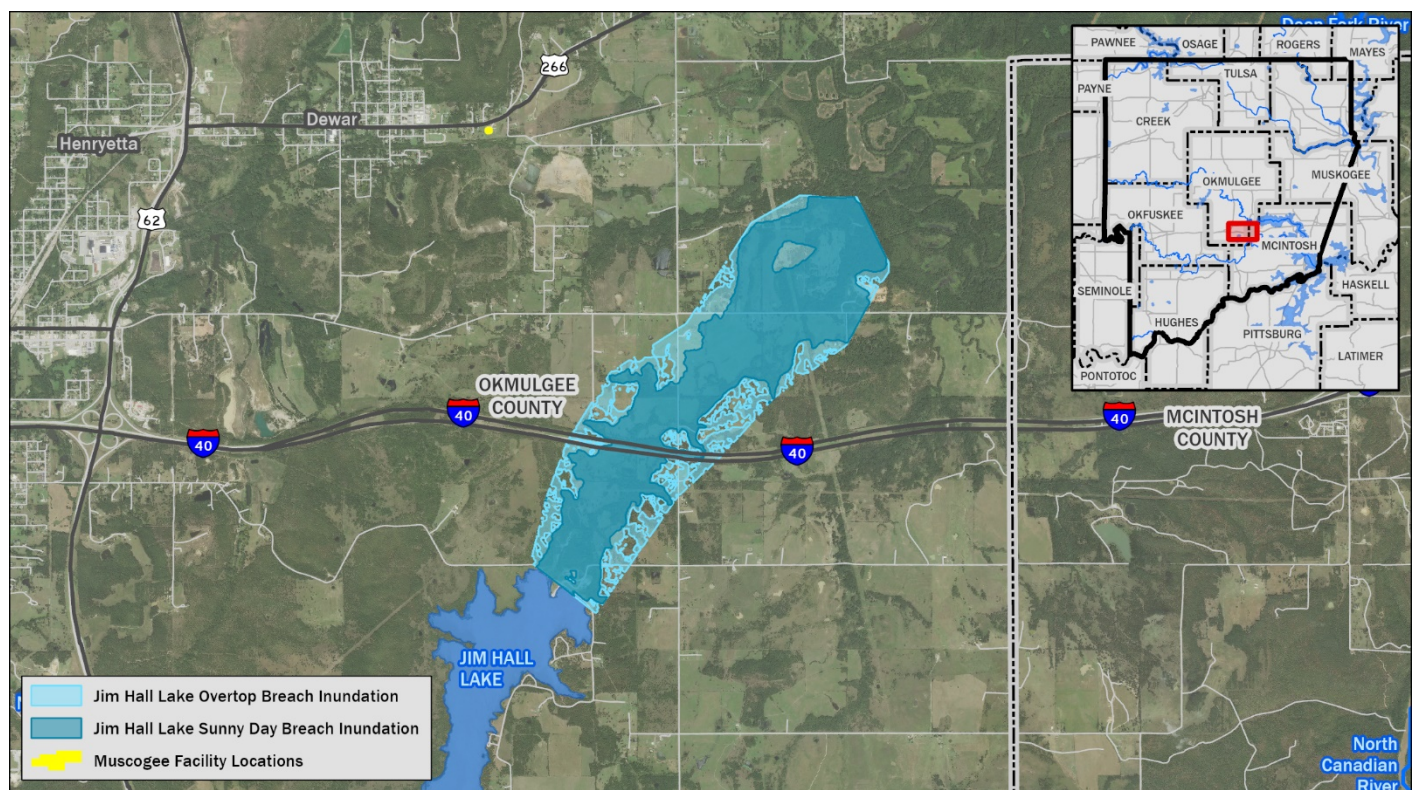


Figure 4-27 Okmulgee Lake Dam (OWRB) Location in the Muscogee Nation

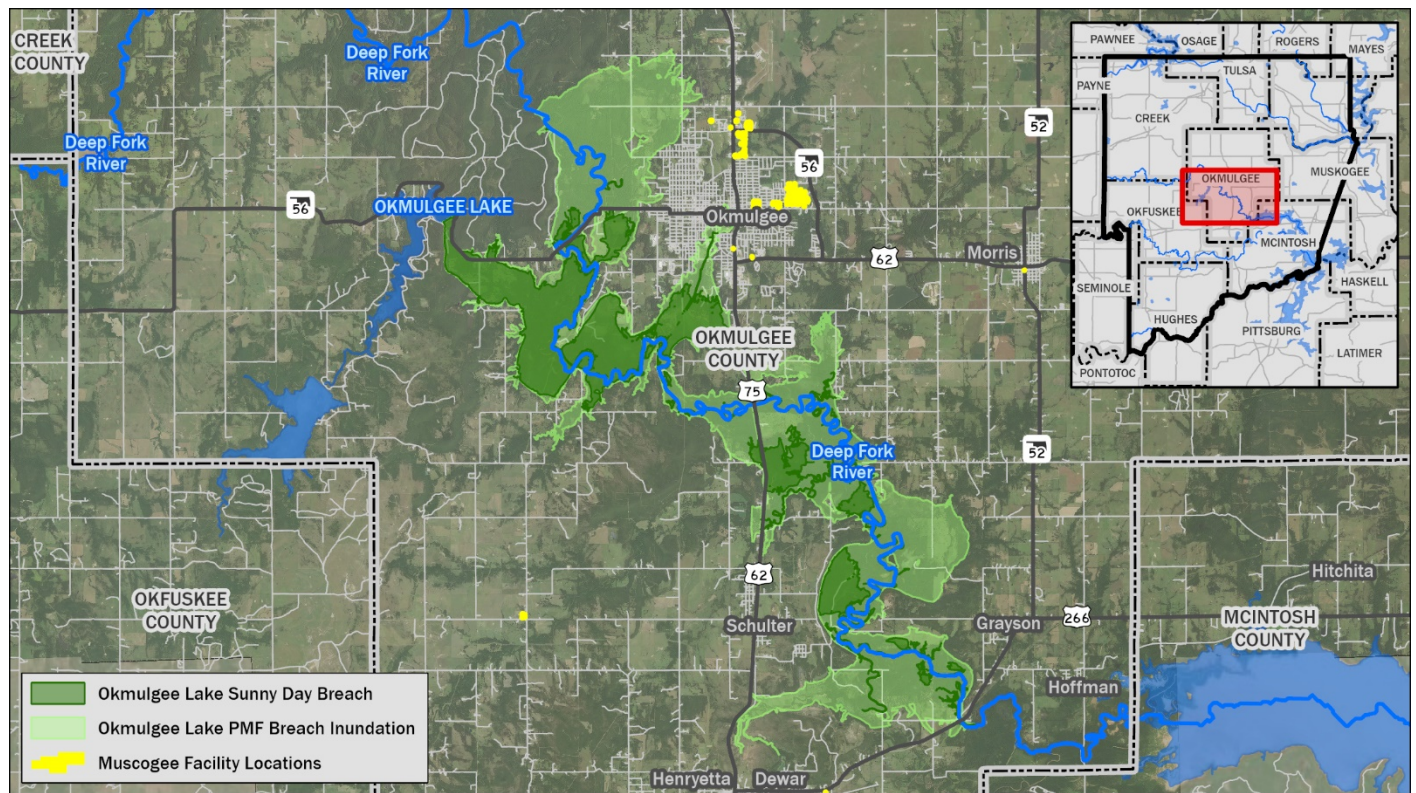


Figure 1-28 Nichols Lake Dam (OWRB) Location in the Muscogee Nation

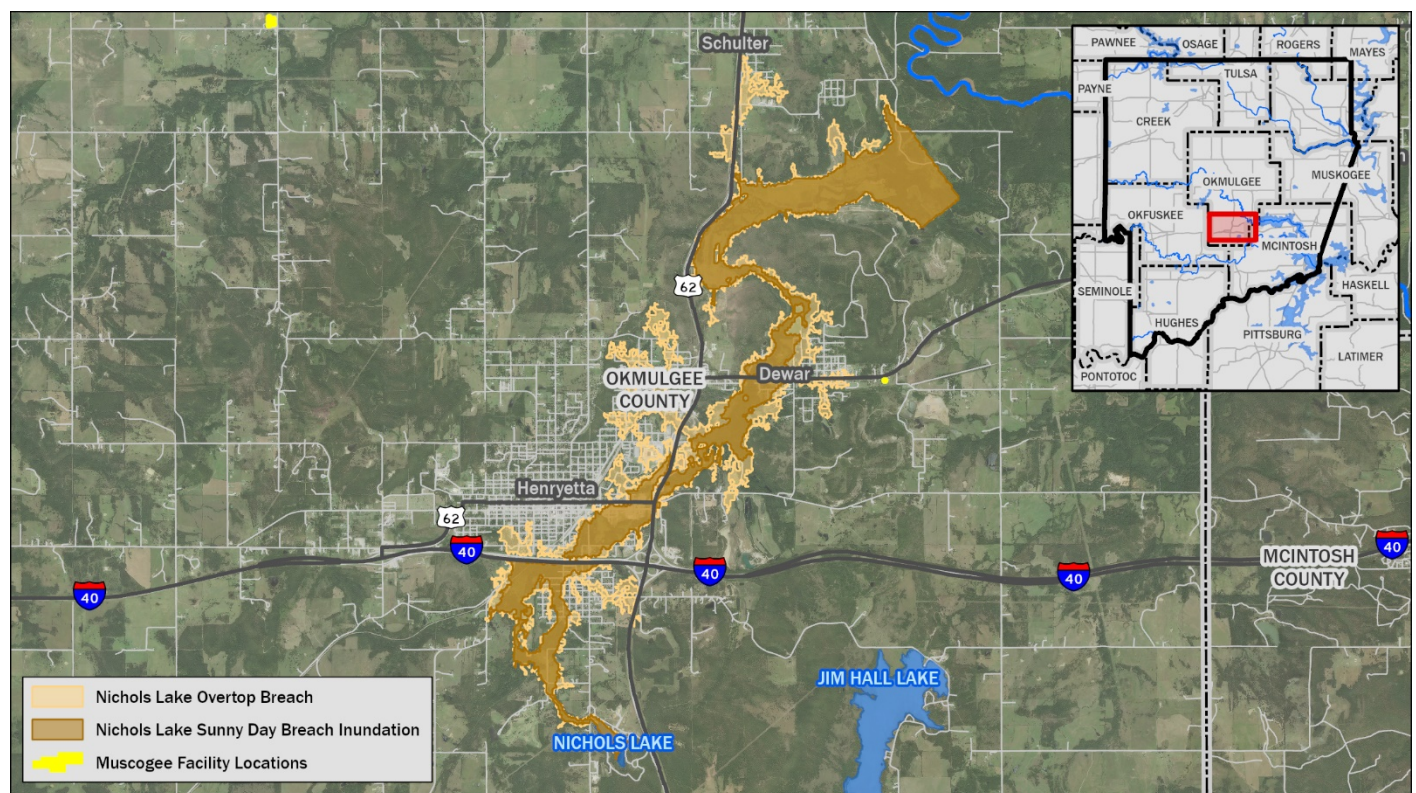
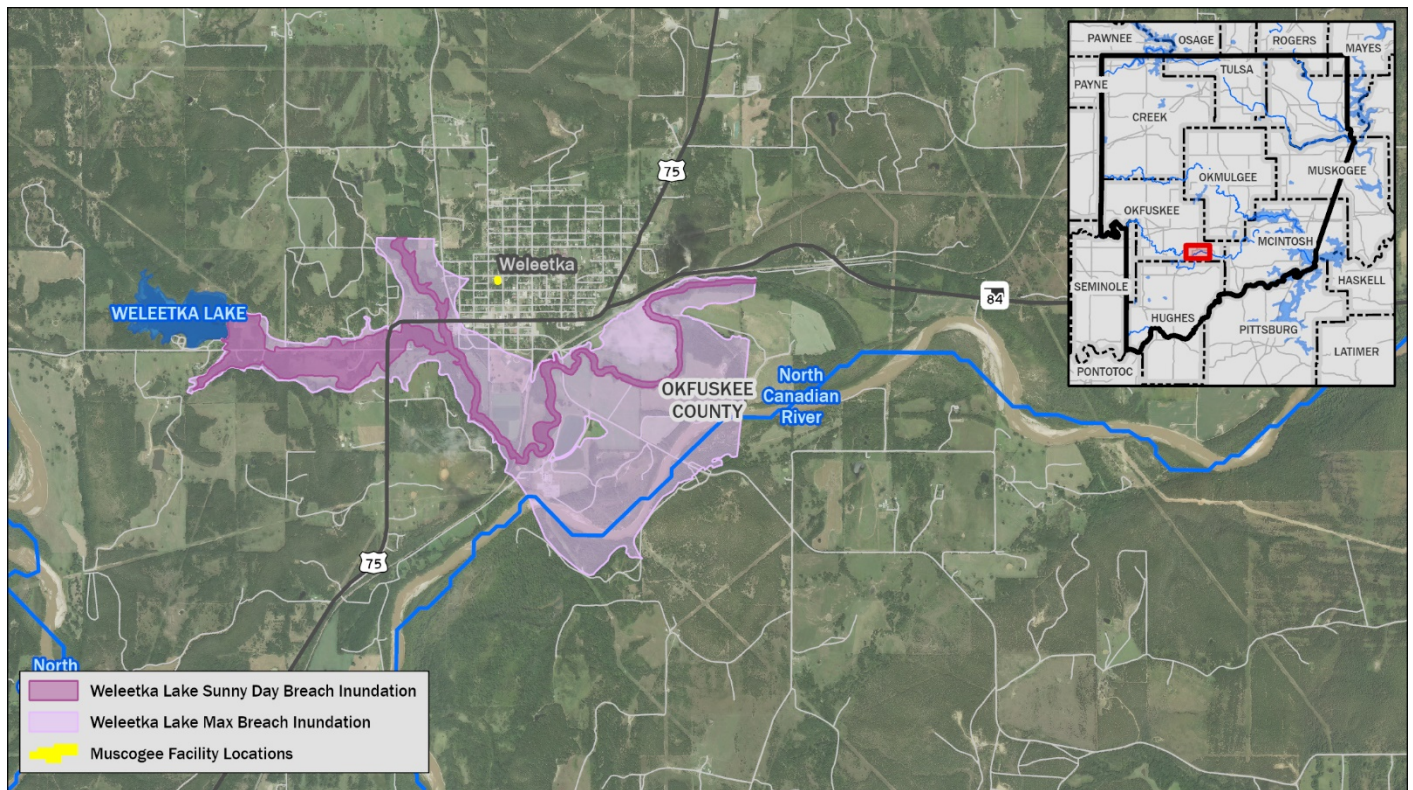


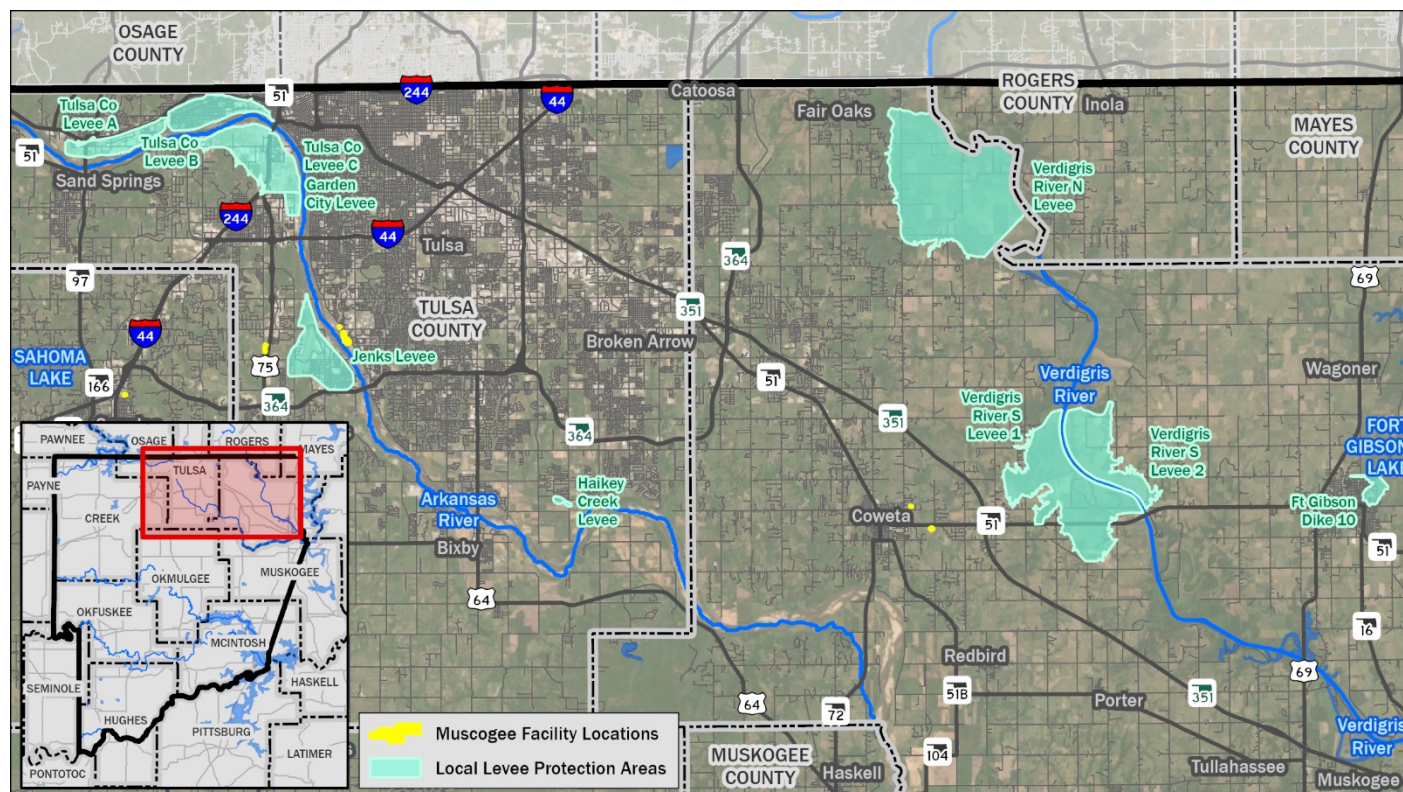
Figure 4-29 Weleetka Lake Dam (OWRB) Location in the Muscogee Nation



Levees

The only known levees within the Muscogee Nation are located in Tulsa County and Wagoner County. The levees are shown in Figure 1-30 and described in the table below.

Figure 1-30 Levee Locations in Muscogee Nation



Tulsa County

Tulsa/West Tulsa Levee A

Flood Source: Arkansas River (west bank)

Location: Sand Springs and unincorporated Tulsa County

Description: Tulsa and West Tulsa Levees A (and B) are earth embankments averaging 15 feet tall and each being about five miles long and they are connected by concrete floodwalls built over a box culvert floodway structure that allows a major road and a railway to cross the mouth of Bigheart Creek. The levees were constructed by the USACE and after completion 1944 ownership was transferred to Tulsa County Drainage District No. 12 for continued operations, maintenance, repair, rehabilitation, and replacement actions. The USACE designed the levees to contain and withstand a Keystone dam release of 350,000 cubic ft/sec, with a minimum of 3 feet of freeboard. The current Revised Peak Discharge from the latest USACE flow and state frequency analysis⁴⁶ (Table 1-1) describes the 0.2% AEP Discharge as 350,000 cfs. These levees would have 3 feet of freeboard during a 0.2% (500-year) storm.

Tulsa/West Tulsa Levee B

Flood Source: Arkansas River (west bank)

⁴⁶ Comprehensive Regulated Flow and Stage Frequency Analysis and Flood Inundation Modeling Study for the Arkansas River and its Tributaries in Oklahoma, FEMA Region VI Mission Assignment, March 2020, developed by the Hydrology and Hydraulics Branch, U.S. Army Corps of Engineers (USACE) Tulsa District.

Location: Primarily within the jurisdiction of the City of Tulsa

Description: See description above

Tulsa Levee C

Flood Source: Arkansas River (east bank)

Location: City of Tulsa and unincorporated Tulsa County

Description: The levee is an earth embankment averaging 11 feet tall and is about 8 miles long. The levee was constructed by USACE and, after completion in 1945, ownership was transferred to Tulsa County Drainage District No. 12 for continued operations, maintenance, repairs, rehabilitation, and replacement actions. This levee would have 3 feet of freeboard during a 0.2% (500-year) storm based on the current Revised Peak Discharge described earlier.

Garden City Levee

Flood Source: Arkansas River (west bank)

Location: City of Tulsa, between 21st and 51st streets

Description: This levee was constructed privately by residents on the west side of the Arkansas River between 21st and 51st streets to protect their homes. The levee has not been certified by FEMA, but would likely overtop from 1500 feet south of 41st St. at approximately the 1% (100-year) water surface elevation on the Arkansas River, based on a review of the elevations on the west bank of the Arkansas River in the vicinity of the levee.

Jenks Levee

Flood Source: Arkansas River (west bank), Polecat Creek (north bank), and Hager Creek (east bank)

Location: City of Jenks

Description: The project was constructed by the U.S. Army Corps of Engineers and, upon completion in 1949, ownership was transferred to Tulsa County for continued operations, maintenance, repair, rehabilitation, and replacement actions. This levee would have 1-1/2 feet of freeboard during a 0.2% (500-year) storm with a discharge on the Arkansas River of the 350,000 cfs and a coincident flow of 45,000 cfs on Polecat Creek with 3 feet of freeboard along that stream⁴⁷. Currently, the 2% (50-year) flow rate on Polecat Creek at the confluence with the Arkansas River is 48,573 cfs, according to the Tulsa County Flood Insurance Study.

Haikey Creek Levee

Flood Source: Haikey Creek (north bank)

Location: Bixby

Description: This earthen levee is approximately 1.1 mile long and 10 feet high. The project was constructed by USACE and, upon completion in 1987 ownership, was transferred to Tulsa County for continued operations, maintenance, repair, rehabilitation, and replacement actions. The project was constructed to 3 feet above the Standard Project Flood (SPF) level. The SPF is described as about two feet higher than the June 1974 flood of record (at the time) that had a recurrence interval of about 10 years under full urbanization. The National Levee Database estimates that the levee protects a population of 120 people and 47 buildings with a property value of \$12M. During the flood event of 2019 the levee was loaded to 100% by backwater with a 277,200 cfs flow on 29MAY2019 in the Arkansas River.

Wagoner County

Salt Creek-Verdigris River North Levee

Flood Source: Adjacent to Salt Creek (south bank) and Verdigris River

Location: Unincorporated Wagoner County

⁴⁷ Jenks Levee Local Flood Protection Project, Arkansas River, Oklahoma, Operation and Maintenance Manual, USACE, September 1983.



Description: It is a non-accredited levee system with a total length of 7.7 miles. The NLD lists the levee as “locally constructed, locally operating and operated.” The population behind the levee is listed as 119 people and 44 structures valued at \$9.35M. It appears to have been constructed at or slightly above the SFHA BFE (see flooding section for more information on SFHA BFE). Both the Salt Creek - Verdigris River North Levee and the Verdigris River South Levee 1 are described by the NLD as “a man-made structure that was not specifically designed with flood risk reduction in mind but may provide some level of flood risk reduction for the levee system.” Both levees probably are spoil areas from excavations made during construction of the navigation channel.

