McAlester Multi-Jurisdictional Multi-Hazard Mitigation Plan 2010

Flanagan & Associates, LLC
Planning Consultants

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Buddy Garvin ..... Vice Mayor/Fifth Ward Representative
Chris Fiedler ..... First Ward Representative
Steve Harrison ..... Second Ward Representative
John Browne ..... Third Ward Representative
Robert Karr ..... Forth Ward Representative
Louis Smitherman ..... Sixth Ward Representative

City of McAlester Citizens' and Technical Advisory Committee

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Richard Cotton, City of McAlester Sr. Engineering Technician
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William Faries, City of McAlester Safety/Risk Management
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Executive Summary

The City of McAlester is faced with a variety of natural and man-made hazards. While winter storms, dam releases, lightning, floods, and tornadoes have made national headlines in recent years, any part of a city can be impacted by these as well as high winds, drought, hail, fire, and other threats. Oklahoma's location at the intersection of the hot arid zone to the west, the temperate zone to the northeast, and the hot humid zone to the southeast makes it subject to a wide variety of potentially violent weather and natural hazards.

The Technical Advisory Committee meeting at McAlester

This City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan 2010 is a strategic planning guide developed in fulfillment of the Hazard Mitigation Grant Program requirements of the Federal Emergency Management Agency (FEMA), according to the *Stafford Disaster Relief and Emergency Assistance Act*. This plan is developed in accordance with, and fulfills requirements for, the Pre-Disaster Mitigation Grant (PDM) and Hazard Mitigation Grant (HMGP). It also fulfills requirements for the Flood Mitigation Assistance Program (FMA), Severe Repetitive Loss Program (SRL), and the Community Rating System Plan (CRS) from the Federal Emergency Management Agency (FEMA).

In December 2005, the Multihazard Mitigation Council of the National Institute of Building Sciences completed a study to assess future savings from mitigation activities. Their findings reflected the fact that mitigation activities in general produced over $4 in savings for every $1 invested in mitigation actions, with the greatest savings in the areas of flood-related events (5:1) and wind-related events (3.9:1). In addition, the report concludes,

> *"Mitigation is most effective when carried out on a comprehensive, community-wide, and long-term basis. Single ...activities can help, but carrying out a slate of coordinated mitigation activities over time is the best way to ensure that communities will be physically, socially, and economically resilient to future hazard impacts."*

Approval of this plan will qualify the City of McAlester and McAlester Public Schools to apply for PDM funds, as well as HMGP funds following a federal disaster declaration, as required under Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 2000.

Background

Virtually every area of the city is vulnerable to natural and man-made hazards. The McAlester Hazard Mitigation Citizen Advisory Committee (HMCAC) has identified 16 hazards affecting the City of McAlester, including floods, tornadoes, high winds, lightning, hailstorms, severe winter storms, extreme heat, drought, expansive soils, wildfires, urban structure fires, earthquakes, subsidence, dam and levee failures, fixed site hazardous materials incidents, and mass-casualty transportation hazards.

Purpose

The purpose of this plan is to:

- Assess the ongoing mitigation activities in the community;
- Identify and assess the hazards that pose a threat to residents and property;
- Evaluate additional mitigation measures that should be undertaken;
- Outline a strategy for implementation of mitigation projects.

The objective of this plan is to provide guidance for community activities for the next five years. It will ensure that the city and other partners implement activities that are most effective and appropriate for mitigating natural hazards and man-made incidents.

Hazard Mitigation Citizens Advisory Committee

Residents and professionals active in disasters provided important input in the development of the plan and recommended goals and objectives, mitigation measures, and priorities for actions. The HMCAC is comprised of residents identified by the McAlester City Council to participate. Members are listed above.

The Planning Process

Planning for the City of McAlester Multi-Hazard Mitigation Plan followed a ten-step process, based on guidance and requirements of FEMA for the PDM grant program, HMGP, the Flood Mitigation Assistance (FMA) program, and the Community Rating System (CRS):

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

Plan Summary

The City of McAlester Multi-Hazard Mitigation Plan provides guidance to help residents protect life and property from natural hazards. The plan identifies the hazards that are most likely to strike each jurisdiction, provides a profile and risk assessment of each hazard, identifies mitigation measures for each hazard, and presents an action plan for the implementation of the mitigation measures.

Chapter 1- Introduction provides a profile of the City of McAlester. This chapter includes a plan overview, as well as a community description including demographics, lifelines, and critical facilities.

Chapter 2- Existing Mitigation Strategies provides an overview and discussion of existing resources and hazard mitigation programs.

Chapter 3- The Planning Process presents detailed information documenting the planning process including residents and agency involvement, a table describing how and why each hazard was identified, and methodologies used in the plan for damage estimates and risk assessments.

Chapter 4- Natural and Man-Made Hazards provides an assessment of 16 natural or man-made hazards. Each assessment includes a hazard profile, catalogs historical events, identifies the vulnerable populations, and presents a conclusion.

Chapter 5- Mitigation Goals and Objectives sets disaster-specific goals and objectives and organizes proposed mitigation strategies under six mitigation categories: public information and education, preventive activities, structural projects, property protection, emergency services, and natural resource protection.

Chapter 6- Action Plan outlines an action plan for the implementation of high priority mitigation projects, including a description of the project, the responsible party, anticipated cost, funding sources, and timelines for implementation.

Chapter 7- Plan Adoption and Maintenance provides a discussion of the plan documentation of the adoption resolutions, and the Plan maintenance process. Plan maintenance includes monitoring, evaluating, and updating the plan with involvement of the public.

Appendix A- Glossary provides a glossary of terms commonly used in disaster management and hazard mitigation.

Appendix B- Mitigation Measures provides a more detailed discussion of possible Mitigation Measures outlined in Chapter 6, organized by category.

Appendix C- Mitigation Committee Meetings provides the agendas and sign-in sheets from the Citizens Advisory and Technical Advisory Committee meetings.

Mitigation Measures

The following are the high priority mitigation measures defined by the McAlester Hazard Mitigation Technical Advisory and Citizens Advisory Committees:

Mitigation Measure Description	*Hazards Addressed*
1. Develop an All-Hazard Public Information, Education, and Awareness Program.	Floods, Tornadoes, High Winds Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Transportation Events, Subsidence
2. Educate the public on the importance of a Family Disaster Plan and Supply Kit.	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Subsidence
3. Develop distribution centers in local libraries, government facilities, and other public buildings where information and safety guidance on natural and man made hazards can be provided to citizens.	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Dam Failures, Transportation Events
4. Distribute a Family Emergency Preparedness Guide to all families.	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Dam Failures, Transportation Events, Subsidence
5. Train/Educate builders, developers, architects and engineers in techniques of disaster-resistant homebuilding, such as the Fortified Home standards developed by the Institute for Business & Home Safety (IBHS), the Blueprint for Safety guidelines developed by the Federal Alliance for Safe Homes (FLASH).	Floods, Tornadoes, High Winds, Lightning, Hail, Winter Storms, Extreme Heat, Drought, Expansive Soil, Wildfires, Earthquakes
6. Educate builders on appropriate foundation types for soils with different degrees of shrink-swell potential. For example, using "post-tensioned slab-on-grade" or "drilled pier" vs. standard "slab-on-grade" or "wall-on-grade" foundations.	Expansive Soils

Mitigation Measure Description	*Hazards Addressed*
7. Educate residents, building professionals and safe room vendors on the International Codes Council/National Storm Shelter Association's "Standard for the Design and Construction of Storm Shelters" and consider incorporating this Standard into current regulatory ordinances.	Tornadoes, High Winds, Earthquakes
8. Establish an administrative procedure or change in City codes that require builders to check for expansive soils when applying for new residential construction permits, and to consider the use of foundations that mitigate expansive soil damages when in a moderate to high-risk area.	Expansive Soils
9. Provide lightning warning systems for City of McAlester public outdoor sports areas, pools, golf courses, and parks.	Lightning
10. Provide lightning warning systems for McAlester Public Schools outdoor sports areas and play grounds.	Lightning
11. Develop an Emergency Back-up Generator Hazard Mitigation Plan Annex to the McAlester Hazard Mitigation Plan for the community, assessing and prioritizing generator needs for critical facilities, both public and private. Assessment should include emergency generator needs, costs of installation for pads/transfer panels only, or for complete generator assembly installation.	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat
12. Based on the results of the Emergency Back-up Generator Hazard Mitigation Plan Annex, provide wiring and transfer switches to accommodate emergency generators during disaster power outages for critical facilities including Emergency Operations Centers, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities.	Floods, Tornadoes, High Winds, Lightning, Severe Winter Storms, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events

Mitigation Measure Description	*Hazards Addressed*
13. Obtain emergency generators for continuity of government/use during disaster power outages for critical facilities including Emergency Operations Centers, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities, as identified in the Emergency Back-up Generator Hazard Mitigation Plan Annex.	Tornadoes, High Winds, Lightning, Severe Winter Storms
14. Identify and encourage Private Critical Facilities (Financial Institutions, Elder Care Facilities, Designated/Potential Community Emergency Shelters, etc.) to have generator pad, wiring/transfer switches and Emergency Back-Up Generators, or Reliable Contracts to provide Back-Up Generators.	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes
15. Adopt an Ordinance requiring generator pad and wiring/transfer switches for Elder Care Facilities and Nursing Homes, to accommodate Emergency Back-Up Generators in the event of prolonged power outages.	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes
16. Identify and/or encourage key important private service facilities (gas stations, convenience stores, etc.) to have wiring/transfer switches and emergency back-up generators installed, or reliable contracts for the provision of back-up generators, in the event of disasters or power outages.	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes
17. Develop Memorandums of Understanding (MOUs) with private sector gasoline service facilities to provide priority fuel to emergency/critical vehicles (government, Police, Fire, ambulance, etc.) in times of emergency or power outage.	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes
18. Provide employee shelters/safe-rooms at critical facilities, such as 911 Center, fire stations and police stations to protect first responders.	Tornadoes, High Winds
19. Install Safe-Rooms in Schools.	Tornadoes, High Winds, Earthquakes
20. Continue Compliance with, and Participation in the National Flood Insurance Program (NFIP) and the Community Rating System (CRS).	Floods

Mitigation Measure Description	*Hazards Addressed*
21. Implement a Stormwater Utility Fee to pay for the Planning, Engineering, Operations and Maintenance costs of the Stormwater Drainage System.	Floods
22. Prepare a comprehensive basin-wide Flood and Drainage Annex to the Hazard Mitigation Plan for all watersheds within the jurisdiction. The Annex should identify all flooding problems within the jurisdiction, and recommend the most cost-effective and politically acceptable solutions.	Floods
23. Acquire and remove floodplain and repetitive loss properties where the community's Repetitive Loss and Flood and Drainage Annex to the Hazard Mitigation Plans identify acquisition as the most cost-effective and desirable mitigation measure.	Floods
24. When replaced, install Break/Shatter Resistant Glass in Government Offices, and critical facilities	Tornadoes, High Winds, Hail, Earthquakes
25. When replaced, install Break/Shatter Resistant Glass in Schools.	Tornadoes, High Winds, Hail, Earthquakes
26. Provide surge and lightning protection for computer-reliant critical facilities (e.g. City Hall, 911 Center, EOC, Police and Fire stations, water/wastewater treatment plant and public works buildings).	Lightning
27. Develop an inventory and database of Special Needs Populations requiring special assistance during disasters.	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Urban Fires, Wildfires, Earthquakes, Fixed-Site Hazardous Materials Events, Transportation Events
28. Install a Mass Emergency Telephone Communication system for mass call-outs to targeted areas of the community for emergency notification and/or information.	Floods, Tornadoes, High Winds, Severe Winter Storms, Extreme Heat, Drought, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Dam Failures, Transportation Events
29. Evaluate, upgrade and maintain community-wide outdoor omni-directional voice/siren warning systems.	Tornadoes, High Winds, Flooding, Dam Failure, Hazardous Materials

Mitigation Measure Description	*Hazards Addressed*
30. Develop / Review / Update the McAlester Debris Management Plan	Floods, Tornadoes, High Winds, Hail, Severe Winter Storms, Earthquakes
31. Provide covered shelters for City First Response/government vehicles to protect against hail damage.	Hail
32. Provide routine trimming of trees to reduce power outages during storms.	Severe Winter Storms, Tornadoes, High Winds

Mitigation Action Plan

The mitigation action plan includes strategies for implementing the mitigation measures, including information on the responsible agency, time frame, cost estimate, funding sources, and a statement of the measurable results.

For further information, contact:

Project Manager:
Cliff Pitner
Floodplain Administrator/
Engineering Inspector
City of McAlester
28 E. Washington
McAlester, OK 74502
918-423-9300 Ext. 4951
918-421-4943 (Fax)
cliff.pitner@cityofmcalester.com

Chapter 1: Introduction

44 CFR Requirements met:

Requirement §201.6(a)(3): *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.*

Requirement §201.6(c)(2)(ii)(C): *[The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

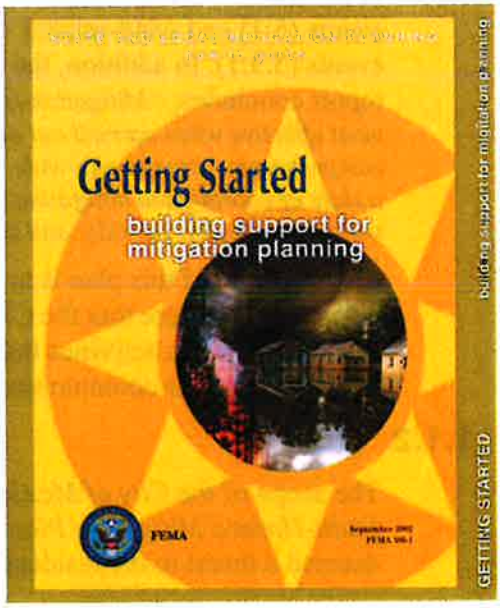
Included in this Chapter:

1.1 About the Plan
- 1.1.1 Purpose
- 1.1.2 Scope
- 1.1.3 Authority
- 1.1.4 Funding
- 1.1.5 Goals
- 1.1.6 Definition of Terms
- 1.1.7 Points of Contact

1.2 Community Information
- 1.2.1 Governance
- 1.2.2 Geography
- 1.2.3 Climate
- 1.2.4 History
- 1.2.5 Cultural & Historic Resources
- 1.2.6 Demographics
- 1.2.7 Lifelines
- 1.2.8 Economy
- 1.2.9 Development
- 1.2.10 Critical Facilities

1.1 About the Plan

This City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan is a strategic planning guide developed in fulfillment of the Hazard Mitigation Grant Program requirements of the Federal Emergency Management Agency (FEMA), according to the Stafford Disaster Relief and Emergency Assistance Act. This act provides federal assistance to state and local governments to alleviate suffering and damage from disasters. It broadens existing relief programs to encourage disaster preparedness plans and programs, coordination and responsiveness, insurance coverage, and hazard mitigation measures.



This plan is developed in accordance with, and fulfills requirements for, the Pre-Disaster Mitigation Grant (PDM) and Hazard Mitigation Grant (HMGP). It also fulfills requirements for the Flood Mitigation Assistance Program (FMA), Severe Repetitive Loss Program (SRL), and the Community Rating System Plan (CRS) from the Federal Emergency Management Agency (FEMA). This plan addresses 16 natural and man-made hazards.

1.1.1 Purpose

The purpose of this plan is to:

- Provide a description of the planning area (Chapter 1);
- Assess the ongoing mitigation activities in the City of McAlester and McAlester Public Schools (Chapter 2);
- Describe the planning process used to develop the mitigation plan (Chapter 3);
- Identify and assess the hazards that pose a threat to citizens, businesses, property, and schools (Chapter 4);
- Establish Goals and Objectives for community mitigation measures (Chapter 5);
- Evaluate Mitigation Measures that should be undertaken to protect citizens, businesses property, and schools(Appendix B);
- Identify and recommend an Action Plan for implementation of mitigation projects (Chapter 6);
- Develop a strategy for the adoption, maintenance, upkeep, and revision of the City of McAlester Multi-Jurisdictional Multi-Hazard Mitigation Plan (Chapter 7).

In December 2005, the Multihazard Mitigation Council of the National Institute of Building Sciences completed a study to assess future savings from mitigation activities. Their findings reflect the fact that mitigation activities in general produced over $4 in savings for every $1 invested in mitigation actions, with the greatest savings in the areas of flood-related events (5:1) and wind-related events (3.9:1). In addition, the report concludes, *"Mitigation is most effective when carried out on a comprehensive, community-wide, and long-term basis. Single activities can help, but carrying out a slate of coordinated mitigation activities over time is the best way to ensure that communities will be physically, socially, and economically resilient to future hazard impacts."*

McAlester Federal Building

The objective of this plan is to provide guidance for mitigation activities for the next five years. It will ensure that the City of McAlester and McAlester Public Schools implement hazard mitigation activities that are most effective and appropriate for the natural hazards that threaten their communities.

1.1.2 Scope

The scope of the *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan* is citywide. It addresses 16 natural and man-made hazards deemed a threat to the residents of McAlester and McAlester Public Schools. Both short-

term and long-term hazard mitigation opportunities are addressed beyond existing federal, state, and local funding programs.

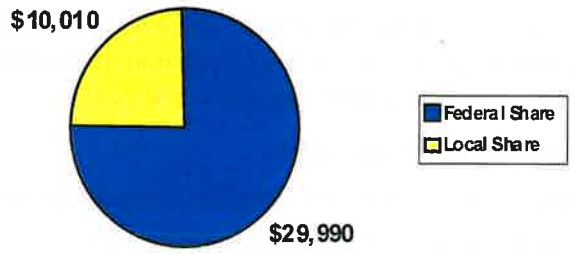
1.1.3 Authority

Section 322 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act, 42 USC 5165, enacted under Section 104 the Disaster Mitigation Act of 2000, P.L. 106-390, provides new and revitalized approaches to mitigation planning. A major requirement of the law is the development of a local hazard mitigation plan. Section 322, in concert with other sections of the Act, provides a significant opportunity to reduce the Nation's disaster losses through mitigation planning.

1.1.4 Funding

Funding for the *City of McAlester Multi-Jurisdictional Multi-Hazard Mitigation Plan* was provided by a $29,990 Pre-Disaster Mitigation grant from the Federal Emergency Management Agency (FEMA) and the Oklahoma Department of Emergency Management (OEM), with a $10,010 local match.

Figure 1–1: McAlester Multi-Hazard Mitigation Plan Funding



Total Funding: $40,000

1.1.5 Goals

The McAlester Technical Advisory Committee (TAC) and the McAlester Citizens' Advisory Committee developed the goals for the City of McAlester Multi-Jurisdictional Multi-Hazard Mitigation Plan with input from interested citizens. The local goals were developed taking into account the hazard mitigation strategies and goals of the federal and state governments.

National Mitigation Strategy and Goal

FEMA has developed ten fundamental principles for the nation's mitigation strategy:

1. Risk reduction measures ensure long-term economic success for the community as a whole, rather than short-term benefits for special interests.
2. Risk reduction measures for one natural hazard must be compatible with risk reduction measures for other natural hazards.
3. Risk reduction measures must be evaluated to achieve the best mix for a given location.
4. Risk reduction measures for natural hazards must be compatible with risk reduction measures for technological hazards and vice versa.

5. All mitigation is local.
6. Emphasizing proactive mitigation before emergency response can reduce disaster costs and the impacts of natural hazards. Both pre-disaster (preventive) and post-disaster (corrective) mitigation is needed.
7. Hazard identification and risk assessment are the cornerstones of mitigation.
8. Building new federal-state-local partnerships and public-private partnerships are the most effective means of implementing measures to reduce the impacts of natural hazards.
9. Those who knowingly choose to assume greater risk must accept responsibility for that choice.
10. Risk reduction measures for natural hazards must be compatible with the protection of natural and cultural resources.

FEMA's goal is to:

1. Substantially increase public awareness of natural hazard risk so that the public demands safer communities in which to live and work;
2. Significantly reduce the risk of loss of life, injuries, economic costs, and destruction of natural and cultural resources that result from natural hazards.

State of Oklahoma Mitigation Strategy and Goals

The State of Oklahoma has developed an Enhanced Natural Hazards Mitigation Plan (updated 2008) to guide all levels of government, business, and the public to reduce or eliminate the effects of natural disasters. The primary goals of the plan are to:

- protect public health and safety;
- eliminate losses from severe repetitive loss properties;
- eliminate losses from repetitive loss properties;
- improve government recovery capability;
- provide pre and post-disaster recovery guidance;
- reduce losses/damage to property and infrastructure;
- preserve natural and historic resources in vulnerable areas;
- preserve the environment;
- focus on those mitigation measures that are cost effective and provide the best benefit to communities.

The key measures to implement these goals include:

- enhance communication between tribal, state, federal agencies and local governments to facilitate post-disaster recovery and pre/post-disaster mitigation;
- coordinate federal, state, local, and private resources to enhance the preparedness and mitigation processes;
- ensure consistency between federal and state regulations;
- provide protection from hazards for critical facilities;
- support legislation that protects hazardous areas from being developed.

Another important goal of the Oklahoma State Mitigation Plan is to expand the focus of mitigation measures to include the major hazard threats to Oklahoma such as floods, tornado, severe weather, earthquakes, winter storms and wildfires.

McAlester's Goal

To improve the safety and well-being of the people residing and working in the City of McAlester by reducing the potential of deaths, injuries, property damage, environmental and other losses from natural hazards, and to do this in a manner that creates a disaster-resistant community, enhances economic development opportunities, and advances community goals and quality of life resulting in a more livable, viable, and sustainable community.

McAlester's Public Schools' Goal

To improve the safety and well-being of the Students, Faculty, and Staff of the McAlester Public School System by reducing the potential of deaths, injuries, property damage, education interruption and other losses from natural hazards, and to do this in a manner that creates a disaster-resistant school system that advances the schools goals and quality of education resulting in a more viable, and sustainable school system.

Goals for the mitigation of each of the hazards are presented in Chapter 5.

1.1.6 Definition of Terms

"Hazard Mitigation" is defined as: sustained actions taken to reduce or eliminate long-term risk to human life and property from natural, man-made, and technological hazards and their effects. Note that this emphasis on "long-term" risk distinguishes mitigation from actions geared primarily toward emergency preparedness and short-term recovery.

A glossary of additional terms commonly used in hazard mitigation is included in Appendix A.

1.1.7 Points of Contact

The primary points of contact for information regarding this plan are:

Primary Program Manager
Clifford Pitner
Flood Plain Administrator
City of McAlester
P.O. Box 578
28 E. Washington St.
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(918) 423-9300 x 4990
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cliff.pitner@cityofmcalester.com

Alternate Program Manager
John Modzelewski
Public Works Director/City Engineer
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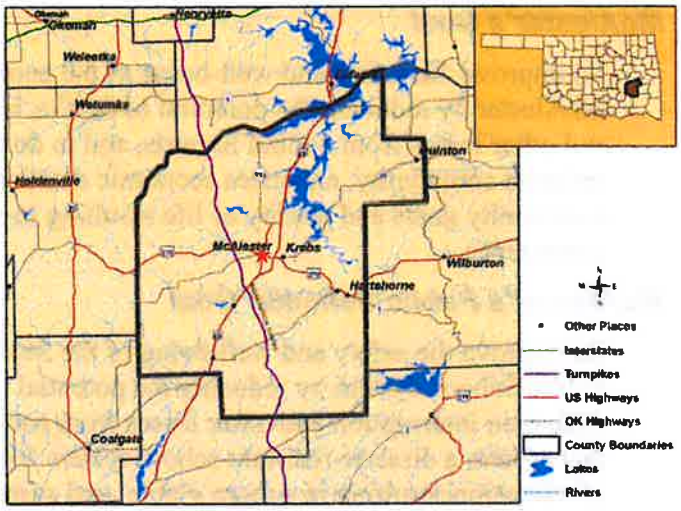
(918) 423-9300 x 4992
Fax: (918) 421-4943
John.modzelewski@cityofmcalester.com

1.2 Community Description

Figure 1–2: McAlester Locator Map



The City of McAlester and McAlester Public Schools are faced with a variety of natural and man-made hazards. While winter storms, dam releases, lightning, floods, and tornadoes have made national headlines in recent years, any part of a city can be impacted by these as well as high winds, drought, hail, fire, and other threats. In some cases, such as flooding and dam failure, the areas most at risk have been delineated and mapped.

The City of McAlester is located in Pittsburg County, in Southeast Oklahoma, 90 miles south of Tulsa and 118 miles east southeast of Oklahoma City. McAlester had a 2000 census population of 17,650 and a 2007 population estimate of 18,232. A basemap of the City of McAlester, with its major features and highways, is shown in Figure 1–3.

McAlester Public Schools serve nearly 3,000 students within the 31.6 square miles of the district. A map of the McAlester Public School locations and boundary are shown in Figure 1-4.

There are three early childhood centers for pre-Kindergarten and Kindergarten students, three elementary schools for student in T-1 through 4th grade, one intermediate center for grades 5 and 6, one middle school for grades 7 and 8, one high school for grades 9 through 12 and an alternative school for grades 9 through 12. (from McAlester Public Schools website)

1.2.1 Governance

The City Charter has established a Council-Manager form of government for McAlester. The Mayor and six council members are elected by the citizens of McAlester. The City Manager is appointed by the City Council and is the Chief Administrative Officer of the City.

The Mayor presides over Council meetings and votes on all City Council business. The Mayor is elected at large and serves a two-year term of office. The Mayor and Council Members enact City Ordinances, set City policy and authorize all expenditures of City funds.

The city is divided into 6 geographical areas called wards. Each Council Member represents one ward. Council Members are elected by the voters in each ward and serve a two-year term of office.

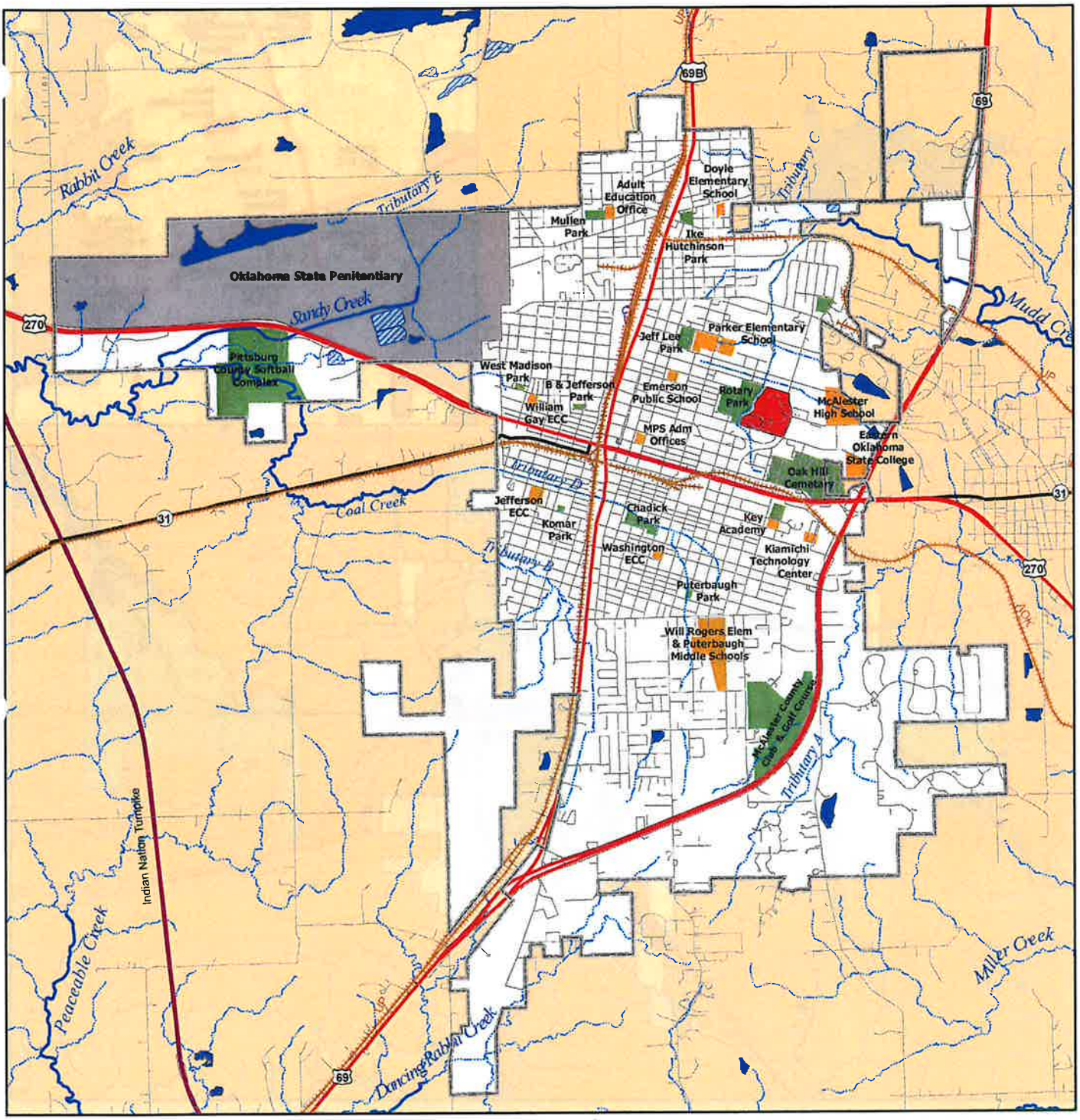
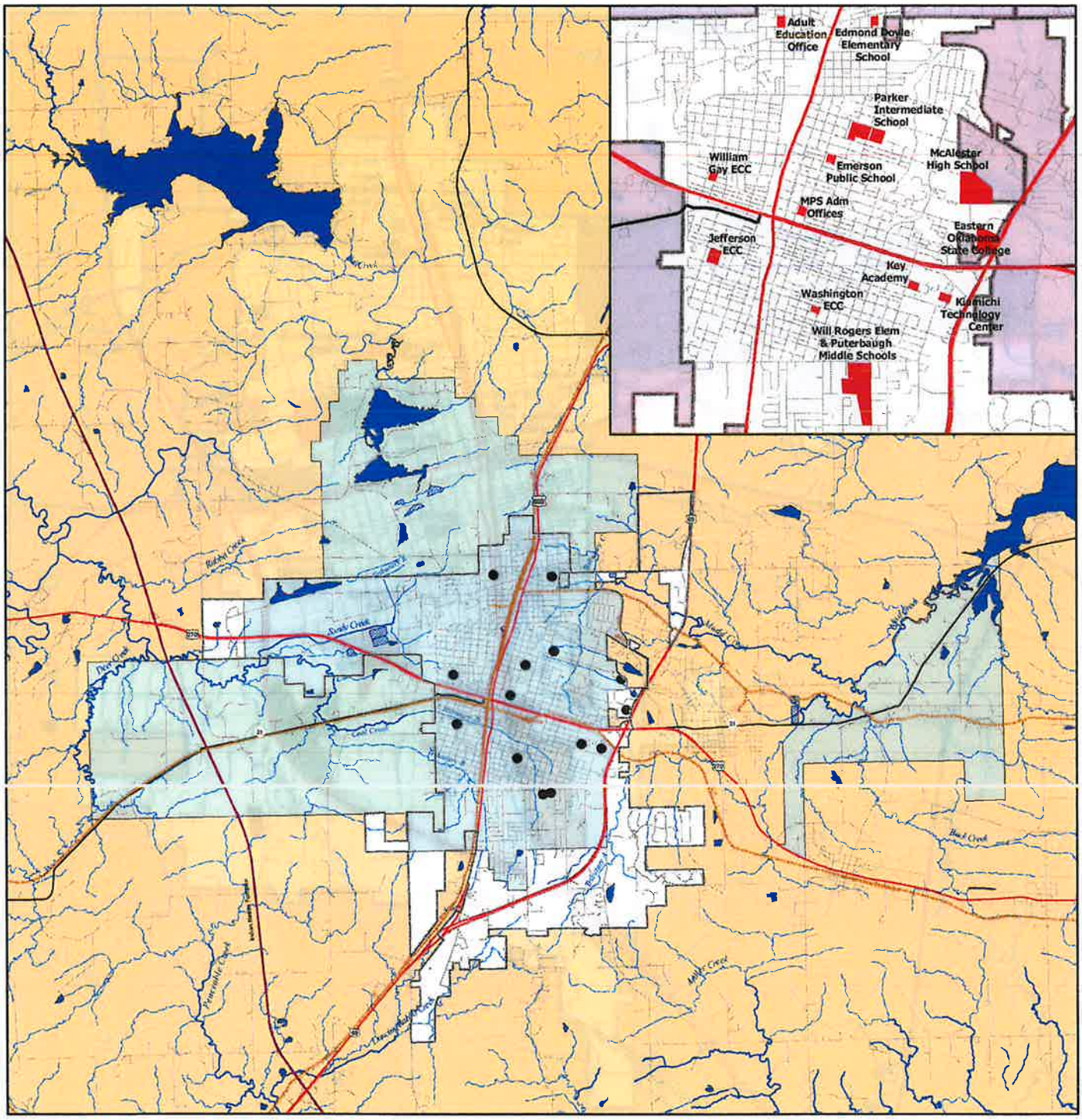


Figure 1-3

City of McAlester

Basemap



Legend

- County Boundary
- City limits
- McAlester School District
- School Site
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 1 2

Figure 1-4

McAlester School District

1.2.2 Geography

Latitude: 34.5559 N **Longitude:** 95.4559 W **FIPS Code:** 040-44800

McAlester is located in Pittsburg County in southeast Oklahoma. Southeast Oklahoma is far more mountainous and forested than any other part of the state, containing most of the Ouachita Mountains in Oklahoma, the Arbuckle Mountains, and five other mountain ranges. The Ouachita National Forest, Oklahoma's only national forest, is also in this area. Nearby Eufaula Lake provides year-round water recreation. The land area of the city covers 15.8 square miles. The land use for the City of McAlester is shown in Figure 1-5.

1.2.3 Climate

McAlester lies at an elevation of approximately 735 feet above sea level. It is far enough south to miss the extreme cold of winter. The climate is essentially continental, characterized by rapid changes in temperature. The winter months are usually mild. Temperatures occasionally fall below zero, but such cold snaps only last a short time. Temperatures of 100°F or higher are often experienced from late July to early September. January's average temperature is 38.9° F and July's average is 82.3° F.

Average annual precipitation ranges from about 42 inches in western Pittsburg County to 48 inches in the east. April and October are the wettest months, on average, but much of the spring through fall receives sufficient rainfall. Nearly every winter has at least one inch of snow, with one year in six having 10 or more inches.

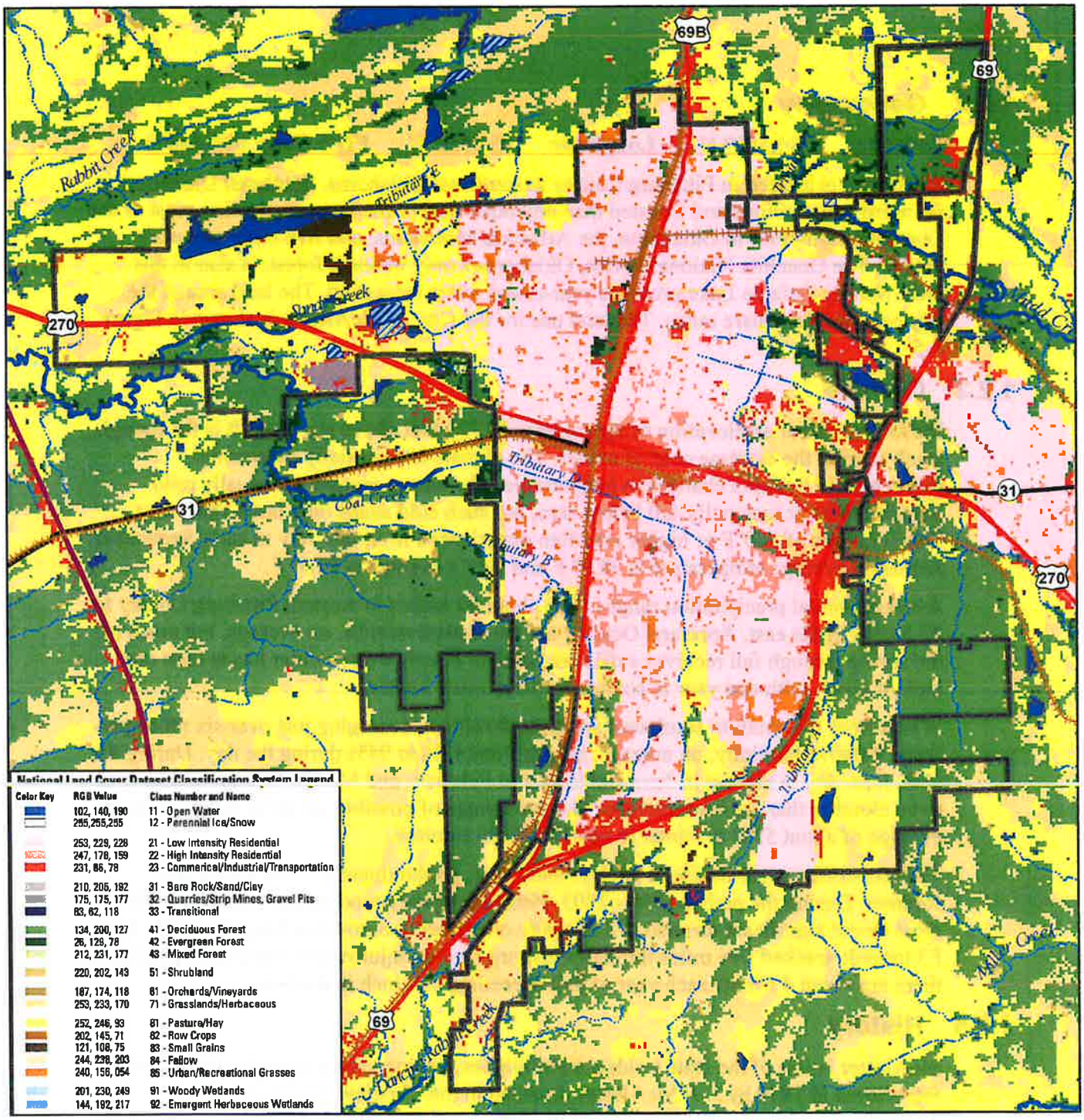
Winds from the south to southwest are quite dominant, averaging just over six miles-per-hour. Relative humidity, on average, ranges from 42% to 94% during the day. During the year, humidity is highest in June and lowest in February and March. Winter months tend to be cloudier than summer months. The percentage of possible sunshine ranges from an average of about 55% in winter to nearly 75% in summer.

Thunderstorms occur on about 58 days each year, predominantly in the spring and summer. During the period 1950 - 2003, Pittsburg County recorded 67 tornadoes. The most recent significant tornado (F2 intensity or greater) occurred on May 26, 1997. This F3 tornado tracked five miles through Pittsburg County injuring one person. Typically, there are about 4 events each year of hail exceeding one inch in diameter.

1.2.4 History

McAlester is one of the state's oldest communities, having grown around a trading post established in 1870 by J. J. McAlester. Located in the Choctaw Nation in Indian Territory, McAlester was incorporated in 1899. Abundant coal deposits discovered in the late 1800s brought an influx of immigrants, particularly Italians, to work the deep mines. As a result, nearby Krebs is known today as Oklahoma's Little Italy and is famous for its Italian cuisine. Another legacy of the coal mining era is that abandoned mines, largely unmapped, underlie much of the community, resulting in occasional and largely unpredictable sinkholes and other forms of subsidence.

After the discovery of coal, the Union Pacific Railway constructed a north-south railroad. The construction of a second railroad firmly established McAlester as the place for industry and manufacturing in the area.



Legend

- County Boundary
- City limits

Landmarks

- Airport
- Hospital
- Park
- School

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles
0 0.5 1

Figure 1-5

City of McAlester

Landcover

The state penitentiary is located in McAlester, and hosts the annual State Prison Rodeo held every Labor Day weekend, with inmates and professional cowboys competing in events.

1.2.5 Cultural and Historic Properties

McAlester has 17 identified locations on the National Register of Historic Places as of March, 2010. Additional local properties of historical and cultural relevance are also included in Table 1-1 and are shown in Figure 1-6:

Table 1–1: City of McAlester Historic Sites

NAME	ADDRESS	LISTED
Aldridge Hotel	200 E. Carl Albert Pkwy.	1995-12-07
Busby Office Building	113 E. Carl Albert Pkwy.	1979-12-06
Busby Theatre	Washington Ave. and 2nd St.	1979-12-06
Federal Building & Courthouse	Jct. of 3rd & Carl Albert Parkway	2000-03-24
First Presbyterian Church	101 E. Washington Ave.	1979-12-11
L'Ouverture Gymnasium	Jct. of S 14th St. & E Chickasaw Ave.	2006-05-26
Jeff Lee Park Bath House & Pool	3rd & Fillmore Sts.	1988-09-08
Mass Grave of the Mexican Miners	Mount Calvary Cemetery	1980-11-14
McAlester Armory	3rd & Polk Sts.	1988-09-08
McAlester DX	5th St. & Carl Albert Pkwy.	1980-08-29
McAlester House	14 E. Smith Ave.	1980-08-29
McAlester Scottish Rite Temple	2nd St. & Adams Ave.	1980-11-22
Mine Rescue Station Building	507-509 E. 3rd St	1980-03-13
OKLA Theater	18 E. Choctaw	2003-06-05
Perryville	SW of McAlester on U.S. 69	1984-08-23
Pittsburg County Courthouse	Washington Ave.	1972-05-05
Warden's House	Penitentiary Blvd & West St.	2005-06-17
Properties of local significance not listed in the National Register		
*Tobucksy County Courthouse	315 E. Krebs	
*Oklahoma State Penitentiary	West St. & Stonewall Ave.	
*Knights Templar Building	122 E. Carl Albert Parkway	
*Pioneer Abstract	105 E. Carl Albert Parkway	
*Old McAlester High School	2nd & Adams	
*Grand Ave. Methodist Church	225 E. Carl Albert Parkway	
*First Christian Church	300 E. Carl Albert Parkway	

Source: National Register of Historic Places

1.2.6 Demographics

Demography is the use of population characteristics (age and income distribution and trends, mobility, educational attainment, home ownership and employment status, for instance) for purposes of social studies.

As was clearly demonstrated in Hurricane Katrina in 2005, the vulnerability of a segment of the community to disasters will often vary according to demographic factors such as income level, age, race, language, education, disability and home ownership. For example, individuals and families in low-income areas often have less extensive safety nets (transportation, savings, credit, food supplies, and extended family networks) than those in high-income districts. Similarly, aging populations are more vulnerable to

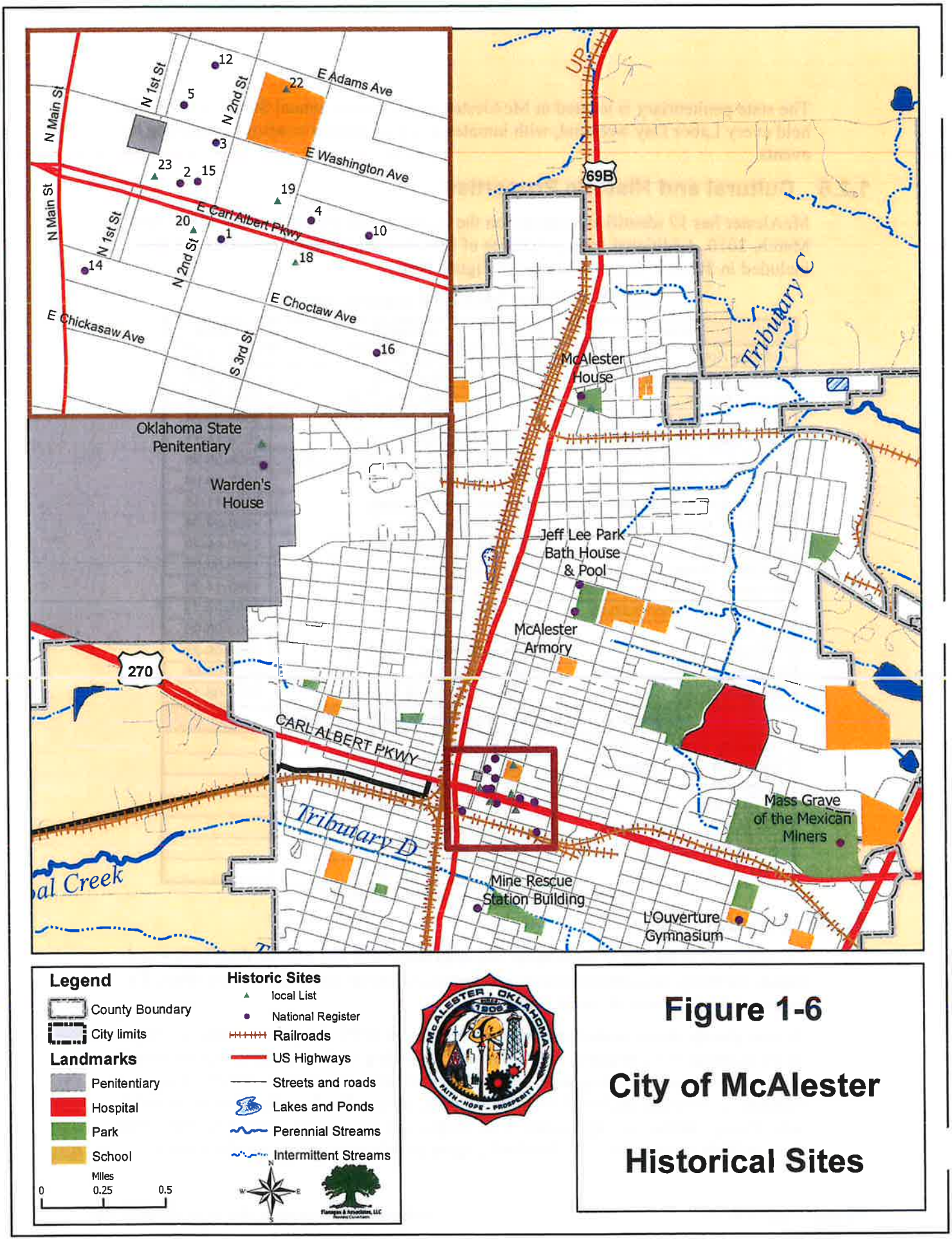


Figure 1-6

City of McAlester

Historical Sites

extreme heat and cold and often have fewer financial resources for purchasing supplies. Knowing the size and geographical location of potential at risk populations (such as small children, the elderly and the impoverished) are important to assessing the community's vulnerability.

McAlester had a 2000 Census population of 17,783 and a 2007 population estimate of 18,232. The density of McAlester in 2000 was 1,133 people per square mile, compared with the population density of Pittsburg County at 34 persons per square mile.

Of McAlester's population, 24.7% are under 18 years of age (2000 Census) and 18.2% are over 65. About 48.13% of McAlester's population is in the labor force (16 years of age and older). A map depicting the percentage of population aged 65 and above is shown in Figure 1-7; and a map depicting the percentage of population below poverty level is shown in Figure 1-8. McAlester's basic demographic data is summarized in Table 1-2.

14.7 percent of McAlester's residents above the age of 25 have a bachelor's degree or better. 78.3% are high school graduates or higher.

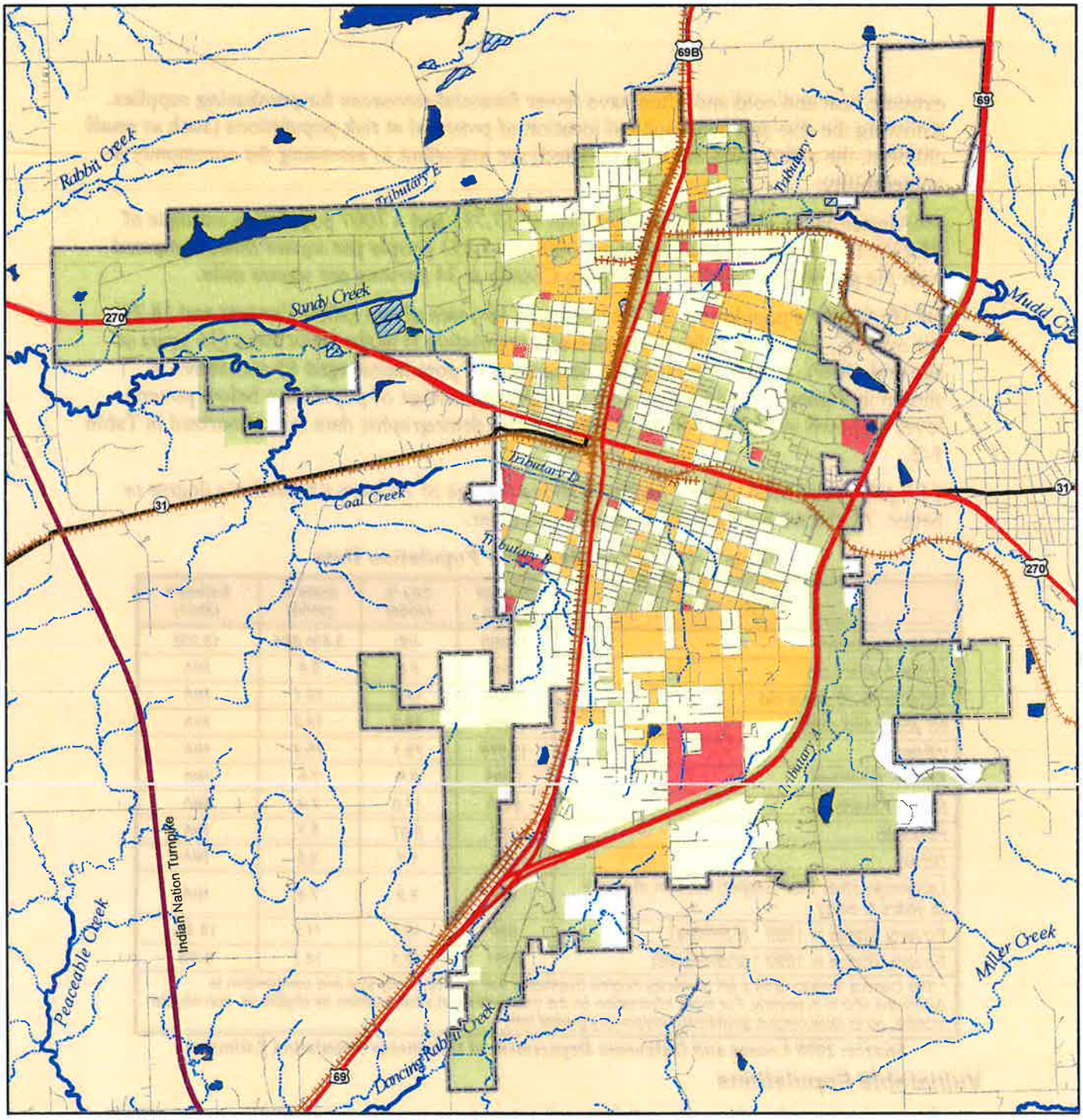
Table 1–2: City of McAlester Population Data

Subject	Number (2000)	City % (2000)	State % (2000)	Estimate (2007)
Total Population	17,650	100	3,450,654	18,232
Under 5 years old	1,041	5.8	6.8	N/A
Between 5-18 years old	3,324	18.8	15.1	N/A
65 years and older	3,206	18.2	13.2	N/A
White	13,976	79.1	76.2	N/A
African-American	1,695	9.6	7.6	N/A
Native American	2499	17.0	7.9	N/A
Hispanic	125	0.07	5.2	N/A
Other	301	1.7	3.8	N/A
Language other than English spoken at home (5 years & over)	878	5.2	7.4	N/A
Poverty Status in 1999 * (Families)	686	16.1	11.2	19.4%
Poverty Status in 1999 * (Individuals)	2951	19.4	14.7	8.3%
* The Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. For more information on the thresholds and what qualifies as eligible vs. non-eligible income, go to www.census.gov/hhes/www/poverty/povdef.html				

Source: 2000 Census and Oklahoma Department of Commerce Population Estimates

Vulnerable Populations

In any community, there are residents who may have greater vulnerability to the effects of disasters than does the general population. These groups may have little or nothing in common, and their needs may be very different. There is no "one size fits all" solution for handling populations with greater vulnerability. Some may need special consideration in warning, communication or evacuation, some may have special sheltering needs, whether medical or non-medical, and some may require other considerations in emergency planning and mitigation. Almost all have the ability to participate in a meaningful and active way in the planning, response, and mitigation activities of the community.



Legend

- County Boundary
- City limits

Population over 65

Percent

- 0% - 9%
- 9.01% - 27%
- 27.01% - 59%
- 59.01% - 100%

Miles: 0, 0.5, 1

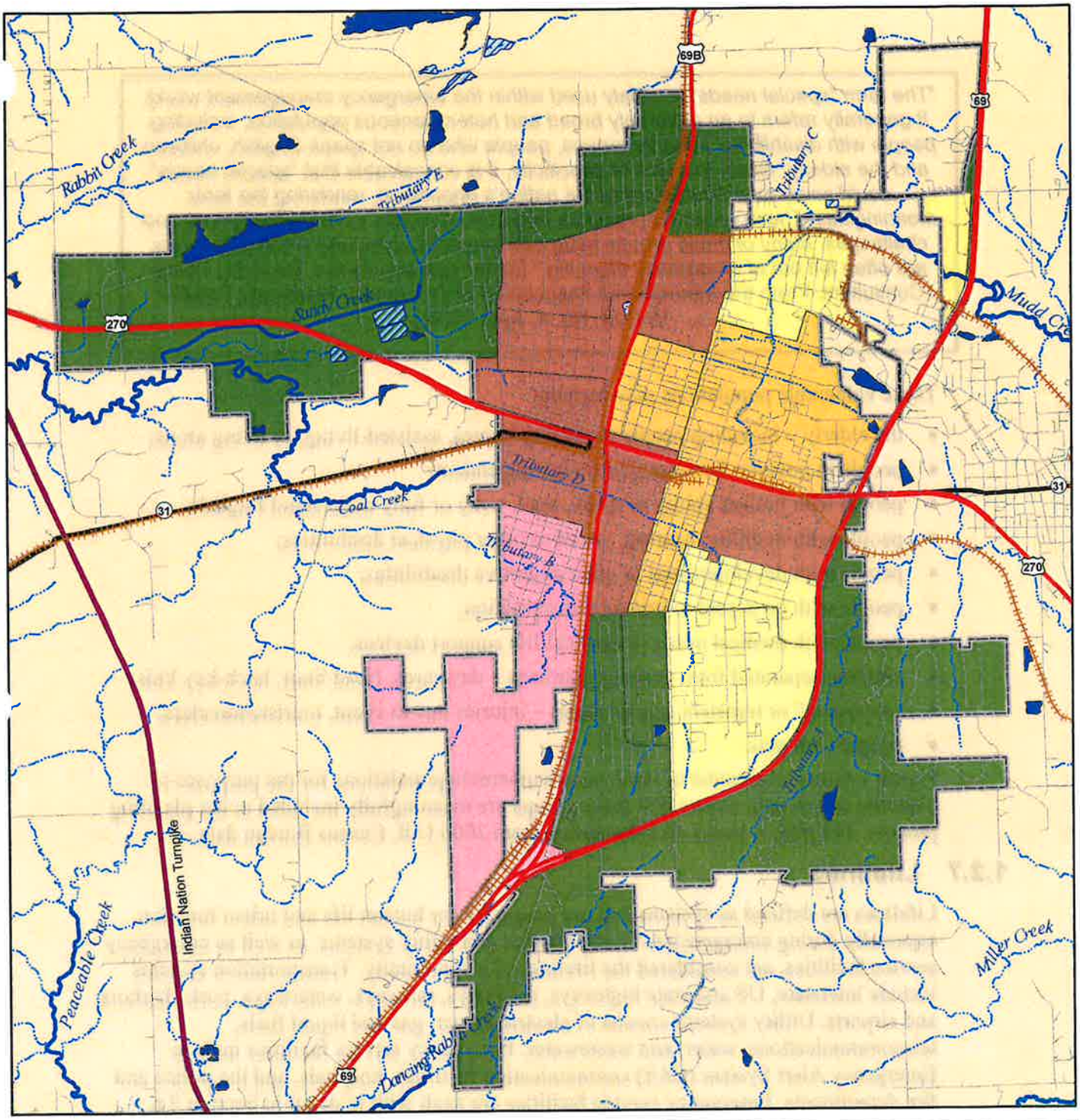
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

McALESTER, OKLAHOMA 1908 FAITH - HOPE - PROSPERITY

Figure 1-7

City of McAlester

Percent Over Age 65



Legend

- County Boundary
- City limits

Population Under Povert Level Percent

- 0% - 3%
- 3.1% - 9.4%
- 9.5% - 20.8%
- 20.9% - 43.5%
- 43.6% - 100%

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

N, W, E, S

Miles

0 0.5 1

Figure 1-8

City of McAlester

Percent In Poverty

"The term "special needs" is widely used within the emergency management world. It generally refers to an extremely broad and heterogeneous population, including people with disabilities, minority groups, people who do not speak English, children and the elderly. Given this lack of specificity, it is conceivable that "special needs" could cover over 50 percent of the nation's population, rendering the term meaningless. These groups represent a large and complex variety of concerns and challenges. Many of these groups have little in common beyond the fact that they are often left out of emergency planning." (June Isaacson Kailes, Disability Policy Consultant. From the International Association of Emergency Managers Bulletin, Vol. 22, No. 4, April 2005.)

These vulnerable populations may include:

- the elderly – including people in nursing homes, assisted-living, or living alone;
- people in poverty, homeless, or shelter dependent;
- people with limited ability to speak, read, write or fully understand English;
- people with mobility, hearing, visual or other physical disabilities;
- people with developmental or other cognitive disabilities;
- people with no access to private transportation;
- people with medical needs or medical/life support devices;
- children separated from parents/guardians – day cares, Head Start, latch-key kids;
- "emerging" or transient special needs – injuries due to event, tourists/travelers;
- people with pets.

Figure 1-9 identifies some of these more vulnerable populations for the purposes of planning and to help ensure that these groups are meaningfully included in the planning process. The map is based on information from 2000 U.S. Census Bureau data.

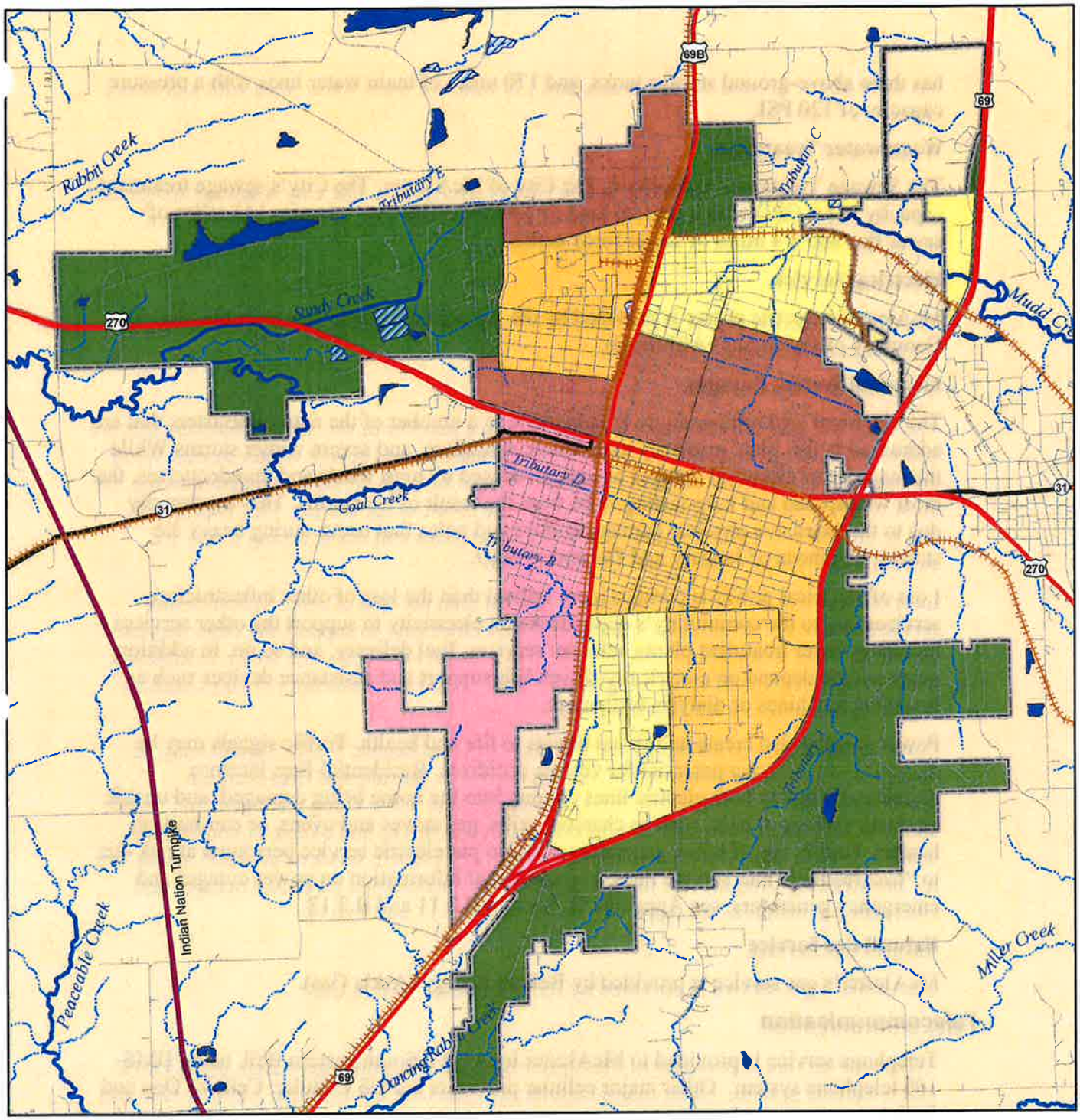
1.2.7 Lifelines

Lifelines are defined as systems that are necessary for human life and urban function, especially during emergencies. Transportation and utility systems, as well as emergency service facilities, are considered the lifelines of a community. Transportation systems include interstate, US and state highways, roadways, railways, waterways, ports, harbors, and airports. Utility systems consist of electric power, gas and liquid fuels, telecommunications, water, and wastewater. Emergency service facilities include Emergency Alert System (EAS) communication facilities, hospitals, and the police and fire departments. Emergency service facilities are dealt with in detail in Section 2.6.

Utility Systems

Water Service

McAlester's water system capacity is 20 million GPD. The system has an average daily use of 5.04 million GPD, with a peak load of 8.28 million GPD. McAlester's water is supplied by two municipal lakes, with backup supplies available from Lake Eufaula. The public water supply system provider is the McAlester Public Works Authority. The City



Legend

- County Boundary
- City limits

Population With a Disability

Percent

- 0% - 7.3%
- 7.4% - 20.1%
- 20.2% - 33.3%
- 33.4% - 42.4%
- 42.5% - 53.2%

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

N W E S

Miles

0 0.5 1

Figure 1-9

City of McAlester

Percent of Population With a Disability

has three above-ground storage tanks, and 170 miles of main water lines with a pressure capacity of 120 PSI.

Wastewater Treatment

The Sewage Treatment Authority is The City of McAlester. The City's sewage treatment capacity is 2.9 GPD with a present load of 2.5 GPD. The City operates 143 miles of sewer line and 6.4 miles of sewer force mains.

Electrical Service

McAlester's electric power is provided by the American Electric Power/Public Service Company of Oklahoma (AEP/PSO).

Electrical System Outages

The electrical grid infrastructure is vulnerable to a number of the natural disasters that are addressed in this plan, primarily high winds, tornadoes, and severe winter storms. While the majority of electrical outages have been caused by high winds and thunderstorms, the most widespread and long-lasting were from the result of ice storms. This is primarily due to the extensive physical damage to lines and poles that occur during heavy ice storms, like those of January and December 2007.

Loss of electrical power is perhaps more critical than the loss of other infrastructure services due to the community's dependence on electricity to support the other services – including water treatment plants, telecom services, fuel delivery, and so on. In addition, many people depend on electrically-driven life-support and assistance devices such as breathing machines or dialysis equipment.

Power outages also create additional threats to life and health. Traffic signals may be disrupted, creating the potential for vehicle accidents. Residential fires increase dramatically due to both electric lines coming into the home being damaged, and unsafe alternate sources of heat, such as charcoal grills, gas stoves and ovens, or combustion heaters. Unsafe use of home generators can also put electric service personnel at risk due to "backfeeding" into service lines. For additional information on power outages and emergency generators, see Appendix B, Section B.2.11 and B.2.12.

Natural Gas Service

McAlester's gas service is provided by Reliant Energy (Arkla Gas).

Telecommunication

Telephone service is provided to McAlester by AT&T/Southwestern Bell, using DMS-100 telephone system. Other major cellular providers are US Cellular, Cellular One and Sprint.

Communications and Media Services

The daily newspapers serving McAlester are *The McAlester News-Capital*, The Tulsa World, and The Daily Oklahoman.

Television/Cable service is provided by Allegiance Cable TV, with Channels 2, 6, and 8 providing local information. Channel 21 at Allegiance is city-owned.

McAlester based radio stations include 1150 and 1400 AM, as well as 101.3 and 105 FM.

Transportation Systems

Major Highways and Roads

The City of McAlester is linked north to south by U.S. 69 and the Indian Nation Turnpike, and linked east to west by U.S. 270 and Oklahoma State Hwy. 31. The nearest Interstate Highway is I-40, which is 40 miles to the north.

- **US Highway 69** – is a major north-south U.S. Highway from the Texas state line south of Colbert to the Kansas state line north of Picher, a distance of approximately 250 miles. It has an interchange with the **Indian Nation Turnpike**, after which it enters McAlester. US-69 mostly runs along the east side of McAlester, the county seat of Pittsburg County, with the downtown area being served by **U.S. Highway 69 Business**.
- **US Highway 270**-runs northwest to southeast from the Kansas state line north of Turpin to the Arkansas state line east of Page, a distance of 477 miles in Oklahoma.
- **Oklahoma State Highway 31**-runs in an irregular west-to-east pattern from State Highway 48 south of Tupelo to US highway59/271 north of Panama, a distance of 132 miles. In McAlester, SH-31 forms a 5-mile (8 km) concurrency with US-270 and SH-1, splitting up just east of the US-69 interchange on the east side of the city.
- **Interstate Highway 40** – runs 331 miles across Oklahoma from Texas to Arkansas.

Traffic counts on these highways are presented in Table 1-2.

Table 1–3: Highway Traffic Counts

Highway	Daily Traffic Counts
U.S. Highway 69	24,200
U.S. Highway 270	8,500
Oklahoma State Highway 31	5,400
Interstate Highway 40 (in Henryetta, north of McAlester)	15,900

Source: Oklahoma Department of Transportation, 2006

Bus Lines and Taxi Service

- McAlester is served by two nationwide bus services: The Greyhound and Jefferson Bus Lines. The bus station is located at 1430 S. George Nigh Expressway.
- Taxi service is available through GEM Cab Company.

Railway

Railroad service to the area is provided by Union Pacific Railroad and A-OK Railroad.

Airports

The City of McAlester is served by three airports, including:

- McAlester Regional Airport, located at Lat. 34-53-56N; Long 95-47-00W; at an elevation of 770 feet. Its concrete runway extends 5,602 feet.

McAlester Regional Airport

- Tulsa International Airport is located approximately 98 miles north of McAlester. American Airlines, Continental, Delta, Northwest and Southwest offer both passenger and freight services. An average of 167 aircraft are based at the field with an average of 79 operations/day. This is Tulsa's primary commercial airport. TIA also houses the 138th Fighter Wing of the Air National Guard and is the global maintenance headquarters for American Airlines.
- Will Rogers World Airport is located approximately 131 miles to the west in Oklahoma City.

Water

- The Port of Muskogee is 60 miles from McAlester and the Port of Catoosa is 90 miles away. Both provide barge transportation to intercontinental, coastal and foreign destinations.

Ground

- Eleven Motor Freight Carriers service the McAlester area, as well as UPS and FEDEX.

1.2.8 Economy

McAlester is the trade center for Southeastern Oklahoma, serving a rural population base of more than 130,000. McAlester is a regional center for commerce. The area has a diversified economy with a range of manufacturing businesses, excellent schools, and a positive business atmosphere. Major employers include the McAlester Army Ammunition Plant and the Oklahoma State Penitentiary.

Table 1–4: City of McAlester Employment and Income Data

Subject	Number (2000)	%
Population 16 Years and Older	14,283	100.0
Population in Labor Force	6875	48.1
Employed	6298	47.9
Total Households	6584	100.0
Household Income Below Poverty Level	686	16.1

Source: 2000 Census Population

Major Employers

McAlester's major employers are listed in Table 1-5.

Table 1–5: Major Employers

Company	Employees (Approx)	Sector
U.S. Department of the Army	1,461	Manufactures Small Arms Ammunition
Oklahoma Department of Corrections	980	State Penitentiary
McAlester Regional Health Center Authority	860	Health Care
Wal-Mart Stores	560	Retail Department Store and Groceries
McAlester Public Schools	478	Education

Company	Employees (Approx)	Sector
Simonton Windows	438	Manufactures Window Glass
DCT, Inc.	380	Security
Defense Ammunition Center	275	Ammunition Training Center
City of McAlester	237	Municipal Government
Spirit Aero Systems	222	Aerospace Manufacturing
Atlantic Meeco	215	Flotation Products
Triad Transportation	182	Trucking
National Oilwell	174	Manufactures Wilson Snyder Pumps
Pliant Corporation	165	Plastic Film
Charles Komar & Sons	159	Manufactures Women's Apparel
Pittsburg County	150	County Government
Big "V" Feeds	138	Livestock Feed
Webcoat Products	104	Outdoor Furniture Manufacturer

Source: Oklahoma Department of Commerce, 2007

1.2.9 Development

According to the Pittsburg County Assessor's Office, there are 8,793 properties within the City of McAlester, 6,776 properties have improvements on them, with a total value, adjusted for fair market value, of $438,522,585. No land values are included. Due to their vulnerability to natural hazards, the locations of mobile homes have been identified on the map in Figure 1–10.

Future Development

McAlester's population growth rate has been approximately .50 percent annually from the years 2000 to 2007. Comparatively, the State of Oklahoma is growing at 1 percent annually.

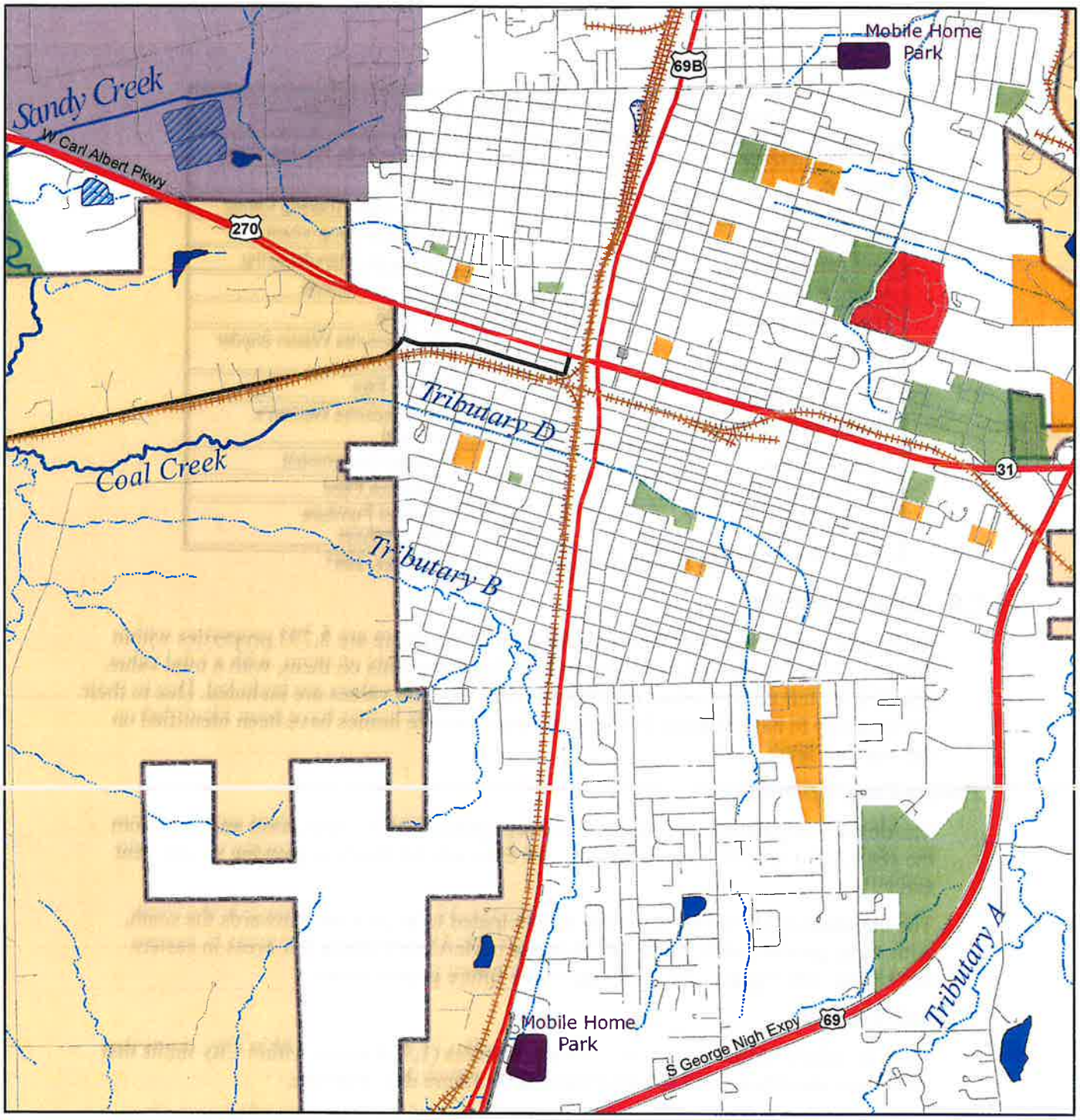
The direction of McAlester's growth is anticipated to be primarily towards the south, with some growth south of US-270 in western McAlester, and a few areas in eastern McAlester. See Figure 1-11 for a map of the future growth areas.

Growth Trends

The City of McAlester has about 2.75 square miles (1,754 acres) within City limits that have been identified as areas with potential for future development.

A "fenceline" is a narrow strip of annexed land around the perimeter of an area of un-annexed land that a community identifies and claims for future growth to protect the area for annexation. (See Figure 1-3)

The growth areas will all continue to be subject to non-site specific natural hazards, such as tornadoes, lightning, hail, winter storms, extreme heat, drought, expansive soils, wildfires, and earthquakes. Dam and levee failures are not a problem for these future growth areas. The multi-hazard mitigation measures identified and recommended in this plan should lessen the impacts of natural hazards on future development and population of the community.



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

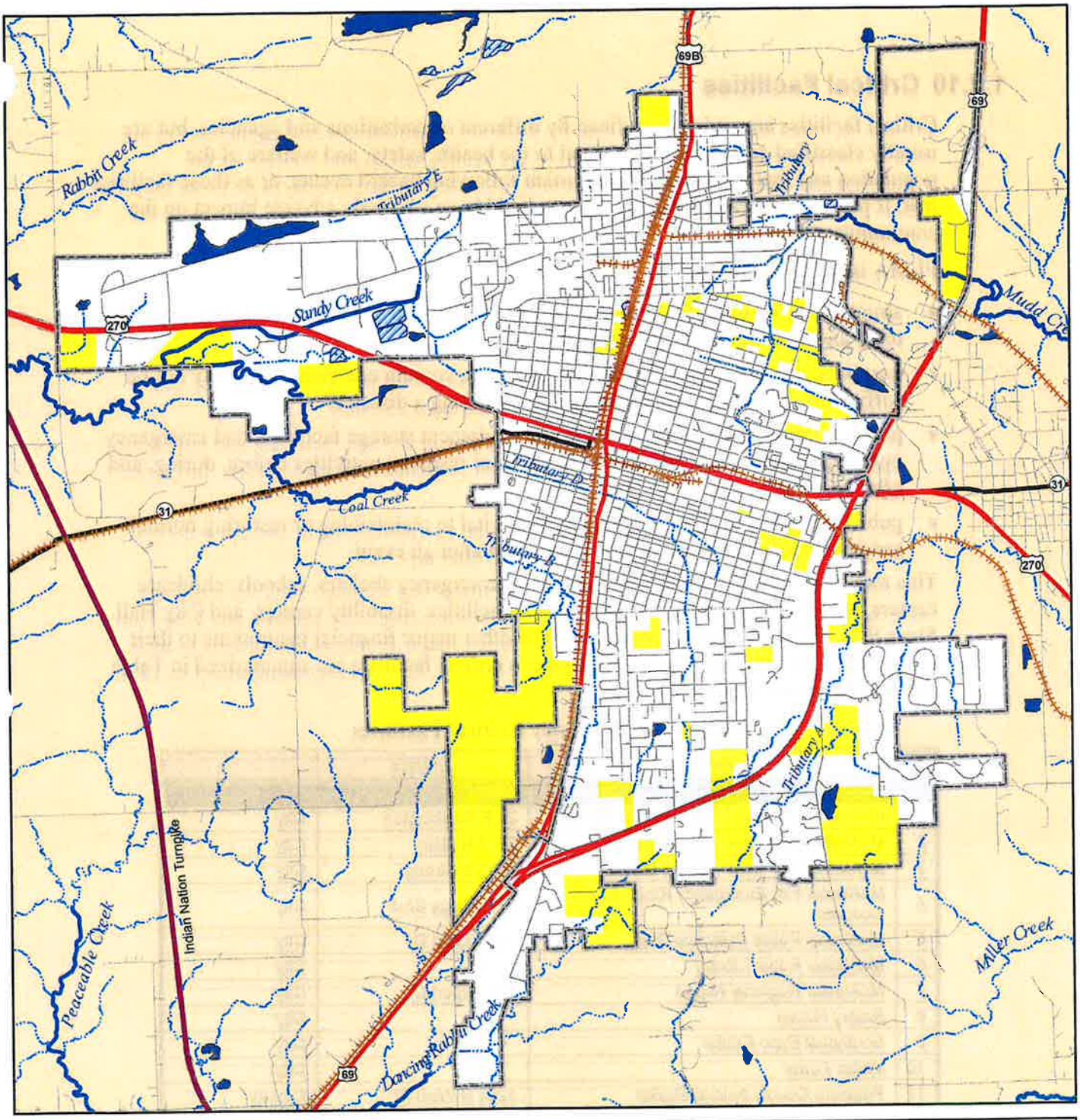
- Mobile Home Parks
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles
0 0.25 0.5

Figure 1-10

City of McAlester

Mobile Home Parks



Legend

- County Boundary
- City limits
- Future Growth Areas
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.5 1

Figure 1-11

City of McAlester

Future Growth Areas

1.2.10 Critical Facilities

Critical facilities are variously defined by different organizations and agencies, but are usually classified as those facilities vital to the health, safety, and welfare of the population and that are especially important following hazard events, or as those facilities that, if put out of operation by any cause, would have a broadly adverse impact on the community as a whole.

FEMA includes the following:

- structures or facilities that produce, use or store highly volatile, flammable, explosive, toxic and/or water-reactive materials;
- hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a disaster;
- police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response activities before, during, and after an event;
- public and private utility facilities that are vital to maintaining or restoring normal services to affected areas before, during and after an event.

This may also include buildings designated as emergency shelters, schools, childcare centers, senior citizen centers, major medical facilities, disability centers, and City Hall. Since 9/11, FEMA has also added banks and other major financial institutions to their critical facilities list. The City of McAlester's critical facilities are summarized in Table 1-6 and are shown in Figure 1-12.

Table 1–6: McAlester Critical Facilities

ID	Name	Address	
Government Facilities			
1	McAlester City Hall / City Hall Fire Station	28 E Washington	City
2	McAlester Fire Dept. - North Station	2717 N Main	City
3	McAlester Fire Dept. - South Station	1313 S Strong	City
4	McAlester Fire Emergency Response Complex	617 Village Blvd.	City
5	McAlester Police Detective Dept.	110 Airport Dr	City
6	McAlester Public Library		City
7	McAlester Regional Airport	104 Airport Dr	City
8	Rotary House		City
9	Southeast Expo Center		City
10	Water Tower		City
11	Pittsburg County Animal Shelter	1204 N West St	County
12	Pittsburg County Courthouse		County
13	Pittsburg County Health Dept	1400 E College	County
14	Pittsburg County Juvenile Detention Center	1208 N West St	County
15	Pittsburg County Sheriff	1210 N West St	County
16	Jackie Brannon Correctional Center	900 N West St	State
17	Oklahoma State Penitentiary	1023 N West St	State
18	Federal Building & US Courthouse		Federal
19	United States Postal Service	500 E Washington	Federal

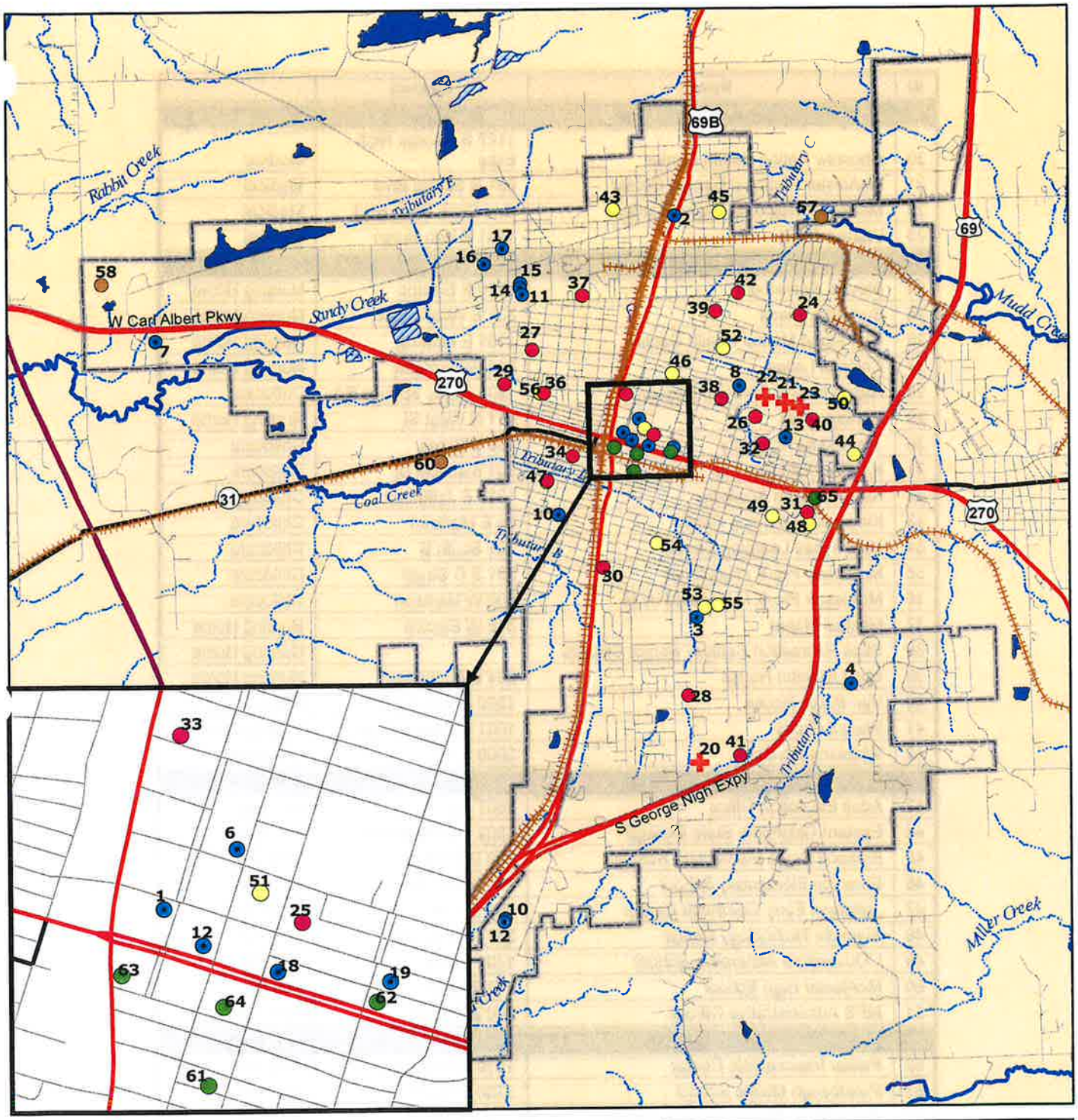


Figure 1-12

City of McAlester

Critical Facilities

ID	Name	Address	
	Medical Facilities		
20	Choctaw Nation Health Center	1127 S George Nigh Expy	Medical
21	McAlester Regional Cancer Center	901 N Strong Blvd	Medical
22	McAlester Regional Health Center	One Clark Bass Blvd	Medical
23	Warren Clinic	1401 E Van Buren	Medical
	Special Needs Facilities		
24	Blevins Retirement	1220 E Electric	Nursing Home
25	Burgandy Place	301 E Washington	Nursing Home
26	Carl Albert Mental Health Center	1101 E Monroe	Nursing Home
27	Colonial Lodge	614 W Harrison	Nursing Home
28	Happy Hearts Christian Daycare	1800 Hardy Springs Rd	Childcare
29	Heritage Hills	411 N West St	Nursing Home
30	Just Kiddin Academy	105 E Creek	Childcare
31	KAVTS Child Dev Lab	301 Kiamichi Dr	Childcare
32	Kiddin Around Academy	1211 E Jefferson	Childcare
33	Kidzkazoo Learning Center	35 E Madison	Childcare
34	Little Tykes Learning Center	101 South B	Childcare
35	McAlester Pre-K / Headstart	501 S C Street	Childcare
36	McAlester Pre-K / Headstart W.M	600 W Madison	Childcare
37	Mitchell Manor	315 W Electric	Nursing Home
38	Stipe Recreation Center / Senior Citizens		Nursing Home
39	Sue Littlejohn House	504 E Buchanan	Nursing Home
40	Van Buren House	1500 E Van Buren	Nursing Home
41	Walnut Grove	1001 S George Nigh	Nursing Home
42	Widening Horizons	2000 N 7th	Childcare
	Education Facilities		
43	Adult Education Office	2801 N A St	Schools
44	Eastern Oklahoma State College	1802 E College Ave	Schools
45	Edmond Doyle Elementary School	520 E Smith St	Schools
46	Emerson Elementary School	301 E Van Buren	Schools
47	Jefferson Early Childhood Center	501 S C St	Schools
48	Kiamichi Technology Center	301 Kiamichi Dr	Schools
49	L'Ouverature Altnerative School	1401 E Cherokee	Schools
50	McAlester High School	1 Buffalo Dr	Schools
51	MPS Administrative Offices	200 E Adams	Schools
	Education Facilities (cont)		
52	Parker Intermediate Center	1310 N Sixth St	Schools
53	Puterbaugh Middle School	1100 E South St	Schools
54	Washington Early Childhood Center	700 S Sixth St	Schools
55	Will Rogers Elementary School	1200 E South St	Schools
56	William Gay Early Childhood Center	600 W Madison	Schools
	Utility Facilities		
57	East Wastewater Plant	1360 E Krebs Ave	Utility
58	McAlester Landfill	2810 N Mitchell Rd	Utility
59	Water Treatment Plant	5200 Waterworks Rd	Utility
60	West Wastewater Plant	2020 W Hwy 31	Utility

ID	Name	Address	
Financial Facilities			
61	Arvest Bank	101 S 3rd	Bank
62	Banc First	501 E Carl Albert	Bank
63	Bank of Oklahoma	1 E Choctaw	Bank
64	First National Bank & Trust	235 E Choctaw	Bank
65	The Bank NA	1706 E Carl Albert	Bank

Source: City of McAlester

1.2.11 References

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Chapter 2: Existing Mitigation Strategies

44 CFR Requirements met:

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:*

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Included in this Chapter:

2.1 About Hazard Mitigation Programs
2.2 Public Information and Education
2.3 Preventive Measures
2.4 Structural Projects
2.5 Property Protection
2.6 Emergency Response Procedures & Resources
2.7 Natural Resource Protection

Requirement §201.6(c)(2)(ii): *[The risk assessment]* ***must*** *also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.*

Requirement: §201.6(c)(3)(ii): *[The mitigation strategy]* ***must*** *also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

2.1 About Hazard Mitigation Programs

Communities can do a number of things to prevent or mitigate the impacts of natural disasters. Such actions range from instituting regulatory measures (e.g., building and zoning codes) and establishing Emergency Operations Plans and Emergency Operations Centers, to purchasing fire trucks and ambulances and constructing large and small infrastructure projects like levees and safe rooms. Most communities have already made considerable investments in these critical areas. The sections that follow in this Chapter survey the regulations, plans and infrastructure that the community has in place for avoiding or mitigating the impacts of natural hazards. This survey is based on FEMA's *State and Local Mitigation Planning How-to Guide* (FEMA 386-1, September 2002), and covers the following topics: Public Information and Education, Prevention, Structural Projects, Property Protection, Emergency Services, and Natural Resource Protection.

There are several national hazard mitigation programs developed by FEMA and other agencies that are designed to help communities organize their mitigation activities to achieve tangible results in specific areas, such as flood protection and fire hazard abatement. This section also looks at McAlester's participation and progress in these national programs.

The Planning Team reviewed relevant community studies, plans, reports, and technical documents in the inventory, evaluation and planning phases of the Multi-Hazard Mitigation Plan development. McAlester has a Comprehensive Plan that needs updating. The City Code, City Council Meeting minutes, Capital Improvements Plan and discussions with City officials were used to determine priorities of public infrastructure improvements, and timing of potential future development. These codes, minutes, plans and discussions were used to identify areas of future growth and development so that hazardous areas could be identified, evaluated, planned for, and appropriate mitigation measures taken.

2.1.1 National Flood Insurance Program (NFIP)

For decades, the national response to flood disasters was simply to provide disaster relief to flood victims. Funded by citizen tax dollars, this approach failed to reduce losses and didn't provide a way to cover the damage costs of all flood victims. To compound the problem, the public generally couldn't buy flood coverage from insurance companies, because private insurance companies consider floods too costly to insure.

In the face of mounting flood losses and escalating costs of disaster relief to U.S. taxpayers, Congress established the National Flood Insurance Program (NFIP). The goals of the program are to reduce future flood damage through floodplain management, and to provide people with flood insurance. Community participation in the NFIP is voluntary.

McAlester has participated in the National Flood Insurance Program since 1974. The Digital Flood Insurance Rate Maps (DFIRMs) are scheduled to be updated in July of 2010. All residents of McAlester are eligible to purchase federal flood insurance. The City of McAlester continues to maintain full compliance with the NFIP. Table 2-1 shows the NFIP insurance information for McAlester.

Table 2–1: City of McAlester Flood Insurance Policies

Flood Insurance	Amount
Flood Insurance Policies in Force	51
Value of Insurance in Force	$7,018,200
Paid Premiums	$24,625
Number of Claims since 1978	3
Amount of Flood Losses Paid	$881.84

Community Rating System (CRS)

The CRS is a voluntary part of the National Flood Insurance Program that seeks to coordinate all flood-related activities, reduce flood losses, facilitate accurate insurance rating, and promote public awareness of flood insurance by creating incentives for a community to go beyond minimum floodplain management requirements. The incentives are in the form of insurance premium discounts. CRS ratings are on a 10-point scale (from 10 to 1, with 1 being the best rating), with residents of the community who live within FEMA's Special Flood Hazard Areas (SFHA) receiving a 5% reduction in flood insurance rates for every Class improvement in the community's CRS rating.

McAlester does not participate in the CRS program at this time.

2.1.2 Firewise Community

The Firewise Community certification is a project of the National Wildfire Coordinating Group. It recognizes communities that have gone through a process to reduce the dangers of wildfires along what is referred to as the Wildland/Urban Interface. Under the program, a specialist from Firewise Communities USA works with the local community to assess wildfire dangers and create a plan that identifies agreed-upon, achievable solutions to be implemented. For additional information on Firewise Communities, see Appendix B, or visit www.firewise.org/usa/.

McAlester does not participate in the Firewise Community program.

2.1.3 Fire Protection Rating

ISO's Public Protection Classification (PPC) program provides important information about municipal fire-protection services, which, in the past, has been used by insurance companies to establish fire insurance premiums. Currently most fire insurance rates are determined by actual loss figures and history within specific zip codes. The PPC program does help communities plan for, budget, and justify improvements in order to mitigate the effects of the fire hazard.

A uniform set of criteria is used to evaluate a community's fire protection service and rate it on a scale from 1 to 10, where lower numbers indicate a better rating. These criteria incorporate nationally-recognized standards developed by the National Fire Protection Association and the American Water Works Association. McAlester, as of 10/4/2010, is rated as a class 4 on the PPC. The evaluation inventories and analyzes the following fire protection resources:

- Fire Alarm and Communication Systems – including telephone systems and lines, staffing, and dispatching systems
- The Fire Department – including equipment, staffing, training, and geographic distribution of fire companies
- The Water Supply System – including condition and maintenance of hydrants, and a careful evaluation of the amount of available water compared with the amount needed to suppress fires.

2.1.4 StormReady Community

StormReady is a nationwide community preparedness program that began in Tulsa in 1999, and uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to tsunamis. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations. The guidelines are population-based, so a larger community, for example, may be required to have more robust warning systems than a smaller one. To be officially StormReady, a community must:

- Establish a warning point and a 24-hour emergency operations center;
- Have multiple ways to receive severe weather warnings and forecasts and to alert the public;

- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars;
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Additional information can be found at www.stormready.noaa.gov.

Both McAlester and Pittsburg County have achieved StormReady status.

2.1.5 Business Continuity Mitigation and Planning Programs

The shutdown or permanent loss of businesses can be particularly devastating to a community for a number of reasons.

1. Loss of a business can negatively affect the city's tax base and revenue. In 1993, a tornado struck in the area of Catoosa, OK, destroying a number of residences and a major truck stop on Interstate 44. The truck stop, and associated traffic and personnel it attracted, supported restaurants, clothing stores, motels, and numerous other businesses in the area. Overall, the loss of the one business cost the community almost 50% of its tax base until the truck stop was able to reopen.
2. Closing of a business may eliminate jobs, not only for the employees of that particular company, but also for vendors for and customers of the affected business. Following a severe tornado in Oklahoma City in 2003 that affected large parts of the community, including a General Motors plant, hundreds of workers were temporarily unemployed, putting a severe strain on the social service agencies for the area.

A great deal of the mitigation information in this document is applicable to residential, public, and commercial properties. When available, the plan will include business-specific information and strategies. For further discussion on business vulnerability and the importance of Business Continuity Planning (BCP), see Appendix B. Section 1.10.

2.2 Public Information and Education

Public information and education strategies are an important part of any successful program to mitigate the loss of life and property from natural and man-made hazards. Examples of such strategies include outreach projects, hazard information distribution, and school age and adult education programs. This section examines the existing communications infrastructure in and around McAlester, and the programs and activities that the City currently has in place to serve this purpose. See Chapter 6 and Appendix B for discussions of potential activities and programs within this category.

2.2.1 Public Information Infrastructure

Television/Radio

McAlester is served by the following TV stations:

Table 2–2: Television Stations Available in the McAlester Area

Channel	Call sign	Network	Community	Owner
2	KJRH	NBC	Tulsa	Scripps Howard
3	KOET	PBS	Eufaula	OETA
5	KFSM	CBS	Fort Smith	New York Times
8	KTUL	ABC	Tulsa	KTUL
10	KTEN	NBC	Ada	Channel 49
11	KOED	PBS	Tulsa	OETA
19	KWBT	The CW	Muskogee	Griffin Licensing
23	KOKI	FOX	Tulsa	Clear Channel
35	KEGG-LP		McAlester	Hispanic Christian Network
41	KTFO	My Network	Tulsa	Clear Channel
44	KTPX	Ion (PAX)	Okmulgee	Paxson
51	K51EK		McAlester	Family Broadcasting

Source: The Center for Public Integrity MediaTracker

McAlester is also served by 4 AM radio stations and 15 FM stations as shown in Table 2-3.

Table 2–3: AM and FM Radio Stations Available in the McAlester Area

AM Stations				
Frequency	**Call Sign**	**Format**	**Community**	**Licensee**
1150	KNED		McAlester	Southeastern Oklahoma Radio
1170	KFAQ	Talk	Tulsa	Journal Broadcast
1260	KWSH		Wewoka	One Ten Broadcasting Group
1400	KTMC		McAlester	Southeastern Oklahoma Radio
FM Stations				
88.5	KTKL	Christian	Stigler	Educational Media Foundation
89.3	KLRB		Stuart	Lighthouse Of Prayer
91.9	KBCW		McAlester	University Of Central Oklahoma

FM Stations				
95.1	KQCV-FM		Shawnee	Community Broadcasting
97.1	KYAL-FM		Muskogee	KMMY
97.9	KZBB	Contemporary	Poteau	Capstar TX
99.1	KMAG	Country	Fort Smith	Capstar TX
99.9	KTCS-FM		Fort Smith	Big Chief Broadcasting
101.3	KMCO		McAlester	Southeastern Oklahoma Radio
102.5	KTNT		Eufaula	K95.5
103.7	KESC		Wilburton	KESC Enterprises
105.1	KTMC-FM		McAlester	Southeastern Oklahoma Radio
105.5	KKFC		Coalgate	Woodstone Broadcasting
106.5	KTLS-FM		Holdenville	Woodstone Broadcasting
106.9	KHTT		Muskogee	Renda Broadcasting

Source: The Center for Public Integrity MediaTracker

Telephone, Wireless and Cable Service

Cable TV service in McAlester and the surrounding unincorporated areas are provided by Allegiance Communications. McAlester has an advanced telecommunications infrastructure provided by AT&T Southwestern Bell. In addition, there are a number of cellular and private telecom providers, including US Cellular, Cellular One, and Sprint.

Newspapers

Daily area newspaper service is provided to McAlester by the McAlester News-Capital, with a circulation of approximately 12,600. Additional newspapers within 50 miles of McAlester include the following:

- Ada Evening News, circulation 9,060;
- The Seminole Producer, circulation 5,340;
- Okmulgee Daily Times, circulation 4,077;
- Holdenville Daily News, circulation 2,050.

2.2.2 Outreach Programs

Outreach Programs, as the name implies, are designed to inform the community about natural hazards and measures that can be taken to protect against them. McAlester has outreach programs through the McAlester Fire Department, City of McAlester Public Works, American Red Cross, McAlester Emergency Management and a number of other organizations. The City also maintains a comprehensive Internet web site that posts local ordinances, agency contact information, and City Council meeting agendas and minutes.

McAlester City government has a close relationship with the *McAlester News-Capital* newspaper which serves as a reliable outlet for municipal news releases on hazard related issues. The newspaper provides coverage of City Council and Planning Commission meetings, and makes itself available for in-depth presentations and discussions of matters of local importance, including emergency preparedness and natural hazard mitigation.

The City of McAlester has an outreach program for informing citizens about natural hazards, how to prevent or mitigate their impacts, and what resources the community has to assist in damage prevention, mitigation and recovery. For example, over the past five years the *McAlester News Capital* has carried articles on topics like family preparedness, tornado mitigation, HazMat training and safety, the 911 system, lightning safety, traffic and transportation safety, drought, wildfire mitigation, earthquake, storm shelters, flooding, the City's EOC, storm sirens, the Red Cross, storm spotters, and hazard mitigation planning.

Other local outreach efforts include:

- The Emergency Operations Center (EOC) and the National Weather Service Tulsa Forecasting Office offers presentations to groups interested in storm preparedness.
- McAlester's Mayor issues a declaration supporting September as being National Preparedness Month.
- The McAlester Public Library Virtual Branch is an on-line library reference that has a wealth of links to resources and search engines.
- McAlester Fire Department participates in preparedness training with the McAlester Army Ammunition Depot, Pittsburg County, and local citizens.
- The National Weather Service and local ham radio groups offer classes for future storm spotters.
- McAlester Fire Department has an active Public Education component that includes a Home Fire Safety Checklist.
- The Governor declared April to be McReady Oklahoma Family Preparedness Month and McAlester participated in the state-wide "McReady" program, distributing disaster safety literature at kiosks in McDonald's restaurants and at City facilities.

City of McAlester Radio/TV Programs/Communications

The Emergency Managers of McAlester and Pittsburg County have direct access to the cable television system and local radio to alert citizens of emergencies. The City of McAlester also has Public Access Channel 21 that can be used to provide natural hazard-related information and other emergency information to cable subscribers.

2.3 Preventive Measures

Preventive measures are defined as government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. This section contains a summary of the current ordinances and codes that relate to land use, zoning, subdivision, and stormwater management in the City of McAlester. See Chapter 6 and Appendix B for discussion of potential activities and programs within this category.

2.3.1 Planning and Zoning Ordinances

The City of McAlester has a Comprehensive Plan that needs to be updated. The City's Code of Ordinances contains community policies regarding land use, zoning, residential, commercial and industrial development, and the use of flood hazard areas. Figure 2-3 shows McAlester zoning.

2.3.2 Flood and Stormwater Management

McAlester has adopted FEMA's Flood Insurance Study, 2005, and Flood Insurance Rate Maps (FIRM) as part of its City Code. No structure or land can be located, altered or have its use changed without full compliance with FEMA regulations and other applicable regulations of the City Code.

All new residential construction or substantial improvements must have the lowest floor (including basement), elevated one or more feet above the base flood elevation, and be certified by a registered professional engineer, architect or land surveyor. New or improved nonresidential structure must either have the lowest floor one or more feet above the base flood level, or be certified as watertight and capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. No manufactured (mobile) homes can be placed within the corporate limits of the City of McAlester.

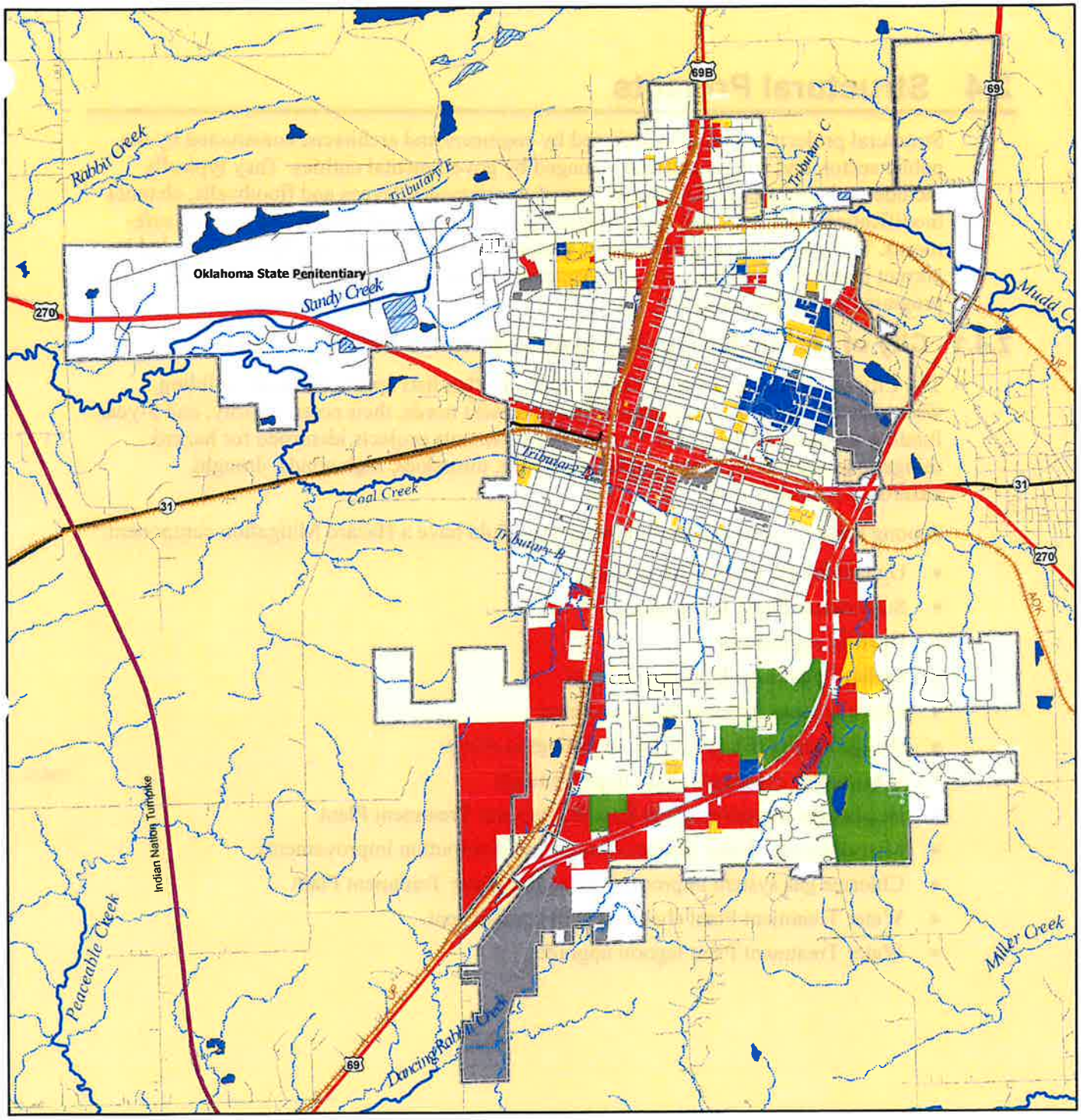
The City Code requires that all nonresidential structures in areas of shallow flooding that have the lowest floor less than one foot above the base flood elevation be floodproofed and certified by a registered professional engineer or architect.

No new construction, substantial improvements or other development (including fill) is allowed in a designated floodway that would, when combined with all other existing and anticipated development, increase the water surface elevation of the base flood more than one foot at any point within the city.

2.3.3 Building Codes

McAlester has adopted the following Building Codes:

- National Electrical Code, 2002 Edition



Legend

City limits

Zoning

- A-1
- R-1a and R-1b
- R-2
- R-3
- H-1
- C-2, C-3, C-4, C-5
- I-1 and I-2

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.5 1

McALESTER, OKLAHOMA SINCE 1908 FAITH - HOPE - PROSPERITY

Figure 2-1

City of McAlester

Zoning

2.4 Structural Projects

Structural projects are usually designed by engineers and architects, constructed by the public sector, and maintained and managed by governmental entities. They typically include such projects as stormwater detention reservoirs, levees and floodwalls, channel modifications, drainage and storm sewer improvements, and community tornado safe-rooms. The following section includes measures that are already in place or included in current planning. See Chapter 6 and Appendix B for discussion of potential activities and programs within this category.

2.4.1 City of McAlester Capital Improvements Plans

The City of McAlester's Capital Improvements Plan lists approved street, building, water, sewer, and stormwater capital improvement needs, their costs, priority, and 5-year funding schedule (2010-2015). Capital improvements projects identified for hazard mitigation purposes include projects for floods, tornadoes, high winds, drought, hazardous materials spills.

Among these projects are the following that could have a Hazard Mitigation component:

- Update Public Works GIS software
- Stormwater Phase II engineering
- HazMat engineering
- Mallard Flamingo Drainage Project
- Miscellaneous drainage improvements
- Bridge repairs (Electric Ave., Washington Ave.)
- Wastewater Treatment Plant improvements
- Headworks improvement at East Wastewater Treatment Plant
- Miscellaneous Water System storage and distribution improvements
- Chlorine gas system improvements at the Water Treatment Plant
- Water Treatment Plant chemical spill containment
- Water Treatment Plant lagoon upgrades

2.5 Property Protection

Property protection measures are used to modify buildings or property that are subject to damage from various hazardous events. The property owner normally implements property protection measures. However, in many cases technical and financial assistance can be provided by a governmental agency. Property protection measures typically include acquisition and relocation, flood-proofing, building elevation, barriers, retrofitting, safe rooms, hail resistant roofing, insurance, and the like. The following section includes examples of property protection measures which have already been implemented within the City of McAlester or which are part of current projects. See Chapter 6 and Appendix B for discussion of potential activities and programs within this category.

2.5.1 City of McAlester Property Protection

The City of McAlester and McAlester Public Schools have a number of policies and procedures that take natural hazards into consideration in planning and construction of its facilities.

- **Expansive Soils:** McAlester typically does soil analyses before beginning construction on any public facility.
- **Flooding:** McAlester City Ordinances do not allow the construction of municipal buildings that would be in violation of FEMA or NFIP guidelines and regulations.
- **Hail:** Providing hail resistant roofing and windows are not normally provided for public buildings, but are considered when project budgets can accommodate the added cost.
- **Lightning:** Critical facilities such as telecommunications and water treatment plants have lightning protection. All critical, individual City computers have surge protection, but not robust enough to protect against a significant lightning strike. Lightning protection is not typically included in the design of new facilities, unless they are to contain sensitive electronics and computer equipment.
- **Transportation:** The City has designated hazardous materials routes around the community. Occasionally, vehicles hauling hazardous materials that travel off these designated routes are met by the Police and escorted through the city on streets that avoid critical facilities.
- **Other Hazards:** Flood proofing and Safe Rooms are typically considered on a site-by-site basis, according to the nature of the facility and its exposure to specific hazards. It is normal business practice for the City of McAlester and McAlester Public Schools to ensure that all municipal construction is done to current 2006 IBC standards.

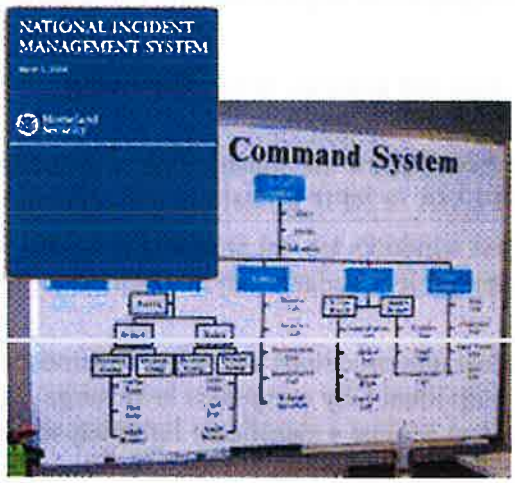
2.6 Emergency Response Procedures and Resources

In times of emergency, it is critical that a community have resources available to respond in an efficient manner to a hazard event. This section outlines McAlester's current emergency response procedures, notification and warning systems, critical facility protection and available emergency response resources. See Chapter 6 and Appendix B for discussion of potential activities and programs within this category.

2.6.1 National Incident Management System (NIMS)

In 2004, Homeland Security Presidential Directive #5 (HSPD-5) was issued stating that, in order to be eligible for certain Federal disaster mitigation funding, state, local, and tribal jurisdictions must incorporate the use of the National Incident Management System (NIMS) into their protocols.

The NIMS incorporates a system currently used called Incident Command System (ICS), a management system developed by the fire service to provide a common language, common management protocols, and scalable incident response chains-of-command that can be applied to any emergency response, whether it be a single family fire to a major tornado event. ICS also allows for "unified command" for situations where multiple agencies may be in charge of various aspects of the operation.