Verdigris River South Levee

Flood Source: Verdigris River Navigation Channel (west bank)

Location: Unincorporated Wagoner County, north of Highway 51

Description: This structure is a non-accredited levee system with a total length of 3.49 miles. The NLD lists the levee as “locally constructed, locally operating and operated”. The population behind the levee is listed as 51 people and 16 structures valued at \$5.93M. Salt Creek-Verdigris River North Levee levee above for additional information on this levee.

Old Channel South of Fish Hatchery Levee

Flood Source: Old Verdigris River channel (east bank)

Location: Unincorporated Wagoner County, south of Highway 51

Description: The levee is approximately four feet lower than the BFE for the SFHA. It is 0.23 miles long and protects 2 people and one structure valued at \$152,000.

Wagoner Dike 10

Flood Source: Fort Gibson Lake (southwest portion)

Location: Unincorporated Wagoner County, just north of the City of Wagoner

Description: Dike 10 is 1.51 miles long with a top elevation of 588ft. The top of the Fort Gibson Lake flood pool is at elevation 582. Dike 10 collects water and discharges by gravity into a drain to the lake. When the elevation of the lake reaches 561.5 ft, a valve is closed to protect the land side from higher elevations in the lake and water must be pumped back into the lake. It protects a population of 1,924 people and 433 buildings with a property value of \$103M, according to the National Levee Database.

Extent

Dams

Thirty-five High-Hazard Dams would affect Muscogee Nation citizens and facilities during a breach or failure. The dams owned and/or operated by the USACE, GRDA or the County Conservation Districts are not likely to fail. They were constructed to federal guidelines and undergo strict maintenance and inspection guidelines.

The remaining high-hazard 15 dams are owned by municipalities or private entities. Ten of those are in good condition based on annual inspections. The other five are in poor condition and are the focus of this assessment. They listed in Table 1-20 with their potential impacts upon failure.

Table 4-20 Poor Condition Dam Breach Events

Dam Name	Breach Impact
Jim Hall Lake (Lake Henryetta)	From the 2021 Emergency Action Plan (EAP), a major flood caused by a sudden breach of the dam is estimated to inundate four homes, zero businesses, and I-40 highway during a 50% PMF flood. No Muscogee citizen locations were identified in the breach zone; however, this dam is the water supply for the City of Henryetta and other rural water districts.
Nichols Lake	From the 2021 Emergency Action Plan (EAP), a major flood caused by a sudden breach of the dam during a 50% Probable Maximum Flood (PMF) is estimated to inundate a large number of homes, businesses, and I-40 & Indian Nation Turnpike highways. Approximately 131 Muscogee citizen (estimated) locations are within this breach.
Sahoma Lake	As of October 2020, a dam breach will inundate 72 residents, 4 businesses, 5 roadways and 2 bridges at depths ranging from 36 feet at the dam to no impact at a point 40,000 feet below the dam. Approximately 9 Muscogee citizen (estimated) locations are within this breach.
Okmulgee Lake	As of January 2016, a sudden breach of the dam during a Probable Maximum Flood (PMF) is estimated to inundate 55 homes, 7 business, 16 roads and highways, and 4 private drives. The depths range from 11 feet near the dam to approximately one foot several miles downstream. Approximately 65 Muscogee citizen (estimated) locations are within this breach.
Weleetka Lake	The 2020 Emergency Action Plan (EAP) lists 7 residential locations downstream from that dam that would flood from 15 to 20 feet deep from a PMF breach. Highway 75 and 10th Street would also be overtopped by several feet. No Muscogee citizen locations were identified in the breach zone.

Levees

Like the planning team's analysis of dams, the planning team prioritized levees that presented a higher risk of failure given the number of levees in the planning area. The levees selected were Tulsa/West Tulsa Levees and the Garden City Levee (see probably for future events for more information). While the location of Levees in the Muscogee Nation is known, there is limited information about the extent of overtopping. More data is needed to identify flood extent due to a levee breach or overtopping of levees located in Wagoner County. This information will be collected and incorporated in the next plan update.

Previous Occurrences

Dams

Muscogee Nation has not been impacted by a dam break or failure (other than the 1986 and 2019 forced-release events) in the past, as seen in Table 1-21.



Table 4-21 Historic Dam High Release Narratives

Date	Event Narrative
September – October 1986	The rainfall that caused the September-October 1986 flood was about one-half of the average annual rainfall in some areas. In many locations, the 6-day rainfall (29 September to 4 October) was more than twice that of the previous record. Several areas reported over 20 inches of rain, and many of the rainfall amounts exceeded previous records. As a result, several lakes in the Arkansas River Basin system filled to the tops of their flood control pools, even though the lakes had 100 percent of their flood control storage available immediately prior to the rainfall. Runoff not only exceeded the flood control capacity of the Arkansas River Basin system, it exceeded stream capacities throughout the area. The result was extensive flooding. Thirty-three counties in Oklahoma, including Tulsa, Rogers, Wagoner, Muskogee, Okfuskee and Okmulgee Counties within the Muscogee Nation boundary, two cities outside those counties, and ten counties in Kansas were included in flood disaster area declarations made by the President of the United States.
May 2019	Several weeks of widespread heavy rainfall over the Arkansas River watershed resulted in historic flooding in many locations in 2019. Fourteen (14) USACE reservoirs in Kansas and Oklahoma reached new pools of record. The historic rainfall observed in May produced widespread flooding along the Arkansas River and its tributaries. Oologah Dam reached a peak release of 64,000 cubic feet per second (cfs), while a peak release of 222,000 cubic feet per second was made from Fort Gibson Dam, both on May 25. A release of 275,000 cubic feet per second on May 29 resulted in the highest release from Keystone Dam into the Arkansas River since 1986. The lower reach of the Arkansas River was most significantly affected by the flood, which was catastrophic in many locations. The flow along the Arkansas River at Muskogee was an estimated 600,000 cubic feet per second, resulting in the second largest crest on record. Extensive flooding occurred in and around the Port of Muskogee. Further downstream, the towns of Webbers Falls and Moffett were completely inundated.

Levees

The table below highlights a history of major levee incidents in Muscogee Nation. In Tulsa County, Jenks and Haikey Creek levees have not experience significant damages or operational concerns until the Arkansas River flooding in 2019. Prior to the Haikey Creek Levee's construction, a record flash flooding event in 1974 resulted in a number of homes being inundated for several hours, some by as much as 4 ½ feet of water. The Haikey Creek levee, which was built to reduce risk from such flash storm events, has not been significantly loaded by a Haikey Creek flood since construction. The levee is designed for a flood that is larger than a 100-year event on Haikey Creek. More information is needed to determine the past extent for levee incidents in Wagoner County.

Table 4-22 Historic Levee Narratives

Date	Event Narrative
May 1984	Levees A, B, and C: Harlow Creek overtopped the levees, causing extensive erosion and foundation failure of floodwalls. Dozens of residential structures were flooded and many were demolished. Localized flooding occurred near an apparent overtopping area near Cherry Creek.



Date	Event Narrative
September – October 1986	<p>Levees A, B, and C: The flood of 1986 had peak releases out of Keystone Dam totaling 305,000 cfs on the Arkansas River for 12 hours. Levees A and B were loaded to approximately 80% of their total height and Levee C was loaded to 75% of its total height. Breaches were barely contained by flood fighting efforts. On-site assistance (USACE) was provided for the emergency repair of two breaches (A and B) in the Tulsa-West Tulsa levee system during the 1986 flood on the Arkansas River. Several accounts of sand boils were also reported on the levees.</p> <p>Garden City Levee: failed in 1986, causing \$1.3 million in damages to 64 buildings. River water entered the Garden City community from the breach in a private levee, causing damage to 14 homes, 11 industrial buildings, and 39 mobile homes. Some of the houses flooded up to the rafters. The City fielded its hazard-mitigation team and eventually purchased 13 parcels, cleared seven homes, and rebuilt the damaged levee to provide at least limited protection to the extensive west bank industrial areas.</p>
May 2019	<p>Levees A, B, and C: At 100,000 cfs flows, emergency response resources were activated. When flows reached 150,000 cfs, Levee District personnel and engineers inspected and monitored the levee for signs of distress or issues. At 200,000 cfs, residents were advised to evacuate. The City of Tulsa used sirens, door-to-door notification, local media, social media, and loudspeakers to warn the population at risk.⁴⁸ The 2019 flood event had peak releases of 277,000 cfs for 30 hours and over 200,000 cfs for 10 days. Although these levees did not experience a severe loss of function, various sandbagging, supplemental pumping, and evacuation efforts were needed to ensure no loss of life occurred.</p> <p>Garden City Levee: was repaired during the 2019 flood by the City of Tulsa to prevent a failure similar to what happened in 1986.</p> <p>Haikey Creek Levee: During the flood event of 2019 the levee was loaded to 100% by flood waters from the Arkansas River (backwater), with a 277,200 cfs flow on May 29th, 2019.</p> <p>Wagoner Dike 10: Dike 10 experienced water levels higher than 561.5 for a period of approximately 3 months. During this time, the valve was closed that allowed gravity flow out of the protected area and water had to be pumped continually back into the lake. The lake stayed at levels higher than 570 (18 feet below the top) for approximately a month and reached 582 (6 feet below the top) twice during the flood period.</p>

Probability of Future Events

Some dams and levees in the area are more prone to failure than others. For this reason, the planning team determined a probability estimate for dams and levees in the area based on the dams and levees that were most likely to experience an event. The criteria for dam breach makes this hazard a **likely** for the highest probability dams. The planning team estimates that the highest risk levees in the planning area have an **occasional** probability of failure. An assessment of higher-risk dams and all levees is included below:

Dams

The dams that present the highest likelihood of incident, especially failure, in Muscogee Nation Muscogee Nation are dams that meet these criteria:

1. High-hazard dam
2. Private or Municipal Ownership
3. Poor Condition

⁴⁸ The refinery behind Levee C temporarily shut down when flows in the Arkansas River were forecast to reach 250,000 cfs, although levees A, B and C were not fully loaded.



The 5 dams that meet these criteria are:

- Jim Hall Lake (Lake Henryetta)
- Nichols Lake
- Sahoma Lake
- Okmulgee Lake
- Weleetka Lake

The general probability for dams in the planning area is included in Table 1-23.

Table 4-23 Dam Incidence Probability

Classification	Probability
5 Poor-Condition Dams	Likely
All Other Non-Federal Dams	Unlikely*
All Federal Dams	Unlikely

*Additional studies are needed to improve the accuracy of this assessment

That being said, a high release from a dam is much more likely to occur. Some high-risk dams are the most concerning for the Muscogee Nation and, considering the history of dam failures, the risk of flooding from dam and levee failures will occasionally occur.

Levees

The probability of failures for levees with the highest risk of incident were determined to be **occasional** by the planning team. These estimates were determined based on risk assessments that were prepared for levees in the planning area. Most levees in Wagoner County need to be assessed, however, to determine their incidence of failure. The planning team included an analysis of all levees to affect the planning area, based on the limited available assessments. This analysis can be found in Table 1-24.

Table 4-24 Probability of Future Events: Levees

Tulsa County

Tulsa/West Tulsa Levee A & B

Risk: Very High (probability: occasional)

Rationale: 2016 Risk Assessment Determined that:

1. Levee overtopping is highly likely
2. Levee erosion and breach is expected during overtopping
3. Rapid and deep flooding will cause extensive property destruction and loss of life

Additional Risk: Levees A and B were designed to provide significant protection from Arkansas River flooding. However, the tie back levees only provide approximately 4% - 3.33% (25-year–30-year) protection from tributary flooding. The toe drains and relief wells along the levees are 75 years old, clogged and collapsed. These features prevent water pressure buildup in levees that can cause sudden failure. Many of the culverts are 70 years old and have not been structurally evaluated. Many modifications (generally abandonment) have not been documented over the years. Levee failure results from seepage around leaking culverts. This happened in 1986 on the Tulsa/West Tulsa levees. In addition, the pump stations have no alternate power source in an emergency. Pumps and switching gear in the pump stations are 70 years old and need to be replaced. Tributary flooding (Harlow Creek) can occur because the levees were constructed to protect against Arkansas River flooding only.

Tulsa Levee C

Risk: High (probability: unlikely)

Rationale: 2017 Risk Assessment Determined that:



1. Levee overtopping is highly likely
2. Levee erosion and breach is expected during overtopping
3. Rapid and deep flooding will cause extensive property destruction and loss of life

Garden City Levee

Risk: Very High (probability: occasional)

Description: The levee failed during the 1986 flood on the Arkansas River and would have failed again in 2019 if early intervention had not occurred. No risk assessment has been prepared since this is a non-accredited levee.

Jenks Levee

Risk: Low (probability: unlikely)

Rationale: 2016 Risk Assessment Determined that:

1. It has a good maintenance record
2. Based on past performance it expected to perform well under significant loading
3. The community has an (EAP) in place to notify residents when and where to evacuate

Haikey Creek Levee

Risk: Low (probability: unlikely)

Rationale: 2016 Risk Assessment Determined that:

1. It has a good maintenance record
2. Based on past performance it expected to perform well under significant loading
3. The community has an (EAP) in place to notify residents when and where to evacuate

Wagoner County

Salt Creek-Verdigris River North Levee

Risk: Unknown

Rationale: This non-accredited levee system has no records on construction but does appears to have been constructed at or slightly above the SFHA BFE. The probability of failure is unknown.

Verdigris River South Levee

Risk: Unknown

Rationale: This is also a non-accredited levee system. The probability of failure is unknown.

Old Channel South of Fish Hatchery Levee

Risk: Unknown

Rationale: This levee is several feet lower than the SFHA BFE. While the probability of failure is unknown, it is more likely to be overtopped during frequent floods.

Wagoner Dike 10

Risk: Low (probability: unlikely)

Rationale: This levee was constructed by the USACE as part of the Fort Gibson Lake project. The probability of failure is low, however the land side of the levee is subject to local flooding once the lake rises to a level where the gravity outlet is closed by a flap gate and must be pumped out.

Future Conditions (Dams and Levees)

Several factors probably will impact the future conditions for dam and levee incidents, but the two most important factors are future probabilities for high rainfall events and the integrity of the structures themselves. An analysis of both factors indicates that the planning area may see more dam and levee incidents in the future. Scientific literature supported by SCIPP predicts that the incidents of severe storms with higher levels of precipitation is likely to increase in the future (see future conditions under the flooding section for more information). The structural integrity of some dams and levees also may be a cause for concern. Most of these structures are designed for a 50-year life cycle, which some of these structures

have already exceeded.⁴⁹ Proper maintenance is also crucial to reducing the risk of future dam and levee incidents. For specific structures that are at greater risk to failure, see the probability and previous events section.

4.5.2 Vulnerability

The hazard has a **high** overall significance based on classifications in the introduction section.

People

People downstream of dams or in the area protected by a dam or levee system could be subject to devastating danger and damage in the event of failure. The number of fatalities or injuries resulting from either hazard is strongly influenced by the number of people occupying the inundation area, the amount of warning they are provided, and the amount of pre-event public education and planning. People who might be at risk include those who are living, working, at school or play, or traveling through vulnerable areas. Muscogee Nation is generally unaware of their risk to dam or levee overtopping. In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Dams

Federal Dams: The total number of people vulnerable to a maximum failure of Heyburn, Keystone, Oologah, and Skiatook Dams is accessible in the USACE Consequence Assessment Reports for each dam, as well as the Emergency Action Plans for Pensacola (Grand) and Fort Gibson Dams. The potential impacts of USACE dams are outlined in Existing structures in the planning area within the mapped inundation areas for dam and levee incidents are at the highest risk to dam and levee incidents in the planning area. A summary of the vulnerabilities to these the maximum types of these events can be found in Table 1-27 and Table 1-28, which compiled using a combination of official studies, reports, and GIS analysis.

Table 1-27. The USACE believes there is a low probability that any of the high hazard dams owned or operated by the USACE during floods would fail. The NRCS (SCS) high hazard dams also have a low probability of failure due to the adequate design, construction, and routine maintenance.

Non-Federal Dams: The non-federal high hazard dams within the Muscogee Nation are all inspected annually and monitored by the OWRB. They are listed in Table 1-20. There are 5 dams that are listed in Poor condition by the OWRB. A summary of their impacts on the planning are listed in Table 1-20 (see extent section). These dams have the potential to fail, causing lives to be lost, water supply to be lost or damaged, and loss of protection against fires and wildfires.

Levees

The human vulnerability to all levees in the planning area were profiled Table 1-28 (the built environment section).

Public Health

The public health effects from inundation due to dams and levees are similar to the effects from flooding. Waters from a dam or levee incident can be polluted. This pollution arises from two sources: waters that become polluted while being impounded by a dam or levee and waters that become polluted based on their interaction with the environment upon release. In the planning area, some of the most common pollution sources are from industrial and agricultural products and biproducts. Standing water following inundation

⁴⁹ <http://www.southernclimate.org/documents/SPTOK.pdf>



also can result in a build-up of mold and other toxic substances (see flooding section). Depending on the scale of the incident a dam or levee incident could result in the mass displacement of populations, which could place additional strain on the health care system, the emergency response system, and the affected populations' psychological health. Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities (see Chapter 3).

Education and Outreach

The public living below this dam, and others, are often unaware of their risk, including Citizens in Muscogee Nation. Officials also noted the lack of consistent education and outreach on dam and levee hazards for developers, builders, realtors, and residents. Officials in the Nation expressed interest in having an emergency management application to reach all residents to warn them about a dam or levee incident. The emergency application could be expanded to provide educational materials as well, especially flood insurance, dangers building in a floodplain, health risks from flooding (e.g. mold), and other materials. Muscogee Nation should partner with public and private entities in the planning area to help them enhance their dam and levee outreach and education efforts.

Culture

It is difficult to overemphasize the importance of culture to the Muscogee Nation, as Muscogee culture is interlinked and inwoven into the government and the Citizenry through shared values, history, and traditions (see Chapter 1). For this reason, it is difficult to separate cultural vulnerabilities into distinct parts. Nonetheless, the cultural resources in Muscogee Nation that are most vulnerable to dam or levee impacts can be grouped into two categories. These categories overlap with other vulnerability sections, especially people and built environment. The first is the people of the Nation, particularly the elders. Muscogee Citizens contain, reflect, and transmit Muscogee culture through language, traditions, and stories (see existing structures in the planning area within the mapped inundation areas for dam and levee incidents are at the highest risk to dam and levee incidents in the planning area. A summary of the vulnerabilities to these the maximum types of these events can be found in Table 1-27 and Table 1-28 for people and Citizens affected by dam and levee impacts. In addition to people, the second category of vulnerability, the built environment, can be divided into three subcomponents:

- Places and sites of deep cultural and religious significance. These spaces are culturally and intrinsically valuable. These include ceremonial sites, cemeteries, and churches. Some of these resources are shown in Table 1-25 and Table 1-26.
- Places and sites that contain cultural objects and articles of intrinsic significance to the Muscogee Nation. Some of these resources are shown in Table 1-25 and Table 1-26.
- Places that serve as wellsprings of cultural knowledge and cultural transmission. Some of these resources are shown in Table 1-25 and Table 1-26.

Some places may contain 2, or even all 3, of these components. It is also important to note that many of these cultural resources also apply to other sections of this vulnerability assessment

Table 4-25 Cultural Resources Impacted by Dams

Name	Churches	Cemeteries
Keystone Dam Normal High Fail	2	1
Keystone Dam Maximum High Fail	5	9



Name	Churches	Cemeteries
Fort Gibson Maximum High Fail	-	1
Heyburn Dan Maximum High Fail	1	6
Oolagah Dam Maximum High Fail	-	2
Okmulgee Lake PMF Fail	2	3
Wewoka Dam PMF Fail	1	1

No educational institutions, Community Centers, or Ceremonial Grounds were reported to be impacted directly by a dam incident.

Table 4-26 Cultural Resources Impacted by Levees

Name	Cemeteries
Tulsa County Levee A	1
Tulsa County Levee C	1

Only 1 cemetery was reported to be impacted by Levee A and C.

To safeguard the confidentiality of these locations, this assessment will not disclose the specific location of ceremonial grounds, churches, or cemeteries, nor will any other hazard assessment disclose them. For similar reasons, the value, or approximate value, of these resources are not disclosed.

Economy

Dam and levees can have a wide range of impacts, which depend on the size of the release and area affected by the release. Although economic impacts of a dam or levee failure could differ, these impacts could include:

- Replacement costs for dam/levee and all assets affected by an incident
- Loss of revenue/utility from dam/levee itself
- Loss of revenue/utility from the areas affected
- Potential economic effects if water shortages result from the incident
- Lost tourism in the planning area

These affects can easily result in more than billions of dollars in damages. Some of the estimated impacts can be seen in Existing structures in the planning area within the mapped inundation areas for dam and levee incidents are at the highest risk to dam and levee incidents in the planning area. A summary of the vulnerabilities to these the maximum types of these events can be found in Table 1-27 and Table 1-28, which compiled using a combination of official studies, reports, and GIS analysis.

Table 1-27 Built Environment

Existing Structures

Existing structures in the planning area within the mapped inundation areas for dam and levee incidents are at the highest risk to dam and levee incidents in the planning area. A summary of the vulnerabilities to these the maximum types of these events can be found in Table 1-27 and Table 1-28, which compiled using a combination of official studies, reports, and GIS analysis.



Table 4-27 USACE Dam Breach Maximum Impacts

Name	Estimated No. of Citizens Affected*	Estimated Total No. of Structures Affected	Estimated Value
Heyburn Lake Dam	1148	7467	\$1,813,585,551
Keystone Lake Dam	3082	30,216	\$2,711,195,070
Ft. Gibson Dam	97	707	\$214,088
Oologah Lake Dam	259	1593	\$6,193,500
Skiatook Lake Dam**	104	183	\$34,833,310
Pensacola Lake Dam	76	294	\$14,912,963

* Totals for Normal High Failure – Max High Failure totals were not available

Table 4-28 Levee Breach Maximum Impacts

Name	Estimated No. of Citizens Protected by Levee*	Estimated Total No. of Structures Protected by Levee	Estimated Value
Tulsa/West Tulsa Levees A and B	192	3,072	\$1,130,000,000
Tulsa Levee C	137	573	\$579,000,000
Garden City Levee (private)	2	61	\$14,898,000
Jenks Levee	180	1,723	\$426,000,000
Haikey Creek Levee	7	47	\$12,000,000
Salt Creek-Verdigris River North Levee	2	44	\$9,350,000
Verdigris River South Levees 1 and 2	6	16	\$5,930,000
Old Channel South of Fish Hatchery Levee	0	1	\$152,000
Wagoner Dike 10 ⁵⁰	13	430	\$102,417,491

Infrastructure

Electric: Although the PSO electric plant that supplies the city is located on the west bank of the Arkansas River, the plant has a mitigation plan in place in the event of river flooding. According to a PSO/AEP representative, the loss of the plant is unlikely to affect overall system reliability because of the redundancy and generating capacity reserves that are planned for on a system wide basis. The largest threat to the delivery of electrical service would be the destruction/damage of power poles/lines in the inundated areas.

Power outages can exacerbate conditions outlined the people and culture section. Muscogee Nation does not control the assets for electrical generation or distribution, nor does it have ownership or right-of-way to most electrical of the vulnerabilities in the Nation. The second part of the previous statement does not

⁵⁰ National Levee Database, <https://levees.sec.usace.army.mil/#/levees/system/1605473001/summary>



apply to the structures and land owned by Muscogee Nation. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

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

Water/wastewater: Water/wastewater facilities and water/wastewater distribution systems can be affected by dam or levee inundation. This inundation can inundate facilities, which can halt operations. If prolonged, a cessation of operations can result in a crisis to provide potable water to citizens or cause a backup of wastewater, which can cause a sanitation and/or environmental crisis. Water seepage into water lines and other distribution systems, although unlikely, could cause contamination and public health issues (see public health for more information).

To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. In terms of mitigation actions, Muscogee Nation could develop its own water treatment facilities, especially in areas that supply critical facilities. Muscogee Nation also could construct water towers or similar water holding facilities, although their limits during a drought.

Transportation: Road blockages and congestion can cut off access to homes and businesses. Closed bridges and roads can cause traffic accidents and other backups that can extend the impact well beyond the inundated area. These concerns result in missed work, extra transportation costs and reduced commerce. Dam or levee inundation can result in hazardous driving conditions, which could cause loss of life, when vehicles are driven or swept into floodwaters. As little as 12 inches of standing water over roadways can stall many vehicles. Only 18 inches of flowing water can sweep most vehicles off roadways.

In particular, a Keystone Dam Failure would affect Interstate 244, a major interstate highway, and the 21st Street Bridge, a major crossing over the Arkansas River, connecting West Tulsa to the rest of the City. The Cherokee Yard, a major intermodal regional transportation hub for the BNSF Corporation, and the railroad bridge at 11th Street would also be impacted by the failure. Failure of Skiatook Dam would inundate parts of US 75 and US 169 and State Highway 266.

Fire, Police and Medical Services would all be similarly at risk to effects of a dam or levee event. Emergency responders would be extremely taxed. With loss of vital utilities, emergency services would be heavily impacted. As with flooding, a dam or levee failure would create a larger call load for all emergency response agencies, presenting various challenges to the agencies, in addition to the posed hazards to emergency personnel performing these services.

Critical Facilities

The tribal complex in Okmulgee is affected by a breach of either of the upstream NRCS dams on Okmulgee Creek. NRCS - Okmulgee Creek Site 2 is approximately 1500 feet upstream from the tribal facilities immediately east of US 75 between Loop 56 and Eufaula St. A breach of this Site 2 could send a flood wave approximately 9.4 feet through this location with little notice. More information on downstream effects of a breach is available in the Emergency Action Plan for Sites 1 and 2.⁵¹ NRCS - Okmulgee Creek Site 1 is

⁵¹ Emergency Action Plan (EAP) Okmulgee Creek Watershed Dams Nos. 1&2, Okmulgee County Conservation District, December 2013.



upstream from Site 2 and would produce a flood wave across the tribal complex referenced above of approximately 1.3 feet, assuming that the flood wave travels through the downstream reservoir without breaching the dam. The effect of both dams being breached is not available.

Future Development

Muscogee Nation plans to work with and partner with local jurisdictions to address ongoing dam concerns and specify needs for updates. The Nation is willing to discuss monetary allocations to fix dams within specific jurisdictions where needed to protect their critical facilities, cultural resources, and citizens. Muscogee Nation has adopted 2021 International Building Codes, which requires that all new residential construction be elevated to one foot above the BFE and that critical facilities be protected to the 0.2% or 500-year level of flooding.⁵² These protections may also offer some protection against inundation from dams or levees in the planning area. Additional studies can provide data and solutions to reduce risk.

Natural Environment

Depending on their size and scope, a dam or levee incident could devastate downstream habitats. Additional environmental consequences could result if the levee breached and resulted chemicals or industrial products spilling to waterways. This is especially the case with Tulsa/West Tulsa levee system if the superfund site behind the levee becomes inundated.

4.5.3 Summary of Observations and Recommendations

Table 4-29 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
Structures located in a dam or levee inundation area are at risk of being damaged and put occupants in danger. Multiple jurisdictions have authority for response and recovery during and after a flood, dam, or levee event along the rivers and creeks throughout the Muscogee Nation. Failure of the Tulsa County Levees A and B would flood many homes and businesses. The USACE is preparing a plan to fortify the levees.	Prepare impact study of NRCS and municipal dam breaches to determine actions in potential inundation areas of current and proposed development.	21
The NRCS dams and the non-federal dams lack audible warnings if a sudden lowering in water surface is noted upstream or a large increase in downstream flow rates occurs. Residents would benefit from an electronic alert system that could provide dam or levee breach warnings and updates.	Install, update, and maintain dambreach detection warning systems such as sirens, telemetry to emergency management personnel and reverse 911 notification of impacted citizens. Develop an emergency management app to send notifications to citizens about various hazards throughout the County.	4
A lack of consistent and current technologies in the planning area makes	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model	24, 26

⁵² https://www.fema.gov/sites/default/files/documents/fema_building-code-exceed-nfip-significant_2021.pdf



the area more vulnerable to dam and levee incidents in terms of response and hazard mitigation.	critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	
Some utilities in the Nation could experience losses in function due to dam and levee inundation. Some critical facilities are located within the inundation area at risk of flooding from a dam breach.	Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.	13, 28
Many areas within the Nation are not equipped to prepare for or recover from dam breach events.	Create community facilities (resilience hubs) that can serve as gathering places during emergencies and interruptions in services, and outfit such facilities with access to key services, including water, electricity for charging cell phones, etc. Such capabilities could be integrated into schools and other existing community facilities.	3, 20
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP. Partner with neighboring jurisdictions to improve transportation abilities of Muscogee Nation Citizens.	27, 31, 30, 34
Citizens should have access to education on the dangers of dam and levee incidents.	Develop and fund hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens.	1, 3
Several critical facilities lost power during the 2019 event, which included high release from dams, and did not have generators to supply backup power. Other critical facilities are also threatened by dam and levee events.	Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	14, 15, 33

Water infrastructure is vulnerable to dam and levee incidents, which could disrupt deliver to critical facilities in Muscogee Nation.	Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	16, 19
Some utilities in the Nation could experience losses in function due to dam and levee inundation.	Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators.	17
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigation some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.6 Extreme Heat (Hiye Rakko)

4.6.1 Hazard Description

Extreme heat: is defined as unusual hot weather (maximum, minimum, daily average) over a region that remains for least two consecutive days based on local climatological conditions, with thermal conditions recorded above given thresholds, according to the World Meteorological Organization (WMO). Note: There is no universally recognized metric for what constitutes extreme heat. The WMO recommends characterizing a heat wave by its magnitude, duration, severity, and extent. This definition also aligns with the definition used in the State of Oklahoma's 2018 Hazard Mitigation Plan.

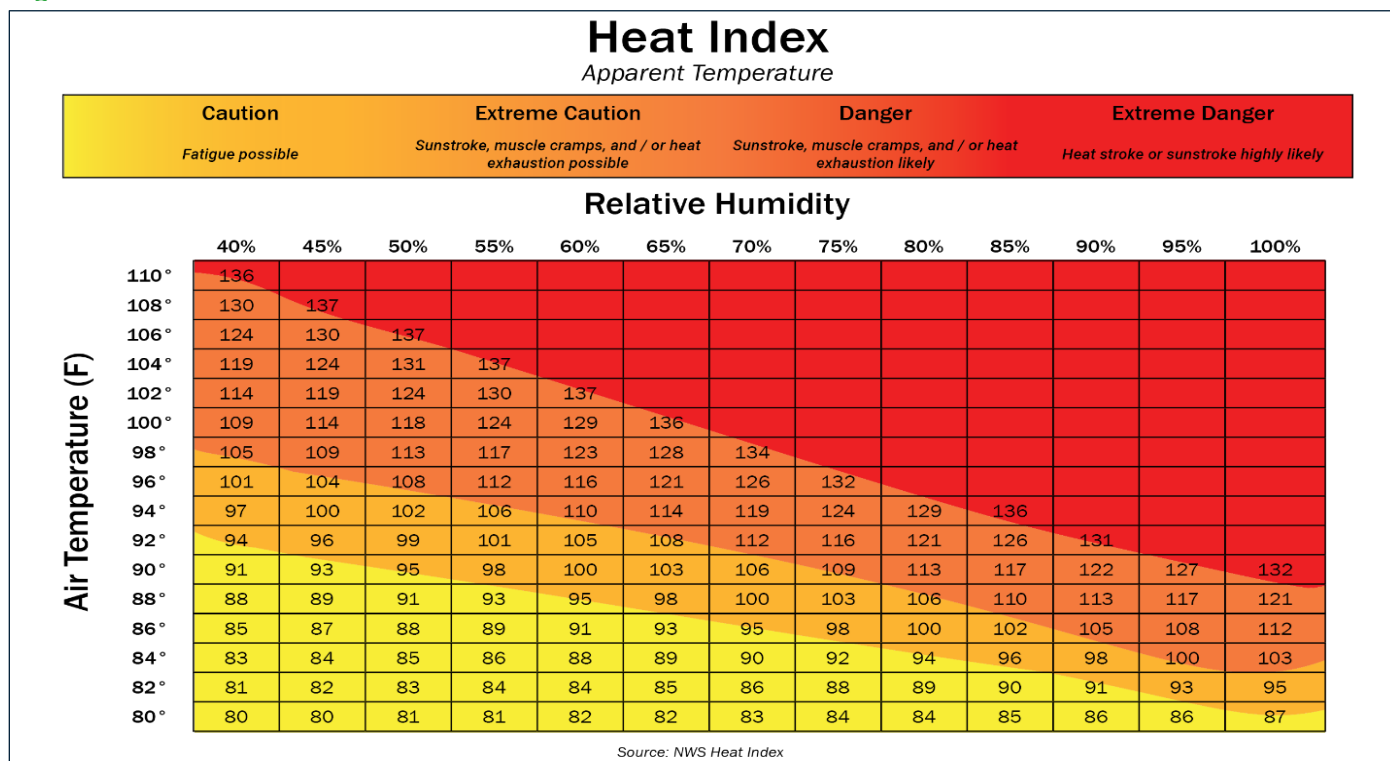
Location

Extreme heat is a hazard that is uniform across the entire planning area. The region of Oklahoma that includes the planning area, is known for its hot, humid summers. The humidity is especially pronounced in the northeast part of the planning area.

Extent

In terms of hazard extent, temperatures in the planning area often reach above 100°F for extended periods, with heat indexes significantly exceeding 100°F. The Heat Index and Heat Disorders table combines temperature and relative humidity into heat index.⁵³ The table suggests 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"

Figure 1-31 Heat Indexes and Heat Disorders



⁵³ <https://www.weather.gov/safety/heat-index>



indicates that sunstroke, muscle cramps or heat exhaustion are a possibility, whereas a “Danger” level means that these symptoms are likely. “Extreme Danger” indicates that heat stroke or sunstroke is highly likely.

Although the heat index captures important elements of extent and risk, some researchers also use Wet Bulb Globe Temperature (WBGT) as the primary index for heat. This transition is driven by research indicating that WBGT is a much more positively correlated with health effects (for examples of these affects, see the people subsection of the vulnerability and risk assessment).⁵⁴

Table 4-30 National Weather Service (NWS) Differences in WBGT and Heat Index⁵⁵

Parameters	Wet Bulb Globe Index	Heat Index
Measured in the Sun	✓	✗
Measured in the Shade	✗	✓
Uses Temperature	✓	✓
Uses Humidity	✓	✓
Uses Windspeed	✓	✗
Uses Sun Angle	✓	✗
Uses Cloud Cover	✓	✗

In addition to the heat index, the National Weather Service has created a series of tables related to WBGT temperature levels and their effects on human health. The table below highlights general guidelines for people working or exercising in Wet Bulb conditions. Other guidelines exist for different at-risk groups (e.g. youth) and activities (e.g. sports and military training). People who are at risk of extreme heat should take precautions in additions to the ones listed below (see the vulnerabilities section for people who may be at-risk).

Table 4-31 NWS Composite Guidelines for Working or Exercising in Full Sun⁵⁶

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

⁵⁴ Kevin Kloesel, University of Oklahoma; National Weather Service

⁵⁵ NWS Atlanta

⁵⁶ <https://www.weather.gov/arx/wbgt>



According to the Oklahoma Climatological Survey, Muscogee Nation has a record high of 119 degrees Fahrenheit, which was recorded in Wagoner County. All Counties within the planning area have reported maximum temperatures of at least 114 degrees Fahrenheit.⁵⁷ The entire planning area should expect to experience temperatures above 100 degrees and high relative humidity in the future, which could reach danger levels (or even extreme danger levels) on the heat index and would contribute to more severe WBGT days each year (see future conditions section for more information).

Previous Occurrences

Extreme heat events have occurred at a high frequency in the planning area over the last 15 years. When temperature and humidity rise higher, as they often do in July and August, conditions throughout Muscogee Nation can reach the “Danger” and even “Extreme Danger” categories on the National Weather Service (NWS) Heat Index scale (see extent section). The NCEI database reported 25 separate events across the planning area from January 2007 to June 2021, as NCEI data indicates that extreme heat events in the planning area began to be collected during this period. Although no economic losses were reported, these events led to 11 deaths and 897 heat-related injuries during this period. All the heat-related deaths and injuries were reported in Tulsa County. This concentration of data may have more to do with Tulsa’s reporting measures than the actual heat casualties in the Nation, especially given Muscogee officials’ concerns about heat-related deaths and illnesses in the southern part of the Nation.

Table 4-8: Historic Extreme Heat Events

Date	Event Narrative
August 6, 2007	A combination of high temperatures and high humidity placed almost the entire Muscogee Nation into an extreme heat advisory, with temperatures ranging from 105 – 113 degrees on the heat index. Tulsa County reported 2 deaths and over 100 heat-related illnesses. Most of the illnesses reported were the result of a golf tournament which occurred concurrently with the heat event.
July 1-9 2011	High heat and high humidity led to a series of extreme heat events across the entire planning area. Temperatures exceeded 100 degrees nearly every day during this period. Tulsa County reported 2 deaths and nearly 200 heat-related illnesses.
August 1-10, 2011	No respite from high temperatures from the previous months put most of the Nation back into an extreme heat advisory in the beginning of August. The heat index during this period was reported to be around 105 -115 degrees in the afternoon. Tulsa County reported 1 death and more than 100 heat-related illnesses.
June 15-16, 2016	High heat and high humidity led to a series of extreme heat events across the entire planning area. The heat index during this period was reported to be around 110 - 115 degrees in the afternoon. Tulsa County reported 2 deaths and nearly 30 heat-related illnesses.

⁵⁷ https://climate.ok.gov/index.php/climate/county_climate_planning_team_analysis



Probability of Future Events

It is **highly likely**, or a recurrence interval of one year or less, that the planning area will experience extreme heat. The planning team reached this determination based on previous occurrences and future conditions (below).

Future Conditions

Research from the Oklahoma Climatological Survey and from SCIPP predicts an increase in more extreme heat events across the planning area as the result of climate change.⁵⁸ The planning area could experience an increase of another 3-9 degrees Fahrenheit by the end of the century. The northern parts of the Nation may experience a greater increase than the southern parts, although the disparity between the increase may be minimal. These conditions are likely to exacerbate public health vulnerabilities (air quality), economic vulnerabilities (cost of cooling), and other existing vulnerabilities across the planning area.⁵⁹

4.6.2 Vulnerability and Risk Assessment

The hazard has a medium impact on the planning area and has a **medium** overall significance based on classifications in the introduction section.

People

Despite being a comparatively normal occurrence, extreme heat poses a risk for Citizens and other residents in Muscogee Nation. Extreme heat can take its toll on all Citizens; even physically fit individuals can succumb to heat effects. Minor temperature differences can be associated with increased illness and death, especially for vulnerable populations. These effects are also dependent on other natural effects, such as duration, windspeed, and, especially, humidity. Wildfire conditions are exacerbated by extreme heat and response during these events puts responders and residents at even greater risk (see fire section).

Certain segments of the population are at higher risk.⁶⁰ Of particular concern are people over the age of 65 and people who live below the poverty line. These people are some of the highest risk population segments of loss of life due to extreme heat conditions. To this end, a sizable proportion of older Citizens rely on lower-fixed incomes (social security) that sometimes cannot match increases in electrical costs and other essential costs that can accompany extreme heat events. In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Public Health and Safety

People in the planning area also can be exposed to physiological and psychological effects from extreme heat. Heat-induced hospitalization death can occur rapidly, over the course of a day. Extreme heat can also exacerbate cardiovascular, respiratory, and other physiological chronic conditions. Extreme heat also can alter population psychology and increase the incidence of negative psychological behaviors, such as increased crime rates. Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities (see Chapter 3).

⁵⁸ https://forestry.ok.gov/sites/g/files/gmc801/f/documents/2020/ok_climatological_survey_climate_statement.pdf

⁵⁹ http://www.southernclimate.org/documents/climatechange_oklahoma.pdf

⁶⁰ Individuals 65 years and older, children under five years old (especially infants), socially isolated individuals, mentally & mobility challenged individuals, obese individuals, individuals under the influence of alcohol or medication, individuals and families living below the poverty line, outdoor workers.



Education and Outreach

The impacts of extreme temperatures on public health can be lessened if citizens know how to prepare and protect themselves. Educating Citizens regarding the dangers of extreme heat and best practices for extreme heat events can protect them from illness and death in the future. Understanding how vulnerable populations obtain their news sources is key and all possible media and outlets should be utilized. These outreach and education activities can be enhanced by a mobile electronic application.

Culture

Culture is an essential element of the Muscogee Nation. The damage, destruction, or disruption of any cultural resources can result in a significant cultural loss to the Nation, in addition to the other benefits that these resources can provide to Citizens. The cultural resources in Muscogee Nation that are most vulnerable to extreme heat are the people of the Nation, particularly the elders. Elders are especially at risk to extreme heat, given that they are more psychologically susceptible to heat and can lack the resources to cool down (see people for more information). In addition to the elders, all Muscogee Citizens also can be at greater risk to extreme heat when participating in festivals and ceremonies, especially for events that take place during the summer. These events can include: the Annual Muscogee (Creek) Nation Festival, Traditional Stomp Dances, Ceremonial Dances, along with other public events and gatherings.

Economy

Heat waves can affect the economy by slowing worker productivity, affecting structures and infrastructure, and damaging crops. Worker productivity decreases during heat waves. Governmental services and businesses owned by Muscogee Citizens that can allow employees to work remotely should develop a plan to develop broadband services if power to business is cut and workers would perform more effectively elsewhere. The slowdown is particularly acute in outdoor industries, such as construction and transportation. During periods of extreme heat, the electrical demand increases greatly, including costs for electricity. If prolonged, an extreme heat event could cause ripple effects, leading to elevated prices for many basic goods and services. To mitigate against this hazard, Muscogee Nation has implemented several programs, including the Hardship Program and NAHASDA, which help with utility and housing expenses for Citizens that meet certain criteria. Although this could reduce some Citizens' risk to some rising utility bills, the assistance may not cover all expenses related to extreme heat events due to the size of the award.

Most electrical motors and controls are designed to operate with ambient air temperatures of 104 degrees Fahrenheit or less. The increased heat from the increased electrical demand by electrical equipment with ambient air temperatures above 104F will result in electrical power outages. Those electrical power outages will reduce the available cooling capacity and could also reduce the treatment and distribution of the domestic water supply.

Built Environment

Existing Structures

Although the direct effects of extreme heat on structures are minimal, extreme heat threatens the built environment, especially infrastructure. Extreme heat also can have secondary effects by heightening the incidence of expansive soils and, especially, fire (for the effects of expansive soils on the planning area, see the drought section, for fire, see the fire section). These affects also depend on the humidity levels in the planning area.



Infrastructure

Only electrical infrastructure has specific vulnerabilities to extreme heat events.

Electric: Prolonged extreme heat events can result in rolling blackouts or other forms of power outage to avoid straining the electrical grid. Power outages can exacerbate conditions outlined the people and culture section. Muscogee Nation does not control the assets for electrical generation or distribution, nor does it have ownership or right-of-way to most electrical of the vulnerabilities in the Nation. The second part of the previous statement does not apply to the structures and land owned by Muscogee Nation. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

Critical Facilities

All critical facilities that do not have current backup generation or that have not been tested to ensure currency are at heightened risk to power failure from extreme heat.

Future Development

All future development is vulnerable to the effects of extreme heat. As of this writing, Muscogee Nation has committed to adopting the 2021 International Building Codes, which can enhance the built environment's resistance to extreme heat and protect Citizens, especially through insulation standards. The Nation should also ensure that this adoption will apply to all structures constructed or purchased by the Government or by a Citizen, with the assistance of the government. The New Cultural Center, which Muscogee Nation is constructing as of this writing, could be more vulnerable to this hazard if the building is not hardened with current approaches, materials, and technologies.

Natural Environment

Extreme heat causes crop loss. High temperatures and dry air can lead to heat stress in trees and other flora. If prolonged, high heat conditions also could cause animals to leave their natural habitats to search for cooler places or places with more water.

4.6.3 Summary of Observations and Recommendations

Table 4-32 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
During periods of extreme heat and drought, Muscogee Nation is vulnerable to experiencing water line breaks due to expansive soils.	Assess an opportunity to partner or obtain a drinking water source. Build water tower(s) as needed. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	16, 19
Extreme heat can cause power disruptions due to high energy demands. Essential facilities and other infrastructure components in Muscogee Nation need back-up generators, improved hardening techniques, and drought coordination strategies.	Coordinate with private utilities and electric co-ops to harden electric utility infrastructure. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant. Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities	11, 13, 15, 17, 28, 33



	and citizens served by various utility operators. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	
Muscogee Nation has many vulnerable Citizens within their boundaries and do not have a program in place to find out which are most vulnerable during heat events and a program/service to assist them during power outages or cooling centers.	Create and maintain a database for assessing vulnerabilities among Citizens. Develop or purchase a voluntary emergency management app to send notifications to citizens about various hazards throughout the tribal boundary.	3, 4
A lack of consistent and current technologies in the planning area makes the area more vulnerable to extreme heat events in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	27, 31, 34
Muscogee Nation is building a new cultural center to better protect and store their cultural artifacts and documents.	Protect the Muscogee Nation cultural center with weather-resistant infrastructure.	5
Many Citizens are unaware of the dangers extreme heat can pose on the body and under certain working conditions.	Develop and implement hazard preparedness, education, information, and awareness programs.	1
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.7 Fire (Totkv)

4.7.1 Hazard Description

Wildfire: any outdoor fire that is not controlled, supervised, or arranged. Wildfire probability depends on local weather conditions; outdoor activities such as camping, debris burning, and construction; and the degree of public cooperation with fire prevention measures. Wildfires can result in widespread damage to property and loss of life.

Structure fire: a fire that burns a home or other improved structure. The fire creates a black, impenetrable smoke that blocks vision and stings the eyes, making it often impossible to navigate through or evacuate a building on fire.

Location

Although fire could occur anywhere in the planning area, several factors increase probability that fire will occur in a specific location. These factors include age of structures, type of construction, and their location relative to vegetation (woods, especially red cedars, and open grasslands) can influence the location of wildfires. The planning team used mapping from wildland-urban interface (WUI) areas and reports from local officials to determine wildfire location

WUI areas note to the zone of transition between unoccupied land and human development. It is the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. To determine the WUI, structures per acre and population per square mile are used. The WUI in the area is divided into two categories: intermix and interface.