A typical Emergency Operations Center ICS Assignment Board

The NIMS enhances ICS by establishing a single, comprehensive system for incident management to help achieve greater cooperation among departments and agencies at all levels of government.

For a jurisdiction to be "NIMS Compliant," the following conditions must be met:

1. NIMS must be incorporated into existing training programs and exercises. Training will include, but not be limited to, completing FEMA course IS 700, National Incident Management System, an Introduction. The course is available on the FEMA website at training.fema.gov/EMIWeb/IS/is700.asp.
2. The jurisdiction must formally recognize NIMS and adopt NIMS principles and policies. State, territorial, tribal, and local entities should establish legislation, executive orders, resolutions or ordinances to formally adopt NIMS.
3. A baseline must be established by determining which NIMS requirements the jurisdiction already meets. As gaps in compliance with NIMS are identified, entities should use existing initiatives such as the Office for Domestic Preparedness (ODP) Homeland Security grant programs to develop strategies for addressing those gaps.

4. The concepts of NIMS must be incorporated into the Emergency Operations Plan (EOP).
5. A timeframe for fully implementing NIMS must be established.
6. As of FY 2007, Federal preparedness assistance became dependent upon the entity being fully NIMS compliant.

The City of McAlester and Pittsburg County have met all the preceding conditions and are both fully NIMS compliant.

2.6.2 Emergency Operation Plan

McAlester does not have a separate Emergency Manager, Emergency Management Office, or Emergency Operations Center (EOC). Instead, the City of McAlester and Pittsburg County share a joint Emergency Manager (Trent Meyers, as of this writing) and EOC located at the Pittsburg County Sheriff's Office at 1210 N. West St. in McAlester. The Pittsburg County Emergency Manager and EOC have an internet presence at: www.angelfire.com/ok2/pittsburgcountyeoc/.

The Emergency Manager is responsible for coordinating all phases of the emergency management program, including emergency planning and training, education and warning, and communications. The EM makes routine decisions and advises the Policy Group on alternatives when major decisions are required of that body. The control of all crisis operations is vested in the Policy Group. The Pittsburg County Policy Group is made up of the County Commissioners; the McAlester Policy Group is comprised of the Mayor, Vice Mayor, and City Councilors. During emergencies, a Chief of Operations (usually the EM) is appointed by the Policy Group and is responsible for the proper functioning of the EOC and its staff and acts, along with the Pittsburg County Sheriff, as liaison with other local, county, state, and federal emergency management agencies.

The Emergency Plan has three stages of operation: Normal Peacetime Readiness, Increased Readiness, and Emergency Period.

- **Normal Peacetime Readiness.** The Emergency Manager ensures the EOC is properly equipped and operationally ready; tests warning systems; reviews and revises the Emergency Operation Plan; educates the public as to warning signals; and practices emergency operations with City and County officials and departments.
- **Increased Readiness**. The EM advises the Policy Group of emergency measures; prepares EOC for activation; reviews EOC procedures and briefs EOC staff; obtains necessary supplies; tests internal and external communications; coordinates feeding of EOC staff.
- **Emergency Period.** Following the instructions of the Mayor of McAlester or Pittsburg County Commission, the EM sounds the warning system, activates the EOC, establishes security and internal and external communications; and moves essential City and County functions to EOC.

McAlester/Pittsburg County Emergency Management trains area volunteers to be Storm Spotters, in cooperation with the National Weather Service Office in Tulsa. Besides providing accurate weather warning information, Spotters also perform damage assessments in the aftermath of an emergency.

McAlester/Pittsburg County Emergency Management works closely with the *McAlester News-Capital* in producing articles on severe weather hazards and preparedness. The Office also maintains close contact with local radio stations, which are a vital link in the severe weather warning system. The Office has direct lines to all three local stations over which to deliver immediate warnings to be passed on to the public.

McAlester/Pittsburg County Emergency Management also sponsors training in explosives and hazardous materials response activities, often in conjunction with the McAlester Army Ammunition Plant.

When necessary, the Emergency Manager and Floodplain Administrator coordinate evacuation, transportation and shelter arrangements with the media and the jurisdictions, agencies and providers of vehicles and facilities.

2.6.3 Emergency Operations Center

The joint McAlester/Pittsburg County Emergency Operations Center is located in the basement of the County Jail (Pittsburg County Sheriff's Office) at 1210 N. West St. in McAlester. There is no permanent backup EOC. Should the EOC (primary) become unusable, an alternate EOC will be established at Pittsburg County Health Department (second) or McAlester Fire Emergency Response Complex (third), or the McAlester Police Department (fourth). The EOC is activated by the Emergency Manager for all Severe Thunderstorm or Tornado Watches that are issued for Pittsburg County. An Emergency Declaration is issued by either the Mayor of McAlester or the Pittsburg County Commission when a disaster exceeds one or both jurisdictions' resources or financial limits.

The McAlester/Pittsburg County EOC is activated during all Severe Thunderstorm or Tornado Watches issued for Pittsburg County. The Severe Weather Warnings are received via the "Weather Wire" satellite link, and immediately issued to all emergency service and law enforcement agencies and local radio stations. The EOC is equipped with a cable override system provided in cooperation with Peak Cable, which provides subscribers immediate warnings via their televisions.

Emergency Management staff and volunteers monitor numerous two-way radio frequencies, including HAM radio frequencies, with equipment and assistance from the Pittsburg County Amateur Radio Club.

The McAlester/Pittsburg County EOC participates in the National Weather Service accredited program *StormReady*, which requires an established warning point and a 24-hour functioning EOC, multiple means of both, receiving severe weather forecasts and providing warnings to the public, systems to monitor local weather conditions, promotion of public safety information, and a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

McAlester/Pittsburg County EOC participates in OKFirst, a system for receiving real-time radar and weather information via computer from the University of Oklahoma and the Oklahoma Mesonet System.

The EOC also receives hazardous weather information from a second satellite link, independent of "Weather Wire," which is re-broadcast via radio transmitter to anyone

who has a computer and radio receiver configured to receive the signal. The broadcast frequency is 148.775.

During major emergencies, the EOC may effectively become the seat of City/County government for the duration of the crisis. Day-to-day functions that do not contribute directly to response actions may be suspended for the duration of the emergency. The establishment and operation of the EOC is covered in detail in the *McAlester/Pittsburg County Emergency Operations Plan.*

The EOC is equipped with a communications center with all necessary communications equipment, including an enhanced 911 (or Reverse 911), storm computer system, siren controls, outdoor warning systems, backup radio systems and Computer Aided Dispatch systems. An emergency generator with fuel for a 24-hour period is available. An incident command post may be set up to coordinate activities at the site of a disaster. When necessary, offices and equipment of the City are available to support emergency operations affecting the city of McAlester.

The McAlester/Pittsburg County EOC keeps an index of citizen storm shelters, so that in the aftermath of a disaster that spreads debris over shelters, emergency rescue teams will know where to begin looking for survivors.

2.6.4 Emergency Notification and Warning Systems

Warning systems may be activated from any level of government by agencies having responsibility to notify the public of imminent danger, such as the Police and Fire Departments. Generally, if time allows, warnings are channeled through the Mayor of McAlester and/or the Pittsburg County Commission to the Emergency Manager, so that a single point of responsibility for the warning process is maintained. In times of emergency, the chain of command for issuing warnings is from the Pittsburg County Sheriff and McAlester Chief of Police to the Emergency Manager. If an event happens when the EOC is not manned and radio or telephone contact cannot be made, then the Police dispatcher has the authority to activate the storm warning devices.

McAlester Emergency Notification and Warning Systems

Emergency Alert System (EAS) Communication

While the Emergency Alert System (EAS) was designed to give the president a means by which to address the American people in the case of a national emergency, it has been used since 1963 by local emergency management personnel for relay of local emergency broadcasts. EAS, which is controlled by the Federal Communications Commission (FCC), utilizes FM, AM, and TV broadcast stations, as well as cable and wireless cable providers to relay emergency messages.

Table 2–4: EAS Stations In or Near McAlester

Facility	Frequency	City
EAS FM radio stations		
KMGL	104.1	Oklahoma City
KLTE	101.9	Oklahoma City
KBCW	91.90	McAlester
KDOE	102.30	Antlers

Facility	Frequency	City
KHKC	102.1	Atoka
KLRB	89.30	Stuart
KMCO	101.30	McAlester
KNNU	92.30	Antlers
KNOR	105.50	Coalgate
KOCD	103.7	Wilburton
KTKL	88.50	Quinton
KTMC	105.10	McAlester
KTNT	102.50	Eufaula
EAS AM radio stations		
KWA	960	Enid
WKY	930	Oklahoma City
KEOR	1110	Atoka
KNED	1150	McAlester
KRAF	1370	Holdenville
KTMC	1400	McAlester
TV broadcast stations		
KOET	3	Eufaula
City of McAlester Cable Access	21	McAlester
Cable TV		
Allegiance Communications (Local television override is available)		

Source: http://okeas.sbe56.com/index.php?search=monarea

NAWAS (National Warning System) Emergency warnings are received and disseminated through NAWAS, a protected, full time, voice communication system interconnecting the National Warning Center and numerous warning points in each state. Oklahoma has one primary state warning point, 2 alternate state warning points, and 30 secondary warning points. The primary point is at Oklahoma Highway Patrol (OHP) headquarters in Oklahoma City. Alternates are located in the Oklahoma Department of Emergency Management EOC and the National Guard EOC. The 30 secondary points are located in OHP district headquarters, sheriff/police departments, fire departments, and local EOCs throughout the state. Pittsburg County Sheriff and McAlester Police Department receive NAWAS alerts.

SkyWarn (Weather Spotters) is a national program designed to place personnel in the field to spot and track tornadoes. They are trained by NWS and instructed in what to report. Teams are made up of government employees and private citizens. During severe weather, storm spotters relay reports to their coordinator in the EOC. Confirmed tornado sightings are relayed to the NWS, which then disseminates appropriate warnings.

Notifications of severe weather or other serious hazards are relayed to the public through McAlester's siren warning system, mobile teams, and TV/Cable override, as authorized by the Mayor, Policy Group, Emergency Manager or Police or Fire Department personnel. Instructions to activate the warning system are channeled through the Emergency Management Director, if time permits, to fix a single point of responsibility for the warnings and ensure control.

NOAA Weather Radios McAlester's Emergency Management has installed NOAA weather radios at all public buildings and schools. The EOC has the capability of overriding local radio and television stations, including cable channels. The emergency warning messages are generic, alerting the public of the danger and advising what to do or where to get further information.

Members of McAlester's deaf and hard-of-hearing community are served by two state programs that can facilitate alerts and warnings:

- **OK-WARN** (Oklahoma Weather Alert Remote Notification) is a program for emergency weather/situation notification service via pagers and/or E-mail addresses. The success of a pilot program in 2001 led to the creation of OK-WARN, which now provides life-saving messages about tornadoes, severe thunderstorms, winter storms, flash floods, river floods and high wind warnings from local National Weather Service offices to deaf and hard-of-hearing people who sign up for the service. There is no cost for qualified deaf and hard-of-hearing persons.
- The State Department of Rehabilitation Services can (a division of Oklahoma Department of Health) provide free NOAA weather radios specially adapted to the needs of the deaf and hard-of-hearing community with such accessories as strobes and bed shakers.

Emergency Mass Notification Systems

McAlester is purchasing a Telephone-based Mass Notification System, commonly referred to as Reverse 911, which will be activated in 2010.

Warning Sirens

The City of McAlester has 9 warning sirens strategically placed around the community. The sirens are computer-controlled and radio-activated, with a battery backup system to ensure uninterrupted service in the event of a power failure. Silent tests are conducted weekly and a full-activated test is performed once a month on a regularly scheduled basis. The system is capable of activating only select sirens or groups of sirens if only an isolated warning is needed. The City of McAlester's Warning Sirens are shown in Figure 2-2.

The all clear is made over local radio stations and Cable Television and not over the warning sirens.

Table 2–5: Alert and Siren Signals

Type of Alert	Hazard	Siren Signal
Natural Disaster Alert	Tornado Warning	3-minute straight tone
Natural Disaster Alert	Flood Warning	3-minute slow high-low siren tone
Other Disaster Alerts	Nuclear Attack	3-minute wavering tone

Source: City of McAlester

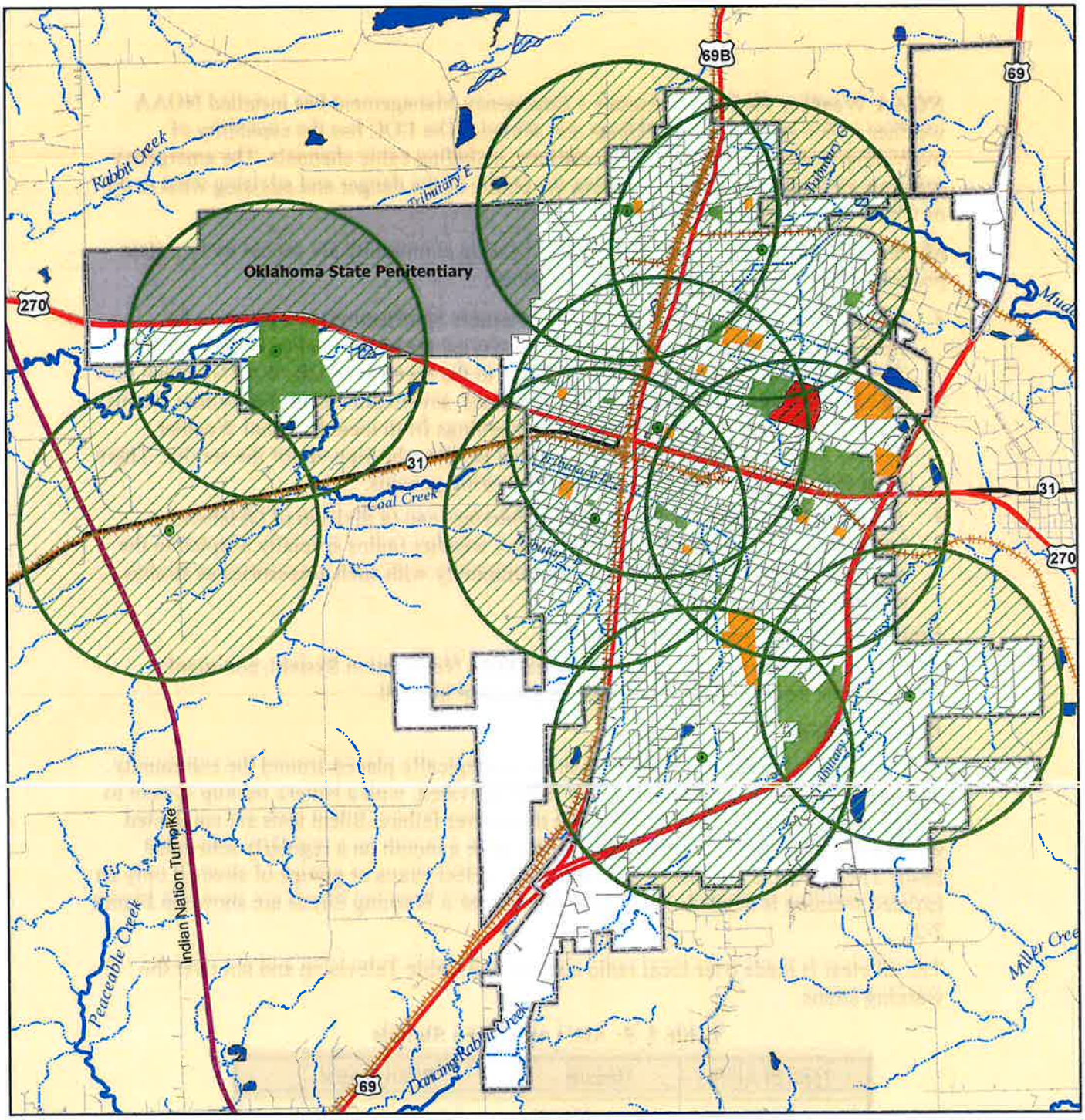


Figure 2-2

City of McAlester

Warning Sirens

2.6.5 Fire Safety Resources

McAlester Fire Department and Resources

The Fire Department, with headquarters located at 617 Village Blvd., has four fire stations staffed by a minimum of 3 firefighters per shift per station, on a 24-hour basis. The city has 43 firefighters. Of the 43 firemen, 43 are Jaws of Life certified, 26 are trained in HazMat, 17 as HazMat Trailer Operators, 16 are Building Inspectors, 20 are trained in Trench Rescue, 4 are on the Scuba Team, 10 are trained in Swift Water Rescue, and 41 are EMS qualified. McAlester Fire Department current ISO rating is 4. Equipment includes five engines, a ladder truck, HazMat truck and trailer, and 1 brush pumper. The Department provides primary fire control and suppression for the City of McAlester.

Table 2–6: McAlester Fire Stations

Station	Location
City Hall Fire Station:	28 E. Washington Ave.
North Fire Station:	2717 North Main Street
South Fire Station:	1313 South Strong Boulevard
McAlester Fire Emergency Response Complex:	617 Village Blvd.

Source: City of McAlester

The *McAlester/Pittsburg County Emergency Operations Plan* lists the emergency functions of the Fire Department as follows:

- Fire suppression
- Assist in radiological protection
- Hazardous material operations
- Operation of warning system
- Enforce Fire Code and Prevention Program
- Search and rescue operations
- Communication system support

McAlester Fire Department has mutual aid agreements with all area Departments, and frequently assists with response in areas outside the McAlester City Limits.

The McAlester Fire Department provides pre-hospital emergency medical service to the City of McAlester, with the number of emergency medical calls continuing to increase each year. All Department firefighters are cross-trained as First Responders, and 41 are EMTs licensed by the Oklahoma State Department of Health and certified by the National Registry of Emergency Medical Technicians.

2.6.6 Public Safety Resources

McAlester Police Department and Resources

The Police Department, located at in the Municipal Building at First St. and E. Washington Ave., has 46 full time, CLEET-certified officers, as well as a Detective Division and a Narcotics Task Force.

The *McAlester/Pittsburg County Emergency Operations Plan* lists the emergency functions of Law Enforcement as follows:

- Maintain law and order
- Monitor communications for warnings
- Provide law enforcement and communication for larger shelters

- Provide mobile units for warning and evacuation
- Provide security for key facilities
- Traffic control
- Crowd control
- Mark expedient emergency shelters
- Provide warning to affected areas
- Execute mutual aid agreements with other jurisdictions
- Provide for security, protection and relocation of jail inmates

2.6.7 Public Works Department Resources

McAlester Public Works Department and Resources

McAlester's Public Works Department is located at various locations around the City. Under McAlester's *Emergency Operations Plan*, the Public Works Department has the following responsibilities:

- Maintain water and sewage systems
- Emergency sign preparation
- Maintain roads and bridges
- Repair and restoration of public services
- Prevent damage to public services
- Debris clearance
- Maintain equipment for emergency use
- Snow removal and assistance to stranded motorists
- Provide earthmoving equipment for emergency use
- Other duties, as assigned by the EOC

2.6.8 Pittsburg County Sheriff's Department Resources

The Pittsburg County Sheriff's Department is located at 1210 N. West St. in McAlester. Under the *McAlester/Pittsburg County Emergency Operations Plan*, the Sheriff's Department has the following responsibilities:

- Coordinate all law enforcement in the County
- Disseminate warnings throughout the County
- Coordinate relocation traffic control
- Coordinate mutual aid agreements
- Support emergency public safety activities
- Provide for security, protection and relocation of inmates in the County Jail
- Search and rescue operations

2.6.9 Other City, County, State and Federal Response

McAlester City Clerk is responsible for City administrative and fiscal duties.

McAlester City Attorney is responsible for legal and emergency information services and serves as a member of an advisory committee.

Superintendent of McAlester Schools is responsible for providing public shelters, buses for transporting evacuees, and for MOUs with neighboring jurisdictions for use of buses for evacuation.

Pittsburg County office of the State Medical Examiner, when committed:

- Collects, identifies, and coordinates interment of deceased disaster victims
- Coordinates funeral home support activities

Pittsburg County Health Department, when committed:

- Investigates sanitation conditions and establishes safe standards for crisis location, emergency shelter, or disaster relief operations
- Coordinates medical support and epidemic control
- Inspects food and water supplies
- Provides public health education

Pittsburg County Office Department of Human Services, when committed:

- Provides provisions and funds for emergency aid
- Coordinates with the Red Cross and other volunteer agencies

Pittsburg County Clerk is responsible for county administrative duties.

Pittsburg County Treasurer is responsible for county fiscal matters.

District Attorney is responsible for legal and emergency information services, and serves on an advisory committee.

Oklahoma National Guard, when committed:

- Assists in radiological protection
- Assists in law enforcement and traffic control
- Assists in search and rescue operations
- Provides military engineer support and assistance in debris clearance
- Provides logistical support with supply, transportation, maintenance and food service
- Provides communication support

Other State and Federal agencies, when committed, assist with:

- Public welfare assistance
- Resources
- Law enforcement
- Health and medical support and supplies
- Debris clearance
- Public information and education

2.6.10 Health Care Facilities and Shelters

McAlester is home to the McAlester Regional Health Center. The Health Center offers a full range of health care services with state of the art technology and diagnostics, community educational programs and support groups. The Center has 200 beds, 101 registered nurses, 65 practical nurses, 4 pharmacists, and a total of 950 employees.

Other emergency medical facilities in the city are:

- Carl Albert Mental Health Center, 1101 E. Monroe, has 30 beds, 5 physicians, 2 pharmacists, 20 registered nurses, 4 practical nurses, and a total of 105 employees.
- Pittsburg County Health Department, 1400 E. College Ave.
- Warren Clinic, 1401 E. Van Buren, has 22 physicians and 7 other medical professionals on its staff. The Clinic is a part of Saint Francis Health System. The McAlester Division includes physicians representing a variety of medical specialties supported by ancillary services. The Clinic moved to its current location adjacent to McAlester Regional Health Center in 1981.
- Choctaw Nation Health Center, 1127 S. George Nigh Expressway, offers a full clinic for family medicine, including primary care, pediatrics, optometry, physical therapy, dentistry, and behavioral health. It has a staff of one physician, one nurse practitioner, two dentists, three pharmacists, and two physical therapists.
- McAlester Regional Cancer Center, 901 N. Strong Blvd.

For locations of healthcare facilities in McAlester, see Figure 1-10.

2.6.11 Medical Response and Coordination

In the event of a multi-jurisdictional response, the Pittsburg County Medical Coordinator serves as the County Health Department Administrator. For a McAlester response, the Medical Director will be the McAlester Fire Chief or his designee.

The City/County Health Director is responsible for:

- Coordinates the provision of medical aid from hospitals, clinics, pharmacies, nursing homes, funeral homes, Red Cross, State agencies, and emergency medical teams.
- Captures pharmaceutical supplies and stockpiles them in a secure area.
- Plans and oversees the inoculation of First Responders and their families.
- Work collaboratively with medical and public health officials to recruit physicians, pharmacists, nurses, mental health professionals, interpreters, fire and rescue personnel, Red Cross, and volunteers.
- Identify and arrange for distribution of medications to medical personnel.
- Identify and treat captive populations.
- Inform the public of the threat, plans of action, and appropriate community response, via Reverse 911, internet, cable television, radio, and print media.
- Controls insects and rodents and employs other environmental health measures to prevent epidemics and the spread of disease.
- Provides core public health services, such as immunization programs and other related medical services.
- Monitors the community health status and reports identified public health problems to appropriate agencies.
- Provides limited hazardous materials emergency response capability.
- Enforces laws and regulations to protect public health and ensure safety.

PITTSBURG COUNTY HEALTH DEPARTMENT
Michael Echelle, Administrative Director
1400 E. College Ave.
McAlester, OK 74501
(918) 423-1267

In the event of a disaster, the Southeastern Oklahoma Chapter of the American Red Cross is responsible for identifying and managing public shelters, in cooperation with other appropriate agencies.

McAlester's long-term care facilities include:

- **Blevins Retirement**, 1220 E. Electric Ave., licensed for 55 beds.
- **Heritage Hills**, 411 N. West St., licensed for 81 beds.
- **Mitchell Manor**, 315 W. Electric Ave., licensed for 100 beds.

During an emergency or disaster, medical service providers are responsible for emergency medical care for victims, health care, and crisis counseling.

In the case of a disaster requiring shelters, the Superintendent of McAlester Public Schools will assist with providing buses for transportation during disaster relief operations. The Southeastern Oklahoma Chapter of the American Red Cross will assist with shelter operation and support activities, supported by the Salvation Army, the County office of the Department of Human Services, and the McAlester Medical Reserve Corps. Emergency shelters will be drawn from a mixture of public and private resources and utilized according to the following priority: public schools first, followed by churches, government buildings, colleges/universities, and private buildings.

Ambulance service is provided by the McAlester Fire Department. The Fire Department operates 4 ambulances staffed by teams of fully certified EMS and First Responders, which are on duty 24 hours a day, seven days a week.

2.6.12 Volunteer and Community Support Organizations

- **Southeastern Oklahoma Chapter of the Red Cross** provides reception, care, food, lodging, and welfare assistance; coordinates relief and shelter activities; and provides first aid support and blood supply, counseling, and damage assessment of private property.

- **Salvation Army** supports shelter/congregate care operations; provides mobile and fixed feeding sites; provides case management services, direct aid for disaster victims, and spiritual counseling service.
- **Ministerial Alliance/Church Volunteer Groups** assist with lodging, feeding and welfare operations in support of disaster relief or relocation; assist with reconstruction; provide volunteer manpower and counseling.
- **The United Way** provides assistance to McAlester area non-profits for such things as emergency food, clothing, shelter, utility bill assistance, counseling, literacy, advocacy and legal assistance.

- **Kibois Community Action, Inc.,** provides food, homeless services, child care, transportation, counseling, nutritional services, and help with past due utility payments and rent.
- **Southern Baptist Disaster Relief** provides teams that prepare and serve hot meals, provide child care, laundry and counseling services, remove debris and mud from damaged homes, purify water, and assist with damage assessments. The focus is on those who cannot help themselves, such as widows, the elderly, handicapped, and single mothers.
- **Pittsburg County Amateur Radio Club** provides emergency communications, storm spotting and damage assessments.
- **United Methodist Committee on Relief, UMCOR,** maintains a corps of trained disaster response specialists for quick reinforcement of local efforts, and maintains a supply of relief materials in warehouses for dispatch when and where required.
- **Catholic Charities** provide critical services including emergency food, shelter, direct financial assistance, counseling, and support—regardless of race, creed, or socio-economic status.
- **Tzu Chi, Buddhist Relief Organization** provides emergency materials like food, clothing, grain seeds, and medical materials, and helps rebuild houses and schools, set up water supply systems, and offer free clinics.
- **Choctaw Nation.** Besides providing emergency assistance to Native Americans to prevent homeless or near homelessness, the Choctaw Nation has agreements with communities throughout the region to provide assistance in the wake of natural disasters and other emergencies, including police and fire response, shelter, food, and medical services.
- **Lutheran Relief Organization, LWR,** helps local organizations respond to disasters in their communities, leveraging the capacity of local people as disaster responders, employing concepts such as participation and empowerment. LWR provides funding and material resources for both immediate response and rehabilitation, and develops and implements strategies for reconstruction, rehabilitation and risk management.
- **Church of Christ Disaster Relief** responds to major disasters in the continental United States by sending truckloads of emergency food, water, cleaning, and other supplies to disaster victims.
- **McAlester Army Ammunition Plant** provides assistance to surrounding communities for floods, fires, winter storms, hazardous materials, and wildfires, and provides training in a range of mitigation and response activities.
- **Oklahoma National Guard** responds to emergencies as directed by the Governor, delivering food and water, medical supplies,

McAlester Army Ammunition Plant provides training in hazardous materials, wildfire, rescue operations, among other assistance activities.

providing security, fighting fires, and helping communities deal with floods, tornadoes, hurricanes, snowstorms or other natural disasters.

- **Oklahoma Floodplain Manager's Association (OFMA) Disaster Response Team** responds to flood disasters across the state, assisting in various response activities and damage assessments.
- **Community Emergency Response Team (CERT) Program.** After a major disaster, local emergency teams quickly become overwhelmed. CERT is designed to have trained groups of citizens in every neighborhood and business ready to assist first responders (police, firefighters and EMS) during an emergency. CERT teams are also available to be used in mitigation activities, including public awareness and other non-structural community mitigation measures. ***CERT Partner Programs***. Police, Fire and Sheriff's departments often have civilian auxiliaries, or volunteers, who assist when disaster strikes. Pittsburg County's Medical Reserve Corps is a CERT Partner.

2.7 Natural Resource Protection

Natural resource protection activities are generally aimed at preserving and restoring the natural and beneficial uses of natural areas. In doing so, these activities enable the beneficial functions of floodplains and drainage ways to be better realized. This section reviews the natural resource protection activities that have already been implemented in the community or are already in the planning stages. See Chapter 6 and Appendix B for discussion of potential activities and programs within this category.

McAlester maintains certain policies in place to address Natural Resource Protection. Erosion and Sediment Control are covered in City development regulations and as required by EPA and the Oklahoma Department of Environmental Quality. Floodplain Regulations require adequate modeling and engineering of any regulated activities that would affect major and minor stream corridors.

2.8 Sources

McAlester/Pittsburg County Emergency Operation Plan, Pittsburg County, OK, June 2005.

Oklahoma EAS Monitoring Assignments, http://okeas.sbe56.com/index.php?search=monarea

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City of McAlester Capital Improvement Program 2010 – 2015, McAlester, OK, http://www.cityofmcalester.com/

City of McAlester Council Minutes, McAlester, OK, http://www.cityofmcalester.com/

National Incident Management System (NIMS), FEMS, http://www.fema.gov/emergency/nims/AboutNIMS.shtm

National Warning System (NAWAS), National Weather Service, http://www.srh.noaa.gov/cwwd/faqs/nawas.htm

NAWAS Coverage in Pittsburg County, National Weather Service, http://www.nws.noaa.gov/nwr/Maps/PHP/site.php?State=OK&Site=WXL49

Oklahoma Weather Alert Remote Notification (OKWARN), Oklahoma Department of Emergency Management, http://www.ok.gov/OEM/Programs_&_Services/OK-WARN/index.html

Choctaw Nation Health Center, McAlester, http://www.choctawnationhealth.com/services/smcalester.php

Chapter 3: The Planning Process

44 CFR Requirements met:

Requirement §201.6(a)(3): *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.*

Requirement §201.6(b): *An open public involvement process is essential to the development of an effective plan.*

Requirement §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process* ***shall*** *include:*

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.6(c)(1): *[The plan* ***shall*** *document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

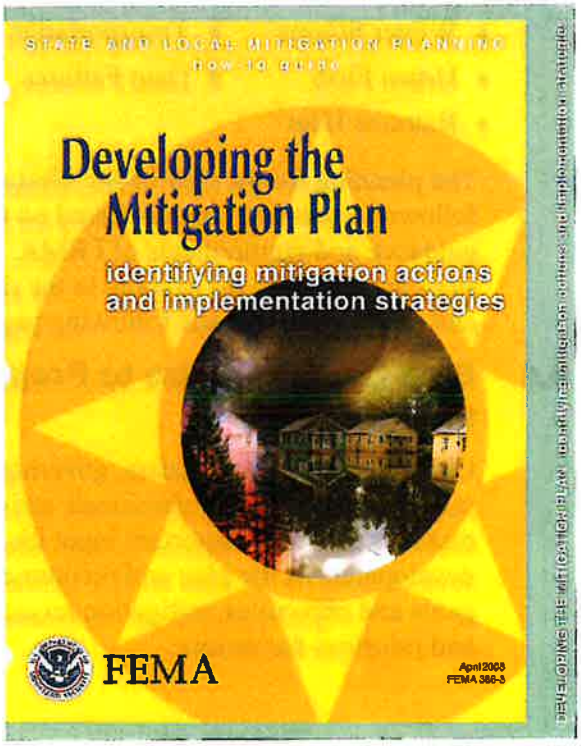
Included in this Chapter:

3.1 Step One: Organize to Prepare the Plan
3.2 Step Two: Involve the Public
3.3 Step Three: Coordinate with Others
3.4 Step Four: Assess the Hazard
3.5 Step Five: Assess the Problem
3.6 Step Six: Set Goals
3.7 Step Seven: Review Possible Activities
3.8 Step Eight: Draft an Action Plan
3.9 Step Nine: Adopt the Plan
3.10 Step Ten: Implement, Evaluate, and Revise

Planning Process Introduction

The City of McAlester Multi-Hazard Mitigation Plan is an effort to direct the multi-hazard planning, development, and mitigation activities of the City of McAlester. The City of McAlester is responsible for overall coordination and management of the study.

A mitigation plan is the product of a rational thought process that reviews the hazards, measures their impacts on the



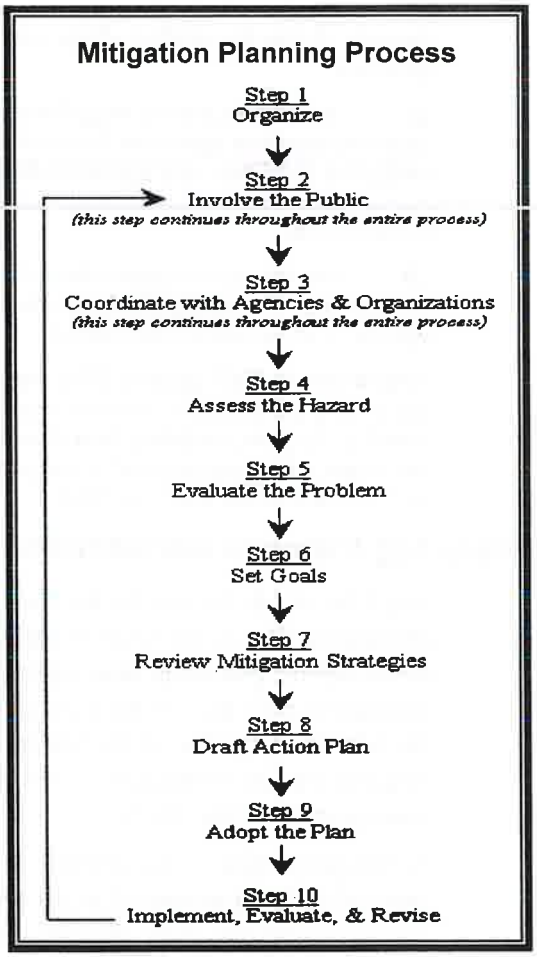
The Technical/Citizens Advisory Committee meeting to review the plan

community, identifies alternative mitigation measures, and selects and designs those that will work best for the community.

This plan addresses the following hazards:

- Floods
- Tornadoes
- High Winds
- Lightning
- Hailstorms
- Winter Storms
- Urban Fires
- Extreme Heat
- Drought
- Expansive Soils
- Wildfires
- Earthquakes
- Hazardous Materials
- Transportation
- Dam Failures

The planning for the City of McAlester followed a ten-step process, based on the guidance and requirements of FEMA. The ten steps are shown in the graphic to the right, and are described on the following pages.



3.1 Step One: Organize to Prepare the Plan

Citizens, community leaders, government staff personnel, and professionals active in disasters provided important input into the development of the plan and recommended goals and objectives, mitigation measures, and priorities for actions.

The planning process was formally created by a resolution of the City Council of McAlester. The resolution designated these five people to serve as the McAlester Citizens' Advisory Committee (CAC) to oversee the planning effort.

City of McAlester Citizens' Advisory Committee

The **CAC** consists of the following members:

J. P. (Pat) Hackler
Brumley-Mills Funeral Home

Master of Funeral Service Science from Dallas Institute of Mortuary Science;
Oklahoma Funeral Directors Association – Disaster Committee.

Charlie Hale
Retired

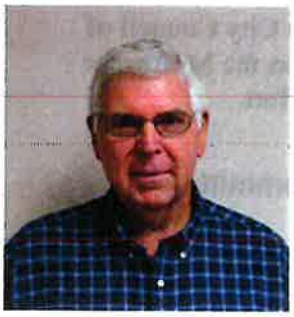
Master of Teaching from SOSU, Durant;
First Baptist Church – Deacon, Sunday School Superintendent:
Historical Society;
BSA – Troop 2;
Meals On Wheels – Volunteer.

Cliff House
Lakewood Christian Church
Pastor

Bachelor of Sacred Literature from Ozark Christian College;
Master of Educational Administration from Pensacola Christian College;
McAlester Rotary Club, Past President;
McAlester Boys and Girls Club, Past President.

John Kuykendahl
Retired

Retired from McAlester Army Ammunition Plant;
McAAP Fire Department Haz-Mat Team – past member;
Worked with Pressure Suits used in the making of ammunition.



Chris Martin
Retired

Bachelor of Science in Education from Midwestern University;
Sertoma Club, Past President, Board Member.

Supporting the CAC is the McAlester Technical Advisory Committee (TAC), which includes representatives of departments that have roles in multi-hazard planning, response, protection, and mitigation. Most of the detail work was done by management teams consisting of the following:

City of McAlester Technical Advisory Committee

Cliff Pitner
City of McAlester
Engineering/Public Works

AA in Police Science from Conners State at Warner, OK;
CFM – Oklahoma Floodplain Managers Association – Board Member;
Engineering Inspector; Stormwater Program Manager; Floodplain Administrator;
Grade I Conc. Testing Tech through ODOT.

Richard Cotton
City of McAlester
Sr. Engineering Technician

AA in Drafting and Design from Eastern Oklahoma State College;
Krebs Public School, Past School Board President.

Mike Echelle
Pittsburg County

Health Department Director.

William Faries
City of McAlester

Safety/Risk Management.

Danny Giacomo
McAlester Public Schools

Director, School Plant.

Cathy Haynes
Pittsburg County Assessors Office

First Deputy.

Clyde Heathcock
McAlester Public Schools

Campus Police.

Lois Lupardus
McAlester/Pittsburg County Emergency Management
Assistant Director

Oklahoma Certified Emergency Manager;
Oklahoma Emergency Management Association.

David Medley
City of McAlester
Utility Director

Bachelor of Science in Civil Engineering from Oklahoma State University;
Master of Science from Oklahoma State University;
Professional Licensed Engineer in the State of Oklahoma Since 1993;
Project and design engineer for municipal water, wastewater, and street projects in Oklahoma, Arizona and Kentucky.

John C. Modzelewski
City of McAlester
Public Works Director/City Engineer

Bachelor of Science in Civil Engineering from WPI;
ASCE West Tennessee Branch – Past President;
TSPE Memphis Chapter – Past President.

Mary Shannon
McAlester Public Schools
Deputy Superintendent

Bachelor of Science in Education from Oklahoma State University
Master of Science in Education from East Central University;
Post graduate work in Educational Administration from the University of Oklahoma;
McAlester Chamber of Commerce, Past Board Member;
Experience in Grant writing and Federal programs management.

Peter Stasiak
City of McAlester
Planning and Community Development Director

Bachelor of Science in Business Management from Regis College;
Rural Committee Chairman and Past Member of AZ Association of Economic Development (AAED).

Lisa Sutterfield
City of McAlester
911 Coordinator

Bachelor of Science in Mass Communications from East Central University.

Gary Wansick
McAlester Police Department
Captain

Associate Degree in Criminal Justice from Eastern Oklahoma State College.

Other participants include:

David Bailey – ***McAlester Police Department***
Dan Hass – ***McAlester Police Department***
Darrell Miller – ***Assistant Chief of Police***
Trent Myers – ***Pittsburg County/McAlester Director of Emergency Management***
Jerry B. Rivas – ***McAlester Fire Department, Assistant Fire Chief***
Harold Stewart – ***McAlester Fire Department, Chief***
Bobby Tucker – ***Fire Marshal***
Bryan Woods – ***Pittsburg County Assessor's Office***

Consultant:

Ronald D. Flanagan, CFM
Principal Planner

R.D. Flanagan & Associates
Planning Consultants
2745 E. Skelly Dr., Suite. 100
Tulsa OK 74105

Other entities involved in the development of the Mitigation Plan included:

Tulsa Partners, Inc

TPi in a Tulsa-based non-profit that has been working since 1998 to develop public / private / non-profit collaborations to help create a disaster-resistant and sustainable community and improve the community's safety and well-being by reducing deaths, injuries, property damage, environmental and other losses from natural or technological hazards. Tulsa Partners provides expertise in the areas of community education and public involvement in the planning process.

The CAC and TAC met monthly at City Hall during the planning process to review progress, identify issues, receive task assignments, and advise the consultants. A list of CAC/TAC, and public meetings and dates is shown in Table 3-1. Refer to Appendix C for meeting agendas.

Table 3–1: McAlester Hazard Mitigation Committee Meetings and Activities

Date	Activity
June 12, 2008	City of McAlester Hazard Mitigation Plan Obligation Date.
February 24, 2009	Project Start Date
February 24, 2009	City of McAlester Multi-Hazard Mitigation Plan Initial Client Introduction Meeting.
March 24, 2009	Technical Advisory Committee (TAC) Introductory Meeting.
April 28, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Lightning and Hail; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
May 26, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Tornadoes and High Winds; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
June 23, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Extreme Heat and Drought; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
July 28, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Earthquakes, Expansive Soils and Subsidence; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
August 25, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Mass Communication; Continued review and discussion of Earthquakes, Expansive Soils and Subsidence.
September 22, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Hazardous Materials and Transportation Hazards; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
October 27, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Urban Fires and Wildfires; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
November 17, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Severe Winter Storms and Emergency Back-up Generator Hazard Mitigation Plan Annex (EBGHMP); Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
December 15, 2009	Meeting of TAC/CAC; Presentation, review, discussion of Flooding and Dam Failures; Goals and Objectives; Existing Mitigation Measures, Potential additional mitigation Measures, Hazard Priority Matrix.
January 26, 2010	Meeting of TAC/CAC; Presentation, review, discussion of Mitigation Measures.
October 21, 2010	TAC Meeting: Review Final Draft HM Plan, prepare to submit to State.

3.2 Step Two: Involve the Public

In addition to the CAC, the management team of TAC undertook projects to inform the public of this effort and to solicit their input. All meetings of the CAC were publicly posted as required by ordinances and rules of the jurisdiction. Public meetings were held in the City of McAlester City Hall. In all public meetings, surveys were made available to the participants to review concerns and questions.

3.3 Step Three: Coordinate with Other Agencies and Organizations

Many public agencies, private organizations, and businesses contend with natural hazards. Management team members contacted them to collect their data on the hazards and determine how their programs can best support the McAlester Multi-Hazard Mitigation planning program. A sample letter and a list of agencies contacted are included below.

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.

The Emergency Operations Plan is administered under McAlester Emergency Management. The Public Works and Planning Departments play key roles during most emergencies.

Federal

Federal Emergency Management Agency, Region VI (FEMA)
National Weather Service (NWS)
Natural Resource Conservation Service (NRCS)
US Army Corps of Engineers
US Fish and Wildlife Service
US Geological Survey

National Non-Profit

American Red Cross, Pittsburg County Chapter
American Red Cross, State Disaster Officer
Oklahomans for Independent Living
Salvation Army, Divisional Director
United Way of Southeastern Oklahoma

Tribal

Choctaw Tribe, Durant
Choctaw Nation Public Safety Department, Durant

State

Oklahoma Biological Survey
Oklahoma Conservation Commission
Oklahoma Department of Agriculture, Food, and Forestry
Oklahoma Department of Commerce
Oklahoma Department of Education
Oklahoma Department of Emergency Management
Oklahoma Department of Environmental Quality

Oklahoma Department of Health
Oklahoma Department of Labor
Oklahoma Department of Transportation
Oklahoma Department of Wildlife Conservation
Oklahoma Fire Marshal
Oklahoma Geological Survey
Oklahoma Insurance Department
Oklahoma Water Resources Board

- State Dam Safety Coordinator
- State National Flood Insurance Program (NFIP) Coordinator

County

Pittsburg County Assessor
Pittsburg County Board of Commissioners
Pittsburg County Health Department
Pittsburg County LEPC
Pittsburg County Sheriff's Office
Pittsburg County/McAlester Emergency Management

City

Blue Community Volunteer Fire Department
Gaines Creek Volunteer Fire Department
Haywood & Arpelar Volunteer Fire Department
High Hill Volunteer Fire Department
Krebs Emergency Management
McAlester City Manager
McAlester Director of Community Services
McAlester Fire Department
McAlester Mayor
McAlester Para Med EMS
McAlester Police Department
Sam's Point Volunteer Fire Department
Shady Grove Volunteer Fire Department
Tanne Hill Scipio Lake Area Volunteer Fire Department

Businesses

AEP/PSO
CenterPoint Energy
Charles Komar and Sons
Choctaw Manufacturing
McAlester Army Ammunition Center
McAlester Chamber of Commerce
McAlester Regional Hospital
Oklahoma State Penitentiary

Education

Eastern Oklahoma State College – McAlester Campus
Kiamichi Technology Center
Pittsburg County Extension Office

Figure 3–1: McAlester Coordination Letter Draft

City of McAlester HOMETOWN Friendly

P.O. BOX 578 • 1ST & WASHINGTON • McALESTER, OKLAHOMA 74502 • 918 423-9300 • FAX 421-4971 • www.cityofmcalester.com

April 21, 2009

«Prefix» «First_Name» «Last_Name»«Certification»
«Title»
«Organization»
«Address»
«City», OK «Zip»

Subject: McAlester Multi-Hazard Mitigation Plan Update

Dear :

The Oklahoma Department of Emergency Management and the Federal Emergency Management Agency have awarded the City of McAlester a Hazard Mitigation Grant Program (HMGP) grant to update the 2004 Multi-Hazard Mitigation Plan for the City.

The planning process began February 2009, and the plan is expected to be submitted by April 2010. A Hazard Mitigation Citizens Advisory Committee and a Staff Technical Advisory Committee have been appointed by the City to oversee the planning process.

You are invited to participate in the planning process, provide input, and receive any data produced during the planning process. We, or our consultants, may contact your agency to solicit information and studies, which may be relevant to the development of our multi-hazard mitigation plan.

If you have any questions about the process or wish to participate in future planning meetings, please contact Cliff Pitner at (918) 423-9300, ext. 4990 or by e-mail at cliff.pitner@cityofmcalester.com .

Sincerely,

Cliff Pitner,

3.4 Step Four: Assess the Hazards

The management team collected data on the hazards from available sources. Hazard assessment is included in Chapter 4, with the discussion of each hazard.

Table 3–2: How and Why Hazards Were Identified

Hazard	*How Identified*	*Why Identified*
Dam/Levee Failures	Input from US Army Corps of Engineers (USACE) Input from Oklahoma Water Resources Board, (OWRB), Dam Safety Division Input from State Levee Coordinator	• There are no High Hazard Dams within McAlester's city limits, however research will be undertaken to identify McAlester's vulnerability to any such hazard events
Drought	Historical vulnerability to drought, the "Dust Bowl" era Recent (2002) drought and water shortages in Bartlesville, just north of Tulsa Widespread Oklahoma drought of 2005-2007.	• Continuing mid-west and western drought and impacts on Oklahoma communities. • Acute awareness of Oklahoma's population to the severe results of drought • Need to ensure adequate long-term-water resources for McAlester's metropolitan area population
Earthquakes	Historic records of area earthquakes Input from Oklahoma Geological Survey Input from USGS HAZUS Surveys of potential damages	• Oklahoma has a history of mild earthquakes • The strongest quake in Pittsburg County was a 3.2. It was hardly felt and produced no recorded damage
Expansive Soils	Review of Natural Resource Conservation Service data Input from City Building Inspections Department Input from Oklahoma Department of Transportation	• 41.6% of McAlester's soils are rated to have "very high", high", or "moderate" expansion potential • Damage to buildings and infrastructure from expansive soils can be mitigated with public information and building code provision
Extreme Heat	Review of number of heat-related deaths and injuries from EMS and State/Local Health Departments Review of data from National Climatic Data Center and National Center for Disease Control & Prevention	• Emergency Management and local community service organizations have made heat-related deaths a high priority • High percentage of outdoor workers at risk • High percentage of poor and elderly populations at risk • 44 heat-related deaths in Oklahoma in the last 5 years
Floods	Review of FEMA floodplain maps Buildings in the floodplains Historical floods and damages (detailed in Chapter 4)	• 3 drainage features contribute to McAlester's floodplains: Dancing Rabbit Creek, Mud Creek and Sandy Creek.

Hazard	How Identified	Why Identified
Hailstorms	Review of data from National Climatic Data Center	• 52 hail damage events in the McAlester area between 1989 and 2008 • $100,000 in reported property damage
High Winds	National Weather Service data Loss information provided by national insurance companies	• 172 high wind-related events in the McAlester area in the last 20 years • $320,000 in reported structure damages
Lightning	National Climatic Data Center information and statistics National Lightning Safety Institute Statistics	• Oklahoma has had 540 incidents resulting in 13 deaths, 87 injuries, and $33.68 Mil between 1989 and 2008 • 2 lightning events in the McAlester between 1989 and 2008 resulting in $65,000 in damages
Severe Winter Storms	Review of past disaster declarations Input from Emergency Management Input from area utility companies	• Severe winter storms occur frequently in the McAlester area and can produce both wide-spread economic disruption and massive public utility outages. • Pittsburg County has had 14 winter storm events since 1996 causing $39 M in damages.
Tornadoes	Review of recent disaster declarations Input from Emergency Management Review of data from the National Climatic Data Center	• McAlester is located in "Tornado Alley" • An average of 52 tornadoes per year strike Oklahoma • Recent disaster events and damage • Oklahoma City tornado of 1999 killed 42 people and destroyed 899 buildings • All citizens and buildings are at risk
Wildfires	Input from McAlester Fire Department Input from surrounding county & community fire departments Input from State Fire Marshal Input from Oklahoma State University Rangeland Conservation Southern Wildfire Assessment Model Analysis	• Fires of the urban/rural interface threaten McAlester properties • Several miles of McAlester's perimeter and a number of identified critical facilities are exposed and vulnerable to wildfires • 302 wildfires in McAlester area between 2002-2006 resulted in 978 acres burned.

3.5 Step Five: Assess the Problem

The hazard data was analyzed in light of what it means to public safety, health, buildings, transportation, infrastructure, critical facilities, and the economy. The discussion of the problem assessment is addressed for each hazard in Chapter 4.

Damage Estimation Methodology

The following methodologies were used in the development of damage cost estimated for buildings and contents for flooding and tornado/high wind damage, used in the *McAlester Multi-Jurisdictional Multi-Hazard Mitigation Plan*

HAZUS Damage Estimation Model: FEMA's HAZUS Damage Estimation Models were used to calculate damages from Flooding and Earthquakes.

Structure Value: Value of buildings within the City of McAlester was obtained from the Pittsburg County Assessor's office.

For critical facilities, non-profit properties with structural improvements, such as churches, which are tax exempt and where no county assessor valuation was available, the buildings' footprints were measured using aerial photography, GIS, and field investigation to determine size, in square feet. The value of structure was obtained by calculating the square footage times the value per square foot obtained by using FEMA publication *State and Local Mitigation Planning: Understanding Your Risks: Identifying Hazards and Estimating Losses*, August 2001, "Average Building Replacement Value per square foot," p. 3-10, source: HAZUS.

Contents Value: Value of contents for all buildings was estimated using "Contents Value as Percentage of Building Replacement Value" table, page 3-11, *Understanding Your Risks*.

Depth of Damage: Flooding damage estimates for building and contents are based on actual structures' estimated flood depth determined by aerial topographic mapping and field investigations. Maps of the floodplains are included in Chapter 4.

Flood damage curves, for structures (single-family, multi-family, office, commercial, industrial), and contents were estimated using Table A-3, "Damage Factors," Economics Branch, Tulsa District, U.S. Army Corps of Engineers.

Flood depth of damage curve estimates were used for riverine flooding and dam failures (Chapter 4).

Tornado Damage: Damage estimates for the tornado scenario were based on:

1. Structure value: Pittsburg County Assessor's office.
2. Contents: FEMA's Contents Value, *Understanding Your Risks*.
3. Damage to structure: based on percent damage experienced during typical events, using the Fujita Scale, damage characteristics, Table 4-14.

Damage estimates were based on the May 1999 Oklahoma City Tornado, assuming about 50% of the buildings structure value would be the average contents value for the affected area.

Estimation of the value of tax-exempt structures, for which no county assessor valuation is available, was done using the same methodology as for flood damaged structures, described above—that is, using FEMA publication, *State and Local Mitigation Planning: Understanding Your Risks: Identifying Hazards and Estimating Losses*, August 2001, "Average Building Replacement Value per square foot," p. 3-10.

3.6 Step Six: Set Goals

Project and community hazard mitigation goals and objectives for McAlester were developed by the CAC to guide the development of the plan. The hazard mitigation goals for the jurisdictions are listed in Chapter 5 and Appendix B.

3.7 Step Seven: Review Possible Activities

Wide varieties of measures that can affect hazards or the damage from hazards were examined. The mitigation activities were organized under the following six categories. A more detailed description of each category is located in "Chapter 5: Mitigation Strategies."

1. **Public Information and Education**—Outreach projects and technical assistance
2. **Preventive Activities**—Zoning, building codes, stormwater ordinances
3. **Structural Projects**—Levees, reservoirs, channel improvements
4. **Property Protection**—Acquisition, retrofitting, insurance
5. **Emergency Services**—Warning, sandbagging, evacuation
6. **Natural Resource Protection**—Wetlands and floodplain protection, natural and beneficial uses of the floodplain, and best management practices

The TAC and the CAC, after reviewing the potential mitigation activities, screened and selected the measures they felt were applicable, feasible, cost effective, and politically acceptable to their community. The measures specifically identified as potentially benefiting the community were combined into a new, more community-specific list for review.

To prioritize the list of possible mitigation measures, made up of over 200 identified mitigation measures, the CAC members were given twenty votes each to select the individual measures they felt would best benefit the community's efforts to reduce or eliminate the adverse impacts of hazards on lives and property. The votes were tallied, and the Mitigation Measures were ranked in descending order. The Mitigation Measures selected and prioritized by this voting process best reflected the values and goals of the community, and the Mitigation priorities generally reflected the disaster and damage experience of the community.

The true challenge is to identify mitigation strategies and measures that represent the goals and political will of the community. Table 6-1, *Multi-Hazard Mitigation Measures, By Priority and Hazard* is the comprehensive list of Mitigation Measures receiving at least one vote from the 20-vote selection process described above.

3.8 Step Eight: Draft an Action Plan

The high-priority Mitigation Measures constituted the Action Plan, and each Measure was further detailed to identify:

- A brief description of the Mitigation Measure (Action Plan Item)
- The lead agency responsible for implementation
- Anticipated time schedule for completion
- Estimated project cost

- Possible sources of funding
- The Work Product, or Expected outcome

The Action Plan items should be developed in enough specificity to respond to a Notice of Intent/Interest (NOI) from the State when HMGP Funds become available, or to provide basic information to begin to put together a Pre-Disaster Mitigation Grant Application.

3.9 Step Nine: Adopt the Plan

The Draft *City of McAlester Multi-Hazard Mitigation Plan 2010* was submitted to the Oklahoma Department of Emergency Management and FEMA Region VI for review and approval. The CAC approved the final plan, adopted it as an amendment to the *Comprehensive Plan*, and submitted it to, and was approved and adopted by the McAlester City Council.

3.10 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 CAC will continue to meet on a regular basis to monitor progress, evaluate the activities, and periodically recommend revisions to the Plan and Action Items. The plan will be formally updated a minimum of every five years, as required by FEMA.

Chapter 4: Natural Hazards

44 CFR Requirements met:

Requirement §201.6(c)(2): *[The plan **shall** include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards*

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the type of all natural hazards that can affect the jurisdiction.*

Requirement §201.6(c)(2)(i): *[The risk assessment **shall** include a] description of the location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.*

Requirement §201.6(c)(2)(ii): *[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.*

Requirement §201.6(c)(2)(ii)(A): *The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.*

Requirement §201.6(c)(2)(ii)(B): *[The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.*

Requirement §201.6(c)(2)(iii): *For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

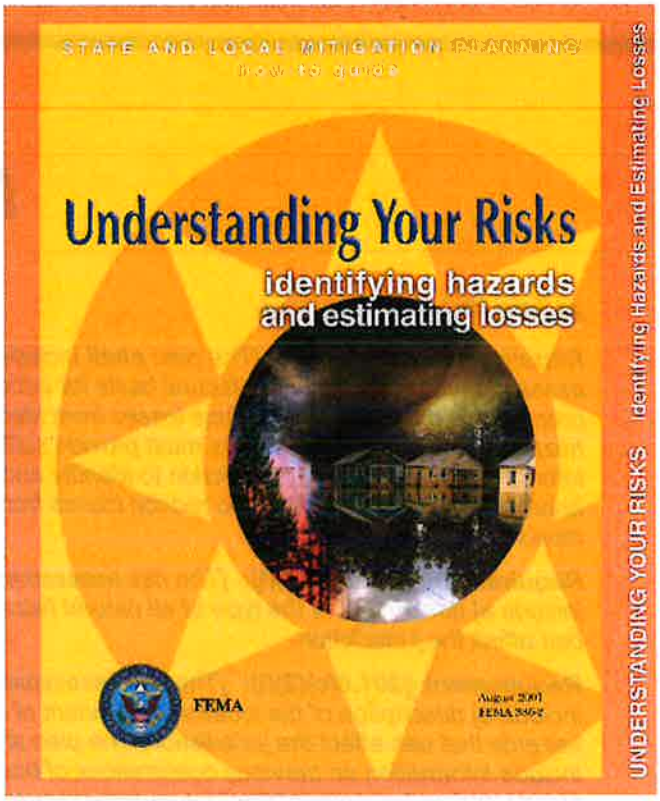
Included in this Chapter:

Introduction
Hazards Summary
Annual Average Damages
Hazards Analysis
4.1 Floods
4.2 Tornadoes
4.3 High Winds
4.4 Lightning
4.5 Hailstorm
4.6 Winter Storms
4.7 Extreme Heat
4.8 Drought
4.9 Expansive Soils
4.10 Urban Fires
4.11 Wildfires
4.12 Earthquakes
4.13 Subsidence
4.14 Hazardous Materials
4.15 Dam Failures
4.16 Transportation
4.17 Hazard Composite

Introduction

According to the Federal Emergency Management Agency (FEMA), a hazard is defined as an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, or agricultural loss, among other types of loss or harm. Hazards are generally defined as one of two categories based on their source: natural hazards and man-made hazards. Each hazard has its own defining characteristics, such as time of year and geographic area of probable occurrence, severity, and risk level.

Natural phenomena, such as floods, tornadoes, severe drought, and wildfires, are natural hazards because they have the potential to destructively impact human settlements and activities. When damages from a natural hazard occur, the event is generally called a natural disaster.



Man-made hazards are broadly defined as a hazard that originates from accidental or intentional human activity. They can affect localized or widespread areas and are frequently unpredictable. This category of hazard includes such events as dam breaks and hazardous material events.

While Oklahoma communities can expect disaster-related losses, hazard assessments can be used to create proactive measures against likely events, and thereby significantly decrease or eliminate their impacts. Therefore, this chapter contains a risk identification and assessment for 16 hazards. The hazards addressed are those deemed most likely to impact the City of McAlester and McAlester Public Schools. The hazards include:

1. Floods
2. Tornadoes
3. High Winds
4. Lightning
5. Hail
6. Severe Winter Storms
7. Extreme Heat
8. Drought
9. Expansive Soils
10. Urban Fires
11. Wildfires
12. Earthquakes
13. Subsidence
14. Dam Failures
15. Transportation
16. Hazardous Materials Events

Each hazard is covered in a separate section, which will include the following information:

- **Hazard Profile** – Causes, effects, normal frequency (how often it is likely to occur at a particular location), and available scales or methods of measuring the severity of the events, if any; the geographical extent and impact of the hazards; and the identification of any topographic or geological conditions that would make a particular area prone to the hazard.
- **History/Previous Occurrences** – Notable past occurrences of the hazard, including national, state, and local examples, if any. Where available, historical losses, in terms of lives and property, are detailed.
- **Vulnerability** – The people, geographic locations, and types of property subject to the particular hazard are identified. For each hazard with a definable

geographic location, such as floods and dam breaks, the number, types and value of buildings and contents are identified, along with the vulnerable populations. In addition, the potential effect on infrastructure, such as communications and utilities are reviewed.

- **Scenario** – When appropriate for the hazard, a "worst-case" scenario is presented and analyzed. This information can be used to further prioritize the risks for the community inherent in a particular hazard.
- **Future Trends** – Potential effects of the hazard in terms of future development areas of the community are reviewed in terms of population, structures, infrastructure, and critical facilities. When known, other factors such as emerging technological trends may be included in this analysis.
- **Conclusion** – The information provided on each of the hazards is condensed into a brief summary/conclusion statement.

Hazards Summary

Floods	A flood is the accumulation of water within a water body and the overflow of excess water onto adjacent lands. From 1995-2009, McAlester experienced 11 flood events that caused occasional urban street flooding and road closures to the west, south and east of the city. There are 177 buildings of all kinds located in the FEMA Special Flood Hazard Area (SFHA), and 53 properties enrolled in the NFIP. Only three flood damage claims have been made under the NFIP totaling $881.85. The city has no repetitive loss properties. There is a critical facility within the SFHA which is the East Wastewater Treatment Plant. Parts of the State Penitentiary are within the SFHA, but are outside the city's jurisdiction. Built on high ground with no major rivers within its fence line, and streams draining away from the city center. McAlester and McAlester Public Schools are at moderate risk from the effects of flooding, and have a moderate probability that a flood event will occur.
Tornadoes	A tornado is a rapidly rotating vortex or funnel of air extending to the ground from a cumulonimbus cloud. When the lower tip of a vortex touches earth, the tornado becomes a force of destruction. The most destructive tornado to hit McAlester occurred on May 8, 1882, when an F3 event destroyed much of the town and killed 21 people. The NCDC reports 28 tornadoes for Pittsburg County between 1995 and 2009, which injured 6 people, and did $2 million in damage. NCDC data has 5 tornadoes occurring within or near McAlester from 1995-2009, injuring 9 people and doing $850,000 damage. Because of McAlester's location and climate, the City and its Public Schools have an extreme risk to the tornado hazard, and have a high probability that a tornado event will occur.
High Winds	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. From 1995 to 2009, Pittsburg County experienced 147 high wind events, almost all connected to thunderstorm activity, which injured 48 people and did a total of $1.004 million in damage. During the same time period, McAlester reported 33 high wind events, with velocities ranging between 60 and 80 mph, and damages totaling $336,000. The highest winds recorded at McAlester were 80 mph on May 7, 2008, and June 10, 2009. Due to the frequency of severe thunderstorms in the jurisdictions, the City of McAlester and McAlester Public Schools are at high risk to winds, and have a high probability that a high wind event will occur.
Lightning	Lightning is generated by the buildup of charged ions in a thundercloud. When that buildup interacts with the best conducting object or surface on the ground, the result is a discharge of a lightning bolt. The air in the channel of a lightning strike reaches temperatures higher than 50,000° Fahrenheit. Between 1995 and 2009, there have been 247 lightning events recorded for the state of Oklahoma, with 11 deaths, 76 injuries and $26.077 million in damages. In that same time period, Pittsburg County experienced 1 event with no deaths or injuries, and $15,000 in damages—this event occurring in McAlester, along with all the reported damage. Lightning, an underreported natural hazard, accompanies the severe thunderstorms that frequent the region. Although the City and Public Schools have reported only one lightning event since 1995, the jurisdictions are exposed to 1.75 severe thunderstorms with lightning each year. Consequently, despite the low number of reported strikes, the jurisdictions' risk from the lightning hazard is still considered high, with a high probability that a lightning event will occur.

Hail	A hailstorm is an outgrowth of a severe thunderstorm in which balls or irregularly shaped lumps of ice fall with rain. Extreme temperature differences from the ground upward into the jet stream produce strong updraft winds that cause hail formation. As of 2010, the National Weather Service has increased its size criteria for hail that defines a severe storm event to 1 inch from ¾ inch.
	The McAlester jurisdictions experienced 50 hailstorms from 1995 through 2009. Based on this data, any specific location in the McAlester metropolitan area can expect to receive hail an average of three times each year, with a "destructive" hailstorm once every 5 years. Hail has been reported in every month, with the highest frequency during the spring.
	The City of McAlester and McAlester Public Schools are considered to be at high risk to the hail hazard, and have a high probability that a hail event will occur.
Severe Winter Storms	A severe winter storm is one that drops four or more inches of snow during a 12-hour period, or six or more inches during a 24-hour period. An ice storm occurs when freezing rain falls from clouds and freezes immediately upon contact with earth, plants, roads, homes and other structures.
	Pittsburg County reported 17 snow and ice events for the period 1995-2009. Winter storms are, by nature, not isolated events. Therefore it can be reasonably assumed that winter weather events affecting the Pittsburg County area will also impact the city to varying degrees.
	Based on the number of storms and weather patterns reported between 1995 and 2009, the jurisdictions of McAlester and McAlester Public Schools can expect to experience a severe winter snow/ice event every 2 years. The jurisdictions are considered to be at extreme risk to the winter storm hazard, and have a high probability that a winter storm event will occur.
Extreme Heat	Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. A heat wave occurs when such conditions persist over time and a heat alert is normally issued by the National Weather Service when daytime heat indices exceed 100°F, with nighttime heat indices remaining above 80°.
	The highest temperature recorded for McAlester was 116 degrees on August 10, 1936. Over the past ten years, the average high temperature for July and August in the McAlester area has been 93 degrees F with an average humidity of 70%, which puts the area in the "Extreme Caution" category on the National Weather Service (NWS) Heat Index scale, and the "Danger" category when relative humidity is factored in.
	Because of the community's location and climate, the City of McAlester and McAlester Public Schools will continue to be impacted by extreme heat events every 2 to 3 years. The risk for extreme heat events is high, and there is a high probability that an extreme heat event will occur.
Drought	Drought is climatic dryness severe enough to reduce soil moisture and water below the minimum necessary to sustain plant, animal and human life systems. Drought duration and severity are usually measured by deviation from norms of soil moisture, annual precipitation and stream flows.
	The severe droughts of the 1930s led to the construction of Oklahoma's numerous hydroelectric dams and reservoirs, as well as to the implementation of new farming and conservation policies. More recent drought response and recovery activities in Oklahoma, both at the state and local level, have not been as ambitious or successful.
	McAlester has experienced droughts of varying length and severity two times in the past 15 years, characterized primarily by crop damage and wildfire: in 1998 and 2005-2006. Because of the City's robust water supply, the City of McAlester and McAlester Public Schools are considered to be at moderate risk to drought and drought's effects on expansive soils and wildfire, and have a moderate probability that a drought event will affect them adversely.
Expansive Soils	Soils and soft rock that swell and shrink with changes in moisture content are commonly known as expansive soils. Expansive soils develop gradually and are seldom a threat to the population, but can cause severe damage to improvements built upon them.
	Only six of McAlester's 86 critical facilities are located on soils with a high shrink/swell potential, including three Public Schools facilities, one City fire station, a County animal shelter, and a bank. The hazard does not affect these facilities' ability to fulfill their critical functions.
	With 88% of McAlester's soils classified as having moderate shrink/swell potential, and only 12% in the high category, the City of McAlester and McAlester Public Schools are considered to be at moderate risk to the damaging effects of expansive soils, but have a high probability of having an expansive soils effect.

Urban (Structure) Fires	A fire that burns a home or other improved structure is classified as a structure fire. Fire generates a black, impenetrable smoke that blocks vision and stings the eyes, making it often impossible to navigate and evacuate the building on fire.
	During the 10-year period from 2000 to 2009, the City of McAlester experienced a total of 409 structural fires, 18 injuries, 8 deaths, and over $12.2 million in fire damage, including fires in critical facilities. Given this data, McAlester can expect 40 structure fires per year that do about $1.220 million in damage annually.
	Urban fires normally affect only a small area or group of the population, as opposed to hazards that occur over much larger geographical areas, such as wind, hail and tornado.
	The City of McAlester and McAlester Public Schools have a high risk to urban fires, and have a high probability that an urban fire event will occur.
Wildfires	A wildfire is a fire that burns along the ground, moving slowly and killing or damaging trees; a fire burning on or below the forest floor in the humus layer down to the mineral soil; or a fire rapidly spread by wind and moves through grass or by jumping along the tops of trees.
	Wildfires are a serious and growing hazard because people continue to move their homes into woodland areas. The value of the property exposed to wildfires is increasing more rapidly, especially in the western states.
	As shown during the rash of wildfires in the winter of 2005-2006, structures and populations in the wildland/urban interface are at moderate to high risk from wildfires, and at severe risk during times of high wind and drought. However, the vulnerable areas in and around McAlester are a relatively low percentage of the total area of the community.
	The City of McAlester and its Public Schools are a high risk to wildfires, and have a high probability that a wildfire event will occur.
Earthquakes	An earthquake is a sudden, rapid shaking of the ground caused by the fracture and movement of rock beneath the earth's surface. Earthquakes, seemingly trivial in Oklahoma, do occur. Although relatively safe from locally generated earthquakes, the region's underlying geology exposes Oklahoma to some risk from a severe earthquake in the New Madrid Seismic Zone. Almost all Oklahoma earthquakes are too small to be felt and cause no visible damage.
	Pittsburg County experienced 20 earthquakes from 1995 through 2009 or 1.3 per year, only one of which was a "felt" earthquake—a 3.2 on the Richter Scale 5 miles west of McAlester. None of these tremors caused any damage. As calculated using HAZUS software, an earthquake similar to the 1952 El Reno event would cause no damage to the City of McAlester or McAlester Public Schools.
	McAlester and McAlester Public schools have a low risk to earthquakes, and have a low probability that an earthquake event will occur.
Subsidence	Land subsidence, the loss of surface elevation due to the removal of subsurface support, ranges from broad, regional lowering of the land surface to localized collapse. The primary causes of most subsidence are human activities: underground mining of coal, groundwater or petroleum withdrawal, and drainage of organic soils. This hazard affects parts of at least 45 states. Collapses, such as the sudden formation of sinkholes into an abandoned mine, may destroy buildings, roads and utilities.
	Pittsburg County has experienced eight mine subsidence events in the past 10 years, with two of these occurring in McAlester. Altogether, there have been six reported incidents of mine subsidence within McAlester, all in the northern part of the city near where the McAlester coal deposits were exposed and shallow mining took place. McAlester's exposure to mine subsidence is limited to a narrow band of land in the northern part of the city, reaching from west to east. The risk of mine subsidence is likely to increase as the mines in this area age and ceiling rock erodes. This exposure can be mitigated through mine mapping, public information and land use regulation.
	McAlester and McAlester Public Schools have an overall moderate risk to the subsidence hazard, with a low risk in most of the city, but a high risk in those areas north of US Hwy 270 where coal mining occurred within 50 feet of the surface. There is a high probability that a subsidence event will occur.
Fixed-Site Hazardous Materials Events	Hazardous materials are chemical substances that, if released or misused, can pose a threat to the environment or human health. They come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials.
	McAlester has had 17 fixed-site hazardous materials events near or in the city from 2000 through 2008. Most were minor releases or spills, but two were relatively significant events. One involved a spill of 3,800 gallons of lubricating oil from a combustion turbine, and the other a catastrophic fire at Diversified Foods in the Steven Taylor Industrial Park during the ice storm of January 2007.
	Nevertheless, with 6% of its population, one school and 22 critical facilities located within ¼ mile of the city's Tier II sites (including four special needs facilities, but no schools), McAlester is considered to have an overall moderate risk to a fixed-site hazardous materials event, and a moderate probability that a fixed-site hazardous materials event will occur.

Dam & Levee Failures	The Federal Emergency Management Agency (FEMA) defines a dam as "a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water." A dam failure is the collapse, breach, or other failure of such a structure resulting in downstream flooding.
	McAlester has no high- or significant-hazard dams that affect the community or any potential growth area. The City does, however, operate three water reservoirs. There are no populations, buildings, critical facilities, utilities or transportation networks within the city that would be impacted by a failure or emergency release – other than McAlester's water supply itself, the roadways that cross the dams, and the OK Hwy 113 bridge across Coal Creek.
	The City of McAlester and McAlester Public Schools are at a low risk for dam failures, and have a low probability that a dam failure event will occur.
Transportation	Transportation is the physical movement of an object through components of a system and its subsystems. Transportation includes the use of aviation, highway, railroad, pipeline, and marine systems to convey movement of objects and people.
	McAlester has a regional airport, 17.4 miles of State and US highways, and 11.46 miles of railroads within its jurisdiction. In all, 6,533 people (37% of the population), 33 of the City's 63 critical facilities (52%), including 13 government buildings, 11 schools, five financial institutions, and four health care facilities, are located within these corridors.
	According to the National Response Center and National Transportation Safety Board, McAlester had 14 mobile accidents occur within its city limits from 2000 to 2009, including six railroad accidents (six involving hazardous chemicals), six aircraft crashes, and two truck-related spills.
	A worst-case railroad chlorine tank explosion could result in hundreds of deaths, severe injuries, and hospitalizations. Based on these considerations, both the City of McAlester and McAlester Public Schools are at high risk for a transportation event, and have a moderate probability that a transportation event will occur.

Annual Average Damages

Although available data is limited, information on total damage to property, injuries and loss of lives for the 10-year period from 1999 through 2008 has been summarized in Table 4-1. Sources for information include the National Climatic Data Center, the National Response Center, the National Transportation Safety Board, and the Oklahoma Fire Marshal's Office, in addition to information obtained from local sources.

Table 4–1: Summary of Damages, 1995-2009

Hazard	Events	Years	Events/ Year	Total Property Dmg	Property Dmg/ Event	Property Dmg/ Year	Injuries	Injuries/ Event	Injuries/ Year	Deaths	Deaths/ Event	Deaths/ Year
Floods	11	15	0.6	$0	$0	$0	0	0	0	0	0	0
Tornadoes[1]	28	15	1.86	$2,003,000	$71,535	$133,533	6	0.21	0.4	0	0	0
High Winds	33	15	2.2	$336,000	$10,182	$22,400	0	0	0	0	0	0
Lightning	1	15	0.06	$15,000	$15,000	$1,000	0	0	0	0	0	0
Hail	50	15	3.3	$100,000	$2,000	$6,666	0	0	0	0	0	0
Winter Storms[1]	17	15	1.13	$1.0 Mil	$58,823	$66,666	0	0	0	0	0	0
Extreme Heat[1]	3	15	1.93	n/a			0	0	0	0	0	0
Drought[1]	2	10	0.2	0	0	0	n/a					
Expansive Soils	Insufficient Data											
Urban Fires[2]	409	10	40.9	$12.2 Mil	$29,828	$1.2 Mil	18	0.04	1.8	8	0.019	0.8
Wildfires[2]	302	5	60.4	$259,500	$859	51,900	Insufficient Data					
Earthquakes	20	15	1.3	0	0	0	0	0	0	0	0	0
HazMat, Fixed	7	10	0.7	Insufficient Data								
Dam Failures	0	15	0	0	0	0	0	0	0	0	0	0
Transportation[3]	22	10	2.2	Insufficient Data								

[1] Since these events cover such a wide region, figures are for the larger Metro Area.

[2] Figures are for 2000-2009, the most updated numbers from the State Fire Marshal's Office.

[3] Based on a 10-year time period from 1999-2008. Source: National Response Center

Hazards Risk Analysis: Probability and Vulnerability

A Hazard Risk Analysis is a quantitative process for assessing and evaluating hazards and promotes a common base for performing the analysis by defining criteria and establishing a rating and scoring system.

Table 4-2 shows the results of the Risk analysis for the City of McAlester and its Public Schools, which includes a quantification of the history, probability, vulnerability, and maximum threat for each event along with mitigating conditions, such as the extent of existing mitigation activities and capabilities of local and area response agencies. Table 4-3 provides a summary of the ranking criteria and the scoring method.

Table 4–2: City of McAlester Hazard Risk Analysis

Type of Hazard	Occurrence		Vulnerability				Mitigation Activities	Resources		Total
	Historical	Probability	Human	Property	Infrastructure	Business		Internal	External	
Tornadoes	5	5	5	5	5	3	2	4	5	6.1
Winter Storm / Ice Storm	5	5	3	3	5	5	2	2	3	6.1
Hail	5	5	1	5	2	3	2	3	3	4.9
High Wind Events	5	5	3	5	2	2	1	5	5	4.8
Heat, Extreme	5	5	4	1	2	2	3	3	3	4.3
Transportation Incidents	5	5	5	1	1	2	3	1	1	4.1
Lightning	2	2	3	5	4	3	2	2	2	4.0
Urban (Structure) Fires	5	5	2	2	2	2	4	4	4	3.8
Subsidence	5	5	1	2	2	1	3	4	4	3.4
Hazardous Material, Fixed Site	2	2	4	2	2	3	3	3	3	2.8
Flooding	4	3	2	2	2	2	4	4	4	2.7
Wildfires	4	4	1	2	1	1	4	4	4	2.4
Expansive Soils	3	3	1	2	2	1	2	4	4	2.2
Drought	2	2	2	1	3	2	4	3	3	2.0
Earthquake	0	1	1	1	1	1	2	2	2	0.7
Dam / Levee Failure	0	1	1	1	1	1	3	3	3	0.3

Table 4–3: Summary of Hazard Risk Analysis Ranking Criteria

Summary:	This tool looks at an organization's or a community's vulnerability to the effects of various hazards. Using a scale of 0 to 5, the probability of occurrence and the impact potential are measured against mitigation activities and the resources available to respond to the hazard. The total is based on a formula that weighs risk heavily but provides credit for mitigation and response and recovery resources. The highest score possible is 7.8. The lower the total score, the lower the overall risk from the Hazard.
Instructions:	Score each hazard based on a scale of 0 to 5 with 5 being the highest. Ratings values: 1 = Low : 2-3 = Moderate : 4-5 = High
Historical Occurrence:	This is based on the number of occurrence in the last 20 years. Maximum is 5; if a new hazard, use 0.
Probability:	Score 0 if non-existent, 1 if less than 1%, 2 if less than 5%, 3 if less than 10%, 4 if less than 20%, and 5 if greater than 20%. Probability is the likelihood an event will occur. History and probability are similar, but hazards that are newly developing, hazards where the likelihood has increased or decreased based upon new developments or activities, or hazards that have a lack of historical information may need to be considered individually.
Impact:	Based on "worst-case scenario" - greatest possible impact should worst-case event occur. Maximum threat is the worst-case scenario of a hazard. Its impact is expressed in terms of human casualties, property loss, and business interruption/loss revenue issues. Secondary events need to be factored in where necessary. Assume maximum population when appropriate (for example, industrial park during peak work hours).
Internal/ External Resources:	Based on the resources available to the community internally, or to Mutual Aid agreements or other understandings with neighboring jurisdictions. May also include private resources available, such as corporate firefighting/hazmat teams or medical resources.
Analysis Results:	**Extreme Risk: Greater than 6.0** / **Moderate Risk: 2.5 to 4.0** **High Risk: 4.0 to 6.0** / **Low Risk: Less than 2.5**

Secondary Events

Although hazards may be individually identified and categorized, many are interrelated, and a disaster may involve multiple hazards. Severe thunderstorms, for example, may spawn high winds, lightning, hailstorms, tornadoes, and flooding. It is generally more useful to consider all secondary events as a part of the overall situation created by the primary event. These are frequently referred to as "Cascade Events." Table 4-4 identifies secondary events that are related to each of the natural and technological hazards studied in this report.

Table 4–4: Secondary (Cascade) Hazard Events

Primary Event	Dam Failure	Drought	Sub-sidence	Expansive Soils	Flood	Haz. Material Event	Power Failure	Urban Fire	Trans-portation	Water Supply Failure	Wild-fire
Flood	•					•	•	•	•	•	
Tornado						•	•	•	•		
High Wind						•	•	•	•	•	•
Lightning						•	•	•	•		•
Hail							•				
Winter Storm							•	•	•		
Extreme Heat		•		•			•				
Drought			•	•						•	•
Expansive Soil									•	•	
Wildfire						•	•	•	•		
Subsidence						•			•	•	
Earthquake	•		•			•	•	•	•	•	
Dam Failure					•	•	•		•	•	

Vulnerability Assessment

The City of McAlester and McAlester Public Schools are vulnerable to all the above listed hazards, although the risk from Earthquakes and Dam/Levee Failures, for the reasons listed above, is extremely low.

Jurisdiction	Flood	Tornadoes	High Winds	Lightning	Hail	Winter Storms	Extreme Heat	Drought	Expansive Soil	Urban Fire	Wild-fire	Earthquake	Subsidence	Expansive Soil	Fixed Site HazMat	Dam Failure	Transportation
City of McAlester	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
McAlester Public Schools	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

4.1 Floods

Flooding is defined as the accumulation of water within a watercourse or water body and the overflow of excess water onto adjacent floodplain lands. The floodplains are the lands adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding.

4.1.1 Hazard Profile

Flooding is the most common and widespread weather hazard in the United States.

Most flood dangers and deaths are caused by flash floods. Flash floods usually result from intense storms dropping large amounts of rain within a brief period. The two key elements are rainfall intensity and duration, but topography, soil conditions and ground cover play important roles also.

Floods can lead to "cascading" events increasing the damage – including power outages, health issues, and hazardous materials releases, as illustrated in the above photo of a community where the flood breached a nearby oil refinery.

Flash floods occur with little or no warning and can reach peak flow within a few minutes. Waters from flash floods move with great force and velocity and can roll boulders, tear out trees, destroy buildings, and sweep away bridges. These walls of water can reach heights of 10 to 30 feet and generally carry large amounts of debris.

Location

McAlester is located in southeastern Oklahoma, in an area of rolling hills, streams and lakes. The weather is mild to hot, with rainfall averaging 44 inches per year. Seasonal weather patterns include huge convective thunderstorms in the spring and autumn months, with the wettest months being March-June and September-October. The city is subject to rains that dump as much as 3 to 5 inches in a 24-hour period. Because of the city's situation on high ground, with streams running off in all directions, and no rivers within the city limits or fence line, McAlester has not been subject to major flooding. The major streams, discussed in greater detail below, are Sandy Creek and its tributaries, Coal Creek, Dancing Rabbit Creek, and Mud Creek and its tributaries.

Locations of lakes and impoundments, as well as more detailed information about reservoirs in and near McAlester, are contained in the section 4.15, Dam Failure.

McAlester Creeks and Drainage Basins

The drainage basins affecting the City of McAlester are listed in Table 4-5 and shown in Figure 4-1.

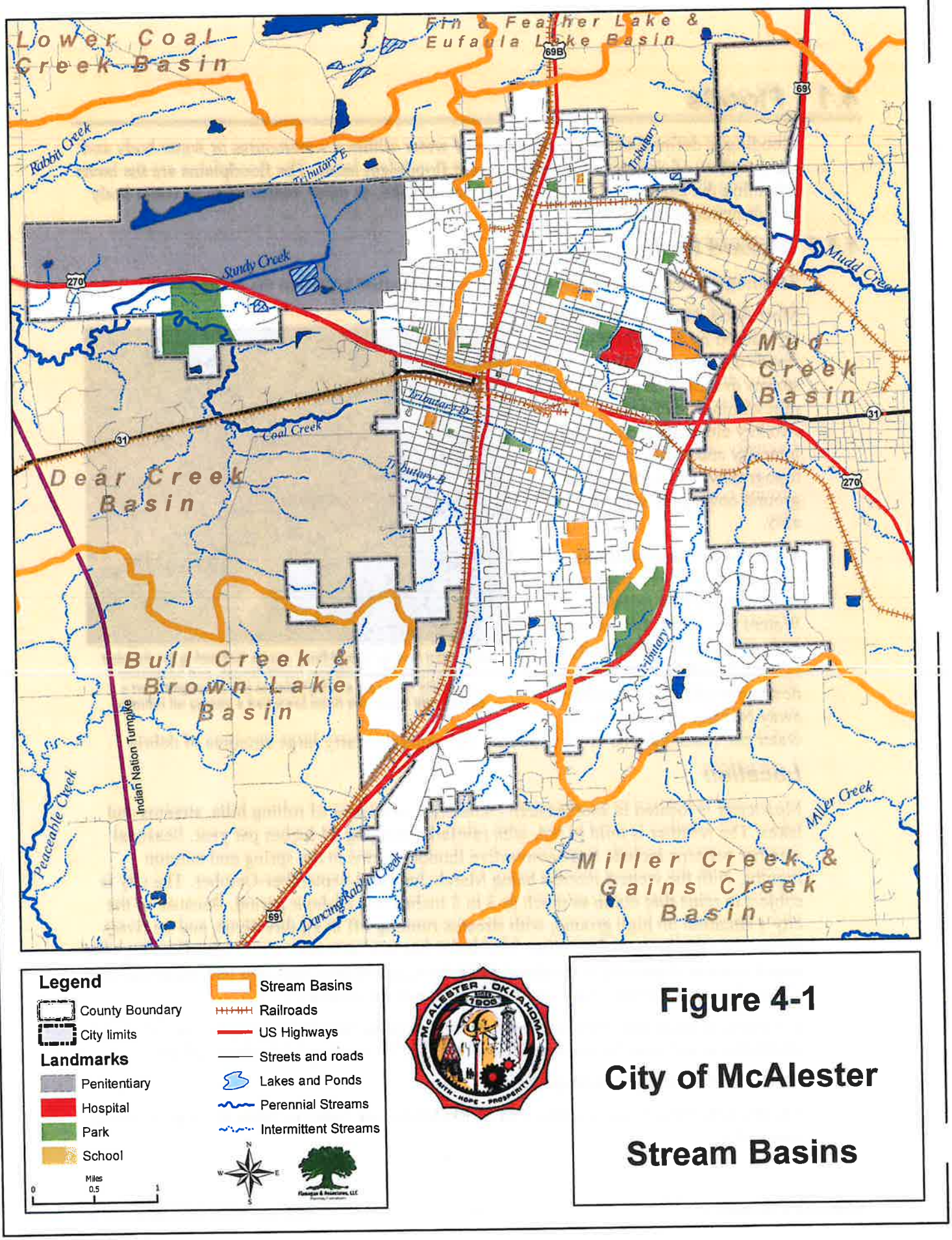


Figure 4-1

City of McAlester

Stream Basins

Table 4–5: City of McAlester Streams and Drainage Areas

Stream	Total Drainage Area at McAlester (Acres)
Brush Creek	**969.8**
Bull Creek	886.2
Miller Creek	83.6
Coal Creek	**5,498.1**
Dear Creek	5,498.1
Brush Creek/Eufaula Lake	**4262.0**
Mud Creek	4257.2
Fin & Feather	4.8

The City of McAlester is situated on high ground, at an elevation of between 700 and 800 feet, with streams flowing off this high ground in all directions. Most streams in the McAlester area begin at about 730 feet elevation.

To the west, the Tributaries B, D and E drain into Sandy Creek, which is a tributary of Coal Creek. Tributary D flows north along the western side of McAlester, and has a number of industrial facilities within its 100-year floodplain. Tributary B flows north and west through the center of the city, parallel to Kiowa and Delaware Aves., and joins Sandy Creek about 1 mile west of the city. Tributary B has a number of residential and commercial properties within its 100-year floodplain. Tributary E flows west from north McAlester through the Oklahoma State Penitentiary property to join Sandy Creek south of US Hwy 270, just west of the Softball Complex. Coal Creek flows eastward on the north side of McAlester to join the Gaines Creek arm of Lake Eufaula. Coal Creek has its headwaters east of Ashland and west of the McAlester US Army Ammunition Plant.

Draining away from McAlester to the south are Dancing Rabbit Creek, which begins in the high ground around the Municipal Airport, and Anderson and Miller Creeks, both of which flow from the Piney Mountain area east of the airport. All three streams flow into Peaceable Creek, which eventually joins Brushy Creek and Lake Eufaula near Haileyville.

On the north and east side of McAlester are Mud Creek and its tributaries A, AA and C. Tributary C begins around 1100 E. Madison, flows north to E. Krebs and Brick Sts. where it joins the east-flowing Mud Creek. Tributary C has been channelized throughout its length. Mud Creek itself flows south and then eastward, south of E. Hereford Rd., before passing under US Hwy 69 and eventually joining Lake Eufaula about 6 miles east of McAlester. Tributaries A and AA flow north on the east side of McAlester, parallel with and to the east of the George Nigh Expressway, before looping around the south side of Krebs to join Mud Creek.

In the extreme north of McAlester are a series of lakes and reservoirs that provide water for the City of McAlester before debouching northward into Coal Creek: Youth Lake, Lake Talawanda Nos. 1 and 2, and Lake McAlester. These lakes are covered in greater detail in Section 4.14, Dam Failure.

Measurement

The probable future impact of flooding can be assessed by mapping urban development, soil conditions, and the 100-year floodplains; researching the extent of past floods; looking at historical rainfall data and the condition of drainage ways and stormwater facilities; and estimating the likely contribution to flooding from recent and future development. A computerized modeling and assessment tool named HAZUS-MH was used to estimate damages within the City of McAlester from a 100-year flood event. Hazard rankings for floodplain lands are typically based on the frequency, depth, duration, and velocity of anticipated floods.

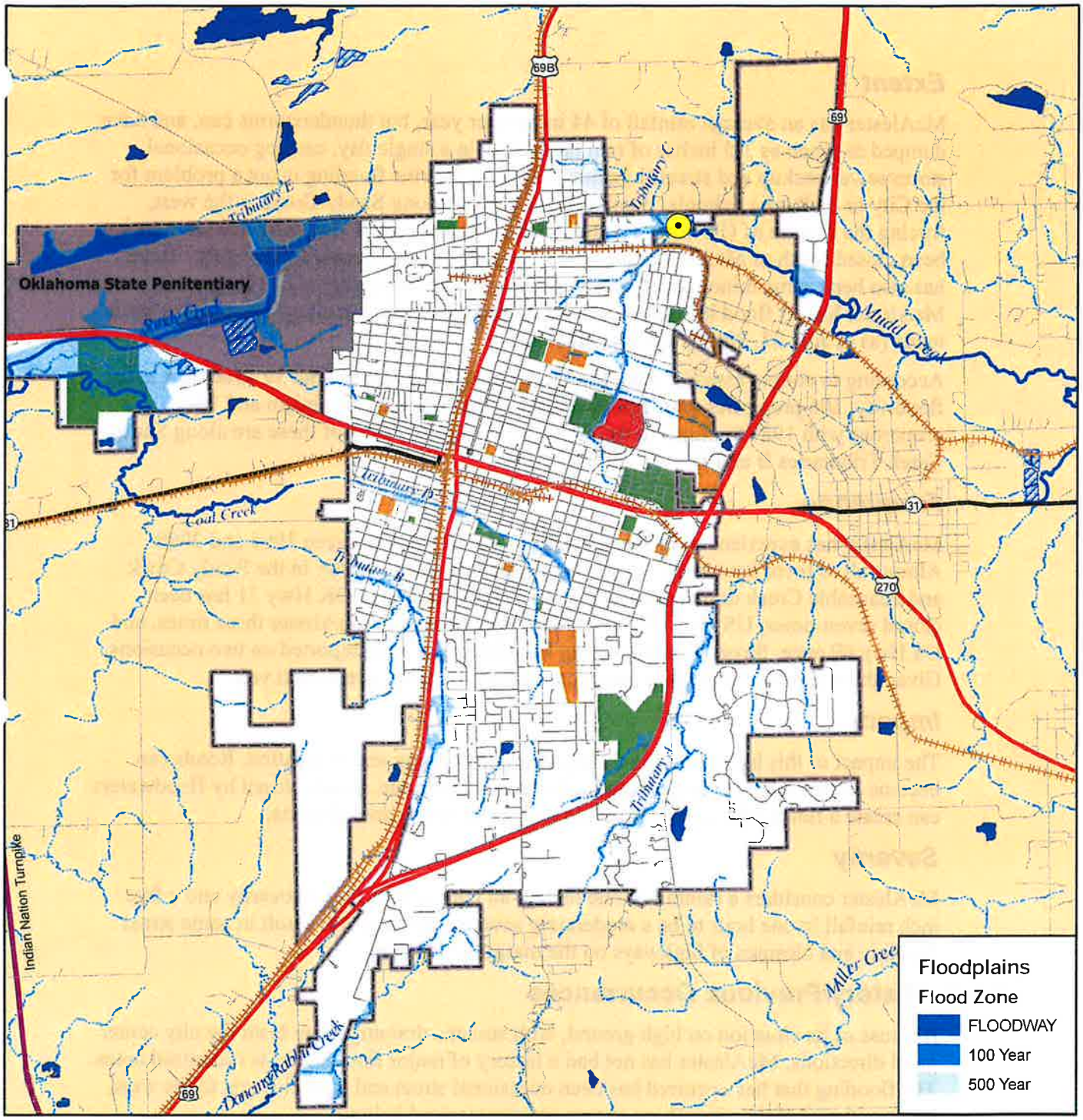
The following table lists areas identified on FEMA's Flood Insurance Rate Maps (FIRM) for use in regulating construction in the floodplain, and for determining insurance rates for properties located in the floodplain. For information on McAlester's existing floodplain management program, see Section 2.3.2.

FEMA and the City of McAlester have identified those areas within the city that have a one-percent chance of flooding in any given year. Figure 4-2 is a generalized map showing floodplains that have been identified along the major waterways.

Table 4–6: FEMA Flood Zones

Flood Zones		
Zone A	The 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 1 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.	

Source: Understanding Your Risks, identifying hazards and estimating losses, FEMA 386-2



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

- Impacted Critical Facilities
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.5 1

Figure 4-2

City of McAlester

100 Year Floodplains

Extent

McAlester has an average rainfall of 44 inches per year, but thunderstorms can, and have, dumped as much as 3-5 inches of rain on the city in a single day, causing occasional storm sewer backup and street flooding. Although riverine flooding is not a problem for the City or its Public Schools, flooding has occurred along Sandy Creek to the west, forcing the closure of OK Hwy 31, and blocking traffic on US Hwy 270. US Hwy 69 has been closed south of McAlester due to high water in the Peaceable Creek basin. There has also been some minor street flooding. The city has no repetitive loss properties. McAlester has 53 flood insurance policies in force, but only three loss claims have been made (as of July 31, 2009), totaling $881.84.

According to county assessor data, McAlester has 30 properties with 39 structures in the floodway, 106 properties with 138 structures in the 100-year floodplain and 162 properties with 198 structures in the 500-year floodplain. Most of these are along Sandy Creek Tributaries B and D.

Frequency

McAlester has experienced 11 flood events in the 15 years between 1995 and 2009. Almost all of these have been outside the urban area of McAlester in the Sandy Creek and Peaceable Creek drainage basins. During this time frame, OK Hwy 31 has been closed seven times, US Hwy 270 twice, OK Hwy 63 east of McAlester three times, and US Hwy 69 once. Street flooding within McAlester has been reported on two occasions. Given these figures, McAlester can expect about one flood event each year.

Impact

The impact of this hazard occurs during times of flooding and inundation. Roads can become impassible, and homes and businesses inaccessible. Roads closed by floodwaters can create a financial and time hardship to citizens and school districts.

Severity

McAlester considers a rainfall of one inch in an hour to be a minor severity and a five inch rainfall in one hour to be a moderately severe event that will result in some street flooding and closures of highways on the margins of the city.

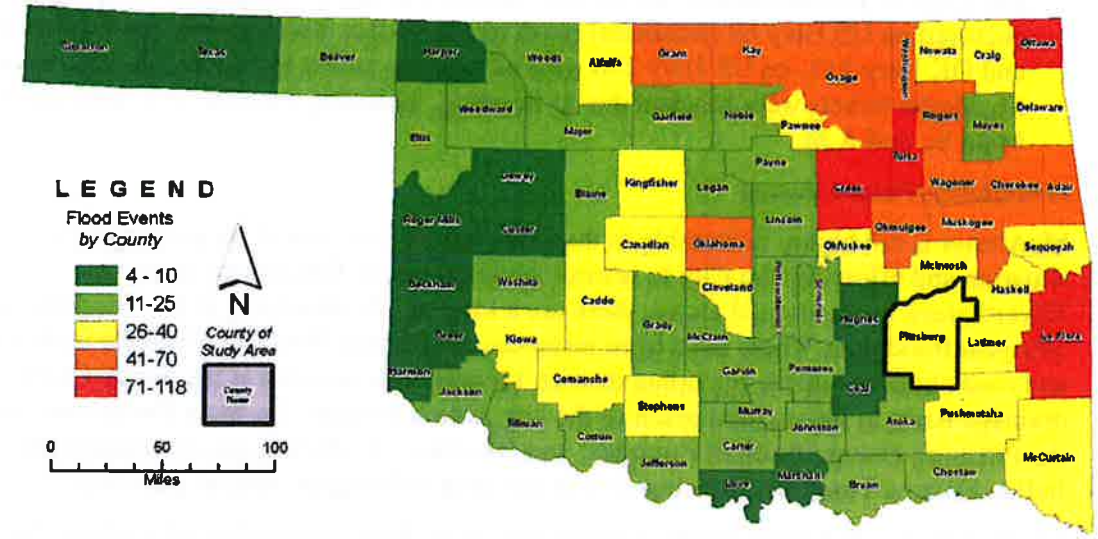
4.1.2 History/Previous Occurrences

Because of its situation on high ground, with streams draining away from the city center in all directions, McAlester has not had a history of major flooding in its urbanized areas. The flooding that has occurred has been occasional street and road closures to the west, south and east of the city. These events are summarized below.

Table 4–7: Floods in Oklahoma and Pittsburg County from 1995-2009

Oklahoma	Events	Deaths	Injuries	Damage Events	Property Damage
McAlester	11	0	0	0	$0
Pittsburg County	40	0	0	5	$42,000
Oklahoma	1,971	25	25	355	$79.67 Million

Figure 4–3: Flood Events in Oklahoma from 1989-2009



Source: National Climatic Data Center U.S. Storm Events Database

Flanagan & Associates, LLC

- **April 22, 1996** - Flooding from thunderstorm rains forced the closure of OK Hwy 31 and US Hwy 270 west of McAlester, and US Hwy 69 to the south.
- **June 16, 1997** - Flooding was reported west of McAlester.
- **October 5, 1998** - 3 to 5 inches of rain in south central Oklahoma caused water to back up in McAlester's storm drains, popping two manhole covers and closing two streets.
- **April 24-26, 1999** - Between 5 and 7 inches of rain fell within 2 days in central Oklahoma, causing Coal Creek north of McAlester to approach flood levels. To the west of the city OK Hwy 31 and US Hwy 270 were closed due to flooding. Some street flooding was reported west of McAlester.
- **March 19-20, 2002** - 4.6 inches of rain caused flash flooding and longer-term flooding on OK Hwy 63 four miles west of Haileyville and OK Hwy 31 three miles west of McAlester.
- **April 7, 2002** - 3.44 inches of rain was recorded near McAlester, resulting in flooding along OK Hwy 31 five miles west of McAlester and OK Hwy 63 six miles west of Haileyville.
- **June 5, 2002** - 3.38 inches of rain at McAlester flooded the playing fields and parking lots at the Pittsburg County Softball Complex, and OK Hwy 31 was temporarily closed due to high water between the Steven W. Taylor Industrial Park and Haywood.
- **November 1, 2004** - Thunderstorm rains forced the closure of OK Hwy 31 west of McAlester and OK Hwy 63 west of Haileyville.
- **December 30, 2006** - Local heavy rainfall of 3 to 4 inches caused flooding west of McAlester.
- **July 2, 2007** - Heavy rainfall forced the closure of OK Hwy 31 west of McAlester.

- **October 9, 2009** - About 4.5 inches of rain fell in McAlester in less than 24 hours. OK Hwy 31 flooded west of the Indian Nations Turnpike. Temporary flooding also occurred on US Hwy 69 (Business) north of McAlester, between Fin and Feather Rd. and OK Hwy 113, on US Hwy 270 west of Arpelar, and in the Alderson area. Several McAlester streets were blocked due to flooding, including Electric Ave. between N. Main St. and A St.

Probability/Future Events

McAlester is not highly vulnerable to the flood hazard, because of its geographical situation and efforts by the City to restrict development in flood prone areas. Nevertheless, as mentioned above, there are a total of 177 structures in the floodway and 100-year floodplain. There have been instances of nuisance flooding of streets in the city and road closures outside the urban district. Of particular concern is the Sandy Creek drainage basin in the western reach of the city, which includes the State Penitentiary and the Pittsburg County Softball Complex, and OK Hwy 31 where it passes beneath the Indian Nations Turnpike. Development in this area will require special planning.

McAlester and McAlester Public Schools have a moderate probability of a future flood event.

4.1.3 Vulnerability

This section summarizes information about McAlester's vulnerability to flooding problems, including problems for people, structures and buildings, critical facilities, and infrastructure. HAZUS modeling was used to help generate this data.

Population

The City of McAlester has 177 structures located within the floodway or 100-year floodplains. According to Hazus-MH, in a citywide 100-year flood, more than 441 households, including an estimated 638 individuals, could be displaced by flooding within or near the inundation areas. Inmates at the State Penitentiary are not included in this number.

Those at greatest risk during major floods are people living in residences located in repetitive flood areas. Also at risk are those traveling by car and on foot in areas prone to flash flooding during heavy rains. Motorists who ignore barricades and warnings against driving on flooded roads are also at high risk. Just two feet of water moving at 10 mph will float virtually any car, SUV or pickup.

Persons who are directed to evacuate an area due to rising water but are without appropriate transportation could also be at increased risk, as well as those who are unwilling to leave their homes for fear of looting or leaving pets behind.

Additionally, persons new to the area, or those whose English language skills are limited, may not understand the true nature of the hazard and take the necessary precautions.

Structures/Buildings

According to HAZUS, McAlester has 156 buildings of all kinds located in or adjacent to the 100-year floodplain.

Information related to NFIP flood insurance policies in McAlester is shown in Table 2-1. Potential vulnerability is detailed in Table 4-8.

Structural values used in this assessment were from the Pittsburg County Assessor's Office. Structures identified in tributary B and D of Sandy Creek floodplains are identified in Figures 4-4 and 4-5. Floodplains around the Penitentiary are shown in Figure 4-6.

Table 4–8: 2010 Floodplain Population & Building Vulnerability

Location	Population	Number of Structures	Improvement Value	Contents Value	Total Value
Floodway	69	39	$1,795,802	$897,901	$2,693,703
A & AE Zone	245	138	$5,210,512	$2,605,256	$7,815,768
500-year	374	198	$8,314,048	$4,157,024	$12,471,072
Total	688	375	$15,320,362	$7,660,181	$22,980,543

Source: Pittsburg County Assessor Data

Repetitive Loss

A repetitive loss property is defined by FEMA as "a property for which two or more National Flood Insurance Program (NFIP) claims of at least $1,000 each have been paid within any 10-year period since 1978." McAlester does not have any NFIP repetitive loss properties.

Critical Facilities

McAlester has one critical facility located in or adjacent to floodplains. Critical facilities located in the floodplains pose a problem for the community. In the event of a flood, they have impacts beyond the flooding of the facility. For example, if child care centers cannot open, parents cannot go to work to provide important community services. First responder services are hampered if flooded police and fire stations cannot operate effectively.

The critical facility located in the 100-year floodplain is the East Water Treatment Plant and is shown in Figure 4-2. For a comprehensive list and addresses of critical facilities, see Table 1-6.

Infrastructure

Water Treatment –The most serious impact to McAlester's water supply would be loss of electrical power. Flooding in the watershed could also impact the water quality in the lakes that supply the city's water system. Impacts could range from minor to significant, depending on the nature of the flooding, pollutants released, location of the release, and impact on the City of McAlester's intakes. Deposition of sediments, nutrients and other contaminants by flooding can have a long-term effect on the lakes that provide water for McAlester.

Wastewater Treatment – As with water treatment, the most significant impact from a major flood event would be the loss of electrical power and the outflow of untreated sewage. The western part of the East Wastewater Treatment Plant is within the 100-year floodplain of Mud Creek. The flooding of wastewater treatment plants could spread

Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

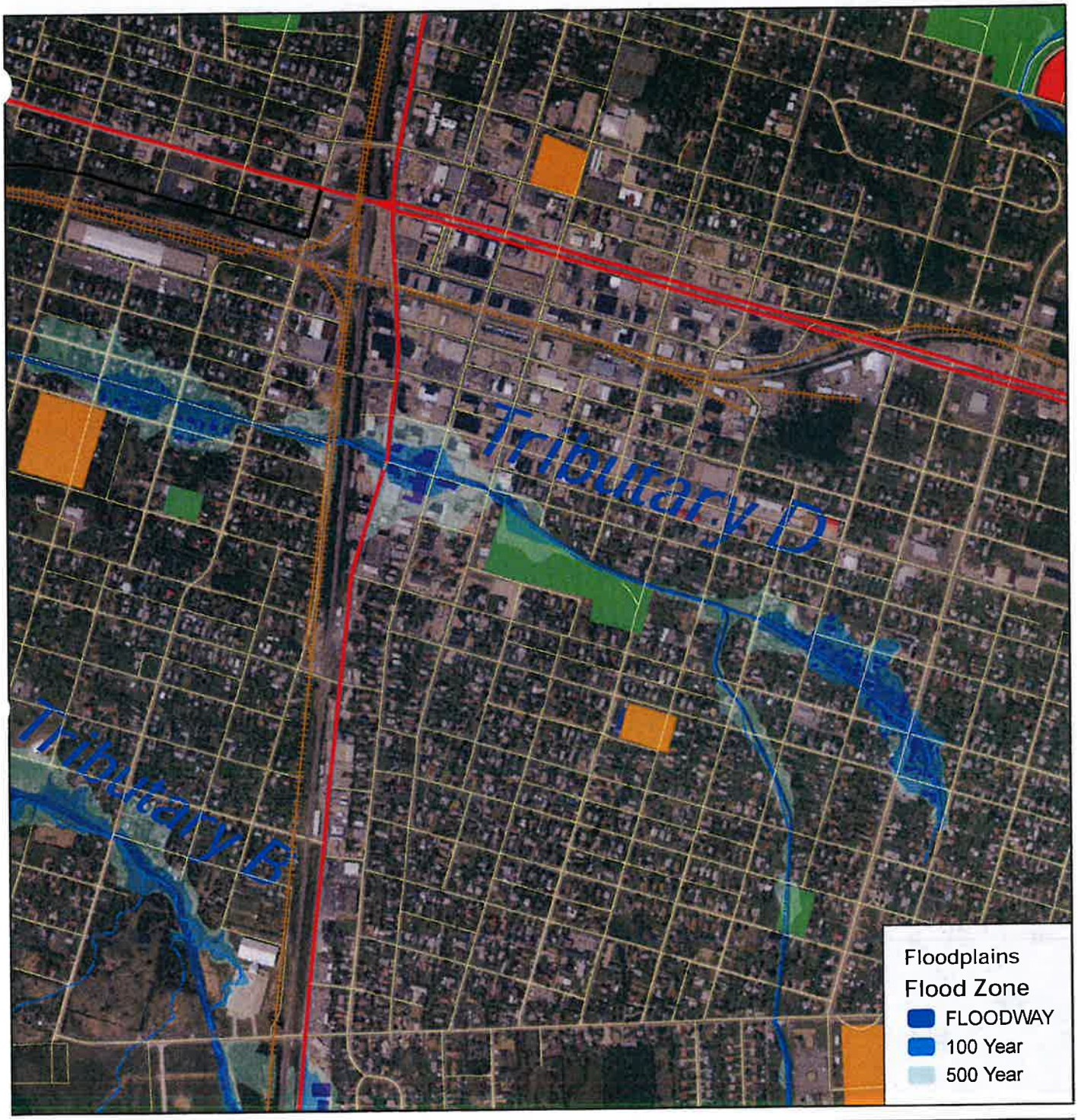
- Structures in Floodplain
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.1 0.2

Figure 4-4

City of McAlester

Tributary B



Legend

County Boundary
City limits

Landmarks

Penitentiary
Hospital
Park
School

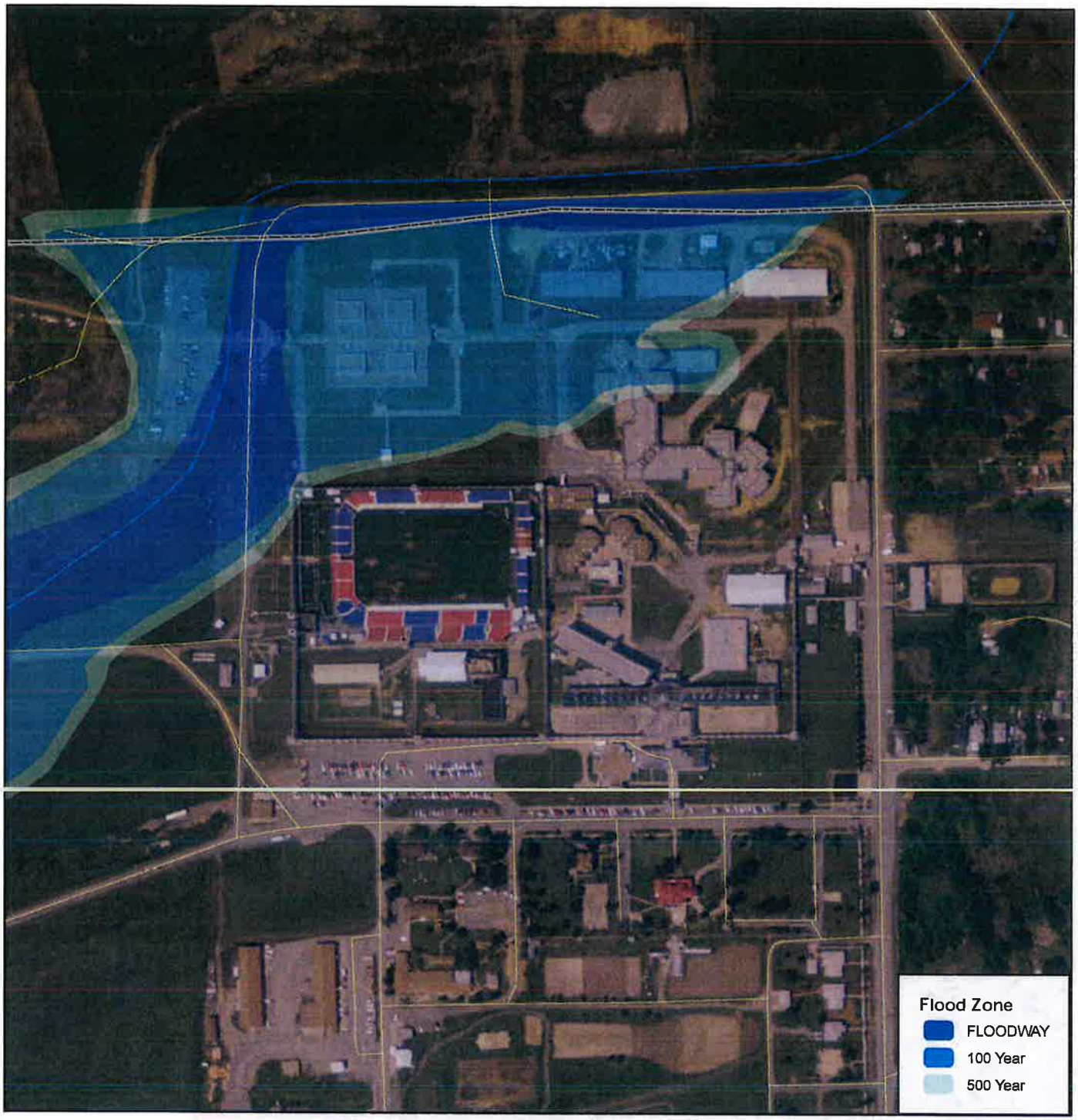
Structures in Floodplain
Railroads
US Highways
Streets and roads
Lakes and Ponds
Perennial Streams
Intermittent Streams

Miles
0 0.1 0.2

Figure 4-5

City of McAlester

Tributary D



Legend

County Boundary
City limits

Landmarks

Penitentiary
Hospital
Park
School

Railroads
US Highways
Streets and roads
Lakes and Ponds
Perennial Streams
Intermittent Streams

Miles
0 0.03 0.06

Figure 4-6

City of McAlester

Oklahoma State Pentitentiary

pollutants and waste into communities and agricultural areas downstream, including Krebs and Eufaula Lake.

Utilities – The primary utility providers for McAlester's jurisdiction is AEP/PSO (electricity) and Reliant Energy/Arkla Gas. Electricity: The largest threat to the delivery of electrical service would be the destruction/damage of power poles/lines. Transportation Systems (Highways, Public Transportation, Railway, Airports) – Flooded roadways and bridges would be the largest transportation system impact from a flood event. Several highways have been repeatedly flooded during severe rainstorms, including OK Hwy 31 and US Hwy 270 west of McAlester and US Hwy 69 south of the city. Most street flooding within the city is short-lived. According to FEMA's 100-year floodplain maps, Sandy Creek's Trib E overtops Yokum Rd., Jess Dunn Rd., and Gladden Rd.; Trib B overtops Oklahoma Ave.; Tributary DD floods the intersection of E. Comanche Ave. and S. Strong Blvd.; and Mud Creek overtops Hereford Rd. west of the East Wastewater Treatment Plant, Electric Ave. between N. Main St. and A St., and the service road and N. George Nigh Rd. between E. 14th and E. Hereford Ln.

Emergency Services- Fire, Police and Medical Services are all at risk to effects of flooding. Flood events create a larger call load for all emergency response agencies, in addition to the hazardous work conditions. When streets are flooded, law enforcement and fire personnel are stationed at intersections to ensure the safety of motorists who may try to enter these barricaded areas. Rescuing people stranded in cars or swept away by floodwaters can be as hazardous to public safety personnel as it is to the victim.

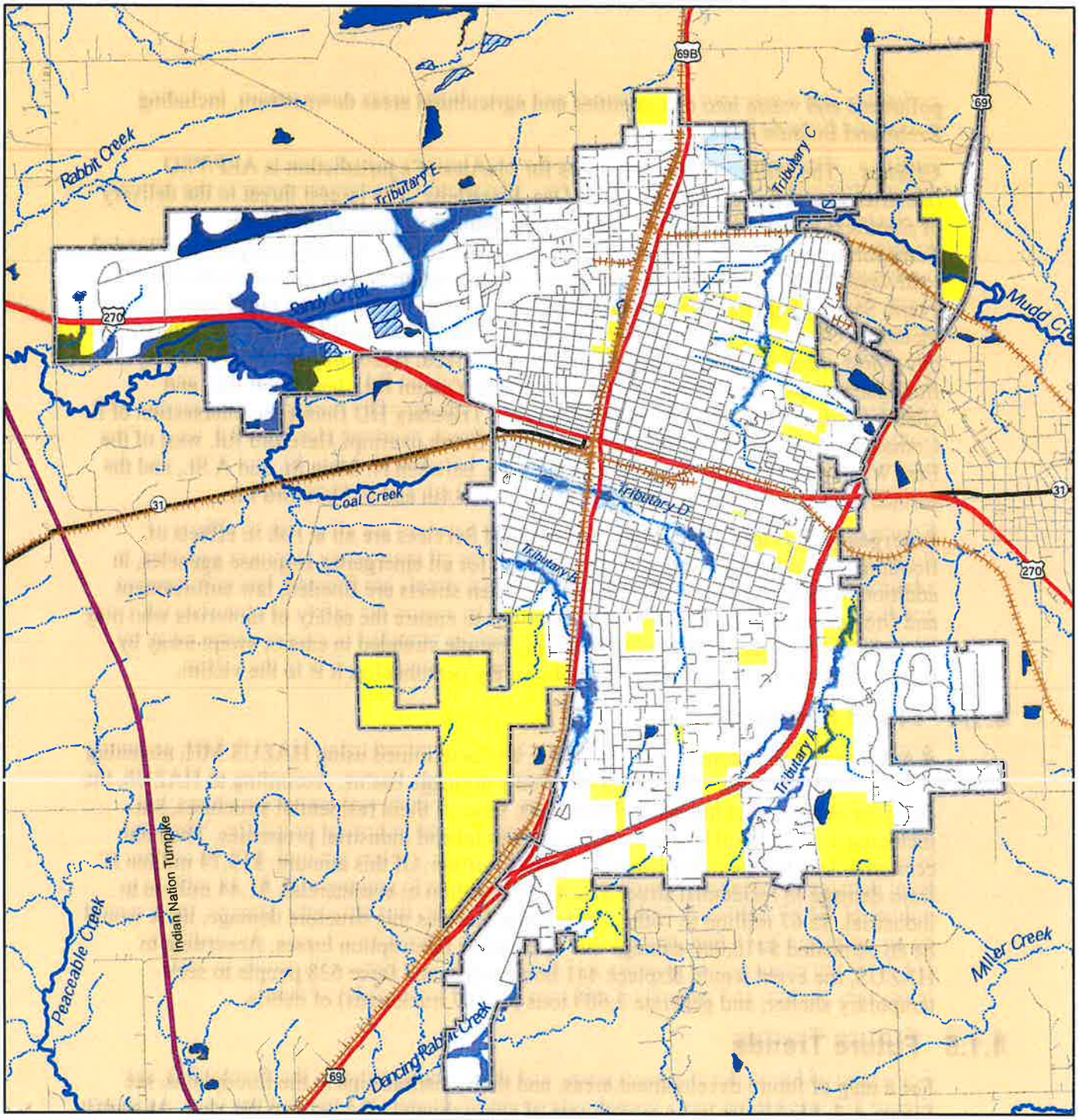
4.1.4 Flood Scenario

A worst case flood scenario for McAlester was determined using HAZUS MH, assuming a 100-year flood event in all the jurisdiction's drainage basins. According to HAZUS, the 100-year event would impact 156 buildings, most of them residential structures, but including 1 school building and some commercial and industrial properties. The total economic loss for the event would be $34.49 million. Of this amount, $19.74 million is from damage to residential structures, $10.23 million to commercial, $1.44 million to industrial, $2.67 million to "other" structures. Besides this structure damage, there would be an estimated $410,000 damage due to business interruption losses. According to HAZUS, the event would displace 441 households, and force 638 people to seek temporary shelter, and generate 2,669 tons (or 107 truckloads) of debris.

4.1.5 Future Trends

For a map of future development areas, and their relationships to the floodplains, see Figure 4-7. McAlester has a growth rate of approximately 0.5 percent per year. As shown in Figure 1-9, the City of McAlester has about 2.75 square miles (1,754 acres) within City limits that have been identified as future development areas.

McAlester's Comprehensive Plan (2002) discourages development in flood-prone areas—a policy supported by the City's Floodplain Regulations (City Code Title 13), and the community's strict drainage standards and stormwater control measures.



Legend

- County Boundary
- City limits
- Future Growth Areas
- 100 Year Floodplain
- 500 Year Floodplain
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.5 1

Figure 4-7

City of McAlester

Future Growth Areas and Floodplains

Population

The City of McAlester adheres to FEMA and NFIP flood policies and regulations, which does not take future urbanization into account. Although, it is expected that the population residing in newly developed areas of McAlester will face less risk from flooding than unregulated development would allow.

Structures/Buildings

As development in new areas and revitalization of existing areas continues, locations and building techniques should be closely examined. Increasing the urban footprint in the community can potentially create water run-off to other areas that were previously at low or no risk of flooding.

Additionally, development in areas along the outer perimeters of the City's boundaries that have been identified as potential flood risk areas could have a substantial impact on the integrity and capacity of existing drainage systems. Current systems are frequently overwhelmed during events that produce slow-moving heavy volume rainfall because of shear volume or debris in the storm drains. An aggressive and ongoing public awareness program should be maintained to ensure new and existing development complies with ordinances and policies in place that address this issue.

City officials have demonstrated awareness of the need to protect the integrity of the stormwater management system.

Critical Facilities

Because of the City of McAlester's and McAlester Public Schools' commitment to maintaining current floodplain zoning guidelines, it is not anticipated that any new critical facilities will be sited within the 100-year floodplain.

Any renovations or improvements made to existing critical facilities should be evaluated to ensure the improvements assist in mitigating any possible flood damage.

Infrastructure

Utility and Transportation Systems (Highways, Public Transportation, Railway, Airports) – The City of McAlester's most likely ongoing threat from flooding would be an event that closes several highways, floods several city streets and intersections, and impacts the State Penitentiary or East Wastewater Treatment Plant. Any plans being developed or implemented for utility and street/roadway improvements within the jurisdiction should seek to mitigate such impacts.

4.1.6 Conclusions

Over recent years, progress has been made in protecting the City of McAlester and McAlester Public Schools from flooding. McAlester has a low to moderate vulnerability to the flood hazard. The City remains vulnerable to frequent nuisance flooding and the potential for an event that could impact the State Penitentiary, low-lying industrial areas in the Sandy Creek basin, or the East Wastewater Treatment Plant.

This study has identified several flood mitigation measures that can help protect McAlester's citizens and its Public Schools from the flood hazard. These are discussed in Chapter 6 and Appendix B.

Data Limitations

While rain events and the extent of flooding produced can be reasonably predicted, other sources of floodwater, such as snowmelt, waterline breaks, or blocked storm drains cannot be as accurately defined and predicted. They are, however, relatively less common than flooding caused by rainfall. The HAZUS-MH model used to determine the results of a 100-year flood in McAlester's drainage basins produced only generalized data. A more accurate and detailed worst-case event for the City of McAlester and McAlester Public Schools will be based on McAlester's revised flood plain maps and a more careful analysis of vulnerable structures—something not provided by HAZUS-MH, which uses census tract data rather than actual, on-the-ground surveys.

4.1.7 Sources

Extreme Weather and Climate Events at National Climatic Data Center website:
http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

FEMA Flood Insurance Statistics at Website:
http://www.fema.gov/business/nfip/statistics/pcstat.shtm

FEMA Historic Flood Maps, McAlester, Oklahoma, used in this Plan, see:
http://msc.fema.gov/webapp/wcs/stores/servlet/CategoryDisplay?catalogId=10001&storeId=10001&categoryId=12010&langId=-1&userType=G&type=9&dfirmCatId=12009

4.2 Tornadoes

A tornado is a rapidly rotating vortex or funnel of air extending to the ground from a cumulonimbus cloud. When the lower tip of a vortex touches earth, the tornado becomes a force of destruction. The path width of a tornado is generally less than a half-mile, but the path length can vary from a few hundred yards to dozens of miles. A tornado moves at speeds from 30 to 125 mph, but can generate winds exceeding 300 mph.

Each year Oklahoma has more tornado events per square mile than any other state

4.2.1 Hazard Profile

Severe thunderstorms produce about 1,000 tornadoes each year in the United States. FEMA reports that 106 federal disaster declarations over the past 20 years have included tornado damage.

The path length and width of a tornado can have a substantial impact on human life and property. The average length and width based on the EF class are shown in table 4-9. Damage from an average tornado can include the destruction of roof surfaces, mobile homes being pushed off their foundations, and automobiles being blown off roadways. More severe tornadoes can lift 300-ton objects and toss homes more than 300 feet.

Location

Oklahoma, along with Texas, Arkansas, Missouri, and Kansas, is located in "Tornado Alley," the most tornado-prone area of the nation. The entire jurisdiction of the City of McAlester is considered to be vulnerable to the effects of a tornado event. See Figure 4-10 for the number of tornado events per county in Oklahoma.

Measurement

Almost 70% of all tornadoes are measured F0 and F1 on the Fujita Scale (see Table 4-11), causing light to moderate damage, with wind speeds between 40 and 112 miles per hour. F4 and F5 tornadoes are considerably less frequent, but are the big killers. Sixty-seven percent of all tornado deaths were caused by F4 and F5 storms, which represent only 1% of all tornadoes. The Enhanced Fujita Scale was adopted in early 2007, although the layperson frequently refers to the earlier F-scale. The new scale is based on a broader set of degrees of damage to a wider variety of structures. A description of the Fujita Scale and comparison to the recently adopted Enhanced Fujita Scale (EF) are included in Table 4-10. Additional information on the Enhanced Fujita Scale is available at http://www.spc.noaa.gov/efscale.

Table 4–9: Mean Tornado Length and Width by EF class

EF Class	Length (miles)	Width (yards)
EF0	.87	31.06
EF1	2.92	69.99
EF2	6.65	137.69
EF3	13.98	288.28
EF4	27.09	503.83
EF5	33.93	607.5

Source: Benefit-Cost Analysis – Tornado Methodology

Table 4–10: Fujita Scale and Enhanced Fujita Scale

Fujita Scale			EF Scale	
Category	**Wind Speed (mph)**	**Current Damage Indicators**	**Category**	**3 Second Gust (mph)**
F0	Gale (40-72)	***Light***: Damage to chimneys, tree branches, shallow-root trees, sign boards	EF0	65-85
F1	Moderate (73-112)	***Moderate***: Lower limit is beginning of hurricane wind speed--surfaces peeled off roofs, mobile homes pushed off foundations or overturned, cars pushed off roads	EF1	86-110
F2	Significant (113-157)	***Considerable***: Roofs torn off frame houses, mobile homes demolished, boxcars pushed over, large trees snapped or uprooted, light-object missiles generated	EF2	111-135
F3	Severe (158-206)	***Severe***: Roofs and some walls torn off well-constructed houses, trains overturned, most trees in forest uprooted, cars lifted off the ground and thrown	EF3	136-165
F4	Devastating (207-260)	***Devastating***: Well-constructed houses leveled, structures with weak foundations blown off some distance, cars thrown and large missiles generated	EF4	166-200
F5	Incredible (261-318)	***Incredible***: Strong frame houses lifted off foundations and carried considerable distance to disintegrate, automobile-sized missiles fly through the air in excess of 100 yards, trees debarked	EF5	Over 200

The F-scale and Enhanced F-scales are a set of wind estimates (not measurements) based on damage. The Enhanced Scale uses three-second gusts estimated at the point of damage based on a judgment of 8 levels of damage to the 28 indicators listed below. These estimates vary with height and exposure.

Structures Used as Damage Indicators in the Enhanced Fujita Scale	
Small barns, farm outbuildings	One- or two-family residences
Single-wide mobile home (MHSW)	Double-wide mobile home
Apartment, condo, townhouse (3 stories or less)	Motel
Masonry apartment or motel	Small retail building (fast food)
Small professional (doctor office, branch bank)	Strip mall
Large shopping mall	Large, isolated ("big box") retail building
Automobile showroom	Automotive service building
School - 1-story elementary (interior or exterior halls)	School - middle or senior high school
Low-rise (1-4 story) bldg.	Mid-rise (5-20 story) building
High-rise (over 20 stories)	Institutional building (hospital, govt. or university)
Metal building system	Service station canopy
Warehouse (tilt-up walls or heavy timber)	Transmission line tower
Free-standing tower	Free-standing pole (light, flag, luminary)
Tree - hardwood	Tree - softwood

Extent

The City of McAlester may experience a tornado ranging from EF0 to EF5.

In a ranking of the Top Ten Costliest U.S. Tornadoes (1950 – 2007), Oklahoma has two entries: May 3, 1999 ranked 3rd ($1.24 billion), and May 8, 2003 ranked 8th ($416.8 million). These figures have been adjusted to reflect 2007 dollars.

The NCDC's ranking of the 25 Deadliest U.S. tornadoes shows two entries for Oklahoma. The Woodward Tornado of April 9, 1947 is ranked 6th, with 181 fatalities and 970 injuries, and the Snyder Tornado of May 10, 1905 is 18th, with 97 deaths.

Oklahoma's neighbors to the north, south and east (Kansas, Texas and Arkansas) share in this rich environment for deadly and destructive events and often share the effects of the same storm systems.

On April 21, 1996, Fort Smith, AR was hit by an F3 tornado that struck in the dead of night with no warning. There were 3 deaths, 89 injuries, and nearly 500 homes destroyed. Severe damage to the city's courthouse/jail-wing building brought the estimated damages to over $300 million.

To the south, Fort Worth, TX experienced a devastating twister on March 28, 2000 when a low-end F3 tornado passed through the west side of the city just after 6:15 p.m. In all, 15 of the downtown buildings were destroyed (7 actually collapsed from the storm), 63 damaged, 93 homes destroyed – 203 suffered major damage. Two fatalities and 80 injuries were also reported. Damages were estimated at $450 million.

Just to the north, on May 4, 2007, Greensburg, KS was hit by an EF5 tornado at 9:45 p.m. CDT. The tornado was estimated to be 1.7 miles (2.7 km) in width and traveled for nearly 22 miles (35 km). Ninety-five percent of the city was confirmed destroyed, with the other five percent being severely damaged. The National Weather Service estimated winds of the tornado to reach 205 mph (330 km/h). This was the first tornado to be rated EF5 since the update of the Fujita scale. The Tornado had caused EF5 damage to at least one well-built home in Greensburg, and also is the first F5 classification since May 3, 1999, when an F5 tornado ripped through Moore, OK.

Frequency

Between the years 1995 – 2009, the National Weather Service reported 986 tornadoes (an average of 65tornadoes each year) for Oklahoma. Oklahoma experiences more tornadoes on average than does any other state, except Texas, which has twice as many, but is also more than twice the size of Oklahoma.
Data from the National Weather Service demonstrates that the most active months for tornadoes in Oklahoma are April and May. It is important to point out, however, that tornadoes occur in every month of the year.

Pittsburg County has reported 28 tornadoes between 1995 and 2009, an average of 1.86 tornadoes per year, that resulted in no deaths, 15 injuries, and $2 million in total damage.

Impact

The impact of this hazard occurs during times of severe storms. Storms that generate tornadoes also have the ability to cause lightning, hail, high winds, and flooding damage.

This can result in the direct loss of homes, businesses, and lives and indirectly cause the loss of income, medical care, and the ability for the government to respond to the disaster.

Severity

McAlester considers a minor severity tornado to be an F1 or lower on the Enhanced Fujita Scale and a major severity to be an F2 or higher.

4.2.2 History/Previous Occurrences

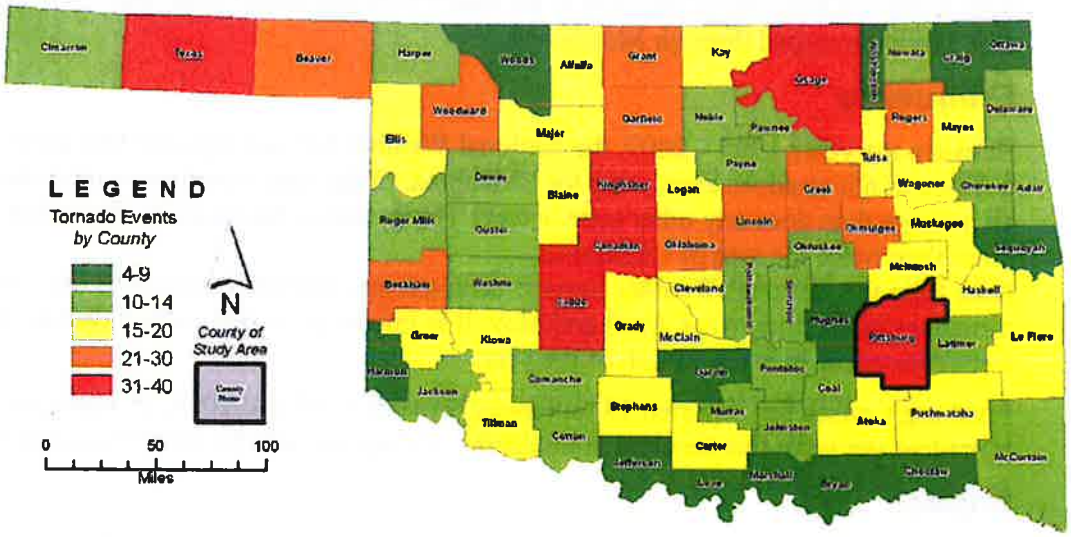
Table 4–11: Tornadoes in Oklahoma and Pittsburg County from 1995 thru 2009

Location	Events	Deaths	Injuries	Damage Events	Property Damages
Pittsburg County – F0	20	0	0	3	$802,000
Pittsburg County – F1	5	0	5	5	$401,000
Pittsburg County – F2	2	0	0	2	$700,000
Pittsburg County – F3	1	0	1	1	$100,000
Pittsburg County – F4	0	0	0	0	$0
Pittsburg County – F5	0	0	0	0	$0
Oklahoma – F0	589	0	14	136	$3,672,000
Oklahoma – F1	268	0	40	229	$50,104,000
Oklahoma – F2	93	5	88	81	$92,723,000
Oklahoma – F3	27	5	116	26	$403,211,000
Oklahoma – F4	7	29	514	7	$650,500,000
Oklahoma – F5	2	23	332	2	$540,000,000

Source: NOAA National Climatic Data Center http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Note: Since the starting point or ending point of many of the tornadoes in the area are not observed, it is not possible to accurately isolate whether tornadoes did or did not occur within the City Limits.

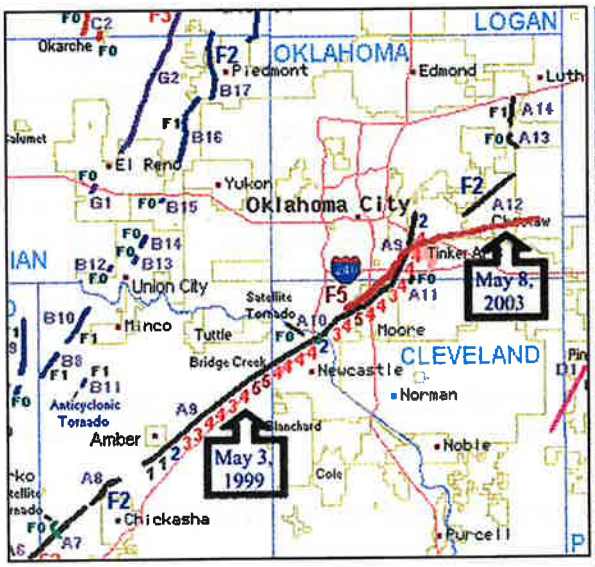
Figure 4–8: Tornado Events in Oklahoma from 1989-2009



Oklahoma has a long history of deadly and destructive tornadoes. Some of the more notable of these events include:

- **April 9, 1947**- A mile-wide F5 tornado cut a 221-mile path across Texas, Oklahoma and Kansas, leaving 169 dead, 890 injured, and $9,700,000 in estimated property damage. In Oklahoma, 101 people were killed, 95 of them at Woodward, the others at Gage and Shattuck. In Woodward, alone, the tornado destroyed 430 homes, damaged 650, and caused $6,608,750 in property damage. Altogether, property losses in Oklahoma totaled $8,022,750.

Figure 4–9: May 1999 Tornadoes and May 8 Tornado Path through Moore, OK



The May 3, 1999 tornadoes caused over $1 billion in damage. The May 8, 2003 tornado caused $100 million in damage

- **May 3, 1999**- A series of severe thunderstorms from the southwest produced several tornadoes that intensified as they moved across the state. One of the tornadoes in the outbreak was an F5, which occurred southwest of Oklahoma City, was measured at 318 mph, and stayed on the ground about four hours, leaving a path approximately thirty-eight miles long. This storm was the first F5 tornado to affect metropolitan Oklahoma City. The path included 6.5 miles of continuous F4 damage as well as several areas of F5 level destruction. Several homes were completely removed from their slabs.

  The National Weather Service reported that 57 tornadoes were recorded in the state during the outbreak. The Oklahoma Hospital Association reported 742 people were treated at 30 hospitals, and 44 people were killed. Approximately 10,000 homes and businesses were affected by the storms, with total losses exceeding $1 billion. Oklahoma's Department of Emergency Management reported that 3,009 homes, 117 businesses, and 10 public buildings were destroyed, including 645 in Oklahoma City and 95% of Mulhall. Sixteen counties were declared Federal disaster areas.

- **May 8, 2003**- At about 5 pm, the path of the estimated F-4 tornado hit Moore, Midwest City, Del City, Stroud and Oklahoma City, many of the same areas damaged by the killer tornado of May 3, 1999. The National Weather Service estimated the

tornado's path to be 19 miles long. Local hospitals reported 145 injuries. Initial estimate of damage include 432 homes destroyed and another 2,457 damaged. About 20 businesses were destroyed. The 4 million square-foot Oklahoma City General Motors automobile plant sustained substantial damage and was knocked out of production, and five schools were damaged. In addition, the City of Moore reported three churches destroyed, and damage to a fire station and elementary school. The Lincoln National Bank in Oklahoma City was leveled. Oklahoma Gas and Electric reported that 4,000 customers in Oklahoma City, Moore, and Midwest City were without power. The Insurance Commissioner estimated damage at more than $100 million.

McAlester Historic Tornado Events

The most destructive tornado to hit McAlester occurred on May 8, 1882, when an F3 tornado destroyed much of the town and killed 21 people. NCDC data show 68 tornado events for Pittsburg County between 1950 and 2008, killing 1 person, injuring 42, and doing $6.823 million in damage. Of these tornadoes, 27 were recorded as F0, 27 as F1, 11 as F2, 2 as F3 and 1 as F4. The NCDC reports five tornadoes within McAlester's city limits from 1993-2009, injuring 9 people and doing $850,000 damage. According to NCDC data, a total of 16 tornadoes have been reported either in or near the city. The worst of these are summarized below. Figure 4-11 shows historic tornado paths for McAlester.

- **May 8, 1882** – An F3 tornado, 400 yards wide, moved northeast destroying much of McAlester (then a population of 800). The twister killed 21 and injured 42, destroyed 59 homes and damaged 27 others.
- **March 27, 1950** – An F2 tornado 77 yards wide and 0.10 miles long touched down 2 miles southeast of McAlester airport, doing $2,500 in damage.
- **February 28, 1955** – An F2 tornado 33 yards wide and 2 miles long was reported south of Lake McAlester. A house was unroofed and a garage, cabin, bath house and trailers were destroyed. Some buildings along Lake McAlester were destroyed. Damage was $25,000.
- **February 26, 1958** – An F0 tornado of unknown width and length did $2,500 damage 4 miles southeast of McAlester airport.
- **March 31, 1959** – An F1 tornado 50 yards wide and 2 miles long did $2,500 damage 5 miles northwest of McAlester, and south of Lake McAlester.
- **May 5, 1960** – An F2 tornado 500 yards wide and 4 miles in length touched down on the west edge of McAlester near South St. and lifted on the northeast edge of the city near Hereford Ln. and US Hwy 69, causing $25,000 damage.
- **April 27, 1966** – An F3 tornado 400 yards wide and 8 miles in length passed 5 miles west of McAlester. Damage was $250,000.
- **October 26, 1970** – An F1 tornado at Mekko, 2 miles north of McAlester, did $25,000 damage.
- **November 3, 1974** – An F1 tornado 500 yards wide and 4 miles long touched down near South Ave. and 6th St. and lifted east of US Hwy 69 and 1420 Rd. Damage was $250,000.

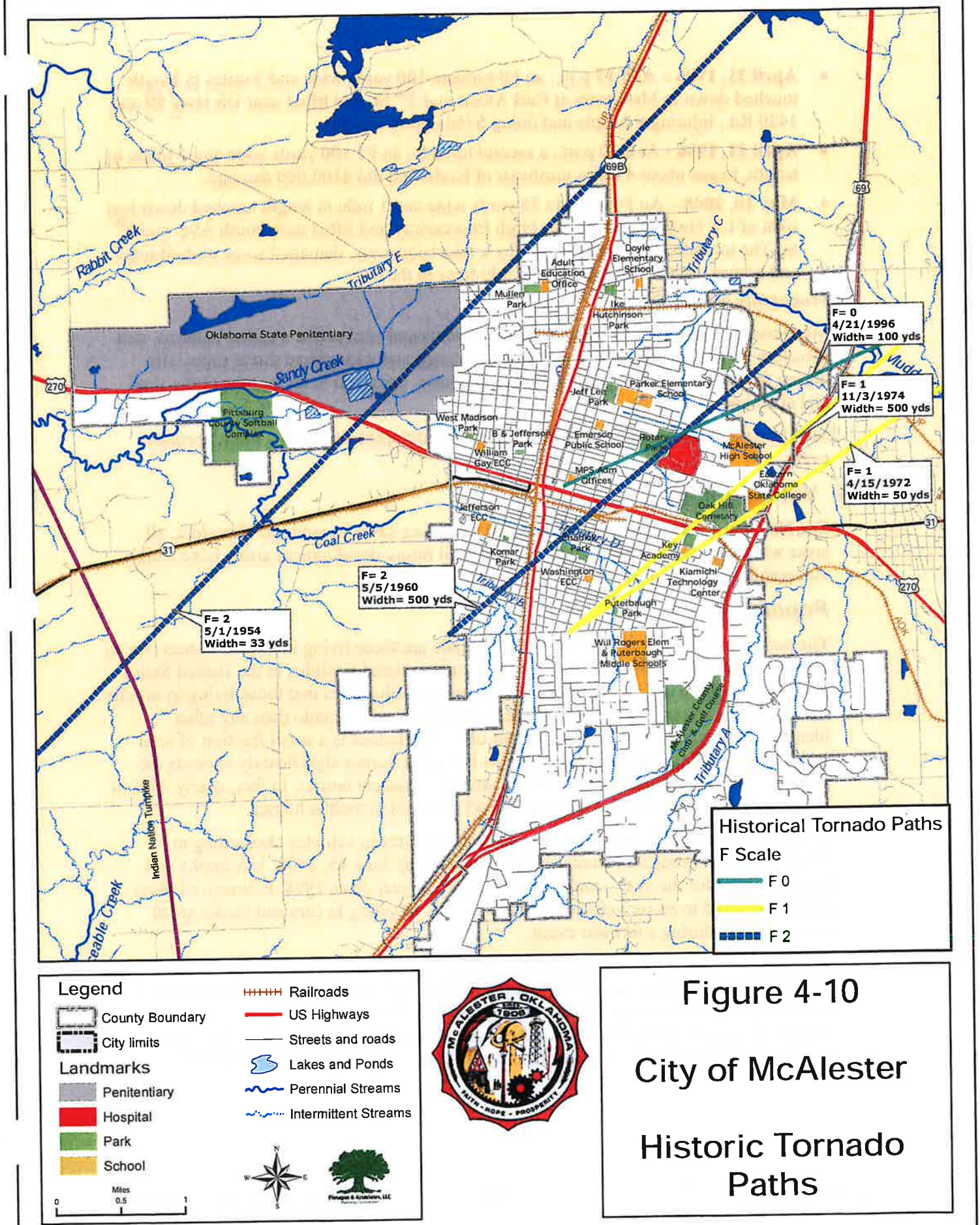


Figure 4-10

City of McAlester

Historic Tornado Paths

- **April 21, 1996** – At 8:15 p.m., an F0 tornado 100 yards wide and 3 miles in length touched down in McAlester at Carl Albert and 2nd St. and lifted near US Hwy 69 and 1420 Rd., injuring 9 people and doing $750,000 in damage.
- **April 21, 1996** - At 8:30 p.m., a second tornado, an F1 100 yards wide and 5 miles in length, began about 4 miles northeast of Krebs and did $100,000 damage.
- **May 10, 2008** – An F0 tornado 75 yards wide and 1 mile in length touched down just west of US Hwy 69 and George Nigh Expressway and lifted near South Ave. and 6th St. The tornado, which was filmed by a television crew, damaged some outbuildings and homes west of McAlester, but only trees in the city.

Probability/Future Events

McAlester is vulnerable to frequent thunderstorms and convective weather patterns, and therefore its vulnerability to tornadoes is a constant and widespread threat especially during the spring months. Tornadoes can, and have, appeared in all months of the year and at all hours of the day.

McAlester and McAlester Public Schools have a high probability of a future tornado event.

4.2.3 Vulnerability

The National Weather Service advises that tornadoes strike at random. Therefore, all areas within the City of McAlester, including all future development areas, have a high vulnerability to tornadoes.

Population

The people most at risk of fatality from a tornado are those living in mobile homes. As an example, Table 4-12 shows the number of tornado-related fatalities in the United States from 1997 to 2006 and where the deaths occurred. It illustrates that those living in mobile homes are significantly more vulnerable to the effects of a tornado than any other identifiable population. While the number of mobile homes is a small fraction of total residential dwellings, the number of deaths in mobile homes significantly exceeds the number of deaths associated with inhabitants of permanent homes. In fact, nearly 45% of all tornado deaths during that ten-year period occurred in mobile homes.

Also significant is the number of tornado-related deaths in vehicles. According to NOAA's Storm Prediction Center in Norman, OK, by June 15, 2008, 115 deaths had been recorded for the year – making it the deadliest year since 1998. Fourteen of these deaths occurred in motor vehicles. Clearly, people traveling in cars and trucks are at increased risk during a tornado event.

Also at an increased risk are members of the hard-of-hearing/deaf community, people not fluent in English, and those without access to broadcast media messages (television or radio) alerting them of approaching severe weather. While much progress has been made in expanding communication resources for these populations, there are still a large number of residents who are unable to receive vital warnings in a timely manner.

Table 4–12: Tornado Fatalities in the United States

Year	Home	Mobile Home	Business	School	Vehicle	In the Open	Other	Total for Year
1997	38	15	3	0	3	7	1	67
1998	46	64	1	0	16	3	0	130
1999	39	36	3	0	6	9	1	94
2000	7	28	0	0	4	2	0	41
2001	15	17	3	0	3	2	0	40
2002	15	32	0	1	4	2	1	55
2003	24	25	0	0	0	3	2	54
2004	15	8	10	0	2	0	0	35
2005	4	32	0	0	1	1	0	38
2006	16	22	0	0	3	2	24	67
Totals	219	279	20	1	42	31	29	621

Source: National Weather Service Storm Prediction Center

Structures/Buildings

Tornado damage is a factor of severity and location, both on a landscape scale – rural/urban areas – and on a structure-by-structure scale. An F4/F5 tornado in an urban area will create phenomenal damage, as experienced with the tornadoes that struck Greensburg, KS (F5, 5/4/2007) and Picher, OK (F4, 5/10/2008), but damage to structures will vary depending on how solidly they are constructed. For example, mobile homes are more easily damaged than permanent structures, buildings with crawl spaces are more susceptible to lift, and the way foundations and roofs are constructed can increase or decrease the structure's vulnerability.

Structures utilizing more modern-looking building materials (reflective glass facades, open breezeways between wings, etc.) should be considered more vulnerable to tornado damage. Wind-driven debris (wood, metal, other heavy items picked up by larger funnels) can cause catastrophic damage to buildings – as witnessed in the tornadoes that struck downtown Fort Worth in 2000 or Atlanta in May 2008.

Critical Facilities

All critical facilities within the jurisdictions of the City of McAlester and McAlester Public Schools should be considered vulnerable to the effects of a tornado event. Structural integrity may be compromised if the buildings are in the direct path of the storm, in addition to any secondary impacts, such as power disruption, water damage from accompanying rain, injury to workers/residents, etc. For a complete list of critical facilities for the City of McAlester, see Table 1-6. It should be noted that none of McAlester's public schools is equipped with a backup generator.

Infrastructure

Water Treatment – The most significant impacts from a tornado would be the destruction of the City's water treatment facilities and loss of electrical power. The City of McAlester and McAlester Public Schools are supplied by the McAlester Public Works Authority with water from McAlester Lake and Lake Talawanda. The Water Treatment Plant has backup generation.

Wastewater Treatment – The most significant threat to the operation of McAlester's two wastewater treatment plants from a tornado would be damage to the wastewater facilities or power outages. Both wastewater plants have backup generators.

Utilities- The primary utility providers for McAlester's jurisdiction are AEP/PSO (electricity) and Reliant Energy/Arkla Gas. The service stations and substations for both of these providers would be vulnerable to damage by a tornado. **Electricity:** During a tornado, AEP/PSO could experience destruction of distribution and transmission poles, downed broken power lines, danger to civilians or work crews from downed power lines, and fallen debris from trees, or insufficient field and/or office staff to effectively handle the workload. **Gas:** During a tornado, Reliant Energy/Arkla Gas could be challenged to meet the needs of the McAlester jurisdiction because of falling power lines or tree debris; inaccessibility to underground gas meters from fallen debris; downed power lines, extreme temperatures, insufficient field and/or office staff to effectively handle workload generated by the event.

Transportation Systems (Highways, Public Transportation, Railway, Airports) – Tornado conditions could result in the interruption of normal operations at McAlester Airport and damage to airport facilities and aircraft.

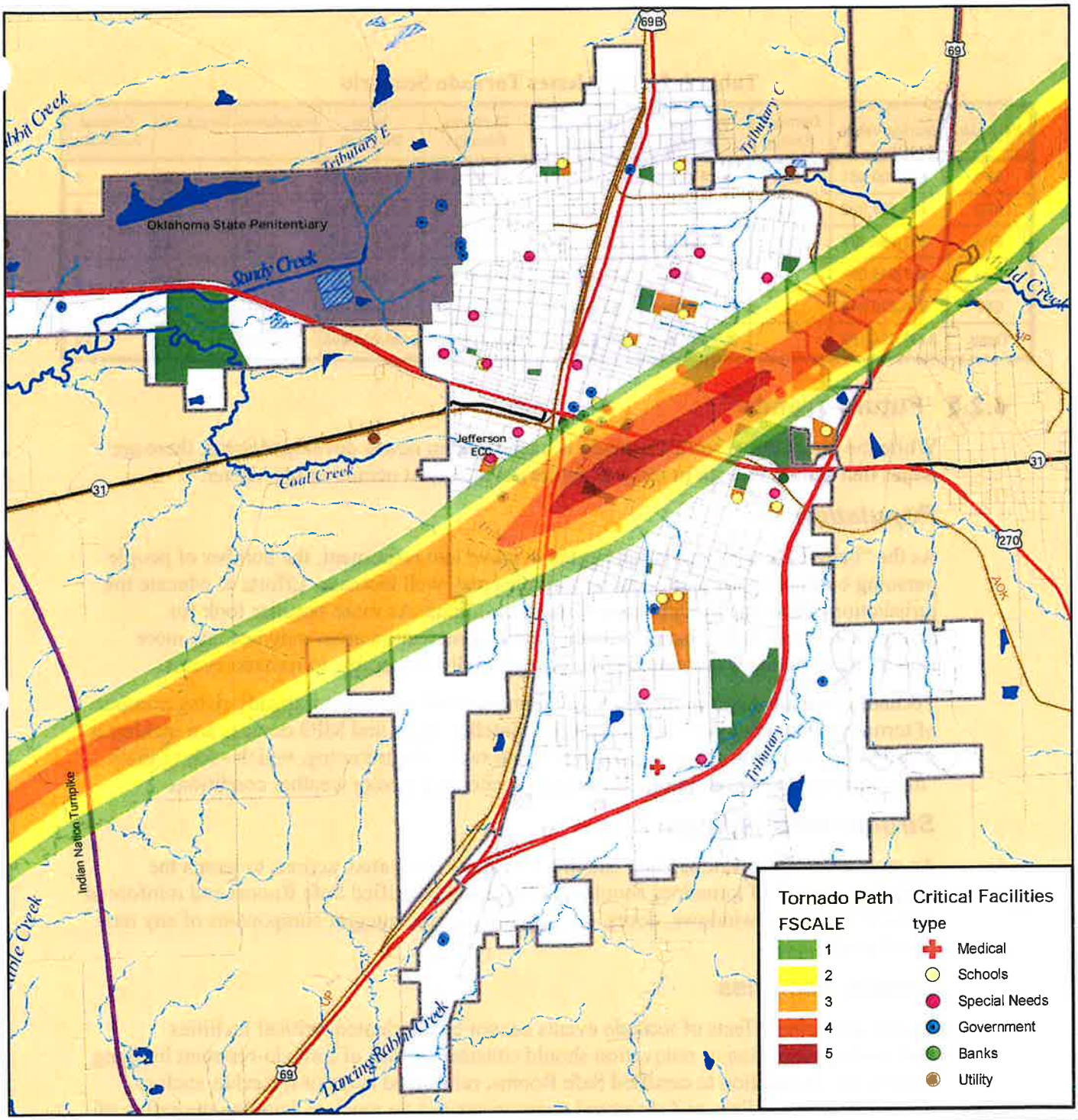
Emergency Services – Fire, Police and Medical services would at risk to tornado damage to facilities and secondary impacts. Downed power lines or debris blocking city streets could limit access to affected areas. Fallen debris could damage emergency vehicles, reducing the number of vehicles available for response. Medical services (including treatment facilities) could be strained in responding to large numbers of injuries.

4.2.4 McAlester Tornado Scenario

A typical tornado path is reported to be approximately 600 feet in width, and 2.5 miles in length. The typical path in Oklahoma runs generally from southwest to northeast with the area of destruction being about 181 acres per event. Approximately 16 square miles of Oklahoma's 69,919 square miles are impacted by tornadoes each year. The annual chance of a tornado of any magnitude hitting any location is roughly 1 in 5,000. Bigger and more devastating tornadoes can and do occur, as evidenced by the 1999 Oklahoma City tornado, which stayed on the ground for 38 miles. However, these events are rare. The chance of an F4 or F5 striking an area is only about 1 in 417,000 per year.

To anticipate the damage from a worst-case tornado event, a portion of Tornado A9 from the Oklahoma City tornado outbreak of May 3, 1999, was placed through the center of McAlester. Shown in Figure 4-12, the tornado scenario would affect both downtown critical facilities and a major portion of McAlester's residential area.

The damages from the events are listed in Table 4-13. Damages in the tornado path, including buildings and contents, approached $115 million in the McAlester scenario.



Legend

County Boundary

City limits

Landmarks

Penitentiary

Hospital

Park

School

Railroads

US Highways

Streets and roads

Lakes and Ponds

Perennial Streams

Intermittent Streams

Miles

0 0.5 1

Figure 4-11

City of McAlester

Tornado Scenario

Table 4–13: McAlester Tornado Scenario

EF-Scale	Market Value	Damage Factor	Structure Damage	Contents Value	Contents Damage	Total Damage	Population	Structures	Critical Facilities
EF1	$24,109,581	0.1	$2,410,958	$12,054,791	$1,205,479	$3,616,437	1,312	568	3
EF2	$30,735,893	0.4	$12,294,357	$15,367,947	$6,147,179	$18,441,536	1,171	507	4
EF3	$32,730,777	0.8	$26,184,622	$16,365,389	$13,092,311	$39,276,932	2,146	929	9
EF4	$27,676,987	1	$27,676,987	$13,838,494	$13,838,494	$41,515,481	1,220	528	5
EF5	$11,870,948	1	$11,870,948	$5,935,474	$5,935,474	$17,806,422	772	334	1
Totals	$127,124,186		$80,437,872	$63,562,093	$40,218,936	$120,656,808	6,620	2,866	22

4.2.5 Future Trends

While the direct threat from a tornado is unchanged in newly developed areas, there are issues that should be kept in mind as future development occurs in McAlester.

Population

As the "baby-boomer" population begins to move into retirement, the number of people pursuing outdoor sports and/or social activities may well increase. Efforts to educate the jurisdictions about the tornado hazard should continue. As more families look for activities closer to home, parks and other outdoor recreation areas may become more heavily used. Outdoor recreation areas are especially vulnerable to tornado events.

Technological advances in mobile entertainment could increase of already rising number of tornado-related fatalities in automobiles. Satellite radio and MP3 devices are making it possible for drivers to enjoy non-local network radio programming, which adds to their "disconnectedness" from public broadcasts concerning severe weather conditions.

Structures/Buildings

As open areas are developed and existing structures renovated, actions to lessen the potential impacts of tornadoes should be considered. Certified Safe Rooms and reinforced exterior materials (windows, doors, etc.) should become integral components of any new development.

Critical Facilities

As the damaging effects of tornado events cannot be eliminated, critical facilities undergoing expansion or renovation should consider the use of tornado-resistant building techniques. In addition to certified Safe Rooms, reinforced exterior materials such as windows, doors, siding, and structural components can do much to improve the safety of critical facilities. Additionally, all efforts to guard against potential secondary effects should also be implemented. These secondary effects may include compromise of structural integrity, broken windows/doors from wind-strewn debris, water damage from accompanying rains, power interruptions/surges and communication interruption from lightning or wind damage.

Infrastructure

Ensuring local government facilities are protected against the potentially devastating effects of a tornado is an on-going endeavor. Implementing new technology as it is made available can help ensure the continuity of operations. The maintenance of uninterrupted communications and protection of electronic data should be considered priorities in any infrastructure development plans.

4.2.6 Conclusions

Due to the nature of McAlester's location and climate, severe thunderstorms and tornadoes will remain a threat to the city and its Public Schools. The vulnerability of the jurisdictions is considered high. The absence of recent, reported "direct hits" on the community does not mean the threat has been reduced. Tornado events are a certainty. Efforts to educate the public and prepare for and fortify the city and its Public Schools against a tornado event should continue to be a priority. Improved building technologies, advances in public communication capabilities, and opportunities for collaboration among community agencies should remain prominent in the planning and response communities' endeavors.

Data Limitations

There are many intangibles in tornado spotting. Low hanging "scud" clouds may be mistaken for a lowering funnel. Tornadoes are frequently reported more often near inhabited areas and major highways, due to the greater likelihood of people being present when a tornado appears that causes little or no damage. In addition, there is frequently disagreement on whether damage has been caused by a tornado or severe straight-line winds or downdrafts. Tornado frequency and damage statistics may be skewed by these factors.

4.2.7 Sources

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www.srh.noaa.gov/tsa/weather-events/may10_2008/PicherTornado.htm

National Weather Service, Norman OK, at website: www.srh.noaa.gov/oun/tornadodata/ok/

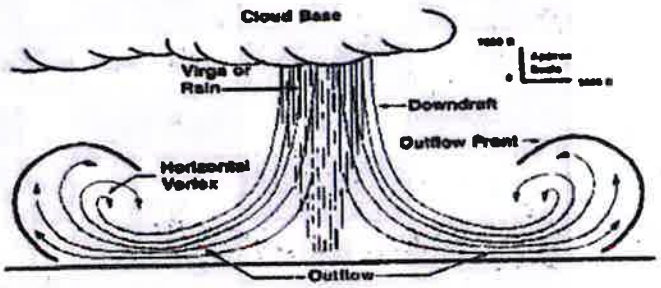
Wikipedia report, authored by the Storm Prediction Center, at website: http://en.wikipedia.org/wiki/Greensburg,_Kansas

4.3 High Winds

Wind is defined as 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. Winds vary from zero at ground level to 200 mph in the upper atmospheric jet stream at 6 to 8 miles above the earth's surface.

The mean annual wind speed in the mainland United States is reported by FEMA to be 8 to 12 mph, with frequent speeds of 50 mph and occasional wind speeds of greater than 70 mph. Tropical cyclone winds along coastal areas from Texas to Maine may exceed 100 mph.

Figure 4–12: Microburst Diagram



A Microburst is a particularly violent type of downburst that can generate winds up to 168 mph

4.3.1 Hazard Profile

Location

The City of McAlester and McAlester Public Schools are at risk from damaging winds. Winds are always part of severe storms, but do not have to accompany a storm to be dangerous.

Down-slope windstorms, straight-line winds, derechoes (a widespread and long-lived, violent straight-line windstorm that is associated with a fast-moving band of severe thunderstorms), and microbursts (a very localized column of sinking air, producing damaging straight-line winds that are similar to but distinguishable from tornadoes) can all cause death, injury, and property and crop damage.

Measurement

While there are several scales that measure wind speeds besides the Fujita and Enhanced Fujita scales (described in the preceding Tornado section), the most appropriate for the purposes of Oklahoma plans would be the Beaufort Scale of Wind Strength.

The city of McAlester may experience a wind force of 9-12, as measured on the Beaufort Scale shown in Table 4-14.

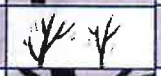
Extent

Wind is the fourth-leading cause of property damage. From 1981 to 1990, the insurance industry spent

High winds generated by Oklahoma's spring and autumn storms can be devastating to older homes and mobile homes

nearly $23 billion on wind-related catastrophic events. Out of the primary sources of high winds, severe local windstorms accounted for 51.3% of the expenditures. See Table 4-15 for data related to casualties and damages caused by high wind events.

Table 4–14: Beaufort Scale of Wind Strength

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Source: Huler, Scott (2004). Defining the Wind: The Beaufort Scale

Cladding damage, especially glass damage, is not only costly but threatens pedestrian safety, increases damage to interior contents, and lengthens business downtime.

In Oklahoma, wind events are generally associated with the huge convective thunderstorms that move through the region in the spring and fall months generating tornadoes, downbursts and high winds. It is not unusual for winds produced by these storms to reach speeds of 80-100 mph, with winds of 50-70 mph being commonplace. Downbursts, like the one that struck Tulsa on June 6, 2006, can topple trees, damage houses and power lines, and break up sidewalks and streets.

Frequency

According to NCDC data, between 1995 and 2009, McAlester experienced 33 wind events with velocities up to 80 mph, with damage reported for 14 of the events. Based on this data, McAlester can expect to be hit by about two high wind events per year with an average velocity 60 mph, and about one event per year that results in property damage.

Impact

The impact of this hazard can result in damage to homes, businesses, infrastructure and people and can cause loss of income to both individuals and communities. According to NCDC data, 33 high wind events did $336,000 damage in McAlester between 1995 and 2009. Based on this data, McAlester can expect two high wind events per year that do an average $10,181 per event. The most damaging event on record was a combination of 70-mph wind and golf ball-size hail, which did an estimated $100,000 damage on April 9, 2008.

A downburst did extensive damage in Midtown Tulsa on June 6, 2006

Severity

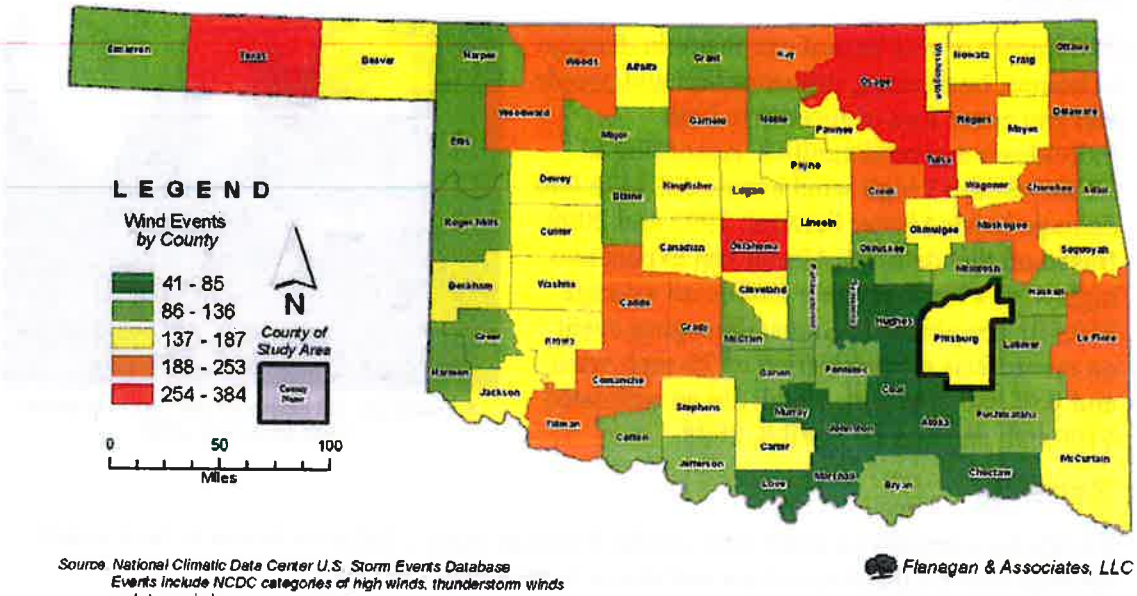
McAlester considers a wind force on the Beaufort Scale of nine or below to be a minor severity and a wind force of ten and above to be a major severity.

4.3.2 History/Previous Occurrences

Since 1995, Pittsburg County has experienced 147 high wind events, almost all connected to thunderstorm activity, which injured 13 people and did a total of $1 million in damage. The highest wind speeds recorded in the county were 101-mph at Quinton on June 8, 1998, and 100-mph at Canadian on June 10, 2009. McAlester has had 14 reported thunderstorm/high wind events between 1995 and 2009, with wind velocities ranging between 60 and 80 mph, and reported damage of $336,000. The highest winds recorded at McAlester were 80 mph on May 7, 2008, and June 10, 2009.

- **May 23, 1995-** Thunderstorm winds estimated at 70 mph did $50,000 damage at McAlester.
- **July 20, 1995-** 70-mph winds downed power lines near McAlester.
- **May 26, 1997-** High wind did $80,000 damage 6 miles north of McAlester.
- **March 19, 1998-** A large radio tower was blown over 3 miles northeast of McAlester. $3,000 damage was reported.
- **July 24, 1998-** An isolated thunderstorm produced an apparent downburst wind on the north side of McAlester, blowing down several trees and privacy fences.
- **November 9, 1998-** Severe thunderstorms generated 80-mph winds across eastern Oklahoma. McAlester reported wind speeds of 60 mph. Damage was reported in the High Hill area, where several barns and roofs were damaged, a piece of tin was driven 4 inches into a tree, and a backyard trampoline was blown away.
- **June 29, 1999-** Two trees were blown over in the Peaceable and Tanglewood neighborhoods just outside McAlester. A tree and a power line were blown down in the High Hill area. Damage was estimated at $2,600.
- **March 9, 2006-** Thunderstorm winds estimated at 60 mph damaged an awning and lamp poles in McAlester. Damage was $5,000.

Figure 4–13: High Wind Events in Oklahoma from 1989-2009



Source: National Climatic Data Center U.S. Storm Events Database
Events include NCDC categories of high winds, thunderstorm winds and storm winds.

Flanagan & Associates, LLC

- **April 9, 2008-** Thunderstorm winds estimated at 70 mph and golf ball size hail broke windows and damaged roofs, signage and trees throughout McAlester. Damage was estimated at $100,000.
- **May 7, 2008-** Thunderstorm winds of 80 mph blew the roof off a mobile home and damaged a storage shed 4 miles west of McAlester. Damage was $25,000.
- **June 13, 2009-** 75-mph winds blew down power lines at McAlester, causing electric power to be cut off for about half of the city. About 22 hours later, the same day, 70-mph wind damaged signs of several businesses. Losses were estimated at $20,000.

Table 4–15: High Wind Events in McAlester from 1995 thru 2009

Location	Events	Deaths	Injuries	Damage Events	Property Damages
McAlester	33	0	0	14	$336,000
Pittsburg County	147	0	13	48	$1,004,000
Oklahoma	9,174	8	196	2,525	$959,603,000

Source: NOAA National Climatic Data Center http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Probability of Future Events

With 33 events recorded within the City of McAlester in a 15-year period, and 14 of those producing reported economic damages, it is apparent that high winds are a common event, and the City of McAlester and McAlester Public Schools can expect of 2.35 events a year, with one event resulting in economic loss. Although not common in high wind events, injuries are possible, but deaths unlikely.

McAlester and McAlester Public Schools have a high probability of a future high wind event.

4.3.3 Vulnerability

The Midwest is especially at risk from high winds because of the powerful thunderstorms that frequent the region.

Population

The people most vulnerable to high wind-related deaths, injuries, and property damage are those residing in mobile homes and deteriorating or poorly constructed homes. Refer to Figure 1-7 for Mobile Home Park Locations. However, those participating in outdoor activities in high-risk weather conditions are at risk from wind-driven debris and falling or collapsing structures. Also at increased risk are those operating motor vehicles during high-wind events. Higher profile vehicles (RV's, full-sized vans, semi's, etc.) can be blown over during strong wind events, and smaller, lower profile vehicles can be moved from their designated lane of travel. It should be noted that anyone operating a vehicle at highway speeds during a sudden burst of high winds is at risk of losing control of their vehicle.

Structures/Buildings

Property damage from windstorms is increasing due to a variety of factors. Manufactured housing, which is becoming more common, provides less resistance to wind than conventional construction. Not all states have uniform building codes for wind-resistant construction. Inferior construction practices result in buildings being more vulnerable to high winds.

The deteriorating condition of older homes and the increased use of aluminum-clad mobile homes will likely cause the impacts of wind hazards to increase. The general design and construction of buildings in many high wind zones do not fully consider wind resistance and its importance to survival. Near-surface winds and associated pressure effects can cause walls, doors, windows, roofs, and structural components to fail.

In particular, certain types of buildings, such as glass-clad office buildings, present increased vulnerability, as reported in *Performance of Glass Cladding of High Rise Buildings in Hurricane Katrina.*

The glass-clad Bank One Tower, Fort Worth TX, following the March 2000 storms. (Photo by Doug Smith, AAWE)

Critical Facilities

All critical facilities within the City of McAlester and McAlester Public Schools should be considered vulnerable to the effects of a high wind event. Structural integrity may be compromised if these are in the direct path of the storm, in addition to any secondary impacts, such as power disruption, water damage from accompanying rain, injury to workers/residents, etc The City of McAlester's critical facilities are listed in Table 1-6,

and are mapped in Figure 1–10. It should be noted that none of McAlester's public schools are equipped with a backup generator.

Infrastructure

Water Treatment – Most significant effect during a high wind event would be the loss of electrical power. The City of McAlester's water treatment plant has backup generation.

Wastewater Treatment – The most significant threat to the operation of McAlester's wastewater treatment plants during a high wind event would be power outages. McAlester's two treatment plants have backup generators.

Utilities – The primary utility providers for the City of McAlester and McAlester Public Schools is AEP/PSO (electricity) and Reliant Energy/Arkla Gas (natural gas). The service stations and substations for both providers would be vulnerable to damage from a high wind event. **Electricity:** During a high wind event, AEP/PSO could experience any combination of the following challenges in meeting the needs of McAlester's jurisdictions: destruction of distribution and transmission poles, downed broken power lines, danger to workers derived from downed power lines, and fallen debris from trees or insufficient field and/or office staff to effectively handle the workload. **Gas:** During a high wind event, Reliant Energy/Arkla Gas could experience a variety of challenges in meeting the needs of McAlester's jurisdictions: falling power lines or tree debris, inaccessibility to underground gas meters due to fallen debris, downed power lines, extreme temperatures, and insufficient field and/or office staff to effectively handle workload generated by such an event.

Transportation Systems (Highways, Public Transportation, Railway, Airports) – Fallen trees, limbs and power lines can block streets, highways and railroads. High wind can also result in damage to McAlester airport facilities and aircraft, as well as interrupt normal operations. Two accidents at McAlester airport in recent years have been attributed to wind gusts: in 1999, a hot air balloon was forced down by thunderstorm winds and bounced on landing, and in 1998 gusting winds caused an airplane to bounce on landing and catch a wheel on a fence wire. McAlester Municipal Airport is not equipped with a backup generator, so is vulnerable to electrical outages.

Emergency Services- Fire, Police and Medical services are all at similar risk to the secondary effects of a high wind event, such as downed power lines or trees blocking city streets and limiting access to affected areas.

4.3.4 High Wind Scenario

The microburst in Tulsa OK on June 6, 2006, at 4:45 am, with winds estimated at over 85 mph, was a well documented event, and could be considered a worst-case scenario for a high wind event anywhere in Pittsburg County.

In that event, while it only lasted for minutes, the Tulsa County Fairgrounds received an estimated $2.5 million in damage. Two nearby churches experienced substantial roof damage, an estimated 1,420 homes experienced varying degrees of damage, primarily to roofs/roofing material, and trees were uprooted destroying sidewalks/driveways. 13,000 customers were without power at the peak of the event, and four people were transported to the hospital for treatment of minor injuries.

Wind speeds in this event would have been the equivalent of an F-1 tornado with velocities in the F-0 range on the perimeter. Damages encompassed approximately 2 sq. mi., with the greatest damage in a ½ sq. mi area near the center of the downburst. Residential properties affected consisted predominately of 1930's – 1950's construction.

By laying this storm footprint on a predominantly residential area in McAlester, damages detailed on Table 4-16 could be expected. In addition, expenses on infrastructure in the scenario could be similar to the City of Tulsa figures listed in Table 4-17:

Approximately 6,786 cubic yards of debris from an affected 1,420 homes was picked up by the City. This breaks down to approximately $159.68 per affected home in infrastructure expense and 4.77 cubic yards of debris per affected home.

Four minor injuries were reported for this event, none requiring hospitalization. The economic value of these injuries would be $6,240, or $4.39 per affected residence.

At the height of the Tulsa event, an estimated 13,000 customers were without power; by late in the day of the event, that number was down to 10,000; approximately 700 remained without electricity the following day, with full restoration two days after the event. Based on this rate of restoration, the economic value of the loss of power for these customers would be estimated at $1.64 million. (Records for the actual Rate of Restoration for the actual event were unavailable, so this was estimated based on periodic reports located in different sources.)

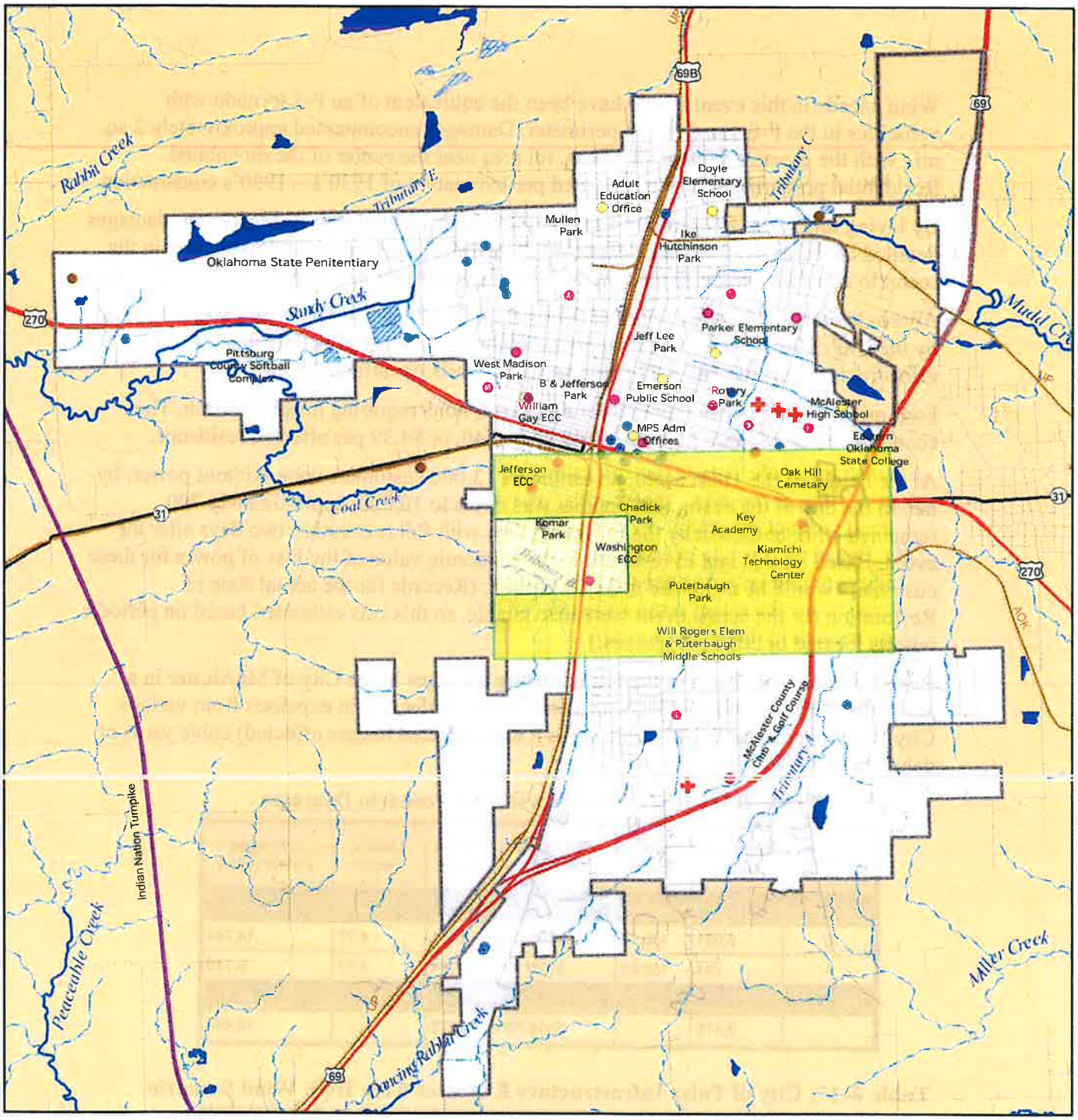
Based on these calculations, the infrastructure damages in the City of McAlester in a similar scenario would be: ($159.68 x total houses affected) in expenses from various City Departments, and (4.77 cubic yards x total affected houses affected) cubic yards of debris to be collected.

Table 4–16: High Wind Worst-Case Scenario Damages

F-Scale	Structure Count	Damage Factor	Averaged Damage	Parcel Count	Debris Factor	Averaged Debris (yds.)
Structures (from McAlester Planimetric Data)						
0	3,091	159.68	$493,571	3,091	4.77	14,744
1	784	159.68	$125,189	784	4.77	3,740
Totals						
	3,875		$618,760	3,875		18,484

Table 4–17: City of Tulsa Infrastructure Expenses from High Wind Scenario

Department	Expenses
Tulsa Police Department	$3,000 (overtime)
Tulsa Fire Department	$15,662 (overtime for 108 personnel logging 533 overtime hours) + $1,000 (equipment and materials)
Tulsa Public Works	$99,400 (vegetation & drainage)
Street Maintenance	$104,720 (labor and equipment)
Traffic & Engineering	$3,115
TOTAL	$226,897



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.5 1

Figure 4-14

City of McAlester

High Wind Scenario

4.3.5 Future Trends

All potential development areas in the City of McAlester are equally at risk from high-wind events, with the following considerations.

Population

As fuel costs continue to rise, more people may turn to lighter-weight vehicles for transportation both in the city and on the highways. Studies have yet to correlate the increase in risk associated with driving these more fuel efficient yet lighter vehicles in dangerous weather conditions, but that possibility certainly merits close monitoring.

Structures/Buildings

Construction materials and debris can easily become flying objects during a high-wind event. Construction companies and crews should be cautioned to exercise care in securing apparatus and supplies that could become wind-borne during thunderstorms. Following Hurricane Alicia, a group of glass distributors determined that more than 80% of glass breakage was caused by wind-borne debris. Sources of debris include roof gravel, construction debris, broken glass and insufficiently secured rooftop appurtenances.

According to a report on "Performance of building cladding in urban environments under extreme winds", close observation often reveals large areas of pits, nicks, and scratches indicative of wind borne debris impact. Although some abraded windows remain completely intact, they are eventually replaced because their decreased glass strength could result in poor performance in future storms.

Critical Facilities

As the threat from the effects of high wind events themselves cannot be eliminated, critical facilities undergoing expansion, renovation or rebuilding should consider the use of wind-resistant construction materials and techniques. The addition of reinforced exterior materials such as windows, doors and siding, can improve the safety of these facilities. Additionally, measures to reduce secondary effects should also be implemented. Secondary effects include compromised structural integrity, broken windows/doors from wind-strewn debris, water damage from accompanying rains, power interruptions/surges, and communication interruption from lightning or wind damage.

Infrastructure

To minimize the impact of a wind event on utility service, consideration should be given to providing underground conduits for utility lines, keeping vegetation well trimmed (to limit falling debris), and ensuring there are multiple access routes to all areas for emergency services vehicles.

4.3.6 Conclusions

Due to McAlester's location and climate, severe thunderstorms and the high winds they produce will remain a threat to its jurisdictions. Future thunderstorm winds and downbursts are certain. The City of McAlester and McAlester Public Schools are considered to have a High vulnerability to the High Wind hazard. Improved building technologies, advances in public communication capabilities, and opportunities for

collaboration among community agencies should remain prominent in the planning and response communities' endeavors.

Data Limitations

In many cases, tornadoes and high winds occur during the same storm event and their impacts are difficult to distinguish. In some cases, unless there is direct observation, it may never be known whether damage was produced by a tornado or a downburst. This Section should be read and analyzed in conjunction with the Tornado section.

4.3.7 Sources

NCDC Storm Event Database, at Web address: www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms. National Climatic Data Center.

National Weather Service: Office of Climate, Water, and Weather Services, at Web address: http://www.nws.noaa.gov/om/hazstats.shtml.

Mighty Thunderstorm hits town (6/7/06) Tulsa World at www.tulsaworld.com.

"Performance of building cladding in urban environments under extreme winds" by Tiphaine Williams and Ahsan Kareem of NatHaz Modeling Lab, University of Notre Dame

Bashor, Rachel and Kareem, Alisan. *Performance of Glass Cladding of High Rise Buildings in Hurricane Katrina.* Newsletter of American Association for Wind Engineering, December 2006. Also on Website: www.aawe.org.

4.4 Lightning

Lightning is generated by the buildup of charged ions in a thundercloud. When the buildup interacts with the best-conducting object or surface on the ground, the result is a discharge of a lightning bolt. Thunder is the sound of the shock wave produced by the rapid heating and cooling of the air near the lightning bolt. The air in the channel of a lightning strike reaches temperatures higher than 50,000 degrees Fahrenheit.

4.4.1 Hazard Profile

Lightning is the most constant and widespread threat to people and property during the thunderstorm season. According to National Oceanic and Atmospheric Administration (NOAA) studies, an average of 44 people per year were killed by lightning between 1998 and 2007 in the United States. From an article in the *TMCNET Newsletter* dated September 14, 2006, "Lightning is responsible for more than $5 billion in total insurance industry losses annually, according to Hartford Insurance Co."

Lightning can strike 10 miles out in front of an advancing rain column

When a person is struck by lightning serious burns or death are obvious outcomes.

Fire is another potential outcome from a cloud-to-ground lightning strike. During 2002-2004 U.S. fire departments responded annually to about 31,000 fires caused by lightning with $213,000,000 in direct property damages.(Source: NFPA Report, January 2008.) The period 2000-2006 showed 12,000 wild land fires started by lightning per year. This amounts to an average of 5.2 million acres annually. (Source: National Interagency Fire Center, 2007).

Lightning strikes can also cause high-voltage power surges that can seriously damage equipment and valuable data if surge protection devices are not installed. Property damage from power surges and resulting fires can destroy not only the electronics in private homes, but also unprotected equipment located in the business sector and critical facilities in a community. Some 30% of all power outages annually are lightning-related, with total costs approaching $1 billion dollars. *(Source: Ralph Bernstein, EPRI; Diels, et al (1997))*

Location

Lightning can strike ten miles out from the rain column, and lightning deaths often occur under a clear sky ahead of the storm. This is largely because people wait until the last minute to seek shelter – not fully comprehending the true danger of lightning.

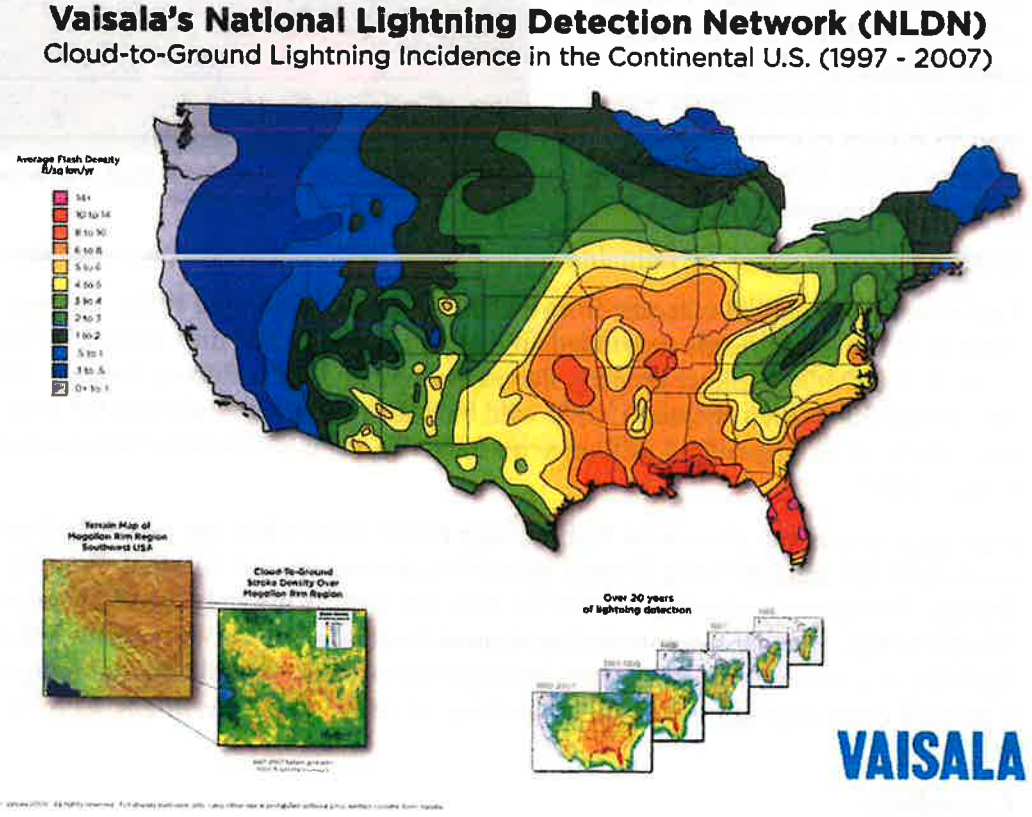
As lightning is a by-product of thunderstorms, the entire jurisdictions of the City of McAlester and McAlester Public Schools are subject to the exposure and effects of lighting events.

Measurement

Lightning can be measured in a variety of ways: lightning flash frequency, flash intensity, and lightning impacts. One method, that is described below is to utilize the National Lightning Detection Networks information from VAISALA to produce the free lightning explorer on the map at http://www.lightningstorm.com/explorer.html.

The U.S. National Lightning Detection Network has some 105 antennae connected to a central processor that records the time, polarity, signal strength, and number of strokes of each cloud-to-ground lightning flash detected over the United States. A combination of time of arrival and direction finding technology is used to locate the flash. Depending on the location within the network, VAISALA claims a location accuracy of a few km, with a detection probability greater than 60%. The flash time is accurate to better than 2 milliseconds.

Figure 4–15: Vaisala Cloud-to-Ground Lightning Incidence (Flash Density) Map



The 15-minute lightning product is made by binning the number of flashes that occur over a 15 minute period to a pixel. A pixel is 0.0718954 degrees (latitude) by 0.0765027 degrees (longitude) (approximately 8 km by 8 km). The grid consists of 459 pixels in the north-south direction and 915 pixels in the east-west direction. Lightning flash values can

range from 0-254. A value of 255 denotes that 255 or more flashes occurred in the pixel during the 15-minute period. (Note: the maximum pixel value observed is about 100).

A daily summary is also produced tallying the number of flashes that occurred in each pixel during a 24 hr period (00 UTC to 00 UTC). The binned values are scaled by 5, such that a value of 1 corresponds to 1-5 flashes, 2 from 6-10, etc. A value of 255 indicates more than 1270 flashes occurred in the pixel over the 24-hr period.

Both the 15 minute and daily products are generated in real time and the annotation (in the hdf file) identifies files run in real time. Missing data occurs in the real-time data, so the raw data file is checked for completeness and data gaps are filled. The products (daily and 15 minute) are then reprocessed and the annotation changed to denote that the files have been quality assured.

Extent

Pittsburg County has reported 1 lightning event between 1995 and 2009 that resulted in $15,000 in damage. This event occurred in McAlester, as did the $15,000 damage. It is likely that there were many unreported lightning events producing unreported damage. Given what data exists, the City of McAlester and McAlester Public Schools can expect a damaging lightning strike once every 15 years, which does approximately $15,000 damage. Although the entire community of McAlester is at risk from lightning, the probable extent of a damaging strike depends upon the type of structure that is hit, the age, condition and density of structures in the strike area, the community's fire response capability and the presence or absence of lightning warning and protection systems.

Frequency

National Geographic reports that lightning strikes the surface of the earth approximately 100 times every second. The National Lightning Detection Network states researchers have typically defined a flash as consisting of all cloud-to-ground discharges which occur within 10 km of each other within a one-second interval. In a report released by the NLDN in 2006, for the time period between 1996 and 2005, Oklahoma ranked 9th in the U.S. for average lightning flashes per year (966,295 flashes/year), which represents an average of 5.3 lightning flashes per square kilometer—about the number estimated by the Vaisala Scale.

According to the Vaisala Flash Density Map, Figure 4-16, the City of McAlester and McAlester Public Schools may experience between 6 and 8 lightning flashes per sq km per year.

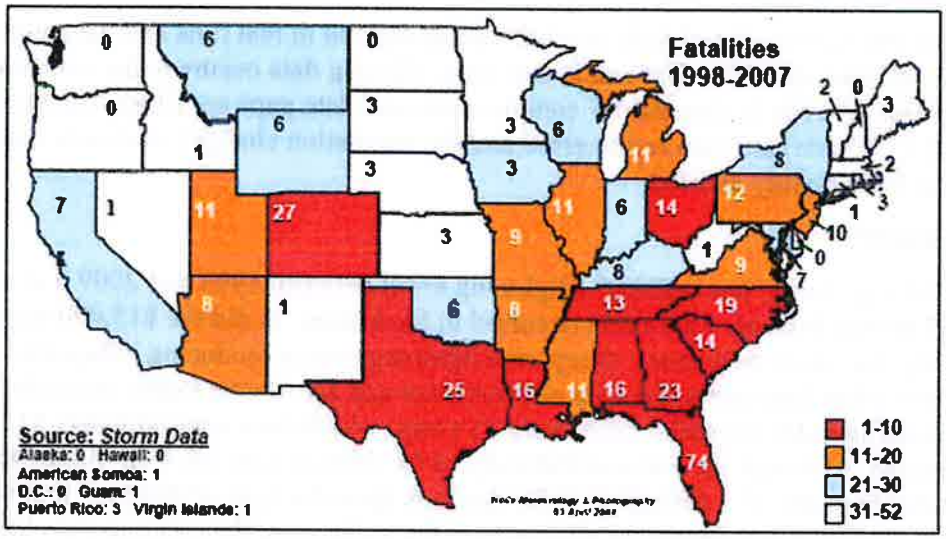
Impact

The impact of this hazard can include people displaced from their homes, businesses being closed, and financial loss due to urban fire, wildfire, power outages, and damaged electronic equipment.

Lightning casualties and damages increase gradually through the spring when thunderstorm season begins for most of the country, and peak during the summer months. The months most notorious for lightning incidents are June (21%), July (30%) and August (22%). The most injurious lightning strikes have been shown to occur on Sundays, Wednesdays and Saturdays between the hours of 12:00 noon and 6:00 pm.

On average, only 20% of lightning strike victims die from their injuries. However, injuries to survivors often lead to permanent disabilities. Seventy percent of lightning strike victims suffer from serious long-term effects, which include memory loss, attention deficits, sleep disturbance, numbness, dizziness, stiffness in joints, irritability, fatigue, weakness, muscle spasms, depression, and an inability to sit for long periods.

Figure 4–16: Lightning Deaths by State 1998-2007

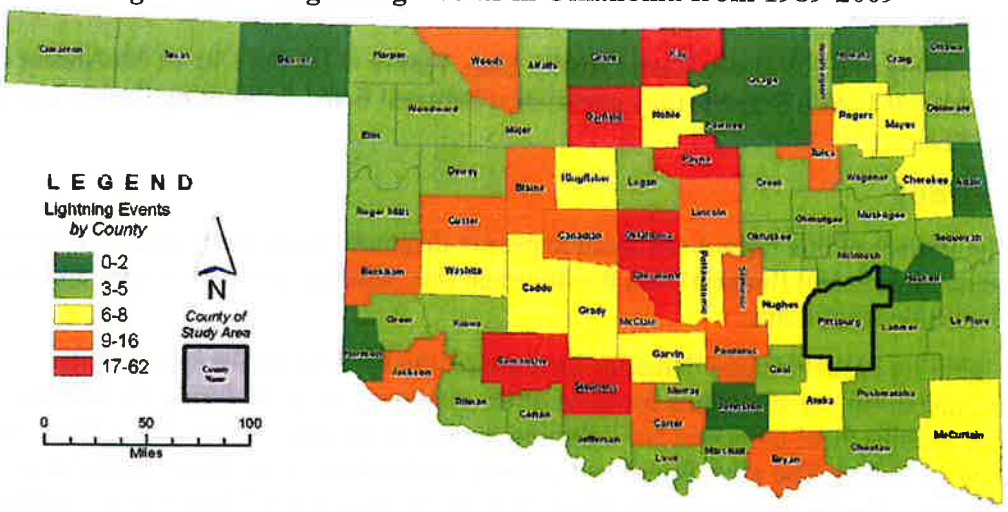


Severity

McAlester and McAlester Public Schools consider a minor severity to be a lightning strike that does not cause bodily injury or causes less than $1,000 in damages; a major severity event is considered a lightning strike that causes bodily injury or more than $1,000 in damage. The City of McAlester may experience lightning flashes between 6 and 8 per sq km per year, as shown on the Vaisala Scale.

4.4.2 History/Previous Occurrences

Figure 4–17: Lightning Events in Oklahoma from 1989-2009



In 2009, there were 31 deaths from lightning strikes in the United States. Florida was hardest hit with 5 deaths, followed by Texas and North Carolina with 3, and California, New York and Minnesota with 2.

Between 2000 and 2006 it was reported that an average of 12,000 wildland fires were started by lightning each year. This amounts to an average of 5.2 million acres burned annually. In 2005, a lightning-caused methane gas explosion in West Virginia killed twelve miners.

According to the National Climatic Data Center, between 1995 and 2009, there were 374 lightning events reported in the state of Oklahoma, resulting in 11 deaths, 76 injuries and $26 million in damages. In that same time period, Pittsburg County experienced 1 event with no deaths or injuries, and $15,000 in damages.

- **June 29, 1999** - Lightning ignited a fire that gutted the attic of a home, resulting in $15,000 damage.

Table 4–18: Casualties and Damages Caused by Lightning from 1995 thru 2009

Source: Storm Data

Location	Events	Fatalities	Injuries	Damages
McAlester	1	0	0	$15,000
Pittsburg County	1	0	0	$15,000
Oklahoma	374	11	76	$26,077,000

Probability/Future Events

Oklahoma, Pittsburg County, the City of McAlester and McAlester Public Schools are all subject to frequent thunderstorms and convective weather patterns, and are therefore all vulnerable to lightning, which is a constant and widespread threat during the thunderstorm season. Future lightning strikes within the jurisdictions of McAlester are certain, but their location and impacts are unpredictable.

McAlester and McAlester Public Schools have a moderate probability of a future lightning event.

4.4.3 Vulnerability

Population

Table 4–19: Locations of Injurious Lightning Strikes

Location	Percent
Not reported	40
Open fields and recreation areas (not golf courses)	27
Under trees (not golf courses)	14
Water related (boating, fishing, swimming)	8
Golfing and on a golf course under trees	5
Heavy equipment and machinery related	3
Telephone related	2.4
Radio, transmitter and antenna related	0.6

Anyone outside during a thunderstorm is exposed to and at risk from lightning. More people are killed by lightning strikes while participating in recreation than any other activity, source, or location. The next largest group of fatalities involves people under trees, followed by those in proximity to bodies of water. Other common lightning strike victims are those involved in agricultural activity, telephone users, and people near radios and antennas.

Structures/Buildings

Because the facilities of the City of McAlester and McAlester Public Schools are visited by frequent thunderstorms and convective weather patterns, their vulnerability to lightning is a constant and widespread during the thunderstorm season. Both jurisdictions are at risk to lightning-caused fires, damages and casualties.

Critical Facilities

All critical facilities within McAlester's jurisdictions should be considered vulnerable to the effects of a lightning event. Power disruption and potential destruction of electronic equipment (computers, vital medical equipment, communication equipment, data storage, etc.) should be considered a primary threat to critical facilities. A list of the critical facilities in McAlester can be found in Table 1-6. It should be noted that none of McAlester's public schools are equipped with a backup generator.

Infrastructure

Lightning-caused problems are one of the most common troubles faced by American businesses. A recent study by Carnegie-Mellon University showed that 33% of U.S. businesses are affected by lightning, and that more businesses are impacted by lightning storms than by floods, fires, explosions, hurricanes, earthquakes, and violence.

Electronic equipment, from computers to enterprise-level communications systems, can be seriously damaged by power surges from lightning strikes. Surge protection should be included in any electronic system to minimize the risk of damage from lightning. In addition, lightning warning/detection systems (such as ThorGuard© which is utilized by Northeastern State University) should be included in protection plans for critical infrastructure components of the City of McAlester and McAlester Public Schools. For additional information about lightning detection/alert systems, see Appendix B, Section B.2.10 and B.4.8.

Water Treatment – The most significant effect from a lightning event would be the loss of electrical power and damage to electrical equipment at the water treatment plant at Lake Talawanda. Water plants often experience power outages related to lightning and thunderstorms, but the outages are usually of short duration. McAlester's water treatment facility has a backup generator.

Wastewater Treatment – The most significant threat to the operation of McAlester's East and West wastewater treatment facilities during a lightning event would be power outages. Both plants and lift stations have backup generators.

Utilities- The primary utility providers for McAlester's jurisdictions are AEP/PSO (electricity) and Reliant Energy/Arkla Gas (natural gas). The service stations and substations for both of these providers are vulnerable to damage from a lightning event.

Electricity: During a lightning event, providers of electrical service could experience any combination of the following challenges in meeting the needs of McAlester jurisdictions: Damage to transformers or other transmission components, downed broken power lines, danger to workers derived from downed power lines, and insufficient field and/or office staff to effectively handle the workload. **Gas**: During a lightning event, gas service to a community could be hampered by downed power lines, electric power outages, and insufficient field and/or office staff.

Transportation Systems (Highways, Public Transportation, Railway, Airports) – Transportations systems would experience the same vulnerability to lightning events as other city facilities, including local electrical blackouts, traffic signal outages over wide areas, communication outages, etc. McAlester Municipal Airport is not equipped with a backup generator.

Emergency Services- Fire, Police and Medical services are all vulnerable to a major effect of a lightning event: the interruption of control and communication capabilities, 911 service, and damaged or destroyed electronic equipment. Secondary impacts include downed power lines and wildfires, both of which can hamper access to neighborhoods and block highway traffic.

4.4.4 Lightning Scenario

A graphic scenario demonstrating the effects of a major lightning event for this jurisdiction would be difficult to assemble, and even more difficult to analyze due to the sporadic and erratic behavior of lightning itself. However, it is possible to examine recent major events involving lightning strikes and parallel these to similar situations for the City of McAlester and McAlester Public Schools.

A similar lightning detector in use at a Bonaire GA football game had prompted officials to begin moving people off the field when lightning struck

Scenario 1: Lightning Strike on Public Building

On October 14, 2007, the city of Holdenville, OK (est. 2007 population 4,582, located in neighboring Hughes County) experienced a thunderstorm that was accompanied by lightning that struck the City Hall building, crippling the community's 911 system. While repairs were being made, those requiring emergency assistance were asked to call a local 7-digit phone number.

In addition to the 911 system, the Holdenville Police Department reported major damage to its radio system. Damages reported were approximately $26,600. This was not the first time Holdenville had to contend with lightning damages. Over a period of 14 months (March 29, 2007 through May 27, 2008), the city experienced three different strikes resulting in damages in excess of $36,000.

Scenario 2: Lightning Strikes at Sporting Events

The most frequently reported incidents involving injuries and/or deaths from lightning strikes occur during common outdoor activities such as hunting, swimming, and outdoor team events such as soccer and football. According to the website "struckbylightning.org", by mid-October 2009 there had been 36 fatalities and 245 injuries attributed to lightning strikes in the United States.

A second worst-case scenario for McAlester would involve participants in organized outdoor sporting event. Two events are exemplary of the lightning hazard.

During a football game in Bonaire Georgia, at approximately 3:30 pm, officials, who were using a hand-held lightning detector, decided to end the game when the detector went into alarm mode due to an approaching thunderstorm. They were in the process of moving players off the field when lightning struck. Thirteen individuals were injured, twelve sent to local hospitals, and one of the coaches remained in critical condition for several days.

A second event took place in Dorchester MA on July 20, 2008, also at approximately 3:30 pm. This time, the sporting event was a local soccer game. There were 10 injuries reported, four of them critical. Seven or eight of the players were knocked unconscious, and the injuries reported ranged from burns to cardiac conditions. The victims ranged in age from 13 to 41yrs, and all were males.

These two events are particularly pertinent to the McAlester area, as there are frequent outdoor gatherings for football, soccer and other sports.

In the McAlester area, football is a popular and widely promoted activity. Youth leagues begin early with flag football, and continue through junior high and high school. High school football is a competitive and highly attended social activity, and places a large number of people at risk during a lightning event.

In the football scenario, it is assumed that 13 people are injured, with 12 being transported to the hospital. Assuming that those transported to the hospital are admitted overnight for observation (at the minimum), the economic value of the hospitalizations, according to "What is a Benefit", would be $187,200 (12 patients x $15,600 each). The economic value of lost wages, according to the same source, would be $21.16/hour per person. If it is assumed that one coach and one teacher are among those injured, and their time off work totaled 10 working days (the time frame noted for the injured coach in Georgia), total economic value of lost wages would be $3,385.60. These two costs represent a direct economic impact of $190,585.60.

In the second example, the soccer match, 10 people are injured, four of whom were critical. Injuries ranged from burns to cardiac-related issues. Utilizing the same method for calculating economic values, the cost of related hospitalizations for a similar event would be $156,000. There are several adult males injured, so the time lost from work would also be a factor. Assuming that one-half of those injured are employed, and the time away from their jobs average 10 days each, lost wages would be $8,464.00, bringing the total direct economic impact to $164,464.

4.4.5 Future Trends

Population

As the "baby-boomer" population moves into retirement, the number of people pursuing outdoor sports and/or social activities can be expected to increase. Ongoing efforts to educate citizens of McAlester and children at its Public Schools about the dangers associated with lightning should be continued. In addition, outdoor workers should be included in public education programs regarding the dangers of lightning.

Structures/Buildings

As new structures are built and existing ones renovated, actions to lessen the potential effects of lightning strikes should be considered. Installation of surge protectors for electricity and phone lines should be actively encouraged and utility companies urged to relocate above-ground utility lines underground.

Critical Facilities

As electronic technology continues to advance, the need to protect power sources supporting that technology should advance as well. Working with local utility companies to coordinate the relocation of above-ground utilities (phone, electricity, etc.) underground should be considered a top priority when new facilities are constructed or existing ones upgraded.

Infrastructure

Ensuring local government facilities are well protected against the potential effects of lightning strikes is an on-going endeavor. Investigating and implementing new technology as it becomes available will help ensure the continuity of operations at all levels. Particularly important is the protection of communication and control systems and the massive amounts of data they both generate and require for operation. The protection of these critical functions should be considered a priority in any future development plans.

4.4.6 Conclusions

Lightning is one of the most deadly and costly hazards in the United States. People working or recreating outside can have a false sense of security, thinking that they are safe because a storm front has not yet reached their location. In fact, lightning can strike 10 miles out from the rain column, putting people that are still in clear weather at risk. The general rule of safety is that anyone outside during a thunderstorm should take cover.

Electronic equipment, from personal computers to enterprise-level communications and control systems, can be seriously damaged by power surges from a lightning strike. Surge protection should be included in any electronic system to minimize the risk of damage from lightning.

In recent years, new technology has brought to the market many devices which communities and individuals can use to provide increased warning, better surge protection, and improved building strike protection.

Although the NCDC lists only one lightning strike for the City of McAlester between 1995 and 2009, because lightning is a random phenomenon, and the city experiences

several severe thunderstorms each year, accompanied by tornadoes, high winds, hail and lightning, the City of McAlester and McAlester Public Schools are considered at high risk from the lightning hazard.

Data Limitations

Accurate data on the effects of lightning events is difficult to obtain for several reasons. *Regarding injuries* – many survivors do not seek immediate medical care and only come to the attention of medical personnel when they seek care for effects of the shock that have not resolved by a few days after their injury. In addition, many lightning deaths and injuries are attributable to nervous system disruption with no visible signs of injury, and are consequently misdiagnosed as heart attacks or other ailments.

Regarding property damages – home and business owners often choose not to report lightning strikes or submit insurance claims in connection with their damages. Typically, the events that do get documented are the more widespread occurrences affecting several business/residential locations.

Regarding data collection – much of the data utilized is taken from newspaper accounts, so if budgets are cut or if people/structures affected by lightning do not make the news, they are not included in the larger pool of statistics.

4.4.7 Sources

eMedicine – Lightning Injuries: Article by Mary Ann Cooper at www.emedicine.com/emerg/TOPIC299.HTM

Lightning Fatalities, Injuries, and Damage Reports in the United States from 1959-1994. NOAA Technical Memorandum NWS SR-19, 1997 and at Web Address: http://www.nssl.noaa.gov/papers/techmemos/NWS_SR_193/techmemo_sr193.html.

Mulkins, Phil. "If you can hear thunder—find cover now!" *Tulsa World*, May 23, 2002.

Multi-Hazard Identification and Risk Assessment, p. 30. Federal Emergency Management Agency, 1977.

National Lightning Safety Institute, at Web address: http://www.lightningsafety.com/.

National Weather Service: Office of Climate, Water, and Weather Services, at Web address: http://www.nws.noaa.gov/om/hazstats.shtml.

NCDC Storm Event Database, at Web address: www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms. National Climatic Data Center.

"Securing the Supply of Electrical Services" by Jay Apt, Carnegie Mellon University

4.5 Hailstorm

A hailstorm is an outgrowth of a severe thunderstorm in which balls or irregularly shaped lumps of ice fall with rain. Extreme temperature differences from the ground upward into the jet stream produce strong updraft winds that cause hail formation. Hailstorms are usually considered "severe" when hail is larger than 1" and accompanied by winds greater than 58 miles per hour.

4.5.1 Hazard Profile

Hail can occur in any strong thunderstorm, which means that hail is a threat throughout the United States. Hail is one of the most destructive hazards to agricultural crops and animals, and the major natural cause of automobile damage.

Location

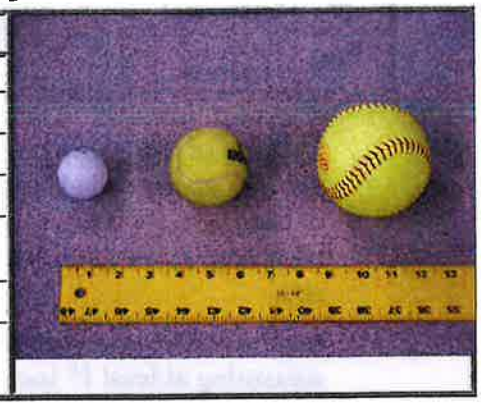
The states in the middle of the Great Plains, and particularly Oklahoma, are the most likely to have severe thunderstorms and have the most hail events. Oklahoma experiences an average of 602 hailstorms each year with hailstones measuring at least 1" inch in diameter. All buildings and agricultural areas in the City of McAlester and McAlester Public Schools are at risk from the hail hazard.

Measurement

Hailstones are typically measured by their diameter. The damages expected from a hail event are a function of the diameter of the hailstones and wind speed, or velocity. There have been numerous instances of hailstones reaching four inches in diameter, or grapefruit size, in Pittsburg County. When hailstones reach such dimensions, they can be extremely dangerous to property, agriculture and people caught outside without shelter. Hailstorms are usually considered "Destructive" when hail reaches golf ball size (1.6 to 2.0 inches in diameter) and accompanied by high winds.

Table 4–20: Common Measures and Descriptions of Hail

Hail Size	Description	Hail Size	Description
0.25 inch	Pea Size	1.75 inch	Golf Ball Size
0.50 inch	Mothball Size	2.00 inch	Hen Egg Size
0.75 inch	Dime/Penny Size	2.50 inch	Tennis Ball Size
0.88 inch	Nickel Size	2.75 inch	Baseball Size
1.00 inch (Severe Criteria)	Quarter Size	3.00 inch	Teacup Size
1.25 inch	Half Dollar Size	4.00 inch	Grapefruit Size
1.50 inch	Walnut or Ping Pong Ball Size	4.50 inch	Softball Size



Source: National Weather Service

Early in 2010, the National Weather Service changed the criteria for a severe thunderstorm alert from predicted winds in excess of 58 mph and hail in excess of ¾ inch to hail in excess of one inch in size. This was in response to the lack of observed damages from hail smaller than one inch and to decrease the number of watches and warnings for storms that ended up doing little or no damage.

Extent

The damages expected from a hail event are a function of the diameter of the hailstones and the wind speed, or hailstone velocity. As shown in the Combined NOAA/TORRO Hailstorm Intensity Scale, hail is considered "destructive" when it reaches 1.6 inches in diameter, or golf ball size. There has been one instance of hailstones reaching four inches in diameter, or softball size in Pittsburg County. The largest hailstone ever measured in the United States fell at Coffeyville, Kansas, on September 3, 1970: it weighed 1.67 pounds and measured 17.5 inches in circumference. When hailstones reach large dimensions, they can be extremely dangerous to property, agriculture and the vulnerable populations of the jurisdiction.

Table 4–21: Combined NOAA/TORRO Hailstorm Intensity Scales

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, 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 dented, brick walls pitted
H7	Very destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injury
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 and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

The size of hailstones is a direct function of the severity and size of a storm. High velocity updraft winds keep hail in suspension in thunderclouds. The greater the intensity of heating at the Earth's surface, the stronger the updraft will be. Higher temperatures relative to elevation result in increased suspension time, allowing hailstones to grow in size.

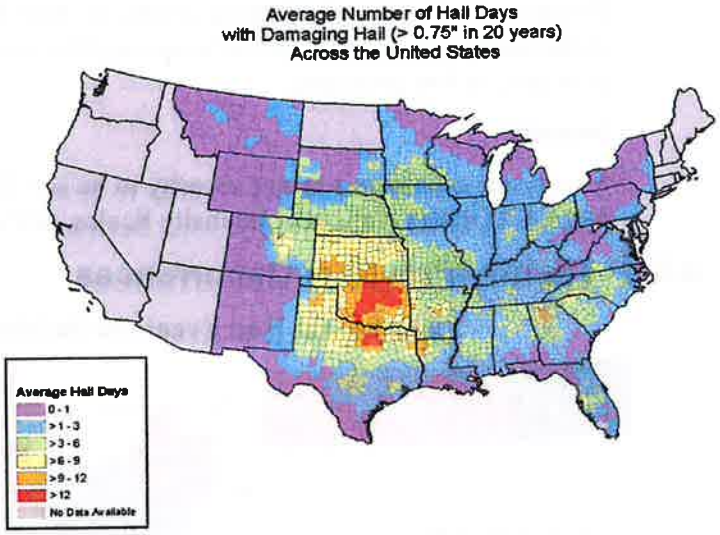
Between 1995 and 2009, McAlester experienced 24 severe hail events, with hailstones measuring at least 1" inch in diameter. Five of these events dropped destructive-size hail

1.75 inches in diameter. Total damage from these 24 hail events was $100,000—all of which resulted from a single storm that dropped 1.75-inch hail on April 9, 2008.

Frequency

Most localities within the United States from the Great Plains eastward experience hailstorms at least two or more days each year. The Great Plains, particularly the states of Oklahoma, Kansas and Texas, are most frequently affected by hailstorms. Figure 4-19 was developed through statistical analysis of hail reported by the National Severe Storm Laboratory from the early 1950's to the late 1990's by using a software program called CHAP that was developed by Haag Engineering in Dallas, TX. (see http://www.disastersafety.org/publications/view.asp?id=8854&cid=1085)

Figure 4–18: Average Number of Hail Storm Days



IBHS has defined "damaging hail" as any reported hail that is larger than 0.75" in diameter. This threshold was chosen because this is the commonly accepted size where damage to asphalt shingles is expected by the majority of hail experts in the country. Counties of Northern Texas and Southern Oklahoma can expect damaging hail to occur upward of 12-14 times every 20 years.

According to Figure 4-19 from the Institute for Business and Home Safety website (http://www.ibhs.org/images/research_library/383/USA_Hail.jpg), Pittsburg County experiences an average of 9-12 damaging hail days each year.

The McAlester jurisdiction experienced 50 hailstorms from 1995 through 2009. Based on this data, any specific location in the McAlester metropolitan area can expect to receive hail an average of two to three times each year. Hail has been reported in every month, with the highest frequency during the transitional months in the spring. The peak time of year falls right in the middle of that transition period, from mid-April to mid-May. Another small peak occurs in November, as the weather pattern transitions back into winter.

Impact

When hail hits, it can damage cars, shred roof coverings, and lead to water damaged ceilings, walls, floors, appliances, and personal possessions. Large hailstones can also cause serious bodily injury.

Multiple impacts of concurrent severe thunderstorm effects (high winds, tornadoes and hail) are very likely within the Great Plains region. About 2% of United States' crop production is damaged by hail each year, and in the Great Plains states damages have

sometimes reached 20%. Pittsburg County reported $150,000 in crop damage from hail between 1995 and 2009, all of it from a single event. In total, hail causes nearly $1 billion in property and crop damage each year. In 2005, there were more than 13,000 hail storms in the United States. According to Swiss Re, four out of the top 20 most costly insurance losses of 2005 were hail related.

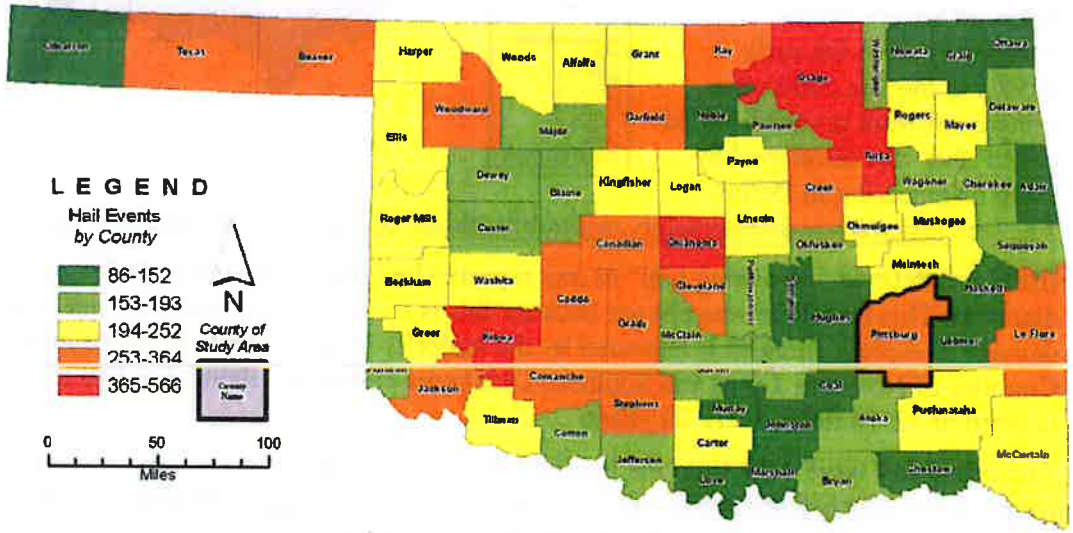
However the impact of this hazard remains mainly financial due to repairs to cars, roofs, walls and windows. The loss of crops and livestock can be devastating to farmers and the economy in lost revenues.

Severity

McAlester considers a minor severity to be an H2 or lower on the Combined NOAA/TORRO Hailstorm Intensity Scales, and a major severity to be an H3 or higher.

4.5.2 History/Previous Occurrences

Figure 4–19: Hail Events in Oklahoma from 1989-2009



Source: National Climatic Data Center U.S. Storm Events Database

Flanagan & Associates, LLC

In the state of Oklahoma there were 930 reported hail events in 2009. The largest reported hailstone was 4.5 inches in diameter (grapefruit- to softball-size) falling in Okesa, in Osage County. Property damage from hail in 2009 was $925,000. In 2008, a record year for hail damage, Oklahoma reported 1,204 hail events and property damage of $43 million. Almost all of this damage was from two hailstorms, one in Norman on November 5, 2008 ($40 million), and the other in Tulsa on April 8, 2008 ($1 million).

On June 1, 2008, a large storm system moved across Oklahoma, dropping hail in several locations. The most devastating reports came from Mannford, in Creek County. City officials estimated that every home in the community (approximately 1,100 homes) sustained some damage from hail stones ranging in size from golf balls to tennis balls. It was reported that approximately 600 homes had windows broken out and that every home suffered roof damage – with hailstones actually tearing through some of the roofs

and landing inside the homes. Between 1,000 and 1,500 vehicles also sustained heavy damage. Two non-life threatening hail-related injuries were also reported.

According to the National Climatic Data Center, Pittsburg County reported 230 hail events from 1995 through 2009, with 13 injuries and $475,000 in property damage. During the same time period, 50 hail events were reported for the McAlester jurisdiction, with $100,000 in property damage. These events are shown in Table 4-22, and selected events are summarized in the following paragraphs.

Table 4–22: Reported Casualties and Damages Caused by Hail from 1995 to 2009

Location	Events	Deaths	Injuries	Damage Events	Property Damage
McAlester	50	0	0	1	$100,000
Pittsburg County	230	0	13	9	$475,000
Oklahoma	6,019	0	2	236	$154,500,000

McAlester Hail Events

From 1995 through 2009, McAlester and McAlester Public Schools experienced a reported 50 hailstorm events. Some of the more recent and significant events are as follows:

- **May 26, 1997** – There were five reports of 1.0-inch hail falling at McAlester between 8:30 and 9:30 pm.
- **June 16, 1997** – There were multiple reports of hail 1.25 inches in diameter falling at McAlester, and 1.75-inch hail 3-4 miles north of the city between 7:30 and 8:00 pm.
- **April 6, 2003** – 1.75-inch hail fell 14 miles NE of McAlester.
- **April 25, 2005** – McAlester reported 1.25-inch hail at 8:37 pm.
- **March 31, 2008** – 1.25-inch hail fell at McAlester at noon.
- **April 9, 2008** – 1.75-inch hail was reported at McAlester, causing $100,000 in damage.

Probability/Future Events

As hail is a direct by-product of thunderstorm activity, and Oklahoma is subject to numerous severe storms each year, the jurisdictions of McAlester and McAlester Public Schools will continue to experience thunderstorms of varying severity with hail present in many of the events.

Based on history and previous occurrences from the past 15 years, the City of McAlester and McAlester Public Schools can expect to experience an average of 3.3 hail events each year, and have a high probability of a future hail event.

4.5.3 Vulnerability

Hailstorms occur in every state of the continental Unites States, but most frequently in the Great Plains during the late spring and early summer when the jet stream migrates northward. This period coincides with the Midwest's peak agricultural seasons for wheat,

corn, barley, oats and rye, tobacco and fruit trees. Long-stemmed vegetation is especially vulnerable to damage by hail impacts and winds.

Population

Hailstones can cause widespread damage to crops and automobiles and serious bodily injury

Given the climatic environment of Pittsburg County and McAlester, all demographic groups located within the jurisdiction are vulnerable to the effects and potential damage from hailstorm events. Of particularly high vulnerability are those engaged in farming and/or ranching activities, as crop damage is the highest percentage of reported hail damage. In addition, people engaging in outdoor recreational activities, such as soccer, golfing and camping, may find themselves in a situation where sufficient shelter is unavailable. In Oklahoma in recent years, an increasing percentage of property damage from hail is to cars, windows and roofs. A single event in Tulsa, lasting less than 20 minutes, did over $65 million in damage to automobiles, homes and businesses in South Tulsa and Jenks.

Structures/Buildings

As noted above, severe hailstorms can cause considerable damage to buildings, particularly roofs and windows. Oklahoma communities have a significant exposure to hailstorms, and virtually all buildings and crops in the region are at risk. The City of McAlester and McAlester Public Schools are no exception. Both jurisdictions have numerous buildings that are vulnerable to the damaging effects of hail.

Critical Facilities

All critical facilities in McAlester are vulnerable to the damaging effects of hail (for a complete list of City of McAlester critical facilities, see Table 1-6). While hail is unlikely to render a building non-operational, the accumulated damage from a severe storm can be significant.

Infrastructure

Water Treatment – It is not anticipated that a hail event would cause a major disruption in the normal operation of McAlester's Water Treatment Plant.

Wastewater Treatment – It is not anticipated that a hail event would cause a major disruption in the normal operation of McAlester's two wastewater treatment plants.

Utilities – The primary utility providers for McAlester's jurisdiction are AEP/PSO (electricity) and Reliant Energy/Arkla Gas (natural gas). Neither service would suffer a major disruption from a hailstorm event.

Transportation Systems (Highways, Public Transportation, Railway, Airports) – During a hail event, transportation vehicles, including school busses may sustain damage. If severe enough (such as the hail events of April 5, 2005 in Jenks and Tulsa, or on June 1, 2008 in Mannford) there could be some risk of serious damage to these vehicles. Aircraft on the runway at McAlester Municipal Airport could suffer damage during a significant hail event.

Emergency Services – Fire, Police and Medical service vehicles would all be similarly at risk to the damaging effects of a hail event, most likely body dents and broken windows and/or windshields.

4.5.4 Hail Scenario

Overview

As mentioned above, on Sunday June 1, 2008, the town of Mannford, OK (Creek County, approximately 85 miles NNW of McAlester) experienced a major hail event. The storm struck at approximately 9 am, and lasted for nearly 20 minutes, damaging virtually every home (approximately 1,100 homes). Nearly 600 homes had broken windows, and every home suffered roof damage – some so severe that the accompanying rain leaked inside causing further damage. Also damaged were between 1,000 and 1,500 vehicles. Two injuries were reported, neither requiring hospital admission.

The City of Mannford encompasses approximately 6.9 sq. miles, with an estimated housing density of 165 houses-condos/square mile (according to 2005 housing demographics). Considering the number of housing units reporting damage, this would indicate that the storm blanketed the entire city limits.

McAlester Comparison

By applying storm data from the Mannford event to housing density figures from McAlester, the projected impacts from a similar worst-case hailstorm can be developed for that jurisdiction.

According to 2000 US Census, the city of McAlester contained 466 houses/condos per square mile and an area of 15.8 square miles. Based on this information, a storm the size and severity of the June 1, 2008 event in Mannford would impact 3,215 residential structures in a major residential area within McAlester's city limits. With an estimated average repair cost of $4,500 per structure (damages ranging anywhere from a few windows and shingles, to several windows broken and/or destroyed and total roof replacement), total housing damages would be $14,467,500.

Comparing the housing density of Mannford to that of McAlester (165 vs. 466 units per square mile), it is noted that McAlester's density is approximately 2.8 times that of Mannford. Applying this increase to the number of vehicles potentially affected would mean that approximately 3,500 vehicles would likely sustain some form of damage.