Intermix areas have more than one house per 40 acres and have more than 50-percent vegetation. Interface areas have more than one house per 40 acres, have less than 50% vegetation, and are within 1.5 miles of an area over 1,235 acres that is more than 75% vegetated. WUI was obtained through the Southern Group of State Foresters, Wildfire Risk Assessment Portal. **Based on the best available data and analyses, the Wildland Urban Interface (WUI) can be used to determine areas of fire hazard location within Muscogee Nation.**⁶¹

As can be seen in Figure 1-32, most of the intermix and interface areas in Muscogee Nation are concentrated in the northcentral and central parts of the Nation. This is concentrations are driven by the higher housing densities in the northcentral (Tulsa and the greater metropolitan area) and central (Okmulgee) areas compared to the rest of the Nation. Tribal facilities at greatest risk are those located in the WUI, primarily located near Okmulgee County and a small area of McIntosh County in and around Eufaula.

Extent

The WUI also contributes to the extent of fire, since the factors contributing to the location of a fire also contribute to the extent (see above). In addition to WUI, the planning team also used the Keetch-Byram Drought Index (KDBI), Fire Danger Rating System, and the Burning Index to determine extent. The WUI map of Muscogee Nation is shown on Figure 1-32. It is important to note that the WUI does not capture the types of vegetation across the Nation, which are subject to different levels of flammability. In particular, the concentration of red cedars in the Northwest part of the Nation (Creek County), could heighten the extent in

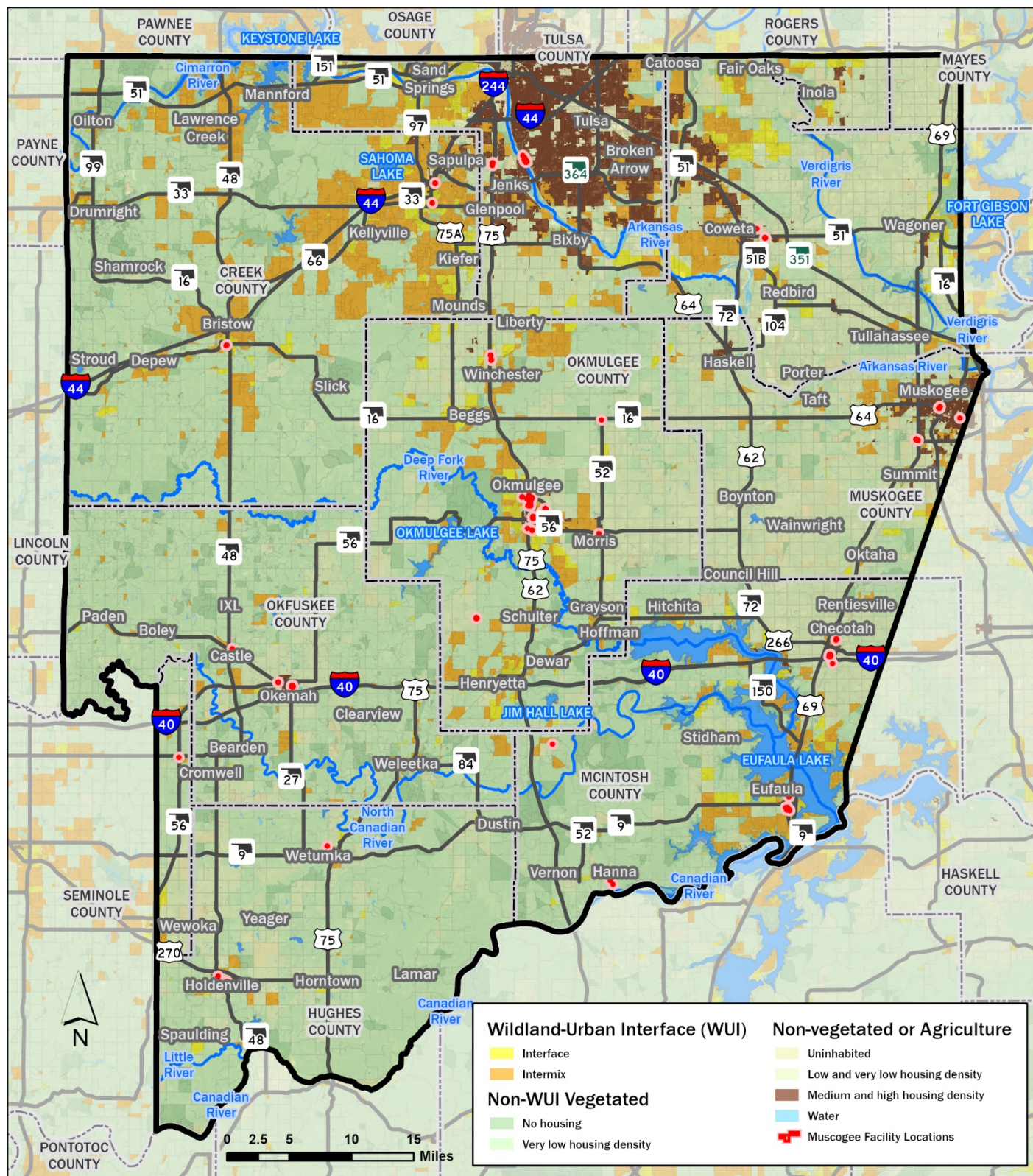
61 Southern Group of State Foresters. <https://www.southernwildfirerisk.com/>



that region.



Figure 4-32 Muscogee Nation WUI



In addition to the WUI, wildfire extent is measured by the expected severity levels of the fire hazards across planning area. Wildfire danger is measured using indices that relate longer-term soil and vegetation conditions to shorter-term weather patterns. The most explosive conditions occur when dry, gusty winds blow across dry vegetation. The planning team combined the Keetch-Byram Drought Index (KDBI), Fire Danger Rating System, and the Burning Index to determine extent in Muscogee Nation.

The Keetch-Byram Index is a drought measurement designed specifically to measure an area's potential for fire. The index measures factors like precipitation, the amount of moisture that is present in soil and vegetation, and evapotranspiration to estimate the "flammability of organic material in the ground." This index measures this estimate in 200-point increments from 0-800, which can be found in the table below.⁶² The planning area could experience a fire extent in the 600-800 point range. The relationship between drought and fire is especially important for Muscogee Nation, as most of the major fires in the planning area have occurred during periods of drought.

Table 4-33 Keetch-Byram Index

Points	Description
0-200	Soil moisture and large class fuel moistures are high and do not contribute much to fire intensity. Typical in spring dormant season following winter precipitation.
200-400	Typical in late spring, early growing season. Lower litter and duff layers are drying and beginning to contribute to fire intensity.
400-600	Typical in late summer and early fall. Lower litter and duff layers actively contribute to fire intensity and will burn actively.
600-800	Often associated with more severe drought with increased wildfire occurrence. Intense, deep burning fires with significant downwind spotting can be expected. Live fuels can also be expected to burn actively at these levels.

The Burning Index relates temperature, relative humidity, wind speed, and solar radiation to the "relative greenness" of vegetation (taken from satellite measurements) and fuel models for native vegetation (assigned on a 1-kilometer grid across the State).⁶³ These factors are used to derive four indices: Spread Component, Energy Release Component, Ignition Component, and Burning Index. The Burning Index is a synthesis of the Spread and Energy Release components. It is used to predict fire line intensity and flame length. The higher the Burning Index number, the higher the potential severity of the fire. The Fire Danger Rating System combines the combustibility of vegetation and weather conditions.⁶⁴ Table 1-34 shows a combination of the Fire Danger Rating System and Burning Index. Muscogee Nation may experience days of extreme fire danger on this combined index.

There is no scientific scale to measure the extent of a structural fire, however, fires that cause a total loss of a structure and contents may occur. The most devastating events are those that cause loss of life. Even

⁶² <https://www.wfas.net/index.php/keetch-byram-index-moisture--drought-49>

⁶³ https://www.mesonet.org/index.php/agriculture/map/range_forest/fire_danger/burning_index1

⁶⁴ <https://www.fs.usda.gov/detail/cibola/landmanagement/resourcemanagement/?cid=stelprdb5368839>



small fires may result in expensive damages and/or force an evacuation and relocation until the damaged structures can be repaired.

Table 4-34 Combined Fire Danger Rating and Burning Index

Fire Danger Rating	Burning Index	Flame Length	Description
Low	<20	<2 feet	Fuels do not ignite readily from small firebrands although a more intense heat source, such as lightning, may start fires in duff or punky wood. Fires in open cured grasslands may burn freely a few hours after rain, but woods fires spread slowly by creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate	20-40	2-4 feet	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grasslands will burn briskly and spread rapidly on windy days. Timber fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur but is not persistent. Fires are not likely to become serious and control is relatively easy
High	40-80	4-8 feet	All fine dead fuels ignite readily, and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes or in concentrations of fine fuels. Fires may become serious and their control difficult unless they are attacked successfully while small.
Very High	80-110	8-11 feet	Fires start easily from all causes and, immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high intensity characteristics such as long-distance spotting and fire whirlwinds when they burn into heavier fuels.
Extreme	>100	> 11 feet	Fires start quickly, spread furiously, and burn intensely All fires are potentially serious Development into high intensity burning will usually be faster and occur from smaller fires than in the very high fire danger class. Direct attack is rarely possible and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash (trunks, branches, and treetops) or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessens



Previous Occurrences

Fire is a very frequent occurrence in Muscogee Nation. Officials in the planning area and data collected from the Oklahoma State Fire Marshal's office indicate that at least one fire (structure or wildfire) will occur annually. Given the high volume of fires in the planning area, this section focuses on the most significant fires in terms of their impact on the planning area. The planning team determined this estimate primarily by relying on federal fire declarations and NCEI data for analysis.

Since 2005, Muscogee Nation has received 24 declarations (19 FM declarations, 2 DR declarations, 1 EM declaration, and 1 FSA declarations). All counties within the planning area were impacted by a fire declaration at least once, while Creek County was the most impacted during this period. NCEI data estimates that fires during this period killed several people and caused over \$65 million in damages. The most impactful periods of fire are summarized in the table below.

Table 4-35 Historic Fire Events (Other Fire Event Narratives)

Date	Event Narrative
November 2005-April 2006	A succession of fires over several months impacted nearly all areas in Muscogee Nation. The fires burned dozens of structures, many to the point of total loss. Most of these structures were residential structures. NCEI estimates damages over \$3 million. Thousands of acres were burned and nearly 20,000 homes were threatened. Although nobody was injured, 2 people died because of the fires, one in Okmulgee and one in Hughes County. Overall, this succession of fires caused 12 declarations (10 fire declarations and 2 disaster declarations).
August 2-8, 2011	A prolonged dry spell resulted in an extreme fire, which was concentrated in the northwestern part of Muscogee Nation. In Tulsa County, the fire damaged 19 homes, burning 13 to the point of total loss. In Creek County, the fire burned one structure. No deaths or injuries were reported, but damages were estimated to be \$185,000 in total. This event received a fire declaration (FM-2946-OK).
August 3-8, 2012	This event was marked by two large fires in Creek County. Oklahoma Forestry Service's Type II Incident Management Team was activated to coordinate the response of all the agencies involved. Several Oklahoma Army National Guard helicopters were also used to fight the fires. The fires burned more than 59,000 acres, destroyed 376 homes and damaged 47 others, leaving many homeless. The estimated property damages totaled to \$55 million, making it the most significant economic loss from fire by a considerable margin. No injuries or deaths were reported. This event received several declarations.
February 18-19, 2016	Warm and dry conditions sparked wildfires in the center and west of Muscogee Nation. Wildfires burned over 25,000 acres, with most of the burning concentrated in Okmulgee County. Okmulgee and Okfuskee County reported \$100,000 total in damages. No deaths or injuries were reported.

Probability of Future Events

Based on datasets of past wildfire events and local input (see previous section), it is **highly likely** that Muscogee Nation will experience a fire (structural and wildfire) in the next year, or a recurrence interval of less than 1 year (90 to 100 percent probability).



Future Conditions

According to SCIPP analysis, climate change is likely to impact the frequency and severity of fires in the planning area, but the explicit correlation between these two factors remains too unclear to determine specifically. This is due to a lack of historical data, in part, as data collection on wildfire events did not begin until the 1990s. Some areas did not begin data collection until several years ago. Nonetheless, the planning area should expect dry/wet periods to fluctuate more dramatically due to climate change, which would heighten the risk of fire in during dry conditions. In addition, urban development could increase the incidence of structure fire (see future development in the vulnerabilities section for more information).⁶⁵

4.7.2 Vulnerability and Risk Assessment

Based on the classifications in the introduction section, the overall significance of a wildfire or structural fire event is **medium**. Fire can result in fatalities, structural damage, and crop damage. Some of the most significant economic vulnerabilities are economic result from structure and infrastructure damage along with costs due to business closures.

People

Structural fires and wildfires can put Citizens in life-threatening danger from smoke inhalation and burn wounds. Residential structural fires can occur at night, putting sleeping people at a very high risk of injury or death. Wildfires moving into residential areas or along roadways can threaten individuals who are traveling or seeking escape from the fire. A wildfire or structural fire could result in evacuation of school or another large gathering facility.

Muscogee Nation does not have its own response arm to fight fires and to rescue Citizens. Instead, the Nation relies on networks composed mostly of local and state response units—most of them within the geographic boundaries of the Nation—to complete these duties. The Nation interfaces directly with the Bureau of Indian Affairs (BIA) branch of Wildland Fire Management to conduct fire suppression activities in the Nation. The BIA also implements prevention and recovery activities including burn permits, investigate the origins of wildfires, and conduct public outreach (see education and outreach section). Muscogee Nation should ensure that its relationship with this network continues to remain strong to reduce vulnerability for its citizens. In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Public Health and Safety

Fires could degrade air quality for part, or the entire, planning area. This depends, in part, on the duration of the fires, the size of the fires, the location of the fires, and the types of matter being burned. Populations with pre-existing conditions or other vulnerability factors (e.g. age) are especially at risk. At the extreme, air quality issues can cause increased hospitalizations and, when combined with other conditions, could even cause death. In addition, fires near densely populated areas also can lead to evacuations or mass casualty incidents, which can further strain Muscogee Nation's resources, especially its healthcare system. Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities (see Chapter 3).

⁶⁵ SCIPP, <http://www.southernclimate.org/documents/SPTOK.pdf>



Education and Outreach

Increased fire awareness can decrease the planning area's vulnerability to wildfires. Muscogee Nation could partner with fire departments, especially BIA, throughout the planning area to offer educational programs in schools, informing the public about proper evacuation and other lifesaving procedures, running fire drills on a regular basis, and proper burning techniques for waste. In addition, Muscogee Nation could partner with BIA to provide fire safety materials for residents, insurance companies, utility providers and other stakeholders. This education can include removing dead or dry leaves, needles, twigs, and combustible materials around property, along with installing and maintaining smoke detectors and fire extinguishers on each floor of homes or other buildings. These outreach and education activities can be enhanced by a mobile electronic application.

Culture

Culture is an essential element of the Muscogee Nation. The damage, destruction, or disruption of any cultural resources from fire can result in a significant cultural loss to the Nation, in addition to the other benefits that these resources can provide to Citizens. These categories overlap with other vulnerability sections, especially people and built environment. The first is the people of the Nation (see the people section regarding how they can be impacted by fire). Muscogee Citizens contain, reflect, and transmit Muscogee culture through language, traditions, and stories. In addition to people, the second category of vulnerability is the built environment. According to the planning team's analysis, the western part of Tulsa County, eastern Creek County Okmulgee County (around the City of Okmulgee) have the highest concentrations of cultural components that are vulnerable to fire, due to their proximity to the WUI along with their age.

Economy

Economic impacts of wildfires can include acreage burned and employment opportunities lost, along with goods and services, especially for industries like agriculture and recreation. Agricultural lands operations owned by the Nation and its Citizens remain especially at risk.

Built Environment

Existing Structures

Although modern buildings are designed to minimize the probability of catastrophic fires, all structures in the planning area are vulnerable to fires. Due to age and other factors, a number of buildings owned Muscogee Nation or its Citizens do not meet modern fire codes or have automatic sprinklers. This is especially the case of private structures owned by Muscogee Nation's citizens.

Infrastructure

Electric: Poles or lines could be damaged by a fire, resulting in power outages. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activities. Muscogee Nation does not control the assets for electrical generation or distribution, nor does it have ownership or right-of-way to most electrical of the vulnerabilities in the Nation. The second part of the previous statement does not apply to the structures and land owned by Muscogee Nation. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

Gas: Gas supply lines threaten to exacerbate the effects of a fire due to their flammability. A fire could lead to burn and inhalation problems outlined in the people and public health sections. Muscogee Nation should ensure that its response efforts continue to complement and enhance the units fighting the fire directly.

Water/Wastewater: Depending on damage levels to infrastructure or the demands from a fire, water and wastewater plants may not meet daily intake levels due to water shortages. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. Muscogee Nation can enhance these capabilities and develop new ones (see suggested actions).

Transportation: Major fires in the planning area could block or limit access from the fire to safety, which could hinder rescue operations and evacuation operations of Citizens.

Critical Facilities

Critical facilities at risk of wildfire are those located in the Wildland Urban Interface. This being said, the southwestern part of Tulsa County, parts of Okmulgee County (Okmulgee, Henryetta, Dewar), and parts of Okfuskee County (Okemah) have the highest concentrations of critical facilities that are vulnerable to fire based on their proximity to the WUI along with their age.

Future Development

All future development is at risk to fire. Climate change may heighten the frequency and severity of wildfires in the planning area due to increased warming and potential for more severe drought in Oklahoma. The BIA manages most of Muscogee Nation's fire prevention activity, including burn permits and wildfire protection plans. Muscogee Nation should ensure that these activities align with the directives of the 2021 International Building Codes, which Muscogee Nation has committed to implement.

When siting locations of new Tribal housing developments or facilities, the Nation should ensure steps are taken to avoid areas at higher risk of wildfire occurrence. The New Cultural Center, which Muscogee Nation is constructing as of this writing, will be more vulnerable to this hazard if the building is not hardened with current approaches, materials, and technologies.

Natural Environment

Wildfires, especially those that result in structure fires, could release pollutants into the natural environment. These could include household chemicals or industrial scale releases. Fire also can cause soil erosion, due to the loss of ground cover, such as leaves and needles. Nonetheless, wildfires are a part of natural cycles and can be beneficial. Controlled burns should be conducted to reap these benefits and minimize the buildup of fuel materials which could result in more dangerous fires. In addition, wildfires can have renewing functions for soil.⁶⁶

4.7.3 Summary of Observations and Recommendations

Table 4-36 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
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⁶⁶ <https://blog.suny.edu/2013/08/ask-an-expert-why-are-wildfires-good/>



Muscogee Nation citizens are less equipped to prepare and recover from hazards. Many Citizens are unaware of the dangers of fire in their areas.	Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens. Develop or purchase a voluntary emergency management app to send notifications to citizens about various hazards throughout the tribal boundary.	1, 3, 4
Structures and people in the Wildland Urban Interface are more vulnerable to major fire events.	Provide and maintain defensible space around structures in the Wildland Urban Interface.	22
Critical facilities in the Nation are threatened by fire.	When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies. Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant. Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Tribal utility authority, Counties, municipalities, HUD and infrastructure owners and operators within the Nation's boundaries. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.	13,14, 28
A lack of consistent and current technologies in the planning area makes the area more vulnerable to fire in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	27, 31, 34
Infrastructure in the planning area is vulnerable to fire events, which threatens the delivery of key infrastructure services to critical facilities.	Coordinate with private utilities and electric co-ops to harden electric utility infrastructure. Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Conduct a utility inventory and conditions	11, 16, 17, 19, 33



	assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	
Muscogee Nation is building a new cultural center to better protect and store their cultural artifacts and documents.	Protect the Muscogee Nation cultural center with weather-resistant infrastructure.	5
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.8 Hail (Hetute-nerkv)

4.8.1 Hazard Description

Hail: (or a hailstorm) often results from severe thunderstorm or similar atmospheric event. Hail, in the form of irregularly shaped lumps of ice, fall with rain. Extreme temperature changes from the ground into the jet stream produce strong updraft winds that cause hail formation. Hail is typically a by-product of thunderstorms, tornadoes, or other atmospheric events, making the location of hail uniform over the planning area.

Location

The risk of this hazard is uniform across the entire planning area.

Extent

Extent is determined by the frequency of hail events that receive a classification of severe or higher. As shown in the Combined NOAA/TORRO Hailstorm Intensity Scale, hail begins to be considered severe when it approaches an inch in diameter or larger.⁶⁷ Hail of this severity tends to be accompanied by winds greater than 58 miles per hour.

Table 4-37 NOAA/TORO 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	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

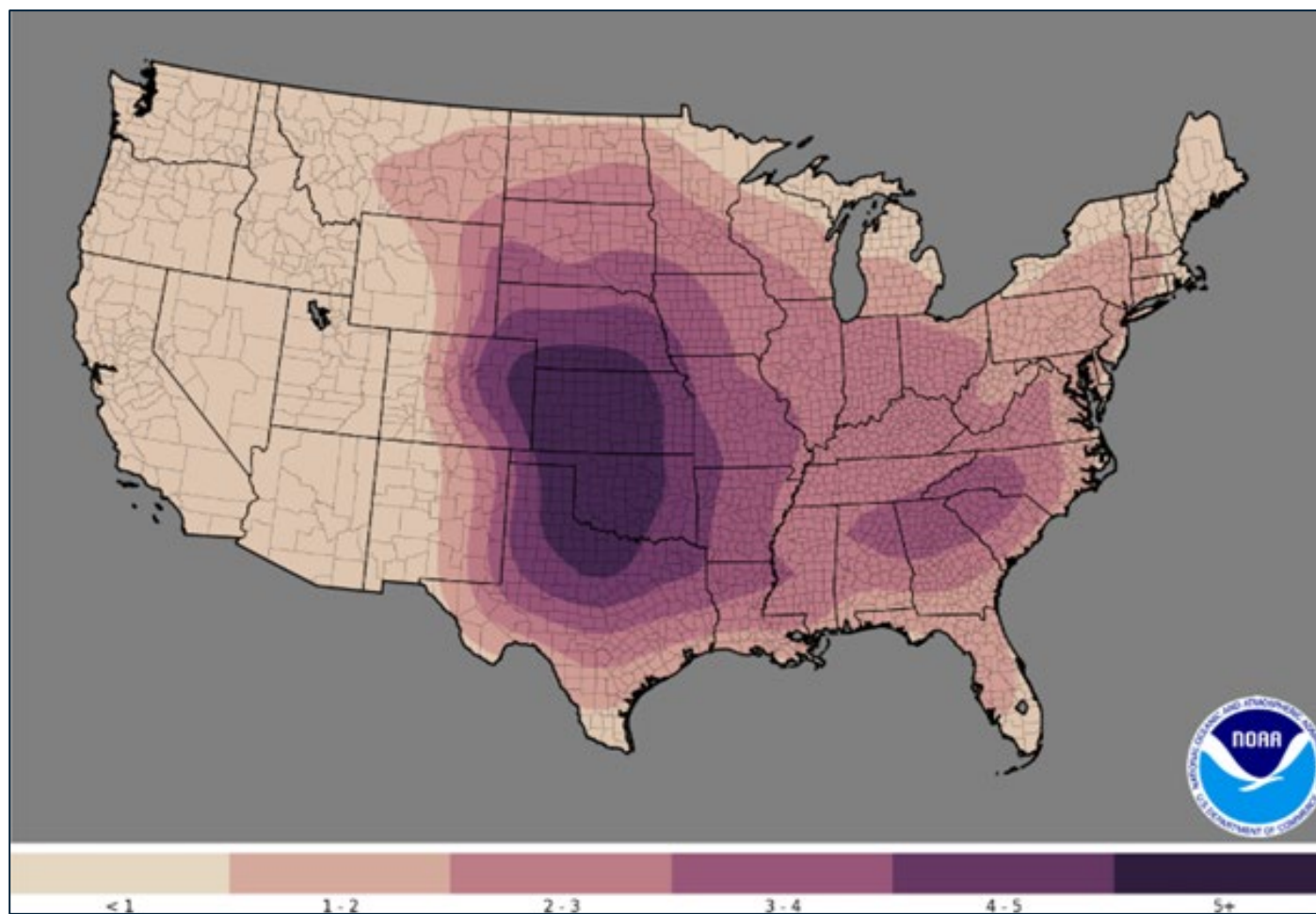
⁶⁷ <http://www.torro.org.uk/hscale.php>



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

The figure below represents NOAA data related to the number of days with hail exceeding 1 inch in diameter.⁶⁸ The NOAA data estimates most of the planning area will experience 5+ events with hail 1 inch or larger hail each year. Some of the eastern part of the planning area is expected to experience 4-5 events with hail 1 inch or larger each year.