Using average repair cost of $500 per vehicle (mostly broken windows/windshields and some with very heavy body damage), vehicle damage would be about $1,750,000.

Using the same method of analysis, McAlester would experience 5 injuries, none of which would require hospitalization. Using the values provided by "What is a Benefit?" the cost of 5 minor injuries would be $7,800 ($1,560 per injury).

Total losses for a McAlester hail event of the severity of the Mannford hail storm would be $16,225,300. These losses are summarized in the following table.

Table 4–23: Hail Scenario Damages

Damage Type	Number of Units	Damage $
Housing	3,215	$14,467,500
Vehicles	3,500	$1,750,000
Injuries	5	$7,800
TOTAL		$16,225,300

Scenario Conclusions

This methodology and data comparison provides a conservative estimate of the damage McAlester could expect from a very severe hail storm. The analysis does not include the economic value of such things as time lost to cleanup activities, inspections, filing insurance claims, or business losses.

Hail events historically do not receive the depth of reports and information sharing common with other natural hazards. Many homeowners do not report minor claims to their insurance companies, and detailed reports are generally unavailable from insurance carriers. These factors make it difficult to accurately analyze the true economic impacts of hail storms.

4.5.5 Future Trends

For maps of McAlester's potential future development areas, see Figure 1-9.

Population

Because deaths or injuries from hail events are rare, the vulnerability of populations in newly developed areas will be low, and will be similar or equal to the vulnerability of already established populations.

Structures/Buildings

In all areas being considered for future development, the construction of new structures/buildings should include plans to utilize impact resistant materials and components, when available. As buildings are considered for renovation and converted from one purpose to another, strong emphasis should be placed on using hail-resistive materials. The two primary areas of concern are roofing and window systems.

Critical Facilities

Any future development and renovation should also include the improvement of existing critical facilities to help ensure the community's sustainability. Hail resistive materials

should become standard in this class of facility, along with the use of protective screens for external equipment (i.e. air filtration/conditioning systems, backup generators, communication terminals, vehicles, etc.) to protect damaging weather events.

Infrastructure

As research and development of alternative fuel sources progresses, it is anticipated that "bio-fuels" will begin to play a much larger role in energy resources. As this technology evolves, it is possible that more agricultural land will be given over to the development of crops for use by this technology. Since harvestable crops are more vulnerable to hail damage than grazing land or some other land uses, the result could be even higher economic impacts from severe hail storms.

4.5.6 Conclusions

The states in the middle of the Great Plains, particularly Oklahoma, are the most likely to be hit with severe thunderstorms and hail events. The peak season for hail is in the late spring and early summer. Oklahoma experiences an average of 602 hailstorms each year with hailstones measuring at least 1 inch in diameter. All buildings and crops in the State are at risk.

Pittsburg County has reported 230 hail events from 1995 through 2009, with 13 injuries and $475,000 in property damage. The McAlester area reported 50 hail events during this same time frame, and $100,000 in property damage. Based on this data, the City of McAlester and McAlester Public Schools have a high vulnerability to the hail hazard, and can expect to be hit by 2 to 3 events each year, and a destructive hailstorm once every 5 years.

Data Limitations

The property losses due to hail are not well defined and conflicting information exists. For example, in 1992 the Property Claims Service declared, "Hailstorms across the country (in 1992) ran up a bill of $1.57 billion." Yet, their data on all weather catastrophes shows that hail plus other conditions caused $3.9 billion in insured losses in 1992, and only one storm was a hail-only event, and it caused losses listed at $275 million. This is just one demonstration of the lack of good data on the property losses due to hail. In addition, since a hailstorm is seldom a nationally declared disaster, there may be no agency gathering aggregate data across a region on losses. Insurance companies are reluctant to reveal hard data to researchers. In addition, the NCDC data will often list six different hail events, for example, for what is basically one storm that had impacts in six different locations, or was reported six times in the same location.

4.5.7 Sources

The Weather Channel Storm Encyclopedia at Website:
www.weather.com/encyclopedia/thunder/hail.html

National Weather Service Forecast Office – Tulsa, OK at
www.srh.noaa.gov/tsa/climate/tulhail.html

"Trends in Hail in the United States" by Stanley Changnon, Chief Emeritus & Principal Scientist at Illinois State Water Survey – Mahomet, IL at http://sciencepolicy.colorado.edu/socasp/weather1/changnon.html

National Climatic Data Center at www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

Tulsa World (Vol. 103, No 262) at www.tulsaworld.com

City-Data.com at www.city-data.com/city/McAlester-oklahoma.html

Institute for Business and Home Safety, (http://www.ibhs.org/images/research_library/383/USA_Hail.jpg)

4.6 Winter Storms

A severe winter storm is one that drops more than 2 inches of snow or more than ¼ inch of ice. An ice storm occurs when freezing rain falls from clouds and freezes immediately upon contact.

The National Weather Service (NWS) in Tulsa issues a winter weather advisory when 1 to 3 inches of new snow is expected or icing which could make driving and walking hazardous. A winter storm warning is issued when a variety of hazardous conditions are forecast to occur across the area, or when there is difficulty in determining the type of conditions which will predominate.

4.6.1 Hazard Profile

A winter storm can range from moderate snow over a few hours to blizzard conditions with blinding wind-driven snow that lasts several days. Many winter depressions give rise to exceptionally heavy rain and widespread flooding. Conditions worsen if the precipitation falls in the form of snow because it occupies seven to ten times more space than the same quantity of rain. The aftermath of a winter storm can impact a community or region for weeks, and even months.

McAlester is vulnerable to ice storms produced by warm, moist Gulf air colliding with arctic air from the Canadian Shield

Location

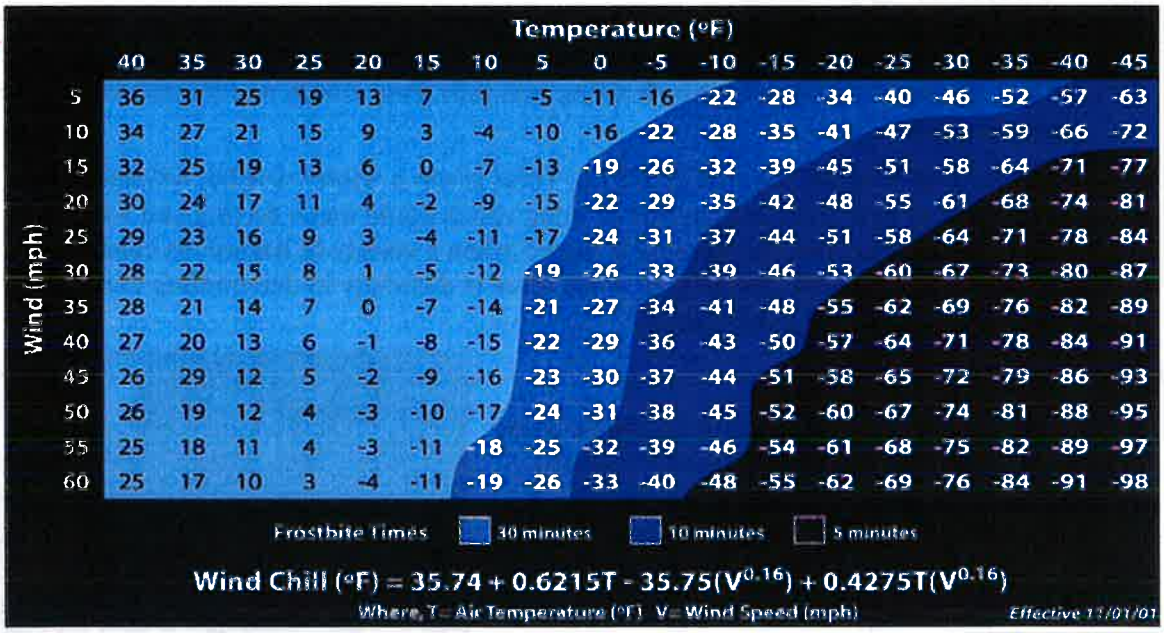
The southeast corner of Oklahoma experiences the periodic collision of warm, moist Gulf air and arctic air from the Canadian Shield. Because of this climatic positioning, McAlester experiences winter weather ranging from occasional sub-zero temperatures, snow and freezing rain to mild, spring-like days. Therefore, the jurisdictions of the City of McAlester and McAlester Public Schools are considered vulnerable to the effects of a severe winter ice/snow event.

Measurement

There are multiple ways to measure the impact of winter storms on a jurisdiction, including the Wind Chill Index, a NOAA Winter Storm Severity Index, and the recently developed Sperry-Piltz Utility Ice Damage Index. The Sperry-Piltz Index is a program currently being refined by the National Weather Service Forecast Office. The three indexes are outlined below.

The familiar *Wind Chill* temperature is simply a measure of how cold the wind makes real air temperature feel to living bodies. Since wind can dramatically accelerate heat loss from the body, a blustery 30° day would have the same physiological effect on a person as a calm day with 0° temperatures. The index was created in 1870, and on November 1, 2001, the National Weather Service released a more scientifically accurate equation, which we use today. Table 4-24 shows the new NOAA chart for calculating wind chill. (Please note that it is not applicable in calm winds or when the temperature is over 40°.)

Table 4–24: NWS – NOAA Wind Chill Chart Measurement



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

The following table gives a range of physical intensities from winter storms along with the potential effect on the City of McAlester.

Table 4–25: NOAA Winter Storm Severity Index

Level 1 – Nuisance **No Major Impact**	Little snowfall accumulation. Roads not hazardous	Little to no effect on the jurisdiction.
Level 2 – Minor **Caution Advised**	Dusting to 2 inches of snow. No measurable ice. Winter Weather Advisory	Untreated roadways may become hazardous and slick. Livestock may need additional supplemental feed.
Level 3 – Major **Isolated Emergency Conditions In the Jurisdiction**	Significant Snow Accumulations 2-8 inches. Ice Accumulations of ¼ to ½ inch. Reduced visibility. Wind causing drifting snow. Winter Storm Warning	Widespread hazardous road conditions. Travel discouraged. Areas isolated because of drifting snow. Isolated power outages because of down power lines from ice accumulation. Tree damage. Livestock loss potential increases, supplemental feed necessary.
Level 4 – Extreme **The Jurisdiction is Under a Full State of Emergency**	Crippling Event. Snow accumulations over 8 inches. Winds over 35 mph. Drifting snow, little to no visibility. Ice Accumulations of more than ½ inch. Blizzard Warning	Road conditions hazardous to impassable. People and livestock isolated. Widespread power and utility outages. Infrastructure damage. High potential for loss of livestock. Structures threatened from accumulating snow and ice. Communications infrastructure lost from ice accumulation. May be a long lasting event.

Table 4–26: The Sperry-Piltz Utility Ice Damage Index

Ice Index	Radial Ice Amount (inches)	Wind (mph)	Damage and Impact Descriptions
1	< 0.25	15 - 25	Some localized utility interruptions possible, typically lasting only 1 or 2 hours maximum.
	0.25 – 0.50	< 10	
2	< 0.25	> = 25	Scattered utility interruptions expected, typically lasting less than 8 – 12 hours maximum.
	0.25 – 0.50	15 - 25	
	0.50 – 1.00	< 10	
3	0.25 – 0.50	> = 25	Numerous utility interruptions, with some damage to main feeder lines expected, with outages lasting from 1 to 5 days.
	0.50 – 0.75	15 - 25	
	0.75 – 1.00	< 10	
4	0.50 – 0.75	> = 25	Prolonged & widespread utility interruptions, with extensive damage to main distribution feeder lines and possibly some high voltage transmission lines. Outages lasting 5 – 10 days.
	0.75 – 1.00	15 - 25	
	1.00 – 1.50	< 10	
5	0.75 – 1.00	> = 25	Catastrophic damage to entire utility systems, including both distribution and transmission. Outages could last from 1 to several weeks in some areas. Shelters needed.
	1.00 – 1.50	15 - 25	
	> 1.50	< 10	

Categories are based upon combinations of precipitation totals, temperature and wind speed. For additional information, go to http://ams.confex.com/ams/pdfpapers/141246.pdf

Extent

Winter storms cause great inconvenience, injuries and deaths. Everyone is affected by the loss of mobility. Streets and highways are slick and hazardous. Even walking from house to car can be dangerous. Public transportation is often blocked. Residents, commuters, travelers and livestock may become isolated or stranded without adequate food, water and fuel supplies. People are often inconvenienced or at risk of physical harm from loss of electric power to their homes. Above-ground electrical and telephone lines and tree limbs are often coated in a heavy build-up of accumulating ice, which break when under the stress of sufficient weight. Falling trees also often bring down power lines. When electrical lines are damaged, other utilities, such as water and natural gas, can become inoperable.

Physical damage to homes and facilities can occur from wind damage, and the accumulation of snow, ice, and hail from accompanying winds. Even small accumulations of snow can wreak havoc on transportation systems due to a lack of snow clearing equipment and experienced drivers.

Winter storms are deceptive killers because most deaths are indirectly related to the storm. While approximately 70 percent of deaths from winter storms occur due to traffic accidents, other risks may include:

- Cold temperatures that accompany winter storms create the threat of hypothermia, primarily in the elderly;
- Slips and falls due to slippery walkways;
- Back injuries or heart attacks may occur during snow removal or debris cleanup;
- House fires occur more frequently in winter due to lack of proper safety precautions when using alternate heating sources, such as unattended fires and

improperly placed space heaters. Fires during winter storms present a great danger because frozen water supplies may impede firefighting efforts.

- Improper hookup of home generators may cause "back feed" into electrical transmission lines thought to be disconnected, threatening utility workers;
- Carbon monoxide from improperly located generators or other heating sources may threaten residents.

Table 4–27: Casualties and Damages Caused by Winter Storms from 1995 thru 2009

Source: National Climatic Data Center

Location	Events	Deaths	Injuries	Damage Events	Property Damages
Pittsburg County	17	0	0	1	$1,000,000
Oklahoma	365	2	7	61	$732,234,000

The National Weather Service does not specify City of McAlester damages.

Frequency

The National Climatic Data Center shows 365 snow and ice events reported for Oklahoma from 1995 through 2009. This calculates to an average of 24 winter storms each year for the state. Occurrences of daily low temperatures below freezing range from an average of 140 days per year in the western panhandle to 60 days in the Red River plain in extreme southeastern Oklahoma. Occurrences of daily high temperatures below freezing range from an average of 15 days per year in portions of north central and northwest Oklahoma to 3 days per year in the southeast.

Pittsburg County reported 17 snow and ice events for this same period (1995-2009). Winter storms are, by nature, not isolated events. Therefore it can be reasonably assumed that winter weather events affecting the Pittsburg County area will also impact the City of McAlester to varying degrees.

Impact

The impact of a winter storm can affect a region for weeks and even months. Houses, roads, electrical poles and lines, water systems, people, crops (such as pecan trees) and cattle are all vulnerable to severe winter storms. Houses are damaged from the weight of snow or ice, roads buckle and or become slick and hazardous, electrical poles and lines break, and people lose electricity and heat, water lines freeze and burst, and people and livestock have no water. People and livestock are also susceptible to frostbite and death from exposure.

Severity

McAlester considers a minor severity winter storm to be no loss of function of transportation, no loss of life, and no loss of electrical or water service, and a major severity event to be one that results in loss of transportation function, loss of life, or loss of electrical or water service.

4.6.2 History/Previous Occurrences

The most significant Oklahoma winter storms bear out the frequency of occurrence across the jurisdiction, with 6 severe storms occurring over an 8 year period.

Figure 4–20: Winter Storms (Snow & Ice Events) in Oklahoma from 1989-2009

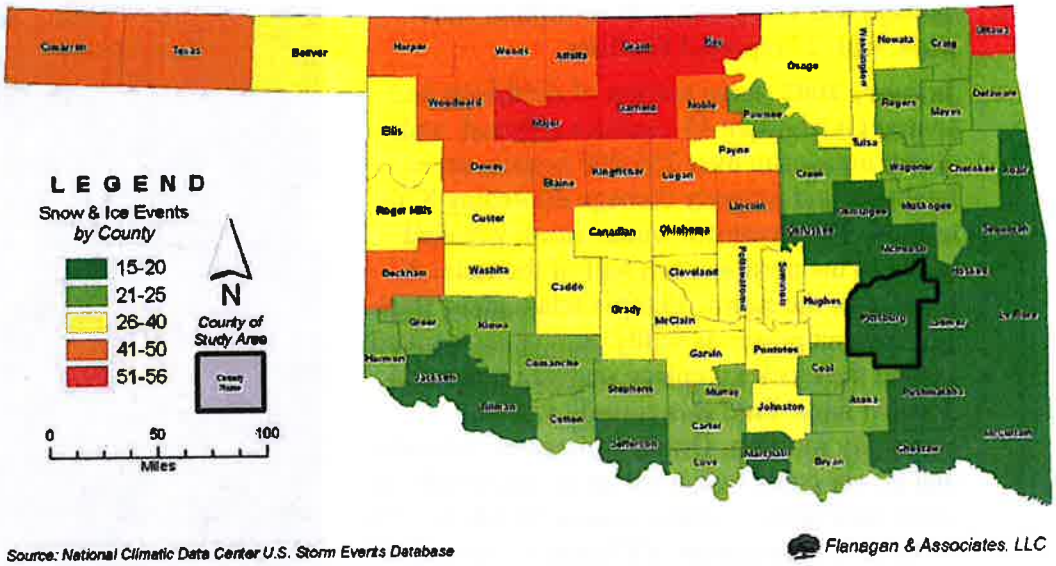


Table 4–28: Significant Oklahoma Ice Storms

December 25-27, 2000	Sperry-Piltz Level 4
January 28-30, 2002	Sperry-Piltz Level 5
December 3, 2002	Sperry-Piltz Level 5
December 18-20 & 28-29, 2006	Sperry-Piltz Level 5
January 12-15, 2007	Sperry-Piltz Level 5
December 8-11, 2007	Sperry-Piltz Level 5

- **November 24, 1996** - Freezing rain and sleet fell across much of eastern Oklahoma from the early morning of November 24th until around midday on November 25th. A band of 2 to 4 inches of sleet fell from near McAlester to near Westville. Numerous traffic accidents occurred on the icy roadways, and the weight of the ice caused some power lines to be downed resulting in power outages in some areas.
- **December 2000** - A slow moving winter storm moved across Oklahoma on December 25 bringing heavy freezing rain and dangerous ice accumulations. While all of eastern Oklahoma received significant ice accumulations, east central and southeast Oklahoma were hardest hit. Although 64 of Oklahoma's 77 counties were impacted, Pittsburg, Latimer and LeFlore counties were hardest hit, with 1 to 2 inches of ice accumulation being common and 3-inch accumulations in some areas. Over 200,000 Oklahomans were without power, including 90 percent of the residents of Pittsburg, Latimer and LeFlore counties. Over 500 power poles were brought down by ice, and thousands were left without telephone and water service. Some locations in southeast Oklahoma, including McAlester, were without utility service for more than a week. Numerous shelters and feeding sites were established to provide water, food and a warm place to sleep. Thousands of trees were damaged across southeast Oklahoma, including seven State parks where tree damage was estimated at over

$1 million. There were numerous reports of trees falling onto vehicles and homes. Property damage was estimated at $170 million statewide, with 27 reported fatalities.

Ice storm damage in Enid, OK, January 2002 (Photo: EnidBuzz.com)

- **January 2002** (large section of northwest and central Oklahoma): 45 counties affected, with power outages to over 255,000 homes, seven fatalities, and property damage exceeding $200 million. This powerful winter storm wreaked havoc in the northwestern half of the state. A week after the storm, 39,000 Oklahomans were still without power as utility companies worked around the clock to replace snapped poles and downed lines. Enid was entirely without electricity for days. Utility companies estimated that power could be out for up to two months in some rural areas of northwestern Oklahoma. The Oklahoma Association of Electric Cooperatives reported over 31,000 electrical poles destroyed due to the ice. Electric power was not fully restored to all Oklahoma City residents until 11 days after the brunt of the storm had exited the region, and 3 weeks after the storm there were still 2,320 Oklahomans without power.
- **December 2002** (west central to north central Oklahoma): Freezing rain began in Oklahoma on December 3, causing outages to 60,000 electric utility customers in a region bounded by Elk City, Enid, and Bartlesville on the north and Roosevelt, Elgin, Norman, and Bristow to the south. This was the third ice storm in two years (December 2000 and January 2002) to cause power outages over a large portion of Oklahoma. One electric co-op still had nine line crews from Texas repairing damage from the January storm when the new storm hit. The towns of Okarche and Geary in Canadian County requested generators to operate their water treatment systems, and a generator was provided to the Canadian Rural Water District to power its wells. Five structures of a 138-kV transmission line failed near Burns Flat. However, most of the damage in this storm was to wires and cross arms rather than poles. By the evening of December 6, there were still 6,800 customers without power.

January 2007 winter storm in east central Oklahoma

- **January 2007** (eastern one-third of Oklahoma): A severe ice storm resulted in power outages to over 122,000 homes (some for up to 3 weeks), damages estimated at $50 million, 32 deaths and 3,919. More than 100 cases of possible carbon monoxide

poisoning were reported in the state, mainly from use of alternate heat and/or power sources. Prolonged power outages combined with extreme temperatures created water supply crises in some of the more rural, isolated communities. In McAlester and Pittsburg County about 16,000 customers (90% of the city) were without electricity and emergency generators had to be used to provide power to essential services like water treatment, hospitals, shelters, City Hall and the County jail. Telephone service was out for approximately 500 customers in Pittsburg County. There were long lines waiting for fuel at the few gas stations that were operating on backup generators. US Hwy 69 Business was closed by fallen power lines, and OK Hwy 31 and 63 were blocked by high water. Total damage from this winter storm for Pittsburg County and McAlester was estimated at $7.5 million, but could well be closer to $18.9 million.

The ice storm that hit McAlester in January 2007 resulted in massive power outages, tree and infrastructure damage, and the closure of US Hwy 69 (Business) due to fallen power lines. (Photo: NYTimes.com, Larry Smith European Pressphoto Agency)

- **December 9-19, 2007** (central to northeastern Oklahoma also referred to as the I-44 Corridor): On Saturday, December 8, an arctic air mass moved into Oklahoma from Kansas, dropping temperatures below freezing. The storm system moved across Kansas/Nebraska early Sunday morning, producing widespread freezing rain in Oklahoma, especially along the I-44 Corridor. This area received at least 1.5 inches of ice accumulations, with some areas getting up to 3 inches between Oklahoma City and Tulsa. Many adjacent areas received ½ inches of ice, with ¼ inches farther south and north from the highest impact areas. At one point over 600,000 homes and businesses were without power state-wide. OG&E reported 289,058 customers without power on December 11, with over 245,000 of these in the Greater Oklahoma City metropolitan area. AEP/PSO reported 253,843 customers without power, 225,769 of these in the Tulsa metropolitan area. Altogether, the storm cut off power to 650,000 customers, and left 29 people dead—16 from motor vehicle accidents, 9 from house fires, 2 from carbon monoxide poisoning, and 2 from hypothermia. Forty-seven shelters were open at the height of the storm, and a total of 100,000 meals were served. Damages were estimated to be in the hundreds of millions of dollars in Oklahoma.

Probability/Future Events

Based on the number of storms and weather patterns reported between 1995 and 2009, the jurisdictions of McAlester and McAlester Public Schools can expect to experience a severe winter snow/ice event nearly every year. Of course, with the unpredictability of the region's fluctuating weather patters, this frequency can be more or less often.

The City of McAlester and McAlester Public Schools have a high probability of a future winter storm event.

4.6.3 Vulnerability

Population

A broad spectrum of any community's population is vulnerable to the effects of winter storms. People who travel in winter storms are at the most risk, since 70% of winter storm-related deaths occur in cars, because of accidents—more than the number of people caught out in the storm. The elderly are at risk due to poor health and frequent isolation. People over 60 years old account for half of all exposure-related deaths. According to NOAA, 50% of hypothermia cases involve people over the age of 60, and 75% of all victims are male. Exhaustion and heart attacks caused by over-exertion are likely causes of winter storm-related deaths.

The homeless population in the McAlester area is served by Hope House of McAlester (women and children), the Salvation Army, and the American Red Cross. During the January 2007 winter storm, several hundred people found shelter at the First Baptist Church, First Pentecostal Church, and the Stipe Recreation Center, with meals provided by the Red Cross, Salvation Army and the Southern Baptist Men's Disaster Response Team. The homeless population is obviously at high-risk to the effects of severe winter weather.

As indicated by the 17 winter storm events between 1995 and 2009 and the four Presidential Disaster Declarations that included Pittsburg County, the population of McAlester, including its Public Schools and those who will live in future development areas, have a high vulnerability to the winter storm hazard.

Structures/Buildings

A direct threat to structures/buildings from a severe winter event would be excessive snow/ice accumulation on flat or low-pitched roofing surfaces. This is especially true for older structures and some farm buildings (like chicken houses) not constructed to withstand such stress. More indirect threats to structures/buildings are from power outages causing interruption to heating (loss of supplies, food, sensitive equipment), frozen water pipes (along with flooding from broken pipes that damages interiors and sensitive electronic equipment), and; fires caused by power lines being torn away from structure, or from power surges when lost power is restored.

Critical Facilities

During a winter event, all critical facilities in the McAlester jurisdiction would be vulnerable to the same potential effects, including power outages that interrupt vital services and road closures or blockages from ice/snow accumulation or debris from ice-damaged trees.

During the January 2007 ice storm, McAlester's Regional Health Center lost electric power, the emergency backup generators failed, and the facility was forced to rely upon emergency batteries. As mentioned above, because of the loss of electric power in the region, several McAlester critical facilities besides the Regional Health Center had to use

backup generators to continue operation, including City Hall, McAlester Water and Wastewater Treatment Plants, emergency shelters, gas stations, and the County jail.

Infrastructure

Water Treatment – The most significant effect from a winter event would be the loss of electrical power, delays of chemical deliveries (road inaccessibility), and personnel and staffing issues. McAlester's Water Treatment Plant has emergency backup generation. Nevertheless, during the 2007 ice storm, OEM, ODOT and the National Guard delivered generators to McAlester's water treatment plant to keep it in operation. In addition, FEMA and OEM staged 100 additional generators in McAlester to provide power for essential and emergency services in the region.

Fallen power lines created treacherous conditions for citizens and emergency service workers, alike.

Wastewater Treatment – The most significant threat to the operation of McAlester Public Work's sewage treatment lagoon during a winter storm would be power outages at its treatment plants. Both plants are equipped with backup generators.

Utilities: Damage to utility infrastructure can result in losses of up to $2 billion per winter storm event. The primary utility providers for McAlester's jurisdiction are AEP/PSO (electricity) and Reliant Energy/ArkLa Gas (natural gas). The service stations and substations for both providers would be vulnerable to the effects of a severe winter event.

Electricity - During a winter storm providers of electrical service could experience any combination of the following challenges in meeting the needs of the McAlester jurisdictions: destruction of distribution and transmission poles, downed or broken power lines, staffing shortages due to impassable roads, danger to workers from downed power lines, hazardous road conditions, fallen trees, and insufficient field and/or office staff to effectively handle the workload. In fact, AEP/PSO encountered all these obstacles during the January 2007 winter storm.

During the January 2007 ice storm, AEP/PSO reported that 90 percent of McAlester's homes and businesses were without power and about 900 distribution poles broken, and countless miles of power lines down. Damage costs for electric utilities serving Pittsburg County (including McAlester) were more than $2.7 million.

Gas – During a winter event, providers of gas service to a community can experience a variety of challenges in meeting the needs of the McAlester jurisdiction, including: damage to gas meters from ice accumulation, fallen power lines or tree debris, inaccessibility to underground gas meters from debris, danger to field employees from road conditions, extreme temperatures, and insufficient field and/or office staff to effectively handle workload generated by such an event.

Transportation Systems (Highways, Public Transportation, Railway, Airports) – All forms of transportation in the McAlester jurisdiction would be at some risk during a winter storm. Road closures due to ice/snow accumulation or high water can result in loss of retail trade, wages and tax revenue. During the January 2007 ice storm, OK Highways 31 and 63 were closed due to high water, and US Hwy 69 Business was blocked by fallen power lines. Severe winter weather can also result in the interruption of normal operations at McAlester Municipal Airport, where ice and snow can render runways unsafe and force flight cancellations.

Emergency Services- Fire, Police and Medical services are all vulnerable to the effects of a winter storm event. Staffing issues due to the inclement weather (some workers may not be able to get out of their homes), danger to workers from downed power lines, hazardous road conditions, fallen debris from trees, and insufficient field and/or office staff to effectively handle the workload can be expected in all areas. In addition, 911 lines can become overloaded or telephone service can be down, as occurred during the January 2007 storm for areas in Pittsburg County.

Fallen debris or impassable roads can lengthen response times for emergency calls, and hazardous road conditions add to the risk of accidents for responders, potentially reducing both fleet resources and manpower (due to injuries).

4.6.4 Winter Storm Scenario

Overview

The eastern portion of Oklahoma experienced two major winter storm events in 2007. The first occurred in January, hitting Muskogee and McAlester and surrounding counties the hardest. The second came in December of the same year that did widespread damage in Tulsa County. Both storms resulted in an Emergency Declaration issued by the Governor of Oklahoma for all 77 counties in the state. The major effects of the storms were widespread and prolonged power outages and tree damage. These outages had a profound impact on the residential and business communities alike.

The response phase of the January 2007 winter event was longer in duration than in the December event, which is attributed largely to the lower temperatures during and immediately following the precipitation. Roads were inaccessible longer, smaller communities experienced severe potable water shortages due to power outages at pump stations, and larger numbers of people sought shelter outside their homes for longer periods. Daytime temperatures during and after the January event remained at or near freezing, with nighttime temperatures dipping into the teens and twenties for 9 days, from January 12th to 20th.

The January 2007 winter storm can be used as a model for a worst-case event for the City of McAlester and McAlester Public Schools. Data utilized for this analysis was gathered from Daily Situation Reports from the State of Oklahoma Department of Emergency Management, the NOAA National Climatic Data Center and the National Weather Service Forecast Office. The OEM SitReps reviewed for the McAlester event provided data for 11 days.

Summary of McAlester Event – January 2007

OEM SitReps for the January storm began on the afternoon of the 12th with a report of 3,500 customers without power, and concluded with a final report on January 23rd when power had been restored to all PSO customers in McAlester who were capable of receiving it. The rate of restoration throughout the reporting period (based on daily SitReps) as a percentage has been calculated and is presented in table 4-29.

Table 4–29: Summary of McAlester Event – January 2007

Source: National Climatic Data Center and Oklahoma Department of Emergency Management

Date	Daily High	Daily Low	Customers Without Power	% increase / decrease restoration
13-Jan	41	25	14,438	--
14-Jan	30	25	15,899	10.12
15-Jan	31	24	14,692	-13.48
16-Jan	26	16	13,952	5.04
17-Jan	21	16	10,814	22.49
18-Jan	30	20	9,784	9.52
19-Jan	33	22	11,139	-13.85
20-Jan	40	23	4,413	60.38
21-Jan	38	32	3,960	10.26
22-Jan	37	31	98	97.5
23-Jan	35	19	--	100.0

In all, 32 people died state-wide because of the storm. There were nearly 700 motor vehicle accidents (injury/non-injury/fatal) resulting in 19 fatalities. There were 8 deaths related to hypothermia, 2 to smoke inhalation and 3 to falls. Nearly 4,000 people were treated at Oklahoma hospitals for various injuries related to the storm.

On January 21st, the American Red Cross reported 4,742 overnight stays in the various shelters established throughout the state during the event. Assuming shelters began operating on the night of January 12th and ran through the night of January 20th, this would equate to an average of approximately 526 shelter residents per night. Many of those without power and heat chose to remain either at their own homes or with a family member/friend, primarily because of fear of looting. The Red Cross and the Salvation Army served approximately 70,000 meals through mobile and fixed feeding stations.

Prolonged freezing temperatures created the largely undocumented side effect of ruptured water lines. Many older, less insulated homes had burst water pipes that flooded the homes when the lines thawed. Depending on where the breaks occurred, this could cause anywhere from minimal to catastrophic damage to a residence. No official data on this aspect of the storm has been made available to date.

This data can be translated into an economic value of loss for utilities and the community. Assuming the average cost of electricity in Oklahoma (as of April 2009) is $0.0747 per

kilowatt hour (kWh), and the average household use is 1,000 kWh per month (or 33 kWh/day), the average lost revenue to utilities per day can be found by multiplying the average number of households without power per day (9,919) by the cost of 33 kWh (or $2.49/day). (See "What does electricity cost?" at http://michaelbluejay.com/electricity/cost.html) Using these numbers, the revenue loss for AEP/PSO would be $24,698 per day during the 10-day outage, or a total of $246,980. These numbers are conservative, since electricity use in winter would normally be considerably above average.

The same comparison can be made regarding the Economic Value of the Interruption of Daily Activities for the community. When people are affected by a disaster, there are scores of tasks to be dealt with, such as evacuation, cleanup of damaged property, meeting with insurance representatives, emergency officials and social service agencies, arranging alternate daycare schedules and transportation, and so on. The time spent dealing with these issues is "time lost" from normal occupations and earnings. This "time lost" is valued at $21.16 per person, per hour, per day. For the purposes of this scenario, the total number of *customers* is used—a conservative figure, since time lost for actual customers is probably more than twice that number, since in most cases a customer represents a household or small business rather than a single individual. By multiplying the average number of customers without power (9,919) by $21.16, and the product by the number of hours lost (8 per day in this scenario), we arrive at the Value of Interruption of Daily Activities, which is $167,908.83 per day. For the 10-day Winter Storm Scenario for McAlester, the costs would be $246,980 lost revenue for utilities and $16,790,088 in lost earnings for the community as a whole.

To these hypothetical losses, should be added the costs apportioned to the City of McAlester for Pittsburg County debris removal ($3,043,570), emergency protective measures ($1,518,120), damage to roads and bridges ($143,685), and building and equipment losses ($50,000). If the costs are apportioned according to McAlester's percentage of Pittsburg County population—40.46 percent—the costs to the City would be $1,231,428 for debris removal, $613,231 for emergency protective measures, $58,135 for road and bridge damage, and $20,230 for building repair.

Table 4–30: Summary of Damage for McAlester Winter Event Scenario

Damage Category	Amount
Utility Lost Revenue	$246,980.00
Lost Time	$16,790,088.00
Debris Removal	$1,231,428.00
Emergency Measures	$613,231.00
Road and Bridge Repair	$58,135.00
Building and Equipment Losses	$20,230.00
Total	**$18,960,092.00**

Source: Based on OEM Situation Updates

Altogether, the costs of the January 2007 winter storm would be in the neighborhood of $18,960,092. This is a conservative number, since it does not include individual costs associated with home and automobile damage, injury and hospitalization, and fires, like the one that destroyed

Clearly, a winter storm like that of January 2007 constitutes a major disaster for the McAlester jurisdictions.

4.6.5 Future Trends

For a map of McAlester's potential future development areas, see Figure 1-9.

Population

Rising energy costs combined with the increasing cost of basic necessities will continue to put a strain on those in the jurisdiction already struggling to take care of basic needs. A steadily growing population of retirees relying on fixed incomes could very easily translate into a larger percentage of people unable to provide heat for their homes in times of severe winter weather.

Additionally, more and more elderly are choosing to remain in their homes rather than move into assisted/progressive living situations – many of them with some type of special needs that may be exacerbated during such an event. Any populations with special needs will require additional planning considerations.

Structures/Buildings

All residential, commercial and industrial buildings added to the city's inventory should consider the placement of trees and large shrubs to reduce the risk of power line interference. Burying of electrical power lines, when possible, is a good way of avoiding this impact. Commercial and industrial projects should include adequate backup power systems to protect critical equipment and data storage.

Critical Facilities

All considerations for Structures/Buildings, above, apply equally, if not more so, to critical facilities. Several mitigation measures included in this plan address the issue of power outages at City of McAlester fueling stations and water/wastewater plants. In addition, due to the widespread power outages in January 2007, this plan includes a mitigation measure addressing the development of an Emergency Back-up Generator Hazard Mitigation Plan Annex (EBGHMP) which reviews the capabilities of all City facilities, their necessity in the response and recovery process, their current capabilities to remain up and running during an extended power outage, and the costs of retrofitting them to an acceptable level. Important, too, is assuring that several gas and fueling stations are equipped with backup generation.

Infrastructure

Since many new residential subdivisions are now burying power lines, this practice should mitigate the impact of future winter storms in developing areas.

4.6.6 Conclusions

Due to the rich, moist atmosphere present in McAlester, both the City and its Public Schools should expect to be impacted by winter snow and ice events each year. The severity of a winter storm depends to a large extent on temperature (with 32- and 33-degree storms being the most treacherous), ice and snow accumulation, extent, and duration. Destructive winter storms appear to be becoming more frequent and electric grid outages more extensive. Particularly vulnerable are McAlester's critical facilities. Efforts should be made to ensure that the City's Water Treatment Plant, Wastewater Plants, City Hall, Police Department, and Regional Health Center can continue to operate during widespread electrical outages like those of December 2000 and January 2007. Special attention should also be given to ensuring that major grocery stores, care facilities and gas stations have backup generators. The City of McAlester and McAlester Public Schools are considered to have a high vulnerability to the winter storm hazard.

Data Limitations

Data kept by the National Climatic Data Center cannot separate out geographically the effects of winter storms that may encompass an extremely wide area. With that in mind, casualties, damages, and the effects of historic events are frequently aggregate numbers for storms that are not specifically confined to the City of McAlester and its Public Schools.

4.6.7 Sources

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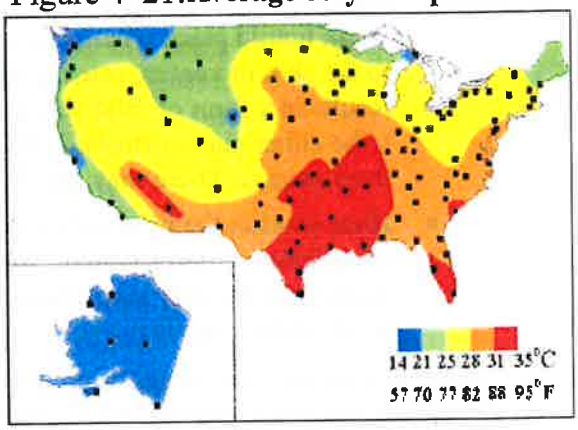
4.7 Extreme Heat

Extreme summer weather is characterized by a combination of very high temperatures and exceptionally humid conditions. A heat wave occurs when such conditions persist over long periods. A lack of nighttime cooling can exacerbate the conditions when community infrastructure fails to release ambient heat increases gained during the day.

The City of McAlester has experienced major heat waves three times in the past 15 years: in 1998, 2006 and 2008. Extreme heat impacts the entire population of McAlester and can be expected every summer. The population at most risk to extreme heat is the 18.1% of the McAlester population aged 65 and above, the 20.7% of the population classified as low income, and that segment of the population that works outdoors. Property damage is also possible, particularly to roads and railways.

Figure 4–21: **Average July Temperatures**



Tulsa County's average high temperature in July is 94° Fahrenheit

4.7.1 Hazard Profile

Each year in the United States, the cause of death for approximately 200 people is listed as heat-related[1], although some estimates of heat-attributable mortality run as high as 1,000 per year. Despite the history of adverse effects, there is consensus that most of these deaths are preventable. Extreme summer temperatures are also hazardous to livestock and crops, can cause water shortages, increase fire hazards, and prompt excessive demands for energy. Even roads, bridges, and railroad tracks are susceptible to damage from extreme heat.

Human bodies dissipate heat by varying the rate and depth of blood circulation and by losing water through the skin and sweat glands. Perspiration is about 90% of the body's heat dissipating function. Sweating, by itself, does nothing to cool the body unless the water is removed by evaporation. High relative humidity retards evaporation, so under conditions of high temperature (above 90° Fahrenheit) and high relative humidity, the body is pressed to maintain an internal temperature of 98.6° Fahrenheit. When heat gain exceeds what the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop.

[1] In most communities in the United States, the cause of death is listed as "heat-related" when the body core temperature is determined to have been above 105° Fahrenheit at the time of death. In recent years, some communities have adopted a broader criterion, declaring a heat-related death when a body is found "in an enclosed environment with a high ambient temperature without adequate cooling devices and the individual had been known to be alive at the onset of the heat wave." When the City of Philadelphia adopted the more general standard, reported heat-related deaths jumped from 20 in 1991 to 105 in 1993.

Heat also affects local workforce capabilities. Workers exposed to these elements must be monitored for heat exhaustion and heat stroke.

Heat-related illnesses can include the following:

- **Heat Cramps:** muscular pains and spasms due to heavy exertion. They usually involve the abdominal muscles or legs. It is generally thought that the loss of water from heavy sweating causes the cramps.
- **Heat Exhaustion:** typically occurs when people exercise heavily or work in a warm humid place where body fluids are lost through heavy sweating. Blood flow to the skin increases, causing blood flow to decrease to the vital organs. This results in a form of mild shock. The skin will be cool and moist, and could appear to be either pale or flushed. The victim may have a headache and/or be suffering from nausea. There may also be some dizziness.
- **Heat stroke:** the most serious heat emergency. It is life threatening. The victim's temperature control system, which produces sweating to cool the body, stops working. The body temperature can rise so high that brain damage and death may result if the body is not cooled quickly.

Another extreme heat hazard is air pollution. During the summer months, consistent high temperatures and stagnant airflow patterns cause a build-up of hydrocarbons to form a dome-like ceiling over large cities. The abundance of factories, automobiles, lawn equipment, and other internal combustion machines emit high particulate matter that builds and worsens as temperatures increase. The resulting stagnant, dirty, and toxic air does not move away until a weather front arrives to disperse it.

When the particulate matter reaches a pre-determined level, cities issue ozone alerts and implement measures to reduce the use of cars and the output of contributing chemicals. Ozone alerts usually include advisories for the elderly and those with breathing difficulties to stay indoors in air-conditioned environments.

Damage to property during extreme heat is more the result of expanding and contracting soil and is covered in Section *4.9 Expansive Soils*.

Location

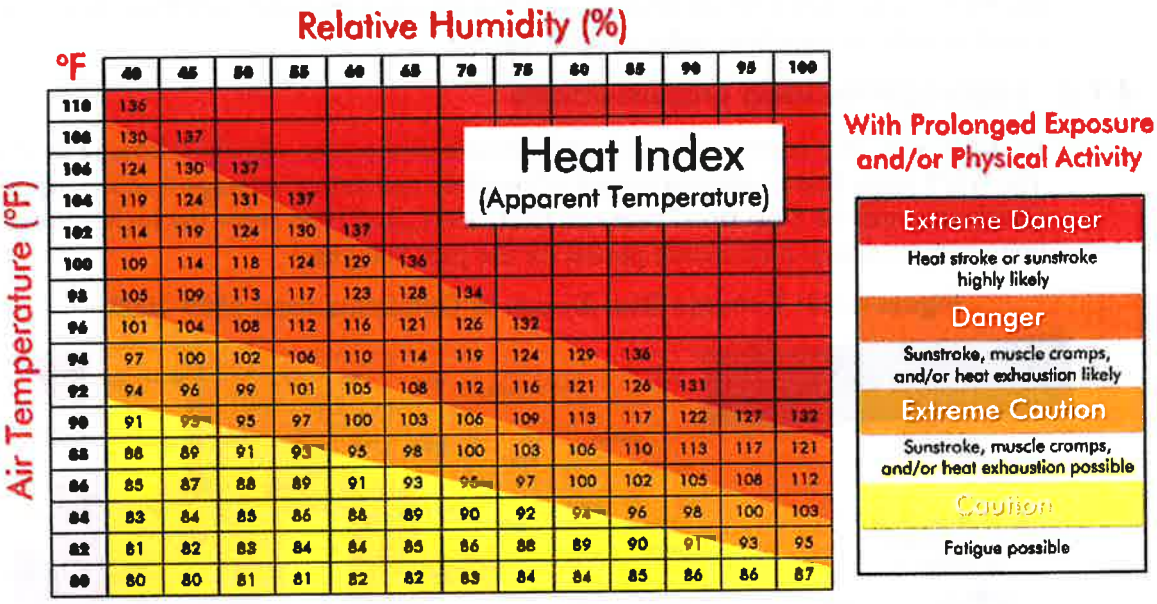
The City of McAlester and McAlester Public Schools are located in east central Oklahoma, a region of warm to hot summer temperatures. Due to its location, sustained high temperature is a hazard that impacts both jurisdictions, but particularly the aged, the poor, the obese, those with heart problems, and people who work out of doors. See Figures 1-4, 1-5 and 1-6 for demographic data on locations of elderly, low income and disabled populations in McAlester.

Measurement

The Heat Index and Heat Disorders table relates index ranges with specific disorders, particularly for people in the higher risk groups. The heat index illustrates how the human body experiences the combined effects of high temperature and humidity. It more accurately reflects what the body experiences than simply measuring the air temperature. For example, when the air temperature is 98° Fahrenheit and the relative humidity is

50%, the human body experiences the discomfort and stress equivalent to 113° Fahrenheit with no humidity.

Table 4–31: Heat Index



Extent

The highest temperature recorded for McAlester was 116 degrees on August 10, 1936. Over the past ten years, the average high temperature for July and August in the McAlester area has been 93 degrees F with an average humidity of 70%, which puts the area in the "Extreme Caution" category on the National Weather Service (NWS) Heat Index scale, and the "Danger" category when relative humidity is factored in.

Sustained high temperatures are a hazard that impacts the entire community, but particularly the aged, the poor, the obese, those with heart problems, and people who work out of doors. The impact of the extreme heat hazard can be mitigated by notifications and warnings to vulnerable populations, the establishment of cooling rooms, utility cost assistance programs, backup electric generation for critical facilities, Medical Reserve Corps training, and similar measures.

Frequency

McAlester has experienced major heat waves three times in the past 10 years: in 1998, 2006 and 2008. Based on this limited data, sustained periods of temperatures above 100 degrees Fahrenheit can be expected on the average of once every 3 years.

Impact

The impact of extreme heat is primarily the danger to people, resulting in muscle cramps, nausea, heat exhaustion, heat stroke, and death, but it can also increase the risk of and impacts from wildfire and drought. Extreme summer heat is hazardous to agricultural crops and livestock. The demands on water supplies can result in shortages, rationing, and increased fire hazards. Roads, bridges and railroads are susceptible to damage from

high temperatures. When high temperatures are combined with drought and high winds, the threat of wildfire can become severe.

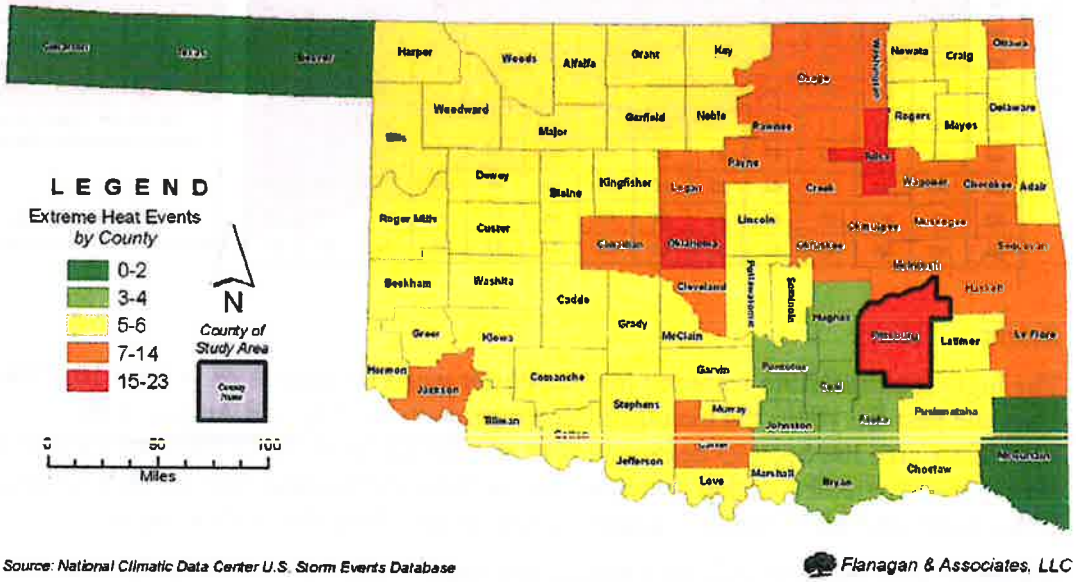
Severity

McAlester considers a minor severity heat event to be a heat index of 95 or less and a major severity to be a heat index greater than 95.

4.7.2 History/Previous Occurrences

In Oklahoma, July is generally the hottest month of the year, closely followed by August. The NWS compiled a 106-year record of monthly and annual average temperatures in Oklahoma, and the Dust Bowl years of 1921, 1931, and 1936 show the highest average temperatures across a 12-month period for the past 100 years.

Figure 4–22: Extreme Heat Events in Oklahoma from 1989-2009



Source: National Climatic Data Center U.S. Storm Events Database

Flanagan & Associates, LLC

In the 40-year period from 1936 through 1975, nearly 20,000 people were killed in the United States by the effects of heat. In the summer of 1936, temperatures across two-thirds of the United States rose well above 110 degrees F, and to as high as 121 degrees in some places. The heat wave lasted for 13 days, killing about 5,000 people in the U.S., and nearly 800 in Canada.

The summer of 1936 was also the hottest summer in Oklahoma history. Daily high temperatures for Oklahoma City were on July 13 - 101, July 14 - 105, July 15 - 108, July 16 - 100, July 17 - 104, July 18 - 108, and then on July 19th - 109 degrees, the hottest day on record in Oklahoma City. Sunday, July 19, was the hottest day in recent Oklahoma history. Altus recorded a high temperature of 120, Hobart had 117, Shawnee, Duncan, and Chickasha reported 115 degrees, Kingfisher had 114; Tulsa 113; Sayre 112; Clinton 109; Enid, Woodward, McAlester, and Ardmore 108; and Bartlesville 106. One woman died of heat in Oklahoma City on July 19, while Tulsa had four heat-related deaths and Oklahoma had 32.

In the disastrous heat wave of 1980, more than 1,250 people died.

A 1988 drought and heat wave affecting the central and eastern United States caused approximately $40 billion in livestock and crop damage. Another in 1993 in the southeastern United States caused approximately $1 billion in livestock and crop damage and an undetermined number of deaths.

The Central Plains and Corn Belt States experienced a heat wave July 11 through 19, 1995, when temperatures climbed above 120° F. A significant portion of the Eastern United States was in the danger category during the same period, with temperatures ranging from 105° to 120° F. This heat wave caused 670 deaths, 465 of them in Chicago alone.

In July 1998, a heat wave settled over the south central US and much of eastern Oklahoma, causing five heat-related deaths. A drought accompanied the high temperatures in Oklahoma, causing widespread crop damage.

During 2005-2006, Oklahoma experienced one of the worst droughts in its history—a result of heavy precipitation in the spring, then months of high temperatures and low precipitation through the summer, fall and winter. One result was a record number of wildfire outbreaks (see Section *4.8 Drought* and *4.11 Wildfire*, below). During the scorching hot months of July and August, 24 people died of heat-related illnesses in Oklahoma.

The table below shows that 91 deaths resulted from extreme heat episodes from 1995 to 2009 in Oklahoma compared with 2,933 deaths in the United States. The table also illustrates the percentage of fatalities in the United States for people over 60 years of age.

Table 4–32: Deaths from Extreme Heat

Year	Oklahoma	United States	Over 60, US
1995	0	1,021	73%
1996	10	36	84%
1997	0	81	65%
1998	24	173	68%
1999	10	502	67%
2000	5	158	68%
2001	9	166	62%
2002	0	167	52%
2003	3	36	61%
2004	0	6	50%
2005	1	158	56%
2006	24	253	48%
2007	1	105	51%
2008	3	71	55%
2009	1	-	no data
Totals	**91**	**2,933**	**68.2%**

From NOAA National Climatic Data Center Annual Summaries

McAlester and Pittsburg County Extreme Heat Events

According to the Oklahoma Climatological Survey, from 1971 to 2000, July in Pittsburg County had an average of 4 days with highs above 100 degrees F, and 5 days above 100 degrees in August. But this is only an average. There have been years since 1995 when summer temperatures in Pittsburg County and McAlester have far exceeded these averages: 1998, 1999, 2006 and 2008. These extreme heat events are summarized below.

- **July-September, 1998** - A blistering heat wave struck the south-central part of the nation during July 1998, including much of eastern Oklahoma. A drought also accompanied the heat wave to cause devastating crop damage. Temperatures in some portions of southeast Oklahoma rose above 100 degrees on all but two days of July. At McAlester, 100+ degree temperatures were recorded on 24 days in July, with 15 consecutive days above the century mark from the 17th through the 31st. Temperatures soared to at least 105 degrees every day from the 23rd through the 31st, rising as high as 107 on three days. The average high temperature for the entire month of July in McAlester was 102 degrees. The average monthly temperature was 89.3 degrees, or 7.4 degrees above normal. Five deaths in eastern Oklahoma during July were attributed to heat. Emergency Medical Services in Oklahoma responded to 452 heat-related injuries during the period June 1 to July 31. On August 1, 1998, the temperature at McAlester Regional Airport rose to 107 degrees, breaking the record high temperature for that date, and to 108 degrees on August 2, setting another heat record. August 2 marked eleven days in a row with high temperatures of at least 105 degrees in McAlester. Drought continued to accompany the heat, with only 0.7 inches of rain falling at McAlester in August. The record high temperatures continued into September, with the thermometer reaching 110 degrees on the 4th, making it the hottest September day on record for the city. On September 5th, the thermometer reached 102 degrees, setting a new temperature record for the date. On September 7, the high temperature of 102 degrees broke the record for that date, also.
- **July-August 1999** – Another blazing summer visited east central Oklahoma on the heels of the scorcher of 1998, with temperatures ranging from the upper 90s to near 105. Eight persons died, and one serious injury resulted from the excessive heat in late July. Altogether, July and August had 33 consecutive days with highs above 94 degrees F. The average high in August was 98.7 degrees. On August 26, the thermometer reached 107 degrees at the McAlester Mesonet station.
- **July 2006** – High temperatures and humid air settled over much of eastern Oklahoma with daytime heat indices at McAlester reaching as high as 115 degrees. The persistent heat resulted in several heat-related fatalities in the region. Heat persisted through late July and into early August, with daytime heat indices approaching 105 to 111 degrees. In all, there were only two days with highs below 90 degrees in July, and only three days with highs below 90 in August. The month of July had a total of 14 days with 100+ temperatures, and August had 21 days above 100 degrees. Altogether, July and August had 56 days in a row with temperatures above 90 degrees.
- **August 2008** - A prolonged period of excessive heat occurred across much of eastern Oklahoma during early August. Daytime high temperatures reached the 100 to 105 degrees, daily maximum heat index values reached the 105 to 115 degree range, and

morning low temperatures only fell into the upper 70s to lower 80s. Dozens of people in the region were treated for heat-related illnesses. In McAlester during July, the temperature rose into the mid- to upper-90s on 28 days, with night time temperatures remaining in the 80s on all but three days. In late July and early August, there was a run of 20 straight days with highs above 95 degrees on all but one day, and night time temperatures in the mid to upper 80s on all but two nights. August brought five days in a row with temperatures of 100+ degrees and night time lows between 87 and 90 degrees.

Probability/Future Events

Because of its location and climate, the residents of McAlester, including its Public Schools, will continue to be impacted by extreme heat events every 2 or 3 years. The impact of future events will be directly related to the development of community programs such as air conditioner loan programs, electricity bill assistance, and ensuring backup generators are available for critical facilities and cooling stations.

The City of McAlester and McAlester Public Schools have a high probability of a future extreme heat event.

4.7.3 Vulnerability

Population

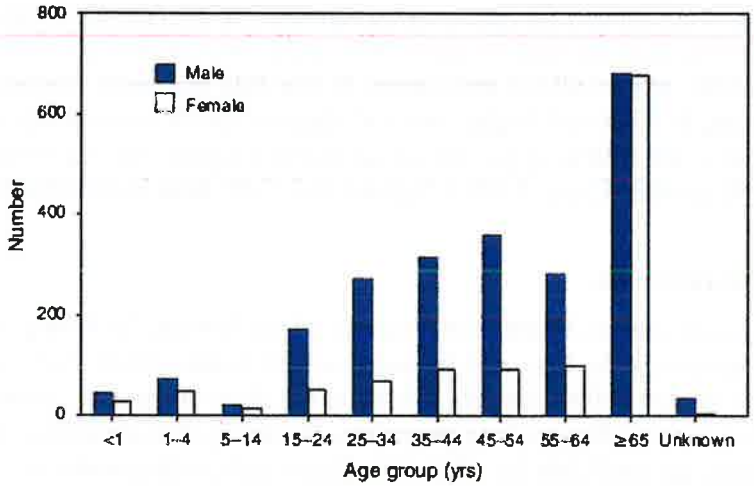
Every person is subject to health problems during a heat wave. However, the following groups are more exposed to the hazard:

- Elderly (65 years of age or older)
- Infants (under 1 year of age)
- Homeless
- Low income
- People who are socially isolated
- People with mobility restrictions or mental impairments
- People taking certain medications (i.e., high blood pressure, insomnia, etc.)
- People engaged in vigorous physical exercise or outdoor labor
- People under the influence of drugs or alcohol

In general, the poor and elderly populations of a community are less able to afford high utility bills and air conditioning units, leaving them with an increased vulnerability to extreme heat events. Another segment of the population at risk is those whose jobs require strenuous labor out-of-doors in the heat and humidity.

Studies indicate that, all things being equal, the severity of heat disorders tends to increase with age. Sweating is the body's natural mechanism for reducing high body temperature, and the body temperature at which sweating begins increases with age. Therefore, what causes heat cramps in a 17-year-old may cause heat exhaustion in a person who is 40, and heat stroke in a person over 60. Figure 4-19, from the Center for Disease Control's Morbidity & Mortality Report for July 2006, demonstrates vulnerability created by age.

Figure 4–23: Number of Heat-Related Deaths, by Sex and Age – US, 1999-2003

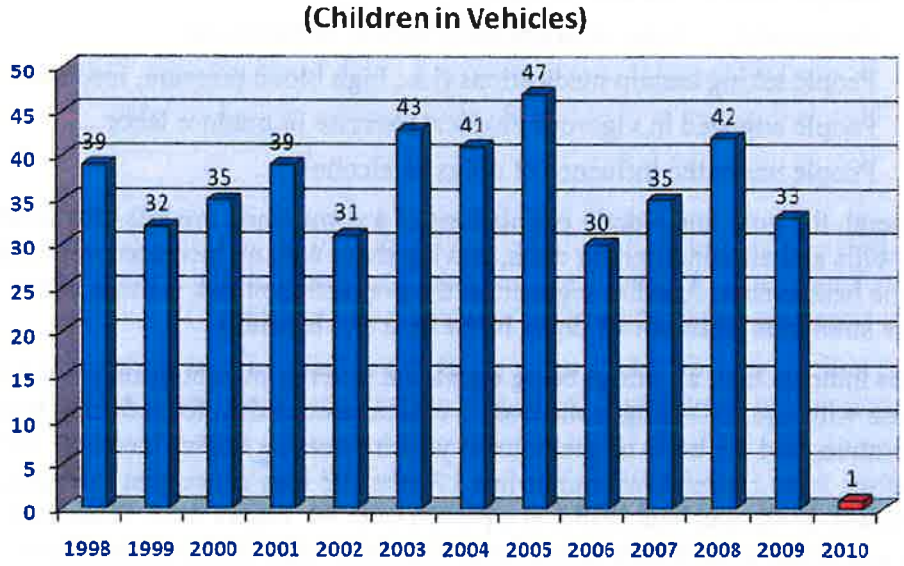


*** Exposure to extreme heat is reported as the underlying cause of or a contributing factor to death.**

More deaths from extreme summer weather occur in urban centers than in rural areas. The masses of stone, brick, concrete, and asphalt that are typical of urban architecture absorb radiant heat energy during the day and radiate that heat during what would be otherwise cooler nights. This phenomenon is referred to as the "urban heat island" effect, or UHI. Tall buildings may effectively decrease wind velocity, thereby reducing the contribution of moving air to evaporative and convective cooling.

A disturbing trend is the increase in the number of heat-related deaths of children under the age of 13 in locked cars. Between 1990 and 1992, ten such deaths were reported. For 2004 through 2006, there were 110 deaths of children left in vehicles. This represents an increase of approximately 14 more deaths in this population group every two years.

Figure 4–24: US Hyperthermia Deaths of Children, as of March 8, 2010
Source: San Francisco State University, Department of Geosciences



Comparatively, between 2004 and 2006, Oklahoma reported 8 heat-related fatalities for children under the age of 13 left in vehicles. One of these deaths was in Tulsa (2005).

The average high temperature in McAlester for July is 92.6° F, with an average afternoon humidity of 71%. This calculates to a heat index of 112° F, putting the area in the "Danger" category on the National Weather Service (NWS) Heat Index scale. This indicates that with prolonged exposure and/or physical exertion, heat-related maladies are likely. Therefore, the City of McAlester and McAlester Public Schools are vulnerable to extreme heat on a yearly basis. This is especially true of the 18.1% of the city's population that is age 65 and above, and the 20.6% who are living in poverty. All future development areas are also at risk from extreme heat events.

Structures/Buildings

During an extreme heat event, it is likely to be hotter in cities than in surrounding rural areas, especially at night. Temperatures typically rise from the outer edges of the city and peak in the centre. This impact of this urban heat island phenomenon can be significant. A number of factors contribute to creating the UHI effect, such as:

- **Thermal properties** of building and road materials, the height and spacing of buildings and air pollution levels. These factors result in more of the sun's energy being captured, absorbed and stored in urban surfaces compared to rural surfaces during the day and a slower loss of this energy at night, thus resulting in comparatively higher air temperatures.
- **Less evaporation and shading**, with the consequent reduction in associated cooling, takes place in the typically drier urban areas as there is less vegetation.
- **Greater inputs of heat** as a result of the high density of energy use in cities. All this energy, for example from buildings and transport, ultimately ends up as heat.

Strategic planning should take the above factors into account, particularly in the context of climate change. At a local scale these include the modification of surface properties, for example, "cool roofs," "green roofs" and "cool pavements." Planting trees and vegetation and the creation of green spaces to enhance evaporation and shading are other options, as temperatures in and around green spaces can be several degrees lower than their surroundings.

Critical Facilities

Critical Facilities would face the same issues as other structures and buildings. In addition, City facilities, such as the Stipe Recreation Center, McAlester Public Schools facilities, and churches, may be designated as cooling centers for vulnerable neighborhoods and equipped with backup generators. When so designated, these facilities should include this function in their plans.

Especially vulnerable to high heat are medical and long-term care facilities. During an extreme heat event, power outages are not uncommon. While the larger medical treatment facilities that serve McAlester are equipped with dependable, redundant generator backup systems, an alarming number of long-term care or nursing home facilities are not. In July 2006, with temperatures ranging between 101 and 109, a Grove area nursing home was forced to evacuate 84 patients when power at the facility failed. In

addition, backup generators can sometimes fail, as occurred at the McAlester Regional Health Center during the severe winter storm of January 2007.

Infrastructure

Water Treatment – Water demand increases significantly during extreme heat events, and can sometimes exceed the delivery capacity of the City of McAlester's water treatment plant, which supplies both the city and outlying areas through Pittsburg County Rural Water Systems #5 and #9. Although McAlester Lake is adequate to supply the city's peak needs, on one occasion (in 1998) it had to supplement withdrawals with water from Talawanda Lake II. A City Ordinance is in place to restrict outdoor and non-essential water use during drought or in times of water emergency.

Given that extreme heat conditions also increase the demand for electricity, power outages can be a potential secondary effect. McAlester's Water Treatment Plant is equipped with a backup generator.

Wastewater Treatment – The most significant threat of extreme heat to the operation of McAlester's two Wastewater Treatment Plants would be a wide-scale power outage. Both facilities have backup generators.

Utilities: The primary utility providers for McAlester's jurisdiction are AEP/PSO (electricity) and Reliant Energy/Arkla Gas (natural gas).

Electricity - During periods of extreme heat, AEP/PSO could experience any combination of the following challenges in meeting the needs of the jurisdictions: Failure of vital delivery components due to high heat, outages or brownouts due to peak loads, or insufficient field and/or office staff to effectively handle the workload.

During typical workweek schedules, it has been noted that demand for electrical power spikes from 4-7 pm as workers are returning to their homes and adjusting thermostats accordingly. The result is an overwhelming demand placed on power station and transformer components, sometimes resulting in power outages across the jurisdiction.

High temperatures and heavy loading can also cause transmission lines to sag into trees and flashover to ground, potentially resulting in widespread power outages.

Gas – No significant vulnerabilities in the delivery of natural gas supply during extreme heat events have been reported.

Transportation Systems (Highways, Railway, Airports) – Although no significant vulnerabilities to the City of McAlester's transportations systems during an extreme heat event have been identified, sustained high temperatures can result in damage to asphalt highways, railways and airport runways.

Emergency Services- Fire, Police and Medical services would all be similarly exposed to the effects of an extreme heat event. Fire and Medical services typically receive a higher volume of heat-related calls, taxing the response capabilities of both services. Fire and Police services would both be exposed to secondary effects of extreme heat by having to perform inherently stressful outdoor work under hazardous temperatures. While extreme heat is not an immediate threat to delivery of Police and Fire services, the demand for additional personnel could potentially increase the cost for these resources.

4.7.4 Heat Scenario

Although the summers of 1998, 2006 and 2008 were scorchers, the summer of 1980 remains the most prolonged and severe heat wave outside of the Dust Bowl years. The 50 days of 100+ temperatures at Oklahoma City is an all-time record. The high temperature during the summer in the Capital, 110 degrees F, is the hottest day on record since the 1930s. Oklahoma was one of several states heavily impacted by this event. There were 37 heat-related fatalities in Oklahoma.

At McAlester, 100 degrees or higher temperatures were recorded on 24 out of 31 days during July 1980, with 15 consecutive days above the century mark from the 17th through the 31st. Temperatures rose to at least 105 degrees every day from the 23rd through the 31st going as high as 107 on three days. The average high temperature for the entire month of July in McAlester was 102 degrees, and the average monthly temperature was 89.3 degrees, or 7.4 degrees above normal. The temperature did not fall below 80 degrees on eight days of the month. Five heat-related deaths occurred in eastern Oklahoma. Emergency Medical Services throughout the state responded to 452 heat-related injuries between June 1st and July 31st. Temperatures remained high at McAlester through the first days of August. On August 1st, the mercury at McAlester Regional Airport was 107 degrees, and the following day 108 degrees, breaking the city's record high temperature for the second day in row. The heat wave finally broke on August 4—the first day since July 16th that the temperature did not reach at least 100 degrees.

A worst-case scenario for McAlester would be a repeat of the extreme heat event of 1980, but lasting two months, preceded by a period of drought, and complicated by high winds, wildfire, and blackouts from widespread power failures. Such an event would put pressure on McAlester's water supply and force the community to institute water rationing and open cooling stations where vulnerable populations could find shelter from the heat. Obviously, cooling stations and other critical facilities would have to be equipped with reliable backup generators to ride through power failures, and vulnerable populations would have to be identified and notified of where to seek shelter.

4.7.5 Future Trends

For a map of McAlester's potential future development areas, see Figure 1-9.

According to NOAA, future extreme heat events are likely to be even worse—more frequent, longer lasting, and more intense.

Population

With the rising cost of fuel and related travel expenses, more people are opting for vacations and/or recreational entertainment at venues close to home, such as public parks etc. As the number of people using local outdoor venues increases, extreme heat vulnerability is likely to increase also.

Also at risk is the homeless population. With the recent home mortgage situation and additional economic stressors on those already struggling to meet financial obligations, the number of homeless may also increase. Facilities designated as shelters (either daytime only or residential) will be further taxed to meet this need, should the number of homeless continue to grow.

If economic conditions remain stressed or worsen, those in the more vulnerable population (elderly, fixed income, compromised health situations) will likely have difficulty cooling their homes.

Structures/Buildings

Structures and buildings are only vulnerable in a limited way, such as in damage from expansive soils. As development in and around McAlester continues, the health aspects of the urban heat island should be considered—that is, the temperature rise that occurs when large quantities of dense materials, such as stone, concrete, asphalt, and other construction materials absorb the heat from sunlight rather than reflect it. These materials act as "storage units" for the energy, and continue to radiate it at night, keeping the ambient temperature from dropping to a level that would provide relief during the night hours.

Critical Facilities

Any future development or renovation of existing critical facilities should include plans for dependable backup systems for delivery of critical power for both equipment and cooling.

Infrastructure

As developed areas of the city continue to age, the water delivery lines that serve these neighborhoods will also deteriorate, increasing the likelihood of line ruptures during peak use periods, such as extreme heat events. As an example, infrastructure deterioration, during the summer of 2009, a 12-inch, cast-iron water main in downtown McAlester ruptured at Choctaw Ave. and A St. and was replaced with PVC pipe. Due to various difficulties, the line was out of operation for 8 weeks, seriously impacting local merchants. Any development in areas facing this possibility should be closely monitored to ensure existing water lines are capable of handling the additional load – and are replaced as necessary.

Sporadic power outages are commonplace during prolonged periods of high temperature. With an average of more than six hundred new residential building permits issued each year, the burden on power delivery systems will continue to grow. Developers building in previously undeveloped areas should work closely with utility companies to ensure that power stations are not overloaded.

4.7.6 Conclusions

Oklahoma and McAlester can expect extreme heat events every summer. The severity of the hazard depends upon a combination of temperature, humidity, duration of the event, and access of vulnerable populations to air conditioning. Over the past ten years, the average high temperature for July and August in the McAlester area has been 93 degrees F with an average humidity of 70%, which puts the jurisdiction in the "Extreme Caution" category on the National Weather Service (NWS) Heat Index scale, and the "Danger" category when relative humidity is factored in. As a result, the City of McAlester and its Public Schools are at high risk to extreme heat.

The most effective proven way to mitigate casualties from extreme heat is through public information and education, although other community programs, such as cooling stations and air conditioner loan programs can also reduce extreme heat impacts.

Data Limitations

The state Medical Examiner's office and the state Health Department have no standardized protocols for defining a "heat-related" death, relying on the judgment of the individual physician attending. This could have resulted in substantially lower mortality/morbidity figures. In addition, death by other causes such as cardiac, with heat as a "contributing factor" can further confound the final statistics for deaths and injuries.

4.7.7 Sources

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4.8 Drought

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. Oklahoma's State Emergency Management Office defines drought as "a persistent and abnormal moisture deficiency having adverse impacts on vegetation, animals or people." Drought is caused by a deficiency of precipitation, which can be aggravated by high temperatures, high winds, and low relative humidity. Duration and severity are usually measured by deviation from norms of annual precipitation and stream flows.

The "Dust Bowl" of the 1930s, the greatest natural disaster in Oklahoma history, drove over 800,000 people off the land

4.8.1 Hazard Profile

Drought is an insidious hazard of nature, characterized as a "creeping phenomenon." It is often difficult to recognize the occurrence of drought before being in the middle of one. Drought analysis is more subjective than that for floods, because droughts do not occur suddenly. They evolve over time as certain conditions are met and spread over a large geographical area. Drought severity depends on its duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. This multi-dimensional nature makes it difficult to define a drought and to perform comprehensive risk assessments. This leads to the lack of accurate, reliable, and timely estimates of drought severity and effects, and ultimately slows the development of drought contingency plans.

There are normally considered to be four kinds of drought, which occur at different stages, illustrated by Figure 4-26. **Meteorological drought** is usually an expression of precipitation's departure from normal over some period of time. These definitions are usually region-specific, and presumably based on a thorough understanding of regional climatology. The variety of meteorological definitions from different countries at different times illustrates why it is folly to apply a definition of drought developed in one part of the world to another:

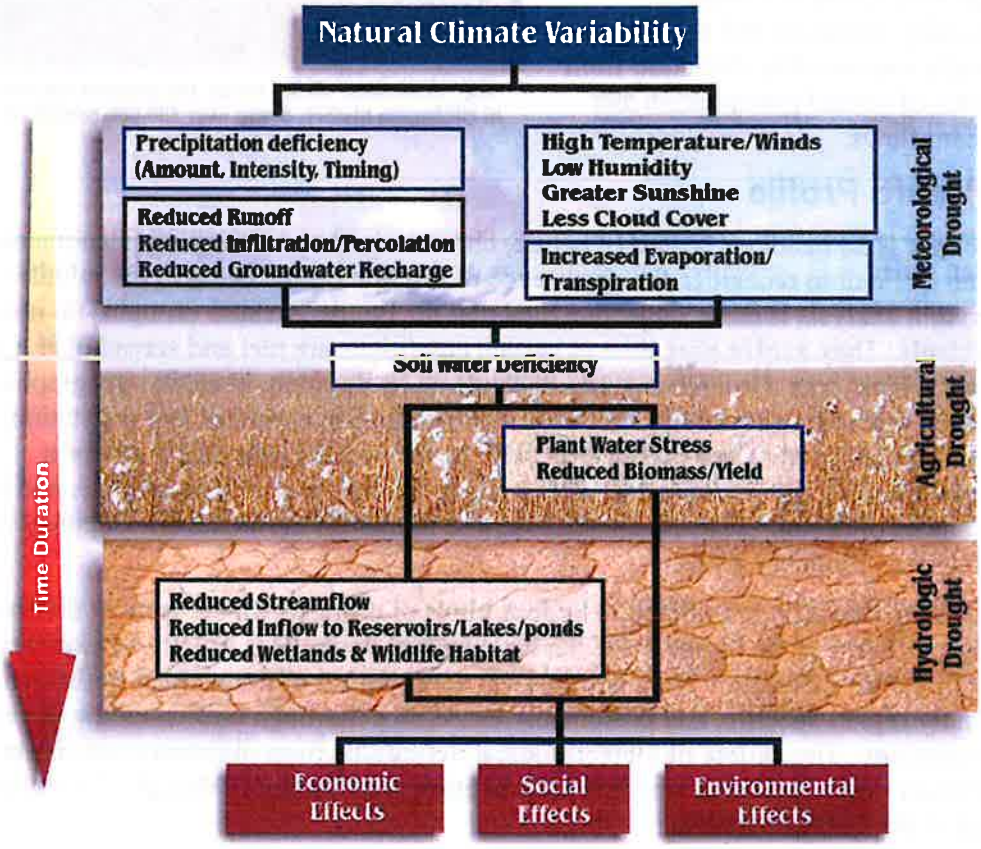
- United States (1942): less than 2.5 mm of rainfall in 48 hours
- Great Britain (1936): 15 consecutive days with daily precipitation totals of less than .25 mm
- Libya (1964): annual rainfall less than 180 mm
- India (1960): actual seasonal rainfall deficient by more than twice the mean deviation
- Bali (1964): a period of six days without rain

Agricultural drought occurs when there isn't enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought happens after meteorological drought but before hydrological drought. Agriculture is usually the first economic sector to be affected by drought.

Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as streamflow and as lake, reservoir, and groundwater levels. There is a time lag between lack of rain and less water in streams, rivers, lakes, and reservoirs, so hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, this shortage will be reflected in declining surface and subsurface water levels.

Socioeconomic drought occurs when physical water shortage starts to affect people, individually and collectively. Or, in more abstract terms, most socioeconomic definitions of drought associate it with the supply and demand of an economic good.

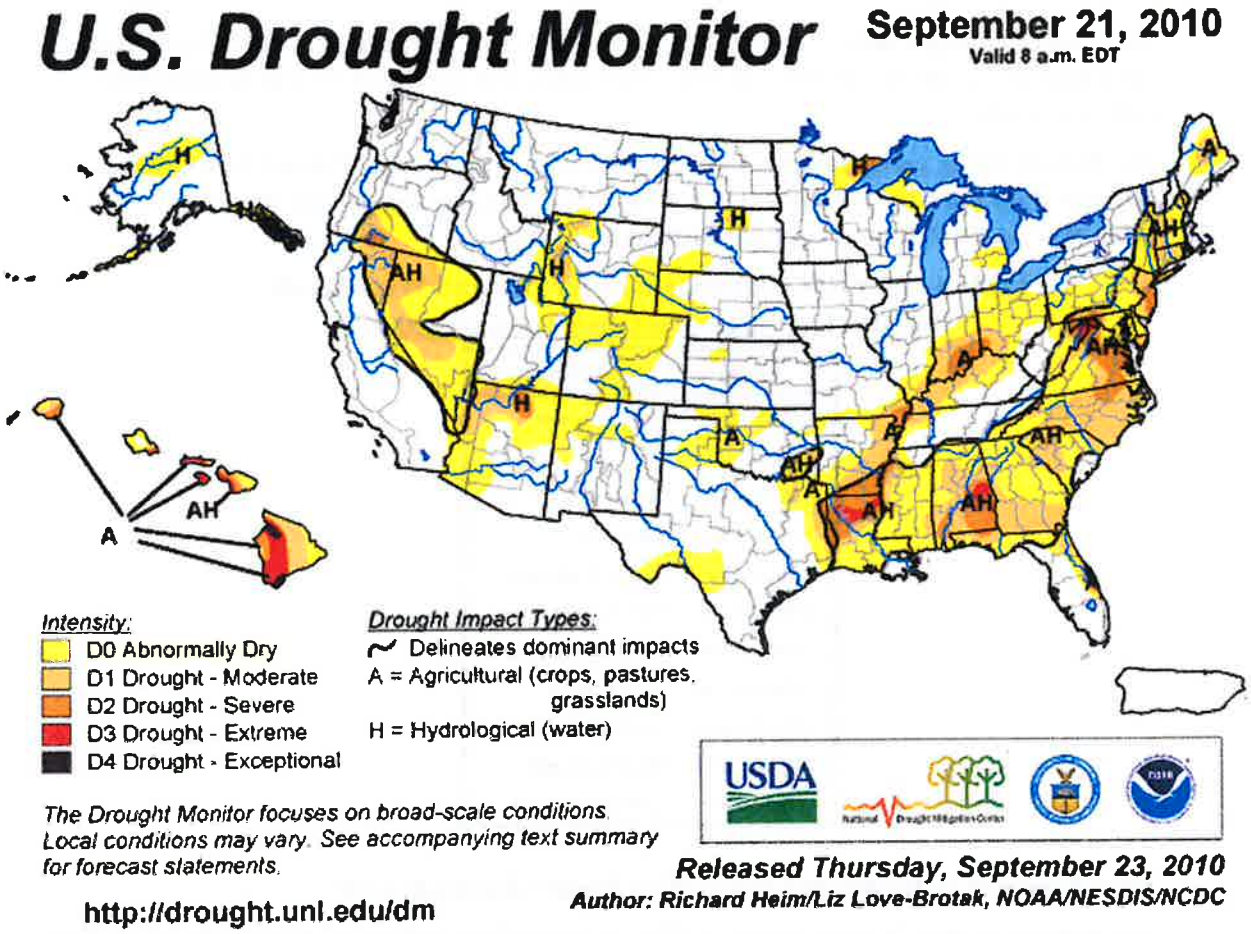
Figure 4–25: Kinds of Drought



Location

Drought is a widespread phenomenon that occurs over broad regions encompassing not only multiple communities, but frequently multiple states. Over the last few years, western Oklahoma has been hit harder by water shortages than eastern Oklahoma, but no location in the state is immune, including the City of McAlester and McAlester Public Schools. See the illustration below for recent information.

Figure 4–26: Drought Severity Index by Division Ending September 21, 2010



Measurement

Different measures are used to predict the severity and impact of droughts, but each one measures different aspects or types of drought. Any single index cannot describe everything about the original data, and the indices are only approximations of real-world phenomena.

The Palmer Index, the most familiar and widely used, measures the departure from normal precipitation. This index uses a range from 4 (extremely wet) to –4 (extremely dry). It incorporates temperature, precipitation, evaporation, runoff, and soil moisture when designating the degree of drought. Hydrologic Indices of drought (such as groundwater levels, reservoir volumes, or water levels) may be used to determine surface water supplies.

Palmer Drought Severity Index (PDSI)

In 1965, Palmer developed an index to "measure the departure of the moisture supply". Palmer based his index on the supply-and-demand concept of the water balance equation, taking into account more than only the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI), as this index is now called, was

to provide a measurement of moisture conditions that were "standardized" so that comparisons using the index could be made between locations and between months.

The Palmer Drought Index is based on precipitation and temperature. The Palmer index can therefore be applied to any site for which sufficient precipitation and temperature data is available.

The Palmer Index varies roughly between -4.0 and +4.0. Weekly Palmer Index values are calculated for the Climate Divisions during every growing season and are on the World Wide Web at the National Drought Mitigation Center.

Table 4–33: PDSI Classifications for Dry and Wet Periods

Source: http://drought.unl.edu/whatis/indices.htm

Rating	Condition
4.00 or more	Extremely wet
3.00 to 3.99	Very wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Slightly wet
0.50 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.50 to -0.99	Incipient dry spell
-1.00 to -1.99	Mild drought
-2.00 to -2.99	Moderate drought
-3.00 to -3.99	Severe drought
-4.00 or less	Extreme drought

Fire: Keetch-Byram Drought Index, Fire Danger Rating System

The Keetch-Byram Drought Index (KBDI) is basically a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. This system was originally developed for the southeastern United States and is based primarily on recent rainfall patterns.

The KBDI is the most widely used drought index system by fire managers in the South. It is also one of the only drought index systems specifically developed to equate the effects of drought with potential fire activities.

The result of this system is a drought index number ranging from 0 to 800 that accurately describes the amount of moisture that is **missing**. A rating of zero defines the point where there is no moisture deficiency and 800 is the maximum drought possible.

These numbers correlate with potential fire behavior as follows:

0 - 200 Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.

200 - 400 Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night.

400 - 600 Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.

600 - 800 Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity. Source: http://www.wfas.us/content/view/32/49/

Extent

Because of the gradual nature of drought's onset, and its uneven impacts, it is often difficult to determine the beginning and end of a drought event. McAlester has experienced drought three times in the past 7 years, characterized primarily by crop damage and wildfire. Based on the Palmer Drought Index, McAlester drought conditions can range from 4 to –4. This value is adjusted weekly through the Climate Prediction Center. McAlester's municipal water supply is strong, supplied, as it is, by Lake McAlester and Lake Talawanda 1 and 2. The capacity of the water supply system is 20 million gallons of water a day (MGD), with an average daily consumption of 6.5 MGD and a peak usage of 12 MGD.

Although McAlester's water supply is adequate for almost all contingencies, during periods of prolonged drought the City has, on occasion, had to draw water from Lake Talawanda to meet demand. In addition to water shortages, which could require the imposition of rationing, drought can also increase the likelihood of wildfire, as was shown in the wide-scale fire losses during the autumn and winter of 2005-2006.

The impacts of drought can be lessened by early warning and notification systems, backup sources of water supply, cooperative agreements with neighboring jurisdictions, local ordinances for rationing water use, clearing brush and Eastern Red cedar from structures in the urban/rural interface, and participating in the national FireWise program.

Adverse consequences of drought occur because of deficiencies in the following:

- Public and rural water supplies for human and livestock consumption;
- Natural soil water or irrigation water for agriculture;
- Water for hydroelectric power, forests, recreation, and navigation;

Frequency

McAlester has experienced drought of varying length and severity three times in the past 10 years, characterized primarily by crop damage and wildfire: 1998, 2005, and 2006.

Given that six major drought events have occurred in Oklahoma over the past 50 years and that nine notable droughts occurred nation-wide in the twentieth century, one may conclude that Oklahoma can expect a drought every decade and expect droughts to occur more frequently than in the country as a whole. However, long-term forecasts of droughts

are difficult and inexact. There is no commonly accepted way of determining the probability that is analogous to the 100-year or 1-percent-annual flood chance.

The U.S. Army Corps of Engineers (USACE) has developed the *National Drought Atlas* to provide information on the magnitude and frequency of minimum precipitation and stream flow for the contiguous United States. On average, the July-to-January period is the lowest six-month period of stream flow throughout the U.S. and is used to characterize drought. The mean monthly flow from July to January has a once-in-20-years chance of falling below a level that would classify it as a drought. In other words, the average occurrence of drought is once every twenty years. Oklahoma, with one per ten years over the past fifty years, is obviously at a greater than normal risk from drought.

Impact

The most direct impact of drought is economic rather than loss of life or immediate destruction of property. Drought affects water levels for use by industry, agriculture, and individual consumers. Water levels can have both a direct and indirect effect on hunting, fishing, and other recreational activities that may have a significant place in a community's revenue. During droughts crops do not mature, wildlife and livestock are undernourished, land values decrease, and unemployment increases.

In addition, water shortages affect fire-fighting capabilities through reduced water flows and pressures. Drought also affects power production, since electric companies cannot produce enough inexpensive hydropower to meet demand and are forced to buy electricity from other, usually more costly sources. Communities that rely on hydroelectric vs. coal/gas-fired generating plants may be more vulnerable.

Most droughts dramatically increase the danger of wildland fires. When wildlands are destroyed by fire, the resulting erosion can result in the heavy silting of streams, rivers, and reservoirs. Serious damage to aquatic life, irrigation, and power production then occurs. (See the section, "Wildfires")

The 1998 drought and heat wave (discussed below) caused crop and hay losses, poor pasture conditions, low stream flows, low water levels in ponds and reservoirs, low subsoil moisture levels, water rationing, wide-scale poultry death, high cattle sales and depressed cattle prices, high nitrate levels in hay crops, and destructive wildfires. Officials estimated that the 1998 drought cost Oklahoma farmers and ranchers at least $2 billion dollars.

Severity

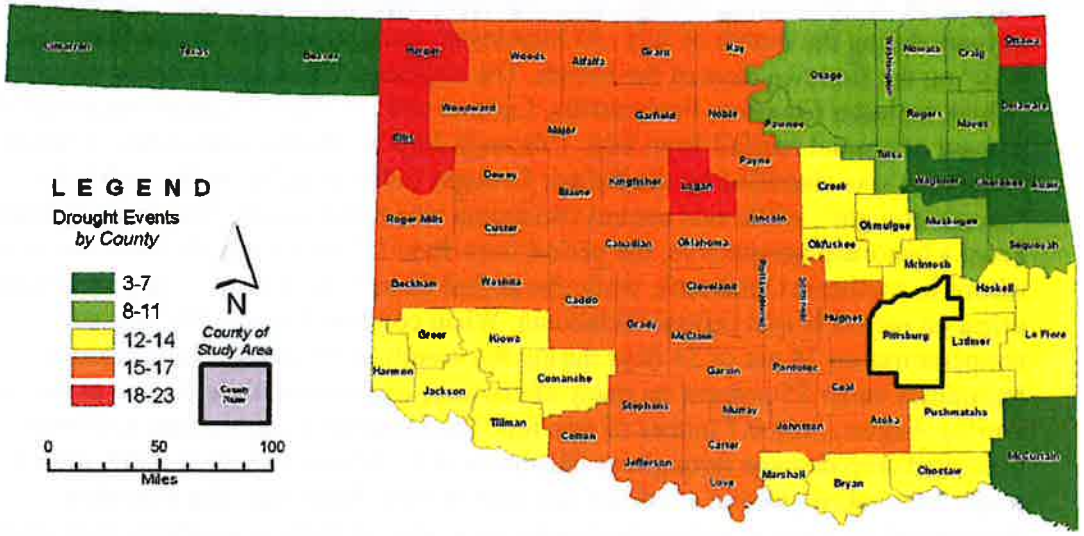
McAlester considers a minor severity to be a -2 to 0 on the Palmer Drought Index and a major severity to be -2 to -4.

4.8.2 History/Previous Occurrences

One of the greatest natural disasters in U.S. history and the most severe and devastating to Oklahoma was the decade-long drought in the 1930s that has become known as the Dust Bowl. Reaching its peak from 1935 through 1938, high temperatures and low rainfall combined to destroy crops and livestock. High winds literally blew the land away, causing massive soil erosion. Hundreds of small rural communities were ruined and about 800,000 people were displaced. The total expenditure by the American Red

Cross for drought relief in Oklahoma in 1930-1931 was the third largest ever in the nation.

Figure 4–27: Drought Events in Oklahoma from 1989-2009



Source: National Climatic Data Center U.S. Storm Events Database

Flanagan & Associates, LLC

Nine notable droughts occurred during the twentieth century in the United States. Damage estimates are not available for most; however estimates indicate that the 1976-1977 drought in the Great Plains, Upper Midwest, and far Western States caused direct losses of $10-$15 billion. The 1987-1989 drought cost $39 billion including agricultural losses, river transportation disruption, economic impacts, water supply problems, and wildfires.

Approximately 20% of the contiguous United States is currently suffering from the effects of prolonged severe to extreme drought. Parts of the east coast have been particularly hard hit, and the drought in those areas is so severe that months of above-normal rainfall would be necessary to end it, according to the National Weather Service.

In Oklahoma, five major drought events were reported over the past 50 years resulting in damage to crops estimated at $900 million.

Major droughts in Oklahoma, as determined from stream flow records collected since the early 1920s, have predominately occurred during four periods: 1929-1941, 1951-1957, 1961-1972, and 1975-1982.

McAlester and Pittsburg County Drought Events

Oklahoma began the new century with drought conditions. In early August 2000, an extended period of unusually dry weather lasted for 2 months. Many parts of the state did not receive rain in August, and portions of southern and south central Oklahoma remained dry for almost 90 days, starting in June. Total agricultural losses were estimated between 600 million and 1 billion dollars statewide. Reservoir levels across southwest and south central Oklahoma averaged 50 percent of normal. Seven counties near the Texas border (not including Grady) were declared federal disaster areas.

McAlester has experienced drought of varying length and severity two times in the past 10 years, characterized primarily by crop damage and wildfire. These events are summarized in the following paragraphs.

- **July 1998.** A devastating drought and heat wave affected southeastern Oklahoma farmers during the month of July. At McAlester, the only rainfall during July was 0.19" on the first two days of the month. The southeast Oklahoma climate division (which includes Choctaw, Pushmataha, Latimer and Le Flore Counties) received 50 percent of normal rainfall from May 1 through July 31. By the end of July, southeast Oklahoma was classified by the Palmer Drought Index as being in the midst of a "severe drought", while east central Oklahoma was experiencing "moderate drought". From a historical perspective, the period from June 1-July 31 was the third driest on record in southeast Oklahoma, while the period from April 1-July 31 was the fourth driest on record in east central Oklahoma. When combined with 100+ degree temperatures on 24 out of 31 days during the month (at McAlester) and relative humidities under 25 percent on many afternoons, crops stood little chance of survival. During August, only 0.7 inches of rain fell. The Oklahoma Agriculture Secretary estimated crop damage throughout Oklahoma at $2 billion, of which $500 million might have taken place in southeast and east central Oklahoma. The President declared 66 counties as a drought disaster area, nine of them in southern and central Oklahoma, including Pittsburg County.
- **August-December 2005**- Moderate to excessive drought conditions prevailed in northeast Texas and southeast Oklahoma. The drought took a toll on the agricultural community of the region, with widespread crop failures. Rainfall for the three-month summer period was only 32 to 43 percent of normal, or deficits of 7 to 10 inches. Drought conditions continued through the end of the year across much of eastern Oklahoma. The worst conditions occurred in southeastern Oklahoma, which had received 40 percent of its normal rainfall since September 1. The period between September and the end of December was the driest in southeastern Oklahoma since 1921. Stream flows throughout the region were well below normal, with Hugo and Eufaula Reservoirs falling below 60 percent of their normal pools. A burn ban was issued in November for the entire state due to the abnormally dry conditions. In December, the drought combined with windy conditions to fuel a catastrophic outbreak of wildfires throughout the state that destroyed hundreds of thousands of acres of pastureland and hay.
- **March-April 2006** – A sustained period of dry weather and high temperatures continued across much of Oklahoma, especially the east central and southeast portions of the state. The winter of 2005-2006 was the second driest since records began being kept in 1895. High winds, combined with dry soil conditions, helped spread the worst series of wildfire outbreaks in Oklahoma history. (See 4.11 Wildfire, below) By April 2006, the severe drought had become "extreme drought" in some areas. Over 40 cities in Oklahoma had to impose some form of water rationing or restrictions on water use. The drought destroyed about half the hay and grass crop in the region, forcing cattlemen to sell their stock early. One rancher said it was the worst drought since 1936. (Pauls Valley Daily Democrat, August 18, 2006) Despite rains in spring and summer, extreme drought conditions remained through September

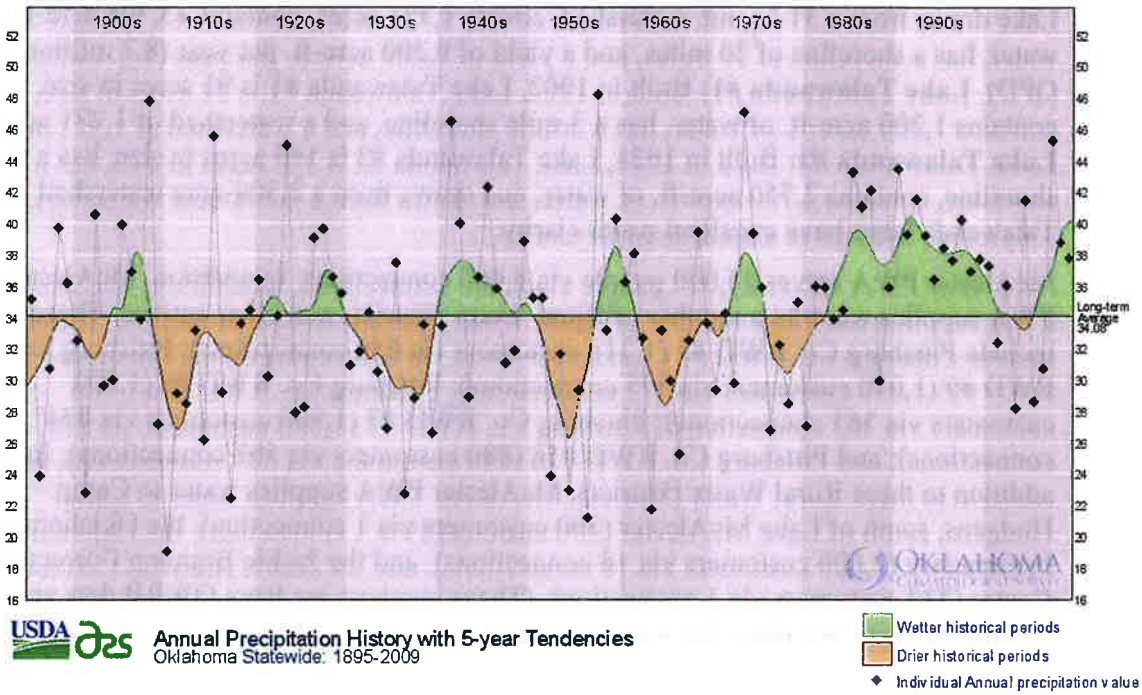
2006 in Choctaw, Haskell, Latimer, LeFlore, Pittsburg, Pushmataha and Sequoyah counties.

Probability/Future Events

As illustrated in Figure 4-29, Oklahoma has gone through six drought cycles, state-wide, since the early 1900s, with the latest being an almost 20-year period of wet weather lasting from about 1983 to 2003. If these trends continue, and the recent wet phase of the cycle is followed by a more or less equal number of dry years, then the State may well be facing a period of prolonged drought in the coming decades.

The City of McAlester and McAlester Public Schools have a low probability of adverse effects from a future drought event.

Figure 4–28: Annual Rainfall History from 1895-2009



Each of the 115 years in Oklahoma's precipitation history is represented with a black diamond, and the average of all years is shown as a horizontal line. Five year weighted trends within the record are shown in color. Green indicates period with greater-than-average, and brown indicates below-average precipitation.

As stated above, based on history and previous occurrences from the past 50 years, the McAlester jurisdictions can expect to experience the effects of a drought cycle every 10-15 years. However, as in the past, it can be expected that drought will have a more devastating effect on rural areas and the agricultural and ranching community than on urban residents.

4.8.3 Vulnerability

Drought and Water Conditions in Pittsburg County and McAlester

The City of McAlester and McAlester Public Schools are served with water by the McAlester Public Works Authority (PWA). McAlester PWA draws water from Lake

McAlester, with occasional extractions from Lake Talawanda 2. In emergencies, water is also available from nearby Lake Eufaula via the Pittsburg County Water Authority.

The primary impacts of drought in Pittsburg County have largely been to farming and ranching operations. Severe drought conditions have, on occasion, resulted in water shortages, or low levels at Lake McAlester. A secondary impact for both Pittsburg County and McAlester is the increased possibility of wildfire.

McAlester Water Supply

McAlester's water system capacity is 20 million GPD. The system has an average daily use of 5.04 million GPD, with a peak load of 8.28 million GPD. McAlester's water is supplied by two municipal lakes, with backup supplies available from Lake Eufaula. The City has three above-ground storage tanks.

McAlester Lake: Built by the City in 1930 for water supply and recreation, McAlester Lake draws from a 31-sq. mi. watershed, covers 1,521 acres, contains 13,398 acre-ft. of water, has a shoreline of 20 miles, and a yield of 9,200 acre-ft. per year (8.2 million GPD). **Lake Talawanda #1:** Built in 1902, Lake Talawanda #1 is 91 acres in size, contains 1,200 acre-ft. of water, has a 3-mile shoreline, and a watershed of 1,271 acres. **Lake Talawanda #2:** Built in 1924, Lake Talawanda #2 is 195 acres in size, has a 4-mile shoreline, contains 2,750 acre-ft. of water, and draws from a 2,304-acre watershed. Both Talawanda lakes have excellent water clarity.

McAlester PWA serves 25,000 people via 8,000 connections. In addition, McAlester PWA supplies water to a number of Rural Water Districts and other entities. These include Pittsburg Co. RWD #5 (1,215 customers via 650 connections); Pittsburg Co. RWD #9 (1,050 customers via 375 connections); Pittsburg Co. RWD #6 (1,500 customers via 565 connections); Pittsburg Co. RWD #7 (1,900 customers via 874 connections); and Pittsburg Co. RWD #16 (880 customers via 507 connections). In addition to these Rural Water Districts, McAlester PWA supplies water to Camp Hudgens, south of Lake McAlester (300 customers via 1 connection), the Oklahoma State Penitentiary (2,000 customers via 18 connections), and the Jackie Brannon Correctional Center (737 customers via 1 connection). (These numbers are from OWRB data and Oklahoma DEQ, for links, see 4.8.8 *Sources*.)

Population

With backup water supplies available from Lake Talawanda 1 and 2, as well as from Lake Eufaula via Pittsburg County Water Authority, McAlester's water supply is considered adequate for drought conditions.

The farmers and ranchers in the McAlester region are the populations most vulnerable to the effects of drought, as demonstrated in 1998, when there were significant crop and poultry losses, and forced cattle sales at depressed prices. (*Pittsburg County MHMP*)

Structures/Buildings

The primary threat to structures within the City of McAlester lies in the effect of drought on Expansive Soils. More information on this hazard is available in Section *4.9 Expansive Soils*.

Critical Facilities

Drought is not expected to produce effects that would prevent critical facilities from fulfilling their functions. In some communities drought can impact a jurisdiction's ability to fight both wildland and structure fires. The City of McAlester's water supply is sufficient enough so that the McAlester Fire Department does not consider this to be an issue for the jurisdictions.

Infrastructure

The effect of drought on infrastructure comes, for the most part, from its effect on expansive soils. Expansive soils can result in broken water lines and cracked roads and building foundations. McAlester's aging water lines are exposed the effects of drought on expansive soils.

Water Treatment – Drought increases the demand for water and at the same time may reduce the availability of raw water. Only on rare occasions has McAlester PWA had to withdraw water from Lake Talawanda to meet peak demand during times of high temperature and drought. Water is also available from Lake Eufaula, via Pittsburg County Water Authority. A secondary vulnerability to drought is McAlester's aging water distribution system, with many pipes now reaching 80-90 years of age. These pipes are increasingly vulnerable to drought's effect on expansive soils.

Wastewater Treatment – McAlester's wastewater facilities are not significantly vulnerable to a drought event.

Utilities- Pittsburg County has not experienced power shortages or brownouts due to drought from the power grid currently in place. However, with almost all electric power provided by AEP/PSO, which is largely generated from Wyoming coal and gas, the cost of fuel, particularly during times of drought and low river flow, could be vulnerable to sudden electricity price spikes. Altogether, Pittsburg County has low vulnerability to electric power shortages due to drought.

Transportation Systems (Highways, Railway, Airports) – Roadways could potentially face secondary impacts from drought, if located in an area if expansive soils.

Emergency Services- Fire services could potentially be affected if a severe drought reduces availability of water for fire suppression. Police and Medical services would not face any special vulnerability beyond those experienced by other City services/facilities.

4.8.4 Drought Scenario

Since the primary impact of drought is in the areas of agriculture, recreational outdoor activities, and the municipal water system, it is not considered necessary to include a specific Drought Scenario in this Multi-Hazard Mitigation Plan. Due to its adequate supply and backup resources, McAlester's water supply is considered to have a low vulnerability to drought. A prolonged drought would, however, impact the surrounding ranching and farming communities. As the economic hub of Pittsburg County, a significant downturn in agricultural revenues could impact businesses in McAlester and revenue flows to both the City and County governments.

4.8.5 Future Trends

For a map of McAlester's potential future development areas, see Figure 1-9. The 2000 Census projects a 12% growth of McAlester by 2030, or a population of 19,910. Given a corresponding 12% increase in water use, McAlester's daily water consumption in 2030 could be 5.65 million GPD, with a peak use of 9.27 million GPD.

Population

As drought is primarily an agricultural threat in nature, and McAlester is a largely urban jurisdiction, the population vulnerable to this threat would be primarily the ranching and farming community in the surrounding area. Significantly reduced income in the agricultural community could, however, impact the economy of McAlester and result in a drop in tax revenues for both the City and County governments.

Structures/Buildings

The primary threat to structures in the City of McAlester, including McAlester Public Schools, is the effect of drought on expansive soils. Any future development/renovations undertaken by the City involving structures/buildings located on expansive soils should consider mitigation measures for this hazard.

Critical Facilities

It is not expected that McAlester's critical facilities would be significantly impacted by drought. Nevertheless, the City and its Public Schools should have contingency plans that ensure that those facilities vulnerable to water shortages, such as daycares, nursing homes, medical clinics and hospitals, have adequate water to continue operation.

Infrastructure

Drought's most likely impact on future infrastructure would be due to expansive soils. As development within McAlester continues (both new and existing projects), the City's water delivery system should be monitored to ensure its integrity is consistent with increased demand. As an example, infrastructure deterioration, during the summer of 2009, a 12-inch, cast-iron water main in downtown McAlester ruptured at Choctaw Ave. and A St. and was replaced with PVC pipe. Due to various difficulties, the line was out of operation for 8 weeks. The location and composition of roadways should be reviewed to ensure appropriate materials and techniques are used. The City's main water supply sources should be monitored during drought events to ensure that water emergency trigger points are accurate and sufficient. The likelihood of future drought events in Oklahoma should stimulate the jurisdiction to ensure that its emergency plans are adequate for such a contingency.

4.8.6 Conclusions

The severe droughts of the 1930s led to the construction of Oklahoma's numerous hydroelectric dams and reservoirs, as well as to the implementation of new farming and conservation policies. However, more recent drought response and recovery activities in Oklahoma, both at the state and local level, have not been as ambitious or successful. Planning for the state's critical and emergency water resource needs should not be carried on only during drought crises. The focus should be on long-term water management and

planning, on integrating the activities of agencies with drought-related missions into a broad coherent approach, and on achieving better coordination of mitigation, response, and planning efforts between State, Federal and Tribal officials.

During most drought events, the agriculture sector receives the brunt of the impact, especially in non-irrigated areas such as dry land farms and rangelands. Other heavy water users, like landscapers, can also be negatively impacted. Droughts may exacerbate the effects of expansive soils, as well as result in power shortages. Another secondary impact of drought, wildfire, can seriously damage homes in the urban/rural interface, as well as destroy crops and harm livestock.

Because of its robust water supply, and backup sources of water from Lake Talawanda and Lake Eufaula, the City of McAlester and McAlester Public Schools are considered to have a low vulnerability to drought, and a low to moderate vulnerability drought's effects on expansive soils and wildfire.

Data Limitations

There are signs that drought is becoming an increasing problem in the United States, including Oklahoma. However, it is difficult to predict drought probabilities for the near future due to the nature and complexity of the hazard. The data for McAlester PWA and Pittsburg County Rural Water Systems was taken from the OWRB and Oklahoma DEQ websites. These numbers were not always in agreement, and in any case are subject to change. The "number of customers" for each Rural Water System, however, was pulled from OWRB's "2005 Rural Water Survey Update."

4.8.7 Sources

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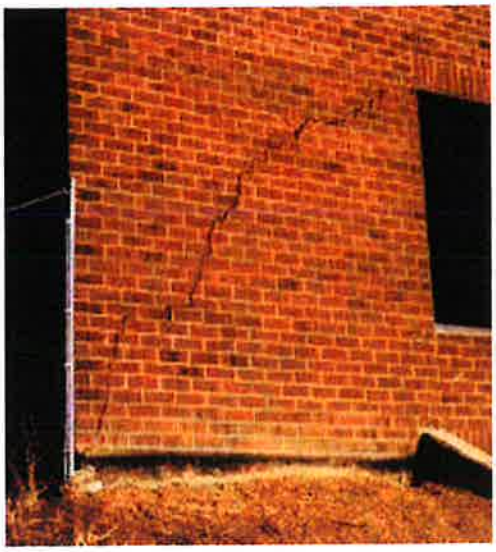
Oklahoma Water Systems, Pittsburg County Water Systems, Oklahoma DEQ, http://sdwis.deq.state.ok.us/JSP/WaterSystems.jsp?PointOfContactType=none&number=&name=&county=Pittsburg

Oklahoma Water Resources Board, Rural Water Systems of Oklahoma, http://www.owrb.ok.gov/maps/maps2/ruralwater.php, and http://www.owrb.ok.gov/maps/pdf_map/rws_contact_info.pdf.

Pittsburg County Hazard Mitigation Plan, McAlester, OK, 2005.

Beaty, James, "Drought, lack of hay force ranchers to sell." *Pauls Valley Daily Democrat*, August 18, 2006

4.9 Expansive Soils



Soils and soft rock that swell and shrink from changes in moisture content are commonly known as expansive soils. Expansive soils, also called shrink/swell soils, are sometimes referred to as swelling clays because clay materials attract and absorb water. Dry clays will increase in volume as water is absorbed and, conversely, decrease as they dry. These movements lead to cracking and buckling of the infrastructure built on or in expansive soils and result in billions of dollars of damage annually.

4.9.1 Hazard Profile

Changes in soil volume present a hazard primarily to buildings or infrastructure built on top of, or within expansive soils. Most often, these volume changes involve swelling clays beneath areas covered by buildings and slabs or layers of concrete and asphalt.

Location

Based on surveys of underlying soils, Figure 4–30 shows a generalized map of the areas of McAlester where soils have from low to very high expansive qualities.

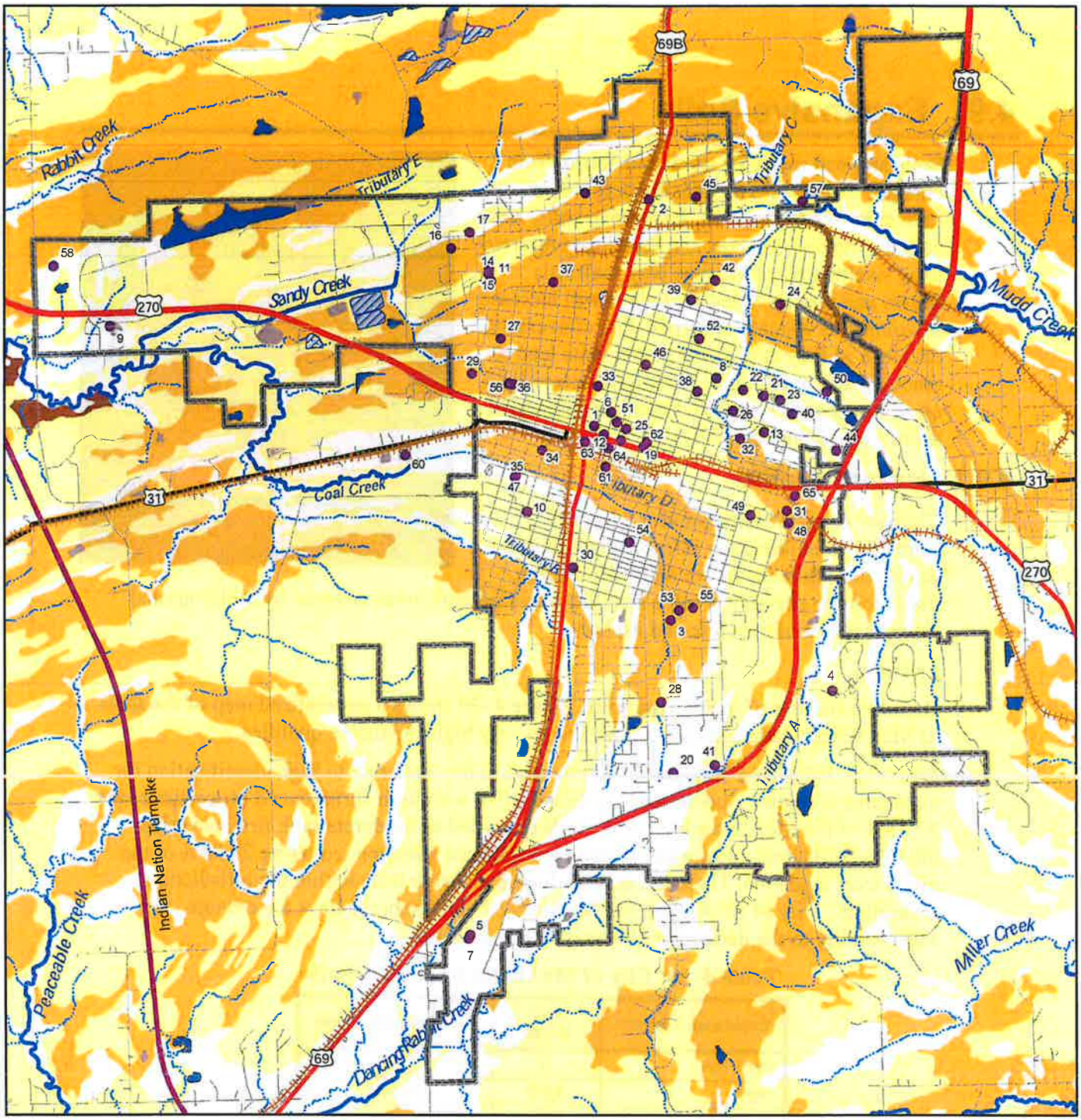
More than half of the soils in McAlester rank in the moderate to high classification for expansive potential. Specifically, soils classified with high shrink/swell properties cover 37.38% of the McAlester land area. Soils classified as moderate rank first, covering 38.56%. Soils with a low classification are the least common, covering 22.88% of the city's total land area. There are no very high expansive soils within the jurisdiction. Overall, the City of McAlester and McAlester Public Schools have a moderate vulnerability to the damaging effects of expansive soils.