Figure 4-33 Mean Number of Hail > 1.00" Days per Year



⁶⁸ http://climate.ok.gov/index.php/climate/map/1.00_inch_hail_days_1986_2015/tornadoes_severe_storms

Previous Occurrences

Hail events occur frequently in Muscogee Nation. According to NOAA data, from 1955 - 2017, the Muscogee Nation and the areas just outside the Nation experienced more than 1,800 hail events, or an average of nearly 30 events per year.⁶⁹ These data were compared and complemented using NCEI data from the Oklahoma counties within the boundaries of the Muscogee Nation. Although hail is a frequent occurrence, not all events have been severe. The table below outlines some of the most impactful events in the Muscogee Nation over the past several decades. Most of the largest, most impactful events have occurred in Okfuskee, Okmulgee, and Tulsa counties.

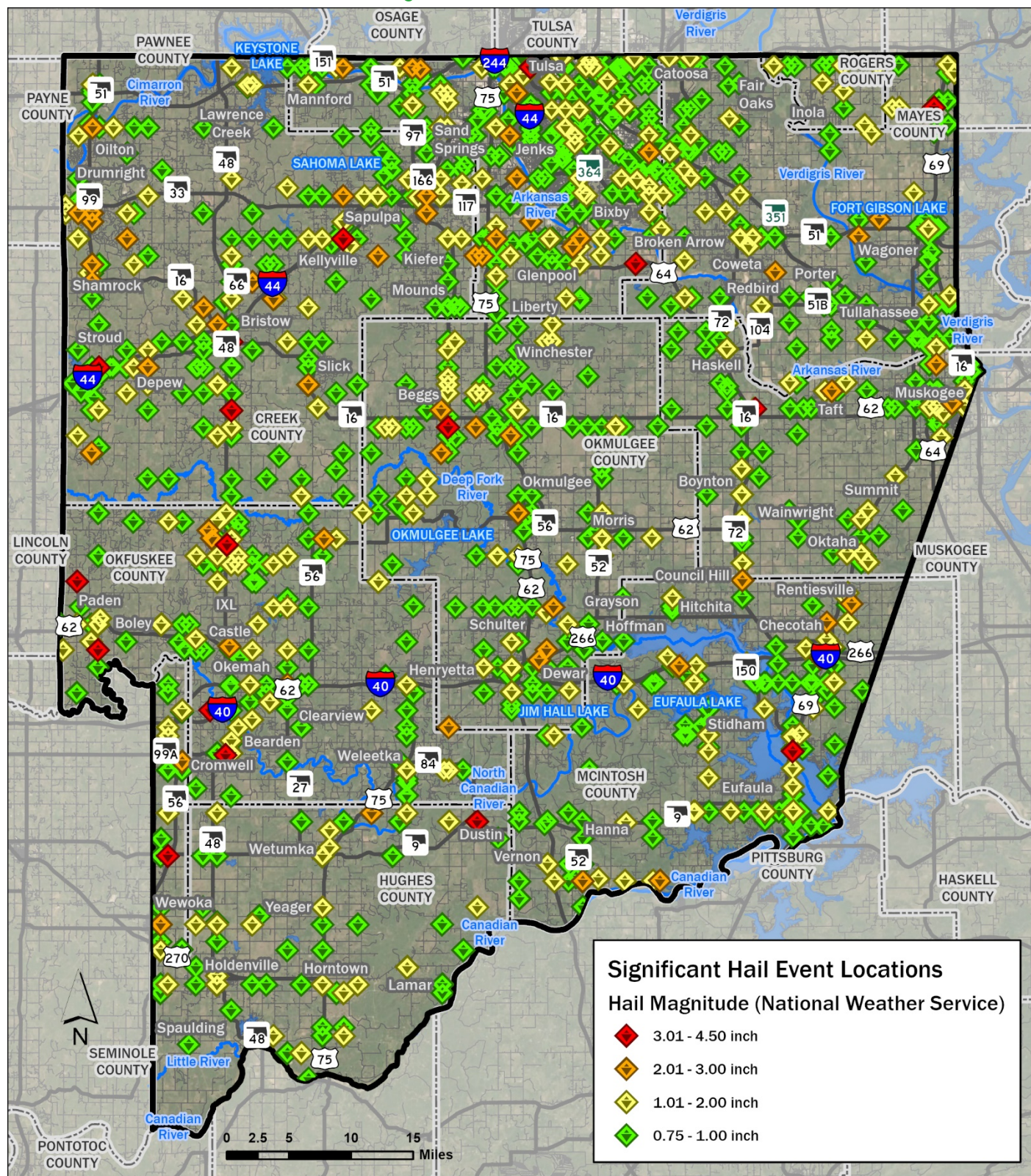
Table 4-12 Historic Hail Events

Date	Event Narrative
May 10, 1963	Tulsa County recorded 4.5-inch hail, the one of largest hail sizes during this period according to NCEI. The hail was recorded in the northmost part of the Nation. Although no damages were reported, the size of the hail suggests that there may have been damages that went unreported.
June 16, 1997	McIntosh County recorded 5.5-inch hail, the hail size during this period according to NCEI. The hail was recorded in the northmost part of the Nation, just north of Eufaula Lake. Although no damages were reported, the size of the hail suggests that there may have been damages that went unreported. Compared to the 1963 event, however, this area was less populated, which may have reduced risk to the even.
April 5, 2005	This event produced the most damage in the planning area during the period queried, according to NCEI. A supercell storm event produced 3.0-inch hail in the middle of Tulsa County, causing \$65 million in combined damages to automobiles, homes, and businesses across Tulsa County. Some of these damages may have been due to high winds.
October 22, 2011	A major supercell event produced high winds and hail up to 4.0 inches across Okfuskee, McIntosh, and Okmulgee Counties in the planning area. Okfuskee was the worst-impacted area within the Nation. A total of \$100K in damages were reported from this event.
May 08, 2015	A series of thunderstorms produced 4.0-inch size hail in the central western part of the planning area. The event was most severe in southwest Okfuskee County. Most of the damages recorded were to residential structures and vehicles, totaling \$50K in damages.

⁶⁹ These data are owned and maintained by the ESRI Federal User Community, who receive their data from NOAA.



Table 1-38 Previous Hail Events in Muscogee Nation



Probability of Future Events

It is **highly likely** that Muscogee Nation will experience a severe hailstorm within the next year or a recurrence interval of less than 1 year (90 to 100 percent probability). The map in Figure 1-33 provided by the *NOAA/National Weather Service Storm Prediction Center* supports this assessment, as it estimates the average number of days per year in which severe hail events occurred in the planning area to be 4-5 (eastern part of the planning area) or 5+ (rest of the planning area).

Future Conditions

Muscogee Nation can continue to expect hail events of severe intensity or greater on the NOAA/TORRO scale with a highly likely occurrence. Some sources, including SCIPP, highlight studies that predict a greater intensity of hail in the future. Although some sources predict that the frequency of hail events may decrease somewhat in the future, SCIPP observes that these predictions have limited variability, given the infrequency and irregularity of historical hail events.⁷⁰

4.8.2 Vulnerability and Risk Assessment

Based on the classifications in the introduction section, the overall significance of a damaging hail event is **medium**. Hail has not led to a recorded fatality in the planning area. The greatest vulnerabilities to hail result from vehicle and roof damage.

People

All people in the planning area are at risk to hail, including Muscogee Nation's Citizens. Although not as common as structure and vehicle damage, personal injury can be caused by large hail driven by high winds. People engaging in outdoor activities may find themselves in a situation where adequate shelter is unavailable. In extreme cases, hail has also resulted in severe injury and death. Hail of 5+ inches, which has been observed in the planning area, can cause brain bleeds and brain damage as well as broken bones if people do not take proper shelter. There were no additional public health and safety concerns from direct hail events, although severe secondary effects, such as power outages or water outages, could strain the healthcare system. For this reason, Muscogee Nation would benefit from enhancing its public health response (see Chapter 3). In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Education and Outreach

Like most hazard-education capabilities identified in this plan, the planning area could benefit from consistent outreach about hail events, which can include:

- Becoming acquainted with communication and warnings about upcoming hail events
- Private and public sheltering (humans and animals)
- Storing outdoor items and other private property
- Preparing for electrical outages that can result from hailstorms
- Securing windows properly and effectively
- Posting warning signage at large, outdoor locations
- Best practices for construction

⁷⁰ SCIPP, <http://www.southernclimate.org/documents/SPTOK.pdf>



Culture

Culture is an essential element of the Muscogee Nation. The damage, destruction, or disruption of any cultural components can result in a significant cultural loss to the Nation, in addition to the other benefits that these components can provide to Citizens. The cultural resources in Muscogee Nation that are most vulnerable to hail are elements of the built environment. These include:

- Places and sites of deep cultural and religious significance, which are culturally and intrinsically valuable. Areas that are especially vulnerable to drought are cemeteries and some religious sites due to their direct exposure to erosion and expansive soils (see built environment for more information), could damage or destroy these places or sites.
- Places that serve as wellsprings of cultural knowledge and cultural transmission. Many of Muscogee Nation's Churches, which due to the age and type of construction, are particularly vulnerable to hail.
- All other cultural components of the built environment share an equal vulnerability to hail.

Some places may contain 2, or even all 3, of these components. It also important to note that many of these cultural components also apply to other sections of this vulnerability assessment.

Economy

The economic impacts associated with this hazard could include agriculture, as crops such as corn or soybeans, which can be damaged to the point of total loss. Damage to buildings and equipment stored outdoors may cause financial hardship (see critical facilities). In addition, vehicles are particularly at risk to hail, including some government vehicles that are in operation or unsheltered during the time of the event.

Built Environment

Existing Structures

All structures in Muscogee Nation are exposed to this hazard. Hail damages occur on an annual basis within the planning area, causing losses to structures and vehicles owned by Muscogee Nation and its Citizens. Hail can cause bruises, punctures, and leaks on roofing systems. The amount of damage depends on the size of the hail, and the age, material, and surface temperature at the time of the event. Substantial hail damage may destroy a roof to the point of replacement. Large hail driven by high winds can break through windows, doors, and skylights that are not impact resistant, allowing subsequent rainwater to enter buildings. When building a new home or replacing the roof, homeowners should consider using hail-resistant roofing materials.

Infrastructure

Major disruption of gas service water/wastewater systems, or transportation networks is not anticipated from hail events.

Electric: Although unlikely, a large hail event could disable or destroy some electrical delivery systems (e.g. poles or lines), which could cause a temporary loss in power to certain areas. This could threaten business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activity.

Like many of the infrastructure components in this assessment, Muscogee Nation does not control the assets for electrical generation or distribution. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).



Critical Facilities

Although critical facilities in Muscogee Nation are vulnerable to hail, it is unlikely a hailstorm would render a government building non-operational. Several cultural facilities may be more vulnerable to a hail event (see Culture section). Lighthorse Police and medical services in the Nation would all be similarly at risk to a hail event. Response vehicles in the open during a hail event would all face the same risk of damage, most likely to windows and windshields. All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the effects of a hail event.

Although these buildings are not particularly at risk, all Muscogee Nation facilities that produce and teach about agriculture and livestock likely would be the most severely impacted by hail event, given the exposure of crops and livestock to hail. Damage to these facilities could cause short and long-term economic interruptions (reduced product for one season to reduced operations for multiple seasons).

Future Development

As of this writing, Muscogee Nation has adopted 2021 International Building Codes, which can enhance the built environment's resilience to hail. In addition, Muscogee Nation should ensure that all windows on current and future government facilities have adequate protection from a severe hailstorm. In addition, the New Cultural Center, which Muscogee Nation is constructing as of this writing, will be more vulnerable to this hazard if the building is not hardened with current approaches, materials, and technologies.

Natural Environment

Large pieces of hail can damage branches and take down tree limbs. A severe hailstorm could affect the large tree population in the planning area. Landscaped areas also can be damaged

4.8.3 Summary of Observations and Recommendations

Table 4-39 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
Hail causes damage to all structure types on an annual basis, including critical facilities owned by the Nation.	When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.	28
Hail causes damage to all structure types on an annual basis, including critical facilities owned and not owned by the Nation. Hail also threatens infrastructure services' delivery to critical facilities and to Citizens.	Partner with private utilities and electric cooperatives to harden electric utility infrastructure. Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	11, 13, 17, 19, 33



<p>Citizens, the general public, and some insurance agents, are unaware of the benefits associated with disaster resistant construction and discounts on insurance premiums. Many Citizens and other residents within Muscogee Nation are unaware of the threats hail poses to their life and property.</p>	<p>Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens. Develop or purchase a voluntary emergency management app to send notifications to citizens about various hazards throughout the tribal boundary.</p>	<p>1, 3, 4</p>
<p>A lack of consistent and current technologies in the planning area makes the area more vulnerable to flooding in terms of response and hazard mitigation.</p>	<p>Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.</p>	<p>24, 26</p>
<p>Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.</p>	<p>Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.</p>	<p>27, 31, 34</p>
<p>Muscogee Nation is building a new cultural center to better protect and store their cultural artifacts and documents.</p>	<p>Protect the Muscogee Nation cultural center with weather-resistant infrastructure.</p>	<p>5</p>
<p>Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigation some vulnerabilities.</p>	<p>Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.</p>	<p>32</p>



4.10 Drought (Oske-seko)

4.10.1 Hazard Description

Drought: refers to a period of unusually persistent dry weather that persists long enough to cause deficiencies in the water supply (surface or underground). Droughts are slow-onset hazards that can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions persist over many months or years, the direct and indirect economic impacts can be devastating. High temperatures, high winds, and low humidity can worsen drought conditions and make areas more susceptible to wildfire. In addition, human actions and demands for water resources can accelerate drought-related impacts.

Location

Drought can affect the entire planning area.

Extent

The extent of droughts was calculated by determining a drought's severity, using the Palmer Drought Severity Index (PDSI), and its duration. The extent of droughts in east-central Oklahoma (including the planning area) was not often expected to be severe or extreme. The PDSI depicts prolonged (months, years) abnormal dryness or wetness. Based on historical averages of the Palmer Drought Index, the drought conditions in Muscogee Nation normally range from -2.9 to +2.9, with more extreme swings to -4.0 and +4.0.⁷¹ All or part of Muscogee could experience an extreme drought, since it has experienced extreme drought.

Table 4-40 Palmer Drought Index

Palmer Drought Index			
		-4.0 or less	Extreme Drought
		-3.0 to -3.9	Severe Drought
		-2.0 to -2.9	Moderate Drought
		-1.9 to 1.9	Near Normal
		+2.0 to +2.9	Unusual Moist Spell
		+3.0 to +3.9	Very Moist Spell
		+4.0 and above	Extremely Moist
		Missing/incomplete	--

Previous Occurrences

Muscogee Nation has experienced drought frequently over the last several years. Based on a combined analysis of NCEI data and Palmer drought historical data, at least one part of the planning area experienced at least moderate drought conditions (on the Palmer Index) for 28 months between January 2010 and June 2021. The major droughts to affect the planning area, in terms of severity and intensity, took place in the

⁷¹ <https://www.drought.gov/drought/data-maps-tools/current-conditions> <https://www.ncdc.noaa.gov/temp-and-precip/drought/weekly-palmers/>



first half of the 2010s. The planning area experienced drier weeks since 2017, but none of these weeks received a moderate drought rating for an entire month. Overall, the planning area experienced three major droughts during this period. Although neither database reported economic or human losses to drought, reports from officials in the planning area indicate that the drought caused economic losses, at least for the agricultural sector.

Table 4-41 Historic Drought Events

Date	Event Narrative
January 2011 – March 2012	The southern and western parts of the planning area reached an extreme level of drought (Palmer Index) for at least 3 months. The northern and eastern areas faced moderate drought levels for several months during the same period. Scattered showers throughout the area provided intermittent local relief during the drought, especially in the northeast part of the planning area.
July 2012 – March 2013	After only a few months from the previous drought, a lack of rain propelled most of the planning area back into a drought. Most east central Oklahoma had only received 10 to 50% of normal rainfall for the month, which persisted throughout December. All of the planning area received at least a severe drought rating for several months according to the Palmer index. The southern and western parts of the planning area reached an extreme level of drought (Palmer Index) for at least 1 month.
December 2016 – January 2017	This drought was less severe than the previous two major droughts, as the entire planning area experienced only moderate drought according to the Palmer index.

Probability of Future Events

Based on drought occurrences over the past 10 years, it is **highly likely** that the planning area will experience the effects of a drought, or a recurrence interval of 1 to 10 years.

Future Conditions

Based on previous occurrences and scientific research, Muscogee Nation can continue to expect drought events in the future. In fact, some scientific and government bodies, including NOAA, predict that the planning area could experience drought events of greater severity (extent) in the future.⁷² Based on historical conditions, the last several years have been marked by high levels of precipitation, but more research and data is needed to determine any trend for the future.

4.10.2 Vulnerability and Risk Assessment

A severe drought even has a **low** and minimal impact on the planning area according to the classifications in the introduction section. In addition to direct effects of a drought, the secondary effects of a drought event can affect the planning area; namely, expansive soils and increased fire activity (for vulnerability to fire, see fire hazard section).

⁷² <https://statesummaries.ncics.org/chapter/ok/>



People

All Muscogee Nation Citizens and other residents in the planning area are at risk to drought. Drought rarely impacts people's health directly. The most significant vulnerability from a drought is a lack of access to drinking water (see built environment for more information).

Public Health and Safety

Drought poses several far-reaching public health implications, of which long-term public health problems to be considered are a shortage of drinking water (see above), degraded clean water, and degraded air quality.

A reduction in water volume due to drought can stagnate water. Stagnant water can degrade the quality of clean water by increasing likelihood of infectious disease. This is particularly the case for people who draw from private wells. Farmers may be more likely to use water with diseases to water or wash crops, increasing the risk to food-borne illness.

The dusty and dry conditions from drought, along with an uptick in drought-induced wildfires, can degrade air quality. Drought conditions can increase the number of particulates in the air, which can irritate people with lung, nasal, or eye problems, especially those with preexisting conditions. Similarly, toxic blooms from stagnant waters (e.g. cyanobacteria) can cause decreases in air quality. Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some of these vulnerabilities (see Chapter 3). In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Education and Outreach

Officials noted the lack of consistent education and outreach related to drought for developers, builders, realtors, and residents. This can include best practices on water conservation, along with other building materials. Education and outreach could be enhanced by the development of an electronic mobile application to assist with disseminating educational materials.

Culture

Culture is an essential element of the Muscogee Nation. The damage, destruction, or disruption of any cultural components can result in a significant cultural loss to the Nation, in addition to the other benefits that these components can provide to Citizens. The cultural resources in Muscogee Nation that are most vulnerable to drought can be grouped into two categories. These categories overlap with other vulnerability sections, especially people and built environment. The first is the people of the Nation, particularly the elders. Muscogee Citizens contain, reflect, and transmit Muscogee culture through language, traditions, and stories. Elders that live in agricultural communities may be especially at risk to drought, given these communities' economic exposure to drought (see economy section). In addition to people, a few elements of the built environment are more exposed to drought.

- Places and sites of deep cultural and religious significance, which are culturally and intrinsically valuable. Areas that are especially vulnerable to drought are cemeteries and some religious sites due to their direct exposure to erosion and expansive soils (see built environment for more information), could damage or destroy these places or sites.
- All other cultural components of the built environment share an equal and low vulnerability to droughts

Some places may contain 2, or even all 3, of these components. It also important to note that many of these cultural components also apply to other sections of this vulnerability assessment.



Economy

A drought would negatively affect Citizens in the Nation and some of the assets and other critical facilities in the Nation, especially those that focus on agricultural production. To this end, a drought can increase wind erosion, insect infestations, and crop diseases.

The Oklahoma Drought Management Plan and additional analysis from the planning team outlines other economic impacts that could apply to Muscogee Nation, or its citizens, during a drought:

- Revenue loss from farms and agricultural education facilities
- Increases in consumer prices for food or decrease in the quality of food (due to their affordability)
- Increases in unemployment
- Reduction tax revenues due to reduced expenditures
- Foreclosures on bank loans to farmers and businesses⁷³

Given the importance of agriculture to the Nation and its Citizens, along with the geographical size of the planning area, Muscogee Nation should consider developing a drought management plan, with an emphasis on agricultural resilience and water sovereignty, to better address critical needs during a prolonged drought.

Built Environment

Existing Structures

The secondary effects of a drought event can affect the built environment; namely, expansive soils and increased fire activity. Historically extreme drought has been positively correlated to significant wildfire activity in the Nation (for vulnerability to fire, see fire hazard section). All structures owned by Muscogee Nation and Tribal Citizens are at risk to these hazards.

Officials in the planning area have noted that the Nation purchases existing residential structures, which it retrofits for Citizens. Given the original condition of some of the structures, officials have expressed concern about their structural integrity regarding extreme soils and other drought effects. For the potential impact of codes on the built environment in the planning area, see future conditions section.

Infrastructure

The planning team did not identify specific vulnerabilities to electric infrastructure due to drought.

Gas Lines: Gas lines could leak or break due to expansive soils in the planning area. This could cause toxic soil seepage into the ground or groundwater, which could affect the environment or health to Citizens. This may also cause a disruption in gas services to homes, which would make Citizens more vulnerable to temperature fluctuations, especially during extreme heat or extreme cold events (see extreme heat or severe winter storm sections for more information). It is important to note that the Muscogee Nation Government or other Muscogee Nation Authority does not own gas lines as of this writing. Developing and enhancing partnerships with private gas companies who own and operate these lines, along with local communities, counties, and the state of Oklahoma will be essential mitigating risk to the built environment and Citizens.

Water/Wastewater: Water lines and structures could be damaged due to expansive soils. Depending on damage levels, water and wastewater plants may not meet daily intake levels due to water shortages. It is

⁷³ https://www.owrb.ok.gov/supply/drought/reports/drought_plan.pdf, 6



more probable, however, that water infrastructure will suffer from a water shortage due to depletion of the primary water source. Irrespective of the source, a drought could cause a water crisis for certain populations in the affected areas if redundancies to supply drinking water are not established.