Table 4–34: City of McAlester Expansive Soils

Expansion Potential	Area (acres)	% of Total City Limits
Very High	0	0%
High	3,579	37.38%
Moderate	3,663	38.26%
Low	2,190	22.88%
Not Rated	142	1.48%

Measurement

The risk associated with expansive soil is related to shrink/swell potential in a qualitative manner: very high, high, moderate and low.



Legend

City limits

Expansive Soils

% Linear Extensiblity

Low (0 - 3)

Moderate (3 - 6)

High (6 - 9)

Very High (9 - 30)

Not rated or not available

Miles

0 0.6 1.2

Critical Facilities

Railroads

US Highways

Streets and roads

Lakes and Ponds

Perennial Streams

Intermittent Streams

N W E S

Figure 4-29

City of McAlester

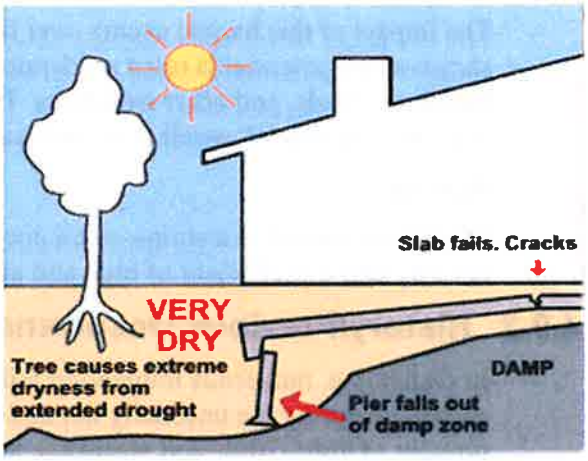
Expansive Soils

Table 4–35: Expansive Soils Linear Extensibility Percent

Expansion Potential	Linear Extensibility Percent
Very High	> 9%
High	6% - 9%
Moderate	3% - 6%
Low	< 3%
Water	0%

The National Resource Conservation Service (NRCS), in its Soil Survey Geographic Database (SSURGO), identified expansive soils for McAlester as shown in Figure 4–30. SSURGO map units were classified from low to very high based on the linear extensibility percent (LEP) for the soils within the identified map units to depths up to 60 inches—the depth at which damage to improvements from expansive soils is most likely to occur. Soil samples are dehydrated through air- or oven-drying for a predetermined length of time under a constant temperature. Linear extensibility percent is the linear expression of the volume difference of natural soil fabric at 1/3 bar or 1/10 bar water content and oven dryness. The volume change is reported as percent change for the whole soil. In addition, the Oklahoma Department of Transportation has a program to evaluate the expansive tendencies of soils and shale formations in the state.

Figure 4–30: Effects of Expansive Soils



Extent

Property damage can vary greatly across a jurisdiction, based on soil types, long-term weather conditions, the type and quality of construction, and materials used in construction. Other cases of damage involve increases of moisture volume from broken or leaking water and sewer lines, over-watering of lawns and landscape, and surface modifications that produce ponding.

Expansive soils are found in every state, and cover one-fourth of the United States. In 1980, the annual cost of expansive soil damage in the U.S. was estimated to be $7 billion, one-third of which was attributed to single family and commercial buildings (Wray and Meyer, 2004). Allowing for annual inflation and population growth, it is likely that total annual damages from expansive clay soils in the U.S. today may well exceed $15 billion. Although expansive soils are not life-threatening or cataclysmic as compared to other natural events, they are certainly a natural hazard. In fact, expansive soil damage exceeds the average annual damage caused by floods, hurricanes, earthquakes, and tornados combined. Expansive soils are frequently overlooked as a major problem because it takes

years for them to cause extensive damage. However, in reality, expansive soils are a widespread and costly natural hazard.

The effects of expansive soils are most prevalent in regions of moderate to high precipitation, where prolonged periods of drought are followed by long periods of rainfall. The most problematic soil type for expansive soils is found in the semiarid west-central United States.

The extent of damage from expansive soils can be reduced by mapping the soils in the jurisdiction and by notifying property owners and prospective buyers and builders of potential soil hazards and the techniques that can be used to limit their impacts.

Frequency

Local frequency analyses have not been prepared because of the nature of this hazard, which is consistent with other geologic hazards that occur rarely or slowly over time.

Impact

The impact of this hazard occurs over time and affects structures and infrastructure. If the shrink-swell potential is rated moderate to very high, shrinking and swelling can damage buildings, roads, and other structures. The high degree of shrinkage associated with high and very high shrink-swell potentials can damage plant roots.

Severity

McAlester considers a shrink-swell coefficient of moderate and below to be of minor severity and a coefficient of high and above to be major severity.

4.9.2 History/Previous Occurrences

In Oklahoma, numerous foundation failures and pipeline breaks resulted from soil shrinkage during the unusually hot and dry summers of 1998 and 2005-2006. During the drought of 2005-2006, soil shrinkage led to water main and sewer pipe breaks and leaks in many Oklahoma cities, including Holdenville, Okmulgee, Muskogee, and Ada.

For example, expansive soils are having a serious impact on Ada's aging water infrastructure, particularly during the drought and high temperature conditions of 2006. In July 2006, Ada lost about 2.5 MGD (million gallons a day) from its water distribution system due to breaks, leaks, and unmonitored (but authorized) use. Similar problems have plagued Okmulgee's water distribution system. Both cities have instituted aggressive pipeline maintenance programs to counter the effects of soil shrinkage during periods of prolonged drought.

The City of McAlester does not have a record of specific structures or infrastructure that have been damaged by expansive soils. If the City begins to identify such damage, it will be noted in future updates of this Plan.

Cracks in exterior walls caused by soil expansion

Probability/Future Events

It can be assumed that shrink-swell soils in McAlester will cause localized problems in areas of high to moderately expansive soils. Areas of particular concern are those with highly expansive soils along Sandy Creek Tributaries B and D in southwest and south central McAlester, which includes the land beneath the South Fire Station, Puterbaugh Middle School and Will Rogers Elementary School. Pittsburg County Animal Shelter at 1204 N. West St., Arvest Bank at 101 S. 3rd St., and the Adult Education Office at 2801 N. A St. The City should continue its efforts to educate builders and property owners in these parts of its future growth areas of soil conditions and remediation measures.

The City of McAlester and McAlester Public Schools have a moderate probability of future expansive soils effects.

4.9.3 Vulnerability

Many researchers show that expansive soil is one of the most costly hazards in the United States, in terms of property damage from shifting soils. For example, out of the 250,000 homes built each year on expansive soils, 10% sustain significant damage during their useful lives, some are damaged beyond repair, and 60% sustain minor damage. For all types of building construction, annual losses of $740 million are estimated. The total annual cost of expansive soil-related damage and preventive design of moderate- to high-risk structures throughout the United States has been conservatively estimated at between $2.5 billion and $10 billion (in 1995 dollars).

Despite its costly effects, expansive soil is a silent hazard. Because the hazard develops gradually and seldom presents a threat to life, expansive soils have received limited attention. Many problems are not recognized as being related to expansive soils or may be considered only nuisances and therefore are never repaired.

The City of McAlester and McAlester Public Schools do not monitor damage due to expansive soils as being the result of a specific natural hazard. In addition, since only about 10% of the city is located on soils with a "high" shrink/swell potential, the jurisdictions are not significantly exposed to such damage. Nevertheless, because of the city's aging infrastructure, particularly its century-old roads and cast iron water and sewer pipes, the McAlester jurisdictions could be facing increased vulnerability to expansive soils.

Population

Due to the nature of the hazard, direct threats to life or personal injury from expansive soils are minimal.

Structures, Buildings

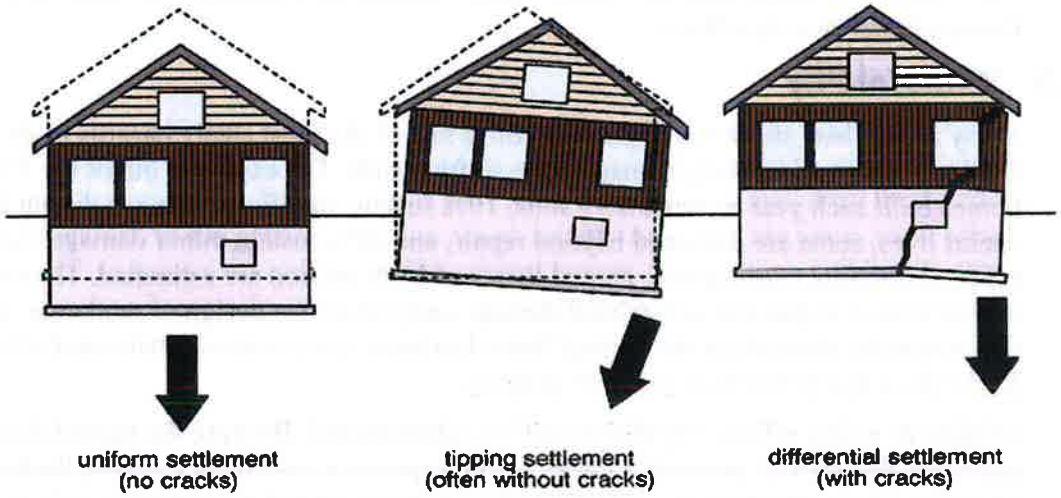
The increase in soil volume that results from expanding soil can cause damage to foundations. The most obvious manifestations of such damage are sticking doors, uneven floors, and cracked foundations, floors, walls, ceilings, and windows. If damage is severe, the cost of repairs may exceed the value of the building.

It does not take much movement to damage buildings. As little as a differential movement of 0.25 inches between adjacent columns can cause cracking in load-bearing walls of a 2-foot wide bay.

Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings, which usually are heavy enough to counter swelling pressures. However, if constructed on wet clay, multi-story buildings may be damaged by shrinkage of the clay if moisture levels are substantially reduced, such as by evapotranspiration or by evaporation from beneath heated buildings.

The greatest damage occurs when small buildings are constructed when clays are dry, such as during a drought, and subsequent soaking rains swell the clay. Other cases of damage involve increases of moisture from broken or leaking water and sewer lines, over-watering of lawns and landscape, and surface modifications that produce ponding.

Figure 4–31: Types of Expansive Soil Damage



Critical Facilities

Twenty-Three of McAlester's Eighty-Seven critical facilities (see Table 4-36) are built upon soils classified as having a high shrink/swell potential. The remainder of McAlester's critical facilities is on either low or moderate shrink/swell soils.

Table 4–36: Critical Facilities on High Shrink/Swell Soils

ID	Facility Name	Shrink –Swell Potential	ID	Facility Name	Shrink –Swell Potential
2	McAlester Fire Dept. - North Station	High	36	McAlester Pre-K / Headstart W.M	High
3	McAlester Fire Dept. - South Station	High	37	Mitchell Manor	High
11	Pittsburg County Animal Shelter	High	42	Widening Horizons	High
14	Pittsburg County Juvenile Detention Center	High	43	Adult Education Office	High
15	Pittsburg County Sheriff	High	45	Edmond Doyle Elementary School	High
16	Jackie Brannon Correctional Center	High	48	Kiamichi Technology Center	High
24	Blevins Retirement	High	53	Puterbaugh Middle School	High

ID	Facility Name	Shrink –Swell Potential	ID	Facility Name	Shrink –Swell Potential
27	Colonial Lodge	High	55	Will Rogers Elementary School	High
28	Happy Hearts Christian Daycare	High	56	William Gay Early Childhood Center	High
29	Heritage Hills	High	61	Arvest Bank	High
31	KAVTS Child Dev Lab	High	65	The Bank NA	High
34	Little Tykes Learning Center	High			

Infrastructure

Damage to the built environment results from differential vertical movement that occurs as clay moisture content adjusts to the changed environment. In a highway pavement, differential movement of 0.4 inches within a horizontal distance of 20 feet is enough to pose an engineering problem if high standards for fast travel are to be maintained. In addition, as mentioned above, expansive soils pose a significant threat to McAlester's aging pipelines, particularly corroded water and sewer lines and pipelines for volatile petroleum products.

4.9.4 Expansive Soils Scenario

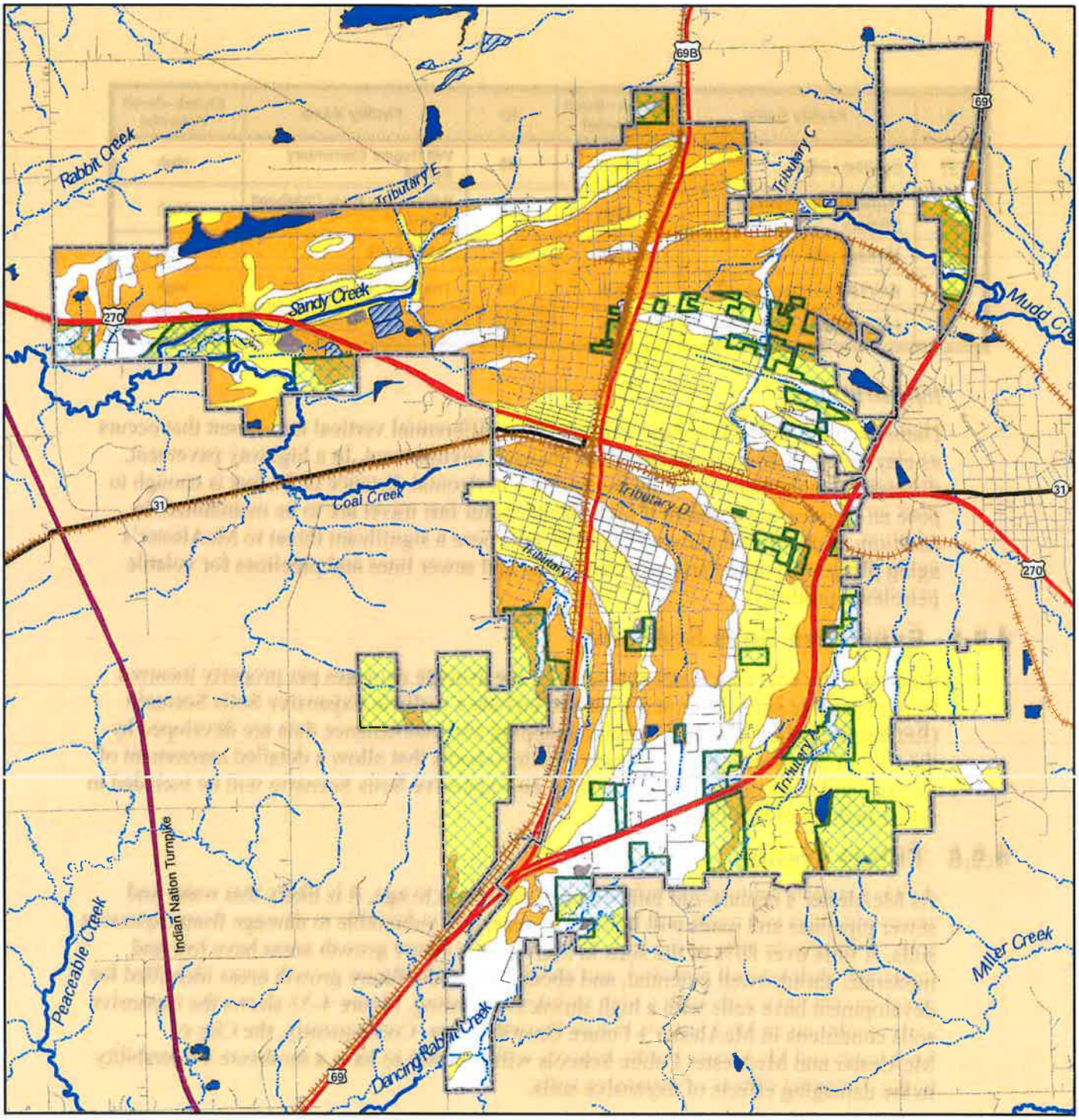
Since specific cost data is not available for the average damages per property incurred from expansive soils, it is not possible to include a realistic Expansive Soils Scenario (Reference Section 4.9.5). If research mapping and maintenance data are developed by the City of McAlester and McAlester Public Schools that allow a detailed assessment of damage and costs due to expansive soils, an Expansive Soils Scenario will be included in future updates of this Plan.

4.9.5 Future Trends

As McAlester's century-old infrastructure continues to age, it is likely that water and sewer pipelines and roads will become increasingly vulnerable to damage from expansive soils. A little over 80% of the soils in McAlester's future growth areas have low and moderate, shrink-swell potential, and about 18% of the future growth areas identified for development have soils with a high shrink/swell rating. Figure 4-33 shows the expansive soils conditions in McAlester's Future Growth Areas. Consequently, the City of McAlester and McAlester Public Schools will continue to have a moderate vulnerability to the damaging effects of expansive soils.

Table 4–37: Expansive Soils in McAlester's Future Development Areas

Expansion Potential	Area (acres)	% of Future Growth Area	% of Total City Limits
Very High	0	0%	0%
High	288	18.41%	3.01%
Moderate	1009	64.52%	10.54%
Low	264	16.88%	2.76%
Not Rated	3	0.19%	0.03%



Legend

- City limits
- Future Growth Areas

Expansive Soils rating

- low
- moderate
- high
- not rated

Miles 0 0.5 1

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

McALESTER, OKLAHOMA 1908 FAITH - HOPE - PROSPERITY

Figure 4-32

City of McAlester

Future Growth Areas and Expansive Soils

Population

Direct threats to life or personal injury have not generally been documented for expansive soils because of the nature of the hazard. The primary threat is economic.

Structures / Buildings

Damage to structures in McAlester can be expected during and following any period of extended drought. This is especially true of structures built during a period of a drought followed by soaking rains that cause swelling of clays. As McAlester develops those parcels with high shrink/swell soils, builders and property owners should be informed of the hazard and of measures that can be taken to lessen its impact.

Critical Facilities

Care should be taken to avoid locating future critical facilities on soils with a high shrink/swell potential, since doing so could shorten the structure's lifespan and increase maintenance costs. In addition, long-term structural damage to buildings housing vulnerable populations, such as schools and care facilities, could place their occupants at risk if the weakened building is exposed to other natural hazards.

Infrastructure

Long referred to as the "unknown hazard," expansive soils may have more of a future than a past. As McAlester's infrastructure continues to age, particularly its water and sewer lines built at the beginning of the last century with materials and techniques that would not meet today's codes, a prolonged period of drought could significantly speed up infrastructure deterioration. For example, aging gas and water pipelines, especially when originally constructed in wet soil, can rupture during periods of extended drought. The rehabilitation of roads and aging central business districts will likely include the replacement of much of the city's infrastructure that lies underground, especially if located in expansive soils. The use of the more flexible PVC or HDPE piping could reduce the impact of expansive soils.

4.9.6 Conclusions

The impacts from expansive soils develop gradually and are seldom a threat to the population, but can cause severe damage to improvements built upon them. The history of McAlester's and McAlester Public Schools' expansive soil hazard is difficult to track, because neither the City nor the Public Schools monitor damage from expansive soils as the impact of a specific natural hazard, but treat all such damage as a maintenance issue. According to City engineering staff, the expansive soil hazard is routinely taken into account in engineering studies and construction practices for infrastructure projects, but is not specifically documented.

Only six of McAlester's 86 critical facilities are located on soils with a high shrink/swell potential. These include three Public Schools facilities (two schools and one administrative building), one City fire station, a County animal shelter, and one bank. The hazard does not affect these facilities' ability to fulfill their critical functions.

Less than 10% of McAlester's identified future growth areas have soils with a high shrink/swell rating. If developed, they would increase the jurisdictions' exposure to the hazard by about 1%.

With 88% of McAlester's soils classified as having low to moderate shrink/swell potential, and only 12% in the high category, the City of McAlester and McAlester Public Schools are considered to have a low vulnerability to the damaging effects of expansive soils.

Data Limitations

Data are limited for McAlester-specific hazard risk, vulnerability, impacts, preventive measures, costs, and benefits for damage to buildings, critical facilities, and infrastructure due to a lack of specific record keeping, as referenced in Section 4.9.5.

4.9.7 Sources

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Landslides and Expansive Soils in Oklahoma, at Web address: www.ou.edu/special/ogs-pttc/earthsci/landsl.htm. Oklahoma Geological Survey, Earth Sciences, October, 1998.

Multi-Hazard Identification and Risk Assessment, p. 122–125. Federal Emergency Management Agency, 1997.

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4.10 Urban Fires

Structure fire is the fifth leading unintentional cause of injury and death in the United States, behind motor vehicle crashes, falls, poisoning by solids or liquids, and drowning. Fire kills more Americans than all natural disasters combined. It also ranks as the leading cause of death for children under the age of 15 at home. Approximately 80% of all fire deaths occur where people sleep, such as in homes, dormitories, barracks, or hotels. The majority of fatal fires occur when people are less likely to be alert, such as nighttime sleeping hours. Nearly all home and other building fires are preventable, even arsons. In 2005 (the most recent year the *National Center for Health Statistics* compiled data), Oklahoma ranked third in number of per capita fire deaths with 28.7 deaths per million residents.

4.10.1 Hazard Profile

Location

While the entire community is at risk from urban structure fires, there are some factors that can increase or decrease the risk of a fire occuring in a given location. Average age of structures, type of construction, and location relative to fire stations can all influence the likelihood or extent of damage of structure fires.

Fire Fighters responding to a house fire, one of thousands that occur every year across the state

Historic properties in particular, due to a lack of applicable modern fire codes at the time of construction, and the reliance on older building materials, are at an increased risk of the initiation of fire, and an increased damage level. Alternative heating methods often used in older homes can also increase the potential for fire.

Measurement

Reports on fires are submitted by local fire departments to the State Fire Marshal's Office. This information is summarized to show community, county and state summaries. This allows the number of fires that a community has to be measured against state and national averages.

Extent

Various factors can determine the extent of an urban fire. The contents and age of a structure influence the extent of an urban fire, as do the local weather conditions. Damages from urban fire can range from minor to substantial with damages far exceeding the value of the structure. In recent years, the impact of urban fire has been greatly reduced due to the improvements in firefighting technology and training of local fire management officials. Improvements in building codes and technology have also enhanced a jurisdiction's ability to contain and mitigate the damage caused by urban fire. Although the extent of an urban fire cannot be qualitatively measured until the fire has

occurred and damage assessed, the likely impact of an urban fire can be affected by public information about common fire hazards, notification techniques and procedures, fire department response speed, structure type and age, density of development, presence of flammable substances, water pressure and availability, and the use of smoke alarms.

Cooking is the leading cause of home fires in the U.S. It is also the leading cause of home fire injuries. Cooking fires often result from unattended cooking and human error, rather than mechanical failure of ovens and stoves.

Eighty-three percent of all civilian fire deaths occur in residences, and careless smoking is the leading cause of those fire deaths. In 2002 alone, lighted tobacco products caused an estimated 14,450 residential fires, 520 civilian deaths, 1,330 injuries, and $371 million in residential property damage.

Frame houses are particularly vulnerable to urban fire

Heating is the second leading cause of residential fires and the second leading cause of fire deaths. However, heating fires are a larger problem in single-family homes than in apartments. Unlike apartments, the heating systems in family homes are often not professionally maintained.

Arson is the third leading cause of both structural fires and structural fire deaths. In commercial properties, arson is the major cause of deaths, injuries and dollar loss. Arson resulted in an estimated $664 million in property damage in 2005 (approximately 6.9% of all fire property loss). *(Source: National Fire Protection Association)*

In addition, fires are an excellent example of how natural hazards interact in ways that spiral out of control. Lightning, high winds, earthquakes, volcanoes, and floods can all trigger or exacerbate fires. Flammable liquid containers or pipelines may be breached. Downed power lines may provide an ignition source. Leaking gas lines and damaged or leaking propane containers, tanks or vehicles may explode or ignite. In addition, when the power is out, unsafe alternative heating sources, candles, or improperly used generators may trigger fire and asphyxiation dangers. Moreover, the disaster conditions may hinder or prevent firefighters from being able to suppress or even reach a fire event.

The leading cause of death in a fire is asphyxiation by a three-to-one ratio over burns. Fire consumes the oxygen and increases the concentration of deadly carbon monoxide and other toxic gases in the air. Inhaling carbon monoxide or some of the other by-products of modern building and upholstery materials can cause loss of consciousness or death within minutes. Fire generates a black, impenetrable smoke that blocks vision and stings the eyes, making it often impossible to navigate and evacuate a burning building. Fire can also produce temperatures in a room far more quickly and far greater than many people anticipate. Where temperatures close to the floor may be survivable, 5-6 feet above the floor the temperature may be hundreds of degrees, and temperatures near the ceiling may reach 1000-1500 degrees Fahrenheit very quickly.

Frequency

According to the U.S. Fire Administration, for the period from 1999 through 2007, there was an average 1,664,800 fires each year in the United States, in which an average 3,940 Americans lost their lives and another 19,485 injured. Average dollar loss was $14,294 million. Structure fires accounted for approximately 34.1% of all fires and 87% of all deaths and injuries. Approximately 78% of all structure fires were residential. (*Source: National Fire Protection Association Fire Loss in the U.S. 2007.)*

During the 10-year period from 2000 to 2009 (the latest year the State Fire Marshal has complete local data) the City of McAlester experienced a total of 409 structural fires, 18 injuries, 8 deaths, and over $12.2 million in fire damage, including fires in critical facilities. Given this limited data, McAlester can expect 40 structure fires per year that do about $1.220 million in damage annually.

Impact

The impact of urban fire can be death and injury to civilians or emergency personnel, the loss of homes and businesses, and the loss of employment and local revenue streams. The loss of homes, businesses, and jobs can be devastating to families and communities.

Severity

McAlester considers an event of minor severity to be $5,000 or less in damages and no loss of life or injury and an event of major severity to be more than $5,000 in damages or loss of life or injury.

4.10.2 History/Previous Occurrences

The City of McAlester, during the 10-year period from 2000 to 2009, (the latest year the State Fire Marshal has complete local data) experienced a total of 409 structural fires, 18 injuries, 8 deaths, and over $12.2 million in fire damage, including fires in critical facilities. Table 4-38 details the type and number of fires, along with damages related to non-critical facilities fires.

Table 4–38: McAlester Urban Fire Damages 2000-2009

Year	Single Family		Apartment		Mobile Homes		Other Residential		Office/ Commercial		Warehouse/ Industrial		Total	
	#	Dmg	#	Dmg	#	Dmg	#	Dmg	#	Dmg	#	Dmg	#	Dmg
2000	58	$183,400	0	$0	0	$0	0	$0	0	$0	0	$0	58	$183,400
2001	40	$300,000	0	$0	0	$0	0	$0	0	$0	0	$0	40	$300,000
2002	29	$134,500	3	$1,000	0	$0	3	$0	2	$1,000	3	$10,000	40	$146,500
2003	30	$94,000	1	$1,000	0	$0	0	$0	1	$0	0	$0	32	$95,000
2004	24	$835,000	3	$20,000	2	$30,000	2	$1,000	2	$76,000	2	$1,000	35	$963,000
2005	29	$268,025	1	$0	0	$0	3	$3,000	2	$800,000	4	$9,500	39	$1,080,525
2006	29	$613,500	0	$0	2	$0	5	$0	1	$0	7	$14,150	44	$627,650
2007	24	$146,000	4	$26,000	1	$0	1	$0	0	$0	6	$8,083,000	36	$8,255,000
2008	20	$119,000	2	$0	0	$0	1	$0	0	$0	3	$125,000	26	$244,000
2009	20	$159,000	3	$40,000	0	$0	3	$155,000	2	$0	3	$0	31	$354,000
Totals	303	$2,852,425	17	$88,000	5	$30,000	18	$159,000	10	$877,000	28	$8,242,650	381	$12,249,075

Source: Oklahoma State Fire Marshal

The vulnerability of critical facilities to fire is of special importance because a fire may damage a community's ability to continue normal or emergency operations, or impact vulnerable populations. Critical facilities that deserve special attention include nursing and retirement homes, hospitals and clinics, child care centers, correctional institutions, schools and colleges. McAlester experienced 28 fires in critical facilities from 2000-2009, which resulted in $15,000 in financial losses, as shown in Table 4-39.

Table 4–39: McAlester Urban Fire Damages in Critical Facilities 2000-2009

Year	Nursing		Childcare		Hospitals		Correctional		School/ University		Public Assembly		Total	
	#	Dmg	#	Dmg	#	Dmg	#	Dmg	#	Dmg	#	Dmg	#	Dmg
2000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
2001	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
2002	0	$0	0	$0	0	$0	1	$0	0	$0	0	$0	1	$0
2003	0	$0	0	$0	3	$0	0	$0	0	$0	0	$0	3	$0
2004	0	$0	0	$0	0	$0	0	$0	0	$0	1	$10,000	1	$10,000
2005	0	$0	0	$0	0	$0	0	$0	0	$0	2	$0	2	$0
2006	9	$0	0	$0	3	$0	0	$0	0	$0	0	$0	12	$0
2007	1	$0	0	$0	1	$0	1	$0	0	$0	3	$5,000	6	$5,000
2008	0	$0	0	$0	0	$0	0	$0	0	$0	1	$0	1	$0
2009	1	$0	0	$0	0	$0	1	$0	0	$0	0	$0	2	$0
Totals	11	$0	0	$0	7	$0	3	$0	0	$0	7	$15,000	28	$15,000

Source: Oklahoma State Fire Marshal

Table 4-40 details the type and number of casualties related to the urban fires.

Table 4–40: McAlester Urban Fire Injuries & Deaths 2000-2009

Year	Civilian Injuries	Civilian Deaths	Firefighter Injuries	Firefighter Deaths	Total Injuries	Total Deaths
2000	0	1	2	0	2	1
2001	0	0	2	0	2	0
2002	4	0	0	0	4	0
2003	2	1	0	0	2	1
2004	0	2	0	0	0	2
2005	0	1	0	0	0	1
2006	2	2	0	0	2	2
2007	0	0	1	0	1	0
2008	1	0	0	0	1	0
2009	0	1	4	0	4	1
Totals	9	8	9	0	18	8

Source: Oklahoma State Fire Marshal

Probability/Future Events

Real progress has been made nationally in reducing the number of urban fires and fire-related fatalities. Nationally, in 1977 there were 3,264,500 fires, and 5,865 fatalities. By 2008, both figures have been reduced significantly to 515,000 fires, and 2,900 fire-related deaths.

The City of McAlester and McAlester Public Schools have a high probability of a future urban fire event.

4.10.3 Vulnerability

Population

In residences, the majority of fatal fires occur when people are less alert or sleeping. Victims are disproportionately children or elderly. Of the fires that kill children, two out of five are started by children playing with fire.

States with the highest density of populations tend to have the greatest number of fire-related fatalities. Some of the vulnerabilities peculiar to Oklahoma are related to flooding, lightning events, and winter storms that result in power outages. These can trigger urban fires, or create conditions that lead to fire, such as the use of alternative heating sources in older homes.

Structures/Buildings

In many cases, communities with aging infrastructures may be more susceptible to urban fire due to the flammability of materials used in construction and number of structures built before current fire safety, plumbing and electrical codes were implemented. The National Association of Home Builders (NAHB) makes the statement in their *Housing Economics* publication:

> "An overarching cause of residential fire deaths is the age of the dwelling. Both known studies that have looked at this question have found that older structures burn much more frequently than newer ones."

Consequently, while any building is vulnerable to fire, particular attention needs to be paid to lower-income neighborhoods with older residences and aging commercial structures.

Almost half (47.3%, or 3,480 out of 7,366 units) of McAlester's residential structures were built before 1960. As a result, McAlester has a significant exposure to urban fire damage.

Critical Facilities

Critical Facilities are prone to the same caveats as listed under Structures/Buildings above. Many critical facilities, from retirement homes to Emergency Operations Centers, are located in older buildings with their intrinsic greater fire susceptibility. The City of McAlester's critical facilities are listed in Table 1-6, and are mapped in Figure 1–10.

All critical facilities within the City of McAlester jurisdiction should be considered vulnerable to the effects of an urban fire event. Structural integrity may be compromised with even a small fire, rendering the structure unusable.

Infrastructure

Water Treatment – The most significant effect during an urban fire event would be from loss of electrical power. McAlester's water treatment plant is located north of the dam at Lake Talawanda #2, and is not at risk from an urban fire event in McAlester.

Wastewater Treatment – The most significant threat to the operation of McAlester's two wastewater treatment facilities during an urban fire event would be from power outages. The plants are not at risk from an urban fire event.

Utilities – The primary utility providers for McAlester's jurisdiction is AEP/PSO (electricity) and ONG (natural gas). The service stations and substations for both of these providers would be vulnerable to the risks from an urban fire event. **Electricity:** During an urban fire event, providers of electrical service could experience any combination of the following challenges in meeting the needs of the McAlester jurisdiction: Destruction of distribution and transmission poles, downed broken power lines, and danger to workers derived from downed power lines. **Gas:** During an urban fire event, providers of gas service to a community could experience a variety of challenges in meeting the needs of the McAlester jurisdiction: downed power lines, inaccessibility to underground gas meters, and extreme temperatures.

Transportation Systems (Highways, Railway, Airports) – Highways and main thoroughfares in McAlester could potentially be vulnerable to secondary effects from an urban fire event. Smoke blowing across the highway could create limited visibility. Depending on location of event, an increased presence of emergency vehicles could slow or inhibit traffic flow on main thoroughfares into and out of the city.

Emergency Services- Fire, Police and Medical services would all be similarly at risk to the secondary effects of an urban fire event. Emergency personnel on scene would be vulnerable to the cumulative affects of heat generated by the fire itself. Call volume to all emergency service agencies could increase dramatically if it is a large scale event. Likewise, medical services in the area could become taxed should the fire event encompass several units / buildings and include multiple injuries.

McAlester firefighters carry hose after battling the blaze that destroyed the Diversified Foods plant during the January 2007 ice storm

4.10.4 Urban Fire Scenario

Most Urban structure fires are limited to one structure. Fire departments are usually very successful at limiting the exposure of surrounding structures, and containing the damage. With that in mind, there are too many variables to attempt to create a "worst case scenario" for an urban fire event. It would vary depending on the time of day, type of occupancy at the time of event, season of the year, and many other factors. A worst-case event would likely be a fire in one of the city's primary employers/revenue generating enterprises, or a fire in a facility containing hazardous chemicals.

In fact, such an event occurred on Thursday, January 18, 2007, during one of the worst ice storms in McAlester's history, when fire broke out at the Diversified Foods and Seasonings Company's plant at the Steven Taylor Industrial Park west of the city. The plant contained 29,000 pounds of anhydrous ammonia, which began leaking as a result of the fire, forcing the evacuation of 40 homes within a 1-mile radius. While temperatures dropped well below freezing, all of McAlester's firefighters, including those off duty, were called in to battle the fire. They were aided by crews from Krebs, Crowder and the Army Ammunition Plant. The fire, which began about 7 p.m., was brought under control at 2:00 a.m. Friday. Evacuated residents, some of whom went to McAlester's two shelters, were allowed to return to their home on the 19th. No injuries were reported. The

cause of the fire, which destroyed the building, was undetermined. It was later learned that the sprinkler system at the plant had been turned off. The Diversified Foods and Seasonings plant had only recently moved to McAlester, having relocated out of Louisiana in the wake of Hurricane Katrina.

In this close to worst-case scenario, the McAlester Fire Department, which has trained toxic materials responders, a HazMat trailer from Homeland Security, and an ISO rating of 4, responded well: citizens were evacuated from the hazard area, fire departments were called in from surrounding areas according to mutual aid agreements, and although the entire plant was destroyed, no injuries or deaths resulted.

4.10.5 Future Trends

All potential development areas for the City and McAlester Public Schools are equally at risk from structure fires, with the following considerations.

Population

Seniors are frequently at higher risk from fire injury or death in connection with a decrease in mobility skills, or due to living in older residential structures. With the aging of the population, educational programs that target seniors and senior living centers may become increasingly significant.

With a more challenging economy comes the increased inability to afford adequate daycare resources for young children. Younger children left on their own, or caring for younger siblings are at a higher risk from accidental fires.

Structures/Buildings

All new and refurbished structures are vulnerable to the potential effects of an urban fire event.

Ensuring that all future commercial and residential development includes appropriate fire detection/protection devices is of considerable importance. The need for fire/smoke detector systems (hardwired with battery backup), sprinkler systems (where appropriate) and fire extinguishers should be considered for all new construction projects.

Properties being refurbished should be evaluated for their resistance to fire, and their compliance to current City codes.

Critical Facilities

Regarding the urban fire hazard, critical facilities need to be especially cognizant of "code plus" fire safety requirements. Sprinkler systems, alarm systems, fire resistant roofing and building materials, fire resistant landscaping, and other features are especially important for facilities that cannot afford to be put out of commission.

Infrastructure

Ensuring a minimized effect on the delivery of firefighting service requires forethought and planning while in the development stage. Any plans for areas currently under development or being considered for development should include the provision for adequate water supplies for firefighting over and above residential or business usage.

Adequate streets design to support the arrival, deployment, and departure of firefighting units should also be taken into account.

The City is in the process of upgrading its aging municipal infrastructure, particularly its roads and cast-iron water pipes. During the summer of 2009, when a 12-inch, cast-iron water main in downtown McAlester ruptured at Choctaw Ave. and A St., it was replaced with PVC pipe. Due to various difficulties, the line was out of operation for 8 weeks. Obviously, broken water lines can interfere with firefighting operations, particularly in the older urban areas, some of which in McAlester are nearing 90 years of age.

4.10.6 Conclusions

Fires occur year-round, but the rate of residential fires during the U.S. holiday season and in January is twice that of the summer months. Advances in building codes have made large inroads into the number of fire casualties and damages. In addition, public information and education on fire safety and smoke alarms have proven very successful in reducing residential fires and fire-related deaths. Information campaigns can be particularly effective, if geared around the times of year and populations outlined above.

A number of factors influence the degree of risk from urban fires for the City of McAlester and McAlester Public Schools.

- The percentage of older structures (built before 1960) is above the state average (47.3% vs. 31.1%);
- The history of casualties due to urban fires listed above is slightly higher than the state numbers (1 casualty per 15.7 fires vs. state figures of 1 casualty per 19.2 structure fires);
- The City of McAlester has a number of public information and education programs in place that include fire safety;
- The City of McAlester has an ISO Fire Protection Rating of 4 (see Section 2.1.3 for more information).

These factors would place The City of McAlester's and McAlester Public Schools' risk from urban fires in the moderate category. As the most common type of disaster, public information about the urban fire hazard should continue to be a strong mitigation response, and other possible mitigation measures should be reviewed.

Data Limitations

Data concerning temperatures in McAlester during the January 2007 ice storm is not available from the National Weather Service's Climatological Survey due to power outages at the McAlester Municipal Airport. Temperatures at the Tulsa International Airport dropped into the mid 20s on the night of January 18, when the Diversified Foods plant was destroyed by fire.

Data is sometimes turned over to the State Fire Marshal's more than a year after the events occurred, and it then takes time for it to be entered into the state database. Consequently, complete data is frequently 1-2, or more, years behind. In addition, the Fire Marshal's office does not list actual number of events, but number of "fire department runs." The McAlester Fire Department may send a unit for "smoke in a

building" at a retirement home, but the units will return to station quickly, and no damage will occur. Because of this, the number of "structure fires" in the above tables may be higher than the occurrence of significant events.

A statement from the U.S. Fire Administration *Residential Structure and Building Fires* October 2008 report highlights some of these issues:

"As troublesome as insufficient data for the various NFIRS [National Fire Incident Reporting System] data items can be, equally challenging is the apparent non-reporting of injuries and property loss associated with the fire incident (although the latter is notoriously difficult to quantify). It is exceedingly rare that a fire department experiences no firefighter injuries of any type. Yet there are fire departments, large and small, that report no firefighter injuries or a minuscule number of them, but report fires. Fire, by its nature, is destructive. Yet there are many reported fires where the flame spread indicates damage but no property loss is indicated."

4.10.7 Sources

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4.11 Wildfires

As more people make their homes in woodland settings in or near forests, rural areas, or remote mountain sites, they face the real danger of wildfire. Wildfires often begin unnoticed and spread quickly, igniting brush, trees, and homes.

Wildfires can move on three different levels. A *surface fire* is the most common type and burns along the surface of grasslands or forests, usually moving quickly through an area. A *ground fire* is usually started by lightning and burns on or below the forest floor in the humus layer down to the mineral soil, mostly by smoldering combustion. A *crown fire* has ascended from the ground into the forest canopy, spreads rapidly by wind and moves by jumping along the tops of trees.

While many people associate wildfires with forest fires, fast-moving grass and wildland fires are the biggest threat in Oklahoma

4.11.1 Hazard Profile

Wildfire is a serious and growing hazard over much of the United States, posing a great threat to life and property, particularly when it moves from forest or rangeland into developed areas. However, forest and grassland fires are a natural process, and help to maintain healthy ecosystems. Naturally occurring or non-native species of trees, brush, and grasses fuel wildfires.

Fire suppression is now recognized to have created a larger fire hazard, because live and dead vegetation accumulates in areas where fire has been excluded. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, United States land management agencies are committed to finding ways of reintroducing fire into natural ecosystems (such as prescribed burning) while recognizing that fire fighting and some types of fire suppression are still important.

According to FEMA, as stated in the report *Multihazard Identification and Risk Assessment*, there are four categories of wildfires experienced throughout the United States:

- **Interface or intermix** fires are fires that are fueled by both wildland vegetation and the built-environment.
- **Firestorms** are events of such extreme intensity that effective suppression is virtually impossible. They occur during extremely dry weather and generally burn until conditions change or available fuel is exhausted.
- **Prescribed fires** are those that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes.

- Wildland fires are fueled by natural vegetation and typically occur in national forests and parks.

Location

Wildfires occur in virtually all of the United States. The western states, with their more arid climate and prevalent conifer and brush fuel types, are subject to more frequent wildfires.

A worker tries to help Tulsa firefighters put out a grass fire at 56th St. North and U.S. 169 northeast of Tulsa International Airport. ***(Source: Tulsa World, 10/25/06)***

Within the McAlester/Pittsburg County jurisdiction development more remote and wooded areas, also referred to as the wildland/urban interface (WUI) continues to take place. Residential and business structures developed in close proximity to grassy and woody fuels will be natural risks for this event. In addition, wildland/grassland fires are a strong threat to agricultural areas such as farms and/or ranches, especially during periods of drought and the high risk fire season.

The U.S. Forest Service (USFS) figures indicate that 25.7% of wildfires reported were caused by arson, debris burns caused 24%, and 13.3% were caused by lightning. Lightning can cause particularly difficult fires when dry thunderstorms move across an area that is suffering from seasonal drought. Multiple fires can be started simultaneously. In dry fuels, these fires can cause massive damage before containment.

Hazard events other than lightning have the potential to cause wildfires, such as earthquakes and high winds. For example, in the dry autumn of 2005, gusting winds downed power lines in south central Oklahoma, sparking wildfires.

Measurement

Wildfire danger is measured using indexes 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. These factors are contained in the Keetch-Byram Drought Index (KDBI), the Fire Danger Rating System, and the Burning Index (BI). The **Keetch-Byram Index**, Table 4-41, relates weather conditions to potential or expected fire behavior, using numbers from 0 to 800 to represent the amount of moisture that is present in soil and vegetation. A Zero rating would indicate no moisture deficiency, while 800 would indicate maximum drought conditions. The **Fire Danger Rating System**, Table 4-42, combines the combustibility of vegetation and weather conditions to derive the easily understood Green-Blue-Yellow-Orange-Red fire danger alerts. These three wildfire measures are summarized in the following tables. The **Burning Index**, Table 4-43, 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). 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, and is used to predict fire line intensity and flame length. The higher the number, the more difficult the wildfire is to fight.

Table 4–41: The Keetch-Byram Drought Index (KBDI)

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

Source: Oklahoma Hazard Mitigation Plan

Table 4–42: Fire Danger Rating System

Rating	Basic Description	Detailed Description
CLASS 1: Low Danger (L) COLOR CODE: Green	Fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: Blue	Fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods 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.
CLASS 3: High Danger (H) COLOR CODE: Yellow	Fires start easily and spread at a rapid rate	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 fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) COLOR CODE: Orange	Fires start very easily and spread at a vary fast rate	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. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: Red	Fire situation is explosive and can result in extensive property damage	Fires under extreme conditions 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 Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash 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.

Source: Oklahoma Hazard Mitigation Plan (http://www.wfas.net/content/view/34/51/)

Table 4–43: Burning Index

Flame Length (ft)	Fire Line Intensity (Btu/(ft-s)	Interpretations
<4 (BI <40)	<100	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 – 8 (BI 40 – 80)	100 – 500	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers and retardant aircraft can be effective.
8 – 11 (BI 80 – 110)	500 – 1,000	Fires may present serious control problems, such as torching out, crowning and spotting. Control efforts at the fire head will probably be ineffective.
>11 (BI >110)	>1,000	Crowning, spotting and major fire runs are probable. Control efforts at head of fire are ineffective.

Extent

Wildfires have been increasing in number and causing a greater economic impact nation-wide, largely due to the rapid spread of rural estates on the peripheries of most American cities. Pittsburg County and McAlester are no exception. From 2004 through 2008, McAlester reported 302 wildfires that burned 972 acres and did $259,500 in damage.

Based on this limited data, McAlester can expect about 60 wildfires each year that burn 194 acres and do approximately $51,900 in damage.

(As will be mentioned several times in this Section, this frequency is only as accurate as is the reported data. For example, for the year 2006, City-Data.com has McAlester's Fire Department responding to 93 different grass and brush fires. instead of 72. with considerably higher numbers for acres burned and losses. In this report, only the State Fire Marshal's data is used to compute overall frequency and impact.)

Dry conditions, high temperatures, low humidity and high winds can increase the potential and severity of a wildfire. In such conditions, wildfires can spread quickly, affecting large areas in a short amount of time. A worst-case scenario would be multiple wildfires started simultaneously by lightning during dry thunderstorms that move across an area that is experiencing drought conditions. The extent of the hazard for McAlester and Pittsburg County varies with landscape and weather conditions, with the relatively more open, grassy land being the most vulnerable. A higher likelihood of ignition exists in the wildland/urban interface, particularly around certain commercial structures, railroad tracks, stands of dry trees, and fields of CRP grass. Generally speaking, wildfires will range from a very small flame to flames of six or seven feet in height (Burning Index of 4-8). Most of these wildland fires can be extinguished with hand tools and pumper trucks.

Fine fuels, such as small twigs and vegetation litter, respond quickly to changing weather conditions and can dry quickly following a rain. Locations with higher average Burning Indexes most likely have experienced repeated periods of high fire danger (Orange and Red Fire Danger), although individual events can cause the Burning Index to peak at locations that are not normally prone to high fire danger.

Although all of unincorporated Pittsburg County is at some risk of wildfire, the structures and critical facilities located in the wildland/urban interface and surrounded by dry grass and trees are clearly the most vulnerable. In this regard, the eastern and western sections of McAlester are particularly vulnerable. Since wildfire risk can be dramatically reduced by landscaping and debris clearance, a detailed wildfire risk assessment should be made of any critical facilities located in the wildland/urban fringe.

Frequency

From 2004 through 2008, Oklahoma's Fire Departments reported 78,221 wildfires that burned over 2.803 million acres and did almost $66 million in damage. This was an average of 15,644 wildfires per year with an average 560,691 acres burned each year and $13 million annual damage. The average fire burned 36 acres and caused $842 damage.

During the same 5-year period, Pittsburg County (including McAlester) experienced 2,227 grass and brush fires that burned 86,250 acres and did a total of $2,809,441 in damage. The average fire burned 39 acres and caused $1,261 damage.

The McAlester area has three primary wild land fire seasons. The most volatile is February through April, when grass fuels are dead, the humidity low, temperatures elevated and winds as high as 50-70 mph. A moderate wildfire season occurs in July or August, when some grasses are dormant or dead from the mid-summer heat. The third wildfire season, also moderate, is in the fall, after frost has killed the annual grasses.

According to the State Fire Marshal, McAlester's Fire Department responded to 302 runs wildfires from 2004 through 2009, which burned a total of 972 acres and did $259,500 in damage. These numbers should be taken with caution. City-Data.com, which has a complete listing of McAlester Fire Department runs for 2006 documents 97 brush and grass fire runs to 93 separate fires, 1,266 acres burned, and $101,300 in damage.

Impact

The impact of the Wildfire hazard can increase during times of drought, high wind and extreme heat. Wildfire can cause loss of life, loss of homes, loss of business, and devastating economic impacts to individual homeowners, ranchers and farmers, and to the community. The McAlester Fire Department, which has an ISO rating of 4, is confident that it can respond quickly and effectively enough to limit damage from wildfires in or adjacent to their jurisdiction. A worst-case scenario, in McAlester's view, would be the destruction of 4 structures and the injury or death of one person, either civilian or firefighter. McAlester has not experienced a wildfire event as severe as those which have struck some south central Oklahoma areas or Oklahoma City suburbs.

Severity

McAlester considers a reading of moderate and below on the Fire Danger Rating system (Table 4-44) to be a minor severity level and a rating of high and above to be of major severity.

4.11.2 History/Previous Occurrences

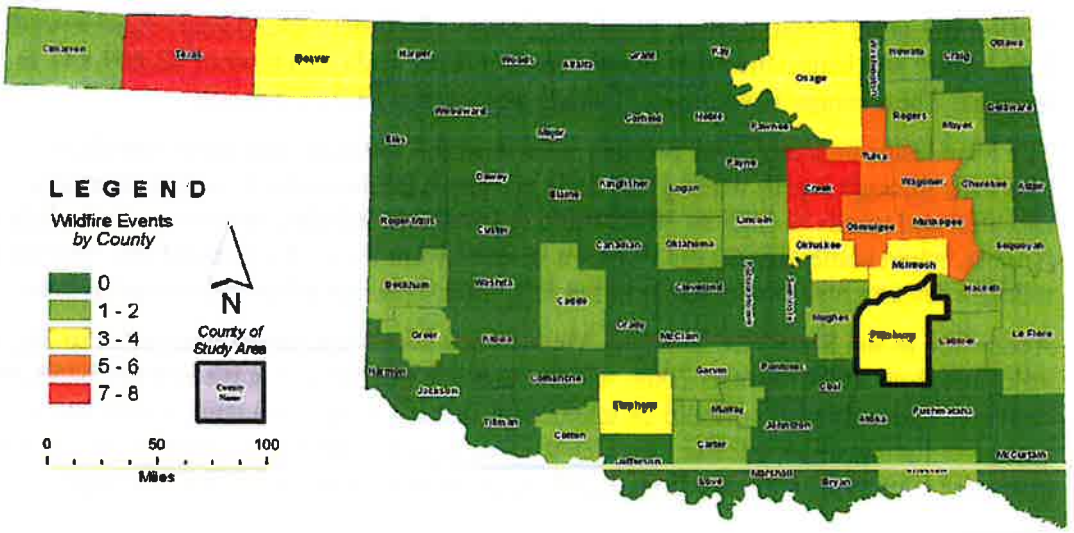
The single worst wildfire event in terms of deaths in United States history occurred in Wisconsin in 1871, killing 1,182 people (FEMA 1990) (ibid., Multi Hazard, p. 239)

In 1994, one of the worst years since the early 1900s, 79,107 fires burned over four million acres and cost $934 million for suppression. Tragically, 34 firefighters lost their lives. On July 6, 1994, 14 firefighters died in one terrible incident during the South Canyon Fire just west of Glenwood Springs, Colorado.

Oklahoma Wildfires

From 2004 through 2008, Oklahoma's Fire Departments reported 78,221 wildfires that burned over 2.803 million acres and did almost $66 million in damage. This was an average of 15,644 wildfires per year with an average 560,691 acres burned each year and $13 million annual damage. The average fire for this 5-year period burned 36 acres and caused $842 damage.

Figure 4–33: Wildfire Events in Oklahoma from 2000-2009



Source: National Climatic Data Center U.S. Storm Events Database

Flanagan & Associates, LLC

Fall 2000 Wildfires

In 2000, an unseasonably wet late spring was followed by several months of dry weather during which the state averaged about 19% of normal rainfall. By mid-September, the soil across much of the state was dry to a depth of eight inches. In late July 2000, a wildfire near Oklahoma City burned 80 acres and injured two firefighters. On August 20, a fire near Binger, in Caddo County, burned 3,200 acres, destroying three homes and part of a Girl Scout lodge.

Arbuckle Mountains Wildfire - Between September 8 and 19, 2000, there was a rash of wildfires in Central Oklahoma. One fire that began near the Carter/Murray County line on September 8 spread north into the Arbuckle Mountains, burning for two weeks and consuming 11,500 acres in Carter, Murray and Garvin Counties. In all, one business and six homes were destroyed, totaling $1 million in damage.

Guthrie Wildfire – On September 19, 2000, a large wildfire began 9 miles south of Guthrie and burned for 6 miles, consuming 35 homes and causing $750,000 in damage.

Late November 2005-March 2006: Oklahoma's Worst Outbreak of Wildfires

In the late summer and autumn of 2005, drought conditions throughout the state set the stage for the worst outbreak of wildfires in recent Oklahoma history.

The winter of 2005 was the driest on record in Oklahoma. The drought, combined with high winds, unleashed a series of devastating wildfires. Between November 2005 and March 2006, Oklahoma had 120 consecutive days without moisture. The result was 2,800 fires and over 560,000 burned acres. By April 2006, 869 structures had been damaged by wildfires, and 300 were destroyed. A Federal disaster declaration was made on January 10, 2006, and Individual Assistance funds were made available to 26 Oklahoma counties. Public Assistance funds were made available to all 77 Oklahoma counties.

Between November 2005 and March 2006, wildfires burned over 560,000 acres in Oklahoma.

The wildfire outbreaks clustered around three time periods: late November to early December 2005, late December 2005 to early January 2006, and March, 2006.

Late November to Early December 2005 Wildfires – Strong surface low pressure in the southern and central plains caused sustained wind speeds of 20-35 mph, with gusts up to 45-65 mph. Combined with the drought-like soil and grass conditions, Oklahoma was like a tinderbox waiting for the spark.

Two areas in the state were hit by large wildfires on November 27-30, 2005. In the northeast part of the state, wildfires were reported in Cherokee, Mayes, McIntosh, Muskogee, Okfuskee, Okmulgee, Osage, Pittsburg, Tulsa and Wagoner Counties, burning 35,000 acres, killing one person, injuring 11, and destroying 35 homes and many outbuildings and automobiles.

In south central Oklahoma, several large wildfires burned in Cotton, Garvin and Stephens Counties. A 15-mile area near Velma in Stephens County caught fire on November 27 and continued to burn into early December, forcing the evacuation of the town. Twenty fire departments responded to the blaze. Altogether, the Stephens County fire destroyed 16 homes, two barns and many outbuildings, leaving $1 million in damage. In Cotton County, a wildfire near Walters destroyed six homes and several barns, causing $650,000 damage. In Garvin County, two wildfires burned 6,000 acres. Fourteen fire departments and 100 firefighters responded. Three homes and several outbuildings were destroyed. Losses were $350,000. Near Pauls Valley 500 acres burned, doing $50,000 in damage. On November 29, a fire near Wilson in Carter County killed one woman.

Late December 2005 to Early January 2006 Wildfires - Another rash of wildfires began on December 25, 2005, and continued, more or less without interruption through the first week of 2006. A string of wildfires began on Christmas Day in Choctaw, Creek and Sequoyah Counties, but others were soon raging throughout the state. On January 8, 2006, the Oklahoma Department of Emergency Management set up an Incident

Command Post at Shawnee to coordinate firefighters who were coming in from Alabama, Tennessee, Florida and North Carolina. On January 10, Oklahoma was declared a wildfire disaster area. Among the many fires were the following:

- **December 27, 2005** – 10,000 acres burned in Hughes County, killing one person and destroying 8 homes, 14 barns and 20 outbuildings.
- A wildfire in Choctaw County burned 1,000 acres, destroyed four homes and injured two people.
- In Tulsa County a wildfire burned three homes, three structures and left $300,000 in damage.
- In Muskogee County, 2,000 acres west of Muskogee burned, destroying one house, one mobile home, two barns and an automobile, and leaving $225,000 in damage. Grassfires were also reported in Rogers, Okmulgee and McIntosh Counties.
- **January 1, 2006** – In Oklahoma County, northeast of Oklahoma City, several homes were destroyed by wildfire and two neighborhoods evacuated. In Muskogee County, 16,000 acres caught fire southwest of Muskogee, destroying four homes, several barns and much hay. Damage was estimated at $500,000. In Creek County, 10,000 acres burned near Bristow, leaving $200,000 in damage. There were also wildfires in Pittsburg, Okfuskee, Haskell and Tulsa Counties.
- **January 3, 2006** – In Beaver County, two fires burned 14,000 acres, while in Creek County, near Shamrock, a wildfire destroyed an abandoned school, a vacant house, and damaged two homes.
- **January 8, 2006** – In McIntosh County, 7,000 acres burned, doing $50,000 in damage. In Payne County, seven miles northwest of Perkins, a grassfire ignited red cedar trees. Fires were reported at Davis, Welty, Bristow, Okemah, Slick, Stroud, Guthrie, Sapulpa, Sparks, Bethel, Skiatook, Wainright, Prague, Stigler, Prue, and Mayesville. The State established an ICP at Shawnee.
- **February 4, 2006** – In Okmulgee County, a wildfire killed one person.
- **February 27, 2006** – In Muskogee County, 750 acres burned and dozens of homes were threatened.

March 2006 Wildfires - On March 1, 2006, high winds, drought conditions, and temperatures in the 90s caused another rash of wildfires across the state. In Stephens County, a wildfire eight miles long injured several firefighters and killed one. In all, 10,000 acres were burned, 65 homes destroyed, 21 houses badly damaged, and numerous outbuildings, farm equipment and vehicles lost. Damage was estimated at $15 million. In Lincoln County, three firefighters were injured when blazing grass caused a propane tank to explode. In Creek County, southwest of Mannford, a wildfire burned hundreds of acres, destroying 4 homes and causing $250,000 in damage. Wildfires were also reported in Wagoner and Sequoyah Counties. Fires continued to plague the state throughout the month.

- **March 7, 2006** – Wildfires were reported in Muskogee, Wagoner and Nowata Counties.
- **March 8, 2006** – In Osage County, 1,000 acres burned near Burbank.

- **March 10, 2006** – In Texas County, 7,000 acres burned east of Guymon, while in Tulsa County, wildfire destroyed two mobile homes, a tractor trailer, fire trucks and storage buildings, causing $150,000 damage.
- **March 15, 2006** – Wildfires broke out in Osage, Rogers, Creek, Wagoner and Cherokee Counties.
- **March 26, 2006** – Despite recent rains, warm and windy conditions led to wildfire outbreaks near Bristow, and at Scipio in Pittsburg County, as well as in Muskogee, Okfuskee, Okmulgee and Wagoner Counties.
- **April 2, 2006** – A Texas County wildfire burned 600 acres.

Pittsburg County and McAlester Wildfires

The State Fire Marshal's wildfire data for McAlester from 2000 through 2009 are summarized in Table 4-44. During this 10-year period, McAlester experienced 588 grass and brush fires that burned 1,254 acres and did a total of $3,000 in reported damage.

Table 4-44: McAlester Grass and Crop Fires, 2000-2009

Year	Runs	Acres Burned	Damages
2000	111	0	$2,500
2001	0	0	$0
2002	55	75	$0
2003	72	126	$0
2004	70	352	$0
2005	70	64	$0
2006	72	265	$500
2007	27	13	$0
2008	63	278	$0
2009	48	81	$0
Totals	588	1254	$3,000

Source: Oklahoma State Fire Marshal

These numbers should be used with caution. According to City-Data.com, which gives details on all McAlester fire runs for 2006, McAlester's firemen made 97 wildfire runs that year to 93 different fires, which burned 1,266 acres and did about $101,300 in damage. Most of these occurred in January, March and April. A few of the largest wildfires from 2006 are summarized below. (*See http://www.city-data.com/fire/fire-McAlester-Oklahoma.html*)

- January 2, 2006 – Firemen fought a 30-acre wildland fire along 2-Mile Lane in McAlester for 7 hours.
- January 7, 2006 – A 50-acre grass fire was extinguished along US Hwy 270 west, apparently set by a tossed cigarette.
- January 15, 2006 – A brush and grass fire burned 30 acres along Key Rd., off OK Hwy 113.
- January 18, 2006 – A 50-acre grass fire burned at the intersection of US Hwy 69 and OK Hwy 113.

- March 26, 2006- A 20-acre brush and grass fire along Wise Rd. in McAlester did $1,700 damage.
- March 27, 2006 – A brush and grass fire on Krebs Lake Rd. burned 80 acres.
- March 28, 2006 – A 60-acre crop fire did $11,170 damage on High Hill Rd, east of Bache.
- March 31, 2006 – Unknown persons started a brush and grass fire that burned 25 acres along Youth Lake Rd.
- April 2, 2006 – A brush and grass fire burned 15 acres and did $8,220 damage near Faith and South End Rds.
- April 3, 2006 – Firemen responded to a 20-acre brush and grass fire near Wise and Doolittle Rds. in McAlester.
- April 7, 2006 – A fire in cultivated fields did $7,000 damage on Peaceable Rd.
- April 22, 2006 – A wildland fire pushed by high winds burned 130 acres and did $10,050 damage in the High Hill area near McAlester.
- April 23, 2006 – A 35-acre wildland fire burned 35 acres in the High Hill area near McAlester.
- June 16, 2006 – Firemen responded to a 40-acre grass fire along McAlester Lake Rd.
- July 7, 2006 – A 40-acre wildland fire near Hagen Rd. did $3,400 damage.
- August 17, 2006 – Equipment sparks set off a 450-acre grass fire that destroyed hay and straw and did a total of $44,500 damage near Bache and James St. in McAlester.
- December 13, 2006 – Firemen put out a 50-acre brush and grass fire alongside OK Hwy 31 west of McAlester.

While 2006 was by no means an average year for wildfire in Oklahoma, it is clear that the detailed information on City-Data.com disagrees substantially with that from the State Fire Marshal's office. Consequently, the number of wildfires, acres burned and total damage listed in the above table for 2000-2009 should be used with caution.

One fire that received mention in the McAlester News-Capital occurred in 2008:

- November 5, 2008 – A grass fire fueled by strong winds threatened the Blevins Retirement and Care Center at Strong Blvd. and Electric Ave. Firefighters from McAlester, Krebs, High Hill, Alderson and Gaines Creek worked together to put out the fire.

Probability/Future Events

The alarming spread of Eastern Red cedar in open grassland, and the abundant fuel load in place from heavy rains and other naturally occurring events (two ice storms within 12 months), combined with the increasing incidence of wildland fire, suggests that wildland/grass fires will continue to be a threat to Pittsburg County, the City of McAlester and McAlester Public Schools. In addition, suburban growth in the wildland/urban interface will be a significant factor in the incidence of wildfire in McAlester's urban fringe.

The City of McAlester and McAlester Public Schools have a high probability of a future wildfire event.

4.11.3 Vulnerability

Because more people are choosing to build expensive homes on acreage in rural settings, surrounded by grasslands and forest, the danger of wildland/urban interface fire is increasing. This is also true of McAlester, with a modestly growing population on its urban fringe. While most grasslands of the U.S. have a fuel load of 1,000 to 2,000 lb. per acre, around McAlester it is between 6,000 and 10,000 lbs. per acre.

The wildland fire danger in the McAlester urban fringe is made even higher by the spread of Eastern Red Cedar, which grows close to the ground, has fine foliage, thin bark and contains volatile oils. When it catches fire, the Eastern Red Cedar explodes into flame, showering sparks to the wind. Vulnerable Urban-Wildland Interface areas in McAlester are shown on the map in Figure 4-35.

Population

As evidenced by the 2005-2006 wildfire outbreaks, populations living in the rural and urban/wildland interface areas of McAlester are vulnerable to the Wildfire hazard. Deaths and injuries from wildfires, however, have been very low in the state, and largely confined to firefighters.

Table 4–45: Wildfire Population & Building Vulnerability

LOC	Population	Structures	Critical Facilities
9	675	292	0
8	698	302	4
7	69	30	0
6	681	295	1
5	270	117	0
Total	2,393	1,036	5

(SFRAS – Level of Concern Calculations)

Structures/Buildings

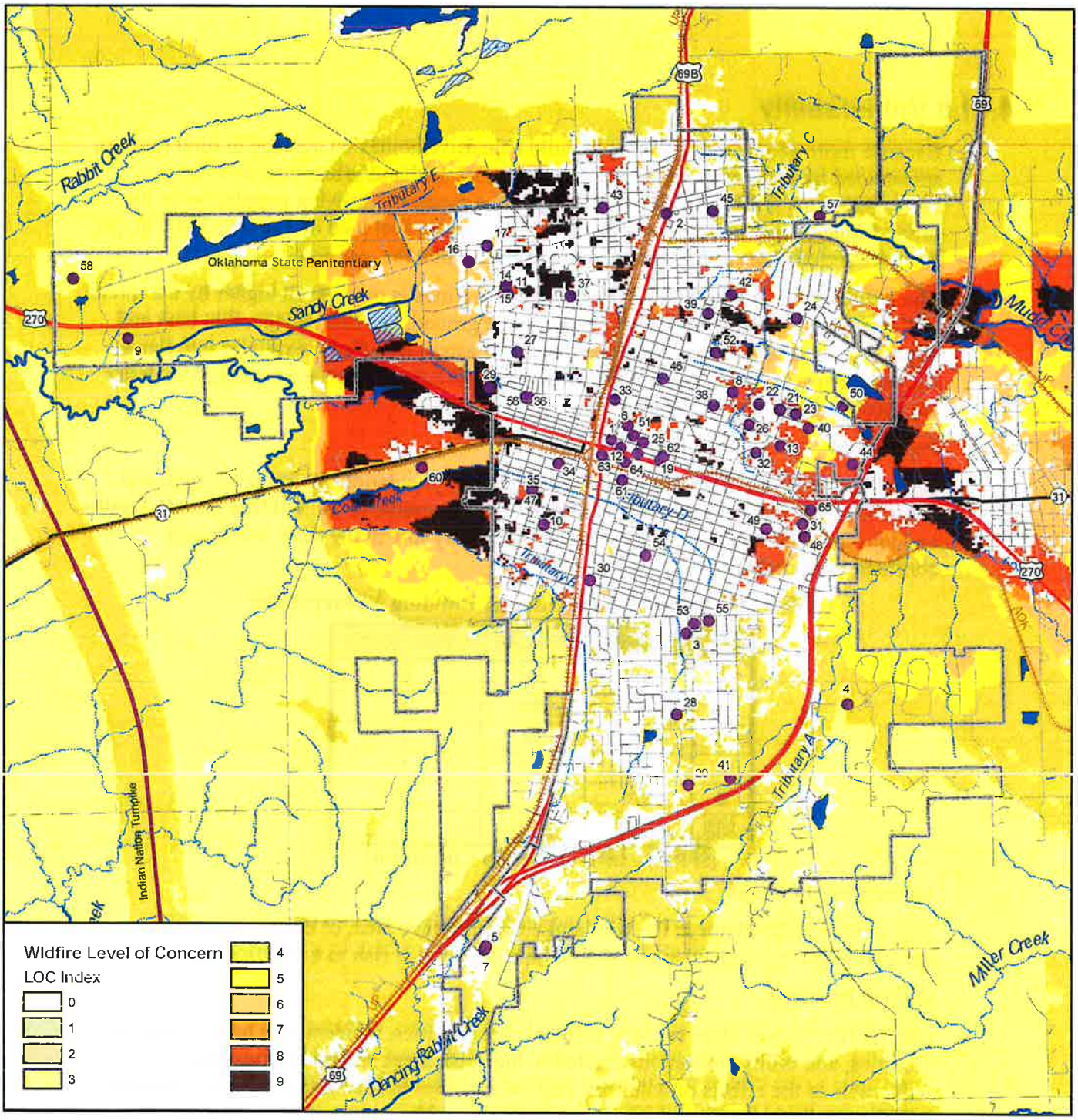
Any structures/buildings in the wildland/urban interface area, or on ranches/farms situated in grassy/wooded areas, should be considered at risk to a wildfire event.

Critical Facilities

Critical facilities, such as schools, medical care facilities, resident care homes, daycare facilities, and utility substations located in high-risk areas should be considered vulnerable to the effects of wildfires. Critical facilities in McAlester that are vulnerable to wildfire are listed below and are shown in Figure 4-35.

Table 4–46: Critical Facilities with Some Vulnerability to Wildfire

ID	Name	Address	Threat
8	Rotary House		8
11	Pittsburg Co. Animal Shelter	1204 N West St	8
13	Pittsburg Co. Health Dept.	1400 E College Ave.	8
44	Eastern Oklahoma State College	1802 E College Ave	8
60	West Wastewater Treatment Plant	2020 W. Hwy 31	6



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

Miles 0 0.5 1

- Critical Facilities
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Figure 4-34

City of McAlester

Wildfire Areas of Concern

ID	Name	Address	Threat
4	McAlester Fire Emergency Response Complex	617 Village Blvd	4
9	Southeast Expo Center		4
57	East Wastewater Plant	1360 E Krebs Ave	3
58	McAlester Landfill	2810 N Mitchell Rd	3

(SFRAS – Level of Concern Calculations)

Infrastructure

Water Treatment – The most likely impact to McAlester's water treatment facility would be from loss of electric power due to flashovers (via dense smoke) or burned poles and power lines. Additional threats from wildfire are not currently documented for facilities of this nature.

Wastewater Treatment – The most likely wildfire impact on McAlester's wastewater treatment facilities would be the loss of electrical power from flashovers or burned poles and power lines. Additional threats from wildfire are not currently documented for facilities of this nature.

Utilities- The primary utility providers for McAlester's jurisdiction are AEP/PSO (electricity) and Reliant Energy/Arkla Gas (natural gas). **Electricity**: The largest threat to the delivery of electrical service would be the destruction/damage of power poles/lines or outages due to flashovers into dense smoke. **Gas:** As most gas delivery lines are below ground, this critical system is not highly vulnerable to wildfires.

Transportation Systems (Highways, Railway, Airports) – Roadway inaccessibility would be the transportation system's largest vulnerability from a Wildfire event. Wildfires may make it necessary to close a section of a major highway or to divert traffic along that route. Roads, airports and railway crossings in the more rural portions of the City's jurisdiction would be at greatest risk during a widespread event.

Emergency Services- Fire, Police and Medical services would all be similarly at risk to effects of a wildfire event. During a severe outbreak of wildfire, roads may become impassable, potentially isolating portions of the community to vital services and/or supplies. While an event affecting the entire community of McAlester would be improbable, the possibility of a more remote portion of the city in the urban/rural interface being impacted is likely. These small pockets of residential developments in urban fringe, along with any businesses/utilities supporting them, are especially at risk in the event of a large wildfire event.

4.11.4 Wildfire Scenario

The McAlester Fire Department has determined that their emergency response would be sufficient in any identified high vulnerability areas, and that structural loss or loss of life would be minimal compared to a wildfire in rural areas, or a community with a greater percentage of exposure. The Fire Department's response record for the wildfires of 2006 exemplifies this preparedness, which is also reflected in the Department's ISO rating of 4. A worst case scenario would be injury to one civilian or firefighter, or loss of a significant structure, barn or home. In such a worst-case event, no more than 4 to 5

structures would be affected, with no more than 1 or 2 suffering major damage before the incident is brought under control. McAlester has one "brush pumper" which can respond to the interface areas on the fringes of the City. This being said, as elsewhere in Oklahoma, there are a growing number of businesses and rural estates on the fringes of the city. If not carefully planned and landscaped, these developments and residences could be at risk to wildfire under worst-case conditions, similar to those of 2005-2006.

4.11.5 Future Trends

Population

Any planned residential development on the fringes of the city, in the urban/rural interface, will be at higher risk to wildfires. It is not anticipated that deaths and injuries would be a greater percentage than it already is.

Structures/Buildings

As development in the urban/rural interface progresses, any structures and/or buildings constructed without careful landscape planning could be at risk during a wildfire event. Structures in the high and moderate areas of concern would be at risk under worst-case conditions, similar to those of 2005-2006.

Critical Facilities

Special care should be exercised to ensure the appropriate location of any new critical facilities such as medical care facilities, day care centers, utility outstations, etc., and that such facilities are constructed or retrofitted using proper fire-resistant building and landscaping practices.

Infrastructure

As these areas continue to develop, roadways, utility access, emergency services and other support businesses will also be at risk from a wildfire event and should be planned for appropriately. Infrastructure improvements, such as highway upgrades and transmission lines in rural and rural/urban interface areas can increase vulnerability to wildfires caused by tossed cigarettes and downed power lines.

4.11.6 Conclusions

Wildfires are a serious and growing hazard because people continue to build homes in woodland areas and grassy knolls. The value of the property exposed to wildfires is increasing rapidly, especially in the western states.

As shown during the rash of wildfire in the winter of 2005-2006, those parts of the City of McAlester and McAlester Public Schools that are in the rural/urban interface are at moderate to high risk from wildfires, and at severe risk during times of high wind and drought. However, these vulnerable spaces are a low percentage of the total area of the community, and are primarily limited to the areas immediately to either side of major roads in the eastern and western sections of the city. Overall, the City of McAlester and McAlester Public Schools exposure to wildfire risk is considered low.

Data Limitations

Data is sometimes turned into the State Fire Marshal's office over a year after the events occur. Consequently, complete data is frequently one, two or more years behind. In addition, the Fire Marshal's office does not list the actual number of wildfire events, but number of "fire department runs." The McAlester Fire Department may send a unit for a small grassfire in a center median, which does not show up as a grassfire in the NCDC database. Also, for a larger wildfire complex, many runs may be made for the event to separate locations for a period of time. As a result, there can be three wildfire "events" listed by the National Climatic Data Center for 1998-2007, but 203 "runs" for the most recent 5-year period for which the state's office has complete data. This limitation is exemplified by the contradictory data on the State Fire Marshal's web site when compared to that of City-Data.com: The Fire Marshal has McAlester's Fire Department making 72 wildfire runs in 2006, 265 acres burned, and $500 damage; City-Data has 97 runs, 1,266 acres burned, and $101,300 damage. There may be a simple explanation for this disagreement, such as the State Fire Marshal listing only damage within McAlester itself.

4.11.7 Sources

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City-Data.com, http://www.city-data.com/fire/fire-McAlester-Oklahoma.html

4.12 Earthquakes

An earthquake is a sudden, rapid shaking of the ground caused by the fracture and movement of rock beneath the Earth's surface. Most severe earthquakes take place where the huge 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 multitude of fault and fracture lines within the plates themselves.

The faults most likely to affect Oklahoma are the New Madrid Fault (centered in the Missouri Bootheel region), the Meers Fault (located in southwestern Oklahoma near Lawton), and the Nemaha Fault (which runs north from Oklahoma through Topeka, KS).

4.12.1 Hazard Profile

As the Earth's crust moves and bends, stresses are built up, sometimes for hundreds of years, before suddenly breaking or slipping. This abrupt release of accumulated tension can be devastating to human communities on the surface.

Although located in the relatively quiet Central Plains Province, nearness to the New Madrid, Missouri, fault exposes some Oklahoma communities to VI intensity tremors

The destructiveness of an earthquake depends upon a number of factors, including the magnitude of the tremor, direction of the fault, distance from the epicenter, regional geology, local soils, and the design characteristics of buildings and infrastructure, such as roads, bridges, and pipelines.

Earthquake intensity can be significantly affected by the stability of underlying soils. For example, during the Northridge, CA earthquake, three times as much damage was done to single-family homes and buried utilities in ground failure zones than in nearby areas where the footing was more solid. In addition, the intensity of West Coast tremors is dissipated by the relative "warmth" of the region's geology. By contrast, the thick Pennsylvanian sandstone and limestone strata of the central United States are much more efficient conductors of tremors. Consequently, a 6.8-magnitude earthquake in the New Madrid Fault would have a much wider impact than a comparable event on the California coast.

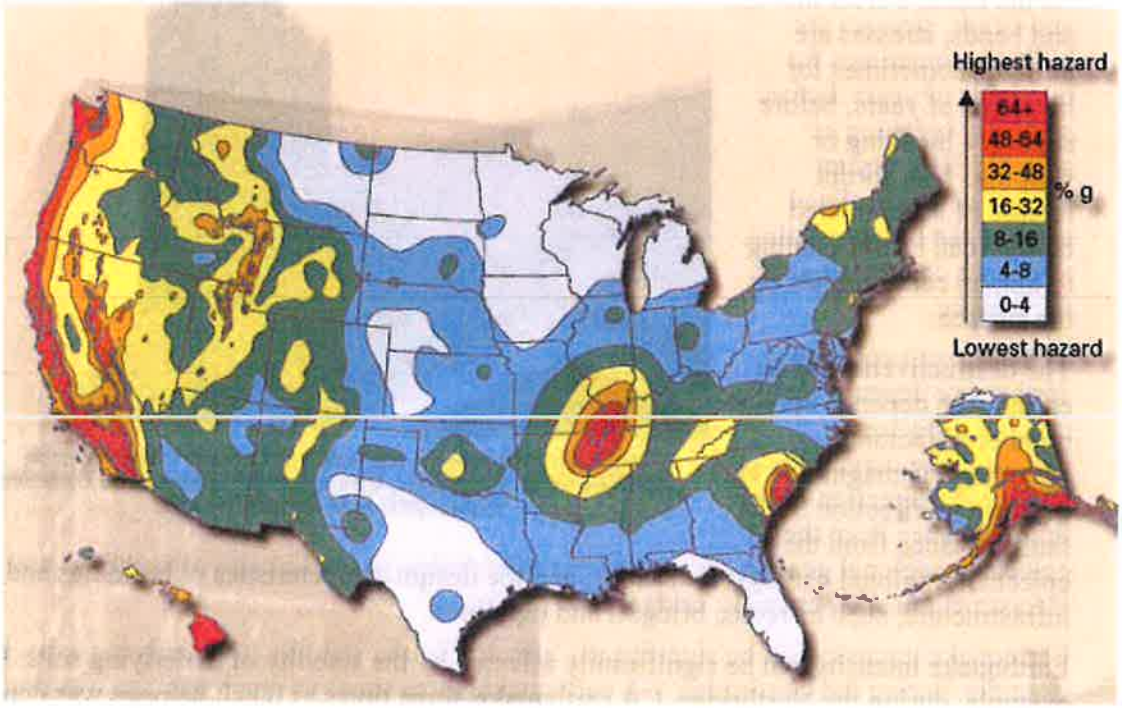
Urbanization is probably the most important factor in translating earthquake magnitude into human impacts. In the continental United States, Alaska has the greatest number of large earthquakes—over a dozen above 7.3 magnitude between 1899 and 1999. However, these severe quakes resulted in relatively little loss of life or damage, since all but one occurred in uninhabited areas.

Location

In the United States, California experiences the most frequent damaging earthquakes, and Alaska has the greatest number of large earthquakes.

Oklahoma has experienced an average of 50 earthquakes each year since records have been kept by the Oklahoma Geological Survey. Most of these earthquakes were so small that they could not be felt by people. Only about two or three per year have been large enough to be felt and most were so small they caused no damage. As shown in the figure below, the majority of Oklahoma earthquakes are concentrated in the area of the Meers Fault in Garvin, Grady, and McClain counties, where the Ouachita, Arbuckle and Wichita mountains converge. The City of McAlester is at low risk from earthquakes from either this zone or the New Madrid Fault in southeastern Missouri.

Figure 4–35: Seismic Hazard Locations in the United States



Colors on this map show the levels of horizontal shaking that have a 2-in-100 chance of being exceeded in a 50-year period. Shaking is expressed as a percentage of g (g is the acceleration of a falling object due to gravity.) – (Source: USGS, 2008 US Nat'l Seismic Hazard Maps)

Measurement

Modern seismological technology has greatly enhanced the capability of scientists to sense earthquakes. Before the development of today's delicate sensors, only "felt" earthquakes were captured in the historical record.

Scientists use two standard measures to classify an earthquake's extent: *magnitude* and *intensity*. These measures are sometimes referred to as the Richter Scale (magnitude) and the Modified Mercalli (intensity).

Magnitude is an Arabic number representing the total amount of energy released by the earthquake source. It is based on the amplitude of the earthquake waves recorded on seismographs that have a common calibration. The magnitude of an earthquake is thus represented by a single, instrumentally determined value.

Intensity, expressed as a Roman numeral, is based on the earthquake's observed effects on people, buildings and natural features. It varies depending on the location of the observer with respect to the earthquake's epicenter. In general, the intensity decreases with distance from the fault, but other factors such as rupture direction and soil type also influence the amount of shaking and damage. The Modified Mercalli and Richter Scales are compared in Table 4-47.

Table 4–47: Comparison of Mercalli and Richter Scales

Mercalli	Richter	Description
I	0-4.3	Vibrations are recorded by instruments. People do not feel any Earth movement.
II		A few people might notice movement if they are at rest and/or on upper floors of tall buildings.
III		Shaking felt indoors; hanging objects swing. People outdoors might not realize that an earthquake is occurring.
IV	4.3-4.8	Dishes rattle; standing cars rock; trees might shake. Most people indoors feel movement. Hanging objects swing. Dishes, windows, and doors rattle. A few people outdoors may feel movement.
V		Doors swing; liquid spills from glasses; sleepers awake. Almost everyone feels movement. Dishes are broken. Pictures on the wall move. Small objects move or are turned over. Trees shake.
VI	4.8-6.2	People walk unsteadily; windows break; pictures fall off walls. Everyone feels movement. Objects fall off shelves. Furniture moves. Plaster in walls may crack. Trees and bushes shake. Damage is slight in poorly built buildings. No structural damage.
VII		Difficult to stand; plaster, bricks, and tiles fall; large bells ring. Drivers feel their cars shaking. Some furniture breaks. Loose bricks fall from buildings. Damage is slight to moderate in well-built buildings; considerable in poorly built buildings.
VIII	6.2-7.3	Chimneys fall; branches break; cracks in wet ground. Drivers have trouble steering. Houses that are not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Well-built buildings suffer slight damage. Poorly built structures suffer severe damage. Water levels in wells might change.
IX		General panic; damage to foundations; sand and mud bubble from ground. Well-built buildings suffer considerable damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks. Reservoirs suffer serious damage.
X		Most buildings destroyed; large landslides; water thrown out of rivers and lakes. Some bridges are destroyed. Dams are seriously damaged. The ground cracks in large areas. Railroad tracks are bent slightly.
XI	7.3-8.9	Roads break up; large cracks appear in ground; rocks fall. Most buildings collapse. Some bridges destroyed. Underground pipelines destroyed. Railroad tracks badly bent.
XII		Total destruction; "waves" seen on ground surface; river courses altered; vision distorted. Almost everything is destroyed. Objects are thrown into the air. Large amounts of rock may move.

Extent

Pittsburg County has experienced 20 reported earthquakes from 1995 through 2009, but only two of these were "felt" events within a 10-mile radius of McAlester. None of the 20 tremors caused any damage.

FEMA's HAZUS software application provides a methodology for estimating earthquake losses at a regional scale. Building and population statistics from the U.S. Census are combined with estimated replacement values for local infrastructure to calculate potential losses from a specified earthquake event. The historic 5.7 magnitude El Reno earthquake event of April 9, 1952, was used as a "worst case" input event in the HAZUS model and run for the City of McAlester and McAlester Public Schools. Based on HAZUS analysis, an El Reno event would cause no damage in McAlester.

Frequency

Pittsburg County experienced 20 earthquakes from 1995 through 2009, or 1.3 events per year, only two of which were "felt" earthquakes. One of these unfelt earthquakes was centered about 1 mile southeast of McAlester.

The Meers Fault has had two major ruptures in the last 3,000 years, the last one about 1,600 years ago. If the fault has a 1,500-year periodicity, it could be due for a major event in the next one or two hundred years.

The most likely major earthquake event that could impact the area would probably originate in the New Madrid Fault Zone, which has been relatively quiet for 150 years. Seismologists estimate the probability of a 6 to 7 magnitude earthquake in the New Madrid area in the next 50 years to be higher than 90 percent.

According to Randy Keller of the Oklahoma Geological Survey, a major quake in the New Madrid area would cause some minor damage in the eastern part of the state. Oklahoma would, however, likely become involved in aiding the victims of a serious New Madrid earthquake, since the State is one of nine associate members of the Central United States Earthquake Consortium.

Impact

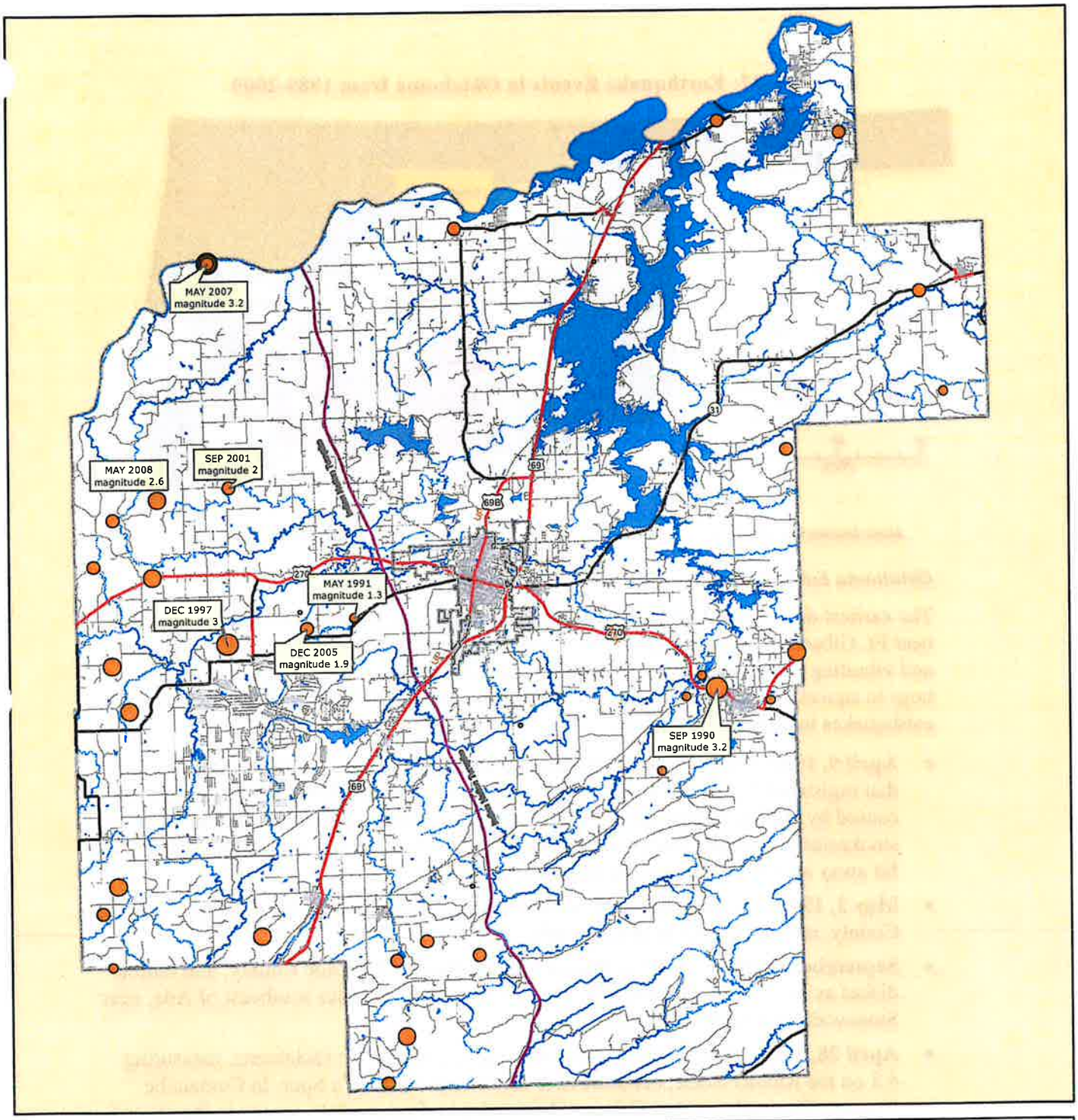
The impact of this hazard depends on the intensity of the earthquake. A 5.7 magnitude event centered in El Reno would not adversely affect any structures in McAlester, including the City's infrastructure, critical facilities and public schools, or result in injuries or fatalities.

Severity

McAlester considers a reading of 4.8 and below on the Richter Scale a minor severity and a reading of 4.8 and above to be a major severity.

4.12.2 History/Previous Occurrences

In the United States, California and Alaska have earthquakes the most frequently, but the largest earthquake felt in the United States in historical times occurred in Missouri, along the New Madrid Fault. There, in 1811 and 1812, three earthquakes larger than a magnitude 8 totally destroyed the town of New Madrid, caused the land to roll in visible waves, raised and sank land as much as 20 feet, and formed and emptied lakes. The tremors rang bells in church steeples as far away as Boston, Massachusetts. These earthquakes were probably the first ones felt by residents in Oklahoma in historical times. Intensity VII earthquakes hit the New Madrid area again in January 1852 and June 1862. Figure 4-36 shows the locations of earthquakes in Pittsburg County from 1980-2009.



Legend

- County Boundary
- City limits
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams

Earthquakes 1980-2009
Magnitude

- 1.0 - 1.2
- 1.3 - 1.6
- 1.7 - 2.1
- 2.2 - 2.6
- 2.7 - 3.2

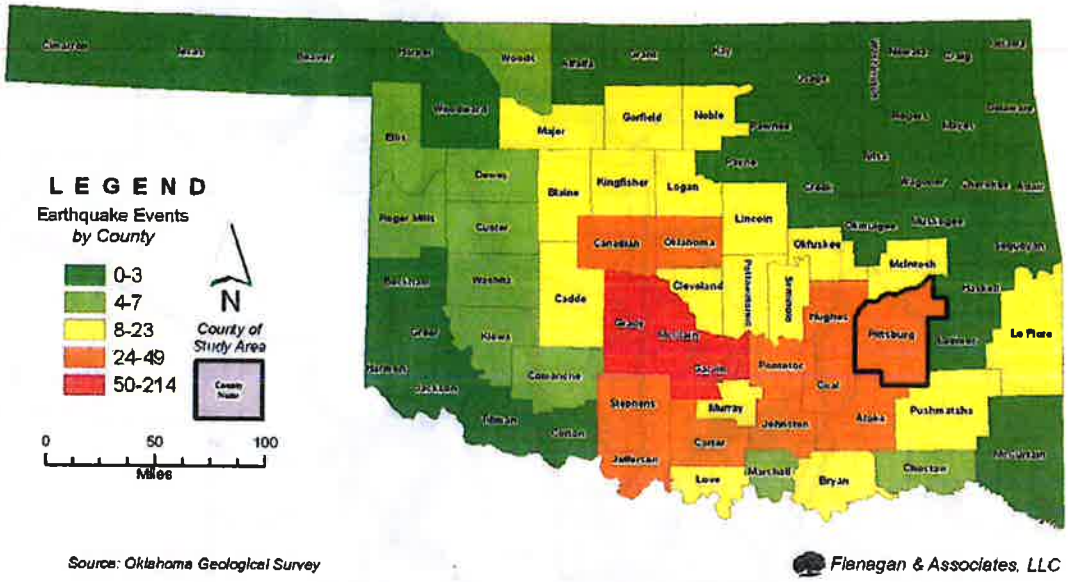
Miles
0 3 6

Figure 4-36

Pittsburg County & City of McAlester

Historical Earthquakes

Figure 4–37: Earthquake Events in Oklahoma from 1989-2009



Oklahoma Earthquakes

The earliest documented quake in what is now Oklahoma occurred on October 22, 1882, near Ft. Gibson, Indian Territory. The *Cherokee Advocate* reported that "the trembling and vibrating were so severe as to cause doors and window shutters to open and shut, hogs to squeal, poultry to run and hide, and cattle to low." Other significant Oklahoma earthquakes include the following:

- **April 9, 1952** – The largest earthquake on record in the state – a VII-intensity event that registered 5.7 on the Richter Scale – happened near El Reno. It was apparently caused by slippage along the Nemaha Fault. The tremor toppled chimneys and smokestacks, cracked bricks on buildings, broke windows and dishes, and was felt as far away as Austin, Texas, and Des Moines, Iowa.
- **May 2, 1969** – A 4.6 magnitude, V intensity quake occurred at Wewoka, in Seminole County, causing cracks in plaster walls.
- **September 6, 1997** – A 4.4 earthquake shook Ada, in Pontotoc County, and rattled dishes as far away as Holdenville. The epicenter was 10 miles southeast of Ada, near Stonewall, at a depth of 15 km.
- **April 28, 1998** – One of the largest earthquakes recorded in Oklahoma, measuring 4.2 on the Richter Scale, occurred near Lawton, at Richard's Spur, in Comanche County. The quake rattled dishes and caused a 14-foot crack to appear in the second floor of the Comanche County courthouse building.
- **February 8, 2002** – A 3.8 magnitude earthquake was detected 5.6 miles north of Lawton. The quake passed from northeast to southwest with a rolling motion that lasted about 1.5 seconds. The tremor was described as moderate, which shook houses with a kind of rolling sensation rather than hard shaking. Pictures were knocked over on dressers.

Pittsburg County Earthquakes

As stated above, Pittsburg County experienced 20 earthquakes from 1995 through 2009, or 1.3 per year. Two of these events were "felt". Pittsburg County's largest earthquake was a V-intensity, 3.2-magnitude event that occurred at Haileyville on September 16, 1990. No damage was reported. The other "felt" event in the county was an IV-intensity, 2.9-magnitude quake that was centered 1 mile northwest of Hayward School, near the intersection of OK Hwy 31 and OK Hwy 31A. The only earthquake that was in or quite near McAlester was an I-intensity event about 1 mile east of George Nigh Expressway and ¼-mile south of Kiamichi Dr. on December 19, 1976.

The Pittsburg County earthquakes that occurred within 10 miles of McAlester are summarized below.

- **December 19, 1976** – An I-intensity tremor was centered 1 mile east of George Nigh Expressway and ¼ mile south of Kiamichi Dr.
- **September 16, 1990** – A V-intensity, 3.2-magnitude earthquake was recorded near the center of Haileyville.
- **May 9, 1991** – A 1.3-magnitude event was centered 5 miles west of McAlester and north of OK Hwy 31.
- **May 26, 1993** – A 1.3-magnitude earthquake occurred 1 mile west of Haileyville.
- **March 9, 1996** – A 1.4-magnitude tremor was centered 0.5 miles northwest of Haileyville.
- **December 6, 1997** – An IV-intensity, 2.9-magnitude earthquake occurred 1 mile northwest of the intersection of OK Hwy 31 and OK Hwy 31A.
- **February 24, 2009** – A 3.3 magnitude earthquake struck 12 miles west southwest of McAlester. The tremor, reported the *McAlester News-Capital*, rattled pictures on the wall of a home 2 miles south of Kiowa. The quake occurred about 3 miles below the surface.

Probability/Future Events

The City of McAlester and its future development areas are at low risk from earthquakes. Any earthquake risk would most likely come from proximity to the New Madrid and Meers faults. According to Dr. James Lawson, chief geophysicist of the Oklahoma Geological Survey's Seismic Observatory at Leonard, the risk of an earthquake in the New Madrid Fault Zone should not be over emphasized. He believes a major seismic event there would have no greater impact on McAlester than a locally-generated earthquake. An 8-magnitude event in New Madrid would likely produce only VI-intensity tremors in Oklahoma, and would not be as severe as the Ft. Gibson quake of 1882.

The City of McAlester and McAlester Public Schools have a low probability of a future earthquake event.

4.12.3 Vulnerability

This section summarizes information about McAlester's vulnerability to earthquakes, including the impact on people, structures and buildings, critical facilities, and

infrastructure. This information, as well as information provided by the City and Public Schools, was used to determine the Vulnerability Criteria identified in Tables 4-2 and 4-3. HAZUS modeling was used to help generate these data. The City of McAlester and McAlester Public Schools were determined to be at low risk for the earthquake hazard. (See Tables 4-2, Hazard Risk Analysis, and Table 4-3, Summary of Hazard Risk Analysis Ranking Criteria for an explanation of how the rankings were derived.)

Population

Most earthquake injuries and fatalities occur within buildings from collapsing walls and roofs, flying glass, and falling objects. As a result, the extent of a community's risk depends not just upon its location relative to a known fault, and its underlying geology and soils, but also on the design of its structures.

Structures/Buildings

Buildings constructed to earlier seismic standards (or to no standard) can pose major threats to life and the continued functioning of key public services during an earthquake disaster. Un-reinforced masonry structures are the most vulnerable, while wood frame structures typically perform well.

Critical Facilities

Of special concern are the design and construction of critical facilities, such as hospitals and transportation facilities, oil and gas pipelines, electrical power and communication facilities, and water supply and sewage treatment facilities.

Infrastructure

McAlester's infrastructure is at low risk of being impacted by an earthquake due to the location of the community in a low seismically active area.

4.12.4 Earthquake Scenario

HAZUS, a software application developed by the Federal Emergency Management Agency and the National Institute of Building Sciences, provides a methodology for estimating earthquake losses at a regional scale. Building and population statistics from the U.S. Census are combined with estimated replacement values for local infrastructure to conclude an estimate on potential damages and losses to be expected within the region from a specified earthquake event.

The historic, 5.7 magnitude, El Reno earthquake event of April 9, 1952 was used as the input event in the HAZUS model run for the City of McAlester and McAlester Public Schools.

HAZUS estimates that no structures would have any damage. All essential facilities, including schools, the EOC, and Police and Fire stations would receive no damage, and experience no loss of functionality.

Transportation system damages and economic losses associated with these systems are estimated at 0%. All utility system facilities, pipeline activity, electric power and potable water would be at 100% following the event. It is estimated that none of the buildings in McAlester, including McAlester Public Schools, would be affected with a power failure

or loss of potable water. HAZUS estimates that no debris will be generated by the earthquake.

The scenario estimates there will be no casualties. The total economic loss for the earthquake is estimated at $0. This includes building and lifeline related losses.

4.12.5 Future Trends

Population

Population in the future growth areas will have the same vulnerability as the current population.

Structures/Buildings

Structures built in the future can be built to withstand the effects from Tornadoes and High Winds. This higher standard for construction would also provide higher resistance to the damages from an earthquake.

Critical Facilities

Critical Facilities built with the same standards that would benefit other structures, would also have better resistance to any damage that might occur due to earthquakes.

Infrastructure

Infrastructure can be built with consideration for damage potential from Expansive Soils, which would provide better resistance to damage from Earthquakes.

4.12.6 Conclusion

Pittsburg County experienced 20 earthquakes from 1995 through 2009 or 1.3 per year. Two of these were "felt" events: one near the center of Haileyville, and another about 1 mile northwest of the intersection of OK Hwy 31 and OK Hwy 31A. The only earthquake in or very close to McAlester was an unfelt event about ½-mile east of George Nigh Blvd. and ¼-mile south of Kiamichi Dr. The City of McAlester and McAlester Public Schools are considered to have a low vulnerability to the earthquake hazard. As calculated using HAZUS software, an El Reno earthquake similar to the 1952 event would cause an estimated $0 in damages. Virtually all Oklahoma earthquakes are too small to be felt and cause no visible damage.

Data Limitations

While the HAZUS software is very comprehensive, structural integrity and Code requirements for a jurisdiction can greatly affect the actual damage taken by structures. Earthquake resistant construction is not something routinely considered in Oklahoma, so damages are not as accurate as they might be in a jurisdiction such as a California community, where earthquake resistant construction and analysis are routinely more studied.

4.12.7 Sources

Oklahoma Geophysical Observatory Examines Earthquakes in Oklahoma, at Web address: http://www.ogs.ou.edu/earthquakes.htm. University of Oklahoma, 1996.

Oklahoma Strategic All-Hazards Mitigation Plan, "Hazard Identification and Vulnerability Assessment," p 7. Oklahoma Department of Emergency Management, September 2001.

Program Statement, at Web address: www.cusec.org. Central United States Earthquake Consortium.

Talking About Disaster: Guide for Standard Messages, "Earthquake," p. 41–49. National Disaster Coalition, Washington, D.C., 1999.

Von Hake, Carl A. Earthquake History of Oklahoma, Abridged from Earthquake Information Bulletin, Vol.8, Number 2. USGS National Earthquake Information Center, March–April 1976.

4.13 Subsidence

Land subsidence, the loss of surface elevation due to the removal of subsurface support, ranges from broad, regional lowering of the land surface to localized collapse. The Primary causes of most subsidence are human activities: underground mining of coal, groundwater or petroleum withdrawal, and drainage of organic soils. This hazard affects parts of at least 45 states. Collapses, such as the sudden formation of sinkholes or the collapse of an abandoned mine, may destroy buildings, roads and utilities.

Generally, subsidence poses a greater risk to property than to life. The average annual damage from all types of subsidence is conservatively estimated to be at least $125 million. Damage consists primarily of direct structural damage and property loss and depreciation of land values, but also includes business and personal losses that accrue during periods of repair.

4.13.1 Hazard Profile

There are two common forms of subsidence, one caused by the erosion of water-soluble subsurface rock, such as limestone, and the other due to the collapse of roof rock into underground mines. Mine subsidence can be defined as movements of the ground surface as a result of readjustments of the overburden due to either erosion or the collapse of underground mine workings. Surface subsidence features usually take the form of sinkholes or troughs.

Approximately 12,400 sq. mi of land in the US is undermined, and it is anticipated that the area will ultimately increase to 62,500 sq. mi. Approximately 3,100 sq mi of the undermined area, most of it in the eastern US has already experienced subsidence. The US Bureau of Mines estimates that 620 sq mi of undermined land is in urban areas, most of it in Pennsylvania, Illinois and West Virginia.

Oklahoma has more than 40,000 acres of abandoned coal mines.

Mine subsidence is common in areas overlying shallow room-and-pillar mines of the sort that were used in and around McAlester, Krebs, Hartshorne and Haileyville, and farther north in the lead and zinc mines of the Picher Field. Sinkholes occur from the collapse of the mine roof into a mine, resulting in a caving-in of the overlying strata and an abrupt depression in the ground surface. The majority of sinkholes usually develop where the amount of cover (vertical distance between the coal seam and the surface) is less than 50 feet. This type of subsidence is generally localized in extent and impacts a relatively small area on the overlying surface. However, structures and surface features affected by sinkhole subsidence tend to experience extensive and costly damages, sometimes in a dramatic fashion. Sinkhole subsidence is responsible for extensive damage to numerous homes and property, and is typically associated with *abandoned* mines, since *active*

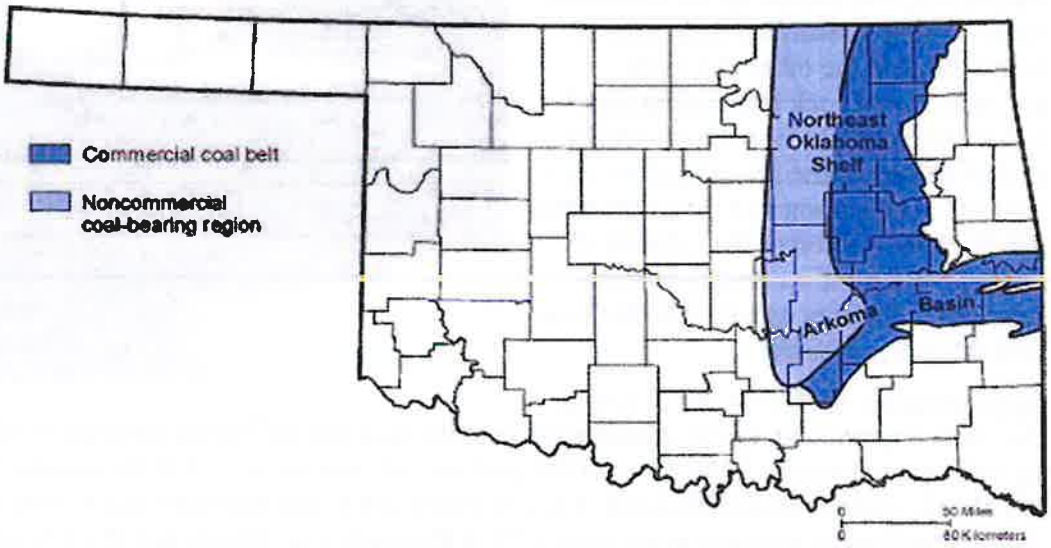
underground mines are usually operating at depths sufficient to preclude the development of sinkhole subsidence.

The risk of subsidence varies according to the depth to the mine cavity, geometry of the mined out area, geology of overlying materials, groundwater movements, and natural and man-made seismic activity.

Location

McAlester is located in the Arkoma Basin and is underlain by coal deposits that were heavily mined from about 1870 to 1930. The McAlester and Hartshorne Coals date from the Pennsylvanian Period. Some coal was stripped in the eastern part of the State between 1829 and 1840, but commercial coal mining was not significant until the coming of the railroads in 1872, when J. J. McAlester began mining a 4-foot vein of coal in the Choctaw Nation in what is now North McAlester. By 1880, coal mining had become a significant industry in the area. Production rose steadily until an all-time peak of 4,849,388 tons was reached in 1920. A total of about 179 million tons of coal were mined. About four-fifths of all Oklahoma coal has been mined by underground methods.

Figure 4–38: The Coal Region of Eastern Oklahoma



All of the mines in the McAlester area were slope mines, and most had a dip of about 30 degrees northward. Coal was taken from both the McAlester and Hartshorne outcrops. The deepest bed was the Hartshorne, which was workable throughout most of the area. It averaged about 4 feet in thickness. The McAlester bed, approximately 1,200 feet above the Hartshorne, varied in thickness from 3 to in a few places 5 feet. All the mines are now closed and filled with water. The land continues to settle gradually, resulting in random sinkholes and troughs (see below).

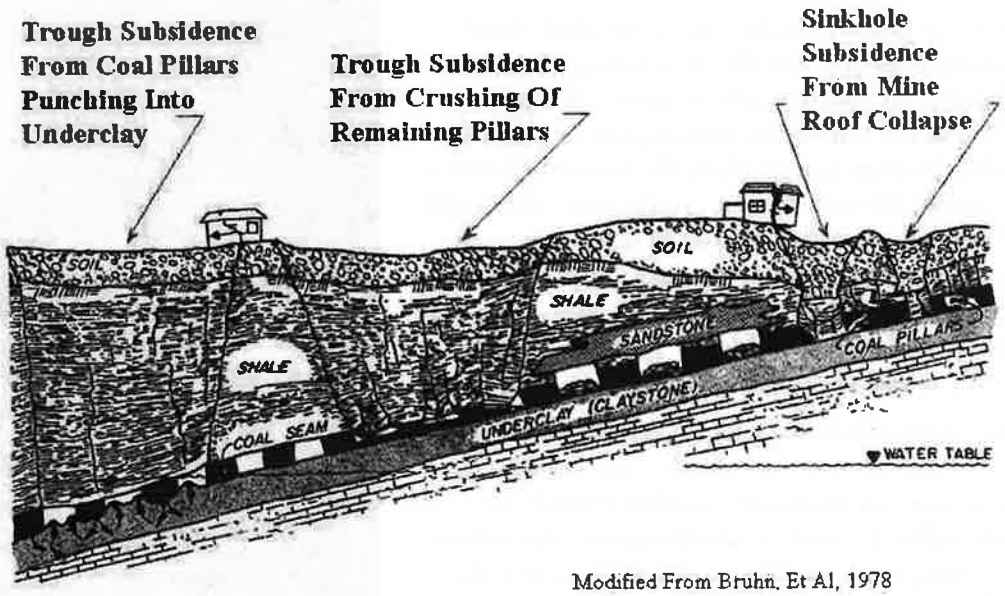
Measurement

Mining subsidence is normally classified by being either sinkhole or trough, with sinkholes being more abrupt and dramatic. Troughs are more general depressions and are usually much larger than sinkholes. Troughs and sinkholes usually occur when the

overburden sags downward due to the failure of remnant mine pillars, or by punching of the pillars into a soft mine floor or roof. It is difficult, if not impossible, to predict if or when failure in an abandoned mine might occur, since abandoned mines may collapse many decades after the mining is completed, if the mine workings were not designed to provide long-term support.

Various geophysical investigation techniques can be used to identify and measure the size and depths of underground mines, such as ground penetrating radar, electrical conductivity, electrical resistivity, magnetic field, very low frequency measurement (ELF), gravity field recording and seismic velocity measurements.

Figure 4–39: Modes of Mine Subsidence



Modified From Bruhn, Et Al, 1978

Extent

Areas over underground mine workings are susceptible to subsidence. Mine collapses have resulted in losses of homes, property value, roadways, utilities and other infrastructure.

Damage to structures is generally classified as cosmetic, functional, or structural. Cosmetic damage refers to slight problems where only the physical appearance of the structure is affected, such as cracking in plaster or drywall. Functional damage refers to situations where the structure's use has been impacted, such as jammed doors or windows. More significant damages that impact structural integrity are classified as structural damage. This would include situations where entire foundations require replacement due to severe cracking of supporting walls and footings, or where roadways and utilities must be relocated or replaced.

Frequency

Land subsidence occurs slowly and continuously over time or on abrupt occasions, as in the case of the sudden formation of sinkholes. Procedures for determining the probability

or frequency of land subsidence have not been recommended by FEMA. Mine subsidence resulting in sinkholes and troughs has been a relatively common event in eastern Oklahoma—perhaps the most publicized being those that forced the abandonment of the town of Picher in northeastern Oklahoma. There were six declared abandoned mine emergencies involving subsidence in Oklahoma in 2006 and 2007. As mines age and experience sequences of drought and heavy rains, water erosion can enlarge underground cavities and increase the likelihood of subsidence. There have been two subsidence events in McAlester, and six in Pittsburg County in the past 10 years.

Impact

The impact of underground mining and subsidence on communities include the collapse of land, structures, roadways and utilities, the loss of property value, the contamination of water supplies, and the dewatering of surface layers, including wells, streams and aquifers. While not usually as catastrophic as sinkholes that develop as a result of the erosion of water-soluble subsurface rock, sinkholes and troughs from mine subsidence can become expensive nuisances to communities and property owners. Room-and-pillar mining, which was commonly practiced in the McAlester area, usually has only minimal, localized dewatering impacts.

In older mines, long-term groundwater recharge is under more or less steady state conditions because the mines are flooded. Periods of drought can lead to subsidence in areas where mining has been close to the surface and the dropping water table removes the water that has acted as a support for the roof rock.

Some surface structural impacts attributed to subsidence can be due to other factors, such as, settlement from drying soils or the weight of surface loads, shrinking and swelling of soils, surface and subsurface erosion, poor construction methods, and structural deterioration due to age, lack of maintenance, or misuse.

Mine subsidence can damage roads, structures and utility systems. This hole developed in US Hwy 270 near Alderson

4.13.2 History/Previous Occurrences

Abandoned mine subsidence is a common occurrence throughout the US, including New York, Pennsylvania, Virginia, West Virginia, Tennessee, Illinois, Indiana, California, Colorado, Kansas, Missouri, and Oklahoma. Mine subsidence is most common where mining extends close to the surface and where no cap rock is present (such as limestone). It is in these areas that large cave-ins have most frequently occurred. It is estimated that there have been more than 6,000 mine-related subsidence events in the eastern US since

1950. The most damaging have been associated with abandoned coal mines over which urban growth has occurred. Losses in urban areas are estimated at more than $30 million annually.