To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. Muscogee Nation can enhance these capabilities and develop new ones (see suggested actions).

Transportation: Roadways and streets used by Citizens could be weakened or damaged due to expansive soils. This may disrupt traffic, including emergency services, or may weaken transportation infrastructure, making it more vulnerable to other hazards. The likelihood of this vulnerability affecting the Nation or its people at a broad scale is very low, however.

Critical Facilities

Critical facilities in Muscogee Nation have no specific vulnerability to severe drought outside of water supply and structural damages resulting from expansive soils. Muscogee Nation’s first hospital, the Okemah Medical Facility, is supplied by the City of Okemah. Its backup water supply source is a second line that pulls water from Okfuskee County RWD 2. Additionally, the line from RWD to the hospital is undersized, and the RWD pulls water from Okemah. During this update, it was determined the water infrastructure in Okemah needs to be updated or entirely replaced. For this reason, it is recommended the Nation consider water towers to supply the hospital in the event of an outage.

Similarly, as noted in the Dam and Levee Section, two water supply lakes in the Nation are considered “Poor Condition Dams” as profiled by the OWRB. Any tribal critical facilities, including the Muscogee Nation Tribal Complex, would lose water in a breach or failure of Jim Hall, Okmulgee, or Nichols. The Nation should coordinate with Okmulgee and Henryetta to resolve Poor Condition Dam status. For critical facilities that are also cultural resources, see the cultural resources section.

Future Development

Future development plans should be completed with water availability in mind. As the Nation continues to expand, it should ensure any future acquisitions include an assessment of existing primary water sources and redundancy options. The Nation plans to invest in water infrastructure. As of this plan update, water infrastructure planning and investments were in the very early stages. The Nation will report progress in the next plan update. The New Cultural Center, which Muscogee Nation is constructing as of this writing, will be more vulnerable to this hazard if the building is not hardened with current approaches, materials, and technologies.

Natural Environment

Drought has many negative effects on the natural environment throughout the Nation. The general effects of drought on the natural environment are like extreme heat, although there may be increased vulnerabilities from the lack of water, such as soil erosion. Drought can lead to crop loss and can stress flora and fauna. Drought conditions could cause animals to leave their natural habitats to search for cooler places or places with more water. Aquatic life is especially at risk to drought.

4.10.3 Summary of Observations and Recommendations

Table 4-42 - Summary of Observations, Recommendations, and Actions



Observation(s)	Recommendation(s)	Action(s)
Though water supply is adequate, Muscogee Nation should be prepared for future drought conditions.	Develop a drought management plan, with an emphasis on agricultural resilience, to better address critical needs during a prolonged drought. Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	12, 16, 19
Muscogee Nation relies on county-level drought education methods to inform their population. The population is projected to increase over the next 20 years.	Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens. Develop an emergency management app to send notifications to citizens about various hazards and emergency events throughout the tribal boundary.	1, 3, 4
Infrastructure is vulnerable to extreme drought events, which could disrupt deliver to critical facilities in Muscogee Nation.	Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	13, 17, 28, 33
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation.	27, 31, 34
A lack of consistent and current technologies in the planning area makes the area more vulnerable to drought events in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26



Essential facilities in Muscogee Nation need back-up generators and would benefit from some retrofitting strategies to improve their resilience to hazards.	Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant.	14, 15
Muscogee Nation is building a new cultural center to better protect and store their cultural artifacts and documents.	Protect the Muscogee Nation cultural center with weather-resistant infrastructure.	5
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigate some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



4.11 Lightning (Vto ye hvttte)

4.11.2 Hazard Description

Lightning: is a discharge of electrical energy that results from the buildup of positive and negative charges in a thunderstorm, generating a “bolt” when the buildup of charges reaches a certain level. Lightning can occur between a cloud and the ground (cloud-to-ground lightning), between two clouds (Intercloud Lightning), or within the same cloud (Intracloud Lightning). Lightning can strike 10 miles outside the rain column.

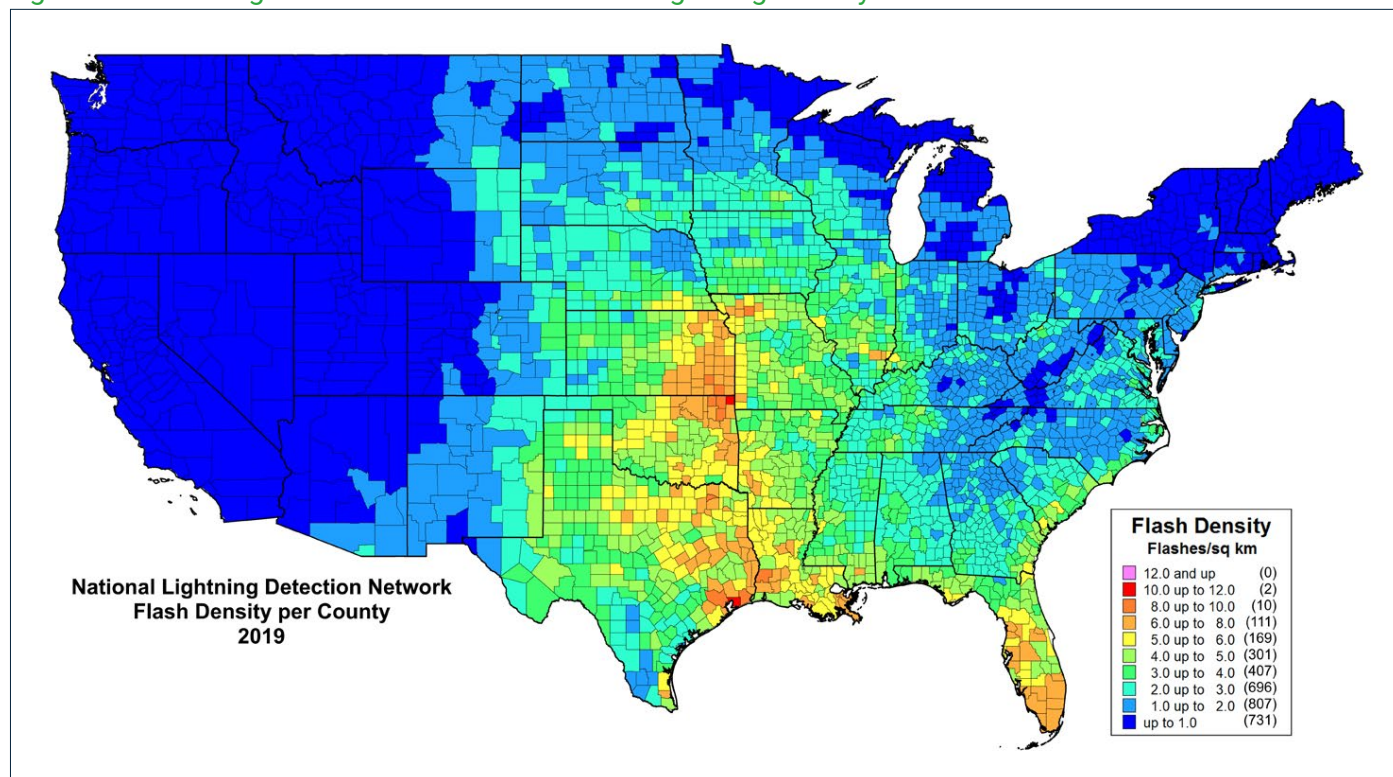
Location

Lightning is typically a by-product of thunderstorms or other atmospheric events, which are uniform over the planning area, making the location of lightning uniform over the planning area.

Extent

Extent is determined by density of lightning strikes that reach the ground (cloud-to-ground strikes). Oklahoma has one of the highest average lighting densities in the United States. Northeast Oklahoma, which includes the northeast part of the planning area, has higher-than-average lightning strike densities compared to the rest of the state. The National Lightning Detection Network estimates that the northeast part of Muscogee Nation experiences 6-8 flashes per square kilometer annually, based on 2019 data (see Figure 1-34).

Figure 1-34 Muscogee Nation Detection Network Lightning Density



The southwestern part of the planning area averages 4 - 5 flashes per square kilometer, annually, according to the National Lightning Detection Network. The Vaisala 2020 Lightning Report similarly indicated that

Muscogee Nation experienced between 4 - 8 cloud-to-ground strikes per square kilometer per year.⁷⁴ This averages to about 50,400 – 100,800 cloud-to-ground lightning strikes across the planning area per year.⁷⁵

Previous Occurrences

According to National Lightning Detection Flash Report and the Vaisala 2020 Lightning Report, the planning area experienced a minimum of 252,000 flashes since the previous plan was approved, as of this writing.⁷⁶ Given the volume of strikes during this period, the planning team focused on the most impactful lightning events in the planning area. NCEI data reported more than 40 damaging lightning events between January 1950 – June 2021. Most of these events were reported in Tulsa and Muskogee County. The concentration of significant events in these counties may have more to do with high levels of reporting in Tulsa County rather than a concentration of lightning events in the County. No injuries and deaths were reported. Nearly than \$4 million in damages were reported during this period, but it is important to note that these damage calculations included hazards that occurred concurrent to the lightning reports, such as high wind and tornadoes. Damages caused by lightning are less than the reported total. Figure 1-34 outlines several of the most significant events during this period.

Figure 4-35 Historic Lightning Events

Date	Event Narrative
May 16 – 17, 1999	A thunderstorm, which was accompanied by high winds and lightning, affected the north and east part of the Nation, with Tulsa County and Muskogee County among the most affected areas. Lightning and high wind caused destruction in Muskogee County, causing several injuries. Lightning caused a structure in Tulsa County to ignite. Approximately \$150K in damages were reported.
June 04, 2005	A lightning storm concentrated in McIntosh County caused a Church to catch fire, burning to the point of total loss. Approximately \$150K in damages were reported.
July 23, 2013	Strong thunderstorms struck several buildings within the planning area, causing a few structure fires and other damages throughout Tulsa County. The public buildings affected were not owned by the Muscogee Nation. It is unclear if the homes were owned by tribal citizens.
July 14, 2017	Lightning started a house fire in Tulsa County. The structure was burned to the point of total loss.

Probability of Future Events

Based on the extent and previous occurrences sections, it is **highly likely** that Muscogee Nation will have a lightning occurrence on an annual basis. According to the most recent 2020 VAISALA report, the planning area has the most lightning events per area in the country per year (107.3 events/km²/year).⁷⁷ According to

⁷⁴ <https://www.vaisala.com/sites/default/files/documents/WEA-MET-Annual-Lightning-Report-2020-B212260EN-A.pdf>

⁷⁵ Muscogee Nation includes an area of about 12,600km². The number 4 was assumed to be the lower bound and the number 8 was assumed to be the upper bound.

⁷⁶ Muscogee Nation includes an area of about 12,600km². The number 4 was taken as the lower bound over the last 5 years.

⁷⁷



this analysis, there is a 90 – 100% probability of occurrence in the next year or a recurrence interval of less than 1 year.

Future Conditions

Scientists, including those at SCIPP, have concluded that changing weather conditions due to climate change likely will result in additional lightning events. Increasing the frequency, and potentially, the severity of lightning could also spark more fires in the area, especially as drought severity could increase due to climate change.⁷⁸

4.11.3 Vulnerability and Risk Assessment

The hazard has a **low** overall significance based on classifications in the introduction section.

People

All Citizens in the planning area are at risk to lightning. Lightning strikes can cause serious injuries or death, although this is rare. Fatalities and injuries can be caused directly (being struck by lightning) or indirectly (through a conductor). Common conductors for indirect lightning strikes can include tree, pole, or other tall object, along with household conductors that include electrical or metallic components. Lightning could also cause an explosion, which may lead to secondary hazard effects that can include hazardous materials releases (see hazardous materials section for more information on the potential effects of hazardous materials).

Recreational areas also can be dangerous during lightning events, especially lakes, golf courses, and other open spaces. Citizens who do not have access, or are out of range, to lightning warnings are at higher risk of being exposed to lightning. Lightning also can spark fires, especially during periods of high heat and low humidity (for vulnerabilities to fire, see the fire section). The planning team could not identify public health impacts for lightning other than the potential effects of mass casualties caused a direct and indirect lightning strikes. Nonetheless, enhancing Muscogee Nation's public health response can mitigate some of these vulnerabilities (see Chapter 3). In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Education and Outreach

Outreach and education on a lightning event for developers, builders, realtors, and residents are inconsistent throughout the planning area. This can include best practices how to shelter from lightning while outdoors and indoors, as lightning can be conducted indoors through commonly used appliances.⁷⁹ People also should receive education on the importance of lightning mitigation measures, such as lightning rods or surge protection. Muscogee Nation should partner with existing public and private partners that are engaging with Citizens on lightning education and outreach.

Culture

Culture is an essential element of the Muscogee Nation. The damage, destruction, or disruption of any cultural components can result in a significant cultural loss to the Nation, in addition to the other benefits that these components can provide to Citizens. The cultural components that are at greatest risk to lightning are structures constructed with flammable materials that also lack lightning mitigation devices

⁷⁸ SCIPP, http://www.southernclimate.org/documents/climatechange_oklahoma.pdf

⁷⁹ <https://www.cdc.gov/disasters/lightning/safetytips.html>



(e.g. lightning rods). These vulnerable to direct strikes and more vulnerable than other structures to fires that result from lightning strikes. Most of these structures are the Nation's Churches, which are culturally and intrinsically valuable sites that also serve as wellsprings of cultural knowledge and cultural transmission. All other cultural components share an equal vulnerability to lightning.

Economy

Economic impacts from lightning are primarily related to loss of power and business interruption. The amount of impact on the economy depends on the length of time until service restoration (see built environment section for more information).

Built Environment

Existing Structures

All structures in the Nation are at risk to lightning. Older buildings and densely concentrated businesses and residences that were built prior to the adoption of current building codes can be more vulnerable to lightning strikes. These buildings often have fewer protective measures to mitigate against the effects of a lightning strike or the secondary effects of a lightning strike (such as a fire). In addition, structures without lightning mitigation measures, such as lightning rods or enhanced surge protection, may be more at risk.

Infrastructure

The planning team did not identify any gas or transportation infrastructure as particularly vulnerable to lightning.

Electric: Electrical infrastructure is likely the most infrastructure segment to lightning. A lightning event could damage electrical generation or transmission (including substations), reducing or cutting off power to critical facilities and other buildings. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activity.

Like many of the infrastructure components in this assessment, Muscogee Nation does not control the assets for electrical generation or distribution. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

Water/Wastewater: Water and wastewater plants have been disabled or damaged by lightning throughout the planning. A prolonged water or wastewater outage could lead to a crisis of a lack of drinking water or significant sanitation issues with wastewater. To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. Muscogee Nation can enhance these capabilities and develop new ones (see suggested actions).

Critical Facilities

All critical facilities are at risk to lightning, especially to a power surge or power outage resulting from lightning. For this reason, power generation and distribution networks are important especially important. Critical facilities with high a quantity or quality of electronics or response equipment, like Lighthorse police, are similarly vulnerable since a power outage or surge led to the disabling of key electronic functions, destruction of expensive electronic equipment, and/or the disabling of emergency operations.

Muscogee Nation should equip all critical facilities with lightning mitigation measures, such as lightning rods and surge protection. Although these measures are helpful mitigation measures, they will not eliminate



the threat of lightning. Muscogee nation should ensure that it has developed sufficient redundancies, such as backup generation (not linked to the grid), to continue to deliver services in the event of a prolonged power outage due to lightning.

Future Development

All buildings in the Nation would also benefit from the installation of lightning mitigation measures, such as lightning rods and enhance surge protection. The National Fire Protection Association document NFPA 780, *Standard for the Installation of Lightning Protection Systems*, for instance, describes lightning protection system installation requirements. NFPA 780.⁸⁰ The New Cultural Center, which Muscogee Nation is constructing as of this writing, will be more vulnerable to this hazard if the building is not equipped with current mitigation technologies.

Natural Environment

Lightning that strikes water could kill aquatic life and damage the ecosystem in ponds, lakes, and rivers. Lightning strikes can damage trees and other vegetation directly. Fires sparked by lightning also can damage vegetation, flora, and crops, along with contributing to air pollution, depending on the size and duration of the fire.

4.11.4 Summary of Observations and Recommendations

Table 4-43 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
Populations involved in outdoor activities are at risk from severe weather events.	Develop and implement hazard preparedness, education, information, and awareness programs.	1
Muscogee Nation has a large space of rural land. The population outdoors in those areas or living in remote areas may be unaware of lightning risks, unless directly connected to a mobile device with severe weather alerts and where service is available.	Create and maintain a database for assessing vulnerabilities among Citizens. Develop or purchase a voluntary emergency management app to send notifications to citizens about various hazards throughout the tribal boundary.	3, 4
A lack of consistent and current technologies in the planning area makes the area more vulnerable to lightning in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Emergency response efforts and coordination in Muscogee Nation would benefit from additional	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations	27, 31, 34

⁸⁰ NFPA <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards?mode=code&code=780>



planning and the construction of an emergency operations center.	guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	
Critical facilities and infrastructure throughout the planning area are vulnerable to lightning events.	Coordinate with private utilities and electric co-ops to harden electric utility infrastructure. Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	11, 13, 14, 15, 17, 28, 33
Muscogee Nation is building a new cultural center to better protect and store their cultural artifacts and documents.	Protect the Muscogee Nation cultural center with weather-resistant infrastructure.	5
Water infrastructure is vulnerable to lightning events, which could disrupt deliver to critical facilities in Muscogee Nation.	Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	16, 19
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigation some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32

4.12 Earthquake (Ekvn nekeyet)

4.12.1 Hazard Description

Earthquake: A is a sudden release of energy that creates a movement in the Earth's crust. Most severe earthquakes take place where the vast tectonic plates that form the Earth's surface collide and slide slowly over, under, and past each other. They can also occur along any of the multitudes of fault and fracture lines within the plates themselves.

Location

Given an earthquake's possible geographic reach, the risk of this hazard is uniform over the entire planning area.

Extent

It is probable that an earthquake would impact the entire planning area. In fact, an earthquake with an epicenter outside the planning area could affect the planning area.

Table 4-44 Richter Scale

Class	Magnitude
Great	8+
Major	7-7.9
Strong	6-6.9
Moderate	5-5.9
Light	4-4.9
Minor	3-3.9

Two standard measures are used to classify an earthquake's extent: magnitude and intensity. In the past, these measures were sometimes referred to as the Richter Scale (magnitude) and the Modified Mercalli (intensity). As more seismograph stations were installed around the world, it became apparent that the method developed by Richter was strictly valid only for certain frequency and distance ranges. Because of the limitations of all three magnitude a new, more uniformly applicable extension of the magnitude scale, known as moment magnitude, was developed.

For very large earthquakes, moment magnitude gives the most reliable estimate of earthquake size. Earthquakes are classified in categories ranging from minor to great, depending on their magnitude.

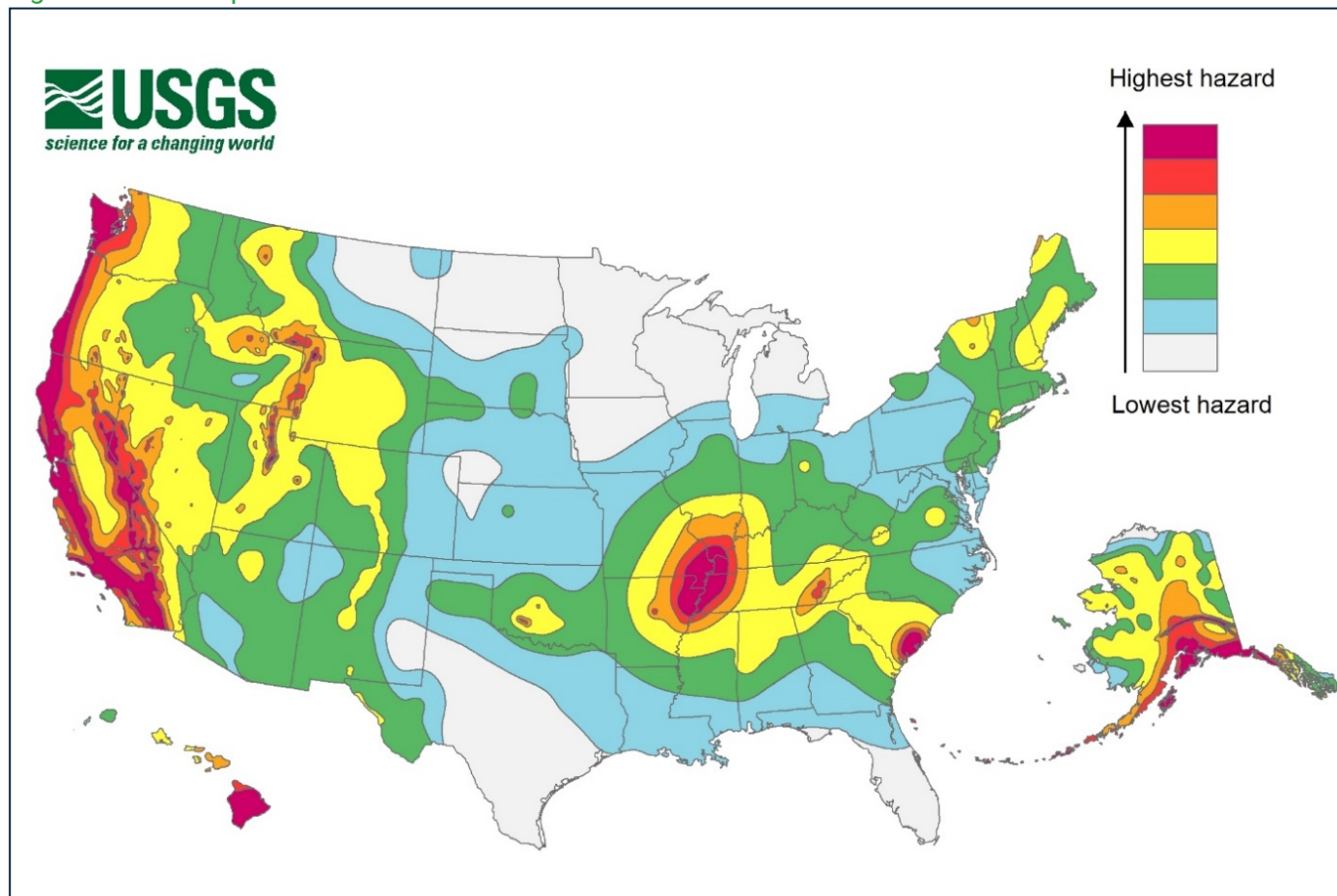
From these and other measures, USGS has charted the probability of peak ground accelerations that have only a 2% probability of being exceeded in 50 years. The map below reflects the upper limits of earthquake severity compared to the rest of the county. According to USGS, Muscogee Nation is at a moderate risk for earthquakes compared to the rest of Oklahoma and lower risk compared to the other areas in the United States.⁸¹

Based on previous occurrences and the lack of overall active fault lines in the Muscogee Nation, the Nation could experience earthquakes ranging from 3.0 to 5.0 magnitude on the Richter Scale.