Significant mine subsidence events include:

- **July 31, 2006, Galena, Kansas** – A 50-foot wide, 60-foot deep sinkhole appeared in an alley behind a local bistro. The alleyway had collapsed into an abandoned lead and zinc mine. A natural gas main, sewer line and water main were all hanging in mid-air, and a utility pole leaned precariously over the hole. The subsidence was unstable and slowly grew larger. The utilities were shut off, and the electric company built a line around the problem, and the Kansas Gas Company dug up the main and capped the line. An ambulance and fire equipment were put in place, along with a Red Cross Disaster Relief Van. The City of Galena isolated the sewer main by plugging the line and looping the flow around the site.

Abandoned mine sinkhole in Galena. Kansas

- **Galena, Kansas, September 2007** – A sinkhole appeared across the street from the Galena High School campus. The hole was 15 feet wide and 8 feet deep. The ground was on top of a shaft of the abandoned Maggie Taylor mine.
- **Alta, California, April 2006** - A large sinkhole opened in the middle of a house, killing a 27-year-old man who fell 10 feet and was covered by rubble. The two-story home, built in the 1980s, was above a decades-old underground mine. Recent rains apparently softened the ground under the home. The Alta region had had from 15 to 25 inches more precipitation than normal in the previous two months.
- **Centralia, Pennsylvania** - In 1962, workers set a heap of trash ablaze in an abandoned coal mine pit, which set fire to a vein of coal. The surface fire was extinguished, but the coal seam continued to burn underground. In 1969 an unsuccessful attempt was made to quench the fire. In the 1970s, concerns over the severity of the extensive subterranean fire were stirred when a gas station owner noticed that the contents of his underground fuel storage tank seemed hot. When measured, the

Underground coal mine fire, Centralia, Pennsylvania.

gasoline's temperature was found to be 180 degrees F. Other attempts were made to extinguish the fire over the next two decades. The mines were flushed with water and the burning coal was excavated, but the measures were unsuccessful. After burning beneath the surface for almost 20 years, the fire drew national media attention in 1981 when the ground crumbled beneath the feet of a 12-year-old boy. The sinkhole, about four feet wide and 150 feet deep, had sufficient heat and carbon monoxide to have killed the boy had his cousin not been there to help pull him to safety. The town's residents were forced to relocate.

Oklahoma Subsidence

Most subsidence in Oklahoma results from the erosion of subsurface limestone and from cave-ins above abandoned mining operations. The best-known mine subsidence events in Oklahoma have been in the Tri-State Mining Field around Picher and Commerce. This area was once the leading U.S. producer of lead and zinc. From 1907 through 1946 more than 1.9 million tons of ore were mined in the area, at a value of more than $202 million. Mining was accomplished by the "room and pillar" method, which consisted of cutting open shafts and rooms supported by irregularly spaced pillars. After the mines became unprofitable, new owners exploited the mines, in part by removing the ore that was left in the pillars that supported the mine roofs. The depth of Oklahoma mines varies according to the slope of ore veins. Although the average depth in the Tri-State Field was 237 feet, some mines were as close as 17 feet to the surface. If the mine was overlain by hard limestone, there would be no immediate danger of roof collapse. But decades of water erosion can result in a thinning or hollowing of the limestone cap and sudden collapses into troughs and sinkholes. Some Oklahoma subsidence events are summarized below.

- **Arno Street Sinkhole** - Twenty feet of a 10-inch clay tile sewer main and a 3/4-inch water line broke in a residential area of Coalgate, in Coal County (population - 2,005). When the city maintenance crew investigated the problem, the underground utility pipes had literally disappeared. The backup of raw sewage on the surface added a health hazard to that of the sinkhole. Remediation was a joint project between the State and the City of Coalgate. The total cost of the project was $3,750.79.
- **McCurtain Park Sinkhole** - A sinkhole opened in the parking area of McCurtain City Park, a quarter mile west of the town of McCurtain (population - 466). The park, on OK Hwy 31, is heavily used by the public because of a water-filled strip pit that is a part of the park. Strip mining in the area had been preceded by underground mining in the early 1900s. The sinkhole was 4 feet in diameter and 11 feet deep. Remediation costs were $7,919.20.
- **Picher, Oklahoma, Subsidence** – Subsidence and groundwater contamination forced the abandonment of Picher, in northeastern Oklahoma. During the heyday

McCurtain Park sinkhole repair

of the Tri-State Field, mining was done using the "room and pillar" method. By 1918, over 200 mills were processing the ore from the field. As the mining progressed, the mine workings became interconnected caverns that extended from the town of Commerce northeast toward Joplin, Missouri. The mining era left a legacy of open mine shafts, acid mine water, large areas prone to subsidence, and hundreds of millions of tons of mining waste contaminated with lead, zinc and cadmium. It was the practice of the mining companies to remove columns (pillars) which supported the mine roof before closing the mine. During the last two decades of the mining era, "gougers" leased abandoned mines and/or mined without benefit of a lease, with the intent of taking ore from the mines' remaining pillars. Removal of the columns made collapse of the mines a greater threat. As of 1986, there were 59 major collapses greater than 95 ft. in diameter in the Picher Field due to underground mining. Of these, 29 were major collapses associated with 34 mine shafts and 30 were non-shaft collapses. Most of the collapses occurred prior to 1952. Although most major collapses occurred in rural areas, several were within the city limits of Picher and Hockerville. Three have occurred within 1000 ft. of the Picher High School and Elementary School, and two were within 50 and 500 ft. of the Hockerville Church. The largest collapse, near Cardin, was 560 ft. long and 400 ft. wide.

- **Tulsa County** – Only one confirmed mine-related subsidence has been reported in Tulsa County since 1982. The subsidence occurred on May 16, 1987, in a street and residential yard at E. 17th St. and S. Erie Ave. The City filled the subsidence as a street repair project. There remains some potential geologic hazard for subsidence above abandoned underground coal mines in eastern Tulsa County in the area of E. 21 St. and Yale Avenue—the degree of hazard depending on depth to the mine and presence of a rigid sandstone bed (layer) in the rock interval between the top of the mine and the surface.

Pittsburg County Subsidence

There have been eight mine subsidence events in Pittsburg County between 1999 and 2009, two of them in McAlester.

- **Hartshorne Ute Street Sinkhole.** A sinkhole opened up at the intersection of 12th and Ute Street in Hartshorne (population 2,102). The sinkhole was about 2 feet in diameter at the opening, but under the surface it was about 6 feet long by 4 feet wide by 5½ feet deep. Cost of repair was $3,231.80.
- **Haileyville.** The roof of a coal mine collapsed 2 miles southeast of Haileyville. The vertical opening was 16 inches across at the top and .belled out to about 12 feet at the bottom. According to old mine maps, the sinkhole was directly over the main entry to an underground mine. There were two 4-inch service sewer lines and one 8-inch tile line inside the sinkhole. The sinkhole was filled at a cost of $3,710.

Ute Street sinkhole repair in Hartshorne

- **Arends Sinkhole, Dow, Pittsburg County.** A sinkhole developed about 1.5 miles north of Dow. The sinkhole developed in a flowerbed approximately 20 feet from the carport of a residence. The opening measured about 2 feet across and 100 feet in depth, and the sides around the vertical opening were actively eroding. The property owners operated a commercial horse training facility with high foot traffic near the opening. It cost $3,448 to fill the hole.

Sinkhole developing near McAlester Expo Center

- **Yellow Brick Road Sinkhole, Hartshorne** – This sinkhole developed in a drainage ditch adjacent to Yellow Brick Road in Hartshorne. A street crew cleaning the ditch discovered an unusually shaped, water-filled hole. A backhoe bucket was lowered into the hole, but never reached bottom. The sinkhole was within 30 feet of the nearest residence. The hole turned out to be 8 feet wide and approximately 28 feet deep. Remediation costs were $13,165.
- **Krebs, Highway 270 - Hillside West** A sinkhole developed along US Hwy 270 at Alderson, 3 miles east of McAlester. The sinkhole was about 2 feet wide and 10 inches deep on the inside lane. The next day ODOT workers found the same area had sunk another 10 inches and the collapsed area measured about 11 feet wide and 16 feet long. The hole was filled first with asphalt, then with concrete. Cost was $4,448.
- **Highway 270, Haileyville #2.** The sudden collapse of an abandoned underground coal mine created a sinkhole in the ditch of US Hwy 270 in Haileyville. The dangerous vertical sinkhole was 4.5 feet in diameter, 10.5 feet deep, and 29 feet from the highway asphalt. It was open to the surface and had active erosion taking dirt deeper underground.

McAlester Subsidence Events

There have been six mine subsidence events within McAlester in recent years, as shown in Figure 4-41. Two of the occurrences are summarized below.

- **McAlester Expo Subsidence -** Workers at the Southeast Expo Center, 2.5 miles west of McAlester, discovered a large "sag" (or trough) subsidence that was filled with water. The subsidence measured 114 feet long, 86 feet wide and 14 inches deep. In addition, a section of the asphalt road leading into the main entrance of the Expo Center from US Hwy 270 had dropped about 12 inches, with large cracks in the asphalt. The Expo Center is used for such events as basketball tournaments, trade shows, fairs and concerts. The subsidence was about 452 feet from the Expo building. A 12-inch water line runs near the subsidence that serves as back-up line to Taylor Industrial Park and a million-gallon water tank. Eleven exploratory drill holes revealed that the mine roof was about 50 feet thick with a 2 to 4 foot void. Each drill hole was plugged with flowable grout. Costs were estimated at $65,000 to $80,000.

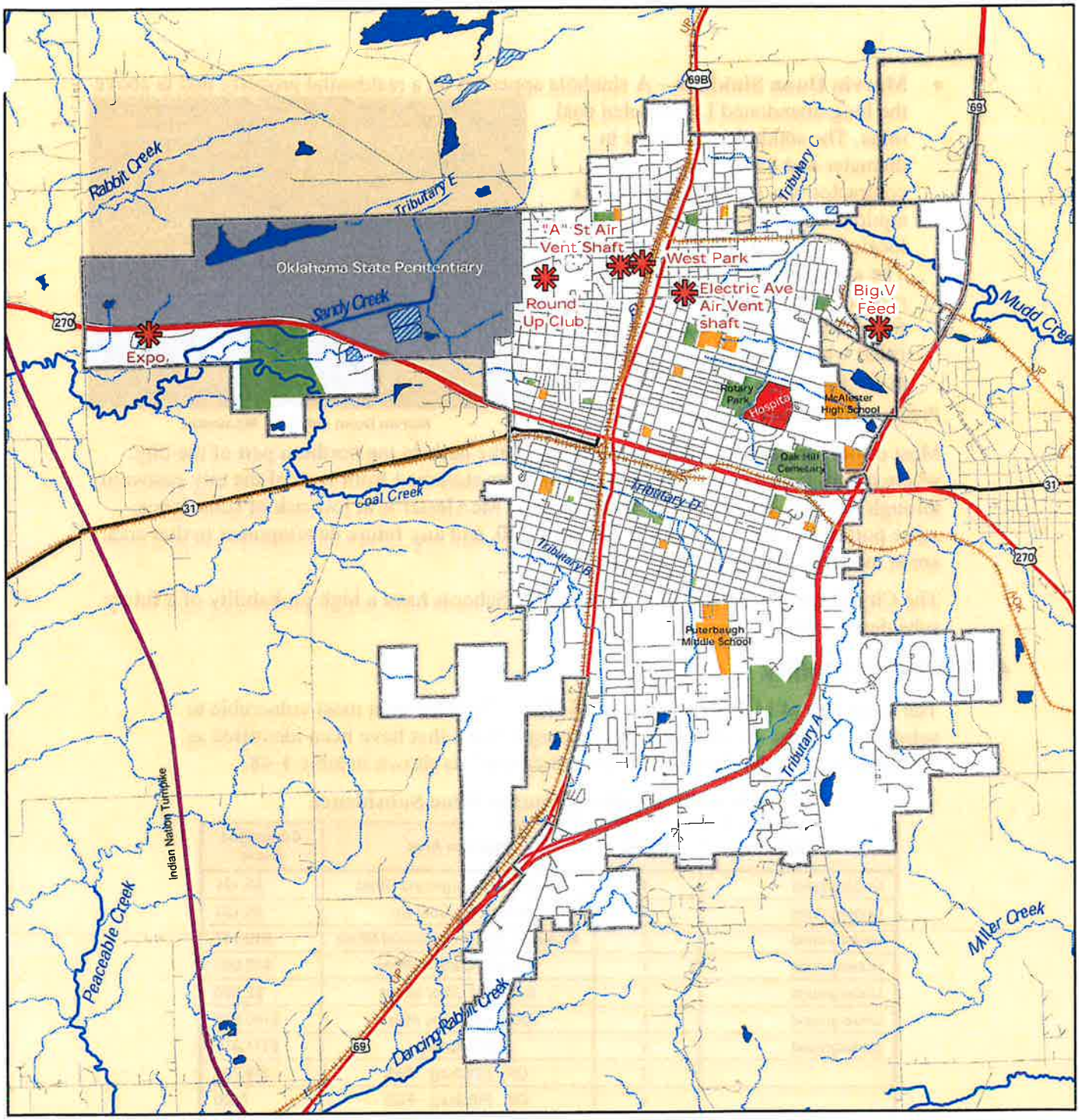
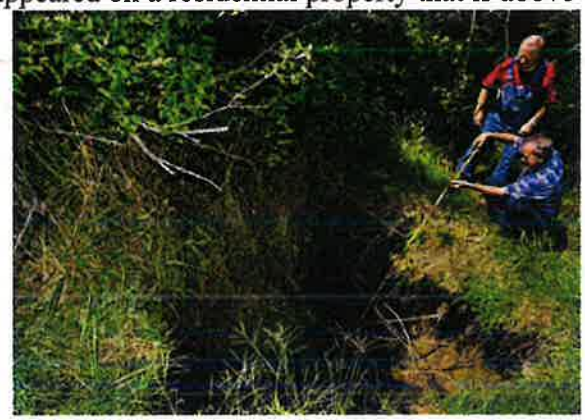


Figure 4-40

City of McAlester

Sinkholes

- **Marvin Dunn Sinkhole** – A sinkhole appeared on a residential property that is above the long-abandoned Little Bolen coal mine. The sinkhole was 9 feet in diameter and 8 feet deep. As the contractor was clearing the area his equipment caved-in a second sinkhole located about 30 feet from the first. The average thickness of the mine roof in the area was about 16 to 17 feet. The holes were excavated and filled with rock and clay. The total project cost was $13,552.



Marvin Dunn sinkhole. McAlester

Probability/Future Events

Most of the subsidence events in McAlester have been in the northern part of the city, where outcroppings of the McAlester coal strata stretched from west of the city eastward through Krebs and Haileyville. While most of McAlester is at low risk of subsidence, some portions of the city north of US Hwy 270, and any future development in that area, are at moderate risk from mine subsidence.

The City of McAlester and McAlester Public Schools have a high probability of a future subsidence event.

4.13.3 Vulnerability

The north part of McAlester, above US Hwy 270, is the area most vulnerable to subsidence. There are 24 mines in Pittsburg County that have been identified as problematic. Most of these have been remediated, as shown in table 4-48.

Table 4–48: Pittsburg County Mine Subsidence

Type	Priority	Problem Area	Completed Costs
Underground	1	Savanna Underground Mines	$3,124
Underground	1	Milby-Dow Coal Co.	$6,125
Underground	1	McAlester SW Underground Mines	$10,147
Underground	1	Richville-Carbon Mines	$32,090
Underground	1	Buck and Other Mines	$2,826
Underground	1	Alderson-Bache Mines	$140,912
Underground	1	Blue Creek	$171,876
	1	OK - Pittsburg - FEA	$16,730
	1	OK - Pittsburg - FEA	$300
	1	OK - Pittsburg - FEA	$200
	1	OK - Pittsburg - FEA	$505
	1	OK - Pittsburg - FEA	$575
	1	OK - Pittsburg - FEA	$4,546
	1	OK - Pittsburg - FEA	$500
	1	OK - Pittsburg - FEA	$543
Underground	1	McAlester City Area Mines	$106,702
Surface	2	McAlester City Area Mines	$0

Type	Priority	Problem Area	Completed Costs
Surface & underground	2	Dow and Jones Academy Area	$0
Surface & underground	2	Alderson-Bache Mines	$0
Underground	2	NE McAlester & Krebs Mines	$0
Underground	2	Blue Creek	$10,208
Underground	2	Richville-Carbon Mines	$0
Underground	2	Buck and Other Mines	$0
Underground	2	Carbon and Adamson Mines	$11,123

Population

Any planned residential development in the north of McAlester where shallow room and pillar mining has occurred will continue to be exposed to sinkhole and trough mine subsidence. Although the location of future sinkholes is almost impossible to predict, it is likely that exposure to this hazard will increase as the abandoned mines age and are subjected to cycles of heavy rain and drought. Mapping or otherwise determining the depth and size of the mines will reduce exposure to the hazard.

Structures/Buildings

As development in the northern part of McAlester progresses, efforts should be made to determine whether underground mines are present and establish their depth and structural integrity. Mine subsidence can cause cosmetic, structural or functional damage to buildings, and loss of property value. Although trough subsidence, like that near the Expo Center, is usually not catastrophic in nature, in some rare instances the sudden appearance of sinkholes can result in significant structural damage.

Critical Facilities

Special care should be exercised to ensure that any new critical facility, such as medical care facilities, day care centers, utility outstations etc., are not located above areas where mining has occurred within 50 feet of the surface, or where—for whatever cause—mine ceiling collapse is a possibility.

Infrastructure

Mine subsidence can be damaging to roads, pipelines, and utilities. Until a careful survey of the subsurface mines in north McAlester is made, it will be difficult to protect infrastructure from occasional damage from subsidence. Mine subsidence is not likely to result in any wide-scale utility outage, although local traffic and services could be interrupted while repairs are made.

4.13.4 Subsidence Scenario

Mine subsidence is highly unpredictable and likely to occur only at specific points, where coal was mined close to the surface, and where either the pillars have been removed or the rooms are not overlain by solid rock strata. Because McAlester coal slopes downward to the north at an angle of about 30 degrees, instances of subsidence are likely to be along a relatively narrow arc of land in the northern part of the city, from west of the State Penitentiary to north of McAlester High School. Since mine subsidence is usually limited

in size, a worst-case scenario for McAlester would be damage to a street, a structure and/or utilities, such as the spread of the trough subsidence near the Expo Center to include both the Expo Center building and a portion of US Hwy 270. Although the depth of the subsidence would only be, in the worst case, about 7 feet, the costs of remediation, building and road repair could be considerable.

4.13.5 Future Trends

Areas in a relatively narrow band from west to east across north McAlester will continue to be vulnerable to the mine subsidence hazard.

Population

Any populations living or traveling in a relatively narrow arc of land in northern McAlester will continue to be exposed to mine subsidence. This exposure could increase over time, if not mitigated by mine mapping, public information, and land use regulation. It is not, however, anticipated that death or injury would result from the appearance of a sinkhole or trough.

Structures/Buildings

As cycles of heavy rain, drought and erosion continue to wear away subsurface rock, it is likely that structures along a narrow band of land in northern McAlester will be increasingly exposed to the mine subsidence hazard. This exposure can be mitigated by public information, mapping, and land use regulation.

Critical Facilities

Care should be taken to ensure that critical facilities are not located in areas exposed to the mine subsidence hazard. Mine mapping, land use regulation and public information can mitigate the exposure of future critical facilities to mine subsidence.

Infrastructure

As times passes, roads, pipelines and utilities in the northern part of McAlester will be at increased risk of mine subsidence. As it is impossible to predict the appearance of sinkholes and troughs from mine subsidence, this increased exposure cannot be quantified. This risk can be mitigated by mine mapping, public information and land use regulation. Mine subsidence is not likely to result in any wide-scale utility outage, although local traffic and services could be interrupted.

4.13.6 Conclusion

Pittsburg County has experienced eight mine subsidence events in the past 10 years, with two of these occurring in McAlester. Altogether, there have been six reported incidents of mine subsidence within McAlester, all of them in the northern part of the city near where the McAlester coal deposits were exposed and shallow mining took place. Although McAlester's exposure to mine subsidence is limited to a narrow band of land reaching from west to east and southeast, the subsidence risk is likely to increase as the mines age and ceiling rock erodes. This exposure can be mitigated through mine mapping, public information and land use regulation. Overall, McAlester has a moderate exposure to the subsidence hazard, with a low vulnerability in most of the city, but a high vulnerability north of US Hwy 270, where coal mining took place within 50 feet of the surface.

Data Limitations

Data on mine subsidence is largely anecdotal, and appears to have only been systematically gathered after the creation of the Abandoned Mine Land Program in 1977. This is particularly true of the McAlester area and eastern Oklahoma. As mine subsidence records are sparse, it is difficult, if not impossible, to either know the number of subsidence events that have occurred or project future exposure.

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4.14 Hazardous Materials Events

Hazardous materials are chemical substances that, if released or misused, can pose a threat to the environment or human health. These chemicals are used in industry, agriculture, medicine, research, and consumer goods. Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These substances are often released as a result of chemical accidents at plant sites or transportation accidents.

In recent years, the increased usage of chemically dependent products and the introduction of new chemicals, materials and substances into commerce have resulted in a corresponding increase in the number of accidents and spills involving toxic and hazardous materials.

4.14.1 Hazard Profile

With 17 Tier II sites located in or adjacent to McAlester's city limits, the City is vulnerable to hazardous materials events

Hazardous materials, for regulatory purposes, are divided into two general categories: fixed sites, and transportation facilities.

Fixed sites include buildings or property where hazardous materials are manufactured or stored, and are regulated nationally under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) by the U.S. Environmental Protection Agency (EPA), and in Oklahoma by the Department of Environmental Quality.

The federal government has established detailed systems for keeping track of Tier II hazardous materials sites. The *Emergency Planning and Community Right to Know Act* of 1986 defines a Tier II site as any location that has, for any 24 hour period, either: 1) specified threshold amounts of defined Extremely Hazardous Substances, or 2) any other substance requiring a Material Safety Data Sheet (MSDS) for amounts greater than 10,000 pounds. In Oklahoma in 2001, there were 28,000 Tier II sites reported to the Oklahoma Department of Environmental Quality. The City of McAlester has 17 Tier II facilities located within or situated adjacent to the city's boundaries.

Transportation of hazardous materials is regulated by the U.S. Department of Transportation (DOT), under the *Hazardous Materials Transportation Act*, 49 CFR 119 for natural and other gases transported by pipeline, and 49 CFR 195 for liquids transported by pipeline. For intrastate commerce, the transportation of hazardous materials is regulated by the Oklahoma Corporation Commission.

The responsibility for receiving reports on hazardous materials and toxic waste events was given to the National Response Center (NRC), www.nrc.uscg.mil/nrcback.html, staffed by the U.S. Coast Guard. The NRC serves as the sole national point of contact for reporting all oil, chemical, radiological, biological, and etiological discharges into the

environment anywhere in the United States or its territories. The NRC also acts as a 24-hour contact point to receive earthquake, flood, hurricane, and evacuation reports.

Many products containing hazardous chemicals are used and stored routinely in residential, commercial, and industrial applications. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. In most cases, disasters involving hazardous materials are confined to a localized area, whether an accidental release occurs at a fixed facility or in association with a transportation incident. Transportation related events are addressed in Section 4.15: *Transportation Hazards*.Gas and oil pipeline spills can be considered as either fixed-site events occurring in an extended industrial plant, or as transportation hazards (see 4.15.1 Hazard Profile, Transportation Hazards). Between 2000 and 2009, there were 651 natural oil and gas pipeline spills in Oklahoma. Most of the accidents were at the local distribution company level. A major cause of pipeline failure, especially in Oklahoma's aging petroleum industry infrastructure, is corrosion. During the same timeframe, Oklahoma reported 374 spills from oil storage tanks, primarily due to lightning strikes and aging or faulty facilities.

As many as 500,000 products pose physical or health hazards and can be defined as hazardous chemicals. Each year, over 1,000 new synthetic chemicals are introduced. In an average city of 100,000 residents, 23.5 tons of toilet bowl cleaner, 13.5 tons of liquid household cleaners, and 3.5 tons of motor oil are discharged into city drains each month.

The US Environmental Protection Agency sorts hazardous materials into six categories:

1. Toxic Agents (irritants, asphyxiates, narcotics)
2. Other Toxic Agents (hepatoxic, nephratoxic)
3. Hazardous Wastes
4. Hazardous Substances
5. Toxic Pollutants
6. Extremely Hazardous Substance

Hazardous materials affect people through inhalation, ingestion, or direct contact with skin. They can cause death, serious injury, long-lasting health problems, and damage to buildings, homes and other property.

Location

McAlester and McAlester Public Schools have inventoried local businesses and industry to identify dangerous chemicals that are being manufactured and/or stored in their communities. Known hazardous materials sites for McAlester and McAlester Public Schools are shown on the map in Figure 4–41 and are listed in Table 4-49.

Table 4–49: Tier II Sites - City of McAlester

ID	Facility	Address	Contains EHS	People within 1/4 mile
EHS Tier II Sites				
1	AT&T McAlester Central Office	332 Carl Albert Parkway.	Y	364
2	Baker Petrolite	2491 N US Hwy 69 Bypass	Y	
3	Choctaw Manufacturing	1 Skyway Dr	Y	12
4	National Oilwell Varco	501 N. George Nigh Expy	Y	37
5	PSO – McAlester S Substation	950 Larue Rd.	Y	198

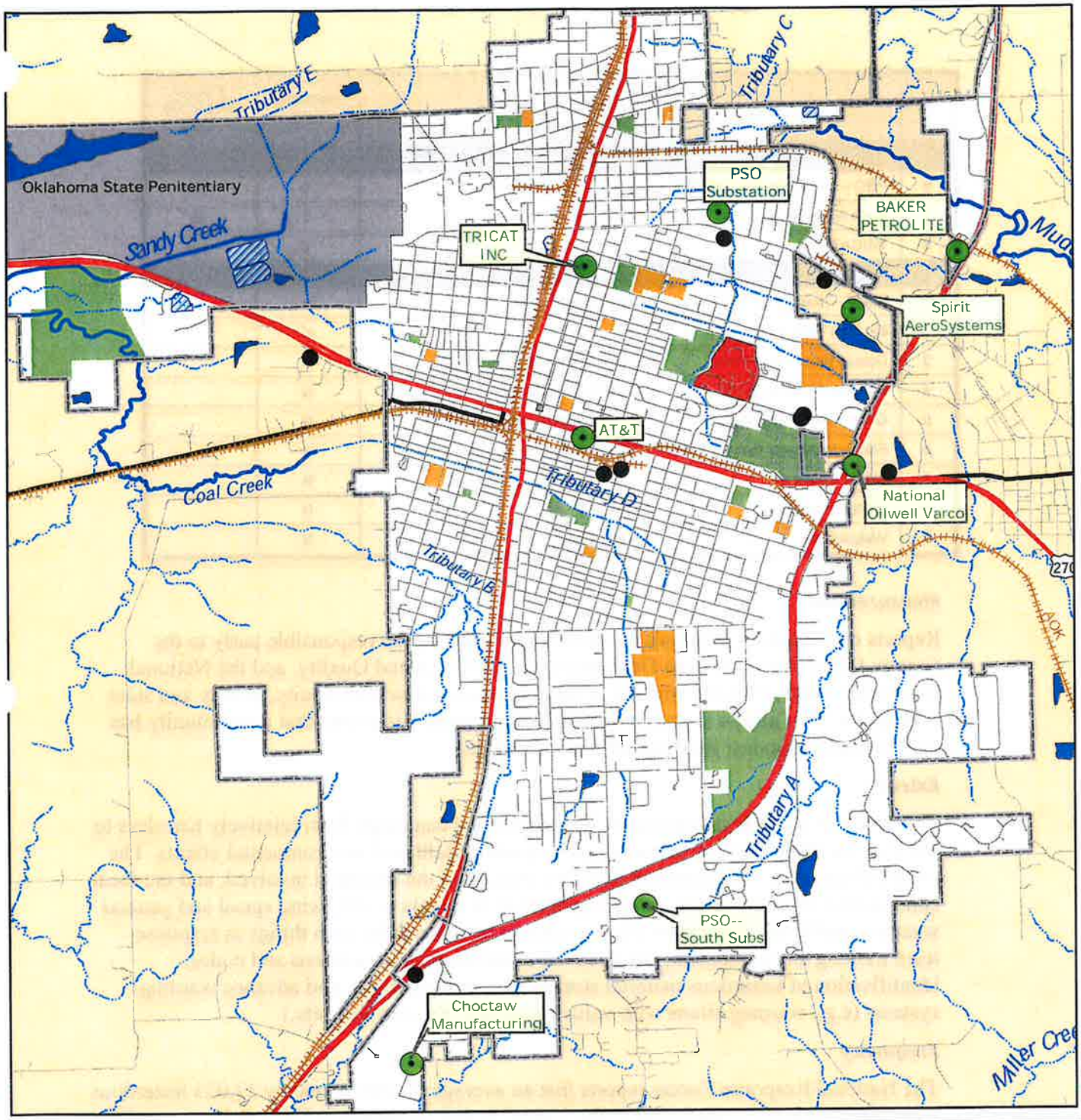


Figure 4-41

City of McAlester

TIER 2 Sites

ID	Facility	Address	Contains EHS	People within 1/4 mile
EHS Tier II Sites (cont)				
6	PSO – McAlester Substation	9th and Gene Stipe Blvd.	Y	720
7	Spirit AeroSystems, Inc.	1900 Electric Ave.	Y	69
8	TRICAT, Inc	100 Taylor Blvd	Y	410
Non-EHS Tier II Sites				
1	Baker – Hughes Drilling Fluids	1610 Electric Ave.	N	
2	Big Mac Tank Trucks, LLC		N	
3	Dolese Bros. Batch Plant	1620 S. George Nigh Expy	N	
4	National Oil Varco DSC	1710 E College Ave	N	
5	ODOT Div-2 Pittsburg Co	¼ mile east of US69 & US270	N	
6	PSO – McAlester Service Center	900 E. Electric Ave.	N	
7	Allford Propane	US Hwy 270	N	
8	Allford Propane	106 S. 6th St.	N	
9	Webcoat Inc.	1801 College Ave.	N	

Measurement

Reports on hazardous materials events are submitted by the responsible party to the County LEPC, the Oklahoma Department of Environmental Quality, and the National Response Center. This information is summarized to show community, county and state summaries. This allows the number of hazardous materials events that a community has to be measured against state and national averages.

Extent

The extent of a fixed-site hazardous materials event can range from relatively harmless to one that is catastrophic, with numerous long-term health and environmental effects. The extent of the hazard is dependent upon the amount of the chemical involved, and the local conditions at the release site, including number of people at risk, wind speed and general weather conditions. The extent of an event can be reduced by such things as response team training and equipment, enforcement of community regulations and codes, identification of hazardous material storage sites and pipelines, and advance warning systems (e.g., warning sirens with voice capability, Reverse 911, etc.)

Frequency

The National Response Center reports that an average of approximately 32,023 hazardous materials events occur each year in the United States, as shown in Table 4-50. Annually, on the average, about 12,070 events are from fixed-site locations, the largest number of any of the defined incident types.

Oklahoma was ranked 31st by the EPA in controlled toxic releases reported from industrial practices in 2008. Over 33.6 million pounds of toxic substances were released by air emissions, water discharges, underground injections, landfills and disposal facilities by industries in Oklahoma during 2008.

Table 4–50: U.S. Hazardous Materials Incidents 2000-2009

Incident Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Fixed	11,813	12,441	11,917	11,975	12,975	13,017	13,621	11,913	10,909	10,123
Unknown Sheen	4,016	4,147	3,426	3,733	3,411	3,934	3,797	4,199	4,278	4,254
Vessel	3,945	4,378	3,919	3,962	4,385	4,611	4,767	4,931	5,030	4,597
Mobile	3,597	3,216	2,942	2,947	3,192	3,215	3,267	3,297	3,238	2,854
Pipeline	1,618	1,841	1,621	1,643	1,574	1,896	1,839	1,580	1,379	1,275
Platform	1,428	1,355	1,233	1,344	1,198	1,395	1,606	1,407	1,362	1,761
Storage Tank	1,379	3,140	3,044	2,808	2,838	2,687	2,577	2,519	2,460	1,973
Railroad	1,332	1,241	1,200	1,074	1,276	1,532	1,451	1,390	1,649	1,306
Aircraft	248	297	278	262	277	211	217	214	204	175
Drill/Exercise	669	789	908	743	1,073	1,223	1,578	1,584	1,829	2,039
TOTAL	30,045	32,845	30,488	30,491	32,199	33,721	34,720	33,034	32,338	30,357

Source: National Response Center

There have been 7 reported fixed-site hazardous material spills in McAlester in the past 10 years. The largest of these involved the catastrophic fire at Diversified Foods on the night of January 18, 2007, during an ice storm. Given this limited data, McAlester can expect a hazardous materials spill every 1.4 years.

Impact

The impact on the community of this hazard can include interrupted business operations, disrupted transportation systems, short- or long-term ecological damage or degradation, diminished emergency response, and injury or loss of life.

Severity

McAlester considers a minor severity event to be a chemical spill that is unlikely to cause severe casualties, or which meets the Emergency Response Guidebook definition of a "small spill," and a major severity event to be the release of a toxic chemical which has the likelihood of producing serious injury or death, or which meets the definition of a "large spill" for a particular chemical according to the most current edition of the Emergency Response Guidebook.

4.14.2 History/Previous Occurrences

In 1984, a deadly cloud of methyl isocyanate killed thousands of people in Bhopal, India. Shortly thereafter, there was a serious chemical release at a sister plant in West Virginia. These incidents underscored demands by industrial workers and communities in several states for information on hazardous materials. Public interest and environmental organizations around the country accelerated demands for information on toxic chemicals being released "beyond the fence line" outside the facility.

Oklahoma Toxic Releases

There have been three recent releases of note in Oklahoma.

- **March 26, 1997** - An explosion at Chief Supply Chemical Company, 5 miles northwest of Haskell on U.S. 64, sent up a column of smoke that could be seen for 50

miles. The fire continued to burn through the night of March 28. One employee was critically burned and later died.

- **January 22, 2001** - Carbon monoxide was released from gas equipment owned by Reliant Energy/Arkla Gas Company into a Chickasha residence causing two fatalities.
- **October 17, 2006** - A toxic chemical release occurred at Muskogee's water treatment plant when sodium chlorite was inadvertently emptied from a tanker truck into a tank of fluorosillic acid. The mixture produced a potentially lethal cloud of chlorine dioxide and forced the evacuation of the Port of Muskogee and the closure of several highways. The toxic cloud was dissipated by strong southeasterly winds.

Pittsburg County Fixed Site Incidents

From January 1, 2000 to December 31, 2008, there were 27 fixed-site toxic release incidents in Pittsburg County reported to the NRC. Of those events, most were minor spills of fuel oil, but a good number involved the release of thousands of gallons of diethanolamine, most from pipeline facilities—and the majority of these were from the Williams Arkoma facility near Quinton. By far the greatest exposure to hazardous materials and chemicals in Pittsburg County would be from the US Army Ammunition facility southwest of the city, which releases thousands of pounds of hazardous wastes each year.

- **March 19, 2003** – 400 gallons of turbine oil was released by BVC Power Partners due to an equipment failure.
- **October 28, 2003** – Fire in a CenterPoint Energy gas transformer 10 miles south of McAlester caused the release of natural gas.
- **February 10, 2004** – The *Tulsa World* reported that three McAlester Army Ammunition Plant workers were sent to a medical clinic, and a warehouse and office building evacuated because of an unspecified chemical leak.
- **May 10, 2004** – Equipment failure at the Williams Arkoma West Liberty compressor station near Quinton led to the release of 850 lbs. of amine into the soil.
- **June 1, 2004** – A leaking valve at the Williams Arkoma facility near Quinton led to the release of 425 lbs of amine.
- **June 10, 2004** – The failure of a nipple on a discharge circulation pump at a Williams Arkoma facility near Quinton caused the release of 1,000 gallons of amine onto the ground.
- **February 7, 2005** – The failure of a process pump at a William Arkoma facility resulted in the release of 1,500 gallons of diethanolamine to the soil.
- **March 3, 2005** – Production at the McAlester Army Ammunition Plant was halted twice within several months when workers developed anemia, reportedly from exposure to TNT.
- **January 9, 2006** – A pin-hole leak in a Williams Arkoma pipe near Quinton caused the release of 833 lbs of diethanolamine to the air.
- **May 27, 2006** – A faulty union tube at Williams Arkoma's amine treating unit caused the release of 400 lbs. of amine to the soil.

- **February 28, 2007** – A pump leak at Williams Arkoma West Liberty station near Quinton caused the release of 700 gallons of 25% diethanolamine to be released to the soil.
- **August 5, 2008** – Unknown amounts of hydrochloric acid and other materials were reportedly dumped behind Frac Tech facility at Alderson along US Hwy 270.

City of McAlester Fixed Site Hazardous Material Events

There have been 7 fixed-site hazardous materials events near or in the City of McAlester reported to the NRC in the past 10 years. Most were minor releases or spills, but two were relatively significant events: a combustion turbine leaked 3,800 gallons of lubricating oil near McAlester on OK Hwy 69 at mile marker 69, and a catastrophic fire at Diversified Foods at the Stephen Taylor Industrial Park (see *4.10 Urban Fire*, above).

- **March 25, 2003** – 3,800 gallons of lubricating oil escaped from a combustion turbine belonging to Tenaska Power Company into Peaceable Creek in south McAlester.
- **July 17, 2005** – High winds caused a pole-mounted transformer to fall and release PCB material into a storm drain near 615 N. George Nigh Expressway.
- **January 18, 2007** – A fire at the Diversified Foods plant in west McAlester completely destroyed the facility and resulted in the incineration of 29,000 lbs of ammonia in an outdoor tank and two 2,000 lb ammonia tanks inside the building. The McAlester Fire Department evacuated everyone within a 1-mile radius of the fire. No injuries were reported.
- **January 22, 2009** – Toxic waste was reportedly being dumped and incinerated behind a pest control business in north McAlester. The unknown material got into a local creek and poisoned the water, killing cattle.

Probability/Future Events

McAlester and McAlester Public Schools have a low probability of a future fixed site hazardous materials event.

4.14.3 Vulnerability

A hazardous material event can occur anywhere due to the widespread use of hazardous chemicals. However, the populations most at risk to a fixed-site incident are the workers in the facility where the release occurs, and the people living nearby. There are 18 Tier II sites within or adjacent to the City of McAlester. These are shown on the map in Figure 4-31. Of these 18 Tier II sites, 15 are located within McAlester's city limits, and three are just outside.

Assessment of vulnerability to a hazardous material release can be meticulous due to the relationship that exists between the toxicity of the material, the amount of material released, the type of release, and the climatic conditions present at the time of the release.

However, for the purposes of this report, general community risk is assessed based on the protective action distances defined by CAMEO and RMP* Comp, two software programs used to plan for hazardous material emergencies. The worst-case protective action distances are based on the physical characteristics of the material and the specified amount of material housed within the largest container at each Tier II site. For chemicals

that do not have definable protective action distances, the evacuation radius for large spills, as listed in the Emergency Response Guide, was used.

McAlester's Fire Department has an Intermediate Hazardous Materials (HazMat) Response Trailer supplied by the Department of Homeland Security. Department staff have spent many hours training and preparing procedures and policies. McAlester now has 23 firefighters trained and certified as IFSAC Hazardous Material Technicians. The other firemen in the Department are certified at IFSAC Hazardous Material Operations level. When the department responds to a WMD/CBRNE, Hazardous Material incident it dispatches 7 certified HazMat Technicians and 2 firemen certified at Operations level.

McAlester's Tier II facilities are listed in Table 4-49, along with the number of people within a quarter mile of the facility.

Population

Since approximately 75-80% of all hazardous materials releases occur at fixed-site facilities, the greatest danger is to the populations working at or living near the facilities where the material is released. Over 250 people, or 1% of the Census 2000 population of McAlester, live within a quarter-mile of at least one Tier II site.

People at heightened risk in the release area are those with mobility or severe health issues that would limit their ability to evacuate quickly, and people who speak a language other than English, limiting their ability to receive warning messages.

Structures/Buildings

Structures and buildings are, as a rule, not vulnerable to hazardous material spills, except in the case of flammable and explosive materials, like natural gas and some petroleum products. No McAlester critical facilities are located close to Tier II facilities utilizing or transporting such materials.

Critical Facilities

There are 11 critical facilities in McAlester within a quarter mile of an EHS Tier II facility. Particularly noteworthy are two special needs critical facilities: Burgundy Place and Widening Horizons. These are listed in Table 4-51.

Table 4–51: McAlester Critical Facilities within ¼-Mile of an EHS Tier II Site

ID	Name	Address
5	McAlester Police Detective Dept	110 Airport Dr
7	McAlester Regional Airport	104 Airport Dr
12	Pittsburg County Courthouse	115 E. Carl Albert Pkwy.
18	Federal Building & U.S. Courthouse	3rd & Carl Albert Pkwy.
19	McAlester USPS	500 E. Washington Ave.
25	Burgundy Place	301 E. Washington Ave.
42	Widening Horizons	2000 N. 7th St.
44	Eastern Oklahoma State College	1802 E. College Ave.
51	McAlester Public Schools Admin.	200 E. Adams Ave.
61	Arvest Bank	101 S. 3rd St.

ID	Name	Address
62	BancFirst	501 E. Carl Albert Pkwy

Infrastructure

Water Treatment – Water treatment plants use large amounts of liquid chlorine for purifying drinking water. A liquid chlorine spill at a water treatment plant could force the evacuation of the facility and a temporary stop of operations. McAlester's Water Treatment Plant is located at Lake Talawanda II, well away from populated areas. The only danger would be to employees at the plant.

Wastewater Treatment – Wastewater treatment plants not only process contaminated waste, but also use hazardous chemicals. A hazardous substance spill at a plant could force the shutdown of the facility. In addition, a malfunction at the plant could cause the spill of contaminated wastes into rivers and streams.

Utilities: The primary utility providers for McAlester's jurisdiction are AEP/PSO (electricity) and Reliant Energy/Arkla (natural gas).

Electricity – There are no immediate vulnerabilities to the supply of electricity because of a hazardous materials spill. Although electrical substations contain hazardous materials, such as battery acids and PCBs, these do not pose a danger to local citizens, as substations are usually fenced and bermed.
Gas – No significant vulnerabilities to a fixed-site toxic materials release are likely to interfere with the delivery of natural gas. Natural gas is, itself, a hazardous material, and leaks from ruptured pipes can result in fires, explosions or the temporary shut off of gas delivery through the affected lines, injury and death.

Transportation Systems (Highways, Railway, Airports) – Evacuation of contaminated areas can clog roadways or block traffic until the event has dissipated.

Emergency Services- Fire, Police and Medical services could be impacted by having to evacuate facilities. In McAlester, there are currently no emergency services located within the evacuation distance of a Tier II facility. Fire, Police and Medical services could have a surge of demand as the result of a Tier II event. While not an immediate threat to delivery of these services, the demand for additional personnel to provide an effective response could potentially increase the cost for these resources.

4.14.4 Fixed-Site Event Scenario

Since approximately 75-80% of all hazardous materials releases occur at fixed-site facilities, the greatest danger is to the populations working at or living near the facility where the material is released. About 90% of toxic material releases are of a single chemical or substance. Two of the most common toxic substances released are chlorine and ammonia, chemicals widely used in manufacturing. Chlorine, which is used in water purification, is one of the most widespread and frequently used chemicals in Pittsburg County. About 90% of toxic releases at fixed site facilities are a result of operator errors and equipment failure.

McAlester has had what, under slightly different circumstances, could be used as a worst-case scenario: the catastrophic fire that consumed the Diversified Foods plant during an

ice storm on the night of January 18, 2007. What prevented this event (which involved the burning of 29,000 gallons of ammonia) from being a worst-case prototype was that it occurred at the Stephen Taylor Industrial Park, well to the west of urban McAlester. Had the fire occurred in or near downtown McAlester, the result (no injuries, no deaths) might have been quite different.

The following scenario involves an accidental explosion that released Sulfuric Acid at the AT&T location at 332 Carl Albert Pkwy., in downtown McAlester. The explosion could be the result of operator error or equipment failure. The population most at risk would be employees working at the site and those people living and working close to the facility when the fire occurs.

The scenario, shown in Figure 4-42, would involve a 1000-foot radius isolation distance. The affected area includes 130 structures, 882 people, 11 critical facilities, and one other Tier II site. It might be mentioned that the McAlester Fire Department, which has an ISO rating of 4, a FEMA/Homeland Security-supplied HazMat trailer, and HazMat certified firemen on every shift, has demonstrated the capability of handling such an event.

Table 4–52: McAlester Fixed Site Hazardous Materials Scenario

	1,000 Ft Isolation Buffer	1.5 Mile Protection Buffer	Entire Plume	Plume Greatest Threat
Population	226	12,723	4,098	1,752
Structures	130	7,920	2,678	1,123
Critical Facilities	5	48	10	3

Table 4–53: Critical Facilities Within 1,000-ft of AT&T

ID	Critical Facility	Address
18	Federal Building & US Courthouse	301 E. Carl Albert Pkwy.
19	McAlester USPS	500 E. Washington Ave.
25	Burgundy Place	301 E. Washington Ave.
62	Banc First	501 E. Carl Albert Pkwy.
64	First National Bank & Trust	235. E. Choctaw Ave.

4.14.5 Future Trends

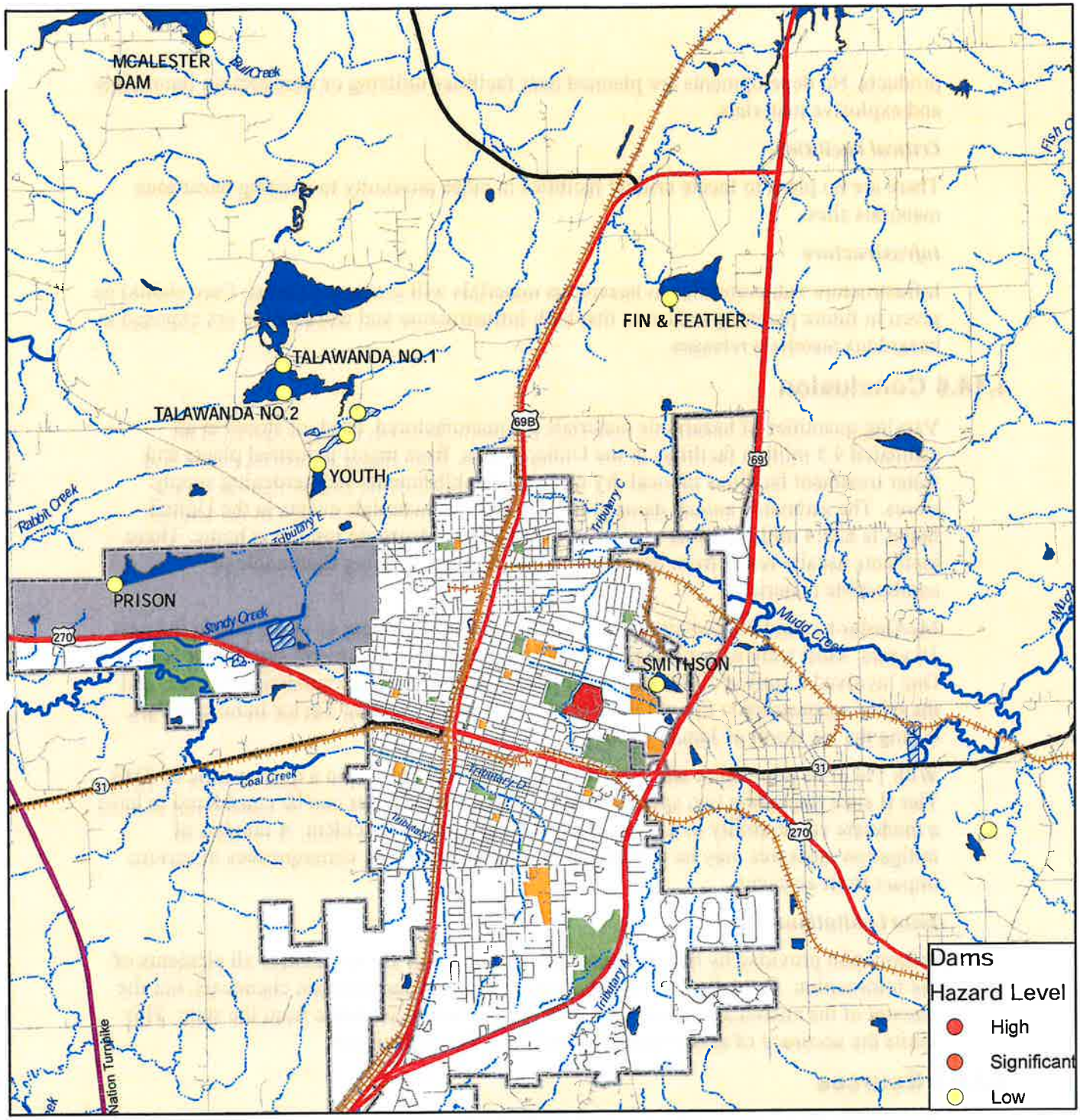
For a map of McAlester's potential future growth areas, see Figure 1-9.

Population

Development in McAlester will continue to expose the population to hazardous material spills.

Structures/Buildings

Structures and buildings in future development areas will remain vulnerable to releases of toxic, flammable and explosive materials, like chlorine, natural gas and some petroleum



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles
0 0.6 1.2

Figure 4-43

City of McAlester

Dam Locations and Hazard Rating

products. No developments are planned near facilities utilizing or transporting flammable and explosive materials.

Critical Facilities

There are no plans to locate critical facilities in close proximity to existing hazardous materials sites.

Infrastructure

Infrastructure vulnerabilities to hazardous materials will continue to exist. Care should be given in future planning to ensure that both infrastructure and workers are not exposed to hazardous materials releases.

4.14.6 Conclusion

Varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States, from major industrial plants and water treatment facilities to local dry cleaning establishments and gardening supply stores. The estimated annual damage from hazardous materials events in the United States is $22.4 million. Most victims of chemical accidents are injured at home. These incidents usually result from ignorance or carelessness in using flammable or combustible materials.

McAlester has had 7 fixed-site hazardous materials events near or in the city in the past 10 years. Most were minor releases or spills, but two were relatively significant events. One involved a spill of 3,800 gallons of lubricating oil from a combustion turbine, and the other a catastrophic fire at Diversified Foods at the Stephen Taylor Industrial Park during the ice storm of January 2007.

With 1% of its population and 11 critical facilities located within a quarter mile of EHS Tier II sites (including two special needs facilities), McAlester can be considered to have a moderate vulnerability to a fixed-site hazardous material incident. A number of mitigation measures may be considered in order to lessen the consequences of serious impact from an event.

Data Limitations

Information provided by the reporting agencies does not always include all elements of the information. Some facilities have reported that they have certain chemicals, but the amount of the chemicals is not in the Tier II information available from the state. This limits the accuracy of assessing the hazard from Tier II facilities.

4.14.7 Sources

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Planning Scenarios: Executive Summaries, Department of Homeland Security. http://www.globalsecurity.org/security/library/report/2004/hsc-planning-scenarios-jul04_exec-sum.pdf

Hazardous Materials and HazMat Trailer, City of McAlester Fire Department, http://www.cityofmcalester.com/fire/Haz-mat/haz_mat.htm

Toxic Release Inventory ranked by State, TRI Explorer, US Environmental Protection Agency, http://www.epa.gov/cgi-bin/broker?_SERVICE=oiaa&_PROGRAM=xp_tri.sasmacr.tristart.macro&VIEW=USST&trilib=TRIQ1&TAB_RPT=1&_LINESPP=ALL&sort=RE_TOLBY&FLD=RELLBY&FLD=TSFDSP&FLD=RE_TOLBY&ONDISPD=+&OTHDISPD=+&OFFDISPD=+&OTHOFFD=+&sort_fmt=2&_TOP=&INDUSTRY=ALL&STATE=ALL+STATES&COUNTY=All+counties&CHEMICAL=_ALL_&YEAR=2008

4.15 Dam Failures

The Federal Emergency Management Agency (FEMA) defines a dam as "a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water." Dams typically are constructed of earth, rock, concrete, or mine tailings. A dam failure is the collapse, breach, overtopping or other failure resulting in downstream flooding.

4.15.1 Hazard Profile

A break in a dam produces an extremely dangerous flood situation because of the high velocities and large volumes of water. In the event of a dam failure, the potential energy of the water stored behind even a small dam can cause great property damage, as well as loss of life if there are people downstream from the dam.

Dam failures are primarily caused by hydrologic or structural deficiencies. A hydrologic deficiency is inadequate spillway capacity caused by excessive runoff from heavy precipitation. Structural deficiencies include seepage, erosion, cracking, sliding, and overturning, mainly caused by the age of a dam and lack of maintenance. The operation of a reservoir can also influence the safety of the structure.

There can be varying levels of dam failure. Partial dam failures include inadequate spillway capacity that causes excess flow to overtop the dam; and internal erosion through the dam or foundation.

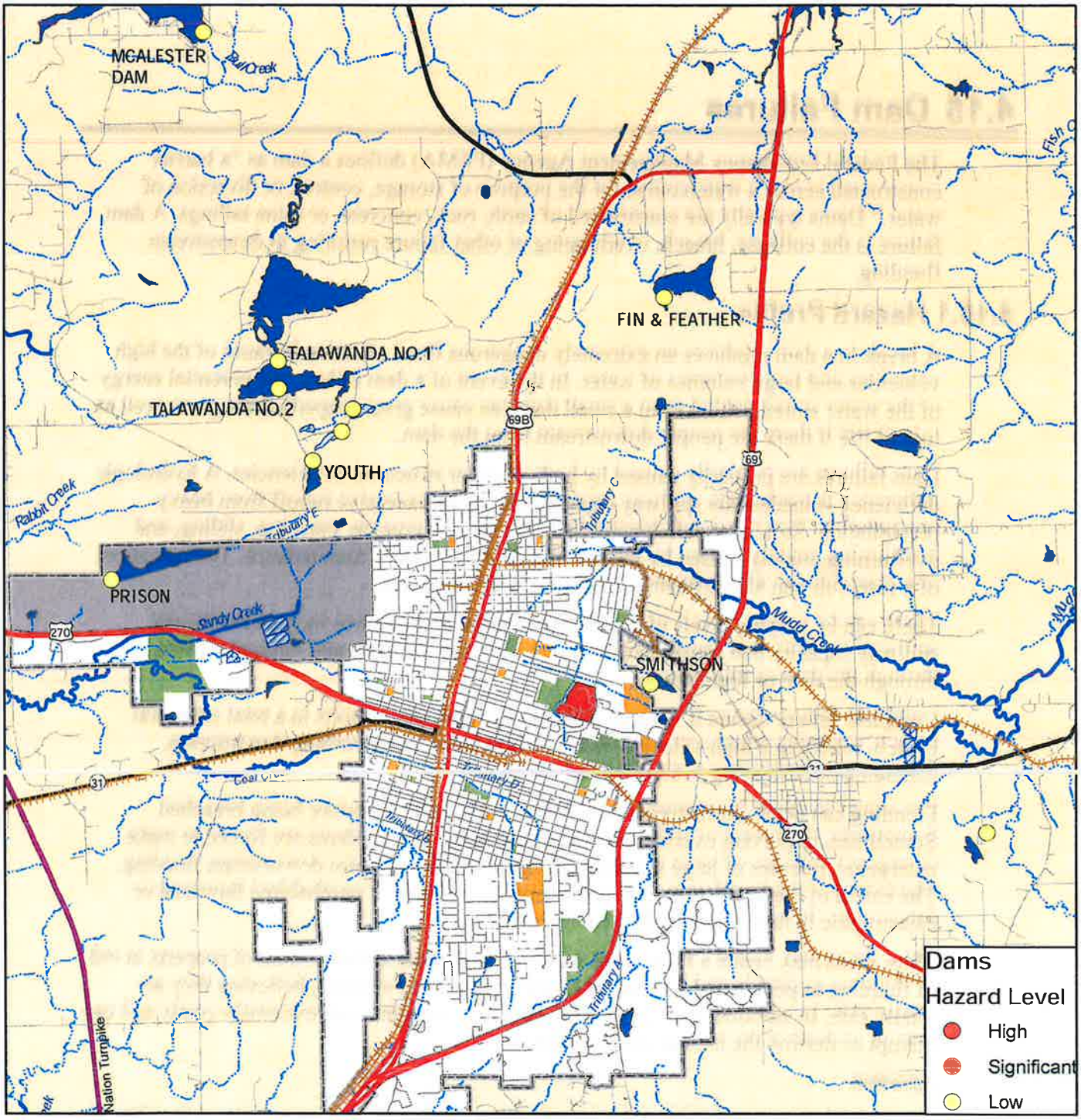
Complete failure occurs if internal erosion or overtopping results in a total structural breach, releasing a high-velocity wall of debris-laden water rushing downstream, damaging or destroying everything in its path.

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. The extent of the inundation that results may be minimal to uninhabited farmland or catastrophic in nature in an urban environment.

Thus, dams may create a false sense of security, increasing the amount of property at risk of flooding as people and businesses locate downstream of dams, believing they are totally safe. In addition, dams, and other structural measures are extremely costly and can disrupt or destroy the natural environment.

Location

Figure 4-44 shows and Table 4-54 lists 10 dams located in close proximity to the City of McAlester. The table includes information on the owner, year built, height and length of the dam, discharge in cubic feet per second (cfs), and storage capacity in acre-feet. Prison dam is located within the city limits of McAlester. Smithson is just outside the city limits to the East. Oklahoma No Name 121013 Dam is located east of McAlester. The rest of the dams are located to the North of McAlester.



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.6 1.2

N W E S

Flanagan & Associates, LLC

McALESTER, OKLAHOMA 1896 FAITH - HOPE - PROSPERITY

Figure 4-43

City of McAlester

Dam Locations and Hazard Rating

Table 4–54: McAlester Area Dams

Nat Id	Dam Name	Owner	River	Near City	Year Built	Dam Length	Dam Height	Max Discharge	Max Storage
OK 10433	Fin & Feather	Fin and Feather Club	Fin & Feather	Bug Tussle	1933	900	33	58590	490
OK 02576	McAlester	City Of McAlester	McAlester	North McAlester	1930	700	35	96720	16170
OK 21096	Ok No Name 121013	W. Riley Murphy	Ok No Name 121013	Richville Church	1930	435	22	3193	87
OK 21099	Ok No Name 121016	State Of Okla.	Ok No Name 121016	McAlester	1930	600	16	5952	50
OK 21100	Ok No Name 121017	State Of Okla	Ok No Name 121017	McAlester	1930	400	16	4166	50
OK 02574	Prison	State Of Okla.	Prison	Christian Hill Cem	1930	3000	28	18352	508
OK 21081	Smithson	Tockwell Int.	Smithson	McAlester	1930	450	18	7068	107
OK 01341	Talawanda No.1	City Of McAlester	Talawanda No.1	Shady Grove	1902	700	38	10440	1578
OK 01340	Talawanda No.2	City Of McAlester	Talawanda No.2	Shady Grove	1924	550	48	200	7781
OK 10431	Youth	City Of McAlester	Youth		1930	255	25	19375	149

Source: National Inventory of Dams

Measurement

The amount of water impounded in the reservoir behind a dam is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot, or approximately 325,000 gallons. Even a very small dam may contain many acre-feet or millions of gallons of water.

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

An artificial water barrier that has a height of 25 feet or more from the natural streambed and 50 acre-feet or more of storage capacity qualifies as a dam and is under the jurisdiction of the Oklahoma Water Resources Board (OWRB). The OWRB classifies dams as high-hazard, significant-hazard, and low-hazard, depending on the amount of water stored and downstream populations.

A **high-hazard dam** is one that has occupied dwellings immediately downstream – it does not mean that the dam is at risk of failing. A **significant-hazard dam** is one that poses no threat to life, but whose failure may interrupt some road or pubic utility services. If a high-hazard dam fails, there probably will be loss of life. This designation does not mean that a dam is in need of repair—it could be in excellent condition or in poor condition. "High-hazard" simply reflects a dam's potential for doing damage downstream if it were to fail.

Extent

The extent of a dam failure can be influenced by several factors: the amount of water behind the dam; the height of the dam itself; and the way in which a dam fails. The extent of a dam failure can be assessed before the event itself occurs. Using a GIS environment, a water body's volume can be measured with a high degree of accuracy. The inundation

area of a dam and depth of flooding can be determined using readily available DEM or topographic maps. The extent of this inundation can be minimal to uninhabited farmland or can be catastrophic in nature in an urban environment.

A break in a dam produces an extremely dangerous flood situation because of the high velocities and large volumes of water. The severity of impact on areas downstream and the height to which waters will rise are largely functions of valley topography and the volume of water released.

Besides dam failures, there are hazardous actions that have to be taken to prevent dam failures, such as sudden releases of water when the dam is threatened with overtopping. In this case, a dam may have failed in its purpose to protect downstream people and property, without having literally or physically failed.

Frequency

Oklahoma has had three dam failures in the past 100 years. McAlester has had no dam breaks or failures at any of the City-owned lakes.

Impact

The impact of this hazard can affect homes, business, agriculture, and infrastructure that are located downstream from the dam. Dam failure can occur over a prolonged period of time, giving people time to prepare for the imminent failure, or can be sudden with little to no warning. Emergency releases from a dam, to avoid the imminent failure of the structure can also cause catastrophic downstream flooding.

Severity

McAlester considers a minor severity dam failure or emergency release to be one that can be contained in the downstream river bed and does not impact any population, structure, utility or transportation facility, and a major severity event to be one that cannot be contained in the riverbed, rises to the 100- and 500-year flood zones, and impacts populations, structures, utilities or transportation facilities.

4.15.2 History/Previous Occurrences

In Oklahoma, there have been three significant documented dam failures, each after sudden and heavy rainfall events:

- **October 3, 1923** - Heavy rain caused a dam failure at Lake Overholser, which displaced 15,000 residents.
- **September 4, 1940** - Cleveland, in Pawnee County, suffered losses in the half-million dollar range when the town was inundated by the failure of Cleveland Dam.
- **April 13-14, 1945** - After 14.6 inches of rain fell in the Wewoka area, heavy flows on Coon Creek overtopped and breached the Wewoka Dam, sending a wall of water into Wewoka Creek. Eight people in the path of the deluge were killed and the town of Wewoka was under 4 feet of water. Eighty people were forced from their homes. (Kuhnert)
- **October 1986** - Nearly 2 feet of rain fell northwest of Tulsa, causing the Arkansas, Caney, and Neosho Rivers to flood. To prevent the Arkansas River from overtopping Keystone Dam, the Corps of Engineers opened floodgates and released 310,000 cfs of

water through Sand Springs, Tulsa, Jenks and Bixby. No one knew if the levees would hold, and a catastrophic failure of the levee system was widely feared. In fact, the Sand Springs levee was breached, but volunteers quickly plugged it with sandbags.

Probability/Future Events

The probability of a failure of dams at Lake McAlester or Lakes Talawanda I and II is considered low.

The City of McAlester and McAlester Public Schools have a low probability of a future dam failure event.

4.15.3 Vulnerability

There are no high-hazard or significant hazard dams in the city of McAlester. The City does, however operate three reservoirs that are used for water supply and recreation: McAlester Lake, and Lakes Talawanda I and II. All three lakes are north of the city and drain northward, away from populated areas, into Coal Creek and Lake Eufaula. There are no structures downstream from any of these lakes that would be impacted by a breach of any of the dams. McAlester's Water Treatment Plant is located "downstream" from Lake Talawanda II dam, but (at 680 ft.) well above any possible outflow from the lake, whose dam is at 637 ft. elevation. The only transportation facility that would be impacted is OK Hwy 113 bridge over Coal Creek about 1 mile north of Mekko.

The Pittsburg County Hazard Mitigation Plan lists one dam owned by the City of McAlester that impounds water on a tributary of Coal Creek near the community of Shady Grove. This dam's gates were reportedly closed in 1902. It remains in use today and has a low downstream hazard potential.

McAlester City Reservoirs

The Oklahoma Water Resources Board lists the following three lakes in their 2007 Water Atlas. This information differs slightly from the 2009 National Inventory of Dams listed in table 4-54.

McAlester Lake. Built in 1930, McAlester Lake has poor color and high turbidity, but produces 9,200 acre-feet of water per year (8.2 million GPD) for the City, and is certainly adequate for both recreation and public and private water supply. McAlester Public Works has only on a few occasions been forced to draw upon Lake Talawanda II or Lake Eufaula to meet its municipal needs.

Stream: Bull Creek
Purpose: Water Supply and Recreation
Shoreline: 20 miles
Normal Area: 1,521 acres
Normal Pool Elevation: 620 ft
Normal Pool Capacity: 13,398 ac-ft
Water Supply Storage: 16,900 ac-ft
Water Supply Yield: 9,200 ac-ft

McAlester Lake

Lake Talawanda I. Built in 1902, Lake Talawanda I has excellent color and clarity. McAlester's second city lake, it is no longer used for water supply.

Stream: Coal Creek Tributary
Purpose: Recreation
Shoreline: 3 miles
Normal Area: 91 acres
Normal Pool Elevation: 650 ft
Normal Pool Capacity: 1,200 ac-ft

Lake Talawanda II. Built in 1924, Lake Talawanda II has excellent water color and clarity, and is used as a backup source of water for the City of McAlester and its water customers. The City's water treatment facility sits at an elevation of 680 ft., well above the 637-ft. level of the spillway, and out of harm's way in the event of a dam failure.

Lake Talawanda II

Stream: Coal Creek Tributary
Purpose: Water Supply and Recreation
Shoreline: 4 miles
Normal Area: 195 acres
Normal Pool Elevation: 627 ft
Normal Pool Capacity: 2,750 ac-ft

Population

People, property, critical facilities, and infrastructure downstream of dams are subject to devastating damage in the event of failure or forced releases. There are no downstream populations that would be impacted by a breach or emergency release from any or all of McAlester's lakes.

Buildings

The only building "downstream" from a McAlester reservoir is the Water Treatment Plant, which is well above (at 680 ft.) the outflow channel and out of risk from a failure of either Lake Talawanda I or II, or both simultaneously.

Critical Facilities

The only critical facility downstream from one of McAlester's three reservoirs is the City's Water Treatment Plant. As stated above, the plant is well above the spillway height of Lake Talawanda II (637 ft.), and would not be impacted by either a breach or emergency release, other than restricting access to the facility from the east via Lakeview Rd. and possible water shortages.

Infrastructure

Water Treatment – The McAlester Public Works' Water Treatment Plant is the only infrastructure "downstream" from one of the City's three reservoirs, and is well above the spillway and outflow channel. It would not be impacted by either a breach or emergency

release, other than having access to the plant from the east via Lakeview Rd. restricted. A failure of the dams at Lake McAlester or Lake Talawanda II could impact the City's water supply and the community's revenues from water sales.

Wastewater Treatment – The City's Wastewater Treatment Plants would not be impacted by a breach or emergency release from any of McAlester's reservoirs.

Utilities: Neither the electric nor gas facilities that serve McAlester would be impacted by a breach of one of the City's reservoirs.

Transportation Systems (Highways, Railway, Airports) – The roads and highways that cross the dams at each reservoir, obviously, could be impacted by a failure of the dam: Lakeview Rd. at Lake Talawanda II, the dam road at Lake Talawanda I, and McAlester Lake Rd. over Lake McAlester dam. A breach of one or all of the dams would also have some impact the OK Hwy 113 bridge over Coal Creek about 1 mile northwest of Mekko.

Emergency Services- No emergency services would be impacted by a failure or emergency release from any or all of McAlester's three reservoirs.

4.15.4 Worst-Case Dam Failure Scenario

The worst-case scenario for McAlester would be the failure of Lake McAlester dam.

Scenario

Torrential rains drop 20 to 25 inches of rain on central Oklahoma in the space of one week. Lake McAlester and Lakes Talawanda I and II fill to capacity, which forces the City to make emergency releases from all three reservoirs. The resulting outflow from the reservoirs would cause widespread flooding along Coal Creek below Lake McAlester and closing OK Hwy 113 northwest of Mekko.

The probable impacts from such an event would be 0 people killed or injured, 0 structures damaged or destroyed, 0 critical facilities impacted, 0 utilities affected, and a closure and possible damage to the OK Hwy 113 bridge over Coal Creek northwest of the town of Mekko.

4.15.5 Future Trends

None of McAlester's future development areas is below a high-hazard or significant-hazard dam. So long as reasonable caution and foresight is used in the development along Coal Creek below Lakes McAlester and Talawanda I and II, there should be no increased impacts. It is however understood that as dam facilities age and reservoirs become silted, their vulnerability to failure and/or overtopping is likely to increase as well.

Population

Given a reasonably cautious approach to development and/or building in the outflow channels of Lakes McAlester and Talawanda I and II, no future populations would be at risk of dam failures or emergency releases.

Buildings

Similarly, given reasonable foresight, no future buildings would be at risk of a failure or emergency release from McAlester's three reservoirs.

Critical Facilities

No future critical facilities are planned for the Coal Creek basin below Lakes McAlester and Talawanda I and II.

Infrastructure

Failures of the dams at Lake McAlester and Lake Talawanda I and II would damage the roadways across the dams and could restrict access to McAlester's Water Treatment Plant. Currently, 100- and 500-year floods along lower Coal Creek impact the OK Hwy 113 bridge, closing travel along the route and potentially damaging both the roadway and structure. These impacts could worsen as both the reservoirs and bridge age.

4.15.6 Conclusion

McAlester has no high- or significant-hazard dams that affect the community or any potential growth area. However, as the City's reservoirs age and silt in, the likelihood of overtopping and emergency releases increases. There are no populations, buildings, critical facilities, utilities or transportation networks that would be impacted by a failure or emergency release—other than McAlester's water supply, the roadways that cross the dams, and the OK Hwy 113 bridge across Coal Creek. The City of McAlester and McAlester Public Schools have a low vulnerability to the dam failure hazard.

Data Limitations

There are no people with disabilities, or with limited knowledge of English, who would be extremely vulnerable in the event of a failure or emergency release from one of the City's reservoirs that has a short warning time.

4.15.7 Sources

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Pittsburg County Hazard Mitigation Plan, Pittsburg County, OK.

McAlester Lake, Oklahoma Water Resources Board, http://www.owrb.ok.gov/news/publications/wa/lakes/McAlester.php

Lakes Talawanda 1 and 2, Oklahoma Water Resources Board, http://www.owrb.ok.gov/news/publications/wa/lakes/Talawanda1.php

4.16 Transportation

Transportation is defined as the physical movement of an object through components of a system and its subsystems. Transportation includes the use of aviation, highway, railroad, pipeline, and marine systems to convey movement of objects and people. In 1967, the Department of Transportation (DOT) was created to administer and protect the nation's transportation systems. The National Transportation Safety Board (NTSB) was established within the DOT as an independent agency responsible for investigating transportation incidents and promoting transportation safety.

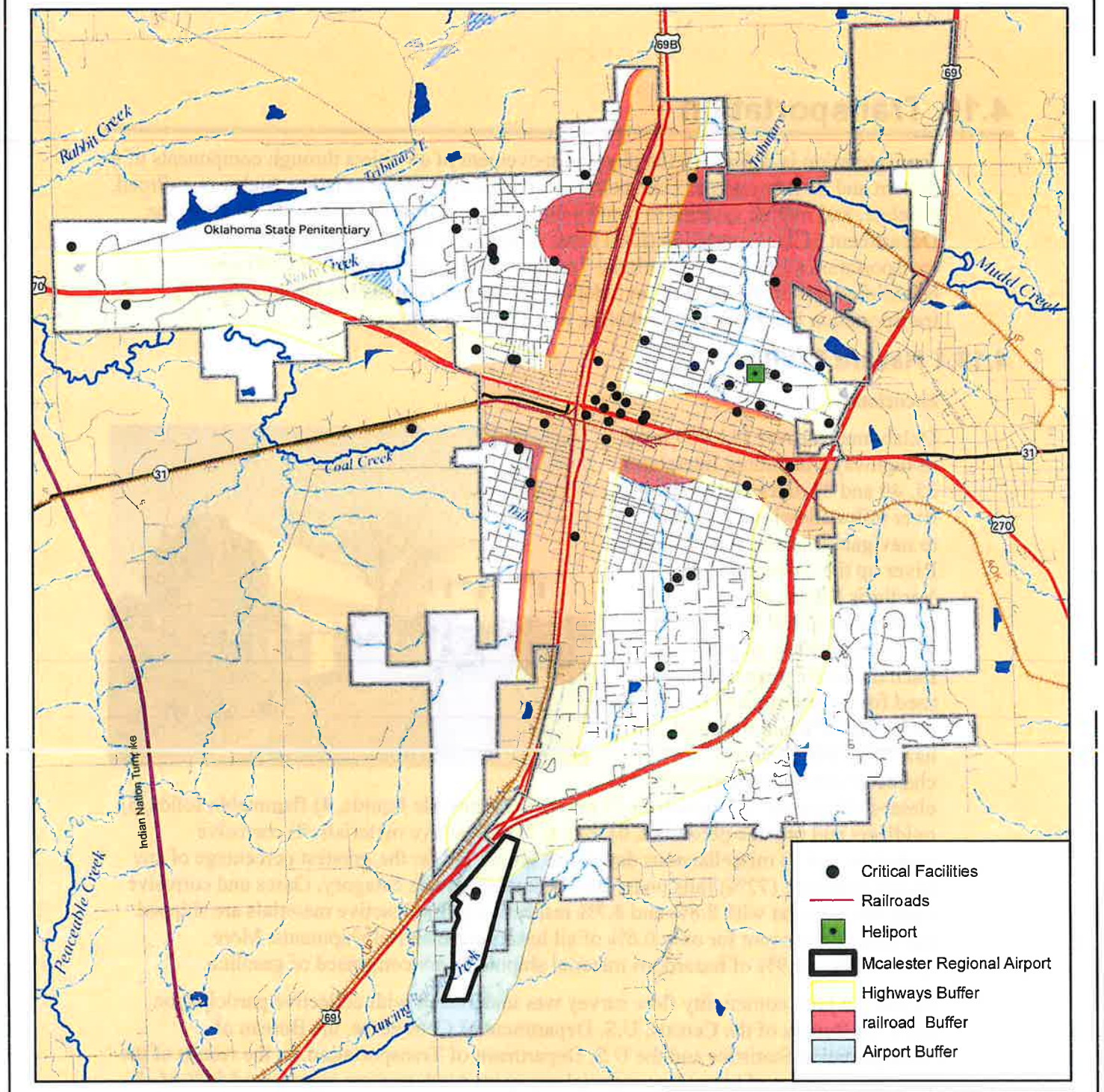
4.16.1 Hazard Profile

Location

Oklahoma has over 111,000 miles of highways, including Interstates 35, 40 and 44, over 180 navigable river miles allowing barge traffic to navigate from the Mississippi River up the Arkansas and Verdigris Rivers, approximately 6,000 miles of rail track and an undisclosed quantity of pipelines. Each mode of transportation is used for the transport of hazardous materials. When in transport, hazardous materials are characterized by nine separate classes of hazards: 1) explosives, 2) gases, 3) flammable liquids, 4) flammable solids, 5) oxidizers and organic peroxides, 6) toxics, 7) radioactive materials, 8) corrosive materials, and 9) miscellaneous dangerous goods. By far the greatest percentage of any hazard shipment (72%) falls under the flammable liquids category. Gases and corrosive materials are next with 8.8% and 8.7% respectively. Radioactive materials are shipped the least and account for only 0.6% of all hazardous material shipments. More specifically, 40.9% of hazardous material shipments are comprised of gasoline.

In 2007, a joint commodity flow survey was undertaken with collective participation from the Bureau of the Census, U.S. Department of Commerce, the Bureau of Transportation Statistics and the U.S. Department of Transportation. In the results of the five major modes of hazardous material transport, truck carriers represented 58% of all hazardous material transports, pipelines accounted for 27%, rails accounted for 5%, water accounted for 5%, and air accounted for 1%.

Roads: The national highway system is made up of 46,876 miles (as of 2006) of Interstate Highways, 114,511 miles of other National Highways and is used by 505,900 active interstate motor carriers. Local governments controlled over 77 percent of total highway miles; States controlled about 20 percent; and the Federal Government owned about 3 percent.



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Miles 0 0.5 1

Figure 4-44

City of McAlester

Transportation Corridors

Hence, the Nation's highway system is overwhelmingly rural and local. Truck shipments represent the greatest mode of transport for hazardous materials accounting for 58% of all shipments and totaling nearly 1.2 billion tons of hazardous materials in 2007.

Oklahoma has 930 miles of interstate highways, or 2% of the nation's total interstates. The state also contains 23,249 bridges, as of August of 2009. The principal north-south arterials traveled in Oklahoma are Interstate 35 crossing the middle of the state from border to border connecting Oklahoma City to major thoroughfares in Kansas and Texas. Interstate 44 crosses the state from the southwest to the northeast and connects the two main metropolitan areas of Tulsa and Oklahoma City to locations in Missouri and Texas. Interstate 40, running east and west, is the modern day thoroughfare replacing the nation's first trans-continental highway, Route 66. It crosses through Oklahoma City and is a major national transportation route of interstate travel. Oklahoma also has major expressways connecting Durant in the south to McAlester and Muskogee (US Hwy 69), the Indian Nations Turnpike connecting Hugo to McAlester and Tulsa, and the combined Cimarron and Cherokee Turnpikes (US Hwy 412) connecting Enid to Tulsa and Siloam Springs, Arkansas. OK Hwy 31 runs from southwest to northeast, connecting McAlester with Coalgate and Spiro, while OK Hwy 1 connects Ada with McAlester and Talihina.

McAlester is located at the intersection of the Indian Nations Turnpike, US Hwy 270 and US Hwy 69, all of which are travelled by commercial truckers with hazardous loads. The City has 16 miles of major highway within its jurisdiction.

Air: There are 8,228 certified air carrier aircrafts in the United States operated by 75 carriers of international, national and regional level. There are 72 airports in the nation considered as large hubs. These 72 airports see almost 75% of all the airline passenger traffic in the nation.

Oklahoma's two largest airports, Will Rogers World Airport in Oklahoma City and Tulsa International saw 3.5 and 1.6 million passengers respectively classifying them both as Medium Air Traffic Hubs for the year 2008. Oklahoma also has several Air Force bases including Tinker AFB in Oklahoma City, Altus AFB in Altus, and Vance AFB in Enid.

McAlester has one public airport, McAlester Regional, a single runway field with 42 based aircraft and an average of 23 operations a day. The field stores both Av and Jet-A Fuel and is located 3 miles southwest of the City. McAlester is also home to one private heliport at McAlester Regional Hospital.

Rail: North American railroads operate over 173,000 miles of track, and earn $42 billion in annual revenues. U.S. freight railroads are the world's busiest, moving 70% of all automobiles produced in the U.S. by train, 30% of the nation's grain harvest, 65% of the nations coal and operating on over 143,000 miles of track. In the U.S., railroads account for more than 40% of all freight transportation.

In Oklahoma, Class I rail carriers include Burlington Northern Santa Fe (BNSF), Union Pacific, and Kansas City Southern for freight. Amtrak connects Oklahoma City to an Amtrak hub in Fort Worth, Texas for passenger travel. Regional rails include the South Kansas & Oklahoma Railroad. Local rails include the Arkansas & Oklahoma Railroad, Inc., AT&L Railroad, De Queen & Eastern Railroad, Grainbelt Corp., Hollis & Eastern

Railroad, Kiamichi Railroad Co., Sand Springs Railway Company, Stillwater Central Railroad, Inc., and Tulsa-Sapulpa Union Railway Co.

The Union Pacific operates a rail line through the City of McAlester. Oklahoma is a vital link in Union Pacific's north-south corridor between the Midwest and the Gulf Coast. Grain bound for export moves through the state, as well as coal bound for southern power plants. Union Pacific also ships Oklahoma wheat, cement and aggregates out of the state. UP operates switchyards and facilities in McAlester, Muskogee, Tulsa, Oklahoma City, Chickasha and Enid.

The Arkansas and Oklahoma Railroad, provides freight operations over a 118-mile line between Oklahoma City and the UP system at McAlester. The State of Oklahoma operates a line from McAlester east to Howe, OK, where it connects with the Kansas City Southern system. The AOK has leased UP's industrial tracks at McAlester (that service the Stephen Taylor Industrial Park), and the 36-mile UP branch line than connects Shawnee with Oklahoma City.

Pipelines: The pipeline network supporting energy transportation in the United States includes approximately 1.9 million miles of natural gas and hazardous liquid pipelines and has more than 3,000 companies operating in all 50 states. Pipelines represent 18.4% of all hazardous material transportation in the U.S.

Figure 4–45: Pipeline Markers

Natural gas distribution, with over 1.8 million miles of pipelines, represents the greatest commodity transported through pipelines. Over 305,000 miles of pipelines are used in the transport of natural gas transmission and almost 160,000 miles of pipelines are used in the transport of hazardous liquids including petroleum products. Most pipelines are installed in underground right-of-ways (ROW), which are maintained for access and marked with above ground markers and warning signs.

From 2000 through 2009, there were 643 pipeline spills in Oklahoma that were reported to the National Response Center. Most of these accidents were at the local collection and distribution company level. The principal cause of pipeline spills was "equipment failure," usually due to aging infrastructure, particularly to corrosion. The other major causes are "operator error" and third-party damage, usually from digging. During the same time frame, there were 368 releases from storage tanks, most of them due to "equipment failure."

According to the National Pipeline Mapping System, there are six active pipeline operators within McAlester. Specific routes of pipelines and their operators within McAlester are not identified. For information on pipeline operators, see Table 4-55.

Table 4–55: Pipeline Operators in McAlester

Pipeline Operator	Contact	Address	Phone/Email
Centerpoint Energy	Alicia Dixon (Mgr Operations Media Relations)	PO Box 1700, Houston TX 77252	(713) 207-5885 alicia.dixon@CenterPointEnergy.com
Enogex	Mike Reed (Mgr, EHS Assessment & DOT Compliance)	515 Central Park Dr., Ste 110, Oklahoma City OK 73105	(405) 558-4685 reedmd@oge.com
Magellan Pipeline	Kenneth Lybarger (Regulatory Compliance Coord)	1 Williams Ctr, Tulsa OK 74172	(918) 574-7315 kenneth.lybarger@magellanlp.com
Reliant Energy Field Svcs	Alicia Dixon (Public Relations Manager)	PO Box 1700, Houston TX 77252	(713) 207-5885 alicia.dixon@centerpointenergy.com
Scissortail Energy	Janel Nelson (Environmental/Safety Coordinator)	1307 S. Boulder, Ste. 200, Tulsa OK 74119	(918) 588-5044 jnelson@scissortailenergy.com
Superior Pipeline	Gary Cook (Projects Coordinator)	7130 S. Lewis, Ste 510, Tulsa OK 74136	(918) 477-5607 gcook@superiorpipeline.com

Source: National Pipeline Mapping System (http://199.107.71.24/publicsearch/)

Measurement

The National Transportation Safety Board (NTSB) investigates significant accidents in all forms of transportation including all civil aviation accidents, selected highway accidents, railroad accidents, major marine accidents, pipeline accidents, hazardous material releases from any form of transportation, and other transportation problems that have a recurring nature. Accident reports, safety studies, numerous databases, and historical archives are all available at the NTSB through the Freedom of Information Act.

Miscellaneous Dangerous Goods, a hazardous materials shipment hazard class, has the highest accident and incident rate of all shipments. The gases class, more specifically, the non-flammable gases sub-class, has the lowest accident and incident rates during shipment. The largest possible economic impact associated with hazardous material transport incidents comes from flammable and combustible liquids. In terms of incident cost, release-causing enroute accidents have the highest average cost, followed by enroute accidents in which a release does not occur. Of those enroute accidents resulting in a release, explosions have the highest per incident cost, followed by fires and then releases where neither a fire nor explosion ensues. Explosions result in an average cost of over $2.1 million per accident, followed by $1.2 million per accident involving fire, and accidents involving releases with no fire or explosions average slightly over $400,000. The greatest economic impact though, is associated with accidents enroute where a release does not occur, due to the higher frequency of these events.

Roads: The Federal Motor Carrier Safety Administration conducted a sample survey of 62% of the nation's active interstate motor carriers. Of the total active interstate motor carriers, 62% received a "satisfactory" safety score while 8% received an unsatisfactory score. The same survey was conducted using 55% of all the hazardous materials carriers. Of those carriers surveyed, 78% received a "satisfactory" score for safety and only 2% received an "unsatisfactory" safety score.

According to the Federal Motor Carrier Safety Administration, 133,931 large trucks were involved in accidents in 2008, resulting in 4,229 fatalities and 71,460 injuries. Hazardous materials were involved in 2,652 of these crashes—or about 2% of the accidents.

In Oklahoma during 2008, there were 1,933 large truck accidents, resulting in 115 fatalities and 1,382 injuries. Hazardous materials were involved in 77 of these accidents—or about 5.5% of the accidents.

Hazardous materials placards are required when shipping hazardous materials on United States, Canada and Mexico highways. The U.S. Department of Transportation (DOT) regulates transportation of materials classified as hazardous, with regulations covering packaging, labeling marking and descriptions on shipping papers. Hazardous materials are classified into the nine numbering system classes in Table 4-56.

According to the US Department of Transportation, for the year 2007:

- ***Highways:*** Trucks carried 52.9% of all hazardous materials transported in the United States.
- ***Pipeline:*** 30.2% of hazardous materials were carried by pipelines.
- ***Water:*** 10.4% of hazardous materials were shipped by water.
- ***Rail:*** Rail transportation carried 5% of all hazardous materials shipped.
- ***Air:*** Airlines carried 1% of all hazardous materials shipped in 2007.

Crude and petroleum products represent over 40% of all hazardous material transports. Pipelines represent the greatest transportation system for petroleum and petroleum by-products. In 2001, pipelines accounted for 66.24% of all U.S. domestic petroleum products transportation. Water carriers accounted for 28.05%, followed by 3.54% by motor carriers and 2.17% by railroads.

Extent

The City of McAlester has 23.5 miles of highway within the city limits, and 13.7 miles of railroad track – all of which carry volatile and toxic chemical products through the jurisdiction. The transportation corridors cover 7.7 square miles within McAlester, which is approximately 48% of the total land area. In all, 11,743 residents, or 64.4% of the population of the community, live within these transportation corridors. In addition, 33 of McAlester's 65 critical facilities are within the corridor.

A worst-case railroad chlorine tank explosion could result in hundreds of deaths, severe injuries, and hospitalizations. The extent of a transportation event can be lessened by, among other measures, well-trained and equipped Hazmat Teams, Reverse 9-1-1 notifications of people in the impact area, planned and practiced notification and evacuation procedures, and by relocating hazardous material transportation routes away from populated areas and critical facilities.

Frequency

According to the National Response Center and National Transportation Safety Board, Pittsburg County had a total of 22 mobile accidents from 2000 through 2009. Six of these events involved the release of hazardous materials, 6 were non-release railroad accidents, and 9 were aircraft crashes. Six railroad accidents, six aircraft accidents, and two truck-related spills occurred at McAlester. In light of this experience, McAlester can expect 1 railroad and 1 aircraft accident every two years, and 1 transportation-related highway spill every 5 years.

Table 4–56: Hazardous Material Transport Placards

Class	Name	Description	Symbol
1 Orange	Explosives	Materials that explode or detonate such as dynamite and military rockets; burn rapidly and give off sparks, such as gunpowder; and pop, such as blasting caps and fireworks.	
2 Red	Compressed Gasses	Pressurized gas ignitable when exposed to air.	
2 Green		Includes compressed gas, liquefied gas, pressurized cryogenic gas, compressed gas in solution, asphyxiate gas and oxidizing gas.	
2 Yellow		Oxygen is considered non-flammable because it does not burn. It is, however, required for combustion to take place. High concentrations of oxygen greatly increase the rate and intensity of combustion.	
2 White		Gas poisonous by inhalation is known or presumed to be so toxic to humans as to pose a hazard to health.	
3 Red	Flammable Liquids	Cargo is easily ignitable. Explosion is possible and vapors may cause dizziness or suffocation. Vapors could ignite.	
4 Red/White Stripes	Flammable Solids	Materials that may cause a fire through friction, metal powders that can ignite or thermally unstable materials.	
4 Red & White		A liquid or solid material that, even without an external ignition source, can ignite or self-heat after coming in contact with air.	
4 Blue		Material when contacted with water is liable to become spontaneously flammable or to give off flammable or toxic gas	
5 Yellow	Oxidizers	Oxidizer means a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials.	
6 White	Poisons	Indicates a severe or presumed severe health hazard. The substance may be poison gas, insecticide, fungicide, hydrochloric acid, chlorine, hydrogen cyanide or other injurious substance.	
7 Yellow & White	Radioactive Materials	Any material or combination of materials that spontaneously emits ionizing radiation.	
8 Black & White	Corrosive Liquids	A liquid or solid that causes destruction of human skin at the site of contact or a liquid that has a severe corrosion rate on steel or aluminum.	
9	Miscellaneous	A material which presents a hazard during transportation but which does not meet the definition of any other hazard class.	

Impact

The impact of transportation events may include lost revenue, highway disruptions, injuries and sometimes even loss of life. Transportation accidents are frequently a "cascade" disaster, occurring more frequently during storms. Storms cause streets to become slick, which increases the risk of transportation hazards. Excessive speed, exhaustion and other causes increase the risk also.

Severity

McAlester considers a minor severity transportation event to be one which results in detours of less than half a mile, traffic disruption of less than half an hour, Hazardous Materials are contained within a quarter mile, and there is no loss of life or major injuries. A major severity incident would include detours exceeding half an hour, traffic disruption of more than half an hour, Hazardous Materials that exceed a quarter mile, and/or loss of life and/or major injuries.

4.16.2 History/Previous Occurrences

Webbers Falls / I-40 Bridge Collapse

On May 27, 2002, three piers connected to an Interstate 40 bridge crossing the Arkansas River near Webbers Falls Oklahoma were struck by a tugboat at 7:43 a.m. collapsing sections of the bridge and killing 14 motorists. The navigation channel and the highway were both subsequently closed for 35 days. Detours were up to 60 miles long for eastbound traffic.

Approximately 20,000 vehicles per day use that portion of I-40, and barges on the navigation system can carry the equivalent load of 15 railcars or 80 semi-trucks. On June 4, 2002, the Federal Highway Administration committed an initial $3 million in emergency relief funds to aid in reconstruction.

Conoco Phillips Tank Fire, Glenpool, Oklahoma

On the evening of April 8, 2003, around 9:00 P.M., a Conoco Phillips holding tank exploded at a storage and distribution facility located east of United States Highway 75 near 131st Street and Elwood Avenue, north of downtown Glenpool. The tank, which contained diesel fuel, ignited after receiving a delivery of 8,400 barrels of diesel from a pipeline that branched off the Explorer Pipeline Company's 1,400-mile main pipeline that connects the Gulf Coast to the upper Midwest. The explosion was reportedly felt over 1½-miles away.

The ConocoPhillips tank fire caused the evacuation of over 400 people in the 1.5 square miles directly south and east of the storage and distribution facility

Responders were concerned with the possibility of the fire spreading to adjacent tanks that contained highly volatile unleaded fuel. Work to contain the fire was effective and appeared under control that night. The following morning, around 5:30 A.M., live power lines melted by the flames fell onto spilled fuel in the containment basin and re-

ignited the blaze. Strong northerly winds helped destabilize and blow the blaze into contact with a second tank containing a petroleum product called naphtha, which subsequently did not explode. Environmental contamination of Coal Creek, which drains directly through the storage and distribution facility, was minimal due to a pre-existing containment levee around the tank involved. Had the levee been compromised, areas along Polecat Creek and the Arkansas River could have been adversely impacted. The fire forced the evacuation of homes and businesses within a 1½-mile radius of the storage and distribution facility and closed down U.S. 75 in both directions, when a strong north wind spread a thick black plume of smoke across the City of Glenpool and into parts of Okmulgee County. Glenpool Schools were closed as a precautionary measure. The fire burned for 25 hours.

Local non-profit organizations assisted by setting up shelters for evacuated people. Firefighters from Glenpool, Jenks and Tulsa responded to the event and were supplied with a foam truck from Sun Refinery. Equipment from Conoco Phillips headquarters in Houston, Texas, was also shipped to the scene. The National Transportation Safety Board concluded that static electricity in a fuel line ignited the fire.

U.S. 75 Hazardous materials (Hydrogen) Spill near Ramona, Oklahoma

In May of 2001, a tanker truck carrying 10 cylinders of hydrogen gas was pushed off the road when a vehicle traveling along side the tanker lost control and forced both vehicles into a roadside ditch. The collision broke a seal on one of the cylinders causing an initial explosion and a subsequent fire. The tanker ended upside down in the ditch and the accident claimed the life of the tanker driver. In response to the accident, several area fire departments assisted with the fire, which due to high winds cascaded to a grass fire. Emergency management remained on the scene until all of the ten leaking cylinders were emptied with the necessary precautions taken to keep those leaks from exploding. Because of the crews continuously extinguishing the hydrogen leaks and grass fires, residents were kept to a limited supply of water for the duration of the response and rural water districts in the area were contacted to help to maintain a consistent and necessary supply of water for the fire fighters.

Explorer Pipeline Tank Fire, Glenpool Oklahoma

On June 18, 2006, just after 9 A.M., the Explorer Pipeline storage and distribution facility experienced a similar blaze when lightning struck a tank containing over 5 million gallons of unleaded gasoline. Explorer Pipeline is also in the 131st & Elwood area, east of Highway 75, southwest of the City of Tulsa. A mandatory evacuation for the area was ordered due to smoke and fumes which, over the course of the next 11 hours, continued to switch direction as the wind shifted. Over 800,000 gallons of fuel was lost, but the loss would have been far greater as the company was able to salvage over 4.3 millions gallons, pumping it out from under the area of the tank that was burning. The firefighters were able to keep adjacent tanks from

Explorer Pipeline tank fire

being affected, which reduced the catastrophic effect of the blaze, unlike the 2003 fire. Responders were prepared to dam adjacent Coal Creek with sand in order to avoid runoff from foam and petroleum. Five families in the area evacuated their homes as a precautionary measure. Responders from Glenpool, Jenks, McAlester and Tulsa battled the blaze, as well as responders from Sun Refinery and Williams Fire Control of Beaumont, Texas.

Union Pacific Collision with Propane Truck in Grant County, OK

BNSF train carrying crude oil and ethanol explodes near Luther, OK. after derailing.

On August 29, 2008, a Union Pacific train collided with a propane truck near Medford, OK killing the truck driver and two UP employees. The propane tanker had just filled up at the ConocoPhillips LP underground gas facility three miles south of Medford before being hit by the 76-car UP train. The locomotive's two-person crew sounded the horn and tried to stop 140 feet before the collision. The train, which was traveling from Wichita, KS to Fort Worth, TX, was going about 37 mph at the time of the crash. The liquid propane facility was shut down briefly. The explosion blew parts of the truck up to a half-mile from the crash site and left a crater in the ground. The UP train was hauling flour, wheat, metals and some flammable substances, including ethanol and methanol. US Hwy 81 was blocked between Medford and Pond Creek for several hours, and electricity was knocked out for a time in Medford.

BNSF Derailment near Luther, OK

August 22, 2008. A Burlington Northern Santa Fe train carrying crude oil and ethanol from Tulsa to Temple, TX derailed northeast of Luther, OK at about 2:30 pm, sending a giant fireball into the sky and forcing evacuations within a half-mile of the wreck. The track is owned by the State of Oklahoma but operated by the Stillwater Central Railroad. There were no injuries.

The City of McAlester Transportation Events

According to the National Response Center and National Transportation Safety Board, Pittsburg County had a total of 22 mobile accidents from 2000 through 2009. Six of these events involved the release of hazardous materials, 6 were non-release railroad accidents, and 9 were aircraft crashes. Six railroad accidents, six aircraft accidents, and two truck-related spills occurred at McAlester. These incidents are summarized below.

- **February 16, 2000** – A mid-air collision occurred between a Cessna 182M and a Cessna 208B, while both airplanes were maneuvering near the McAlester Regional Airport. The Cessna 182 was destroyed, and the Cessna 208 sustained substantial

damage. The private pilot of the Cessna 182 sustained fatal injuries, and the airline transport rated pilot of the Cessna 208 was not injured. There were no passengers in either airplane.

- **March 3, 2000** – 100 gallons of diesel fuel leaked from a locomotive fuel tank in the Union Pacific yard in McAlester.
- **June 24, 2001** – A single engine airplane crashed ¼-mile from the departure end of the runway at McAlester Regional Airport. The apparent cause of the accident was inadvertent engine stall by the pilot. There was one fatality.
- **November 27, 2002** - A Piper twin-engine airplane was destroyed following a loss of control while executing a go-around near McAlester, Oklahoma. The airplane was registered to Grayco Bank Products Inc., of Carrollton, TX, and operated by a private individual. The pilot and four passengers sustained fatal injuries. The flight originated from the Addison, TX and was destined for Monett, MO.
- **May 31, 2003** – 200 gallons of diesel fuel leaked from a locomotive into a drainage ditch.
- **June 13, 2003** – Three locomotives and three railroad cars derailed when one train made contact with another.
- **February 2, 2006** – A body was found alongside the UP tracks in McAlester.
- **July 25, 2006** - A single-engine Cessna was destroyed by fire following a precautionary landing at the McAlester Regional Airport. The flight instructor and the pilot receiving training were not injured. The airplane was owned and operated by the Southeastern Oklahoma State University, of Durant, OK. The flight originated at Tulsa, OK and was destined for Durant, OK.
- **January 21, 2007** – A student pilot was unable to recover from a bounced landing and lost control of the single-engine airplane while landing at McAlester. The pilot made a normal approach for landing but after touching down on all three wheels, bounced, and on the second touch-down impacted the runway in a nose low attitude that collapsed the landing gear assembly. The engine firewall sustained structural damage. The pilot sustained minor injuries.
- **January 21, 2007** – A truck carrying radiography equipment was swept away by floodwaters in a remote area near McAlester.
- **July 8, 2007** - A twin-engine Boeing 737-800 transport category airplane operated by American Airlines Incorporated encountered clear air turbulence during the climb to cruise altitude near McAlester. One flight attendant sustained serious injuries and the other two attendants sustained minor injuries. The two pilots and 99 passengers were uninjured. No reported damage was sustained by the aircraft. The flight originated at the Dallas Fort Worth International Airport and was destined for Toronto, Canada. The three flight attendants were performing crew duties when the unexpected turbulence was encountered.
- **October 12, 2007** – A freight train was derailed along US Hwy 69 (Business) at 2500 N. Main St. in McAlester.
- **May 28, 2009** – An unknown person dumped what appeared to be diesel fuel into Coal Creek near Lake McAlester.

- **June 15, 2009** – A freight train and passenger van collided at a railroad crossing near the intersection of North St. and US Hwy 69 (Business) in McAlester.

Probability/Future Events

Given that six railroad accidents, six aircraft accidents, and two truck-related spills occurred at McAlester from 2000 through 2009, McAlester can expect 1 railroad and 1 aircraft accident every two years, and 1 transportation-related highway spill every 5 years. Although the completion of the Indian Nations Turnpike and the George Nigh Expressway has significantly lessened heavy truck traffic carrying volatile or toxic materials through the city, McAlester remains a regional hub for pipeline and railroad traffic.

The City of McAlester and McAlester Public Schools have a high probability of a future transportation event.

4.16.3 Vulnerability

Communities close to highway, railroad, pipeline, air and water transportation systems are at risk from transportation accidents and possible subsequent hazardous material events.

Population

The City of McAlester has approximately 23.5 miles of US and State highways within its boundaries, 13.7 miles of railroad tracks, and an airfield with approach and departure corridors. A ¼ mile buffer was placed around these transportation features, as shown in Figure 4-44, to identify vulnerable populations.

Table 4–57: Transportation Corridor Statistics

Name	Town Area (sq. mi)	Buffer Area (sq. mi)	% of Town Area	# of Structures	Buffer Area	% of Structures	Total Pop.	Pop. In Buffer	% of Pop. In Buffer
Highways	15.8	6.1	38.61%	8,270	4,618	55.84%	18,232	9,477	51.98%
Railroads	15.8	3.7	23.42%	8,270	4,989	60.33%	18,232	8,507	46.66%
Airport	15.8	0.88	5.57%	8,270	59	0.71%	18,232	12	0.07%
Combined	15.8	7.7	48.73%	8,270	5,911	71.48%	18,232	11,743	64.41%

A total of approximately 64% (11,743) of McAlester's population lives within the highway, railway and airway corridors.

Structures/Buildings

While there are 5,911 buildings within the transportation corridors, structure damage, although possible, is unusual from a transportation event. As a result, this was not considered a significant vulnerability.

Critical Facilities

A ¼ mile buffer was placed around transportation features, as shown in Figure 4-45, to identify vulnerable critical facilities. In all, 33 of the City's 65 critical facilities (50.8%) are located within these corridors. These vulnerable facilities are listed in Table 4-58.

Table 4–58: McAlester Critical Facilities in Transportation Corridors

ID	Name	Address	Highway	Railroad
	Government			
1	McAlester City Hall/City Hall Fire Station	28 E. Washington	X	X
2	McAlester Fire Dept. - North Station	2717 N. Main	X	X
4	McAlester Fire Emergency Response Complex	617 Village Blvd	X	
6	McAlester Public Library	401 N. 2nd St.	X	X
9	S.E. Expo Center	4500 US Hwy 270	X	
10	Water Tower			X
12	Pittsburg County Courthouse	Washington Ave.	X	X
18	Federal Building & U.S. Courthouse	3rd & Carl Albert	X	X
19	McAlester USPS	500 E. Washington	X	X
	Health Care / Nursing Homes			
20	Choctaw Nation Health Center	1127 S. George Nigh Expwy.	X	
24	Blevins Retirement	1220 E Electric		X
25	Burgundy Place	301 E. Washington	X	X
29	Heritage Hills	411 N. West St.	X	
	Educational			
30	Just Kiddin' Academy	105 E. Creek	X	X
31	KAVTS Child Development Lab	301 E. Kiamichi Dr.	X	X
32	Kiddin' Around Academy	1211 E. Jefferson	X	X
33	Kidzkazoo Learning Center	35 E. Madison	X	X
34	Little Tykes Learning Center	101 S. B Street	X	X
36	McAlester Pre-K / Headstart	501 S. C Street	X	
37	Mitchell Manor	315 W Electric		X
41	Walnut Grove	1001 S. George Nigh Expwy.	X	
44	Eastern Oklahoma State College	1802 E. College Ave.	X	
45	Doyle Elementary School	520 E. Smith		X
48	Kiamichi Technology Center	301 Kiamichi Drive	X	X
49	L'Ouverature Alternative School	1401 E Cherokee	X	X
51	McAlester Public Schools Admin.	200 E. Adams Ave.	X	X
56	William Gay ECC	600 W. Madison	X	
	Public Works			
57	East Wastewater Treatment Plant	1360 E. Krebs Ave.		X
	Financial Institution			
61	Arvest Bank	101 S. 3rd	X	X
62	BancFirst	501 E. Carl Albert	X	X
63	Bank of Oklahoma	1 E. Choctaw	X	X

ID	Name	Address	Highway	Railroad
64	First National Bank & Trust	235. E. Choctaw	X	X
65	The Bank, N.A.	1706 E. Carl Albert	X	X

As the above table illustrates, the City of McAlester and McAlester Public Schools have a high vulnerability to the transportation hazard.

Infrastructure

Water Treatment – The most significant impact from a transportation event on McAlester's Water Treatment Plant would be from loss of access due to its proximity to a hazardous materials (e.g., chlorine gas) release.

Wastewater Treatment – As with water treatment facilities, loss of access to McAlester's Wastewater Treatment facilities would be the primary impact from a transportation event.

Utilities – The primary utility providers for McAlester's jurisdiction is AEP/PSO (electricity) and Reliant/Arkla (natural gas). **Electricity:** The service stations and substations for electrical service would be vulnerable to the risks from a transportation event, although since the majority of the substations are unmanned, the effect of loss of access would be low unless there were additional issues. **Gas:** The primary danger to the Reliant Energy/Arkla Gas infrastructure would be if damage to a pipeline affected the supply of natural gas.

Transportation Systems (Highways, Railway, Airports) – The primary threat would be the shutdown of major highways or railroad lines in the event of a transportation incident. In previous cases, railways and highways have been shut down for hours at a time, disrupting both commuter and commercial traffic and creating lengthy delays.

Emergency Services- Fire, Police and Medical services are all at risk to a transportation incident. The release of hazardous materials as a result of a transportation incident could limit or eliminate access to affected areas. Medical services (including treatment facilities) could be strained in responding to large numbers of casualties, whether physical or psychological.

4.16.4 Transportation Scenario(s)

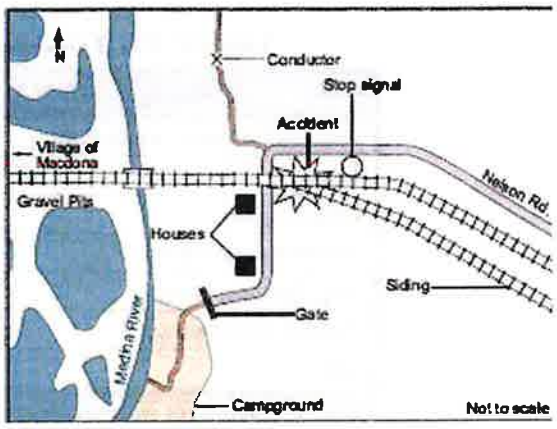
The worst-case scenario for McAlester, given the type of traffic through the community, would likely be a railroad tank car accident resulting in an explosion and/or spill of a toxic load, such as ethanol or chlorine. The McAlester scenario is based on a fatal train collision and

Macdona, TX train collision and fatal chlorine gas release.

chlorine gas release at Macdona, TX on June 28, 2004.

At 5:03 a.m. at Macdona TX, a Union Pacific train collided with a Burlington Northern (BNSF) train resulting in a derailment of four locomotives and 35 railcars. A filled 90-ton chlorine railcar was breached releasing 60 tons (120,000 lbs) of chlorine as of three days after the accident. Also released was about 78,000 gallons of urea fertilizer plus diesel fuel from the four locomotives. The train conductor was killed, two residents in a house nearby died from chlorine inhalation, and about 43 people were hospitalized, including 6 emergency responders. Property damage and environmental cleanup costs exceeded $7 million.

Initial 911 calls mentioned a train wreck and smoke and "difficulty breathing", but the dispatcher had difficulty picking up on the implications of these emergency calls. Unaware of the chlorine release, the first Responders to arrive (a local volunteer fire department) at 5:15 a.m. reported driving into a "yellow cloud" of an "unknown substance" and were unable to enter the scene until protective clothing and self-contained breathing apparatuses became available at about 5:40 a.m. At 6:10 a.m., the Bexar County Office of Emergency Management established the unified command system. The San Antonio Fire Department arrived at 6:15 a.m. The hazardous materials response contractors retained by the railroad arrived at 6:33 a.m. and began to assess the chlorine release. The major concern was rescue of nearby residents. However, the train derailment blocked the main road to the closest residences, and access to the rear of the residences was blocked by a flooded river. Access was also hampered by locked gates and high security fences. The only way to reach the residents was on foot. Emergency response personnel also did not have enough personal protective equipment to enter the stricken area. Immediate rescue was therefore not feasible. The nearby residents initially were ordered via the 911 Center to shelter-in-place while a site assessment was conducted, but there were no instructions to residents about how to do this. Some of the residents walked away on foot, but the people in the two closest houses were trapped inside. Notification for other residences (about 57,000 houses) based on preliminary plume modeling (about 7:15 a.m.) was identified, but not conducted because of an identified 8-hour notification process. There were also conflicting reports of who should evacuate and who should shelter in place. The first attempt to enter the area of the trapped residents took place at 9:45 a.m., but the rescuers became disoriented and could not locate the houses. A second team entered the area to come to the aid of one of the entry team firefighters. A third team entered at 10:12 a.m. and reached three residents at 10:55 a.m. who were found to be in considerable respiratory distress. The two residents who had died from chlorine inhalation were reached at 11:55 a.m. In all, six emergency responders and 23 local residents were treated for chlorine inhalation.



Map from Railroad Accident report showing accident location, the two houses where residents were trapped inside, and the location of the conductor's body. Two residents in the house closest to the accident died from chlorine inhalation.

To estimate the impacts from a railroad accident resulting in a release of chlorine gas, the potential area of impact was overlain on a heavily populated area near the Union Pacific tracks in McAlester. There are a total of 1,214 structures and 1,987 residents within ½ mile of the site that would be impacted by the event. There are a total of 1,697 structures and 2,804 residents within the plume that would be impacted by the event. The danger from this type of event is primarily to those living and working near the accident, and to the First Responders dispatched to the scene.

Based on average wind directions and speed for McAlester, the probable area of impact/evacuation was calculated and is displayed in Figure 4-47.

The deaths, injuries and economic impacts from this hypothetical worst-case event are detailed in Table 4-59 and are based on an analysis of the Macdona, TX event.

Table 4–59: Transportation Scenario Damages

Impacts	Macdona, TX	McAlester Scenario
Evacuated Homes (1.5-Mile Radius)	219	7,600
Deaths	3	23
Civilian Injuries	23	798
First Responder Injuries	6	46
Train Company Losses	$5,700,764	$789,367
Environmental Cleanup	$150,000	$150,000
Total	$5,850,764	$939,367

Note: Locomotives were damaged in Macdona and are not in the scenario.

4.16.5 Future Trends

All potential development areas for the City are at risk based on their proximity to the previously defined transportation corridors.