⁸¹ <https://www.usgs.gov/media/images/2018-long-term-national-seismic-hazard-map>



Figure 4-36 Earthquake Hazards



Previous Occurrences

Earthquakes are often not felt until they reach a magnitude of 3.0 on the Richter Scale. For this reason, OGS data was queried for earthquakes of 3.0 and higher in the planning area from January 1955 – June 2021, which identified 15 discrete events within the planning area during this period.⁸² It is important to note, however, that more events could have occurred during this period, since the OGS data for many counties in the planning area seems to have begun in the last several decades.

Of the 11 counties within the planning area, only Okfuskee, Rogers, and Seminole reported an earthquake over 3.0 in magnitude. Although 4.0 magnitude earthquakes have been reported just outside the planning area, the highest magnitude earthquake recorded in the planning area reached a 3.6 magnitude. No damages or injuries were reported in the planning area.

Some of the more impactful events, in terms of magnitude, are recorded below.

Table 4-45 Historic Earthquake Events

Date	Event Narrative
May 2, 1959	A 3.5 magnitude earthquake was recorded in Okfuskee County.

⁸² The recorded longitude for many of these events occurred just outside of the planning area in Seminole and Rogers counties, respectively.

Date	Event Narrative
November 12, 2013	A 3.2 magnitude earthquake was recorded in Seminole County, on the border of Muscogee Nation.
October 20, 2014	A 3.5. magnitude earthquake was recorded at the southwestern edge Okfuskee County.
November 13, 2014	A 3.6 magnitude earthquake was recorded in Seminole County, on the border of Muscogee Nation.

Probability of Future Events

Based on previous occurrences, the likelihood that the planning area will experience an earthquake event with a magnitude of 3.0 or greater is **unlikely**.

Future Conditions

Although scientific and other governmental sources do not link earthquake activity and climate change, conditions for earthquake hazards in Muscogee Nation can be the result of human activity. Researchers at the USGS conclude that the uptick in Oklahoma's earthquake activity (<3.0 magnitude) from 2014-2017 was due in large part to human activity, particularly from the wastewater disposal process in oil and gas.⁸³ For this reason, future conditions of earthquakes will likely depend on continued drilling and injection activities, especially wastewater disposal.

4.12.2 Vulnerability and Risk Assessment

The hazard has a minimal impact on the planning area and has a **low** vulnerability based on classifications in the introduction section.

People

A severe earthquake, although unlikely, would threaten people across the entire planning area. Although these events are rare, earthquakes could be dangerous. Most earthquake injuries and fatalities occur within buildings from structural collapse and its associated affects, such as glass and the movement of other objects. Contents in a home can be equally, if not more, dangerous than the structure itself. Any unsecured objects that can move, break, or fall during an earthquake event are potential safety hazards and can cause potential property losses. All Citizens should receive education on best practices to take during an earthquake event. Populations considered most vulnerable are people located in structures with unreinforced or weakened masonry construction (see built environment). In addition to these factors, Muscogee Nation lacks an Emergency Operations Center to coordinate joint operations, which is a particular vulnerability for the Nation, given its reliance on response partnerships.

Public Health and Safety

All Citizens can be affected by degradation in air quality and or the accidental release of hazardous materials due to an earthquake event (see the built environment for additional commentary on its effects). Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigation some of these vulnerabilities (see Chapter 3).

⁸³ https://www.usgs.gov/faqs/oklahoma-has-had-a-surge-earthquakes-2009-are-they-due-fracking?qt-news_science_products=0#qt-news_science_products



Education and Outreach

Citizens would benefit from consistent Earthquake drill scenarios to mitigate reduce confusion and to serve as an estimate of potential losses related to loss/injuries, types of potential damage, and to confirm existing roles and priorities.

During and after earthquakes, families could be separated. Reuniting them should be a priority for the Nation by establishing a coordinated approach for accessing search and rescue data. This should include social media, community hotlines and assistance centers, shelter rosters, and healthcare facility information, which can be improved by the development on a mobile electronic emergency management application.

Culture

The damage, destruction, or disruption of any cultural resources can result in a significant cultural loss to the Nation, in addition to the other benefits that these resources can provide to Citizens. Although it is unlikely that a severe earthquake would occur in or around planning area, a high magnitude earthquake could cause significant damages to some of these important resources. The cultural resources in Muscogee Nation that are most vulnerable to earthquake can be grouped into two categories. These categories overlap with other vulnerability sections, especially people and built environment. The first is the people of the Nation, particularly the elders. Muscogee Citizens contain, reflect, and transmit Muscogee culture through language, traditions, and stories. These people are vulnerable to earthquake based, in large part, on their proximity to collapsing structures and falling objects (see people section). In addition to people, the second category of vulnerability, the built environment, can be divided into three subcomponents:

- The places and sites of deep cultural and religious significance. These spaces are culturally and intrinsically valuable. To this end, a severe earthquake could disrupt the grounds of religious sites and cemeteries, depending on their proximity to the epicenter of the earthquake.
- Places and sites that contain cultural objects and articles of intrinsic significance to the Muscogee Nation. Apart from the examples listed in the other bullet points, no other element of the built environment was identified as being particularly vulnerable to earthquakes.
- Places that serve as wellsprings of cultural knowledge and cultural transmission. Muscogee Nation's Churches, which due to the age and type of construction, are particularly vulnerable to an earthquake.

Some places may contain 2, or even all 3, of these components (for example, the Churches and religious sites). It also important to note that many of these cultural components also apply to other sections of this vulnerability assessment, especially people and the built environment.

Economy

Earthquakes could affect the economy in the planning area. Small business owners should make their businesses safer to be in during earthquakes and more resistant to earthquake damage by assessing its structure and contents and correcting any weaknesses, as structural damage could limit or eliminate business activity (see the build environment for more information). The Nation also benefits from economic drivers, especially in the casino and agricultural industries, which could be exposed to risk from an extreme earthquake (see critical facilities).

Built Environment

Existing Structures

Depending on when and how it was designed and built, a structure may have weaknesses that make it more vulnerable to earthquakes. Common examples include structures that are not anchored to foundations, or unreinforced/unbraced masonry walls or foundations. Older homes, due to their age and standards of design, are at heightened risk. For this reason, Muscogee Nation should consider the homes that it purchases for retrofit meet current earthquake standards. In addition, structures with a higher potential for structural weaknesses, such as mobile or prefabricated homes, may wish to be examined (see people for effects of collapsing structures).

Infrastructure

It is not likely that infrastructure will be impacted by an earthquake, as the Nation is in an area of lower seismicity, at least in terms of historical magnitude impacts. This being said, an earthquake with high magnitude could disrupt vital infrastructure services, which are explained below.

Electric: An extreme earthquake could damage electrical generation or transmission (including substations), reducing or cutting off power to critical facilities and other buildings. This would affect business operations, health (for people who rely on electricity to sustain their health), food refrigeration, and other essential daily activity. Like many of the infrastructure components in this assessment, Muscogee Nation does not control the assets for electrical generation or distribution. To limit the exposure to electrical outages and given Muscogee Nation's limited ownership of the electrical infrastructure in its borders, the Nation can enhance and develop solutions to improve electrical resilience in the planning area (see suggested actions section).

Gas: An extreme event could cause major gas leaks or leaks in other hazardous materials. Leaks from hazardous material in storage facilities can affect human health and the environment, or it could increase the risk of fires (see the fire section). Depending on rainfall or other conditions, this can occur miles from the initial earthquake zone. Muscogee Nation does not own gas distribution systems in the planning area as of this writing. Developing and enhancing partnerships with private gas companies who own and operate these lines, along with local communities, counties, and the state of Oklahoma will be essential mitigating risk to the built environment and Citizens.

Water/Sewer: An extreme event could damage lines or the facility itself, causing a disruption in services. This could cause a water crisis for certain populations, if redundancies to supply drinking water are not established. To mitigate this issue, Muscogee Nation has several water buffaloes that it can deploy during an emergency event. Muscogee Nation also has partnerships with local, state, and federal partners to provide similar services in emergency situations. In terms of mitigation actions, Muscogee Nation could develop its own water treatment facilities, especially in areas that supply critical facilities. Muscogee Nation also could construct water towers or similar water holding facilities, although their limits during a drought.

Transportation: In the event of an extreme earthquake, roads may be damaged or destroyed, which could delay emergency response times or disrupt evacuation routes, further straining Muscogee Nation's public health systems and threatening personal health of its Citizens.

Critical Facilities

Critical facilities face the same potential impacts to earthquakes as other structures in Nation. Some cultural critical facilities are particularly at risk, given their age and method of construction (see Culture



section). All critical facilities should ensure that their backup generation is up-to-date and secured as best as possible from the cascading effects of a power failure following an earthquake event.

Future Development

All future development is vulnerable to earthquake. As of this writing, Muscogee Nation has committed to adopting the 2021 International Building Codes, which can enhance the built environment's resilience to earthquakes. The Nation should also ensure that this adoption will apply to all structures constructed or purchased by the Government or by a Citizen, with the assistance of the government. The retroactive application of these codes, if feasible, also would help strengthen building standards for all structures in the Nation. The New Cultural Center, which Muscogee Nation is constructing as of this writing, will be more vulnerable to this hazard if the building is not hardened with current approaches, materials, and technologies.

Natural Environment

Earthquakes can cause land subsidence, either directly related to an earthquake or as the result of shaking.

4.12.3 Summary of Observations and Recommendations

Table 4-46 - Summary of Observations, Recommendations, and Actions

Observation(s)	Recommendation(s)	Action(s)
The seismic effects of earthquakes outside the Muscogee Nation boundaries may still affect structures within the Nation. Citizens are unaware of the dangers.	Develop and implement hazard preparedness, education, information, and awareness programs. Create and maintain a database for assessing vulnerabilities among Citizens. Develop or purchase a voluntary emergency management app to send notifications to citizens about various hazards throughout the tribal boundary.	1, 3, 4
Emergency response efforts and coordination in Muscogee Nation would benefit from additional planning and the construction of an emergency operations center.	Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines. Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation. Develop Housing Recovery and Resilience Strategy and adopt as Annex to EOP.	27, 31, 34
Damage associated with earthquakes in Muscogee Nation is generally minor, so many structures Muscogee Nation were not constructed with earthquakes in mind, including infrastructure.	Coordinate with private utilities and electric co-ops to harden electric utility infrastructure. Conduct a generator assessment for facilities to prioritize need for permanent or temporary backup electrical generation. Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant. Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, municipalities and infrastructure owners and operators within the Nation's boundaries. Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. When government or critical	11, 13, 14, 15, 17, 28, 33



	facilities are damaged, rebuild with disaster resistant construction techniques and technologies. Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.	
A lack of consistent and current technologies in the planning area makes the area more vulnerable to earthquakes in terms of response and hazard mitigation.	Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology. Obtain broadband/fiber connectivity for citizens.	24, 26
Water infrastructure is vulnerable to earthquakes, which could disrupt deliver to critical facilities in Muscogee Nation.	Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable. Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.	16, 19
Muscogee Nation is building a new cultural center to better protect and store their cultural artifacts and documents.	Protect the Muscogee Nation cultural center with weather-resistant infrastructure.	5
Although Muscogee Nation benefits from a strong healthcare network, enhancing its public health response can mitigation some vulnerabilities.	Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.	32



Chapter 5 Mitigation Strategy

This chapter identifies the hazard mitigation strategy and goals set by the Muscogee Nation and discusses the mitigation projects, or measures, to be taken to achieve those goals. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. The mitigation strategy is made up of three main required components: mitigation goals, mitigation actions, and a plan for implementation. These provide the framework to identify, prioritize, and implement actions to reduce risk to hazards.

5.1 Mitigation Goals

The mitigation goals section is composed of a mission statement, community goals, and guiding principles subsections. The mission statement provides Muscogee Nation's overarching goal that governs the entire mitigation strategy. The community goals subsection outlines specific jurisdictional and school district goals. It also considers the goals from the 2016 Muscogee Nation Plan and the State of Oklahoma's 2018 Plan. From these two subsections, the planning team developed a set of principles that will guide the Nation's strategic approach to risk mitigation.

5.1.1 Mission Statement

To create a disaster-resistant community by preserving the Muscogee Nation's culture and to improve the safety and well-being of the citizens of Muscogee Nation by reducing deaths, injuries, property damage, environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life, and results in a more livable, viable, and sustainable community.

Previous Plan Mission Statement

The 2016 Muscogee Nation plan included the same mission statement as this 2021 Plan Update (although the 2016 Plan called the mission statement "the goal").⁸⁴ The 2021 Plan update also aligns with the goals established by the State of Oklahoma's Hazard mitigation plan.⁸⁵

5.1.2 Mitigation Goal

Muscogee Nation's Mitigation Goal is guided by the mission statement above.

To identify Tribal policies, actions and tools for long-term implementation in order to reduce risk and future losses stemming from natural and technological hazards that are likely to impact the Muscogee Nation.

5.1.3 Goals for all Hazards

To meet Muscogee Nation's mission statement and mitigation goal, mitigation actions are guided by several goals for all hazards. The planning team reviewed and incorporated the Nation's previous goals, when applicable.⁸⁶ These goals are the actionable components of this section, as they appear as a line-

⁸⁴ Muscogee Nation 2016 plan, 3.

⁸⁵ State of Oklahoma 2018 plan, 4.1.

⁸⁶ Muscogee Nation Plan, 47.



item in the mitigation strategy. Not every mitigation action will meet all these goals, but all mitigation actions will fulfill at least one of these goals:

- Minimize loss of life and property from natural hazard events
- Protect public health and safety
- Increase public awareness of risk from natural hazards
- Reduce risk and effects of natural hazards
- Identify hazards and assess risk for local area
- Ascertain historical incidence and frequency of occurrence
- Determine increased risk from specific hazards due to location and other factors
- Improve disaster prevention
- Improve forecasting of natural hazard events
- Limit building in high-risk areas
- Improve building construction to reduce the dangers of natural hazards
- Improve government and public response to natural hazard disasters

5.2 Actions

A mitigation action is a policy, project, activity, or process taken to reduce or eliminate long-term risk to people, property, and the environment from hazards. Based on the principles section, the types of mitigation actions reviewed to reduce long-term vulnerability include:

- Preventative Activities
- Floodplain Management Regulatory/Current and Future Conditions
- Property Protection Activities
- Natural Resource Protection Activities
- Emergency Services Activities
- Structural Projects
- Public Information Activity

Specific observations and problem statements, resulting in the actions listed below, are included at the end of each hazard section in Chapter 4. Stakeholders reviewed actions to mitigate against the observations identified in the risk assessment.

This actions section is divided into two parts. The first part provides an overview of the status of actions listed in the 2016 Muscogee Nation Plan. Items were segmented into three categories: “completed,” “ongoing,” and “not started.” Actions were evaluated with the intent of carrying over “ongoing” and “not started” actions that also remain relevant to the planning area. These actions were reviewed and prioritized in the prioritization section for the 2021 Plan update. This section also provides a list of actions identified by the planning team to reduce long-term vulnerability.

The second part discusses the benefit and cost review that was used to prioritize mitigation actions. The benefits and costs of an action, which included qualitative and quantitative measures, were measured together to generate a Benefit-Cost Review (BCR). The planning team prioritized actions based on the BCR.



5.2.1 2016 Muscogee Nation HMP Action Items

A review of the 2016 mitigation actions was completed by the planning team. Of the 22 action items listed in the 2016 plan, most were listed as not started as of this Plan update. None of the actions were completed as of this Plan update. A list of ongoing actions be seen below:

Ongoing Actions

- Tornado/Wind, Action Number 5: *Install early warning devices within the Muscogee (Creek) Nation*. Muscogee Nation has installed some early warning devices in various communities within the boundaries of Muscogee Nation, most recently in 2021 the Nation funded a siren in Okemah (Okfuskee County), many other communities still lack warning devices or the warning systems remain in need of upgrade. The Nation has prioritized an installation for facilities in Coweta (Wagoner County) in 2022.
- Flood, Action Number 3: *Clean out ditches*. Several departments conduct this activity as part of their routine maintenance and projects, Environmental Services, and others (see Chapter 3).
- Flood, Action Number 3: *Development and Implementation of regulations for infrastructure built in flood plains*. Muscogee Nation has begun to develop and implement regulations for infrastructure in floodplains, including updated floodplain ordinances, joining the NFIP, and the commission of floodplain studies (see Chapters 3 and 4).
- Winter Storm, Action Number 2: *Trim Trees around tribal homes*. These activities are completed by Arbor Care (see Chapter 3).

For a complete list of actions, see Appendix A.

5.2.2 Prioritization

The planning team identified possible actions to mitigate risk in Muscogee Nation. From these potential mitigation actions, the planning team and community stakeholders weighed benefits and costs of each action. This review allowed Muscogee Nation to prioritize actions that mitigate risk across the Nation's vulnerable areas.

This section includes a commentary on the types of benefits and costs that were considered for each action. The benefits and costs of each action were weighted against each other to calculate a Benefit Cost Ratio (BCR). The prioritization of actions was determined by the BCR.

Benefits

Mitigation actions were evaluated using these benefits criteria. Although this list does not include every specific benefit discussed during this process, this list of items covers all categories of benefits that were considered. Muscogee Nation emphasized benefits impacting continuity of government, public safety and property protection, which is consistent with the previous Muscogee Nation Hazard Mitigation Plan.

Criteria	Description
Public Safety	How effective will the action be at protecting lives and preventing injuries?
Critical Infrastructure	Will the action safeguard assets that are vital for the community's functioning?
Other Public Property	How significant will the action be at eliminating or reducing damage to infrastructure and public open spaces? What is approximate dollar value of the expected benefit(s)?



Criteria	Description
Other Private Property	How significant will the action be at eliminating or reducing damage to private property? What is approximate dollar value of the expected benefit(s)?
Development	Does the action mitigate or prevent development in high-risk areas?
Environmental	Will the action include natural solutions or safeguard the environment?
Partnerships	Will the action provide an opportunity to foster new partnerships or strengthen existing ones?
NFIP	Will the action maintain, increase, or commence a jurisdiction's compliance with NFIP requirements? (For more information, see capability section)
Other Community Objectives	Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation?

Costs

An action's costs were also considered for the review. Some of the costs made it difficult to execute an action, while other costs made an action impossible to complete. Items that were considered impossible to complete were discarded at this stage. The list below provides an overview of all the general categories of costs considered.



Criteria	Description
Technical	Is the mitigation action technically feasible? Is it financially feasible? Is it a long-term solution?
Financial	Is the action financially feasible?
Cultural	Does the action align with the cultural values of the Nation?
Political	Is there overall public support for the mitigation action? Is there the political will to support it?
Legal	Does the community have the authority to implement the action?
Environmental	What are the potential environmental impacts of the action? Will it comply with environmental regulations?
Social	Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of marginalized people?
Administrative	Does the community have the personnel and administrative capabilities to implement the action and maintain it or it require outside help? Will this strain community resources excessively? Could the cost of maintaining partnerships necessary to complete this project be burdensome?

Benefit-Cost Review (BCR)

The benefits of each action are assigned a high, medium, or low rating. This is based on which benefits an action incorporates and to what degree it incorporates these benefits. Costs are also measured as high, medium, or low. Costs estimate the internal and external resources needed to implement an action,



including the likelihood of obtaining those resources. External resources will be discussed in the

Benefits			Costs		
Scale	Classification	Description	Scale	Classification	Description
	High	The action meets many priority benefit criteria and/or meets these criteria to a significant degree		Low	The action does not strain community resources and minimal external assistance is required
	Medium	The action meets some priority benefit criteria and/or meets criteria to moderate degree		Medium	The action could strain community resources, making external assistance a significant component of the action
	Low	The action meets almost no priority benefit criteria and/or meets criteria to a minimal degree		High	The action strains community resources significantly; external assistance, which is crucial, is not guaranteed

implementation section.

From these metrics, the planning team developed a benefit-cost review BCR. The higher the BCR assigned to an action, the higher that action was prioritized. The prioritized actions can be found in section 3 of this chapter.

5.3 2021 Hazard Mitigation Actions

The mitigation strategy combines the previous three sections into a cogent and comprehensive approach to mitigating risk in Muscogee Nation. Each action includes components from the goals, actions, and implementations sections to provide planners with a clear *why, what, how* template that can drive actions.

The Goal(s) component from the goals section provides the most significant reason(s) (the *why*) motivating each action. The action type, priority (determined by the BCR), key lifeline addressed, and hazards addressed highlight the *what* behind each action. Although they are discussed in Chapter 4, FEMA lifelines are included in the strategy to give the reader an understand of the critical networks that would benefit the most from an action. The lead agency and partners, funding



sources, and timeframe components from the implementation section focus on *how* each action will be implemented.

Action 1: Develop and implement hazard preparedness, education, information, and awareness programs to better educate citizens of their risks to hazard events and how to prepare. When possible, incorporate Mvskoke language into outreach materials.

Goals	Increase public awareness of risk from natural hazards. Preserve Mvskoke language.
Action Type	Public Information Activity
Priority (BCR)	Highest
Key Lifelines Addressed	Communications
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management and Historical and Cultural Preservation in partnership with State of Oklahoma and Local Governments
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-2026

Action 2: Develop and maintain outreach about the availability and importance of flood insurance.

Goal(s)	Increase flood insurance coverage of tribal citizens in Muscogee Nation. Improve and increase public awareness and response to natural hazards
Action Type	Public Information Activity
Priority (BCR)	Highest
Key Lifelines Addressed	Communications
Hazard(s) Addressed	Flood, Dam/Levee
Lead Agency (Partners)	Muscogee Nation Emergency Management in partnership with Oklahoma Water Resources Board and Local Governments
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-2026

Action 3: Create and maintain a database for assessing vulnerabilities among Citizens.

Goal(s)	Improve public response to natural hazards
Action Type	Emergency Services Activity
Priority (BCR)	Highest
Key Lifelines Addressed	Safety and Security; Communications
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management in partnership with State of Oklahoma and Local Governments
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance



Timeframe	2021-2026
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Action 4: Develop an emergency management app to send notifications to citizens about various hazards and emergency events throughout the tribal boundary.

Goal(s)	Improve governmental and public response to natural hazards
Action Type	Emergency Services Activity; Preventative Activity, Public Information Activity
Priority (BCR)	Highest
Key Lifelines Addressed	Safety and Security; Communications
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management and all county-involved jurisdictions
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-2026

Action 5: Construct the Muscogee Nation cultural center using hazard resistant construction practices

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk.
Action Type	Preventative Activity, Property Protection Activity, Structural Project
Priority (BCR)	Highest
Key Lifelines Addressed	Safety and Security
Hazard(s) Addressed	High Wind, Hail, Earthquake, Extreme Heat, Fire, Lightning, Severe Winter Storms
Lead Agency (Partners)	Muscogee Nation Emergency Management, Muscogee Nation Construction Services Department,, Historic and Culture Preservation Department
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2022-Ongoing

Action 6: Provide residential saferoom(s) to Tribal citizens through Muscogee Nation Safe Room Program.

Goal(s)	Expand saferooms to more citizens and households within the Nation; improve shelters in public spaces and critical facilities.
Action Type	Preventative Activity
Priority (BCR)	Highest
Key Lifelines Addressed	Safety and Security lifeline
Hazard(s) Addressed	Tornado/High Wind
Lead Agency (Partners)	Muscogee Nation Emergency Management, Muscogee Nation Construction Services Department, external partners



Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2022-2026

Action 7: Prepare master drainage plan drainage studies for flood areas and implement recommended activities.

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk for local area.
Action Type	Preventative Activity
Priority (BCR)	High
Key Lifelines Addressed	Safety and Security; Food, Water, and Shelter
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muscogee Nation Construction Services Department, external partners
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing

Action 8: Develop Advance Measures Plan for River Spirit Casino reduce impacts of future flooding along the Arkansas River.

Goal(s)	Plan for and implement temporary mitigation activities to be deployed during future flood events along the Arkansas River. Minimize property loss/damage as a result of flood events in partnership with USACE and River Spirit. Reduce closure time of Tribal revenue source and resulting economic impacts.
Action Type	Preventative Activity
Priority (BCR)	Highest
Key Lifelines Addressed	Safety and Security; Communications
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muscogee Nation, River Spirit Casino, USACE Tulsa District
Funding Sources	River Spirit Casino, USACE
Timeframe	2022-2023

Action 9: Implement long-term mitigation solutions to reduce the impact of future flood events at River Spirit Casino.

Goal(s)	Minimize property loss/damage as a result of flood events in partnership with River Spirit Casino. Reduce closure time of Tribal revenue source and resulting economic impacts.
Action Type	Property Protection Activity, Structural Projects
Priority (BCR)	Highest



Key Lifelines Addressed	Safety and Security. River Spirit Casino is identified in the Muscogee Nation Continuity of Government Plan and is one of the top revenue sources for the Tribe. Maintaining operability ensures critical government services remain intact.
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, River Spirit Casino, USACE, other external partners
Funding Sources	FEMA Hazard Mitigation Assistance
Timeframe	2022-Completion. Timeframe likely exceeds five-year maintenance timeframe. Status of this action will be included in the next plan update.

Action 10: Develop a comprehensive recurrent loss analysis study to determine the most appropriate mitigation actions for areas identified as “flood problem areas,” in the risk assessment. Implement activities identified in the plan.

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk for local area
Action Type	Preventative Activity
Priority (BCR)	High
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter Lifeline
Hazard(s) Addressed	Flooding, Dam, Levee
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, USACE, other external partners, River Spirit Casino
Funding Sources	Tribal Resources, FEMA Hazard Mitigation Assistance
Timeframe	2022-2027

Action 11: Partner with private utilities and electric cooperatives to harden electric utility infrastructure.

Goal(s)	Minimize property loss/ damage from natural hazard events
Action Type	Structural Activity; Property Protection Activity
Priority (BCR)	High
Key Lifelines Addressed	Safety and Security lifeline
Hazard(s) Addressed	Hail, Tornado/ High Wind, Severe Winter Storm, Extreme Heat, Earthquake, Lightning, Fire
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Private electric utility providers and Electric Cooperatives in the planning area
Funding Sources	Tribal Resources, FEMA Hazard Mitigation Assistance
Timeframe	2022-Ongoing



Action 12: Develop a drought management plan, with an emphasis on agricultural resilience, to better address critical needs during a prolonged drought.

Goal(s)	Minimize property loss/ damage from natural hazard events
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security; Food, Water, Shelter
Hazard(s) Addressed	Drought
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Muscogee Nation Water Resource Management, Oklahoma Water Resources Board, US Army Corps of Engineers Tulsa District.
Funding Sources	Tribal Resources, FEMA Hazard Mitigation Assistance,
Timeframe	2022-Ongoing

Action 13: Develop an Infrastructure Resilience Plan for Muscogee Nation, partnering with Counties, Municipalities and infrastructure owners and operators within the Nation's boundaries. Recognize interdependencies and interconnectedness of infrastructure and critical infrastructure.

Goal(s)	Further assess condition of critical infrastructure that services Muscogee Nation and its citizens, and identify mitigation actions that will minimize property loss/ damage from hazard events
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security; Food, Water, Shelter
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, State of Oklahoma, Infrastructure Owners and Operators
Funding Sources	Local sources, FEMA Hazard Mitigation Assistance, Department of Homeland Security
Timeframe	2022-2027

Action 14: Conduct a generator assessment for government facilities to prioritize need for permanent or temporary backup electrical generation. Install permanent generators where recommended.

Goal(s)	Protect Public Health and Safety
Action Type	Emergency Services Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter lifeline; Health and Medical lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Muscogee Nation Department of Administration



Funding Sources	Local Sources, FEMA HMGP/BRIC, State Funding
Timeframe	2021-2026

Action 15: Complete hazard evaluations of critical facilities and retrofit buildings to make them more disaster resistant.

Goal(s)	Minimize property loss/damage from natural hazard events; Protect Public Health and Safety
Action Type	Emergency Services Activity, Preventative Activity, Property Protection Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Food, Water, Shelter lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management, Muscogee Nation Construction Department
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance, Other Tribal and Federal Funding
Timeframe	2021-Ongoing

Action 16: Build water tower(s) as needed to ensure continued water availability and operation of Muscogee Nation Government, Business, and Health Facilities when primary water sources become unavailable.

Goal(s)	Minimize agricultural loss and damage from natural hazard events; Protect Public Health and Safety
Action Type	Structural Project Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security; Food, Water, Shelter;
Hazard(s) Addressed	Flooding, Dam/Levee, Drought, Earthquake, Tornado/High Wind, Severe Winter Storm, Fire, Lightning
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Muscogee Nation Water Resource Management, Muscogee Nation Construction Department
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance, Tribal Water Funding Sources
Timeframe	2021-Ongoing

Action 17: Conduct a utility inventory and conditions assessment for the Nation to identify locations of critical infrastructure and government facilities and citizens served by various utility operators. Use this information to establish common operating picture during emergency events (identify impacts of utility outages on Tribal operations and citizens) and prioritize partnerships with utility owners and operators.



Goal(s)	Protect Public Health and Safety; Improve governmental and public response to hazards
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security; Food, Water Shelter; Health and Medical; Energy; Communications
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Muscogee Nation Water Resource Management, Utility owners and operators within Muscogee Nation
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-2026

Action 18: Partner with the Oklahoma Department of Transportation to mitigate roadways with repeated flooding events.

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk for local area
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter Lifeline
Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Tribal Transportation Program, Muscogee Nation Emergency Management Department, State of Oklahoma Department of Transportation, Muscogee Nation Construction Department
Funding Sources	Federal Highway Administration, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing

Action 19: Develop Continuity of Operations Plans with water distributors and the Nation to mitigate the effects of all hazards on water supply and quality.

Goal(s)	Improve governmental and public response to hazards
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, Shelter lifeline; Energy Lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, External Municipal Water Departments, Rural Water Districts
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing



Action 20: Complete wind feasibility study and cost effectiveness determination of building tribal housing and commercial facilities to Insurance Institute of Building and Home Safety (IBHS) FORTIFIED standards.

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk for local area
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security
Hazard(s) Addressed	Tornado/High Wind
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, external partners
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing

Action 21: Prepare impact study of NRCS and municipal dam breaches to determine actions in potential inundation areas of current and proposed development.

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk for local area
Action Type	Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter Lifeline
Hazard(s) Addressed	Dam/Levee, Flooding
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, NRCS, Oklahoma Water Resources Board, US Army Corps of Engineers Tulsa District
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance, NRCS, USACE Silver Jackets
Timeframe	2021-Ongoing

Action 22: Provide and maintain defensible space around structures in the Wildland Urban Interface.

Goal(s)	Improve disaster prevention; Continue to assess and update hazard risk for local area
Action Type	Natural Resources Protection Activity; Property Protection Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Food, Water, and Shelter lifeline
Hazard(s) Addressed	Fire
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Arbor Care, Muscogee Nation Environmental Services
Funding Sources	Tribal Sources, FEMA HMGP Post Fire (following a fire declaration)



Timeframe	2021-2026
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Action 23: Establish construction management procedures compliant with FEMA Community Rating System (CRS) and join the CRS program.

Goal(s)	Increase public awareness of risk from natural hazards
Action Type	Floodplain Management Regulatory/Current and Future Conditions, Public Information Activity
Priority (BCR)	Medium
Key Lifelines Addressed	N/A
Hazard(s) Addressed	Flood, Dam/Levee
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Muscogee Nation Construction Department
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-2026

Action 24: Develop GIS and other web-based and mobile capabilities in three key areas: to identify and model critical components of the built environment, to provide advanced and early detection, modeling, and warning systems for risks based on GIS platforms, and to develop the ability to distribute information on risks through web-based and mobile technology.

Goal(s)	Improve governmental and public response to natural hazards
Action Type	Emergency Services Activity; Preventative Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Communications lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Geospatial Department, Muscogee Nation Emergency Management Department
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing

Action 25: Develop and adopt stormwater engineering and development criteria to protect roadways and buildings from flooding damage.

Goal(s)	Minimize property loss/damage from natural hazard events; Continue to assess and update hazard risk for local area
Action Type	Preventative Activity; Floodplain Management Regulatory/Current and Future Conditions
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter Lifeline



Hazard(s) Addressed	Flooding
Lead Agency (Partners)	Muscogee Nation Construction Department, Muscogee Nation Emergency Services
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing

Action 26: Obtain broadband/fiber connectivity for citizens.

Goal(s)	Protect public health and safety
Action Type	Emergency Services Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Construction Department
Funding Sources	Local Sources, ARPA funding, Other Federal funding focused on broadband actions
Timeframe	2021-Ongoing

Action 27: Develop emergency operations plans (or addendums to existing plans) for Muscogee Nation that address actions and procedures for all the hazards identified in this plan and conforms to national emergency operations guidelines.

Goal(s)	Improve governmental and public response to hazards
Action Type	Preventative Activity, Emergency Services Activities
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security lifeline; Food, Water, Shelter lifeline; Energy Lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management, Tribal Transportation Department, Storm Shelter Program
Funding Sources	Local Sources, EODD/INCOG
Timeframe	2021-Ongoing

Action 28: When government or critical facilities are damaged, rebuild with disaster resistant construction techniques and technologies.

Goal(s)	Minimize property loss/damage from natural hazard events; Improve building construction
Action Type	Preventative Activity
Priority (BCR)	Medium



Key Lifelines Addressed	Safety and Security lifeline; Food, Water, and Shelter lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Construction Department
Funding Sources	Tribal Resources, FEMA 406 Funding, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing

Action 29: Maintain tree-trimming capabilities around electrical lines to prevent fire and electrical outages.

Goal(s)	Minimize property loss/damage from natural hazard events
Action Type	Preventative Activity, Emergency Services Activity
Priority (BCR)	Low
Key Lifelines Addressed	Safety and Security lifeline; Energy lifeline
Hazard(s) Addressed	Severe Winter Storm, Tornado/ High Wind
Lead Agency (Partners)	Muscogee Nation Arbor Care
Funding Sources	Tribal Resources, Arbor Care
Timeframe	2021-2026

Action 30: Partner with neighboring jurisdictions to improve transportation abilities of Muscogee Nation citizens.

Goal(s)	Improve disaster prevention; Minimize property loss/damage from natural hazard events
Action Type	Preventative Activity
Priority (BCR)	Low
Key Lifelines Addressed	Food, Water, and Shelter lifeline
Hazard(s) Addressed	Flood, Dam
Lead Agency (Partners)	Muscogee Nation Transportation Department, Muscogee Nation Emergency Management, and participating Counties
Funding Sources	Local Sources, FEMA HMGP/BRIC
Timeframe	2021-2031

Action 31: Construct an Emergency Operations Center hardened to withstand high wind and power outages, that can be used as a regional hub in partnership with the Oklahoma Department of Emergency Management, to better respond and organize recovery from emergency and disaster events within the Muscogee Nation Reservation.



Goal(s)	Public Health and Safety, minimize property loss/ damage from natural hazard events
Action Type	Emergency Services Activity, Structural Project Activity
Priority (BCR)	Medium
Key Lifelines Addressed	Safety and Security; Food, Water, and Shelter lifeline; Communications lifeline; Hazardous Materials lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management
Funding Sources	Local Sources, FEMA HMGP/BRIC, HUD CDBG
Timeframe	2021-2026

Action 32: Develop a public health coordination plan with the Muscogee Nation Department of Emergency Management and the Muscogee Nation Department of Health.

Goal(s)	Public Health and Safety
Action Type	Emergency Services Activity
Priority (BCR)	Low
Key Lifelines Addressed	Health and Medical
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Health Department, Muscogee Emergency Management
Funding Sources	Tribal Sources, Indian Health Services (IHS), Emergency Management Performance Grant
Timeframe	2021-Ongoing

Action 33: Obtain alternate and back-up power sources for Muscogee Nation government facilities and critical facilities such as sub-stations, micro-grids, and solar power.

Goal(s)	Public Health and Safety
Action Type	Emergency Services Activity, Preventative
Priority (BCR)	Low
Key Lifelines Addressed	Safety and Security; Communications Energy; Food, Water, and Shelter Lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Emergency Management Department, Muscogee Nation Transportation
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing



Action 34: Develop Housing Recovery and Resilience Strategy and adopt as annex to Muscogee Nation Emergency Operations Plan

Goal(s)	Public Health and Safety
Action Type	Emergency Services Activity, Preventative
Priority (BCR)	Low
Key Lifelines Addressed	Safety and Security; Communications Energy; Food, Water, and Shelter Lifeline
Hazard(s) Addressed	All
Lead Agency (Partners)	Muscogee Nation Department of Housing
Funding Sources	Tribal Sources, FEMA Hazard Mitigation Assistance
Timeframe	2021-Ongoing



Chapter 6 Plan Maintenance and Adoption

This chapter includes a discussion of the plan maintenance process and documentation of the adoption of the plan by the Muscogee Nation. The Muscogee Nation will ensure that a regular review and update of the Multi-Hazard Mitigation Plan occurs per the guidance in this Chapter.

Since the last plan update, Muscogee Nation established a Floodplain Advisory Board (herein referred to as “the Board”). The Board, which was created in 2021, will serve as the committee that oversees all maintenance efforts in this Plan, which is also discussed in other sections. All mitigation activities on the board will be directed and coordinated by the Emergency Management Director for the Muscogee Nation, given the Director’s pivotal role in coordinating mitigation and emergency response efforts throughout the Nation.

Led by the Emergency Management Director, Board will hold quarterly sessions beginning in February of each year, or as needed, to complete the monitoring, evaluation, updating, public involvement, and plan incorporation activities required to meet the targets listed in each of the respective sections. The Plan will be updated and resubmitted to FEMA for approval prior to the 5-year approval period expiration, per FEMA requirements (see: updating the Plan section).

6.1 Monitoring the Plan

Monitoring of the Plan, especially the mitigation strategy and its action items, is the primary responsibility of the Emergency Management Director, with the guidance and support of the Board. Cabinet members and other senior members outside the board can also serve in an advisory role, when requested.

Departments responsible for implementing the action items or other components of this Plan will update their progress reports on an annual basis at minimum, including impediments to progress of the mitigation measures. These reports will be made available to the Emergency Management Director prior to the annual evaluation of the plan. Monitoring of the Plan will adhere to the schedule outlined in Table 6-1.

Table 6-1 Plan Maintenance Schedule

Meeting Year	Topic
2022	Monitor Plan Progress and Hazard Activity
2023	Monitor Plan Progress and Hazard Activity
2024	Monitor Plan Progress, Hazard Activity, Secure Funding, and Start Plan Update
2025	2026 Update Planning Process
2026	Adopt Plan Update and Begin Monitoring Process

6.2 Evaluating the Plan

This Plan will be continually evaluated by the Emergency Management Director in the Director’s role as director and coordinator of mitigation for the Board. The Muscogee Nation Government Departments and other entities responsible for the implementation of action items, as outlined in the mitigation strategy and as directed by the Board, will evaluate the effectiveness of the action item(s) tasked and the applicability of



the goals attached to the items. Reports will be made to the Emergency Management Director on these evaluations along with progress in the implementation of the Plan. Based on these and other notes, the emergency manager will complete an evaluation of the Plan's stated purpose and goals. In addition, the basic components of this evaluation will assess:

- Adequacy of adopted goals and strategy in addressing current and future expected conditions
- Whether the nature and magnitude of the risks have changed
- Appropriateness of current resources allocated for implementation of the Plan
- To what extent the outcomes of the action items occurred as expected
- Whether agencies, departments, and other partners have participated in the monitoring and upkeep of the Plan as originally anticipated
- Whether mitigation actions have been incorporated into new planning processes
- To make necessary adjustments to reflect changes in tribal laws in statutes
- Incorporation activities listed in section 6.5

These programs will continue to be monitored and updated on an annual basis, if not more often.

6.3 Updating the Plan

Future updates of this plan will seek to adhere to the following schedule. Although this Plan establishes mitigation activities as continuous over the next 5 years (see the other sections), this section refers to the official process used to execute this plan.

Begin the Official Process

The Nation will secure funding to update this plan no later than two (2) years prior to the plan's expiration date. Upon securing funding, the Nation will officially begin to revise and update this plan.

Revise and Update

The Nation will incorporate revisions to the plan document identified during the monitoring and evaluation period, as well as items identified in the previous Planning Tool.

Submit for Review

The revised plan will be submitted to FEMA no later than six (6) months prior to the Plan's expiration date.

Final Revision and Adoption

If necessary, the plan will be revised per FEMA remarks, adopted by the participating jurisdictions, and the updated plan sent to FEMA prior to the expiration of the 5-year approval period. The Plan will be adopted by the Muscogee Nation by signature authority of the Principal Chief.

6.4 Public Involvement

The Nation is committed to involving the public directly in updating and maintaining the Multi-Hazard Mitigation Plan as much as is feasible. Public involvement includes incorporating public opinion on the plan update and other mitigation activities, which can be enhanced through other education and outreach programs to Citizens in the Nation. Public involvement activities will include, but are not limited to:

- Maintaining a current copy of the Plan on the Muscogee Nation's hub page or other website



- Maintaining a hard copy at relevant locations, such as the Muscogee Nation Council House and at the Office of the Emergency Management
- Routine and ad hoc public meetings, which will be announced and advertised with sufficient advanced notice
- Periodic information updates on the Plan's progress, which can include meetings, presentations, media summaries, or official releases
- Any outreach involving hazard education or partnership with another entity to achieve the same goal (see Chapter 5)

6.5 Incorporating the Mitigation Plan

The Hazard Mitigation Planning Committee recognizes the importance of fully integrating hazard mitigation planning and implementation into existing local plans, regulatory tools, and related programs; this process was used for the integration of the *2021 Muscogee Nation Multi-Hazard Mitigation Plan*.

This section notes Muscogee Nation's continued commitment "to comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002."⁸⁷ This commitment is reflected throughout this planning process and all governmental activities in the Nation.

Some of Muscogee Nation's planning tools available for incorporating the recommendations and requirements of the Hazard Mitigation Measures are listed below. The Emergency Manager will ensure annual review of specific plans, ordinances, and codes identified in Chapter 3 to incorporate the requirements of this plan and hazard mitigation practices, into those documents whenever feasible.

The Muscogee Nation incorporated the 2016 Hazard Mitigation Plan into several government efforts. The plan was used as justification to seek Federal disaster relief after the historic 2019 flood and several subsequent events in 2020 and 2021. The Hazard Mitigation Plan was used as a justification of Federal Disaster Assistance and was considered when developing the required administrative plans for the Public Assistance Program and Hazard Mitigation Grant Program.

- *FEMA DR-4456 Muscogee (creek) Nation Severe Storms, Straight-line Winds, Tornadoes, and Flooding*
- *EM-3502 Muscogee (creek) Nation Covid-19*
- *FEMA DR-4587 Oklahoma Severe Winter Storms*

The Mitigation Plan was also used to identify projects to fund through the FY 2019 Pre-Disaster Mitigation Program. It is currently being incorporated into the Tribal Master Plan to ensure development on the Tribal Complex considers adequate drainage and does not cause increased flood impacts.

The Plan will be adopted by the Muscogee Nation through the authority of the Principal Chief. The Plan guides the Nation's mitigation activities. Appropriate Action Items and Mitigation Measures from the plan will be incorporated into the following plans and codes:

- Capital Improvements Plan and planning process
- Muscogee Nation Building Codes
- Muscogee Nation Emergency Operations Plan

⁸⁷ Plan Review Guide, 30.



- Muscogee Nation Water and Sewer Plan
- Muscogee Nation Tribal Master Plan

In particular, the Mitigation Strategy outlined in this Plan (Chapter 5) will serve as the primary guide for emergency and competitive hazard mitigation funding received by Muscogee Nation from federal and state sources.

In keeping with the intent of this Chapter, the Emergency Management Director, as director and coordinator of mitigation for the Board, will lead implementation and ensure that incorporation of plan elements into other planning tools is maximized. The process to include the mitigation actions follows the same procedures as the monitoring, evaluating, and updating procedures of the Plan.



Appendix A. Status of the 2016 Action Items

Mitigation action items from the 2016 *Muscogee Nation Hazard Mitigation Plan* and were assessed to determine their status. Items determined to still be operable in reducing Muscogee Nation's exposure to hazards were incorporated into the 2021 mitigation strategy in Chapter 5.

Table 1 2016 Muscogee Nation Mitigation Actions

Item #	Action Description	2021 Status
Drought (D)		
D1	Drill additional water wells ensuring that an adequate water supply is available for residents of the Muscogee (Creek) Nation Planning Area	Not Started
D2	Prepare Radio and TV ads for distribution to the media as well as emergency planning guide book	Not Started
D3	Incorporate drought tolerant or xeriscaping practices into landscape ordinances to reduce dependence on irrigation	Not Started
Tornado/Wind (TW)		
TW1	Installation of a community storm shelter within the Muscogee (Creek) Nation Housing Developments	Not Started
TW2	Pass Tribal Law that all new construction to have a safe room or storm shelter	Not Started
TW3	Install window film on windows of all Muscogee (Creek) Nation infrastructures	Not Started
TW4	Install standalone generators at all Muscogee (Creek) Tribal Administration Buildings	Not Started
TW5	Install early warning devices within the Muscogee (Creek) Nation	Ongoing
Thunderstorm (T)		
T1	Install window film on windows of all Muscogee (Creek) Nation infrastructures	Not Started
T2	Harden roofs on all existing and future critical facilities of the Muscogee (Creek) Nation such as Tribal Police Building, Administrative Building, Human Development Building, etc.	Not Started
T3	Purchase and install surge/lightning protectors in and around all critical facilities	Not Started
Extreme Heat (E)		
E1	Purchase and install window film on all critical facilities to reduce heat within those structures	Not Started
E2	Prepare Radio and TV ads for distribution to the media as well as emergency planning guidebook	Not Started
E3	Increasing tree plantings around buildings to shade parking lots and along public right-of-ways	Not Started
Flood (F)		
F1	Elevate utilities at tribal administration buildings	Not Started
F2	Tribal roadways could be impacted by flood waters	Not Started
F3	Clean out ditches	Ongoing



Item #	Action Description	2021 Status
F4	Development and Implementation of regulations for infrastructure built in flood plains	Ongoing
Wildfire (WF)		
WF1	Purchase and install dry hydrants within the Muscogee (Creek) Nation planning area	Not Started
WF2	Purchase and install fire retardant materials on all existing facilities	Not Started
WF3	Incorporate drought tolerant or xeriscaping practices into landscape ordinances to reduce dependence on irrigation	Not Started
Winter Storm (WS)		
WS1	Work with local utility companies to bury utility lines to prevent loss	Not Started
WS2	Trim Trees around tribal homes	Ongoing