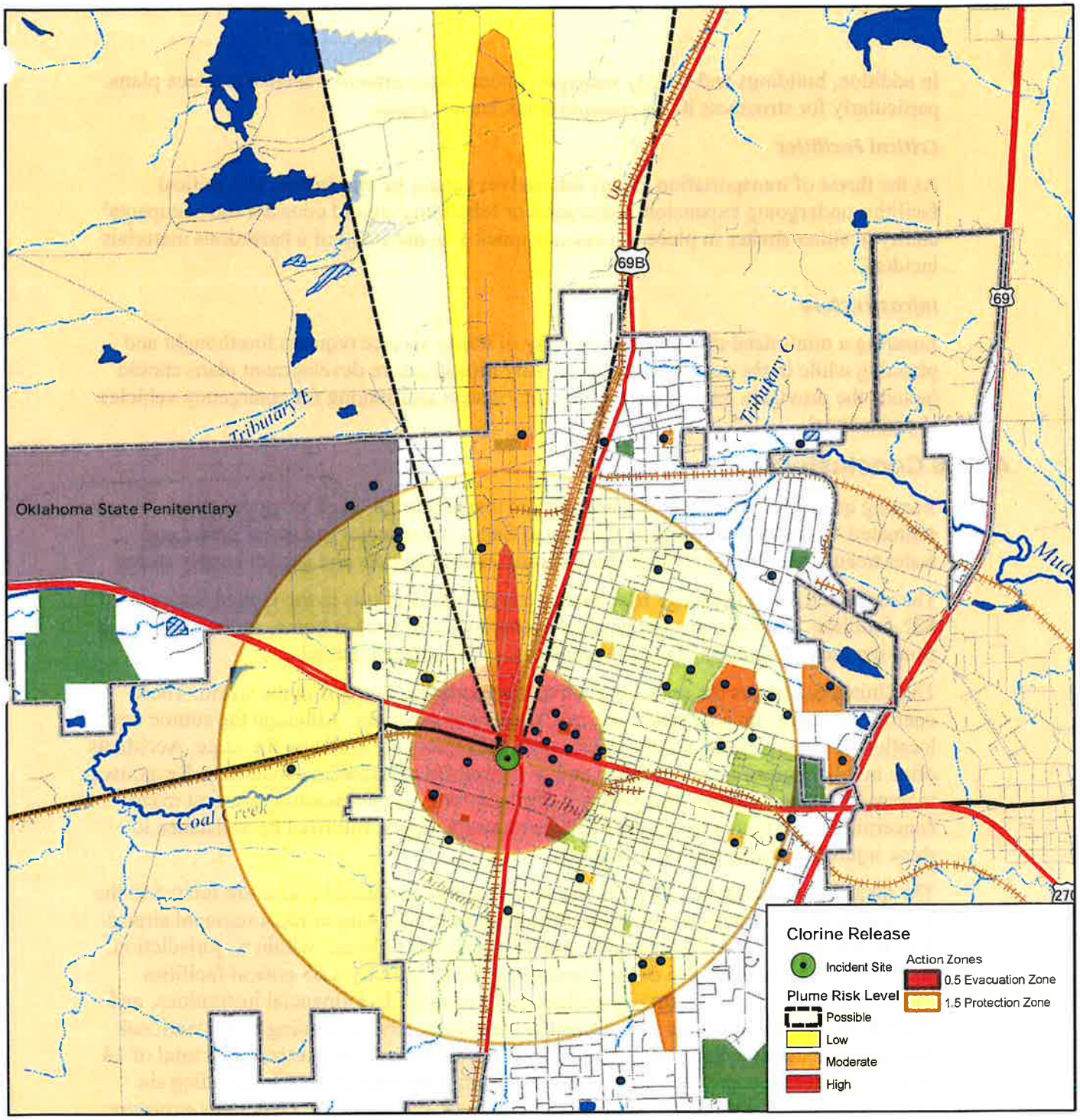
Population

McAlester has excellent and well-equipped Police and Fire Departments staffed with trained hazmat responders. Continuing efforts can be made in the following areas:

- Upgraded warning and notification procedures for non-weather events, such as targeted calling systems like Reverse911 or CTYConnect;
- Resident education on procedures for sheltering in place vs. evacuating in the event of a hazardous materials incident, particularly for residents in identified risk areas;
- Creation of notification methods targeting people with sensory disabilities – individuals who are deaf, hard of hearing, blind, visually impaired, or deaf-blind.
- Continue to upgrade the capabilities of local emergency responders to provide fast, effective intervention during hazmat events, including mass decontamination.

Structures/Buildings

The ability to quickly evacuate commercial buildings has often been an afterthought of the designers, usually geared more toward a structure fire than an external threat. New structures should have hazmat evacuation protocols included in their design parameters.



Legend

- County Boundary
- City limits

Landmarks

- Penitentiary
- Hospital
- Park
- School

Miles 0 0.4 0.8

- Critical Facilities
- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

Figure 4-46

City of McAlester

Transportation Scenario: Rail Tank Car Containing Clorine

In addition, buildings and facility managers should have effective shelter-in-place plans, particularly for structures in the transportation hazard zones.

Critical Facilities

As the threat of transportation events themselves cannot be eliminated, any critical facilities undergoing expansion, renovation or rebuilding should consider the occupants' ability to either shelter in place or evacuate quickly in the event of a hazardous materials incident.

Infrastructure

Ensuring a minimized effect on the delivery of utility service requires forethought and planning while in the development stage. Any infrastructure development plans should include the provision for effective emergency access and staging for emergency vehicles and personnel.

4.16.6 Conclusions

Varying quantities of hazardous materials are manufactured, used, or stored at an estimated 4.5 million facilities in the United States, from major industrial plants and water treatment facilities to local dry cleaning establishments and garden supply stores.

The estimated annual damage from hazardous materials events in the United States is $22.4 million. Most victims of chemical accidents are injured at home, and usually result from ignorant or careless use of flammable or combustible materials.

The United States has the most productive transportation systems in the world. These operating systems include roads, air, rail, water, and pipelines. Although the source and location of transportation accidents can vary, the effects are typically the same. Accidents often involve human injury or death and/or the release of hazardous materials. Responses to transportation incidents also follow a similar course. Determinations are first made concerning the presence or absence of hazardous materials, followed by assistance to those injured or involved in the incident.

The majority of McAlester's Tier II sites and hazardous material events are related to the extraction, storage and transportation of hydrocarbons. McAlester has a regional airport, 23.5 miles of State and US highways, and 13.7 miles of railroads within its jurisdiction. In all, 11,743 people (64.4% of the population), 33 of the City's 65 critical facilities (50.8%), including 13 government buildings, 11 schools, five financial institutions, and four health care facilities are located within these corridors. According to the National Response Center and National Transportation Safety Board, McAlester had a total of 14 mobile accidents occur within its jurisdiction from 2000 through 2009, including six railroad accidents, six aircraft crashes, and two truck-related spills. Given this exposure, McAlester is considered to have a high vulnerability to the transportation hazard.

Data Limitations

In the National Response Center database, many reports come from callers who only supply preliminary information. Follow-up information, unless the event is significant, is usually not pursued, so data is frequently incomplete. A caller, for instance, may call in "unknown sheen" on a body of water in a community. If the material on the water's surface is gone before investigators arrive, the material may never be known. Location

may be similarly vague if the caller is not familiar with the area and cannot give precise location of what they are reporting. When possible, NRC information is reviewed by the Technical Advisory Committee for factual updates.

4.16.7 Sources

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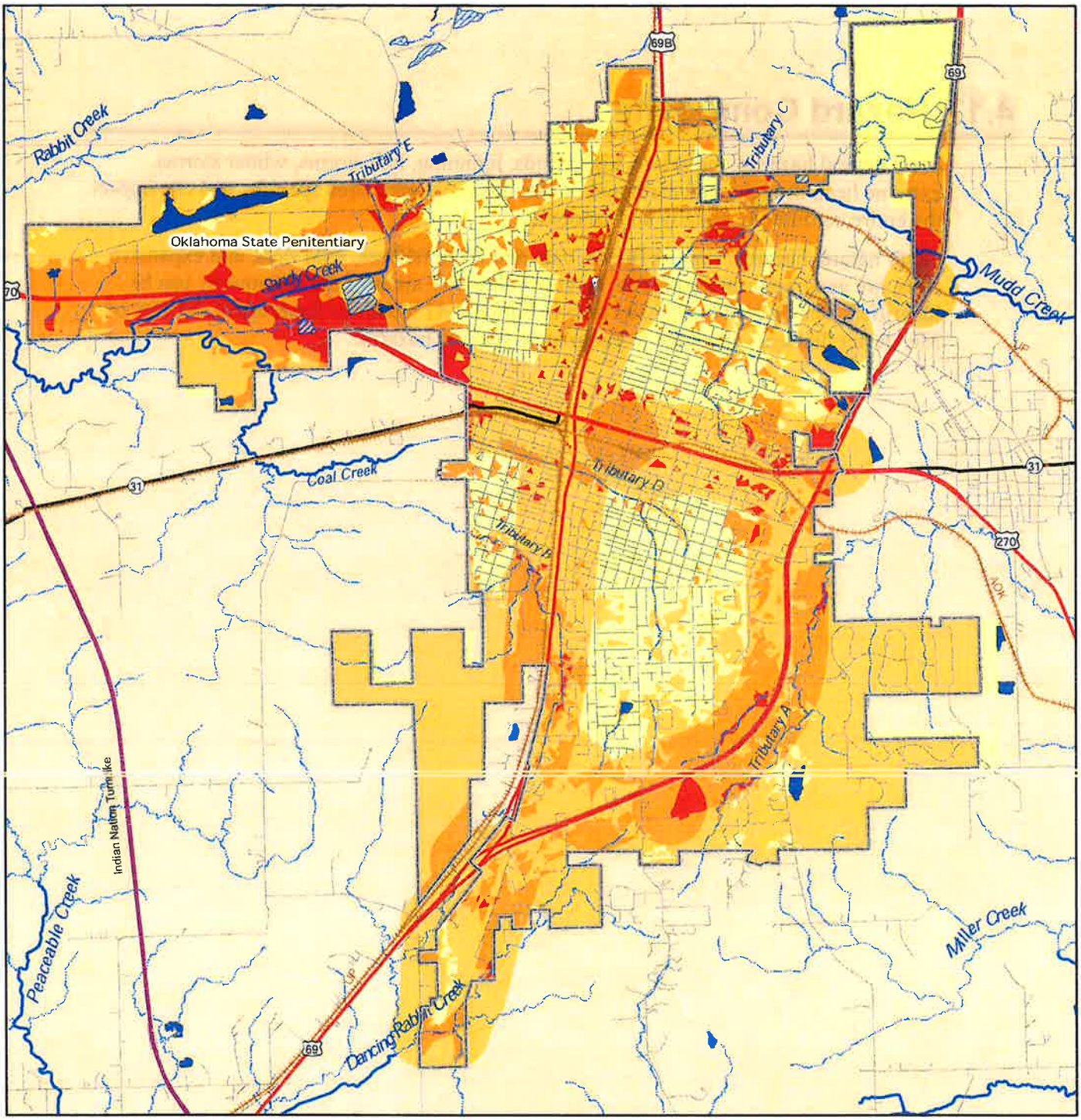
4.17 Hazard Composite

Most natural hazards- tornadoes, high winds, lightning, hail storms, winter storms, extreme heat, drought, and earthquakes- are not geographic area specific, and can impact the entire community equally and randomly.

Other natural hazards, such as floods, dam and levee failures, wild fires, and expansive soils, are geographic area specific, and the vulnerable areas of the community can be identified. The Hazard Composite map in Figure 4-47 identifies the areas of the City of McAlester that are vulnerable to geographic specific hazards.



Legend

- County Boundary
- City limits

Composite Risk Index

- Very Low
- Low
- Moderate
- High
- Very High

Miles: 0, 0.5, 1

- Railroads
- US Highways
- Streets and roads
- Lakes and Ponds
- Perennial Streams
- Intermittent Streams

N, W, E, S

Flanigan & Associates, LLC

McALESTER, OKLAHOMA 1906 FAITH - HOPE - PROSPERITY

Figure 4-47

City of McAlester

Composite Hazard Map

Chapter 5: Mitigation Goals and Objectives

44 CFR Requirements met:

Requirement §201.6(c)(3): *The plan **shall** include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

This chapter identifies the hazard mitigation goals set by the City of McAlester and discusses the mitigation projects, or measures, to be taken to achieve those goals.

Included in this Chapter:

The Research, Review, and Prioritization Process

Mitigation Categories

5.1 Hazard Mitigation Goals

5.1.1 Mission Statement

5.1.2 Mitigation Goal

5.1.3 Goals for All Natural Hazards

5.2 Hazard-Specific Goals and Objectives

The Research, Review, and Prioritization Process

The Hazard Mitigation Planning Committee (HMPC) and supporting staff identified and prioritized the measures that will help protect the lives and property of the residents of McAlester.

National literature and sources were researched to identify best practices mitigation measures for each hazard. These measures were documented, and staff screened several hundred recommended mitigation actions and selected those that were most appropriate for the McAlester area.

The HMPC reviewed the measures recommended by staff and revised, added, deleted, and approved measures for each hazard. The HMPC and staff prioritized the measures through a prioritization exercise using STAPLEE criteria recommended by FEMA. Table 5-1 lists these criteria. The results were tabulated and the individual measures were ranked by priority. The measures were then grouped into categories.

Table 5–1: STAPLEE Prioritization and Review Criteria

Evaluation Category	Sources of Information
Social	Members of Local, County and State Government were members of the Hazard Mitigation Planning Committee and had input throughout the planning process. Existing community plans were used wherever possible. Members of the Media were contacted and invited to attend all HMPC meetings.

Evaluation Category	Sources of Information
Technical	The following Persons/Agencies were consulted as to the technical feasibility of the various projects: McAlester City Council, McAlester Public Works, Oklahoma State University Extension Service, Soil Conservation Service, National Weather Service, the Corps of Engineers, County and State Health Departments, and Oklahoma Forestry Service. All of these had their comments and suggestions incorporated.
Administrative	Staffing for proper implementation of the plan currently will rely on existing members of the various agencies involved. Technical assistance is available from contractors and various State Agencies. Some local jurisdictions have incorporated Hazard Mitigation efforts into their Capital Improvement Plans. The Stormwater Drainage & Hazard Mitigation Advisory Board has agreed to an annual review and assessment of the Plan and its progress. Operations Costs are under discussion by relevant department heads.
Political	A representative of the McAlester City Council and the Mayor or his representative attended the HMPC meetings and were consulted on all aspects of the Plan.
Legal	Members of the HMPC discussed legal issues with the City Council, and it was their opinion that no significant legal issues were involved in the projects that were selected by the HMPC.
Economic	Economic issues were the predominant issues discussed by all concerned, with an emphasis on cost/benefit review. Each entity felt that the projects selected would have a positive effect in that the projects would attract business and recreation to the area as well as help the community be better prepared for a disaster. Funding for the various projects was the major concern as local budgets were not capable of fulfilling the needs due to the economic down turn. Reliance on outside grants will be relied on heavily for completion of some projects.
Environmental	Oklahoma Department of Environmental Quality, Oklahoma Forestry Service, and the Oklahoma Water Resources Board were all consulted as to the environmental impact of the various projects and it was felt that there would be no negative impact. Local governments are currently considering zoning of environmentally sensitive areas.

Mitigation Categories

The measures that communities and individuals can use to protect themselves from, or mitigate the impacts of, natural and man-made hazards fall into six categories:

- Public Information and Education
- Preventive Measures
- Structural Projects
- Property Protection
- Emergency Services, and
- Natural Resources Protection

This chapter is organized by mitigation category, with the HMPC mitigation mission statement and goals listed first in section 5.1.

5.1 Hazard Mitigation Goals

5.1.1 Mission Statement

To create a disaster-resistant community and improve the safety and well-being of McAlester 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.

5.1.2 Mitigation Goal

To identify community 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 community.

5.1.3 Goals for All Natural Hazards

- 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 Hazard-Specific Goals and Objectives

Flood	
GOAL: ***To reduce injuries and loss of life; trauma; damage to property, equipment and infrastructure; community disruption; and economic, environmental, and other losses caused by floods and flash floods.***	
Objective 1.	**Public Information & Education.** Improve public awareness of flood and flash flood hazards in general and at specific high-risk locations; and give people knowledge about measures they can use to protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Expand mapping, regulations, and loss-prevention programs in areas with high risks and catastrophic potential, such as local portions of multi-jurisdictional floodways and floodplains where additional safety considerations are warranted because McAlester does not have jurisdiction to regulate upstream/downstream runoff, blockages, or other actions that can affect the safety of McAlester residents.
Objective 3.	**Structural Projects.** Obtain funding for and implement projects that can reduce flood and drainage hazards, with consideration for comprehensive solutions in accord with watershed-wide management plans.
Objective 4.	**Property Protection.** Identify and protect people, structures, critical facilities, and critical infrastructure that are vulnerable to flood and flash flood hazards.
Objective 5.	**Emergency Services.** Identify the needs and implement additional emergency operations plans and services for areas at high risk of flooding, including additional prediction and forecasting capability, emergency alerts, and evacuation plans.
Objective 6.	**Natural Resource Protection.** Protect and enhance natural floodplain and stormwater resources by adopting and implementing sustainable flood-management policies that have few or no negative impacts and have positive environmental effects whenever possible.

Tornado	
GOAL: ***To reduce injuries and loss of life; trauma; damage to property, equipment and infrastructure; community disruption; and economic, environmental and other losses caused by tornadoes.***	
Objective 7.	**Public Information & Education.** Improve public awareness of tornado hazards, in general and in specific high-risk situations; and give people knowledge about measures they can use to protect themselves, their property, and their community.
Objective 8.	**Preventive Measures.** Prevent or reduce tornado losses by strengthening buildings and by publicizing, training, and creating market options for fortified new construction, retrofits, code changes and code-plus innovations.
Objective 9.	**Structural Projects.** Provide safe tornado shelters, SafeRooms, and fortified buildings for vulnerable populations, including children; offer training and incentives to encourage people of means to include shelters and SafeRooms in new and retrofit building projects.
Objective 10.	**Property Protection.** Identify and protect people, structures, and critical infrastructure that are vulnerable to tornado hazards, with emphasis on critical facilities.

Tornado	
Objective 11.	**Emergency Services.** Identify the needs for and implement additional emergency operations plans and services to expand tornado safety, including Community Emergency Response Team training.
Objective 12.	**Natural Resource Protection.** Take advantage of opportunities for tornado programs and policies that reduce negative environmental impacts. Examples include sustainable programs for debris management and recycling, and fortified construction with environmentally friendly materials.

High Wind	
GOAL: ***To reduce injuries and loss of life; trauma; damage to property, equipment and infrastructure; community disruption; and economic, environmental and other losses caused by high winds.***	
Objective 1.	**Public Information & Education.** Improve public awareness of high-wind hazards, in general and in specific high-risk situations; and give people knowledge about measures they can use to protect themselves, their property, and their community.
Objective 2.	**Preventive Measures.** Prevent or reduce tornado losses by strengthening buildings and by publicizing, training, and creating market options for fortified new construction, retrofits, code changes and code-plus innovations.
Objective 3.	**Structural Projects.** Provide fortified buildings for critical public facilities and vulnerable populations, including children; offer training and incentives to encourage people of means to build stronger structures in new and retrofit building projects.
Objective 4.	**Property Protection.** Identify and protect people, structures, and critical infrastructure that are vulnerable to high winds, with emphasis on critical facilities.
Objective 5.	**Emergency Services.** Identify needs for and implement additional emergency operations plans and services to expand safety in dangerous windstorms, including Community Emergency Response Team training.
Objective 6.	**Natural Resource Protection.** Take advantage of opportunities for high-wind programs and policies that reduce negative environmental impacts. Examples include sustainable programs for debris management and recycling, and fortified construction with environmentally friendly materials.

Lightning	
GOAL: ***To reduce injuries, loss of life, and damage to property, equipment and infrastructure caused by Lightning strikes.***	
Objective 1.	**Public Information & Education.** Improve public awareness of Lightning hazards and measures by which people can protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify the costs and the benefits of loss-prevention programs, such as whole building surge protection, with consideration for uncalculated benefits such as data or work productivity loss.
Objective 3.	**Structural Projects**. Provide for necessary construction, renovation, retrofitting or refurbishment of city infrastructure to protect vulnerable populations from the effects of lightning strikes.

Lightning	
Objective 4.	**Property Protection.** Identify ways to protect structures, infrastructure, and critical facilities and their occupants from damage caused by lightning strikes.
Objective 5.	**Emergency Services.** Establish or expand emergency services protocols that adequately address response scenarios in the event of scenarios with the possibility of severe lightning.
Objective 6.	**Natural Resource Protection.** Ensure that lightning damage mitigation policies have no negative impacts and, when possible, provide positive enhancements to the environment.

Hail	
GOAL: ***To reduce the high costs of property and infrastructure damage caused by Hailstorms.***	
Objective 1.	**Public Information and Education.** Improve public awareness of Hailstorm hazards and measures by which people can protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify the costs and the benefits of loss-prevention ordinances, such as building codes, with consideration for uncalculated benefits such as employee downtime or loss of city services.
Objective 3.	**Structural Projects.** Identify costs and benefits of loss-prevention programs, such as covered vehicle parking, with consideration for uncalculated benefits such as averting response delays and business losses.
Objective 4.	**Property Protection.** Identify, fund, and implement projects to protect people and public and private property from losses in hail events, including critical infrastructure such as utilities or public vehicles.
Objective 5.	**Emergency Services.** Establish or expand emergency services protocols that adequately address response scenarios in the event of severe hail events.
Objective 6.	**Natural Resource Protection.** Ensure that Hail mitigation policies have no negative impacts and, when possible, provide positive enhancements to the environment. Encourage homeowners, for example, to use Class 4 roofing made of recycled materials.

Winter Storms	
GOAL: ***To reduce injuries and loss of life; trauma; loss of critical utilities; damage to property, equipment and infrastructure; community disruption; and economic, environmental and other losses caused by winter storms. Winter hazards can include extreme temperatures, ice and snow, high winds, and cascading hazards such as loss of utilities.***	
Objective 1.	**Public Information & Education.** Improve public awareness of winter storm hazards and give people knowledge about measures they can use to protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify costs and the benefits of loss-prevention programs such as burying power lines to reduce utility outages or building snow-load roofs, with consideration for uncalculated benefits such as averting environmental and business losses.
Objective 3.	**Structural Projects.** Identify, fund, and implement measures, such as winterization retrofits to homes, critical facilities, transportation systems and infrastructure, to avert or reduce losses from winter storms. Provide additional protection, such as generators and emergency shelters, for agencies and facilities that serve vulnerable populations.

Winter Storms	
Objective 4.	**Property Protection.** Identify, fund, and implement projects to protect people and public and private property from losses in winter storms.
Objective 5.	**Emergency Services.** Identify and expand emergency services for people at high risk in winter storms, such as the homeless, elderly, disabled, and oxygen-dependent people.
Objective 6.	**Natural Resource Protection.** Evaluate options and take advantage of opportunities for sustainable winter-storm policies and programs to reduce negative environmental impacts; examples include programs for debris management, streets snow removal, tree trimming and replacement, energy conservation, and winterization.

Heat	
GOAL: ***To reduce heat-related illnesses, loss of life, and exacerbation of other hazards such as drought and expansive soils caused by extreme Heat conditions.***	
Objective 1.	**Public Information and Education.** Improve public awareness of extreme heat hazards and measures by which people can protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify and protect people and critical infrastructure that are vulnerable to extreme heat conditions.
Objective 3.	**Structural Projects.** Provide for necessary construction, renovation, retrofitting or refurbishment of city properties to protect vulnerable populations from the effects of extreme heat.
Objective 4.	**Property Protection.** Implement construction and retrofitting measures to minimize the risk to public properties and their occupants caused by extreme heat.
Objective 5.	**Emergency Services.** Ensure that a Heat Emergency Action Plan is followed and that heat alerts are issued in a timely manner. Establish or expand emergency services protocols that adequately address response scenarios in the event of extreme heat.
Objective 6.	**Natural Resources Protection.** Ensure that extreme Heat mitigation policies have no negative impacts and, when possible, provide positive enhancements to the environment, such as the creation and development of urban green spaces.

Drought	
GOAL: ***To reduce the impact of Drought on property, infrastructure, natural resources and local government response functions.***	
Objective 1.	**Public Information and Education.** Improve public awareness of Drought and measures by which people can protect themselves, their property, and their community.
Objective 2.	**Preventive Measures.** Identify and protect resources and critical infrastructure that are vulnerable to Drought.
Objective 3.	**Structural Projects.** Provide for necessary construction, renovation, retrofitting or refurbishment to protect vulnerable structures from the effects of drought.
Objective 4.	**Property Protection.** Implement measures to minimize the risk to public property caused by drought events.
Objective 5.	**Emergency Services.** Establish or expand emergency services protocols that adequately address response scenarios in the event of drought.

Drought	
Objective 6.	**Natural Resource Protection.** Ensure that Drought mitigation policies have no negative impacts and, whenever possible, provide positive enhancements to the environment.

Expansive Soil	
GOAL: To reduce the damage and economic losses caused by expansive soils on property and local infrastructure.	
Objective 1.	**Public Information & Education.** Improve public awareness of expansive-soil hazards, with both general and site-specific information, and provide knowledge about available measures by which people can protect their property and their community.
Objective 2.	**Preventive Measures.** Avoid expansive-soils locations, whenever possible. Explore options for loss-mitigation from expansive soils, including building codes and code-plus options. Examine expansive soils before building critical facilities and infrastructure.
Objective 3.	**Structural Projects.** Identify and implement measures to reduce or avert expansive-soil damages and losses to structures and infrastructure, with emphasis on critical facilities and utilities.
Objective 4.	**Property Protection.** Identify and protect resources and critical infrastructure that are vulnerable to expansive soils.
Objective 5.	**Emergency Services.** Survey emergency and critical facilities for potential expansive-soil problems; repair and retrofit as needed; and consider soils when building emergency facilities.
Objective 6.	**Natural Resource Protection.** Protect and enhance natural resources by adopting and implementing sustainable expansive-soils policies that have few or no negative impacts and have positive environmental effects whenever possible.

Urban Fires	
GOAL: ***To reduce injuries, loss of life, and damage to property, equipment and infrastructure caused by Urban Structure Fires.***	
Objective 1.	**Public Information & Education.** Improve public awareness of structure fires hazards and measures by which people can protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify and protect populations, structures, and critical infrastructure particularly vulnerable to Urban Fires.
Objective 3.	**Structural Projects.** Include structure fire considerations in landscaping. Include infrastructure improvements that support effective firefighting.
Objective 4.	**Property Protection.** Implement building materials and techniques in retrofitting or in new construction to minimize the risk to public property caused by Structure Fires.
Objective 5.	**Emergency Services.** Establish or expand emergency services protocols that adequately address firefighting response.
Objective 6.	**Natural Resource Protection.** Ensure that Structure fire mitigation policies have no negative impacts and, whenever possible, provide positive enhancements to the environment.

Wildfire	
GOAL: *To reduce injuries, loss of life, and damage to property, equipment and infrastructure caused by Wildfires.*	
Objective 1.	**Public Information & Education.** Improve public awareness of Wildfire hazards and measures by which people can protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify and protect populations, structures, and critical infrastructure that are vulnerable to Wildfires.
Objective 3.	**Structural Projects.** Include wildfire considerations in landscaping, public park, and other properties that would fall into wildland-urban interface or other areas of wildfire risk. Include infrastructure improvements that support effective firefighting.
Objective 4.	**Property Protection.** Implement building materials and techniques in retrofitting or in new construction to minimize the risk to public property caused by wildfires.
Objective 5.	**Emergency Services.** Establish or expand emergency services protocols that adequately address response scenarios in wildfire events.
Objective 6.	**Natural Resource Protection.** Ensure that Wildfire mitigation policies have no negative impacts and, whenever possible, provide positive enhancements to the environment.

Earthquake	
GOAL: *To reduce injury, loss of life, and damage to property, equipment and infrastructure caused by Earthquakes.*	
Objective 1.	**Public Information and Education.** Improve public awareness of Earthquake hazards and measures by which people can protect themselves, their property and their community.
Objective 2.	**Preventive Measures.** Identify and protect populations, structures, and critical infrastructure that are vulnerable to Earthquakes.
Objective 3.	**Structural Projects.** Provide for necessary construction, renovation, retrofitting or refurbishment to protect vulnerable structures from the effects of Earthquakes.
Objective 4.	**Property Protection.** Implement building materials and techniques in retrofitting or in new construction to minimize the risk to public properties and their occupants caused by Earthquakes.
Objective 5.	**Emergency Services.** Establish emergency services protocols that adequately address response scenarios in the event of Earthquake.
Objective 6.	**Natural Resource Protection.** Take advantage of opportunities for earthquake programs and policies that reduce negative environmental impacts. Examples include sustainable programs for debris management and recycling, and fortified construction with environmentally friendly materials.

Fixed Site Hazardous Materials	
GOAL: *To reduce injuries, loss of life, and damage to property, equipment and infrastructure caused by Fixed Site Hazardous Materials releases.*	
Objective 1.	**Public Information & Education.** Improve public awareness of Hazardous Material hazards and measures by which people can protect themselves, their property and their community, including instructions on effective "sheltering in place."

Fixed Site Hazardous Materials	
Objective 2.	**Preventive Measures.** Identify and protect populations, structures, and critical infrastructure particularly vulnerable to Fixed Site Hazardous Material releases, with consideration for uncalculated benefits such as averting environmental and business losses.
Objective 3.	**Structural Projects**. Include considerations in project development that provide the ability to protect building residents during a Hazardous Materials incident. Include infrastructure improvements that support effective HazMat response.
Objective 4.	**Property Protection**. Implement building materials and techniques in retrofitting or in new construction to minimize the risk to public property caused by Hazardous Materials.
Objective 5.	**Emergency Services**. Establish or expand emergency services protocols that adequately address Hazardous Materials response.
Objective 6.	**Natural Resource Protection.** Ensure that HazMat incident response and mitigation policies include environmental control of substances, have no negative impacts and, when possible, provide positive enhancements to the environment.

Dam and Levee Break	
GOAL: ***To reduce injuries and loss of life; trauma; damage to property, equipment, critical facilities, and infrastructure; community disruption; and economic, environmental, and other losses caused by partial or total dam and levee failures.***	
Objective 1.	**Public information & education**. Improve public awareness of dam and levee break hazards, in general and at specific high-risk locations; and give people knowledge about measures they can use to protect themselves, their property, and their community.
Objective 2.	**Preventive measures.** Expand mapping, regulations, and loss-prevention programs in areas with high risks, including extension of flood insurance regulations behind high-risk levees; updated risk mapping downstream of high-risk dams; and pre-disaster evacuation and hazard-mitigation programs.
Objective 3.	**Structural projects.** Analyze safety of existing high-risk dams and levees, including maintenance programs and funding; and implement highest-priority measures to strengthen the structures and reduce risks.
Objective 4.	**Property protection measures.** Identify and protect people, structures, critical facilities, and critical infrastructure that are vulnerable to dam and levee break hazards.
Objective 5.	**Emergency services.** Identify needs for and implement additional emergency operations plans and services in areas at high risk to dam and levee breaks, including additional prediction and forecasting capability, emergency alerts, and evacuation plans.
Objective 6.	**Natural resource protection.** Protect and enhance natural resources by adopting and implementing sustainable dam and levee break policies that have few or no negative impacts and have positive environmental effects whenever possible. Include analysis of downstream impacts on environment and wildlife in dam and levee planning.

Transportation Incidents
GOAL: ***To reduce injuries, loss of life, and damage to property, equipment and infrastructure caused by Transportation Incidents involving Hazardous Materials or other potential for mass casualties.***

Transportation Incidents	
Objective 1.	**Public Information & Education.** Improve public awareness of Transportation hazards and measures by which people can protect themselves, their property and their community, including instructions on effective "sheltering in place."
Objective 2.	**Preventive Measures.** Identify and protect populations, structures, and critical infrastructure particularly vulnerable to Transportation incidents, with consideration for uncalculated benefits such as averting environmental and business losses.
Objective 3.	**Structural Projects**. Include considerations in project development that provide the ability to protect building residents during a Transportation incident. Include infrastructure improvements that support effective HazMat and Search & Rescue response.
Objective 4.	**Property Protection**. Implement building materials and techniques in retrofitting or in new construction to minimize the risk to public property caused by Transportation incidents.
Objective 5.	**Emergency Services**. Establish or expand emergency services protocols that adequately address HazMat and Search & Rescue response.
Objective 6.	**Natural Resource Protection.** Ensure that Transportation hazard mitigation policies have no negative impacts and, whenever possible, provide positive enhancements to the environment.

Chapter 6: Action Plan

44 CFR Requirements met:

Included in this Chapter:

6.1 Action Plan
6.2 Mitigation Measures

Requirement §201.6(c)(3): *The plan **shall** include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

Requirement §201.6(c)(3)(ii): *[The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

Requirement: §201.6(c)(3)(ii): *[The mitigation strategy] **must** also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

Requirement: §201.6(c)(3)(iii): *[The mitigation strategy section **shall** include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

Requirement §201.6(c)(3)(iv): *For multi-jurisdictional plans, there **must** be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.*

Table 6–1: Measures per Hazard

Hazard	Measures Addressing	Hazard	Measures Addressing
Floods	12	Expansive Soil	5
Tornadoes	19	Urban Fires	9
High Wind Events	21	Wildfires	9
Lightning	16	Earthquakes	19
Hail	11	Fixed Site HazMat	7
Winter Storms	15	Dam/Levee Failures	6
Extreme Heat	11	Transportation	6
Drought	5		

The City of McAlester and McAlester Public Schools have reviewed and analyzed the risk assessment studies for the natural hazards and hazardous material events that may impact their communities. The McAlester Hazard Mitigation Technical and Citizens'

Advisory Committees prioritized the mitigation measures, and developed an Action Plan for the highest priority measures. This chapter identifies specific high priority actions to achieve the City's and the McAlester School's mitigation goals, the lead agency responsible for implementation of each action item, an anticipated time schedule, estimated cost opinion, and identification of possible funding sources. It also lists the Prioritized Mitigation Measures for each hazard in the Public Information and Education, Preventive Measures, Structural Projects, Property Protection, Emergency Services, and Natural Resource Protection categories.

6.1 Recommended High Priority Action Plan

Floods, Tornadoes, High Winds Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Transportation Events, Subsidence

1. Develop an All-Hazard Public Information, Education, and Awareness Program.

Lead:	Emergency Management
Time Schedule:	2010-2015
Estimated Cost:	$ 14,250
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: An All-Hazards Public Information and Education Strategy to inform the public of the imminent natural and man-made hazards, and actions the public can take to protect themselves and their property from damage and destruction, and themselves from injury and death.

Resource: Appendix B.1.1 Public Information Program Strategy

Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Subsidence

2. Educate the public on the importance of a Family Disaster Plan and Supply Kit.

Lead:	City Manager/Emergency Manager
Time Schedule:	2010- On Going
Estimated Cost:	Undetermined
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: An informed public that understands the importance of having a Family Disaster Plan and an emergency supply kit.

Resource: Appendix B.1.2 Educational Programs

Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Dam Failures, Transportation Events

3. **Develop distribution centers in local libraries, government facilities, and other public buildings where information and safety guidance on natural and man made hazards can be provided to citizens.**

Lead:	Emergency Manager
Time Schedule:	2010- On going
Estimated Cost:	$ 750
Source of Funding:	Local/General budget, State Emergency Management, Red Cross, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Informational kiosks and display racks easily available to the public that contain brochures and materials on various natural and man-made hazards, and how citizens can prepare for, mitigate, respond to, and recover from disasters.

Resource: Appendix B.1.3 Outreach Projects

Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Dam Failures, Transportation Events, Subsidence

4. **Develop and Distribute a Family Emergency Preparedness Guide to all families.**

Lead:	City Manager/Emergency Manager
Time Schedule:	2010- On Going
Estimated Cost:	Undetermined
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: An informed public about preparedness, response, mitigation and recovery activities and actions that can be taken by families and citizens to better protect themselves from disasters.

Resource: Appendix B.1.3 Outreach Projects

Floods, Tornadoes, High Winds, Lightning, Hail, Winter Storms, Extreme Heat, Drought, Expansive Soil, Wildfires, Earthquakes

5. **Train/Educate builders, developers, architects and engineers in techniques of disaster-resistant homebuilding, such as the Fortified Home standards developed by the Institute for Business & Home Safety (IBHS), the Blueprint for Safety guidelines developed by the Federal Alliance for Safe Homes (FLASH).**

Lead:	City Manager/Code Enforcement

Time Schedule: 2010- On Going

Estimated Cost: Undetermined

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Enhanced construction practices for residences that will result in homes that will withstand most tornadoes, high winds and earthquakes.

Resource: Section B.2.6 IBHS Fortified Home Program

Expansive Soils

6. **Educate builders on appropriate foundation types for soils with different degrees of shrink-swell potential. For example, using "post-tensioned slab-on-grade" or "drilled pier" vs. standard "slab-on-grade" or "wall-on-grade" foundations.**

Lead: City Manager/Code Enforcement

Time Schedule: 2010- On Going

Estimated Cost: Undetermined

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Enhanced construction practices for residences that will result in homes built with foundations appropriate for the soil conditions, and will withstand the shrinking and swelling of highly expansive soils found in the McAlester area.

Resource: Appendix B.2.6 IBHS Fortified Homes program

Tornadoes, High Winds, Earthquakes

7. **Educate residents, building professionals and safe room vendors on the International Codes Council/National Storm Shelter Association's "Standard for the Design and Construction of Storm Shelters" and consider incorporating this Standard into current regulatory ordinances.**

Lead: City Manager,/Code Enforcement

Time Schedule: 2010- On Going

Estimated Cost: Undetermined

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: An educated citizenry and professional building and design community as to the advantages and requirements of the ICC/NSSA "Standard for the Design and Construction of Storm Shelters," and the adoption of an ordinance requiring that all safe rooms comply with the ICC/NSSA standard.

Resource: Appendix B.3.1 Safe Rooms

Expansive Soils

8. **Establish an administrative procedure or change in City codes that require builders to check for expansive soils when applying for new residential construction permits, and to consider the use of foundations that mitigate expansive soil damages when in a moderate to high-risk area.**

Lead: City Manager/Code Enforcement

Time Schedule: 2010

Estimated Cost: Minimal

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Adoption of an ordinance, administrative procedure or City code that requires builders to check for expansive soils when applying for new residential building permits, and to consider the use of foundations that mitigate expansive soil damage in moderate to high-risk areas.

Resources: Appendix B.2.6 IBHS Fortified Homes program

Lightning

9. **Provide lightning warning systems for City of McAlester public outdoor sports areas, pools, golf courses, and parks.**

Lead: Parks Department/Emergency Management

Time Schedule: 2010-2012

Estimated Cost: $52,000

Source of Funding: Local, FEMA HMGP and PDM

Work Product/Expected Outcome: Lightning sensing and warning systems for McAlester's parks, and golf courses.

Resource: Appendix B.2.10 Lightning Warning Systems

Lightning

10. **Provide lightning warning systems for McAlester Public Schools outdoor sports areas and play grounds.**

Lead: McAlester Public Schools/Emergency Management

Time Schedule: 2010 - Ongoing

Estimated Cost: $36,000

Source of Funding: Local, FEMA HMGP and PDM

Work Product/Expected Outcome: Lightning sensing and warning systems for McAlester's schools.

Resource: Appendix B.2.10 Lightning Warning Systems

Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat

11. Develop an Emergency Back-up Generator Hazard Mitigation Plan Annex to the McAlester Hazard Mitigation Plan for the community, assessing and prioritizing generator needs for critical facilities, both public and private. Assessment should include emergency generator needs, costs of installation for pads/transfer panels only, or for complete generator assembly installation.

Lead: Emergency Management

Time Schedule: 2010

Estimated Cost: $8,500

Source of Funding: Local Funds and FEMA HMGP, and PDM.

Work Product/Expected Outcome: An Emergency Back-up Generator Hazard Mitigation Plan Annex that inventories McAlester's Critical Facilities, including City Hall, Police Station, Public Works, McAlester EMS, Nursing Homes, Early Childhood Centers, Community Emergency Shelters; sets priorities, evaluates current electrical usage, emergency electrical load/needs, fuel sources (natural gas/diesel/propane), pad location, wiring, transfer switches, contract or on-site, and generator type and size.

Resource: Appendix B.2.12 Back-Up Generators

Floods, Tornadoes, High Winds, Lightning, Severe Winter Storms, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events

12. Based on the results of the Emergency Back-up Generator Hazard Mitigation Plan Annex, provide wiring and transfer switches to accommodate emergency generators during disaster power outages for critical facilities including Emergency Operations Centers, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities.

Lead: Department of Public Works

Time Schedule: 2010-Ongoing

Estimated Cost: Costs to be determined based on findings of the Emergency Back-up Generator Hazard Mitigation Plan Annex.

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Adequate pre-installed wiring and required automatic transfer switches in Critical Facilities that will accommodate emergency generators during power outages in a disaster.

Resource: Appendix B.2.12 Back-Up Generators

Tornadoes, High Winds, Lightning, Severe Winter Storms

13. Obtain emergency generators for continuity of government/use during disaster power outages for critical facilities including Emergency Operations Centers,

City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities, as identified in the Emergency Back-up Generator Hazard Mitigation Plan Annex.

Lead: Department of Public Works

Time Schedule: 2010-Ongoing

Estimated Cost: To be determined

Sources of Funding: Local, FEMA HMGP/PDM

Work Products/Expected Outcome: This will provide sufficient generators or access to generators during a disaster that will provide sufficient power for critical community functions. This will aid in the recovery and response effort after a disaster.

Resource: Appendix B.2.12 Back-Up Generators

Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes

14. **Identify and encourage Private Critical Facilities (Financial Institutions, Elder Care Facilities, Designated/Potential Community Emergency Shelters, etc.) to have generator pad, wiring/transfer switches and Emergency Back-Up Generators, or Reliable Contracts to provide Back-Up Generators.**

Lead: City Manager

Time Schedule: 2010-2014

Estimated Cost: Undetermined

Source of Funding: Local/General budget.

Work Product/Expected Outcome: Private critical facilities (financial institutions, elder care facilities, designated/potential community emergency shelters, etc.) have generator pads, wiring and transfer switches, and emergency back-up generators, or reliable contracts for the provision of back-up generators, in the event of power failure.

Resource: Appendix B.2.12 Back-Up Generators

Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes

15. **Adopt an Ordinance requiring generator pad and wiring/transfer switches for Elder Care Facilities and Nursing Homes, to accommodate Emergency Back-Up Generators in the event of prolonged power outages.**

Lead: City Manager

Time Schedule: 2010- On Going

Estimated Cost: Undetermined

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Adoption of an Ordinance requiring generator pad and wiring/transfer switches for Elder Care Facilities and Nursing Homes, to accommodate Emergency Back-Up Generators in the event of prolonged power outages.

Resource: Appendix B.2.12 Back-Up Generators

Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes

16. Identify and/or encourage key important private service facilities (gas stations, convenience stores, etc.) to have wiring/transfer switches and emergency back-up generators installed, or reliable contracts for the provision of back-up generators, in the event of disasters or power outages.

Lead: City Manager

Time Schedule: 2010-2014

Estimated Cost: Undetermined

Source of Funding: Local/General budget.

Work Product/Expected Outcome: Key important private service facilities (gas stations, convenience stores, etc.) have wiring, transfer switches and emergency back-up generators, or reliable contracts for the provision of back-up generators, to ensure continued operation of essential services in times of emergency, disaster, or power outage.

Resource: Appendix B.2.12 Back-Up Generators

Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes

17. Develop Memorandums of Understanding (MOUs) with private sector gasoline service facilities to provide priority fuel to emergency/critical vehicles (government, Police, Fire, ambulance, etc.) in times of emergency or power outage.

Lead: City Manager

Time Schedule: 2010

Estimated Cost: None anticipated

Source of Funding: None anticipated

Work Product/Expected Outcome: Memorandums of understanding (MOUs) with private sector gasoline service facilities to provide priority fuel to emergency/critical vehicles (government, Police, Fire, ambulance, etc.) in times of emergency or power outage, so that emergency and First Responder personnel can meet the needs of the community.

Resource: Appendix B.5.8 Mutual Aid/Inter Agency Agreements

Tornadoes, High Winds

18. Provide employee shelters/safe-rooms at critical facilities, such as 911 Center, fire stations and police stations to protect first responders.

Lead: City Manager/Emergency Management/City Engineer

Time Schedule: 2010-1015

Estimated Cost: $?

Source of Funding: HMGP, PDM, Local Share

Work Product/Expected Outcome: Construction of shelters or safe rooms with the intent of protecting first responders from tornadoes and high winds.

Tornadoes, High Winds, Earthquakes

19. Install Safe-Rooms in Schools.

Lead: Superintendent, McAlester Public Schools

Time Schedule: 2010-ongoing

Estimated Cost: $ 3,217,500 (see below for details)

School	Staff	Students	Total	Size, Sq. Ft.	Cost
Administration	18	-	18	108	$ 17,820
McAlester HS	88	855	943	5,658	933,570
Puterbaugh MS	46	370	416	2,496	411,840
Parker Int. Cntr.	39	363	402	2,412	397,980
Doyle Elem.	13	103	116	696	114,840
Emerson Elem.	28	230	258	1,548	255,420
Will Rogers Elem.	48	448	496	2,976	491,040
Washington ECC	20	166	186	1,116	184,140
Jefferson ECC	29	175	204	1,224	201,960
William Gay ECC	35	149	184	1,104	182,160
Eugene Field Adult Ed. Off.	7	20	27	162	26,730
Totals	**371**	**2,879**	**3,250**	**19,500**	**$ 3,217,500**

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Safe Rooms in, or in close proximity to all Public School buildings, to provide safe shelter for staff and students in the event of High Winds, Tornadoes, and Earthquakes.

Floods

20. Continue Compliance with, and Participation in the National Flood Insurance Program (NFIP) and the Community Rating System (CRS).

Lead: City Manager/Floodplain Manager

Time Schedule: 2010- On Going

Estimated Cost: Undetermined

Source of Funding: Local/General budget.

Work Product/Expected Outcome: Compliance with, and enforcement of local storm drainage and floodplain management ordinances and regulations, and requirements of the National Flood Insurance Program and the Community Rating System (CRS).

Resource: Appendix B.4.2 Insurance

Floods

21. Implement a Stormwater Utility Fee to pay for the Planning, Engineering, Operations and Maintenance costs of the Stormwater Drainage System.

Lead: Public Works

Time Schedule: 2010-2011

Estimated Cost: Undetermined

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: A monthly Stormwater Utility Service Fee to provide a stable source of income to pay for the Operation and Maintenance of the City of McAlester's floodplains and storm drainage system.

Resource: How to Develop a Stormwater Utility Fee; Bulletin No. 3, Floodplain Management Information Series; OWRB, Dec. 2004.

Floods

22. Prepare a comprehensive basin-wide Flood and Drainage Annex to the Hazard Mitigation Plan for all watersheds within the jurisdiction. The Annex should identify all flooding problems within the jurisdiction, and recommend the most cost-effective and politically acceptable solutions.

Lead: Department of Public Works

Time Schedule: 2010-2015

Estimated Cost: $450,000

Source of Funding: Local Funds, FEMA HMGP/PDM

Work Product/Expected Outcome: A comprehensive Flood and Drainage Annex for all watersheds within the community that identifies flooding problems and provides

guidance for cost-effective and politically acceptable actions to correct the problems, and to address future development impacts and appropriate mitigation measures.

Resource: Appendix B.2.1 Planning

Floods

23. Acquire and remove floodplain and repetitive loss properties where the community's Repetitive Loss and Flood and Drainage Annex to the Hazard Mitigation Plans identify acquisition as the most cost-effective and desirable mitigation measure.

Lead:	Public Works
Time Schedule:	Ongoing
Estimated Cost:	To be determined
Source of Funding:	Local Funds and FEMA HMGP/PDM

Work Product/Expected Outcome: Acquisition of the community's most severely vulnerable flood-risk properties, and relocation of flood victim families to safe homes out of the floodplain and harm's way.

Tornadoes, High Winds, Hail, Earthquakes

24. When replaced, install Break/Shatter Resistant Glass in Government Offices, and critical facilities.

Lead:	City Manager
Time Schedule:	On-Going
Estimated Cost:	To be determined
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Impact-, break- and shatter-resistant windows and frames in Government Offices and administrative buildings that protect staff, and First Responders from broken glass and projectiles resulting from tornadoes, high winds, and earthquakes.

Resource: Appendix B.4.7 Impact Resistant Windows & Doors

Tornadoes, High Winds, Hail, Earthquakes

25. When replaced, install Break/Shatter Resistant Glass in Schools.

Lead:	Superintendent, McAlester Public Schools
Time Schedule:	On-Going
Estimated Cost:	To be determined
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Impact-, break- and shatter-resistant windows and frames in schools and administrative buildings that protect staff, teachers, and students from broken glass and projectiles resulting from tornadoes, high winds, and earthquakes.

Resource: Appendix B.4.7 Impact resistant Windows & Doors

Lightning

26. Provide surge and lightning protection for computer-reliant critical facilities (e.g. City Hall, 911 Center, EOC, Police and Fire stations, water/wastewater treatment plant and public works buildings).

Lead:	City Manager
Time Schedule:	2010- On Going
Estimated Cost:	To be determined
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: Computer-reliant systems in government and public critical facilities are protected from lightning and power surges.

Resource: Appendix B.4.9 Lightning Protection Systems; B.4.10 Surge Protection

Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Urban Fires, Wildfires, Earthquakes, Fixed-Site Hazardous Materials Events, Transportation Events

27. Develop an inventory and database of Special Needs Populations requiring special assistance during disasters.

Lead:	City Manager/Emergency Manager
Time Schedule:	2010- On Going
Estimated Cost:	Undetermined
Source of Funding:	Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: A community inventory and database of Special Needs Populations requiring special assistance during disasters.

Floods, Tornadoes, High Winds, Severe Winter Storms, Extreme Heat, Drought, Urban Fires, Wildfires, Earthquakes, Fixed Site Hazardous Materials Events, Dam Failures, Transportation Events

28. Install a Mass Emergency Telephone Communication system for mass call-outs to targeted areas of the community for emergency notification and/or information.

Lead:	City Manager/Emergency Management

Time Schedule: 2010-2012

Estimated Cost: 8,500 addresses X $1.91 per address per year = $16,250, (1 Year Start-up + 1 year operation = $32,500.

Source of Funding: Local/General budget, Federal Emergency Management Agency (FEMA) PDM and/or HMGP.

Work Product/Expected Outcome: An Emergency Mass Communications System (Reverse 911) capable of simultaneously calling targeted areas and delivering specific emergency/hazard messages to the occupants.

Tornadoes, High Winds, Flooding, Dam Failure, Hazardous Materials

29. Evaluate, upgrade and maintain community-wide outdoor omni-directional voice/siren warning systems.

Lead: Emergency Management

Time Schedule: 2010 - Ongoing

Estimated Cost: $75,000

Source of Funding: Local and FEMA HMGP/PDM.

Work Product/Expected Outcome: 1) Identify locations were warning siren coverage is less than adequate; 2) Routinely test sirens for operational adequacy and maintenance/system required updates, and 3) Upgrade 3 existing sirens with modern multi functional capabilities.

Floods, Tornadoes, High Winds, Hail, Severe Winter Storms, Earthquakes

30. Develop / Review / Update the McAlester Debris Management Plan.

Lead: City Manager/Public Works

Time Schedule: 2010-2012

Estimated Cost: $ 8,500

Source of Funding: Local Budget

Work Product/Expected Outcome: 1) Identify locations clean up crews can deposit debris before a final disposal. Public safety and efficiency in relocating debris piles should be considered; 2) Assess priorities for clearing routes involving critical structures or facilities.3) Purchase tub grinder for areas serviced by McAlester Landfill.

Resource: Appendix B.5.10 Debris Management

Hail

31. Provide covered shelters for City First Response/government vehicles to protect against hail damage.

Lead: City Manager

Time Schedule: 2010 - 2012

Estimated Cost: To be determined

Source of Funding: Local, HMGP, PDM

Work Product/Expected Outcome: Covered parking to provide protection against Hail Damage for emergency/critical vehicles (government, Police, Fire, ambulance, etc.), so that emergency and First Responder/City personnel can meet the needs of the community in times of emergency.

Severe Winter Storms, Tornadoes, High Winds

32. Provide routine trimming of trees to reduce power outages during storms.

Lead: City Manager/ Public Works Director

Time Schedule: On going

Estimated Cost: Undetermined

Source of Funding: Local/General budget, local Utility Providers.

Work Product/Expected Outcome: The City of McAlester will inspect feeder lines to the individual building Weatherheads, and provide routine trimming of overhanging trees to reduce power outages during Tornadoes, High Winds, and Severe Winter and Ice Storms.

Resource: Appendix B.2.11 Power Outages from Winter Storms

Floods

34. Inform floodplain residents of the availability of flood insurance to eligible National Flood Insurance Program communities.

Lead: City Manager/ Public Works Director

Time Schedule: On going

Estimated Cost: Undetermined

Source of Funding: Local/General budget

Work Product/Expected Outcome: Provides information on the ability to obtain insurance for flooding to minimize the costs associated with this disaster.

Resource: Appendix B.4.2 Insurance

Subsidence

35. Perform an engineering study of underground mine locations and implement recommendations for mitigating the hazard recommended by the study.

Lead: City Manager/ Public Works Director

Time Schedule: On going

Estimated Cost: Undetermined

Source of Funding: Local/General budget

Work Product/Expected Outcome: Maps for locating the areas that are highly susceptible to subsidence, and methods to mitigate the dangers of the hazard.

Dam Failures

36. Perform Dam failure study to determine possible inundation areas and map these findings.

Lead: City Manager/ Public Works Director

Time Schedule: On going

Estimated Cost: Undetermined

Source of Funding: Local/General budget

Work Product/Expected Outcome: Updated warning and evacuation plans for areas at risk by identifying key evacuation routes and shelter locations outside of dam inundation areas and identify by travel time, inundation areas downstream from the dam.

Expansive Soils

37. Implement/enforce an administrative procedure/ordinance to require permits for foundation repair.

Lead: City Manager/ Public Works Director

Time Schedule: On going

Table 6-2: Prioritized Mitigation Measures for McAlester

Rank	Hazard	Mitigation Category	Mitigation Measure
1	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events, Dam Failures, Transportation Events, Subsidence	Public Information and Education	Develop an all-hazard public information, education, and awareness strategy and program.
2	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events, Subsidence	Public Information and Education	Educate the public on the importance of a family disaster plan and supply kit
3	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events, Dam Failures, Transportation Events	Public Information and Education	Develop distribution centers in local libraries, government facilities, and other public buildings where information and safety guidance on natural and man-made hazards can be provided to citizens.
4	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events, Dam Failures, Transportation Events, Subsidence	Public Information and Education	Develop and distribute a Family Emergency Preparedness Guide to all families.
5	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Wildfires, Earthquakes	Public Information and Education	Train/Educate builders, developers, architects and engineers in techniques of disaster-resistant homebuilding, such as the Fortified Home standards developed by the Institute for Business & Home Safety (IBHS), the Blueprint for Safety guidelines developed by the Federal Alliance for Safe Homes (FLASH)
6	Expansive Soils	Preventive Measures	Educate builders on appropriate foundation types for soils with different degrees of shrink-swell potential. For example, using "post-tensioned slab-on-grade" or "drilled pier" vs. standard "slab-on-grade" or "wall-on-grade" foundations.
7	Tornadoes, High Winds, Earthquakes	Public Information and Education	Educate residents, building professionals and Safe Room vendors on the ICC/NSSA "Standard for the Design and Construction of Storm Shelters" and consider incorporating into current regulatory measures.

Rank	Hazard	Mitigation Category	Mitigation Measure
8	Expansive Soils	Preventive Measures	Establish an administrative procedure or change in City codes that require builders to check for expansive soils when applying for new residential construction permits, and to consider the use of foundations that mitigate expansive soil damages when in a moderate to high-risk area.
9	Lightning	Preventive Measures	Provide lightning warning systems for City of McAlester public outdoor sports areas, pools, golf courses, and parks.
10	Lightning	Preventive Measures	Provide lightning warning systems for McAlester Public Schools outdoor sports areas and parks.
11	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat	Emergency Services	Develop an Emergency Back-up Generator Hazard Mitigation Plan Annex to the McAlester Hazard Mitigation Plan for the community, assessing and prioritizing generator needs for critical facilities, both public and private. Assessment should include emergency generator needs, costs of installation for pads/transfer panels only, or for complete generator assembly installation.
12	Floods, Tornadoes, High Winds, Lightning, Severe Winter Storms, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events	Preventive Measures	Based on the results of the Emergency Back-up Generator Hazard Mitigation Plan Annex, provide wiring and transfer switches to accommodate emergency generators during disaster power outages for critical facilities including Emergency Operations Centers, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities
13	Tornadoes, High Winds, Lightning, Severe Winter Storms	Emergency Services	Obtain emergency generators for continuity of government/use during disaster power outages for critical facilities including Emergency Operations Centers, City Hall, Dispatch, Police, Fire, Community Centers used for emergency housing during disasters, critical facilities, lift stations, water treatment plants, and community medical facilities, as identified in the Emergency Back-up Generator Hazard Mitigation Plan Annex.
14	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes	Preventive Measures	Identify and encourage Private Critical Facilities (Financial Institutions, Long Term Care Facilities, Designated/Potential Community Emergency Shelters, etc.) to have generator pad, wiring/transfer switches and Emergency Back-Up Generators, or Reliable Contracts to provide Back-Up Generators
15	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes	Preventive Measures	Adopt an Ordinance requiring generator pad and wiring/transfer switches for Elder Care Facilities and Nursing Homes, to accommodate Emergency Back-Up Generators in the event of prolonged power outages.
16	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes	Preventive Measures	Identify and/or encourage key important private service facilities (gas stations, convenience stores, etc.) to have wiring/transfer switches and emergency back-up generators installed, or reliable contracts for the provision of back-up generators, in the event of disasters or power outages.
17	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes	Emergency Services	Develop Memorandums of Understanding (MOUs) with private sector gasoline service facilities to provide priority fuel to emergency/critical vehicles (government, Police, Fire, ambulance, etc.) in times of emergency or power outage

Rank	Hazard	Mitigation Category	Mitigation Measure
18	Tornadoes, High Winds, Earthquakes	Structural Projects	Provide employee shelters/safe-rooms at critical facilities, such as 911 Center, fire stations and police stations to protect first responders.
19	Tornadoes, High Winds, Earthquakes	Structural Projects	Install safe-rooms in schools.
20	Floods, Dam Failures	Property Protection	Continue Compliance with, and Participation in the National Flood Insurance Program (NFIP) and the Community Rating System (CRS)
21	Floods	Preventive Measures	Implement a Stormwater Utility Fee to pay for the Planning, Engineering, Operations and Maintenance costs of the Stormwater Drainage System
22	Floods	Preventive Measures	Prepare a comprehensive basin-wide Flood & Drainage Annex to the Hazard Mitigation Plan for all watersheds within the Community. The plan should identify all flooding problems within the community, and recommend the most cost-effective and politically acceptable solutions to the flooding problems.
23	Floods	Property Protection	Acquire and remove floodplain and repetitive loss properties where the community's Repetitive Loss Plan and Flood & Drainage Annex to the Hazard Mitigation Plan identify acquisition as the most cost-effective and desirable mitigation measure.
24	Tornadoes, High Winds, Hail, Earthquakes	Property Protection	When replaced, install break/shatter resistant glass in government offices, and critical facilities.
25	Tornadoes, High Winds, Hail, Earthquakes	Preventive Measures	When replaced, install break/shatter resistant glass in schools
26	Tornadoes, High Winds, Lightning, Severe Winter Storms, Extreme Heat, Earthquakes	Preventive Measures	Provide surge and lightning protection for computer-reliant critical facilities (e.g. City Hall, 911 Center, EOC, Police and Fire stations, water/wastewater treatment plant and public works buildings)
27	Floods, Tornadoes, High Winds, Lightning, Hail, Severe Winter Storms, Extreme Heat, Drought, Expansive Soils, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events, Dam Failures, Transportation Events	Public Information and Education	Develop an inventory and GIS database of special needs populations requiring special assistance during disasters.
28	Floods, Tornadoes, High Winds, Severe Winter Storms, Extreme Heat, Drought, Urban Fires, Wildfires, Earthquakes, Fixed Site Haz Mat Events, Dam Failures, Transportation Events	Emergency Services	Install a Mass Emergency Telephone Communication system for mass call-outs to targeted areas of the community for emergency notification and/or information
29	Tornadoes, High Winds, Lightning, Hail	Emergency Services	Evaluate, upgrade and maintain community-wide outdoor omni-directional voice/siren warning systems

Rank	Hazard	Mitigation Category	Mitigation Measure
30	Floods, Tornadoes, High Winds, Hail, Severe Winter Storms, Earthquakes	Preventive Measures	Develop / Review / Update the debris management plan.
31	Hail	Property Protection	Provide covered shelters for City First Response/government vehicles to protect against hail damage.
32	Tornadoes, High Winds, Severe Winter Storms	Preventive Measures	Provide routine trimming of trees to reduce power outages during storms.
33	Floods	Public Information and Educat: on	Inform floodplain residents of the availability of flood insurance to eligible National Flood Insurance Program communities
34	Subsidence	Preventive Measures	Verify and update maps of old underground mines

Chapter 7: Plan Maintenance and Adoption

44 CFR Requirements met:

Requirement §201.6(c)(4)(i): *[The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.*

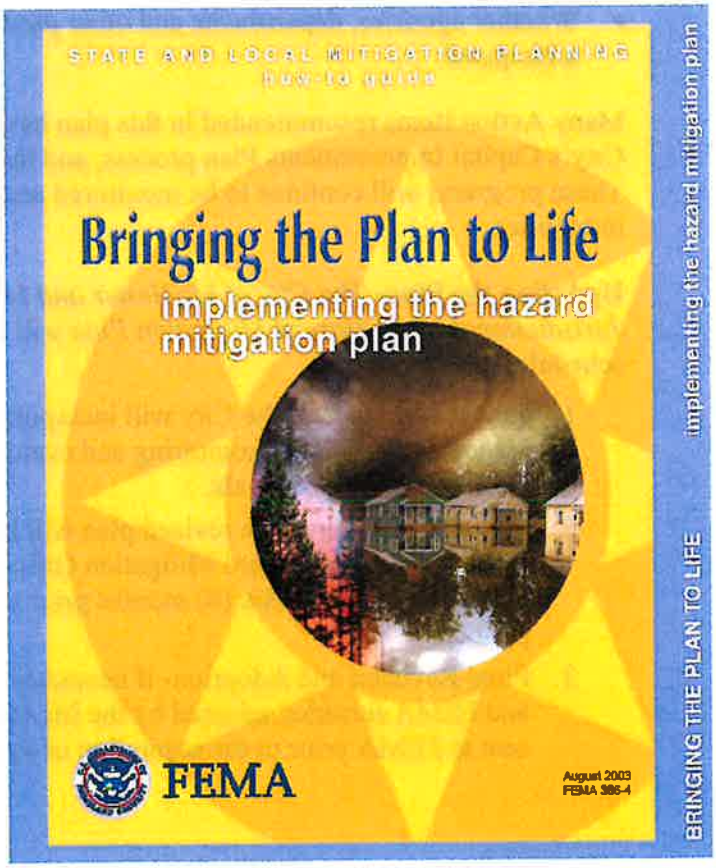
Requirement §201.6(c)(4)(ii): *[The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

Requirement §201.6(c)(4)(iii): *[The plan maintenance process **shall** include a] discussion on how the community will continue public participation in the plan maintenance process.*

Requirement §201.6(c)(5): *[The local hazard mitigation plan **shall** include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council).*

Requirement §201.6(c)(5): *For multi-jurisdictional plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.*

This chapter includes a discussion of the plan maintenance process and documentation of the adoption of the plan by the Bartlesville City Council and Bartlesville Public Schools.



7.1 Monitoring, Evaluating, and Updating the Plan

The City of McAlester and McAlester Public Schools will ensure that a regular review and update of the *Multi-Jurisdictional Multi-Hazard Mitigation Plan* occurs. The Hazard Mitigation Planning Committee (HMPC) will continue to meet on a semi-

annual basis, or as conditions warrant, to oversee and review updates and revisions to the plan. The McAlester City Engineer will continue to head the Staff Technical Advisory Committee, which will monitor and oversee the day-to-day implementation of the plan. The plan will be updated and resubmitted to the State and FEMA for approval prior to the 5-year approval period expiration, as per FEMA requirements.

Monitoring the Plan- Monitoring of the Plan, the Action Plan, and Mitigation Measures is the responsibility of the City Manager, City Engineer, School Superintendent, and Floodplain Administrator. Departments responsible for implementation of the Action Plan and the Mitigation Measures will update their Progress Reports on an annual basis, and report to the HMPC on progress and/or impediments to progress of the mitigation measures.

Evaluating the Plan- The *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan* will be continually evaluated by the Project Manager, and a report will be made to the HMPC twice each year. The evaluation will assess:

- Adequacy of adopted Goals and Objectives 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 Mitigation Measures occurred as expected;
- Whether agencies, departments and other partners participated as originally anticipated.

Many Action Items recommended in this plan have already been incorporated into the City's Capital Improvements Plan process, and the Public Schools planning process. These programs will continue to be monitored and updated on an annual basis, if not more often.

Updating the Plan- The *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan* will be updated according to the following schedule:

1. Revise and Update- the City will incorporate revisions to the plan document identified during the monitoring and evaluation period, as well as items identified in the previous Crosswalk.
2. Submit for Review- the revised plan will be submitted to ODEM and FEMA through the State Hazard Mitigation Officer for review and approval, and to FEMA no later than six (6) months prior to the end of the original performance period.
3. Final Revision and Adoption- if necessary, the plan will be revised per ODEM and FEMA remarks, adopted by the McAlester City Council, and the updated plan sent to FEMA prior to the expiration of the 5-year approval period.

7.2 Public Involvement

The City of McAlester and the McAlester Public Schools are committed to involving the public directly in updating and maintaining the *Multi-Jurisdiction Multi-Hazard Mitigation Plan.*

Copies of the Plan will be maintained at the public library, and the plan will be placed on the City of McAlester's Website.

A public meeting will be held prior to submission of the update of the *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan.* This meeting will be advertised to the general public, and will update residents on the progress that has been made in implementing the plan and related capital projects. The meeting will also be used to distribute literature and inform and educate residents as to actions they can take to mitigate natural hazards, save lives, and prevent property damage. Input from the public will be solicited as to how the mitigation process can be more effective.

7.3 Incorporating the Multi-Hazard Mitigation Plan

The City of McAlester's local planning mechanisms available for incorporating the recommendations and requirements of the Hazard Mitigation Measures are listed below. The *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan* will be approved by the McAlester School Board, adopted by the McAlester City Council as an amendment to the City's Comprehensive Plan and as a guide to City 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
- City of McAlester Building Code
- McAlester Emergency Operations Plan
- City of McAlester Water and Sewer Plan
- McAlester Public Schools planning process
- Various Flood & Drainage Annexes to the Hazard Mitigation Plan

The process to include the adopted Mitigation Measures into other local planning mechanisms includes the following:

1. Mitigation Measures will be assigned to the appropriate departments for planning and implementation.
2. The responsible departments will report to the HMPC on an annual basis as to the progress made on each measure, identifying successes and impediments to their implementation.

To be included on the following pages of this chapter are Resolutions of Adoption of the *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan*:

1. McAlester City Council
2. McAlester Board of Education

RESOLUTION NO. _____

A RESOLUTION ADOPTING THE *CITY OF MCALESTER AND MCALESTER PUBLIC SCHOOLS MULTI-JURISDICTIONAL MULTI-HAZARD MITIGATION PLAN*

WHEREAS, the City of McAlester and its environs are subject to danger and damage from tornadoes, high winds, lightning, wildfire and other natural hazards;

WHEREAS, several different agencies, organizations and business have programs that can address these hazards or their impact, but there is an overriding need for a comprehensive, coordinated plan to assess the problems faced by the City and measures that are and can be brought to bear on them;

WHEREAS, the City of McAlester participates in the National Flood Insurance Program and would benefit from the development and adoption of a comprehensive basin-wide Master Drainage Plan for all watersheds within the City;

WHEREAS, the City of McAlester has approximately 177 structures in the 100-year floodplain;

WHEREAS, the 2000 Stafford Act mandates that communities must have a hazard mitigation plan before they can apply for funds from the Hazard Mitigation Grant Program, and Pre-Disaster Mitigation Grant Program;

WHEREAS, the City of McAlester was awarded a Hazard Mitigation Grant Program planning grant in the amount of $40,000 to prepare a hazard mitigation plan for the City of McAlester and McAlester Public Schools;

WHEREAS, the McAlester City Council, after due and proper notice and hearing, has considered said multi-hazard mitigation plan and has determined that it is in the best interest of the citizens of the City of McAlester to approve such a plan.

NOW, THEREFORE, BE IT RESOLVED BY THE MAYOR AND CITY COUNCIL OF THE CITY OF MCALESTER, OKLAHOMA:

Section 1. That the *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan*, made a part of this resolution, together with any and all graphic representations referenced in this *Multi-Jurisdictional Multi-Hazard Mitigation Plan*, are hereby approved;

Section 2: That upon its adoption, this plan should be considered as an amendment to the *McAlester Comprehensive Plan* and City Ordinances;

Section 3: That upon its adoption of the Multi-Jurisdictional Multi-Hazard Mitigation Plan, all previous versions of the document shall be repealed; and

Section 4: That copies of the *Multi-Jurisdictional Multi-Hazard Mitigation Plan* will be maintained in the City Hall and Public Library.

PASSED BY THE CITY COUNCIL AND APPROVED BY THE MAYOR OF THE CITY OF MCALESTER, OKLAHOMA, THIS ___ DAY OF _____, 2010.

_____
Kevin Priddle, Mayor

Attest:

_____
City Clerk

RESOLUTION NO. _____

A RESOLUTION ADOPTING THE *CITY OF MCALESTER AND MCALESTER PUBLIC SCHOOLS MULTI-JURISDICTIONAL MULTI-HAZARD MITIGATION PLAN*

WHEREAS, the McAlester Public Schools are subject to danger and damage from tornadoes, high winds, lightning, wildfire and other natural hazards;

WHEREAS, several different agencies, organizations and business have programs that can address these hazards or their impact, but there is an overriding need for a comprehensive, coordinated plan to assess the problems faced by the City of McAlester and McAlester Public Schools and measures that are and can be brought to bear on them;

WHEREAS, the 2000 Stafford Act mandates that jurisdictions must have a hazard mitigation plan before they can apply for funds from the Hazard Mitigation Grant Program, and the Pre-Disaster Mitigation Grant Program;

WHEREAS, the City of McAlester was awarded a Hazard Mitigation Grant Program planning grant in the amount of $40,000 to prepare a hazard mitigation plan for the City and the Public Schools;

WHEREAS, the McAlester Board of Education, after due and proper notice and hearing, has considered said *Multi-Jurisdictional Multi-Hazard Mitigation Plan* and has determined that it is in the best interest of the McAlester Public Schools to approve such a plan.

NOW, THEREFORE, BE IT RESOLVED BY THE MCALESTER BOARD OF EDUCATION:

Section 1. That the *City of McAlester and McAlester Public Schools Multi-Jurisdictional Multi-Hazard Mitigation Plan*, made a part of this resolution, together with any and all graphic representations referenced in this *Multi-Jurisdictional Multi-Hazard Mitigation Plan*, are hereby approved;

Section 2: That copies of the *Multi-Jurisdictional Multi-Hazard Mitigation Plan* will be maintained in the Office of the Superintendent of McAlester Public Schools.

PASSED BY THE MCALESTER BOARD OF EDUCATION THIS ___ DAY OF _____, 2010.

_____	_____
President	Superintendent
McAlester Board of Education	McAlester Public Schools

Appendix A: Glossary of Terms

Anchoring: Special connections made to ensure that a building will not float off, blow off or be pushed off its foundation during a flood or storm.

Base Flood: Flood that has a 1 percent probability of being equaled or exceeded in any given year. Also known as the 100-year flood.

Base Flood Elevation (BFE): Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation is used as the standard for the National Flood Insurance Program.

Basement: Any floor level below grade.

Bedrock: The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Building: A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Community Rating System (CRS): A National Flood Insurance Program (NFIP) that provides incentives for NFIP communities to complete activities that reduce flood hazard risk. When the community completes specified activities, the insurance premiums of policyholders in these communities are reduced.

Computer-Aided Design And Drafting (CADD): A computerized system enabling quick and accurate electronic 2-D and 3-D drawings, topographic mapping, site plans, and profile/cross-section drawings.

Consequences: The damages, injuries, and loss of life, property, environment, and business that can be quantified by some unit of measure, often in economic or financial terms.

Contour: A line of equal ground elevation on a topographic (contour) map.

Critical Facility: Facilities that are critical to the health and welfare of the population and that are especially important during and following hazard events. Critical facilities include shelters, police and fire stations, schools, childcare centers, senior citizen centers, hospitals, disability centers, vehicle and equipment storage facilities, emergency operations centers, and city hall. The term also includes buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials facilities, vulnerable facilities, day care centers, nursing homes, and housing likely to contain occupants who are not very mobile. Other critical city infrastructure such as telephone exchanges and water treatment plants are referred to as lifelines. See Lifelines.

Dam Breach Inundation Area: The area flooded by a dam failure or programmed release.

Debris: The scattered remains of assets broken or destroyed in a hazard event. Debris caused by a wind or water hazard event can cause additional damage to other assets.

Development: Any man-made change to real estate.

Digitize: To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer applications.

Duration: How long a hazard event lasts.

Earthquake: A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.

Emergency: Any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which requires federal emergency assistance to supplement State and local efforts to save lives and protect property, public health and safety, or to avert or lessen the threat of a disaster. Defined in Title V of Public Law 93-288, Section 102(1).

Emergency Operations Center (EOC): A facility that houses communications equipment that is used to coordinate the response to a disaster or emergency.

Emergency Operations Plan (EOP): Sets forth actions to be taken by State or local governments for response to emergencies or major disasters.

Emergency Response Plan: A document that contains information on the actions that may be taken by a governmental jurisdiction to protect people and property before, during, and after a disaster.

Extent: The size of an area affected by a hazard or hazard event.

Fault: A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are differentially displaced parallel to the plane of fracture.

Federal Emergency Management Agency (FEMA): The independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery.

FIPS: Stands for Federal Information Processing Standards. Under the Information Technology Management Reform Act (Public Law 104-106), the Secretary of Commerce approves standards and guidelines that are developed by the National Institute of Standards and Technology (NIST)

for Federal computer systems. These standards and guidelines are issued by NIST as Federal Information Processing Standards (FIPS) for use government-wide. NIST develops FIPS when there are compelling Federal government requirements such as for security and interoperability and there are no acceptable industry standards or solutions.

Fire Potential Index (FPI): Developed by United States Geological Survey (USGS) and United States Forest Service (USFS) to assess and map fire hazard potential over broad areas. Based on such geographic information, national policy makers and on-the-ground fire managers established priorities for prevention activities in the defined area to reduce the risk of managed and wildfire ignition and spread. Prediction of fire hazard shortens the time between fire ignition and initial attack by enabling fire managers to pre-allocate and stage suppression forces to high fire risk areas.

Flash Flood: A flood event occurring with little or no warning where water levels rise at an extremely fast rate.

Flood: A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

Flood Depth: Height of the flood water surface above the ground surface.

Flood Elevation: Elevation of the water surface above an established datum, e.g. National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or Mean Sea Level.

Flood Hazard Area: The area shown to be inundated by a flood of a given magnitude on a map.

Flood Insurance Rate Map (FIRM): Map of a community, prepared by the Federal Emergency Management Agency, which shows both the special flood hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study (FIS): A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.

Flood Mitigation Assistance Program (FMA): A planning and project implementation grant program funded by the National Flood Insurance Program. Provides pre-disaster grants to State and local governments for both planning and implementation of mitigation strategies. Grant funds are made available from NFIP insurance premiums, and therefore are only available to communities participating in the NFIP.

Flood of Record: The highest known flood level for the area, as recorded in historical documents.

Floodplain: Any land area, including watercourse, susceptible to partial or complete inundation by water from any source.

Floodproofing: Protective measures added to or incorporated in a building to prevent or minimize flood damage. "Dry floodproofing" measures are designed to keep water from entering a building. "Wet floodproofing" measures minimize damage to a structure and its contents from water that is allowed into a building.

Floodway: The stream channel and that portion of the adjacent floodplain which must remain open to permit conveyance of the base flood. Floodwaters are generally the swiftest and deepest in the floodway. The floodway should remain clear of buildings and impediments to the flow of water.

Freeboard: A margin of safety added to a protection measure to account for waves, debris, miscalculations, lack of scientific data, floodplain fill, or upstream development.

Frequency: A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1 percent chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

Fujita Scale of Tornado Intensity: Rates tornadoes with numeric values from F0 to F5 based on tornado wind speed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while an F5 indicates severe damage sustained.

Functional Downtime: The average time (in days) during which a function (business or service) is unable to provide its services due to a hazard event.

Geographic Area Impacted: The physical area in which the effects of the hazard are experienced.

Geographic Information System (GIS): A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

Ground Motion: The vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions.

Hazard: A source of potential danger or adverse condition. An event or physical condition that has the potential to cause fatalities, injuries, property and infrastructure damage, agriculture loss, damage to the environment, interruption of business, or other types of harm or loss. Hazards, as defined in this study, will include naturally occurring events such as floods, dam failures, levee failures, tornadoes, high winds, hailstorms, lightning, winter storms, extreme heat, drought,

expansive soils, urban fires, wildfires that strike populated areas, and earthquakes. A natural event is a hazard when it has the potential to harm people or property. For purposes of this study, hazardous materials events are also included.

Hazard Event: A specific occurrence of a particular type of hazard.

Hazard Identification: The process of defining and describing a hazard, including its physical characteristics, magnitude and severity, probability and frequency, causative factors, and locations or areas affected.

Hazard Mitigation: Sustained actions taken to reduce or eliminate long-term risk to human life and property from natural and technological hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 404 of the Stafford Act; a FEMA disaster assistance grant program that funds mitigation projects in conformance with post-disaster mitigation plans required under Section 409 of the Stafford Act. The program is available only after a Presidential disaster declaration.

Hazard Mitigation Plan: The plan resulting from a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in society that includes the actions needed to minimize future vulnerability to hazards. Section 409 of the Stafford Act requires the identification and evaluation of mitigation opportunities, and that all repairs be made to applicable codes and standards, as condition for receiving Federal disaster assistance. Enacted to encourage identification and mitigation of hazards at all levels of government.

Hazard Profile: A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.

HAZUS (Hazards U.S.): A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA.

Hydrology: The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.

Infrastructure: The public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots, and waterways, canals, locks, and regional dams.

Insurance Service Office, Inc. (ISO): An insurance organization that administers several programs that rate a community's hazard mitigation activities.

Intensity: A measure of the effects of a hazard event at a particular place.

Landslide: Downward movement of a slope and materials under the force of gravity.

Lifelines: Systems necessary for human life and urban function, especially during emergencies. Transportation and utility systems, as well as emergency service facilities are considered the lifelines of a community. Transportation systems include interstate, US, and state highways, roadways, railways, waterways, ports, harbors, and airports. Utility systems consist of electric power, gas and liquid fuels, telecommunications, water, and wastewater. Emergency service facilities include Emergency Alert System communication facilities, hospitals, and the police and fire departments.

Liquefaction: The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Lowest Floor: Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure.

Magnitude: A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.

Mitigation: Sustained action taken to reduce or eliminate the long-term risk to human life and property from natural and technological hazards and their effects. Note that this emphasis on long-term risk distinguishes mitigation from actions geared primarily to emergency preparedness and short-term recovery (Burby, 1998).

National Flood Insurance Program (NFIP): A federal program created by Congress in 1968 that provides the availability of flood insurance to communities in exchange for the adoption and enforcement of a minimum floodplain management ordinance specified in 44 CFR §60.3. The ordinance regulates new and substantially damaged or improved development in identified flood hazard areas.

National Geodetic Vertical Datum of 1929 (NGVD): Datum established in 1929 and used in the NFIP as a basis for measuring flood, ground, and structural elevations, previously referred to as Sea Level Datum or Mean Sea Level. The Base Flood Elevations shown on most of the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency are referenced to NGVD.

National Weather Service (NWS): Prepares and issues flood, severe weather, and coastal storm warnings and can provide technical assistance to Federal and state entities in preparing weather and flood warning plans.

Oklahoma Department of Civil Emergency Management (ODCEM): The State department responsible for hazard mitigation, community preparedness, emergency response, and disaster recovery.

Oklahoma Water Resources Board (OWRB): The State agency responsible for administration of the National Flood Insurance Program, and the dam safety program.

Planimetric: Describes maps that indicate only man-made features like buildings.

Planning: The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.

Planning for Post-Disaster Reconstruction: The process of planning (preferably prior to an actual disaster) those steps the community will take to implement long-term reconstruction with one of the primary goals being to reduce or minimize its vulnerability to future disasters. These measures can include a wide variety of land-use planning tools, such as acquisition, design review, zoning, and subdivision review procedures. It can also involve coordination with other types of plans and agencies but is distinct from planning for emergency operations, such as restoration of utility services and basic infrastructure.

Preparedness: Activities to ensure that people are ready for a disaster and respond to it effectively. Preparedness requires figuring out what will be done if essential services break down, developing a plan for contingencies, and practicing the plan.

Probability: A statistical measure of the likelihood that a hazard event will occur.

Project Impact: A program that encourages business, government agencies and the public to work together to build disaster-resistant communities.

Reconstruction: The long-term process of rebuilding the community's destroyed or damaged buildings, public facilities, or other structures.

Recovery: The process of restoring normal public or utility services following a disaster, perhaps starting during but extending beyond the emergency period to that point when the vast majority of such services, including electricity, water, communications, and public transportation have resumed normal operations. Recovery activities necessary to rebuild after a disaster include rebuilding homes, businesses and public facilities, clearing debris, repairing roads and bridges, and restoring water, sewer and other essential services. Short-term recovery does not include the reconstruction of the built environment, although reconstruction may commence during this period.

Recurrence Interval: The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any given year.

Repetitive Loss Property: A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978. While Repetitive Loss Properties constitute only 2% of insured properties, they account for 40% of flood damage claims against the NFIP.

Replacement Value: The cost of rebuilding a structure. This is usually expressed in terms of cost per square foot, and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.

Retrofitting: Modifications to a building or other structure to reduce its susceptibility to damage by a hazard.

Richter Scale: A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.

Risk: The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: A process or method for evaluating risk associated with a specific hazard and defined in terms of probability and frequency of occurrence, magnitude and severity, exposure and consequences. Also defined as: "The process of measuring the potential loss of life, personal property, housing, public facilities, equipment, and infrastructure; lost jobs, business earnings, and lost revenues, as well as indirect losses caused by interruption of business and production; and the public cost of planning, preparedness, mitigation, response, and recovery. (Burby, 1998).

Riverine: Of or produced by a river.

Scale: A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.

Scarp: A steep slope.

Scour: Removal of soil or fill material by the flow of flood waters. The term is frequently used to describe storm-induced, localized conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.

Seismicity: Describes the likelihood of an area being subject to earthquakes.

Special Flood Hazard Area (SFHA): An area within a floodplain having a 1 percent or greater chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designations that include the letter A or V.

Special Needs: The FEMA National Response Framework (NRF) definition for "special needs" provides a function-based approach for planning and seeks to establish a flexible framework that addresses a broad set of common function-based needs irrespective of specific diagnosis, statuses, or labels (e.g., children, the elderly, transportation disadvantaged). In other words, this function-based definition reflects the capabilities of the individual, not the condition or label. Governments that choose to align their language to the NRF definition will improve inter-government communication during an incident. The definition of "special needs populations" as it appears in the NRF is as follows:

Populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to:

- Maintaining independence
- Communication
- Transportation
- Supervision
- Medical care

Individuals in need of additional response assistance may include those who have disabilities; who live in institutionalized settings; who are elderly; who are children; who are from diverse cultures; who have limited English proficiency; or who are non-English speaking; or who are transportation disadvantaged.

The definition focuses on the following function-based aspects:

- **Maintaining Independence** – Individuals requiring support to be independent in daily activities may lose this support during an emergency or a disaster. Such support may include consumable medical supplies (diapers, formula, bandages, ostomy supplies, etc.), durable medical equipment (wheelchairs, walkers, scooters, etc.), service animals, and/or attendants or caregivers. Supplying needed support to these individuals will enable them to maintain their pre- disaster level of independence.
- **Communication** – Individuals who have limitations that interfere with the receipt of and response to information will need that information provided in methods they can understand and use. They may not be able to hear verbal announcements, see directional signs, or understand how to get assistance due to hearing, vision, speech, cognitive, or intellectual limitations, and/or limited English proficiency.
- **Transportation** – Individuals who cannot drive or who do not have a vehicle may require transportation support for successful evacuation. This support may include accessible vehicles (e.g., lift-equipped or vehicles suitable for transporting individuals who use oxygen) or information about how and where to access mass transportation during an evacuation.
- **Supervision** – Before, during, and after an emergency individuals may lose the support of caregivers, family, or friends or may be unable to cope in a new environment (particularly if they have dementia, Alzheimer's or psychiatric conditions such as schizophrenia or intense anxiety). If separated from their caregivers, young children may

be unable to identify themselves; and when in danger, they may lack the cognitive ability to assess the situation and react appropriately.

- **Medical Care** – Individuals who are not self-sufficient or who do not have adequate support from caregivers, family, or friends may need assistance with: managing unstable, terminal or contagious conditions that require observation and ongoing treatment; managing intravenous therapy, tube feeding, and vital signs; receiving dialysis, oxygen, and suction administration; managing wounds; and operating power dependent equipment to sustain life. These individuals require support of trained medical professionals.

(**Source**: FEMA 301, "Interim Emergency Management Planning Guide for Special Needs Populations.")

Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-107 was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.

State Hazard Mitigation Team: Composed of key State agency representatives, the team evaluates hazards, identifies strategies, coordinates resources, and implements measures that will reduce the vulnerability of people and property to damage from hazards. The Oklahoma State Hazard Mitigation Team is convened by the Oklahoma Department of Civil Emergency Management (ODCEM), and includes the State departments of Agriculture, Climatological Survey, Commerce, Environmental Quality, Health, Human Services, Insurance, Transportation, Wildlife Conservation, Conservation Commission, Corporation Commission, Historical Society, Insurance Commission, Water Resources Board, Association of County Commissioners (AACCO), Oklahoma Municipal League (OML), Department of Housing and Urban Development (HUD), and the U.S. Army Corps of Engineers (USACE).

State Hazard Mitigation Officer (SHMO): The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.

Stormwater Management: Efforts to reduce the impact of stormwater or snowmelt runoff on flooding and water quality.

Stormwater Detention: The storing of stormwater runoff for release at a restricted rate after the storm subsides, or the flood crest passes.

Substantial Damage: Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage.

Surface Faulting: The differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.

Tectonic Plate: Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.

Topographic: Characterizes maps that show natural features and indicate the physical shape of the land using contour lines. These maps may also include man-made features.

Tornado: A violently rotating column of air extending from a thunderstorm to the ground.

Vulnerability: Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.

Vulnerability Assessment: The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.

Wildfire: An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.

Zone: A geographical area shown on a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

Appendix B: Mitigation Strategies

The following items illustrate many of the broad mitigation strategies that communities, tribes, counties, and other entities can implement to help protect lives, property and the environment in their jurisdictions. The following grid lists the six basic mitigation categories outlined by FEMA (introduced in Chapter 2), the strategies that fall in those categories, and the hazards those strategies may be effective for.

Many of the strategies, while listed in one category, may have elements that include other categories as well. For example, almost all strategies have a Public Information & Education component, where homeowners and business owners are educated about possible measures they may take on their own.

Table B–1: List of Mitigation Strategies

Category	Mitigation Strategy		Hazards Impacted
Public Information & Education	B.1.1	Public Information Program Strategy	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.1.2	Educational Programs	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.1.3	Outreach Projects	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.1.4	Technical Assistance	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.1.5	Map Information	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.1.6	Library	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation

Category	Mitigation Strategy		Hazards Impacted
	B.1.7	Websites	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.1.8	Real Estate Disclosure	Flood, Expansive Soils
	B.1.9	FireWise Communities	Wildfire
	B.1.10	Business Continuity Planning & Mitigation	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
Preventive Measures	B.2.1	Planning	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.2.2	Zoning	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.2.3	Floodplain Development Regulations	Flood, Dam Failure
	B.2.4	Stormwater Management	Flood, Dam Failure
	B.2.5	Building Codes	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Expansive Soil, Urban Fire, Wildfire, Earthquake
	B.2.6	IBHS Fortified Home Program	Flood, Tornado, High Wind, Lightning, Hail, Urban Fire, Wildfire, Earthquake
	B.2.7	Smoke Detectors	Urban Fire
	B.2.8	Hurricane Fasteners	Tornado, High Wind, Earthquake
	B.2.9	Mobile Home Tie-Downs	Tornado, High Wind
	B.2.10	Lightning Warning Systems	Lightning
	B.2.11	Power Outages from Winter Storms	Winter Storm, Lightning
	B.2.12	Standby Electric Generators	Tornado, High Wind, Lightning, Winter Storm
	B.2.13	Critical Facility Protection	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.2.14	Extreme Heat Protection	Extreme Heat
	B.2.15	Proper Storage & Disposal of Hazardous Materials	Hazardous Material
	B.2.16	Water Conservation	Drought
	B.2.17	Open Space Preservation	Flood, Drought, Dam Failure
Structural Projects	B.3.1	Safe Rooms	Tornado, High Wind
	B.3.2	School Safe Rooms	Tornado, High Wind
	B.3.3	Reservoirs and Detention	Flood

Category	Mitigation Strategy		Hazards Impacted
	B.3.4	Levees & Floodwalls	Flood, Dam Failure
	B.3.5	Channel Improvements	Flood, Dam Failure
	B.3.6	Crossings and Roadways	Flood, Dam Failure
	B.3.7	Drainage and Storm Sewer Improvements	Flood, Dam Failure
	B.3.8	Drainage System Maintenance	Flood, Dam Failure
Property Protection	B.4.1	The Community's Role	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.4.2	Insurance	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Dam Failure, Transportation
	B.4.3	Acquisition and Relocation	Flood
	B.4.4	Building Elevation	Flood, Dam Failure
	B.4.5	Barriers	Flood, Dam Failure
	B.4.6	Retrofitting	Flood, Tornado, High Wind, Lightning, Hail, Expansive Soil, Wildfire, Earthquake
	B.4.7	Impact Resistant Windows & Doors	Tornado, High Wind, Hail
	B.4.8	Impact Resistant Roofing	Tornado, High Wind, Hail
	B.4.9	Lightning Protection Systems	Lightning
	B.4.10	Surge and Spike Protection	Lightning
	B.4.11	Landscaping for Wildfire Prevention	Wildfire
Emergency Services	B.5.1	Threat Recognition	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.2	Warning	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.3	9-1-1 and 2-1-1	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Expansive Soils, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.4	Emergency Telephone Notification Systems (ETNS)	Flood, Winter Storm, Extreme Heat, Urban Fire, Wildfire, Hazardous Material
	B.5.5	Response	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Extreme Heat, Drought, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.6	Emergency Operations Plan (EOP)	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation

Category	Mitigation Strategy		Hazards Impacted
	B.5.7	Incident Command System (ICS)	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.8	Mutual Aid / Interagency Agreements	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.9	CERT (Community Emergency Response Teams)	Flood, Tornado, High Wind, Winter Storm, Extreme Heat, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.10	Debris Management	Flood, Tornado, High Wind, Winter Storm, Wildfire, Earthquake
	B.5.11	Critical Facilities Protection	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.12	Site Emergency Plans	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.13	Post-Disaster Recovery & Mitigation	Flood, Tornado, High Wind, Lightning, Hail, Winter Storm, Urban Fire, Wildfire, Earthquake, Hazardous Material, Dam Failure, Transportation
	B.5.14	StormReady Communities	Flood, Tornado, High Wind, Hail, Winter Storm
Natural Resource Protection	B.6.1	Wetland Protection	Flood, Wildfire
	B.6.2	Erosion and Sedimentation Control	Flood, Wildfire
	B.6.3	River Restoration	Flood, Wildfire, Hazardous Material
	B.6.4	Best Management Practices	Flood, Hazardous Material
	B.6.5	Dumping Regulations	Flood, Tornado, High Winds, Winter Storm, Hazardous Material

B.1 Public Information and Education

A successful public information and education program involves both the public and private sectors. Public information and education activities advise and educate residents, property owners, renters, businesses, and local officials about hazards and ways to protect people and property from them. Public information activities are among the least expensive mitigation measures, and at the same time are often the most effective thing a community can do to save lives and property. All mitigation activities – preventive, structural, property protection, emergency services, and natural resource protection – begin with public information and education.

B.1.1 Public Information Program Strategy

Getting Your Message Out

Professional advertising agencies may be willing to help get the message out regarding disaster preparedness and mitigation at little or no cost. They have a vested interest in their community and want to keep it safe. The same holds true for the media. The local newspaper, radio or television will contribute to keeping a safe and prepared community. Invite them to, and let them participate in special events, meetings, practice exercises, etc.

Education alliance partners, such as restaurants, convenience stores or the library, can put preparedness tips on tray liners or sacks, distribute brochures or allow you to erect a display with disaster information of local interest.

Many other options are available such as including brochures with utility bills, presentations at local gatherings, billboards, direct mailing and websites. See an example of a sample Flood Safety flyer at the end of this section, Figure B-1.

Summer camps, and other educational programs for children, can teach a new generation about nature, natural hazards, and preservation.

General

Numerous publications on tornadoes, thunderstorms, lightning, winter storms and flooding are available through NOAA. Up to 300 copies of most publications can be ordered from your local National Weather Service, NOAA Outreach Unit or American Red Cross. Many of the brochures can be downloaded from www.nws.noaa.gov/om/brochures.shtml.

For a nominal fee the American Red Cross offers videos on general preparedness, winter storms, chemical emergencies, hurricanes and earthquakes.

The National Weather Service issues watches and warnings for tornadoes, severe thunderstorms, floods, winter storms and extreme heat that may include "Call to Action" statements. The messages appear on the NWS telephone line, the local weather service office website and on television stations carrying Emergency Alert System messages.

Communities can encourage residents to prepare themselves by stocking up with necessary items and planning for how family members should respond if any of a number of possible emergency or disaster events strike.

Hazard Brochures

Area agencies or the American Red Cross have available the book *Repairing Your Flooded Home* and fliers *Are You Ready for a Flood?* and *Avoiding Flood Damage.* For a summary of what to do after a tornado see www.redcross.org/services/disaster/0,1082,0_502_,00.html. The brochure *Taking Shelter From the Storm: Building a Safe Room for your Home or Small Business* is available from FEMA. A copy of the brochure can be requested from the FEMA website www.fema.gov/library/viewRecord.do?id=1536. *Are You Ready for a Tornado?* is available from the American Red Cross, FEMA and the National Oceanic and Atmospheric Administration. Area agencies or the American Red Cross have available the fliers *Are You Ready For a Heat Wave? Are You Ready For a Winter Storm?* and *Are You Ready For a Thunderstorm?*

After reviewing possible and locally implemented public information activities covered in the previous sections, a community may develop a strategy based on the Community Rating System format, including the following components:

a. The local hazards, discussed in Chapter 4 of this plan

b. The safety and property protection measures appropriate for the hazards, discussed in Chapter 5 and this Appendix.

c. Hazard-related public information activities currently being implemented in the community or Tribe, including those by non-government agencies (discussed in Chapter 2)

d. Goals and Objectives for the community's public information program (covered in Chapter 5)

e. Outreach projects that will reach the goals (see Chapter 6, Action Items and Table 6-2.)

f. A process for monitoring and evaluating the projects (see Chapter 7)

B.1.2 Educational Programs

A community's most important natural resource is its children. They will inherit the resources, infrastructure and development built by earlier generations at great cost and effort. They will also face the same natural forces that bring floods, tornadoes, storms and other hazards.

Environmental education programs can teach children about natural hazards, the forces that cause them, and the importance of protecting people, property and nature, such as watersheds and floodplains. Educational programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps. An activity can be complex enough as to require course curriculum development, or as simple as an explanatory sign near a river.

Educational programs designed for children often reach adults as well. Parents often learn innovative concepts or new ideas from their children. If a child comes home from school with an assignment in natural hazard safety, the parents will normally become interested in finding out about it as well.

There are many programs that provide information and curriculum materials on nature and natural hazards. On FEMA website www.fema.gov/kids/ children can learn about having a family disaster plan, what they might feel in and following a disaster, what the different disasters are, what to do during a disaster, take quizzes and play games. There is also information on how to get a free video, brochures and other fun stuff.

Another site, for students and educators on water resources, is the USGS "Water Science for Schools" http://ga.usgs.gov/edu/. The American Red Cross has a 24-page *Disaster Preparedness Coloring Book* for kids age 3-10. The coloring book is available online and can be printed from www.redcross.org/pubs/dspubs/genprep.html.

Youth programs and activities often include posters, coloring books, games, and references. Hands-on models that allow students to see the effects of different land use practices are also available through local natural resources conservation districts.

B.1.3 Outreach Projects

Mapping and library activities are of little use if no one knows they exist. An outreach project can remedy this. Sending notices to property owners can help introduce the idea of property protection and identify sources of assistance.

Outreach projects are the first step in the process of orienting property owners to property protection and assisting them in designing and implementing a project. They are designed to encourage people to seek out more information in order to take steps to protect themselves and their properties.

The most effective types of outreach projects are mailed or otherwise distributed to flood-prone property owners or to everyone in the community. Other approaches may include the following:

- articles and special sections in newspapers;
- radio and TV news releases and interview shows;
- hazard protection video for cable TV programs or to loan to organizations;
- presentations at meetings of neighborhood, civic or business/professional groups;
- displays in public buildings or shopping malls;

- open houses about floodproofing.

Research has proven that outreach projects work. However, awareness of the hazard is not enough. People need to be told what they can do about the hazard, so projects should include information on safety, health, and property protection measures. Research has also shown that a properly run local information program is more effective than national advertising or publicity campaigns.

B.1.4 Technical Assistance

While general information helps, most property owners do not feel ready to take major steps, like retrofitting their buildings, without help or guidance. Check with your local community government, Tribal resource or Chamber of Commerce to see what expert guidance, such as a Home Builders Association or Remodelers Council, may be available in your area. Experienced construction specialists can provide advice, not necessarily to design a protection measure, but to steer the owner onto the right track.

Local building, public works, or engineering staff members may be available to visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, an important resource for owners who are unsure of the project or the contractor.

Other new construction or retrofitting guidance and resources, such as the National Storm Shelter Association or the Institute for Business and Home Safety's *Fortified...for Safer Living* program, are available on the websites listed in Table B-2.

B.1.5 Map Information

Many benefits stem from providing map information to inquirers. Residents and businesses that are aware of the potential hazards can take steps to avoid problems and reduce their exposure to flooding, dam failure or releases, expansive soils, hazardous materials events, and other hazards that have a geographical distribution. Real estate agents and house hunters can find out if a property is flood-prone and whether flood insurance may be required.

Maps provide a wealth of information about past and potential hazards. Geographic Information Systems, sometimes called smart maps, provide efficiency and add to capabilities of many government services. Assessors, public works, parks and recreation, and 911 services are all typical departments capable of applying GIS applications to improve their services. GIS allows trained users to complete comprehensive queries, extract statistical information, and completely manage all relevant spatial information and the associated attribute information that pertain to those departments.

Flood maps

Several legal requirements are tied to FEMA's Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study Maps. These include building regulations and the mandatory purchase of flood insurance. FEMA provides floodplain and FIRM information as a mitigation service. Local government can help residents submit requests for map amendments and revisions when these are needed to show that a building is outside the mapped floodplain.

Although FEMA maps are accurate, users and inquirers must remember that maps are not perfect. They display only the larger flood-prone areas that have been studied. In some areas, watershed developments make even recent maps outdated. Those inquiring about flood maps must be reminded that being outside the mapped floodplain is no guarantee that a property will never flood. In fact, many properties that flood are not located in a designated floodplain.

By taking the initiative locally to accurately map problem areas with information not already on FEMA maps, a community can warn residents about potential risks that may not have been anticipated. Upgrading maps provides a truer measure of risks to a community.

Other Hazard Data

Other data that can be shown on maps include those hazards that are distributed geographically. These include:

- dam breach inundation areas;
- levee failure inundation areas;
- expansive soils;
- wildfire risk zones;
- earthquake risk zones;
- hazardous materials sites;
- wetlands.

General location maps for many of these natural and man-made hazards have been developed by U. S. Army Corps of Engineers, Association of South Central Governments (ASCOG), Oklahoma Geological Survey, and Flanagan & Associates, LLC, several of which are included in this Multi-Hazard Disaster Mitigation Plan study.

Flood zone determinations are usually available, possibly free of charge, to any resident through a local Floodplain Administrator or other local government office. If the determination is for a building permit, local ordinances must be followed.

B.1.6 Library

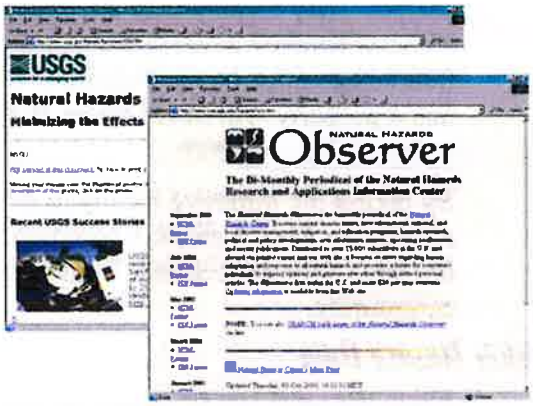
The local Public Library is a place for residents to seek information on hazards, hazard protection, and protecting natural resources. Historically, libraries have been the first place people turn to when they want to research a topic. Interested property owners can read or check out handbooks or other publications that cover their situation. The libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government.

The local public library System may maintain flood related documents, available to library patrons, required under the NFIP and CRS.

B.1.7 Websites

Today, Websites are becoming more popular as research tools. They provide quick access to a wealth of public and private sites and sources of information. Through links to other Websites, there is almost no limit to the amount of up to date information that can be accessed by the user.

Most communities, counties or Tribes have a local website where safety information can be made available to local residents. FEMA's Mapping Website is at http://msc.fema.gov. Additional websites related to specific hazards are listed in the following table.



Websites have become one of the more popular research tools

Table B–2: Disaster Safety and Mitigation Websites

Agency	Web Address
General	
American Red Cross	www.redcross.org/services/prepare/0,1082,0_239_,00.html
Federal Alliance for Safe Homes (FLASH)	www.flash.org
Federal Emergency Management Agency	www.fema.gov
Oklahoma Dept. of Emergency Management	www.odcem.state.ok.us
Institute for Business and Home Safety (IBHS)	www.ibhs.org/
National Clearinghouse for Educational Facilities	www.edfacilities.org
USGS - Hazards Page	www.usgs.gov/themes/hazard.html
Floods	
CDC – Floods	http://emergency.cdc.gov/disasters/floods/
FLASH – Floods	www.flash.org/activity.cfm?currentPeril=2
Oklahoma Water Resources Board	www.owrb.state.ok.us/
Oklahoma Floodplain Managers Association	www.okflood.org/
U.S. Army Corps of Engineers	www.usace.army.mil/
National Flood Insurance Program	www.fema.gov/nfip/whonfip.shtm
Stormwater Manager's Resource Center	www.stormwatercenter.net/
USGS – Floods	www.usgs.gov/hazards/
High Winds / Tornadoes	
CDC – Tornadoes	http://emergency.cdc.gov/disasters/tornadoes/
FLASH – Tornadoes	www.flash.org/activity.cfm?currentPeril=3
National Climatic Data Center	www.ncdc.noaa.gov/oa/ncdc.html
The Tornado Project Online	www.tornadoproject.com/
Lightning	
FLASH – Lightning	www.flash.org/activity.cfm?currentPeril=4
National Lightning Safety Institute	www.lightningsafety.com/nlsi_lls.html
Hailstorms	
FLASH – Hail	www.flash.org/activity.cfm?currentPeril=5
Winter Storms	

Agency	Web Address
American Red Cross – Power Outage	www.redcross.org/services/prepare/0,1082
American Red Cross – Winter Storms	www.redcross.org/services/prepare/0,1082,0_252_,00.html
CDC – Winter Weather	http://emergency.cdc.gov/disasters/winter/
FLASH – Power Outages	www.flash.org/activity.cfm?currentPeril=13
FLASH – Winter Storms	www.flash.org/activity.cfm?currentPeril=15
Extreme Heat	
American Red Cross – Heatwaves	www.redcross.org/services/prepare/0,1082,0_243_,00.html
Centers for Disease Control & Prevention (CDC)	http://emergency.cdc.gov/disasters/extremeheat/
National Weather Service – Heat Index	www.hpc.ncep.noaa.gov/heat_index.shtml
Drought	
American Red Cross – Drought	www.redcross.org/services/prepare/0,1082,0_95_,00.html
OWRB - Drought Monitoring Page	www.owrb.state.ok.us/supply/drought/drought_index.php
Expansive Soils	
US Department of Agriculture	www.usda.gov/
Natural Resource Conservation Service	www.nrcs.usda.gov/
Urban Fires	
Oklahoma State Fire Marshal's Office	www.oklaosf.state.ok.us/~firemar/
National Fire protection Association	www.nfpa.org
Wildfires	
CDC – Wildfires	http://www.bt.cdc.gov/disasters/wildfires/
FireWise Communities	www.firewise.org
FLASH – Wildfire	www.flash.org/activity.cfm?currentPeril=8
USGS Wildfires	www.usgs.gov/themes/wildfire.html
Earthquakes	
CDC – Earthquakes	http://emergency.cdc.gov/disasters/earthquakes/
FLASH – Earthquake	www.flash.org/activity.cfm?currentPeril=7
U.S. Geological Survey	www.usgs.gov/hazards/earthquakes/
Oklahoma Geological Survey	www.okgeosurvey1.gov/home.html
National Geophysical Data Center	www.ngdc.noaa.gov/
Hazardous Materials Events	
National Response Center	www.nrc.uscg.mil
National Transportation Safety Board	www.ntsb.gov/
Oklahoma Department of Environmental Quality	www.deq.state.ok.us/
Environmental Protection Agency	www.epa.gov
Dam Failures	
Oklahoma Water Resources Board	www.owrb.state.ok.us/
US Army Corps of Engineers	www.usace.army.mil/
Grand River Dam Authority	www.grda.com/

B.1.8 Real Estate Disclosure

After a flood or other natural disaster, people often say they would have taken steps to protect themselves if they had known their property was exposed to a hazard.

Flood insurance is required for buildings located within the base floodplain if the mortgage or loan is federally insured. However, because this requirement has to be met only ten days before closing, applicants are often already committed to purchasing a property when they first learn of the flood hazard.

Flooding and other hazards are sometimes not disclosed until it is too late. Hazard maps can help homebuyers avoid surprises like this.

The "Residential Property Condition Disclosure Act" requires sellers to provide potential buyers with a completed, signed and dated "Residential Property Condition Disclosure Statement". Included in the statement are disclosures regarding flooding and flood insurance. For a copy of the "Residential Property Condition Disclosure Statement" see www.orec.state.ok.us/pdf/disclose3.pdf.

B.1.9 Firewise Communities

While incorporating components from several of the different mitigation strategies, The Firewise program primarily depends on homeowners taking actions to protect their own property. Therefore Public Education and Information is a key factor to its success. While it is not possible, or in many cases even desirable, to prevent wildfires, it is certainly possible, by interrupting the natural flow of the fire, to assure that wildfires will not produce catastrophic home or crop losses. In the words of Judith Cook, Project Manager for Firewise Communities/USA, "We can modify our home ignition zones. We're basically saying to the fire, 'there's nothing for you here!'"

Firewise Community USA is a project of the National Wildfire Coordinating Group. It recognizes communities that have gone through a process to reduce the dangers of wildfires along what is referred to as the Wildland-Urban Interface (WUI). Additional information on the Firewise Community program can be found at www.firewise.org/usa.

In order to become a Firewise Community, a community will:

1. Contact a Firewise Specialist. In Oklahoma, the Firewise Specialist may be reached through the Oklahoma Department of Agriculture, Forestry Services, at (405) 521-3864. The Specialist will coordinate with local fire officials to schedule a site visit and assess the community.

2. The community will create a Firewise Board that includes homeowners, fire professionals, and other stakeholders.
3. The Firewise Specialist will schedule a meeting with the Board to present the assessment report for review and acceptance.
4. The Board will use the report to create agreed-upon, area-specific solutions to the fire issues, which the Specialist will review and, if acceptable, will work with the community to seek project implementation funds, if necessary.

A home in the WUI surrounded by a "defensible" zone that helped protect it from damage during a wildfire outbreak.

5. Local solutions will be implemented following a schedule designed by the local Board and the Specialist, A permanent Firewise task force or committee is created that will maintain the program into the future.
6. A completed plan and registration form will be submitted to Firewise Communities/USA for formal recognition of the Community.
7. An important consideration to remember is that if a community or Tribe covers a larger jurisdiction, it may be appropriate to identify smaller areas, such as a homeowner's addition, that can be developed independently of the community at large. The smaller project can then serve as a model program for other homeowner's associations or planning groups to develop programs in their at-risk area.

B.1.10 Business Continuity Planning and Mitigation

While Business Continuity Planning (BCP) can include portions from many of the categories listed in this chapter, an integrated program for small and medium businesses and non-profits is a frequently neglected component in a community's mitigation strategy. It has been demonstrated repeatedly that many businesses and non-profits that close their doors following a disaster either fail to re-open, or struggle to remain open following the event. This is especially true of smaller businesses that may rely on a limited number of locations and a

Insurance is a start, but won't cover the cost of lost sales, lost jobs and lost customers if a business is affected.

narrow customer base, or may not have the economic reserves to recover from financial losses. The lack of ability to recover may be for several reasons:

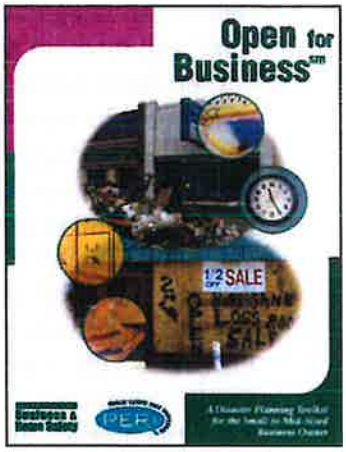
- absenteeism from employees who are affected or who have affected family members;
- psychological trauma from losing co-workers;
- loss of an irreplaceable executive or manager;
- economic stress on the business from having to make repairs and replenish stock over and above what may be covered by insurance;
- loss of revenue from having the doors closed for even a short period of time;
- loss of the customer base, either from people who are forced to evacuate the area or who may not have immediate disposable income for the company's products;
- loss of a critical customer or the vendor of a critical inventory item ("upstream" and "downstream" issues);
- loss of critical data, either paper or electronic records;
- an interruption in community or Tribal infrastructure (utilities, road access, media losses, etc.).

In addition, the loss of a business, even for a short period of time, may adversely affect the community or Tribe in many ways, some of which may include:

- loss of tax revenue for community services;
- loss of jobs for community residents;
- loss of access to the company's products (especially significant if the company supplies an essential service or product, such as construction equipment, medications, transportation, or groceries);

Effective Business Continuity Planning (BCP) may include such activities as:

- making regular back-ups of critical data and keeping it in an off-site location;
- maintaining accurate contact information (phone, e-mail, pager, etc.) on critical employees;
- identifying potential off-site locations that can be used in case the primary location of the company is damaged or inaccessible;
- reviewing all activities of a company and identifying which activities are critical and must resume right away, which are less critical and may not need to resume for a short period of time, and which activities can be put on hold for a longer period of time;
- developing "canned" PR pieces that can be quickly disseminated in the event of an incident at the company;
- having an honest conversation with insurers to determine that policies are sufficiently inclusive and appropriate for the business;
- communicating with suppliers and critical customers on



what their emergency response and business resumption plans include.

Business continuity planning can be facilitated by the community in a number of ways, primarily in the area of Public Information.

- The Chamber of Commerce may sponsor programs such as the Institute for Business & Home Safety's (IBHS) *Open For Business* presentation. For more information, see www.ibhs.org/business_protection.
- The American Red Cross has also teamed with the Federal Emergency Management Agency to produce the *Emergency Management Guide for Business and Industry.* More information is available at www.redcross.org/services/disaster/0,1082,0_606_,00.html.

Several professional groups such as the Association of Contingency Planners (www.acp-international.com/okla/) or ARMA, a professional organization of Records & Information Management professionals (www.arma.org) may be available in your area to assist with developing disaster preparedness and mitigation plans or exploring ways to safeguard critical records and information.

In addition, if a community, Tribe or other entity (such as a University) is promoting Community Emergency Response Teams (CERT), business CERTs can be developed to respond to a disaster, not only within a neighborhood, but also within a business establishment. CERTs are trained in disaster organization, immediate disaster evaluation, immediate disaster first aid, light search and rescue, and light fire suppression. For more information on CERT, see www.citizencorps.gov/cert.

B.1.11 Conclusions

1. There are many ways public information programs can be used so people and businesses will be more aware of hazards they face and how they can protect themselves.
2. Most public information activities can be used to advise people about all hazards, not just floods.
3. Other public information activities require coordination with other organizations, such as schools and real estate agents.
4. There are several area organizations that can provide support for public information and educational programs.
5. Developing effective strategies for small businesses and non-profits is as critical as for other elements of the communities.

B.1.12 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

Figure B–1: A Sample Public Service Notice for Flooding

Flood Safety

- Do not walk through flowing water. Drowning is the number one cause of flood deaths. Currents can be deceptive; six inches of moving water can knock you off your feet. Use a pole or stick to ensure that the ground is still there before you go through an area where the water is not flowing.
- Do not drive through a flooded area. More people drown in their cars than anywhere else. Don't drive around road barriers; the road or bridge may be washed out.
- Stay away from power lines and electrical wires. The number two flood killer after drowning is electrocution. Electrical current can travel through water. Immediately report downed power lines to your local fire department.
- Look out for animals that have been flooded out of their homes and who may seek shelter in yours. Use a pole or stick to poke and turn things over and scare away small animals.
- Look before you step. After a flood, the ground and floors are covered with debris including broken bottles and nails. Floors and stairs that have been covered with mud can be very slippery.
- Be alert for gas leaks. Use a flashlight to inspect for damage. Don't smoke or use candles, lanterns, or an open flame unless you know the gas has been turned off and the area has been ventilated.
- Carbon monoxide exhaust kills. Use a generator or other gasoline-powered machine outdoors. The same goes for camping stoves. Charcoal fumes are especially deadly -- cook with charcoal outdoors.
- Clean everything that got wet. Floodwaters have picked up sewage and chemicals from roads, farms, factories, and storage buildings. Spoiled food, flooded cosmetics, and medicine can be health hazards. When in doubt, throw them out.
- Take good care of yourself. Recovering from a flood is a big job. It is tough on both the body and the spirit and the effects a disaster has on you and your family may last a long time.

B.2 Preventive Measures

Preventive activities are designed to keep matters from occurring or getting worse. Their objective is to ensure that future development does not increase damages or loss of life, and that new or remodeled construction is protected from those hazards. Preventive measures are often administered by building, zoning, planning, and code enforcement offices. They typically include planning, zoning, open space preservation, building codes, drainage criteria, a flood and drainage annex, and floodplain development regulations, and stormwater management. In addition, there are a number of other ways to make homes and commercial structures stronger and less vulnerable to the effects of disasters.

The first three measures (planning, zoning, and open space preservation) work to keep damage-prone development *out* of hazardous or sensitive areas.

The next two measures (building codes and floodplain development regulations) impose standards on what is allowed to be built *in* the floodplain. These protect buildings, roads, and other facilities from flood damage and prevent the new development from making any existing flood problem worse. Building codes are also critical to mitigating the impact of non-flood hazards on new buildings.

Stormwater management addresses the runoff of stormwater from new developments onto other properties and into floodplains.

The mitigation planning process involves meetings with civic groups and local residents, as well as with decision-making councils and commissions

B.2.1 Planning

While plans generally have limited authority, they reflect what the community would like to see happen in the future. Plans guide other local measures such as capital improvements and the development of ordinances. Planning can include, but is not limited to:

- Capital Improvement Plans — Infrastructure planning decisions can affect flood hazard mitigation. For example, decisions to extend roads or utilities to an area may increase exposure. Communities may consider structural flood protections such as levees or floodwalls.
- Flood & Drainage Annex to the Hazard Mitigation Plan — A flood & drainage annex to the hazard mitigation plan (FDAHMP) addresses the current and future drainage needs of a given community. The boundary of the plan usually follows regional watershed limits. The proposed facilities may include channels, storm drains, levees, basins, dams, wetlands or any other conveyance capable of economically relieving flooding

problems within the plan area. The plan includes an estimate of facility capacity, sizes and costs.

FDAHMP's are prepared for a variety of purposes. First, the plans provide a guide for the orderly development of the community. Second, they provide an estimate of costs to resolve flooding issues within a community. Community or Tribal officials will use FDAHMP's to determine Capital expenditures for each budget year. Finally, the plans can be used to establish Area Drainage Plan fees for a given community, which prevent existing taxpayers from having to shoulder the burden of land development costs.

- Emergency Back-up Generator Hazard Mitigation Plan Annex

During power outages, public and private critical facilities are frequently unable to perform functions necessary for effective response and recovery. Social Service agencies cannot serve their clients, police/fire/EMS cannot refuel or replenish supplies, communications systems fail, financial and economic systems break down, and childcare and long term care facilities cannot care for their residents. Emergency management is not able to supply generators to all critical facilities in a timely manner.

With that in mind, just as a community needs to develop a plan before implementing floodplain improvements, a community-wide Emergency Back-up Generator Hazard Mitigation Plan Annex (EBGHMP) needs to be developed before spending time and money purchasing expensive equipment. This will ensure that the community has effectively determined needs and priorities and has a clear vision of what steps produce the most effective generator use for dollars spent.

A comprehensive community EBGHMP might include the following:

1. Inventory all critical facilities
2. Determine critical functions and the timeline
3. Determine generator size and whether a permanent vs. "generator-ready" installation is appropriate.
4. Determine the appropriate type of fuel for each location.
5. Develop a budget and operational timeline.
6. Provide for continual maintenance and ongoing testing.

- Zoning Ordinance Adoption or Amendments

Examples of zoning methods that affect flood hazard mitigation include:

1. adopting ordinances that limit development in the floodplain;
2. limiting the density of developments in the floodplain;
3. requiring floodplains be kept as open space.

- **Subdivision Ordinances or Amendments**

  Subdivision design standards can require elevation data collection during the platting process. Lots may be required to have buildable space above the base flood elevation.

- **Building Code Adoption or Amendments**

  Requirements for building design standards and enforcement include that:

  1. a residential structure be elevated;
  2. a non-residential structure be elevated or floodproofed.

- **Conservation Easements**

  Conservation easements may be used to protect environmentally significant portions of parcels from development. They do not restrict all use of the land. Rather, they direct development to areas of land not environmentally significant.

- **Transfer of Development Rights**

  In return for keeping floodplain areas in open space, a community may agree to allow a developer to increase densities on another parcel that is not at risk. This allows a developer to recoup losses from non-use of a floodplain site with gains from development of a non-floodplain site.

- **Purchase of Easement / Development Rights**

  Compensating an owner for partial rights, such as easement or development rights, can prevent a property from being developed contrary to a community's plan to maintain open space. This may apply to undeveloped land generally or to farmland in particular.

- **Stormwater Management Ordinances or Amendments**

  Stormwater ordinances may regulate development in upland areas in order to reduce stormwater run-off. Examples of erosion control techniques that may be employed within a watershed include proper bank stabilization with sloping or grading techniques, planting vegetation on slopes, terracing hillsides, or installing riprap boulders or geotextile fabric.

- **Multi-Jurisdiction Cooperation Within Watershed**

  Forming a regional watershed council helps bring together resources for comprehensive analysis, planning, decision-making, and cooperation.

- **Comprehensive Watershed Tax**

  A tax can be used as a mitigation action in several ways:

  1. Tax funds may be used to finance maintenance of drainage systems or to construct reservoirs.
  2. Tax assessments may discourage builders from constructing in a given area.
  3. Taxes may be used to support a regulatory system.

- **Post-Disaster Recovery Ordinance**

  A post-disaster recovery ordinance regulates repair activity, generally depending on property location. It prepares a community to respond to a disaster event in an orderly fashion by requiring homeowners to:

  1. obtain permits for repairs;
  2. refrain from making repairs;
  3. make repairs using standard methods.

  While many communities will attempt to build back rapidly just

as they were before, it is far preferable to build back stronger and more disaster resistant.

B.2.2 Zoning

A community's zoning ordinances should regulate development by dividing the community into zones or districts and setting development criteria for each zone or district. Zoning ordinances are considered the primary tool to implement a comprehensive plan's guidelines for how land should be developed.

B.2.3 Floodplain Development Regulations

Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for subdivision regulations and building codes. These are usually spelled out in a separate ordinance.

Experience shows that the National Flood Insurance Program's minimum standard is insufficient for developing urban communities. A community's regulations may exceed the NFIP's minimum national standards in several significant ways.

The Community Rating System (CRS) is a companion program to the NFIP. It rewards a community for taking actions over and above minimum NFIP requirements with the goal of further reducing flood damages in the jurisdiction. The more actions a community or Tribe takes, the lower the premiums for flood insurance within that community.

Subdivision regulations govern how land will be subdivided into individual lots, and set the construction and location standards for the infrastructure the developer builds to serve those lots, including roads, sidewalks, utility lines, storm sewers, and drainageways. They provide an additional vehicle for floodplain development rules. For example, some communities require that every subdivision in a floodplain provide a building site above the flood level for every lot and/or require streets to be at or no more than one foot below the base flood elevation.

Floodplains are only part of flood-management considerations. Water gathers and drains throughout entire watersheds, from uplands to lowlands. Each watershed is an interactive element of the whole. A change at one place can cause changes elsewhere, whether planned or inadvertent. The development of a comprehensive, basin-wide Flood and Drainage Annex to the Mitigation Plan that identifies existing and potential future drainage and flooding problems to public facilities and private property can be a vital tool in disaster mitigation planning.

Minimum National Flood Insurance Program Regulatory Requirements

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, communities that participate in the NFIP agree to regulate new construction in the area subject to inundation by the 100-year (base) flood.

There are four major floodplain regulatory requirements. State and local law may set additional floodplain regulatory requirements.

1. All development in the 100-year floodplain must have a permit from the community. The NFIP regulations define "development" as any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.
2. Development should not be allowed in the floodway. The NFIP regulations define the floodway as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. The floodway is usually the most hazardous area of a riverine floodplain and the most sensitive to development. At a minimum, no development in the floodway may cause an obstruction to flood flows. Generally an engineering study must be performed to determine whether an obstruction will be created.
3. New buildings may be built in the floodplain, but they must be protected from damage by the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or floodproofed.
4. Under the NFIP, a "substantially improved" building is treated as a new building. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged.

Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the state or Federal criteria. This is especially important in areas with older Flood Insurance Rate Maps that may not reflect the current hazard. Such ordinances could include prohibiting certain types of highly damage-prone uses from the floodway or requiring that structures be elevated 1 or more feet above the BFE. The NFIP's Community Rating System provides insurance premium credits to recognize the additional flood protection benefit of higher regulatory standards.

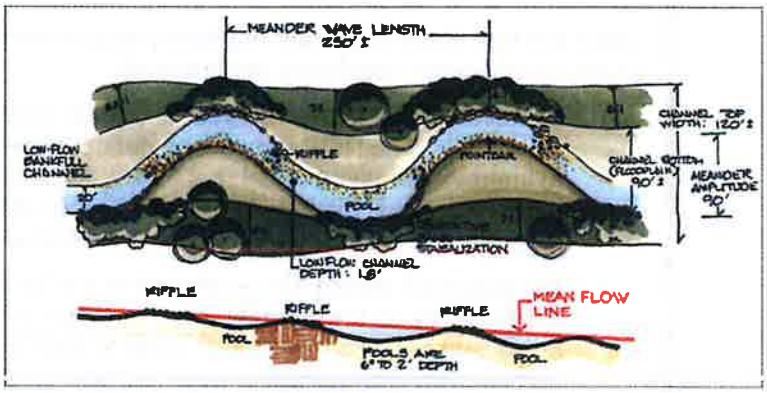
B.2.4 Stormwater Management

Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased when natural ground cover is replaced by urban development. To prevent stormwater from flooding roads and buildings, developers construct storm sewers and improve ditches to carry the water away more efficiently.

As watersheds develop, runoff usually becomes deeper and faster and floods become more frequent. Water that once lingered in hollows, meandered around oxbows, and soaked into the ground now speeds downhill, shoots through pipes, and sheets off rooftops and paving.

Insurance purposes require that NFIP floodplain maps must be based on existing watershed development, but unless plans and regulations are based on future watershed urbanization, development permitted today may flood tomorrow as uphill urbanization increases runoff.

This combination of increased runoff and more efficient stormwater channels leads to increases in downstream storm peaks and changes in the timing when storm peaks move downstream. Unconstrained watershed development often will overload a community's drainage system and aggravate downstream flooding.



In addition to detention facilities, stormwater management plans can include restoring some channelized streams with meanders and native vegetation to slow runoff and prevent flash flooding.

A second problem with stormwater is its impact on water quality. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them to the receiving streams.

Oklahoma communities that participate in the NFIP are listed at www.fema.gov/cis/OK.pdf.

Retention / Detention

Some communities with stormwater management regulations require developers to build retention or detention basins to minimize the increases in the runoff rate caused by impervious surfaces and new drainage systems. Generally, each development must not let stormwater leave at a higher rate than under pre-development conditions. It is recommended that communities require a drainage plan from new developments.

The Community Rating System (CRS) uses three factors to measure the impact of stormwater management regulations on downstream flooding:

1. What developments have to account for their runoff? If only larger subdivisions have to detain the increased runoff, the cumulative effect of many small projects can still produce greater flows to downstream properties.
2. How much water is managed? Historically, local stormwater management programs address smaller storms, such as the 2- or 10-year storms. The CRS reflects the growing realization nationally that the runoff from larger storms must be managed. It provides full credit only for programs that address all storms up to the 100-year storm.
3. Who is responsible to ensure that the facility works over time? Roads and sewers are located on dedicated public rights-of-way and the community assumes the job of maintaining them in the future. Stormwater management detention basins have traditionally stayed on private property and maintenance has been left up to the owner. Often homeowners associations do not know how and do not have the capability to properly maintain these facilities. The community receives up to 110 points if the community assumes responsibility to ensure that the facilities are maintained.

Stormwater Detention Ponds manage the increased runoff from new developments, temporarily store flood waters, and can be used for community parks, recreation, and open-space.

Watershed Approaches

The standard regulatory approach of requiring each development to manage stormwater to the same criteria has several shortcomings:

1. It does not account for differences in stream and watershed conditions (although the standards can be revised to reflect findings from watershed studies).
2. Municipalities within the same watershed may require different levels of control of stormwater.
3. There is no review of the downstream impacts from runoff or any determination of whether the usual standards compound existing flooding problems.
4. It results in many small basins on private property that may or may not be properly maintained.

The way to correct these deficiencies is to conduct a master study of the watershed to determine the appropriate standards for different areas and, sometimes, to identify where

a larger central basin would be more effective and efficient than many smaller ones. The CRS program provides up to 225 points if communities adopt such master plans.

B.2.5 Building Codes

Hazard protection standards for all new and improved or repaired buildings can be incorporated into the local building code. These standards should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Building codes are also a prime mitigation measure for other natural hazards, especially earthquakes, tornadoes, windstorms and heat and cold. When properly designed and constructed according to code, the average building can withstand the impacts of most of these forces. The code could include provisions such as:

- requiring sprinkler systems for fire protection in larger or public buildings;
- regulating overhanging masonry elements that can fall during an earthquake;
- ensuring that foundations are strong enough for earth movement and that all structural elements are properly connected to the foundation;
- making sure roofing systems will handle high winds and expected snow loads.

Ideally, current codes should include elements from the most recent International Building Codes (IBC), which includes the International Residential Code, the Plumbing Code, Mechanical Code, Fire Code, and Residential and Fuel Gas Codes. For additional information on International Building Codes, see www.iccsafe.org.

B.2.6 IBHS Fortified Home Program

What is a Fortified Home

The *Fortified...for Safer Living* home program gives builders and homeowners a set of criteria for upgrades that help reduce the risk of damage from natural disasters. The program raises a homes' overall safety above building code minimum requirements. During construction and upon completion a home is inspected and certified as a "Fortified...for Safer Living" home.

The combination of materials and techniques produces residences equipped to better resist hurricanes, tornadoes, fire and floods. The fortified home construction method produces homes that are comfortable while being resistant to natural disasters.

The following are features of a "Fortified...for Safer Living" home:

- The home and critical utilities are elevated by reinforced continuous piles a minimum of two feet above ground-level walls, stairs and Base Flood Elevation (BFE).
- The home is connected from the peak of the roof to the foot of the reinforced piles to form a continuous load path capable of withstanding 130 mph winds.
- Windows, doors and other openings are properly flashed and protected to withstand the impact of windborne debris without penetration of wind and water.

- The roof truss system has a 110 mph wind rated covering, a secondary moisture barrier, twice the required underlayment, thicker plywood deck sheathing and a stronger holding nail and nailing pattern.
- Other features include non-combustible roof materials, reinforced entry garage doors and landscaping techniques reducing wildfire and flooding vulnerability.
- A certified inspector verifies all required Fortified home products and materials are installed correctly in accordance with manufacturer's specifications for "Fortified…for Safer Living" program specifications.
- The home and property are also verified to be a low risk hazard for exposure to wildfire.

More information about Fortified Home guidelines is available at www.disastersafety.org/text.asp?id=fortified.

Economics of a Fortified Home

Cost (new home)

Depending on the quality of the material the buyer chooses, the cost to add fortified features could be as low as five percent of the total cost of a new home. See the following table, from the Institute of Business and Home Safety (IBHS) for a typical upgrade.

Table B–3: Cost Differentials for Fortified Home vs. standard Construction
As-built base home price: $151,500 (including lot and options, before "Fortified" upgrade).

	Standard Home	"Fortified" Home	Incremental Cost to "Fortify"
Windows and doors	5,450*	$15,500** ($7,700)	$10,050 ($2,250)
Garage doors	$650	$1,250	$600
Roof decking	$650	$1,750	$1,100
Sealing roof joints	$0	$650	$650
Roof covering	$2,350	$3,350	$1,000
Concrete/steel down pours	$0	$500	$500
Fortified inspection costs	$0	$1,000	$1,000
		Total increment cost:	$14,900 ($7,100)
		Percentage of base cost:	9.8% (4.7%***)

* Based on selection of PGT® window & door products.
** Fortified with PGT® WinGuard™ impact-resistant windows & doors.
*** Cost of panel shutters instead of impact-resistant windows.

Cost (existing home)

Many of the fortification techniques used to build new homes are too expensive as retrofits. Fortifying is much more expensive when a home is already built. However, there are creative ways to reduce costs and still fortify an existing home. Improving roof decking on an existing structure would cost about $5,000. For $50 a certain type of glue

gun available in most hardware stores can retrofit a roof as effectively as if a new roof had been put on with wood screws.

Savings

In Florida, a fortified home can save homeowners over 20% in insurance premiums. A standard brick, stone, or masonry house in a coastal area, with a deductible of $500 and a 2% hurricane deductible, would generate an annual premium of $2,240. In contrast, the same home with the additional fortified construction features would pay an annual premium of $1,746, a savings of $504, or 22.5%. Also, underwriting guidelines may be relaxed for fortified homes. Insurers may make exceptions for fortified homes in areas where they wouldn't normally write policies.

Lower deductibles may be available. In Florida, policies covering wind damage typically have a deductible of 2% of the covered amount. On a $150,000 home the deductible would be $3,000. Fortified homeowners may be eligible for a flat deductible of $500.

As for intangible savings, personal photographs, important family documents and computer data are just a few of the items a fortified home may protect. Additionally there is the inconvenience and cost of other living arrangements while a home is being rebuilt.

For more information about one insurer's guidelines on insuring fortified homes see www.roughnotes.com/rnmagazine/search/general_articles/01_08p52.htm.

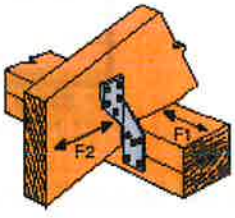
B.2.7 Smoke Detectors

Smoke detectors save lives. Approximately two-thirds of fatal fires occur in the 10% of homes not protected with smoke detectors. You are twice as likely to die in a fire if you do not have a properly operating smoke detector.

There are two basic types of smoke detectors - photoelectric and ionization. Photoelectric smoke alarms generally are more effective at detecting slow-smoldering fires, fires that might smolder for hours before bursting into flames. Ionization smoke alarms are more effective at detecting fast-flaming fires, fires that consume materials rapidly and spread quickly.

Test smoke detectors every month, change the batteries twice per year, clean detectors at least once per year and replace smoke detectors every 10 years. For more facts about smoke detectors see www.firemar.state.ok.us/forms/lg-alarm.pdf.

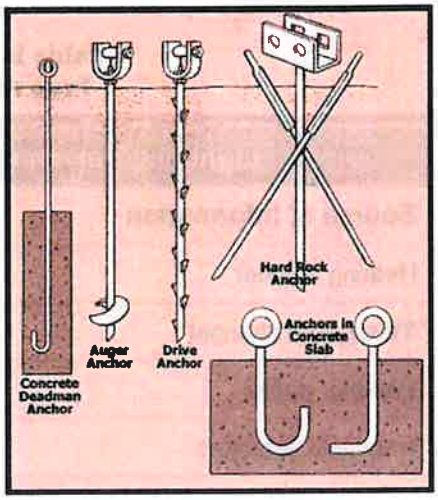
B.2.8 Hurricane Fasteners



A home's roof system is its most vulnerable and expensive component. Hurricane roof-to-wall and additional straps are metal connectors designed to hold a roof to its walls in high winds. They make a home's roof-to-wall connection five-to-15 times stronger than traditional construction and can prevent damage in winds at least 75 mph. In many coastal communities, reinforcing connections are enforced as a code restriction for new homes. Although designed to protect roofs during the extended and violent winds of hurricanes, these fasteners have proven effective in preventing roof removal in tornado events. For more information on hurricane fasteners

and straps and protecting your roof, go to www.nhc.noaa.gov/HAW2/pdf/hurricane_retrofit.pdf.

B.2.9 Mobile Home Tie-Downs



Tie-downs are devices that anchor or otherwise secure a mobile home to the ground in order to protect the mobile home and its surroundings from damage caused by wind and/or other natural forces. All tie-downs must comply with the specifications of the home manufacturer and, if applicable, with standards set by local government officials. Anchoring and tie-down systems vary greatly. It's important for a homeowner to contact the local building inspector for regulations regarding anchoring and blocking installation in each community. Regulations may vary considerably from one community to the next.

Anchors are available for different types of soil conditions, including concrete slab. Auger anchors have been designed for both hard soil and soft soil. Rock anchors or drive anchors allow attachment to a rock or coral base. This type of anchor is also pinned to the ground with crossing steel stakes.

To resist wind forces, a home may need two different types of tie-downs. In older homes, a vertical or over-the-top tie-down is needed to compensate for the uplift force. A diagonal or frame tie-down is needed to compensate for both lateral and uplift forces. Singlewide manufactured homes need both types of tie-downs. Doublewide homes only need the diagonal ties.

To be tied down safely, find out from a local manufactured home association or building inspector how many tie-downs and anchors are needed for local wind and soil conditions. The cost of installing additional tie-downs and anchors is small compared to the potential cost of wind damage to a manufactured home that was not properly tied down.

B.2.10 Lightning Warning Systems

There are two basic types of warning systems:

Strike Location and Identification Systems sense the electromagnetic pulse or the electrostatic pulse that accompanies a lightning discharge. Sensors and processing equipment work from those pulses or transients. These systems are most useful for tracking storms, locating a lightning strike and producing density plots of lightning activity by geographical area. They do not provide early warning of an impending storm.

Pre-storm Warning Systems sense the conditions that precede a storm. All severe storms create a related electrostatic field. This field provides a reliable storm signature that is peculiar to severe storms and can be related to the severity of the storm. That signature is present prior to lightning activity and provides a measurable parameter for

pre-storm warning. The electrostatic field strength is directly related to the state of the storm and/or its proximity to the site. Therefore, an increase in the electrostatic field is an indicator of a storm moving into or building up over the area. The warning time is determined by the rate of buildup or the rate of movement of the storm.

Table B–4: Lightning Detection Options
From the National Lightning Safety Institute

Lightning Detection Options - Accuracy vs. Cost vs. Complexity			
Source of Information	**Accuracy**	**Cost**	**Complexity**
Hearing thunder	Danger is near	None	Simple
TV weather channel	General info.	None	Simple
Weather radios	General info.	Up to $40	Simple
Handheld detectors	50-60% accurate	Up to $500	Somewhat
Boltek system (www.boltek.com)	70-80% accurate	Up to $1,500	Somewhat
ThorGuard system (www.thorguard.com)	85-90%	$1,000 - $6,500	Somewhat
WXLine system (www.WXLine.com)	90-95% accurate	Up to $7,000	Somewhat
Subscription service	95%+ accurate	Monthly fee	Simple

Essential companions to any type of lightning warning system include:

- a written Lightning Safety Policy;
- designation of Primary Safety Person;
- determination of when to suspend activities;
- determination of Safe/Not Safe Shelters;
- notification to Persons at Risk;
- education – at a minimum consider posting information about lightning and the organization's safety program;
- determination of when to resume activities.

The above options can be developed with many variations, up to and including all-in-one units that include a lightning threat detector, strobe light and 360° warning horn, and fully-automated programmable computer to pre-set various options for different types of facilities, such as times of operation, degrees of sensitivity, and appropriate sounding of an "all clear" signal.

B.2.11 Power Outages from Winter Storms

Power outages from winter storms can lead to an abundance of problems. Homeowners without power will resort to candles or open flames for heat and light. Generators are noisy, produce potentially deadly exhaust and can cause power spikes damaging equipment. Kerosene heaters burn oxygen and increase the potential of asphyxiation and production of carbon monoxide. With fuel burning equipment there is a constant danger of fire or explosion, burns and breathing poisonous exhaust. In addition, the inability to heat a home increases the risk of pipes freezing.

Power lines can be protected and power outages prevented by:

- Replacing existing power lines with heavier T-2 line, shorter spans, and heavier poles and crossbars. It is estimated this will increase the overall strength of power distribution lines by 66%.
- Burying utility lines. This removes the risk of power outages due to ice accumulation or tree limbs bringing down power lines.
- Pruning trees away from power lines and enforcing policies regarding tree limb clearances.
- Designed-failure allowing for lines to fall or fail in small sections rather than as a complete system.

For a success story on wind storm power outage mitigation, see www.fema.gov/regions/v/ss/r5_n09.shtm. Options for alternate power sources are described at www.currentsolutionspc.com/doc/distributed.pdf.

When power outages occur, the first imperative in emergency power planning is to equip essential facilities with permanent backup power, and to make sure existing backup sources are properly sized and maintained. Essential post-disaster services include:

- medical care;
- drinking water supply;
- police and fire protection;
- refrigeration;
- communications;
- pollution control (especially wastewater treatment);
- transportation (especially airports and seaports);
- weather forecasting;
- temporary relief shelters;
- emergency response command and control.

Ice can add up to 500# of weight per line between power poles. (Picture from the Oklahoma 12/2007 ice storms)

Backup systems should be sized

to meet the requirements of a facility's necessary public services. Some facilities, such as wastewater treatment plants and hospitals, are so important that backup systems should be sized to carry full loads. A complete and consistent planned maintenance program that includes regular inspection and operational testing should cover all backup power systems.

B.2.12 Standby Electric Generators

Standby electric generators can provide an extra sense of security during unpredictable weather and resulting power outages. But even small, portable electric generators – if used improperly – can threaten resident safety and the safety of power company linemen working on the electrical system. For information on safely purchasing and using a residential generator, see www.redcross.org/services/disaster/0,1082,0_565_,00.html.

Before purchasing a generator, consider how it will be used. That will help ensure buying a generator that is correctly sized for the application in mind. Portable, gasoline-driven generators are designed to be used for appliances with cords connected to them. Typically, they are not designed to be connected to a home or building wiring. Residents should not attempt to install these devices to an electrical panel.

Fixed Generators

Large, fixed generators generally are directly connected to building wiring to provide standby power during emergencies or power outages. However, the wiring needs to be properly installed by a qualified electrical contractor. Properly installing a "permanent" generator is extremely dangerous, and usually requires an electrical permit from the local electrical or building inspector's office. It is recommended that a community develop an Emergency Back-Up Generator Hazard Mitigation Plan Annex in order to set priorities for acquisition and budget development. Picking an appropriate fixed-site emergency generator involves a number of issues including:

- Type of fuel – Usually a choice between propane, natural gas or diesel, depending on the availability of either fuel in an emergency, and any possible regulations concerning on-site storage. Other considerations:
  - Natural gas or propane emit far fewer exhaust emissions, which may be a factor.
  - Natural gas generators usually have to be larger, since natural gas does not have the BTU output of gasoline or diesel, and NG generators tend to be more expensive.
  - Natural gas is frequently shut off in the event of a fire or some other disasters. This may not be an issue during winter storms or following lightning strikes (the two most common causes of major power outages), but should be considered during other events.
  - Diesel will require an onsite storage tank and a reliable source for refills during an extended outage. This is frequently an issue since so many commercial sources are dependent on electric pumps to deliver fuel. Also, diesel is seasonally-rated, since extreme cold can have a detrimental effect on standard diesel.
  - Propane will also require onsite storage, which could be a safety concern since propane tanks are traditionally above ground. But getting commercial propane tanks refilled may be easier during a power outage than getting diesel refills.

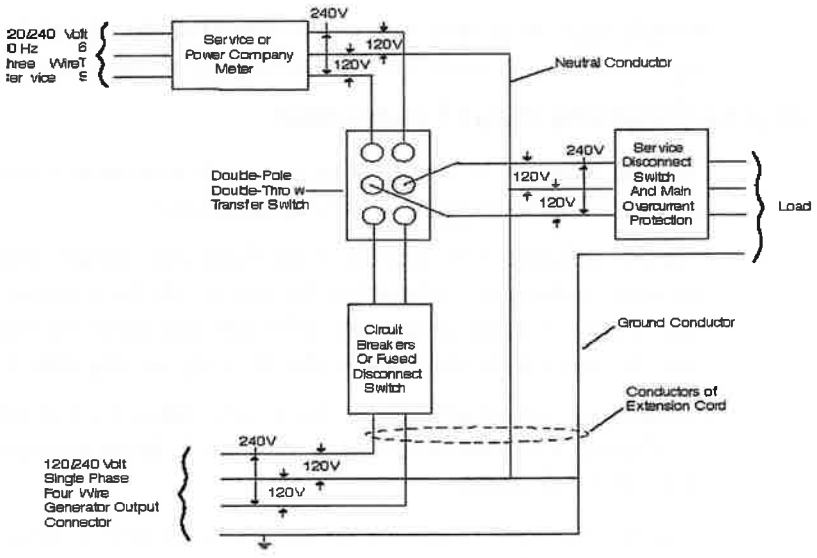
- Proper voltage – It's usually best for an emergency generator to match your standard incoming voltage, whether it's single-phase 120/240 or three-phase 277/480, which is the more common commercial application.
- Power requirements – this will entail (a) identifying your critical functions, and (b) having an electrical professional rate the running/start-up kilowatt (kW) requirements for those functions. (See Table B-5 for some basic power ratings for typical applications.)
- Cost – even a small (30-45 kW, 277/480 volt) natural gas standby generator can cost $10,000, plus expenses for installation and automatic transfer switches. Most emergency operations centers, 911 dispatch centers, and other critical facilities will need a generator with higher requirements.

"Back feeding" - a dangerous condition

Improperly connecting a portable generator to electric wiring can produce "back feed" – a dangerous current that can electrocute or critically injure residents or others. Back feed into power lines from a generator could create "hot" power lines during an outage. Linemen who expected lines to be de-energized have been injured or killed.

One good way to avoid back feeding is to install a double-pole, double throw transfer-switch gear. A qualified electrical contractor can install this transfer switch so that dangerous back feed can be prevented. "In accordance with the National Electrical Code, paragraph 700-6; Transfer equipment shall be designed and installed to prevent the inadvertent interconnection of normal and emergency sources of supply in any operation of the transfer equipment. Automatic transfer switches shall be electrically operated and mechanically held." The transfer switch must be a break-before-make switch, which will "break" the electrical connection with commercial power lines before it "makes" the connection between the generator and wiring. The switch also will prevent utility power from damaging the generator when regular service is restored. An electrical diagram of an installation using a transfer switch appears in Figure B-2.

Figure B–2: Standby power equipment and connections



Since transfer switches can be expensive, another way to install a generator is to have a sub-panel with main breakers and power from the main panel or generator. Main panel breaker and generator breaker in sub-panel would have handles interlocked to prevent both from being opened and closed at the same time. This prevents back feed to commercial power when the generator is in use.

For commercial emergency installations, it is also critical that an electrical professional review what the standard and max loads will be on the system. An evaluation needs to be made as to what critical functions need to be operational – HVAC, communications, lighting, security, cooking capabilities, and so on. In health care facilities, assistive devices and water supply equipment can pull large quantities of power, which will need to be taken into account.

Typical wattage requirements are described in the following table:

Table B–5: Typical Wattage Requirements for Generator Usage

Item	Running Watts	Item	Running Watts
Air conditioner (12,000 BTU)	1,700	Furnace Fan (1/3 HP)	1,200
Battery Charger (20 A)	500	Light Bulb	100
Chain Saw	1,200	Microwave Oven	1,000
Circular Saw	1,000	Oil Burner on Furnace	300
Coffee Maker	1,000	Radio	50
Compressor (1 HP)	2,000	Refrigerator	600
Deep Freeze	500	Submersible Pump (1 HP)	2,000
Electric heater (small)	1,500	Sump Pump	600
Electric Range (1 element)	1,500	Television	300

Source: Above information adapted from American Electric Power, *A Word About Portable Electric Generators*, and Flathead Electric Cooperative, *Safely Installing Your Electric Generator, 2007.*

B.2.13 Critical Facility Protection

Critical facilities require a higher level of protection because they are vital public facilities, pose a higher risk of pollution of floodwaters from hazardous materials, or are critical to the response and recovery effort during and after a disaster. The Community Rating System (CRS) provides credit for regulations protecting critical facilities from the 500-year flood.

Sample regulatory language can be found at the FEMA training website at http://training.fema.gov/EMIWeb/CRS/m6s4main.htm.

B.2.14 Extreme Heat Protection

Outdoor workers or people who engage in strenuous yard work or recreational activities are extremely vulnerable to heat-related illness.

Elderly, children, low-income individuals and people with compromised immune systems are more vulnerable to health risks due to intense climate changes, especially extreme heat. Aging is often accompanied by chronic illnesses that may increase susceptibility to extreme environmental conditions. Poverty among elderly increases the risk.

Children are vulnerable due to their size, behavior and fact that they are growing and developing. Children living in poverty or without access to proper medical care are especially vulnerable.

Low-income individuals are less likely to be able to afford air-conditioning and have less access to health care.

Cancer, AIDS and diabetes compromise individual's immune systems. Afflicted individuals are more susceptible to physical stresses such as those during extreme heat.

Steps individuals and families can take to protect themselves from the heat include:

- install window air-conditioners snugly and insulate spaces for a tighter fit;
- hang shades, draperies, awnings or louvers on windows receiving morning or afternoon sun. Awnings or louvers can reduce heat entering the house by up to 80%.
- stay indoors as much as possible. If air conditioning is not available stay on the lowest floor out of the sunshine.
- drink plenty of water and limit alcoholic beverages;
- dress in light-colored, loose fitting clothes that cover as much skin as possible;
- take a cool bath.

Suggestions for a community heat emergency intervention plan include:

- Standardizing guidelines for providing warnings to the public, including not only the National Weather Service, but also Emergency Medical Services, the Health Department, Emergency Management, Tribal Community Health Representatives and other recognized agencies.
- The public must have access to steps to take to lessen the likelihood of heat problems, such as staying in air-conditioning, if possible, and drinking plenty of fluids.
- A room air conditioner loan program for bed-ridden/chair-ridden individuals can assist those individuals who cannot physically leave their homes to visit an air-conditioned location each day.
- "Buddy systems" can be established where an individual is assigned to check on people at risk. The "buddy" should be trained to deal with heat related emergencies.
- Utility companies should not be allowed to terminate service during a heat emergency, even if individuals have not paid their bill.

For more information on extreme heat, mitigation and protection from the heat see www.fema.gov/hazards/extremeheat/heatf.shtm.

B.2.15 Proper Storage and Disposal of Hazardous Materials

Household chemicals and motor oil dumped down drains or directly onto the ground can work their way into the waterways and ground waters. Oil from a single oil change can ruin one million gallons of fresh water. Used crankcase oil has been reported to account for more than 40% of the oil pollution in waterways.

Most public and private vehicle maintenance facilities have well-developed systems to store their waste oil for recycling. However, "do-it-yourselfers" account for a large percentage of the oil changes in any community. Therefore, it is important for community recycling and solid waste management programs to include a system for waste oil collection and provide ways to collect and dispose of household chemicals.

Many counties and communities offer household pollutant collection events. Among the pollutants collected are oil-based paints, paint thinners, pesticides, fertilizers, cleansers,

acids, ammunition, batteries, motor oil, and antifreeze. Residents are not charged for items collected. Events are typically funded by participating communities.

Containers of hazardous materials should not be located in a flood hazard area. If such a location is necessary hazardous material containers need to be anchored. Contents can contaminate water and multiply the damaging effects of flooding by causing fires or explosions, or by otherwise making structures unusable. Buoyant materials should be anchored. If they float downstream they may cause additional damage to buildings or bridges or may plug a stream resulting in higher flood heights.

The link www.earth911.org/zip.asp provides a list of hazardous waste recycling centers and used oil collection facilities based on zip code.

B.2.16 Water Conservation

97% of the earth's water is in the oceans and 2% is trapped in icecaps and glaciers. Only about 1% of the earth's water is available for human consumption. The water supply is taxed to supply all the competing interests: residential – including drinking and sanitation, manufacturing, environmental, agricultural, and recreational.

Conserving water conserves energy – gas, electric or both – reduces monthly water/ sewer bills and postpones the construction of or eliminates the need to build expensive capital projects such as wastewater or water treatment plants that need future maintenance.

Plumbing codes implemented in Phoenix Arizona in 1990 required low-flow faucets, shower heads, and toilets. Since then water consumption per capita has decreased 27 percent. Other cities, such as Wilsonville, Oregon, have implemented an inverted block water rate structure charging customers higher rates as water consumption increases.

Public education can have a significant impact. Household conservation tips include:

- updating plumbing fixtures with low-flow devices;
- keeping a pitcher of water in the refrigerator instead of running the tap;
- watering the yard and gardens in the morning or evening when temperatures are cooler to minimize evaporation;
- collecting water used for rinsing and reusing it to water plants;
- landscaping with drought-resistant, low water use plants;
- using a hose nozzle and turning off the water while washing cars.

B.2.17 Open Space Preservation

Keeping the floodplain open and free from development is the best approach to preventing flood damage. Preserving open space is beneficial to the public in several ways. Preserving floodplains, wetlands, and natural water storage areas maintains the existing stormwater storage capacities of an area. These sites can also serve as recreational areas, greenway corridors and provide habitat for local flora and fauna. In addition to being preserved in its natural landscape, open space may also be maintained as a park, golf course, or in agricultural use.

B.2.18 Conclusions

1. Planning and zoning will help the community or Tribe develop proactively so that the resulting infrastructure is laid out in a coherent and safe manner.
2. Building codes for foundations, sprinkler systems, masonry, and structural elements such as roofs are prime mitigation measures for occurrences of floods, tornadoes, high winds, extreme heat and cold, lightning strikes, and earthquakes.
3. Public education (see Section B.1) can demonstrate preventive measures individuals and businesses can use to protect their own lives and facilities.
4. Communities should participate in the NFIP and use subdivision regulations to control the direction of floodplain development.
5. Deficiencies in stormwater management can be identified by conducting a Flood and Drainage Annex for watersheds to determine appropriate standards for different areas.

B.2.19 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures*, Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

B.3 Structural Projects

Structural projects are usually designed by engineers or architects, constructed by the public sector, and maintained and managed by governmental entities. Structural projects traditionally include stormwater detention reservoirs, levees and floodwalls, channel modifications, drainage and storm sewer improvements, and community tornado safe-rooms.

B.3.1 Safe Rooms

Safe rooms are specially constructed shelters intended to protect occupants from tornados and high winds. Constructed of concrete and steel, properly built safe rooms can provide protection against wind speeds of 250mph and airborne debris traveling as fast as 100mph.

A safe room can be incorporated into the construction of a new home, or can be retrofitted above or below ground into an existing home. The cost of constructing a safe room is between $2500 and $6000, depending on the room size, location and type of foundation on which the home is built. Safe rooms can function year-round as a usable area, such as a bathroom, closet or utility room.

Dr. Ernst Kiesling, Civil Engineering Professor at Texas Tech University, inspects a safe room in the aftermath of the May 8, 2003 tornadoes in Moore, Oklahoma.

The State of Oklahoma, FEMA and communities may offer reimbursement grants for construction of certain categories of Safe Rooms through the Hazard Mitigation Grant Program (HMPG).

FEMA 320, *Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business* has specific designs for tornado and hurricane safe rooms. To obtain a copy of FEMA 320 refer to www.fema.gov/plan/prevent/saferoom/fema320.shtm.

National Storm Shelter Association

The National Storm Shelter Association (NSSA) is an industry organization developed to ensure the highest quality of manufactured and constructed storm shelters. The NSSA has developed a program to verify that design, construction, and installation of storm shelters are in compliance with the most comprehensive and extensive safety standards available. Without full compliance with the standard, vulnerabilities may exist and safety may be compromised. Shelter-producing members of the NSSA submit shelter designs to the

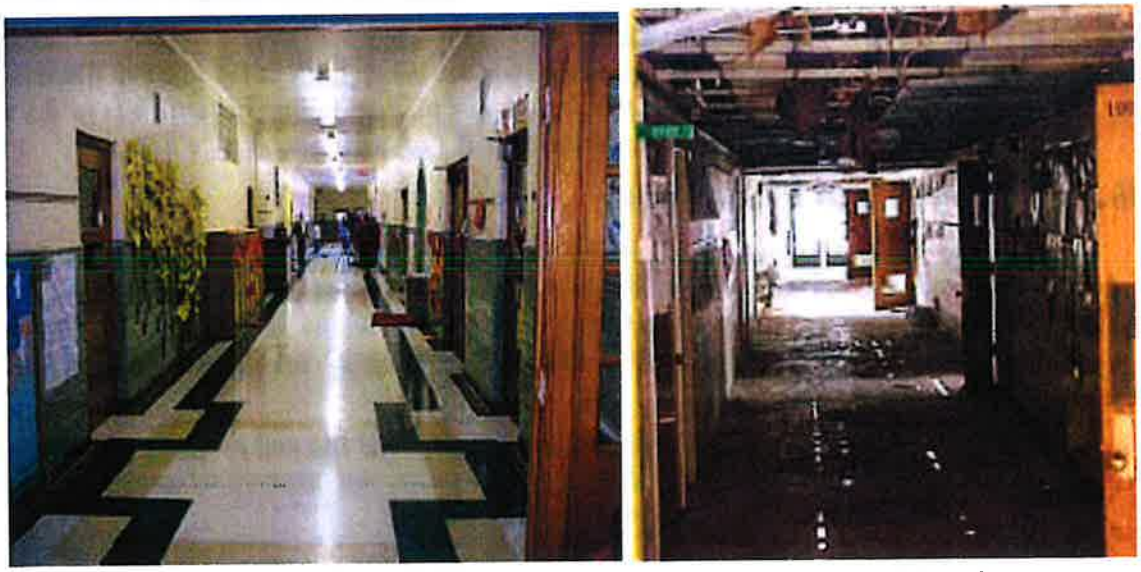
scrutiny of an independent third-party engineering company and have their shelters tested for debris impact resistance (FEMA 320 designs have been tested). In addition they will file a certificate of installation with NSSA for each shelter.

Upon building or installing a storm shelter, the member applies a seal to the shelter certifying that it is designed, built, and installed to meet the NSSA standard. Only the shelter producer or an agency that carefully inspects the shelter design, construction, and installation may certify compliance with an applicable standard. Claims of "FEMA Certified" or "Texas Tech Certified" are misleading since neither FEMA nor the Texas Tech Wind Science and Engineering Research Center (contributors to the FEMA standards for individual and community SafeRooms) certifies shelter quality. This program not only provides assurance to the user of a storm shelter that it has been built to a certain performance standard, but it shifts some responsibility from the community to provide verification from building inspectors for compliance and reduces building inspectors' training requirements. Additional information on the NSSA certification program can be obtained at www.nssa.cc.

B.3.2 School Safe Rooms

In the past, a school's interior areas, especially hallways, have been designated as the best place to seek refuge from violent storms. However, in 1999 the hallways of two schools in Sedgwick County, Kansas received significant damage which could have resulted in student casualties had school been in session.

The FEMA 361 publication, *Design and Construction Guidance for Community Shelters*, provides guidelines for constructing school safe rooms. A community shelter strong enough to survive a violent storm can also be used as a



Before and after photos of hallways in Wichita Kansas schools damaged by a tornado

cafeteria, gymnasium or other common area.

Schools, administration buildings and institutions of higher learning are required to have written plans and procedures in place for protecting students, faculty, administrators and visitors from natural and man-made disasters and emergencies. The requirement, directed by Oklahoma House Bill HB1512, was enacted May 29, 2003.

For more information about Sedgwick County's new school safe rooms go to www.fema.gov/mit/saferoom/casestudies.shtm. To receive a copy of FEMA 361, see www.fema.gov/pdf/hazards/nhp_fema361.pdf. For more information on HB1512, see www.lsb.state.ok.us/2003-04HB/HB1512_int.rtf.

B.3.3 Reservoirs and Detention

Reservoirs control flooding by holding high flows behind dams or in storage basins. After a flood peaks, water is released or pumped out slowly at a rate that the river can accommodate downstream. The lake created may provide recreational benefits or water supply (which could help mitigate a drought).

Reservoirs are suitable for protecting existing development downstream from the project site. Unlike levees and channel modifications, they do not have to be built close to or disrupt the area to be protected. Reservoirs are most efficient in deeper valleys where there is more room to store water, or on smaller rivers where there is less water to store. Building a reservoir in flat areas and on large rivers may not be cost-effective, because large areas of land have to be purchased.

Reservoirs provide storage of rainwater without the hazards of maintaining a dam.

In urban areas, some reservoirs are simply man-made holes dug to store floodwaters. When built in the ground, there is no dam for these retention and detention basins and no dam failure hazard. Wet or dry basins can also serve multiple uses by doubling as parks or other open space uses.

B.3.4 Levees and Floodwalls

Probably the best-known flood control measure is a barrier of earth (levee) or concrete (floodwall) erected between the watercourse and the property to be protected. Levees and floodwalls confine water to the stream channel by raising its banks. They must be well designed to account for large floods, underground seepage, pumping of internal drainage, and erosion and scour.

Failure to maintain levees can lead to significant loss of life and property if they are stressed and broken or breached during a flood event. An inspection, maintenance and enforcement program helps ensure structural integrity.

Levees placed along the river or stream edge degrade the aquatic habitat and water quality of the stream. They also are more likely to push floodwater onto other properties upstream or downstream. To reduce environmental impacts and provide multiple use benefits, a setback levee (set back from the floodway) is the best project design. The area inside a setback levee can provide open space for recreational purposes and provide access sites to the river or stream.

B.3.5 Channel Improvements

By improving channel conveyance, more water is carried away at a faster rate. Improvements generally include making a channel wider, deeper, smoother or straighter. Some smaller channels in urban areas have been lined with concrete or put in underground pipes.

B.3.6 Crossings and Roadways

In some cases buildings may be elevated above floodwaters, but access to the building is lost when floodwaters overtop local roadways, driveways, and culverts or ditches. Depending on the recurrence interval between floods, the availability of alternative access, and the level of need for access, it may be economically justifiable to elevate some roadways and improve crossing points.

Culverts like this one can constrict flow and cause backwater flooding.

For example, if there is sufficient downstream channel capacity, a small culvert that constricts flows and causes localized backwater flooding may be replaced with a larger culvert to eliminate flooding at the waterway crossing point. The potential for worsening adjacent or downstream flooding should be considered before implementing any crossing or roadway drainage improvements.

B.3.7 Drainage and Storm Sewer Improvements

Man-made ditches and storm sewers help drain areas where the surface drainage system is inadequate, or where underground drainageways may be safer or more practical. Storm sewer improvements include installing new sewers, enlarging small pipes, and preventing back flows. Particularly appropriate for depressions and low spots that will not drain naturally, drainage and storm sewer improvements usually are designed to carry the runoff from smaller, more frequent storms.

Drainageways should be inspected regularly for blockage from debris

Because drainage ditches and storm sewers convey water faster to other locations, improvements are only recommended for small local problems where the receiving stream or river has sufficient capacity to handle the additional volume and flow of water. To reduce the cumulative downstream flood impacts of numerous small drainage projects, additional detention or run-off reduction practices should be provided in conjunction with the drainage system improvements.

B.3.8 Drainage System Maintenance

The drainage system may include detention ponds, stream channels, swales, ditches and culverts. Drainage system maintenance is an ongoing program to clean out blockages caused by an accumulation of sediment or overgrowth of weedy, non-native vegetation or debris, and remediation of stream bank erosion sites.

"Debris" refers to a wide range of blockage materials that may include tree limbs and branches that accumulate naturally, or large items of trash or lawn waste accidentally or intentionally dumped into channels, drainage swales or detention basins. Maintenance of detention ponds may also require revegetation or repairs of a restrictor pipe, berms or overflow structure.

Maintenance activities normally do not alter the shape of a channel or pond, but they do affect how well a drainage system can do its job. Sometimes it is a very fine line that separates debris that should be removed from natural material that helps form habitat.

B.3.9 Conclusions

1. Reservoirs can hold high flows of water that can later be released slowly or retained for recreational purposes or drought mitigation.
2. Levees and floodwalls are not as effective overall because of possible underground seepage, erosion, degradation of aquatic habitat and water quality, and ineffectiveness in large floods.
3. Channel improvements allow more water to be carried away faster.
4. The effectiveness of elevating buildings depends on the availability of alternative access when flooding occurs.
5. Crossing and roadway drainage improvements must take into account additional detention or run-off reduction.
6. Drainage and storm sewer improvements carry runoff from smaller, more frequent storms.
7. Drainage system maintenance is an ongoing project of removing debris that decreases the effectiveness of detention ponds, channels, ditches, and culverts.

B.3.10 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures*, Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

B.4 Property Protection

Property protection measures are used to modify buildings or property subject to damage from various hazardous events. The property owner normally implements property protection measures. However, in many cases technical and financial assistance can be provided by a governmental agency. Property protection measures typically include acquisition and relocation, flood-proofing, building elevation, barriers, retrofitting, safe rooms, hail resistant roofing, insurance, and the like.

B.4.1 The Community's Role

Property protection measures are usually considered the responsibility of the property owner. However, local government should be involved in all strategies that can reduce losses from natural hazards, especially acquisition. There are various roles the community can play in encouraging and supporting implementation of these measures.

Providing basic information to property owners is the first step in supporting property protection measures. Owners need general information on what can be done. They need to see examples, preferably from nearby neighborhoods or communities.

Financial Assistance

Communities can help owners by helping to pay for a retrofitting project, just like they pay for flood control projects. Financial assistance can range from full funding of a project to helping residents find money from other programs. Some communities assume responsibility for sewer backups and other flood problems that arise from an inadequate public sewer or drain system.

Less expensive community programs include low interest loans, forgivable low interest loans and rebates. A forgivable loan is one that does not need to be repaid if the owner does not sell the house for a specified period, such as five years. These approaches do not fully fund the project but they cost the community treasury less and they increase the owner's commitment to the flood protection project.

Often, small amounts of money act as a catalyst to pique the owner's interest to get a self-protection project moving. Several Chicago suburbs have active rebate programs that fund only 20% or 25% of the total cost of a retrofitting project. These programs have helped install hundreds of projects that protect buildings from low flood hazards.

Acquisition Agent

Local Government can be a focal point for many acquisition projects. In most cases, when acquisition of a property is feasible, the local government is the ultimate owner of the property, but in other cases, the school district or other public agencies can assume ownership and the attendant maintenance responsibilities.

Other Incentives: "Non-financial Incentives"

Sometimes government actions can provide a financial incentive from another source, or other incentive options are available. A flood insurance premium reduction will result if a building is elevated above the flood level. This reduction is not enough to take much of a bite out of the cost of the project, but it reassures the owner that he or she is doing the

right thing. Other forms of floodproofing are not reflected in the flood insurance rates for residential properties, but they may help with the Community Rating System, which provides a premium reduction for all policies in the community.

Other incentives to consider are programs to help owners calculate the benefits and costs of a project and a "seal of approval" for retrofitted buildings. The latter would be given following an inspection that confirms that the building meets certain standards. There are many other personal but non-economic incentives to protect a property from flood damage, such as peace of mind and increased value at property resale.

B.4.2 Insurance

Insurance has the advantage that, as long as the policy is in force, the property is protected and no human intervention is needed for the measure to work. There are three types of insurance coverage:

1. The standard homeowner's, dwelling, and commercial insurance policies cover against the perils of wildfire and the effects of severe weather, such as frozen water pipes.
2. Many companies sell earthquake insurance as an additional peril rider on homeowner's policies. Individual policies can be written for large commercial properties. Rates and deductibles vary depending on the potential risk and the nature of the insured properties.

NFIP Coordinator Dianna Herrera presenting a class on flood insurance requirements

3. Flood insurance is provided under the National Flood Insurance Program.

Flood Insurance

Although most homeowner's insurance policies do not cover a property for flood damage, an owner can insure a building for damage by surface flooding through the National Flood Insurance Program (NFIP). Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area.

Building coverage is for the structure. Contents coverage is for the removable items inside an insurable building. A renter can take out a policy with contents coverage, even if there is no structural coverage.

Some people have purchased flood insurance because the bank required it when they got a mortgage or home improvement loan. Usually these policies just cover the building's structure and not the contents.

In most cases, a 30-day waiting period follows the purchase of a flood insurance policy before it goes into effect. The objective of this waiting period is to encourage people to keep a policy at all times. People cannot wait for the river to rise before they buy their coverage.

B.4.3 Acquisition and Relocation

Moving out of harm's way is the surest and safest way to protect a building from damage. Acquiring buildings and removing them is also a way to convert a problem area into a community asset and obtain environmental benefits.

Moving a home out of the floodplain is sometimes the only way to protect it from flooding

The major difference between the two approaches is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public use, such as a park. Relocation can be either government or owner-financed.

While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and large or irregularly shaped buildings. However, experienced building movers know how to handle any job.

Cost

An acquisition budget should be based on the median price of similar properties in the community, plus $10,000 to $20,000 for appraisals, abstracts, title opinions, relocation benefits, and demolition. Costs may be lower after a flood or other disaster. For example, the community may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner.

One problem that sometimes results from an acquisition project is a "checkerboard" pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creating such an acquisition pattern in a community simply adds to the maintenance costs that taxpayers must support.

Relocation can be expensive, with costs ranging from $30,000 for a small wood frame building to over $60,000 for masonry and slab on grade buildings. Two story houses are more expensive to move because of the need to relocate wires and avoid overpasses. Additional costs may be necessary for acquiring a new lot on which to place the relocated building and for restoring the old site. Larger buildings may have to be cut and the parts moved separately. Because of all these complications, there are cases where acquisition is less expensive than relocation.

Where Appropriate

Acquisition and relocation are appropriate in areas subject to:

- flash flooding;
- deep waters;
- dam break flooding;

- landslides;
- potential hazardous materials spills;
- other high hazard that affects a specific area.

Acquisition and relocation are not appropriate for hazards like tornadoes or winter storms because there are no areas safe from the hazard. Relocation is also preferred for large lots that include buildable areas outside the hazardous area or where the owner has a new lot in a safer area.

Acquisition (followed by demolition) is preferred over relocation for buildings that are difficult to move, such as larger, slab foundation, or masonry structures, and for dilapidated structures that are not worth protecting.

B.4.4 Building Elevation

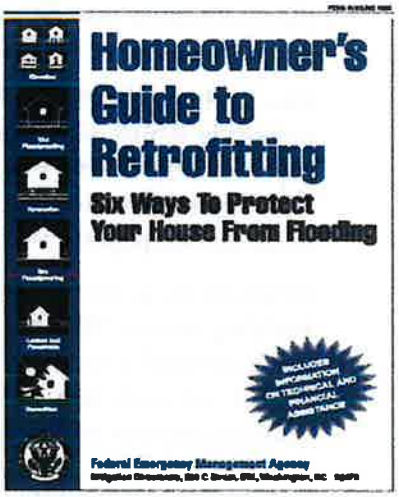
Raising a building above the flood level is the best on-site property protection method for flooding. Water flows under the building, causing little or no damage to the structure or its contents. Alternatives are to elevate on continuous foundation walls (creating an enclosed space below the building) or elevation on compacted earthen fill.

B.4.5 Barriers

Barriers keep surface waters from reaching a building. A barrier can be built of dirt or soil ("berm") or concrete or steel ("floodwall"). In cases of shallow flooding, regrading a yard can provide the same protection as a separate barrier.

B.4.6 Retrofitting

This term covers a variety of techniques for modifying a building to reduce its susceptibility to damage by one or more hazards.



FEMA guides are available to help homeowners retrofit their flood-prone properties

Where Appropriate

Some of the more common approaches are:

Floods and dam failures:

- Dry floodproofing keeps the water out by strengthening walls, sealing openings, or using waterproof compounds or plastic sheeting on walls. Dry floodproofing is not recommended for residential construction.
- Wet floodproofing, using water resistant paints and elevating anything that could be damaged by a flood, allows for easy cleanup after floodwaters recede. Accessory structures or garages below the residential structure are potential candidates for wet floodproofing.
- Installing drain plugs, standpipes or backflow valves to stop sewer backup.

Tornado:

- Constructing an underground shelter or in-building "safe room"
- Securing roofs, walls and foundations with adequate fasteners or tie downs
- Strengthening garage doors and other large openings

High winds:

- Installing storm shutters and storm windows
- Burying utility lines
- Using special roofing shingles designed to interlock and resist uplift forces
- Installing/incorporating backup power supplies

Hailstorms:

- Installing hail resistant roofing materials

Lightning:

- Installing lightning rods and lightning surge interrupters
- Burying utility lines
- Installing/incorporating backup power supplies

Winter storms:

- Adding insulation
- Relocating water lines from outside walls to interior spaces
- Sealing windows
- Burying utility lines
- Installing/incorporating backup power supplies

Extreme heat and drought:

- Adding insulation
- Installing water saver appliances, such as shower heads and toilets

Urban and wild fires:

- Replacing wood shingles with fire resistant roofing
- Adding spark arrestors on chimneys
- Landscaping to keep bushes and trees away from structures
- Installing sprinkler systems
- Installing smoke alarms

Earthquake:

- Retrofitting structures to better withstand shaking.

- Tying down appliances, water heaters, bookcases and fragile furniture so they won't fall over during a quake.

Common Measures

From the above lists, it can be seen that certain approaches can help protect from more than one hazard. These include:

- strengthening roofs and walls to protect from wind and earthquake forces;
- bolting or tying walls to the foundation protect from wind and earthquake forces and the effects of buoyancy during a flood;
- adding insulation to protect for extreme heat and cold;
- anchoring water heaters and tanks to protect from ground shaking and flotation;
- burying utility lines to protect from wind, ice and snow;
- installing backup power systems for power losses during storms;
- installing roofing that is hail resistant and fireproof.

B.4.7 Impact Resistant Windows and Doors

Doors and windows can be the most vulnerable components of your home. During high wind events, such as thunderstorms or tornadoes, wind-driven debris can easily penetrate unprotected or unreinforced windows and doors, breaching the secure envelope of the structure. The debris and rain may cause damage to interior furnishings or harm to residents, but the wind itself can create extreme pressures on the walls and ceiling, leading to catastrophic structural failure. This danger can be mitigated by the installation of impact-resistant windows and doors.

When windows and doors fail, wind enters and creates an internal pressure that can lead to catastrophic damage to a home. (*Drawing courtesy of Flash.org*)

Windows

Today's impact-resistant glass sandwiches a laminated inner layer made of polyvinyl butyral, a plastic, between two sheets of glass. Stronger than a car windshield, the glass might shatter if a heavy object crashes into it, but it won't break to bits. That makes wind less likely to penetrate the envelope of a home and create interior pressure severe enough to blow a roof off. Impact-resistant windows are only as strong, though, as the frame in which they rest. "An impact resistant window is tested

as a unit that includes the glass, the frame as well as the attachment hardware and the installation method." (*Federal Alliance for Safe Homes – FLASH*)

The second type of impact-resistant glass uses a film applied to the surface. Impact-resistant film is placed over the glass to keep windows from shattering into sharp particles if broken. Since these films are added to the glass, they may not be as effective as a standard impact-resistant system. Their durability depends on how well the glass and protective laminate stay in the frame and window assembly. They will be effective against smaller objects, but larger pieces of debris may still take the window out of the frame. For more information on protective window films and other technologies, visit the Protecting People First Initiative (www.protectingpeople.org/arenspage.shtm) or the International Window Film Association (www.iwfa.com/iwfa/Consumer_Info/safety.html).

While costs for replacing window glass or using impact-resistant glass in new construction can be expensive, there are additional benefits that may be gained. Impact-resistant glass has been used successfully to reduce burglaries, vandalism and break-ins with both homes and businesses. In addition, using an impact-resistant glazing that is also more energy efficient can produce substantial energy savings. According to the Partnership for Advancing Housing Technology (PATH), a public-private partnership between leaders in the homebuilding, product manufacturing, and insurance industries and several Federal agencies:

> Special glass "…can be used to both make windows impact resistant and more energy efficient. Low-E and solar control low-E (also called spectrally selective) coatings can be used to boost the energy efficiency of windows. Low-E double pane windows, most common in cold and moderate climates, are more energy efficient than clear windows because the low-E coating reduces heat loss through the window.
>
> Solar control glass, also called Low E2, is a good glass for hot climates because, in addition to improving the insulating ability of windows, it also limits solar heat gain by blocking passage of infrared and some ultraviolet rays. Solar control glass allows a higher level of visible light to pass through a window with less solar heat gain reduction than tinted window coatings."

PATH gives a tentative cost estimate for using impact resistant glass systems in a model 2,250 sq. ft. home at $14,850. (www.pathnet.org/sp.asp?id=18692). In addition, residential users may view a window and door protection cost estimate tool at the Federal Alliance for Safe Homes (FLASH) website www.blueprintforsafety.org/tools/shuttertoolhome.aspx.

One manufacturer provides the following pricing table for commercial applications:

Table B–6: Impact Resistant Windows Cost Estimate Table

The following pricing table is for estimating purposes only. Changes in dimensions, glass types, finishes, hardware selection, volume discounts, and other variables could raise or lower prices.
(Provided by CGI Windows, www.cgiwindows.com.)

APPROXIMATE IMPACT RESISTANT PRICING 2007 - COMMERCIAL GRADE ALUMINUM PRODUCTS

Product	W	x	H	Max. Design Pressure (PSF)	COST*
Series 238 - Casement Window	24"	x	48	+110 / -120	$400.12
Series 238 - Casement Window	30"	x	60	+110 / -120	$526.63
Series 238 - Casement Window	36"	x	60	+110 / -120	$593.31
Series 238 - Casement Window	32"	x	72	+85 / -85	$625.18
Series 360 - Single Hung Window	36"	x	72	+100 / -167.2	$593.80
Series 360 - Single Hung Window	54"	x	96"	+100 / -120	$1,274.27
Series 450 - Pair of Door	74 1/2"	x	96 3/4	+100 / -110	$2,425.69

Aluminum Finish: White, Bronze, or Driftwood ESP
Glass Type: 7/16" Laminated Glass Typical (Ann/Ann) / 5/16" Lami Glass at Single Hungs (Ann/Ann)
Glass Color: Clear, Gray, Bronze, Dark Gray (Turtle Code)

** Note: Cost excludes special items, colonial muntins, HS/HS Glass, Temp/Temp Glass, aluminum tube mullions, shipping, shop drawings, installation, permits, special engineering, windload calculations, etc.*

Garage Doors

Garage doors are particularly vulnerable, especially doublewide garage doors because of their long span and, frequently, lightweight materials. Reinforced garage door and track systems are available to help avoid that problem. Retrofit kits are also available to reinforce existing garage doors, but the retrofit kits do not provide the same level of protection as systems designed to be wind and impact-resistant. (*Source: Federal Alliance for Safe Homes – FLASH. www.flash.org.)*

Illustrating the dangers of unreinforced garage doors, in all but the house at upper left, these doors have been breached, leading to substantial roof damage – in some cases, completely removing a second floor. But in the home with an intact garage door, the roof is almost entirely undamaged.

B.4.8 Impact Resistant Roofing

Hail is a hazard that threatens most states, but it doesn't strike all areas equally. Since 1980, the country has averaged 3,000 hailstorms per year, with four states accounting for 42% of the total: Texas, 500 per year; Oklahoma, 400; Kansas, 225; Nebraska, 135. In these high risk states, hail strikes may occur up to 6 times a year, putting houses in repeated danger. (Source: State Farm Insurance)

In 1996, the Institute for Business & Home Safety (IBHS) and Underwriters Laboratory (UL) developed a protocol for testing and rating roofing systems against impact damage. The test uses four sizes of steel balls, ranging from 1¼ -2 inches in diameter, to replicate different sizes of hailstones. The balls are dropped from different heights to simulate various impact speeds. The materials are rated on a scale of 1 (least resistant) to 4 (most resistant).

New impact-resistant roofing will cost more, even in mass production. New shingles may also require more labor at installation. However, some impact-resistive, asphalt-based products will add as little as 10-15% up to 50% to the cost. Class 4 products made of aluminum, copper, plastic and resin shingles have been available for years, but they cost considerably more than standard roofing materials. With the introduction of modified asphalt materials, many more homeowners are able to achieve greater wind and hail resistance than ever before.

Photos courtesy of State Farm Insurance

However, in areas where storms and high winds can damage many roofs, these shingles offer additional protection to the structure and occupants. Depending on location and frequency of storms, the costs for this type of roofing could be less than the costs of replacing roofing due to impact or wind. With a 6-nail vs. 3-nail installation, Class 4 shingles frequently come with a limited warranty against 120-130 mph winds. (Source: National Association

LET IT HAIL, LET IT HAIL!

The March thunderstorm blew in without much warning during the Ft. Worth early evening rush hour. When softball-size hail smashed through the roof of a downtown restaurant, customer Mario Valverde headed for safety to escape falling debris and glass shards from exploding windows.

Valverde, a National Weather Service (NWS) veteran, knew this storm would make headlines.

"The hail punched right through the ceiling," Valverde said. "The hailstones knocked ceiling tiles loose and rainwater cascaded down from the electrical fixtures. I hid out in the restaurant's freezer room along with the other customers and employees. I found out later the storm killed two people." An experienced weatherman, Valverde knew that the fierce storm had passed directly over his home in Saginaw. "I called my insurer and the claim adjuster told me the roof had to be replaced. Afterwards, property insurance premiums went up ten percent in my area."

Fortunately, most storms aren't as violent as the one Valverde experienced, and hail larger than baseball size is rare. "Ninety percent of hail is golf ball size or less," said contractor Scott Hamilton, of Lon Smith Roofing in Fort Worth. However, while smaller hailstones may not fracture standard roof shingles, damage still remains.

(Source: Insurance Journal – TX)

of Home Builders). Additionally, insurance companies may offer a discount to homeowners on their homeowner's insurance policy for shingles meeting Class 4 rating from UL 2218. Also, Class 4 shingles frequently have a 30-50 year guarantee, vs. a 15-20 year guarantee for conventional Class 1 material, thus greatly extending the period between roof replacements.

Class 4 Roofing materials Cost Effectiveness

If the insurance carrier offers a premium discount, the total impact to the homeowner is reduced. Assuming an average annual premium for our sample home of $800, and further assuming our hail-resistant product qualifies for the maximum discount offered by the insurance carrier (25 percent), then our homeowner will be saving $200 per year in premiums, or $6,000 over 30 years. The total impact to the homeowner of $2,100 now becomes a savings of $3,900 or approximately $130 per year.

The selection of a hail-resistant shingle, in conjunction with an incentive from the insurance carrier, is a cost effective alternative for both the homeowner and the insurance company. To make this program a reality, however, the insurance company must educate the homeowner on the potential long-term cost savings that are associated with the installation of the preferred roofing system.

Article originally published by: Professional Investigative Engineers, Inc.

B.4.9 Lightning Protection Systems

The purpose of a lightning protection system is to intercept lightning and safely direct its current to ground. If the system is properly designed, installed and maintained it can provide almost 100% protection to buildings.

The system for an ordinary structure includes at least air terminals (lightning rods), down conductors, and ground terminals. These three elements of the system must form a continuous conductive path for lightning current. Many systems of air terminals now may not even be connected to the building. They may be comprised of freestanding cables or towers above or next to the building. This is especially needed where the structure may house explosives or delicate electronics, since even with a lightning rod, some energy may be transferred to the structure through induction.

National Fire Protection Association document NFPA 780, *Standard for the Installation of Lightning Protection Systems* describes lightning protection system installation requirements. NFPA 780 is available through www.nfpa.org/Codes/NFPA_Codes_and_Standards/List_of_NFPA_documents/NFPA_780.asp. Additional information on design and construction of lightning protection systems is available on www.montana.edu/wwwpb/pubs/mt8529ag.pdf.

B.4.10 Surge and Spike Protection

The average home has 2,200 or more power surges annually, 60% of which are generated within the home. Most surges are caused

by motors starting in air conditioners, garage doors, refrigerators and other major appliances. Electronic appliances can be damaged or destroyed by over-voltage surges or spikes.

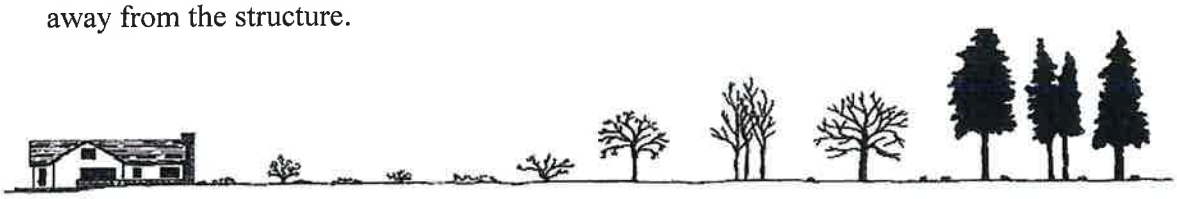
Whole house surge protectors offer the first line of defense against high-energy, high-voltage surges. These devices thwart the energy of the initial surge and reduce it before it reaches electrical appliances. In many cases this level of protection is enough to protect the home. Surge protectors should be sufficient to also provide "spike protection," which can defend against the extremely high spiking voltage created by lightning strikes. Many surge protectors, while effective against routine voltage fluctuations, may not defend against high level spikes.

Surge protection devices connected directly to appliances offer the second line of defense. They are the only defense against surges within the home as when, for example, a large appliance kicks in. The combination of whole house and point-of-use surge protection provides the best possible protection.

For more information on whole house and point-of-use surge protectors, refer to www.howstuffworks.com/surge-protector.htm.

B.4.11 Landscaping for Wildfire Prevention

The chance of losing property due to wildfire can be reduced using fire prevention landscaping techniques. The amount of cleared space around a home improves its ability to survive a wildfire. A structure is more likely to survive when grasses, trees and other common fuels are removed, reduced or modified to reduce a fire's intensity and keep it away from the structure.



Zone 1: Moist and trim. Turf, perennials, groundcovers and annuals form a greenbelt that is regularly watered and maintained. Shrubs and trees are located at least 10 feet from the house.

Zone 2: Low and sparse. Slow growing, drought-tolerant shrubs and groundcovers keep fire near ground level. Native vegetation can be retained if it is low growing, does not accumulate dry, flammable material and is irrigated.

Zone 3: High and clean. Native trees and shrubs are thinned and dry debris on the ground is removed. Overgrowth is removed and trees are pruned every 3-5 years.

Zone 4: Natural area. Native plants are selectively thinned. Highly flammable vegetation is replaced with less fire-prone species.

For comprehensive lists of steps to protect your home before, during and after a wildfire, see www.fema.gov/pdf/library/98surst_wf.pdf or www.cnr.uidaho.edu/extforest/F3.pdf.

B.4.12 Conclusions

1. Acquisition and relocation of property is the most effective for property protection in the case of hazards that are expected to occur repeatedly in the same locations. Acquisition followed by demolition is preferable.

2. Other methods of property protection for flooding include raising building elevations and building berms and floodwalls.
3. Building modifications are also appropriate for some hazards.
4. Property insurance has the advantage of protecting the property without human intervention.
5. Local government can help in reducing losses from natural hazards by providing financial assistance, having an acquisition program, and other incentives.

B.4.13 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

B.5 Emergency Services

Emergency services measures protect people during and after a hazard event. Measures include preparedness, threat recognition, warning, response, critical facilities protection, and post-disaster recovery and mitigation.

B.5.1 Threat Recognition

Threat recognition is the key. The first step in responding to a flood, tornado, storm or other natural hazard is being aware that one is coming. Without a proper and timely threat recognition system, adequate warnings cannot be disseminated.

Emergency Alert System (EAS)

Using digital technology to distribute messages to radio, television and cable systems, the EAS provides state and local officials with the ability to send out emergency information targeted to a specific area. The information can be sent electronically through broadcast stations and cable systems even if those facilities are unattended.

Floods

A flood threat recognition system provides early warning to emergency managers. A good system will predict the time and height of the flood crest. This can be done by measuring rainfall, soil moisture, and stream flows upstream of the community and calculating the subsequent flood levels.

Areas subject to flooding should be clearly posted

On larger rivers, including the Washita, the National Weather Service does the measuring and calculating, which is in the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Flood threat predictions are disseminated on the NOAA Weather Wire or NOAA Weather Radio. NOAA Weather Radio is considered by the federal government to be the official source for weather information.

The National Weather Service issues notices to the public, using two levels of notification:

Flood watch: conditions are right for flooding;

Flood warning: a flood has started or is expected to occur.

On smaller rivers, local rainfall and river gages are needed to establish a flood threat recognition system. The National Weather Service may issue a "flash flood watch." This means the amount of rain expected will cause ponding and other flooding on small streams and depressions. These events are sometimes so localized and rapid that a "flash

flood warning" may not be issued, especially if no gauges or other remote threat recognition equipment is available.

Meteorological Hazards

The National Weather Service is the primary agency for detecting meteorological threats, such as tornadoes, thunderstorms, and winter storms. As with floods, the Federal agency can only look at the large scale, e.g., whether conditions are appropriate for formation of a tornado. For tornadoes and thunderstorms, the local government can provide more site-specific and timely recognition by sending out spotters to watch the skies when the Weather Service issues a watch or warning.

NOAA Weather (All-Hazard) Radios

The National Oceanographic and Atmospheric Administration (the parent agency for the National Weather Service) maintains a nationwide network of radio stations broadcasting continuous weather information direct from regional National Weather Service offices. The NWS broadcasts warnings, watches, and forecasts 24 hours a day. Post-event information is also broadcast for natural hazards (such as tornados and earthquakes) and environmental hazards (such as chemical releases or oil spills). In addition, many emergency management agencies have access to these radios to broadcast Amber Alerts and other hazard and safety information.

These broadcasts can be received by any radio capable of receiving the Weather Service frequency. NOAA All Hazard Radios have the additional advantage of being activated by a pre-broadcast signal transmitted by the NWS, coming off standby and sounding an alert tone loud enough to wake sleeping individuals before transmitting the warning message. NOAA Weather Radio receivers can be purchased at many retail stores that sell electronic merchandise. Typical cost of a residential grade NOAA Weather Radio is between $20 and $80.

For more information on NOAA Weather Radios, see www.nws.noaa.gov/nwr/.

B.5.2 Warning

After the threat recognition system tells the Emergency Manager or other local government official that a flood or other hazard is coming, the next step is to notify the public and staff of other agencies and critical facilities. The earlier and the more specific the warning is given, the greater the number of people who can implement protection measures. The following are some of the more common warning methods:

Broadcast announcements & EAS	Good tools for delivering an alert to a wide coverage area but not well suited for delivering "actionable" information to specific population segments. For an EAS to be effective, it is essential for the target audience to be tuned in to a regional station. Actual practice shows this is not always the case, particularly late at night when the general population is asleep.

Door-to-door Notification	Door-to-door notification would be an ideal way to communicate with specific individuals or neighborhoods. However, efficiency is impacted by the number of addresses to be contacted, the number of personnel available to "walk the streets", and the amount of time available prior to the event (i.e., evacuation). It is highly unlikely that sufficient public safety personnel would be available to effectively provide such door-to-door notification services. Door-to-door also has the potential of putting first responders in harm's way.
Other Communications Devices	There are many communication devices available that may be able to receive emergency notifications – faxes, pagers, PDAs and cell phones. However, as with Weather Alert Radio, their level of penetration throughout the population is too low to ensure effective delivery. Selecting distinct population segments based on geography with such devices is also a problem.
Outdoor warning sirens	Sirens can be effective in their ability to alert people within hearing distance that a crisis or emergency situation may exist. Outdoor warning sirens and public address systems are commonly located in densely populated urban settings, but are not as useful in rural areas. Sirens are intended to alert the public to implement some pre-determined action (i.e., tune to radio and television for specific information on a hazard). However the public generally has no awareness of the need to do so and often will ignore sirens thinking they are a "test" unless they see the hazard approaching, which is often then too late to take appropriate action. In addition, in many areas, sirens are used only for specific emergencies, such as floods or tornadoes, and are of little use in helping public safety personnel alert residents to other events/crises.
NOAA Weather Radio	Weather Alert Radio, while an invaluable tool, has limited applicability. Lacking proper feedback, public safety and emergency management officials have no way of being sure that everyone in their jurisdiction can be reached with such announcements because, similar to broadcast announcements, the audience must have a NOAA radio, and be tuned in.
Sirens on public safety vehicles	These have many of the same drawbacks as both door-to-door notification and outdoor warning sirens. Emergency vehicle sirens do not provide "actionable" information on how to respond. In addition, crucial emergency service personnel may be tied up when their services are more urgently needed for response.

Adapted from *NENA Minimum Standards for Emergency Telephone Notification Systems, NENA 56-003, June 12, 2004*

Multiple or redundant systems are the most effective, since people do not hear one warning, they may still get the message from another part of the system. Each has advantages and disadvantages. Outdoor warning sirens can reach the most people quickly (except those around loud noise, such as at a factory or during a thunderstorm), but they do not explain what hazard is coming and cannot be sounded unless a timely means of threat recognition exists. Radio and TV provide a lot of information, but people have to know to turn them on. Telephone trees are fast, but can be expensive, do not work when phones lines are down, and can break down if some people in the chain are directly affected.

Just as important as issuing a warning is telling people what to do. A warning program should have a public information aspect. People need to know the difference between a

tornado warning (when they should seek shelter in a basement) and a flood warning (when they should stay out of basements).

B.5.3 9-1-1 and 2-1-1

Some communities have expanded their basic 9-1-1 location identification telephone service to include features such as "enhanced 9-1-1" registering name, address, and a description of the building/site. Additionally, non-emergency 2-1-1 service can be used to have people call to get information, such as locations of cooling shelters during a heat wave. For information on coverage areas and contact information for area 2-1-1 systems, see www.211oklahoma.org.

B.5.4 Emergency Telephone Notification Systems (ETNS)

It has become more common to use an "Emergency Telephone Notification System" (frequently referred to as "reverse 9-1-1") with which a community or Tribe can send out a mass telephone announcement to targeted numbers in the 9-1-1 system, effectively supplementing a community's other warning systems. An effective ETNS can offer certain advantages over other systems:

- ETNS systems provide the ability to precisely target populations in specific geographic locations better than existing alternatives, particularly when ETNS systems are integrated with geographic information systems (GIS) maps commonly used by 9-1-1 systems;
- The telephone, more than any other communications medium, allows officials to deliver specific actionable information that lets those in harm's way know exactly what to do, what to expect, or what to look for;
- The telephone is always on, providing the opportunity to reach nearly everyone in a target area either live or through voicemail.
- Many systems also offer the option of allowing people to call in and retrieve the same message or an updated one. This can reduce the subsequent number of calls to 9-1-1 from people who did not fully understand the message the first time. (*Source: NENA Minimum Standards for Emergency Telephone Notification Systems, NENA 56-003, June 12, 2004*).

B.5.5 Response

The protection of life and property is the foremost important task of emergency responders. Concurrent with threat recognition and issuing warnings, government officials should respond with actions that can prevent or reduce damage and injuries. Typical actions and responding parties include the following:

- activating the emergency operations room (emergency management);
- closing streets or bridges (police or public works);

- shutting off power to threatened areas (utility company);
- holding children at school/releasing children from school (school district);
- passing out sand and sandbags (public works);
- ordering an evacuation (mayor);
- opening evacuation shelters (Red Cross);
- monitoring water levels (engineering);
- providing security and other protection measures (police).

In the event of an emergency, responders must make an organized effort to minimize the impacts of the incident.

An emergency action plan ensures that all bases are covered and that the response activities are appropriate for the expected threat. These plans are developed in coordination with the agencies or offices that are given various responsibilities.

Emergency response plans should be updated annually to keep contact names and telephone numbers current and to make sure that supplies and equipment that will be needed are still available. They should be critiqued and revised after disasters and exercises to take advantage of the lessons learned and changing conditions. The end result is a coordinated effort implemented by people who have experience working together so that available resources will be used in the most efficient manner.

B.5.6 Emergency Operations Plan (EOP)

An EOP develops a comprehensive (multi-use) emergency management program which seeks to mitigate the effects of a hazard, to prepare for measures to be taken which will preserve life and minimize damage, to respond during emergencies and provide necessary assistance and to establish a recovery system in order to return communities to their normal state of affairs. The plan defines who does what, when, where and how in order to mitigate, prepare for, respond to and recover from the effects of war, natural disasters, technological accidents and other major incidents / hazards.

Funding for creating or updating an EOP is available from FEMA. For information on how to obtain funding contact the Oklahoma Office of Homeland Security or go to www.dhs.gov/xopnbiz/grants/.

The State of Oklahoma's Emergency Operations Plan is published on www.ok.gov/OEM/Programs_&_Services/Planning/State_Emergency_Operations_Plan_(EOP)/.

Communities and Public School Districts should coordinate the local emergency response plans with the local school district's emergency operations plan.

B.5.7 Incident Command System (ICS)

The Incident Command System is the model tool for the command, control and coordination of resources at the scene of an emergency. It is a management tool of procedures for organizing personnel, facilities, equipment and communications. ICS is based upon basic management skills managers and leaders already know: planning, directing, organizing, coordinating, communicating, delegating and evaluating.

Continuity of Operations (COOP) planning should be addressed in the EOP. COOP ensures the essential functions of an organization, including government, can continue to operate during and after an emergency incident. An incident may prevent access to normally operating systems, such as physical plant, data or communication networks, or transportation. Government, business, other organizations, and families should be encouraged to prepare by regularly backing up computer hard drives, copying essential files, and storing these items in a separate location.

ICS is not a means to wrestle control or authority away from agencies or departments, a way to subvert the normal chain of command within a department or agency, nor is it always managed by the fire department, too big for small everyday events or restricted to use by government agencies and departments. ICS is an adaptable methodology suitable for emergency management as well as many other categories. If leadership is essential for the success of an event or a response, ICS is the supporting foundation for successfully managing that event.

The Incident Command System is built around five major management activities. These activities are:

- Command – sets objectives and priorities and has overall responsibility at the incident or event.
- Operations – conducts tactical operations to carry out the plan and directs resources.
- Planning – develops the action plan to accomplish objectives and collects and evaluates information.
- Logistics – provides resources and services to support incident needs.
- Finance / Administration – monitors costs, provides accounting, reports time and cost analysis.

The system can grow or shrink to meet changing needs. This makes it very cost-effective and efficient. The system can be applied to a wide variety of situations such as fires, multi-jurisdiction and multi-agency disasters, hazardous material spills and recovery incidents, pest eradication programs and state or local natural hazards management.

For a detailed description of ICS, a diagram of ICS organization, or checklists of duties for each management activity and links to other resources see http://www.911dispatch.com/ics/ics_main.html.

B.5.8 Mutual Aid / Interagency Agreements

Local governments should establish mutual aid agreements for utility and communications systems, including 9-1-1. Mutual aid or interagency agreements have

value for preventing or responding to other hazard or emergency situations, as fire and police departments often do.

B.5.9 CERT (Community Emergency Response Team)

After a major disaster, local emergency teams quickly become overwhelmed. CERT is designed to have trained groups of people in every neighborhood and business ready to assist first responders (police, firefighters and EMS) during an emergency.

CERT programs train and equip residents in neighborhoods and businesses enabling them to "self-activate" immediately after a disaster. CERT teams are trained in:

- disaster preparedness;
- light fire suppression;
- Incident Command System;
- light search and rescue;
- basic disaster medical care;
- basic disaster psychology.

FEMA grants have been given to states for funding CERT programs or expanding existing teams. For information about the Oklahoma grant see www.fema.gov/news/newsrelease.fema?id=3155.

For more information on the CERT program talk to your local emergency management official or visit training.fema.gov/emiweb/CERT/.

B.5.10 Debris Management

The tornados of May 3, 1999 left an estimated 500,000 cubic yards of debris. Debris in the aftermath of a disaster poses significant health and safety risks. Debris can include fuel containers, chemicals, appliances and explosives.

Two key considerations regarding debris management are the need for rapid removal and protection of the public health and environment. Before a disaster strikes, communities should set up staging area(s) where residents and cleanup crews can take debris prior to final disposal.

Community members can participate in debris control by securing debris, yard items, or stored objects that may otherwise be swept away, damaged, or pose a hazard if floodwaters would pick them up and carry them away. Additionally, a community can pass and enforce an ordinance regulating dumping.

For the Oklahoma Department of Environmental Quality's *Guidelines for Debris Management* see document: http://www.deq.state.ok.us/factsheets/local/debris.pdf.

B.5.11 Critical Facilities Protection

"Critical facilities" were previously discussed in Section 2.3.5. Generally, they fall into three categories:

- buildings or locations vital to the response and recovery effort, such as police and fire stations and telephone exchanges;
- buildings or locations that, if damaged, would create secondary disasters, such as hazardous materials or utility facilities, or water treatment plants;
- locations that would require extraordinary response or preparedness measures, such as hospitals, retirement homes, or childcare facilities.

In addition, since September 11th, FEMA has included financial institutions as possible critical facilities, because of the potential devastating effect on the community infrastructure upon their loss.

Protecting privately-owned critical facilities during a disaster is the responsibility of the facility owner or operator. However, if they are not prepared for an emergency, the rest of the Tribe or community could be impacted. If a critical facility is damaged, workers and resources may be unnecessarily drawn away from other disaster response efforts. If the owner or operator adequately prepares such a facility, it will be better able to support the community's emergency response efforts.

Many critical facilities have full-time professional managers or staff who are responsible for the facility during a disaster. These people often have their own emergency response plans. Many facilities would benefit from early disaster warning, disaster response planning, and coordination with community disaster response efforts.

Schools are critical facilities not only because of the special population they accommodate, but because they are often identified as shelter sites for residents. Processes and procedures can be developed to determine mitigation priorities incorporated into capital improvement plans that will ensure these buildings function after an event.

Protocols should be in place to ensure there are adequate backup facilities for the Emergency Operations Centers and 9-1-1 Centers, both of which are critical facilities.

B.5.12 Site Emergency Plans

Communities can encourage development and testing of internal emergency plans and procedures, including continuity planning, by businesses and other organizations.

Communities should develop and test site emergency plans for schools, factories, office buildings, shopping malls, Tribal casinos, hospitals, correctional facilities, stadiums, recreation areas, and other similar facilities.

B.5.13 Post-Disaster Recovery and Mitigation

After a disaster, communities should undertake activities to protect public health and safety, facilitate recovery, and help people and property for the next disaster. Throughout the recovery phase, everyone wants to get "back to normal." The problem is, "normal" means the way they were before the disaster. Measures needed include the following:

Recovery Actions

- patrolling evacuated areas to prevent looting;
- providing safe drinking water;

- monitoring for diseases;
- vaccinating residents for tetanus;
- clearing streets;
- cleaning up debris and garbage;
- regulating reconstruction to ensure that it meets all code requirements, including the NFIP's substantial damage regulations.

A firefighter searches through the remains of a hotel in Midwest City.
Oklahoman Staff Photo by Paul Hellstern

Mitigation Actions

- conducting a public information effort to advise residents about mitigation measures they can incorporate into their reconstruction work;
- evaluating damaged public facilities to identify mitigation measures that can be included during repairs;
- acquiring substantially or repeatedly damaged properties from willing sellers;
- planning for long term mitigation activities;
- applying for post-disaster mitigation funds.

Requiring permits, conducting inspections, and enforcing the NFIP substantial improvement/substantial damage regulations can be very difficult for local, understaffed overworked offices after a disaster. If these activities are not carried out properly, not only does the municipality miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP.

B.5.14 StormReady Communities

StormReady, a program started by the National Weather Service in Oklahoma in 1999, helps arm America's communities with the communication and safety skills needed to save lives and property before and during an event. *StormReady* communities are better prepared to save lives from the onslaught of severe weather through better planning, education, and awareness.

StormReady has different guidelines for different sized communities. To be StormReady a community must:

- establish a 24-hour warning point and emergency operations center;
- have more than one way to receive severe weather warnings and forecasts and to alert the public;
- create a system that monitors weather conditions locally;
- promote the importance of public readiness through community seminars;
- develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

The economic investment in *StormReady* will depend on current assets. There is currently no grant funding for becoming *StormReady*. However, the Insurance Services Organization (ISO) provides CRS credit to *StormReady* communities. This credit is used to determine the CRS rating, which can lower flood insurance rates.

For details on how to become *StormReady* and the requirements based on community size see http://www.stormready.noaa.gov/. For a list of currently certified Stormready communities and counties, see www.stormready.noaa.gov/com-maps/ok-com.htm.

B.5.15 Conclusions

1. Using solid, dependable threat recognition systems is first and foremost in emergency services.
2. Following a threat recognition, multiple or redundant warning systems and instructions for action are most effective in protecting residents.
3. Good emergency response plans that are updated yearly ensure that well-trained and experienced people can quickly take the appropriate measures to protect residents and property.
4. To ensure effective emergency response, critical facilities protection must be part of the plan.
5. Post-disaster recovery activities include providing neighborhood security, safe drinking water, appropriate vaccinations, and cleanup and regulated reconstruction.

B.5.16 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures*. Table 6–2. for a complete listing of all recommended mitigation measures by hazard and priority.

B.6 Natural Resource Protection

Natural resource protection activities are generally aimed at preserving and restoring the natural and beneficial uses of natural areas. In doing so, these activities enable the beneficial functions of floodplains and drainageways to be better realized. These natural functions include:

- storage of floodwaters;
- absorption of flood energy;
- reduction of flood scour;
- infiltration and aquifer/groundwater recharge;
- removal/filtration of excess nutrients, pollutants, and sediments from floodwaters;
- habitat for flora and fauna;
- recreation and aesthetic opportunities;
- opportunities for off-street hiking and biking trails.

Wetlands are a valued resource to ecosystems and should be protected.

This Section reviews natural resource protection activities that protect natural areas and mitigate damage from other hazards. Integrating these activities into the hazard mitigation program will not only reduce the community's susceptibility to flood damage, but will also improve the overall environment.

B.6.1 Wetland Protection

Wetlands are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality, and provide habitat for many species of fish, wildlife, and plants.

Wetlands are regulated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency under Section 404 of the Clean Water Act. Before a "404" permit is issued, the plans are reviewed by several agencies, including the Corps and the U.S. Fish and Wildlife Service. Each of these agencies must sign off on individual permits. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits.

Wetlands

- Store large amounts of floodwaters.
- Reduce flood velocities and erosion.
- Filter water, making it cleaner for those downstream.
- Provide habitat for species that cannot live or breed elsewhere.

B.6.2 Erosion and Sedimentation Control

Farmlands and construction sites typically contain large areas of bare exposed soil. Surface water runoff can erode soil from these sites, sending sediment into downstream waterways. Sediment tends to settle where the river slows down and loses power, such as when it enters a lake or a wetland.

Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. When channels are constricted and flooding cannot deposit sediment in the bottomlands, even more is left in the channels. The result is either clogged streams or increased dredging costs.

Construction projects, which can expose large areas to erosion, should be closely monitored.

Not only are the drainage channels less able to do their job, but also the sediment in the water reduces light, oxygen, and water quality and often brings chemicals, heavy metals and other pollutants. Sediment has been identified as the nation's number one nonpoint source pollutant for aquatic life.

Practices to reduce erosion and sedimentation have two principal components:

1. minimize erosion with vegetation;
2. capture sediment before it leaves the site.

Lack of vegetation along drainage channels promotes erosion.

Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site. Runoff can be slowed down by measures such as terraces, contour strip farming, no-till farm practices, sediment fences, hay or straw bales (as illustrated), constructed wetlands, and impoundments (e.g., sediment basins and farm ponds).

Erosion and sedimentation control regulations mandate that these types of practices be incorporated into construction plans. They are usually oriented toward construction sites rather than farms. The most common approach is to require applicants for permits to submit an erosion and sediment control plan for the construction project. This allows the applicant to determine the best practices for the site.

One tried and true approach is to have the contractor design the detention basins with extra capacity. They are built first, so they detain runoff during construction and act as sediment catch basins. The extra capacity collects the sediment that comes with the runoff until the site is planted and erosion is reduced.

B.6.3 River Restoration

There is a growing movement that has several names, such as "stream conservation," "bioengineering" or "riparian corridor restoration." The objective of these approaches is to return streams, stream banks and adjacent land to a more natural condition, including the natural meanders. Another term is "ecological restoration" which restores native indigenous plants and animals to an area.

A key component of these efforts is using appropriate native plantings along the banks that resist erosion. This may involve "retrofitting" the shoreline with willow cuttings, wetland plants, and/or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

Retrofitting streambanks with willow cuttings and geotextiles can be more cost effective than riprap or concrete-lined floodways.

Studies have shown that after establishing the right vegetation, long-term maintenance costs are lower than if the banks were concrete. The Natural Resources Conservation Service estimates that over a ten-year period, the combined costs of installation and maintenance of a natural landscape may be one-fifth of the cost for conventional landscape maintenance, e.g., mowing turf grass.

B.6.4 Best Management Practices

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. State and federal water quality laws have reduced the pollutants that come from these facilities.

Non-point source pollutants come from non-specific locations and are harder to regulate. Examples are lawn fertilizers, pesticides, and other farm chemicals, animal wastes, oils from street surfaces and industrial areas, and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams.

Best management practices (BMPs) are measures that reduce nonpoint source pollutants that enter the waterways. BMPs can be implemented during construction and as part of a project's design to permanently address nonpoint source pollutants.

There are three general categories of BMPs:

1. **Avoidance**—Setting construction projects back from the stream;
2. **Reduction**—Preventing runoff that conveys sediment and other water-borne pollutants, such as planting proper vegetation and conservation tillage;
3. **Cleansing**—Stopping pollutants after they are en route to a stream, such as using grass drainageways that filter the water and retention and detention basins that let pollutants settle to the bottom before they are drained.

In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. Combining water quality and water quantity measures can result in more efficient multi-purpose stormwater facilities.

Because of the need to clean up our rivers and lakes, there are several laws mandating the use of best management practices for new developments and various land uses. The furthest reaching one is the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) requirements.

B.6.5 Dumping Regulations

NPDES addresses liquid pollutants. Dumping regulations address solid matter, such as shopping carts, appliances and landscape waste that can be accidentally or intentionally thrown into channels or wetlands. Such materials may not pollute the water, but they can obstruct even low flows and reduce the channels' and wetlands' ability to convey or clean stormwater.

Many cities have nuisance ordinances that prohibit dumping garbage or other "objectionable waste" on public or private property. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions in channels.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or discarding leaves or branches in a watercourse can cause a problem to themselves and others. Therefore, a dumping enforcement program should include public information materials that explain the reasons for the rules as well as the penalties.

Regular inspections to catch violations also should be scheduled. Finding dumped materials is easy; locating the source of the refuse is hard. Usually the owner of a property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points.

B.6.6 Conclusions

1. Wetlands play an important role in the natural course of flood control, preservation of water quality, and wildlife habitation, making a strong case for their protection.
2. Erosion can be reduced by use of vegetation. Sedimentation should be captured before it leaves its original location with oversized detention basins.
3. Vegetation used along riverbanks works more effectively in river maintenance than using banks made of concrete.
4. Nonpoint source pollutants are best managed by keeping construction projects away from streams, reducing sediment runoff, and using grass drainageways and detention basins for filtration.
5. Dumping regulations need to be communicated to the public and enforced.

6. The establishment and maintenance of wildlife habitat and natural ecosystems should be an important aspect of any drainage system program the community may implement in regards to floodplain management. This can be developed in cooperation with the Oklahoma Department of Wildlife Conservation, allowing aquatic plants and wildlife to be established in stormwater detention ponds and floodways.

B.6.7 Recommendations

Refer to *Chapter 6: Action Plan and Mitigation Measures,* Table 6–2, for a complete listing of all recommended mitigation measures by hazard and priority.

Appendix C: Meeting Sign-in Sheets and Agendas

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Initial Client Introduction Meeting		
Date of Meeting: February 24, 2009	**Time Begin: 3 pm/ City Council: 6pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	1. Peter Stasiak	Planning & Com. Dev. Dir.		ext. 4982 918 423 9300	peter.stasiak@cityofmcalester.com
	2. Cliff Pitner	Engineering		EXT. 4951 918-423-9300	Cliff.Pitner@CityofMcAlester.com
	3. George Marcangeli	Public Works Dir.		EXT. 4992 918-423-9300	George.Marcangeli@CityofMcAlester.com
	4.				
	5.				
	6.				
	7.				
	8.				
	9.				
	10.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project:	**City of McAlester Multi-Hazard Mitigation Plan**	
Purpose of Meeting:	**Introductory Meeting**	
Date of Meeting: March 24, 2009	**Time Begin: 3:00 pm**	**Time End:** 4:45

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
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CP	2. Pitner, Cliff	Engineering		918-423-9300 X4951	cliff.pitner@cityofmcalester.com
	3. Marcangeli, George	Public Works Director		918-423-9300 X4992	george.marcangeli@cityofmcalester.com
	4. GARY WANSICK	MCALESTER PD (CAPTAIN)		423 1212	gary.wansick@ " " "
LS	5. LISA SUTTERFIELD	MCALESTER PD / 911 Coordinator (ASST. E. MGR.)		423-9300 X4978	lisa.sutterfield@cityofmcalester.com
	6. Lois Lupardus	McAlester/Pitts Co Emergency Mgmt		918-423-5655	civildefense@allegiance.tv
	7. HAROLD Stewart	Fire Dept. (CHIEF)		918-423-9300 ext. 4932	HAROLD.stewart@cityofmcalester.com
DM	8. David Medley	Utilities Director		918-423-9300 Ext. 4995	david.medley@cityofmcalester.com
	9. RICHARD COTTON	SR. ENG. TECH		918-423-9300 EXT. 4994	richard.cotton@cityofmcalester.com
	10.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Lightning and Hail		
Date of Meeting: April 28, 2009	**Time Begin:** 3:00 pm	**Time End:** 4:30

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
PJS	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
CP	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
GM	3. Marcangeli, George	Public Works Director		918-423-9300 X4992	george.marcangeli@cityofmcalester.com
GW	4. Wansick, Gary	Captian, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
LS	5. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
LL	6. Lupardus, Lois McAlester →	Pitts Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	7. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
DM	8. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
RC	9. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com

Initial	Name	Position or Organizatior	T/C	Phone(s)	E-mail
	10. Rivas, Brett	Asst. Fire Chief	T		brett.rivas@cityofmcalester.com
MP	11. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
	12. House, Cliff		C	918-423-2736	
	13. Kuykendahl, John		C	918-423-5441	
	14. Hale, Charlie		C	918-423-5055	
PH	15. Hackler, Pat		C	405-371-4754	Faithusks @ Yahoo.com
CM	16. Martin, Chris		C	918-423-9397	bandcmartin@ALLEGIANCE.TV
	17. Testa, Ron		C	918-423-7414	
	18. Haynes, Cathy	First Deputy Pittsburg C. Assessor Office		918-423-4926	pittsburgassessor@yahoo.com
	19. Shannon, Mary	Deputy Supt.		918-423-4771	mshannon@mcalester.k12.ok.us
	20. Fanics, Willie	Safety/Risk mgt. City of McAlester		918-423-9300 EXT 4983	willie.fanics@cityofmcalester.com
	21.				
	22.				
	23.				
	24.				
	25.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project:	**City of McAlester Multi-Hazard Mitigation Plan**	
Purpose of Meeting:	**Tornadoes and High Winds**	
Date of Meeting: May 26, 2009	**Time Begin: 3:00 pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
RF	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
CP	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
Retired	3. Marcangeli, George	Public Works Director		918-423-9300 X4992	george.marcangeli@cityofmcalester.com
	4. Wansick, Gary	Captian, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	5. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	6. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	7. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
DRM	8. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
	9. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Rivas, Brett	Asst. Fire Chief	T		brett.rivas@cityofmcalester.com
ME	11. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
CH	12. House, Cliff		C	918-423-2736	
JL	13. Kuykendahl, John	Retired MCAAP	C	918-423-5441	
CLH	14. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
ABSENT	15. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
CMh	16. Martin, Chris	Retired (Boys & Girls Club of McA	C	918-423-9397	bandcmartin@allegiance.tv
Resigned	17. Testa, Ron		C	918-423-7414	
	18. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com
	19. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
WF	20. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
CH	21. Heathcock Clyde	MCA. Public Schools Campus Police Department		424-1611	cheathcock@mcalester.k12.ok.us
DG	22. Giacomo Danny	Director School Plant		918 423-1232	dgiacomo@mcalester.k12.ok.us
TM	23 Myers Trent	Pitts. Co. / McAlester Director Emergency Management		918 423-5655	
	24.				
	25.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Extreme Heat & Drought		
Date of Meeting: June23 , 2009	**Time Begin:** 3:00 pm	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
RDF	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
PJS	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
	3. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	4. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	5. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	6. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
DRM	7. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
	8. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	9. Rivas, Brett	Asst. Fire Chief	T		brett.rivas@cityofmcalester.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
	11. House, Cliff		C	918-423-2736	
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
	13. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	14. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
	15. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
	16. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com
	17. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	18. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
	19. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
	20. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
	21. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	22.				
	23.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Earthquakes, Expansive Soils & Subsidence		
Date of Meeting: July 28, 2009	**Time Begin: 3:00 pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
CP	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
PH	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
CEH	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
CH	11. House, Cliff		C	918-423-2736	
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
CM	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
DRM	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
	16. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	17. Rivas, Brett	Asst. Fire Chief	T		brett.rivas@cityofmcalester.com
	18. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	19. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
	20. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	21. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	22.				
	23.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting:		
Date of Meeting: August 25, 2009	**Time Begin: 3:00 pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
PJS	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
WF	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
DG	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
CEH	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
	11. House, Cliff		C	918-423-2736	
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
	16. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	17. Rivas, Brett	Asst. Fire Chief	T		brett.rivas@cityofmcalester.com
	18. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	19. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
	20. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	21. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	22. Woods, Bryan	Pittsburg County Assessor Field Deputy		9184234726	Jimkelley46@yahoo.com
BRT	23. Tucker, Bobby	Fire Marshal			

Modzelewski, John Public Works Director 918-421-0379 John.Modzelewski@cityofmcalester.com
City Engineer

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Hazardous Materials & Transportation		
Date of Meeting: September 22, 2009	**Time Begin: 3:00 pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	Rob Robb				
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com ✓
	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com ✓
	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com ✓
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com ✓
	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us ✓
	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com ✓
✓	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net ✓
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com ✓

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us ✓
CH	11. House, Cliff	Lakewood Christian Church	C	918-423-2736	cliff.lcc@hotmail.com ✓
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
ll	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv ✓
	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
DRM	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com ✓
	16. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
BR	17. Rivas, Brett	Asst. Fire Chief	T		brett.rivas@cityofmcalester.com
	18. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us ✓
	19. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com ✓
	20. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com ✓
	21. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com ✓
	22. Modzelewski John	Public Works Director	T	918-423-9300	
	23.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Urban Fires & Wildfires		
Date of Meeting: October 27, 2009	**Time Begin: 3:00 pm**	**Time End:** 4:15

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
RDF	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
CEH	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
CH	11. House, Cliff	Lakewood Christian Church	C	918-423-2736	cliff.lcc@hotmail.com
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
CM	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
DRM	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
JM	16. Modzelewski, John	Public Works Director	T	918-423-9300	john.modzelewski@cityofmcalester.com PIC
	17. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	18. Rivas, Brett	Asst. Fire Chief	T		jerry.rivas@cityofmcalester.com
	19. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	20. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
	21. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	22. Tucker, Bobby	Fire Marshal	T		
	23. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	24. Woods, Bryan	Pittsburg County Assessor Field Deputy	T	918-423-4726	jimkelley46@yahoo.com
	25.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Winter Storms & Master Generator Plans		
Date of Meeting: November 17, 2009	**Time Begin: 3:00 pm**	**Time End:** 4:45

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
RF	Flanagan, Ron	Consultant	TC	918-749-2696	rdflanagan@rdflanagan.com
TW	WENRICK, TOM	CONSULTANT	TC	918-749-7781	
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
CP	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
RC	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
WF	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
PH	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
	11. House, Cliff	Lakewood Christian Church	C	918-423-2736	cliff.lcc@hotmail.com
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
	16. Modzelewski, John	Public Works Director	T	918-423-9300	john.modzelewski@cityofmcalester.com
	17. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	18. Rivas, Brett	Asst. Fire Chief	T		jerry.rivas@cityofmcalester.com
	19. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	20. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
	21. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	22. Tucker, Bobby	Fire Marshal	T		
	23. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	24. Woods, Bryan	Pittsburg County Assessor Field Deputy	T	918-423-4726	jimkelley46@yahoo.com
	25.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Flooding & Dam Failures		
Date of Meeting: December 15, 2009	**Time Begin: 3:00 pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
CP	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
RLa	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
DG	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
CEH	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
	11. House, Cliff	Lakewood Christian Church	C	918-423-2736	cliff.lcc@hotmail.com
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
ll	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
DM	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
JM	16. Modzelewski, John	Public Works Director	T	918-423-9300	john.modzelewski@cityofmcalester.com
	17. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	18. Rivas, Brett	Asst. Fire Chief	T		jerry.rivas@cityofmcalester.com
	19. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	20. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
	21. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
BRT	22. Tucker, Bobby	Fire Marshal	T		
	23. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	24. Woods, Bryan	Pittsburg County Assessor Field Deputy	T	918-423-4726	jimkelley46@yahoo.com
	25.				

Meeting Sign in Sheet

R.D. FLANAGAN & ASSOCIATES
Planning Consultants
www.rdflanagan.com

Project: City of McAlester Multi-Hazard Mitigation Plan		
Purpose of Meeting: Mitigation Measures		
Date of Meeting: January 26, 2010	**Time Begin: 3:00 pm**	**Time End:**

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
RDF	Flanagan, Ron	Consultant		918-749-2696	rdflanagan@rdflanagan.com
	1. Stasiak, Peter	Planning & Com Dev. Director	T	918-423-9300 X4982	peter.stasiak@cityofmcalester.com
CP	2. Pitner, Cliff	Engineering/Public Works	T	918-423-9300 X4951	cliff.pitner@cityofmcalester.com
RC	3. Cotton, Richard	Sr. Engineering Tech.		918-423-9300 X4994	richard.cotton@cityofmcalester.com
	4. Echelle, Mike	Director, Pittsburg County Health Dept,	T		
WF	5. Faries, William	Safety/Risk Management, City of McAlester	T	918-423-9300 x4983	willie.faries@cityofmcalester.com
	6. Giacomo, Danny	Director, School Plant	T	918-424-1232	dgiacomo@mcalester.k12.ok.us
	7. Hackler, Pat		C	405-371-4754	faithusus@yahoo.com
CEH	8. Hale, Charlie	Retired Teacher	C	918-423-5055	chale3870@sbcglobal.net
	9. Haynes, Cathy	First Deputy Pittsburg County Assessors Office	T	918-423-4726	pittsburgassessor@yahoo.com

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	10. Heathcock, Clyde	McAlester Public Schools, Campus Police Department	T	918-424-1611	cheathcock@mcalester.k12.ok.us
	11. House, Cliff	Lakewood Christian Church	C	918-423-2736	cliff.lcc@hotmail.com
	12. Kuykendahl, John	Retired - MCAAP	C	918-423-5441	
	13. Lupardus, Lois	McAlester/Pittsburg Co. Emergency Management	T	918-423-5655	civildefense@allegiance.tv
	14. Martin, Chris	Retired, Boys & Girls Club of McAlester	C	918-423-9397	bandcmartin@allegiance.tv
	15. Medley, David	Utilities Director	T	918-423-9300 X4995	david.medley@cityofmcalester.com
	16. Modzelewski, John	Public Works Director	T	918-423-9300	john.modzelewski@cityofmcalester.com
	17. Myers, Trent	Pittsburg County/McAlester Director, Emer. Management	T	918-423-5653	
	18. Rivas, Brett	Asst. Fire Chief	T		jerry.rivas@cityofmcalester.com
	19. Shannon, Mary	Deputy Superintendent	T	918-423-4771	mshannon@mcalester.k12.ok.us
	20. Stewart, Harold	McAlester Fire Chief	T	918-423-9300 X4932	harold.stewart@cityofmcalester.com
	21. Sutterfield, Lisa	McAlester PD/ 911 Coordinator	T	918-423-9300 X4928	lisa.sutterfield@cityofmcalester.com
	22. Tucker, Bobby	Fire Marshal	T		
	23. Wansick, Gary	Captain, McAlester PD	T	918-423-1212	gary.wansick@cityofmcalester.com
	24. Woods, Bryan	Pittsburg County Assessor Field Deputy	T	918-423-4726	jimkelley46@yahoo.com
	25.				

Initial	Name	Position or Organization	T/C	Phone(s)	E-mail
	26. Darrell Miller	Asst. Chief		919-423-1212	darrell.miller@edgecombecounty.com
	27. David Bailey	Capt. Police Dept		423-1212	
	28. Don Hart	CAPT. Police Dept		423-1212	dhass2525@yahoo.com
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