

CARTER COUNTY OKLAHOMA



HAZARD MITIGATION PLAN 2018 UPDATE

*Including the towns of: Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City,
Springer, Tatums, Wilson*

*The Public School Districts of: Dickson, Fox, Healdton, Lone Grove, Springer,
Wilson, Zaneis, and Southern Oklahoma Technology Center*

35 A ST SW
Ardmore, OK 73401

Developed by the Carter County Hazard Mitigation Planning Team
Appendices of this Plan are for Official Use Only. Not for public viewing.

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Section 1

Introduction

SECTION ONE

Introduction

This Plan is a hazard mitigation plan update for Carter County, the Towns of Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, and Wilson. This plan also includes the school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, and Zaneis. It also includes Southern Oklahoma Technology Center (Southern Tech), which did not participate in the previous plan. When referring to the “Planning Area,” the term is inclusive of all participating jurisdictions listed. Carter County is bordered by Garvin and Murray Counties to the north, Johnston and Marshall Counties to the east, Love County to the south, and Jefferson and Stephens Counties to the west. The total land area within the County is approximately 834 square miles.



Carter County Planning Area

Planning Process:

Carter County Planning Team Members:

Name	Title	Jurisdiction Represented	Contribution to Planning Process
Paul Tucker Shelly Stahlbusch Lorraine Acevedo	County EM 911 Coordinator LEPC LEPC Health Department	Carter County	<ul style="list-style-type: none"> • Lead planning team • Provided County hazard information • Provided County Mitigation Actions

Amber Wilson Joe David McReynolds Bill Baker Jerry Alvord	EM Commissioner Commissioner Commissioner	City of Ardmore Carter County Carter County Carter County	<ul style="list-style-type: none"> Assembled public comments from Carter County Provided County capability assessment
Bobbie Robbins Robert Thornton Chris Chancellor Lane Jones Frank Schaff Kyle Lawson Troy Duke Judy Cavner Lovie Carter Stacy Phelps Bruce Hoyt Johnny Turner Ann Marutzky Denny Meeks	City Clerk EM EM City Manager Mayor Mayor Fire Chief Mayor City Clerk Fire Chief Code Officer Police Chief City Clerk Fire Chief	Ratliff City Ratliff City Healdton Healdton Wilson Gene Autry Dickson Springer Tatums Lone Grove Healdton Healdton Wilson Springer	<ul style="list-style-type: none"> Provided city hazard information Provided city mitigation actions Provided city capability assessment
Matt Krimmer Jeff Couasure Brent Phelps Terry Shaw Mary Jane Miller Cynthia Hunter Eric Smith Ryan Cole Dr. David Powell Kerry Blankenship Sherry Carlile	Principle Superintendent Superintendent Superintendent Superintendent Superintendent Superintendent Superintendent Superintendent Safety Secretary	Dickson Schools Dickson Schools Fox Schools Healdton Schools Lone Grove Schools Springer Schools Wilson Schools Zaneis Schools Southern Tech Southern Tech Wilson Schools	<ul style="list-style-type: none"> Provided school district hazard information, mitigation actions, and capability assessment. Assembled public comments from school district staff.
Charles Newell Casper Warren Nancy McMillen Steven Leverett	Citizen Citizen Citizen Citizen	Dickson Dickson Wilson Springer	<ul style="list-style-type: none"> Provided mitigation actions and hazard information.

The Carter County Hazard Mitigation Planning Committee was formed to provide guidance during the preparation of this Plan. This committee was comprised of representatives from local government, County Commissioners, state government, local businesses/industries and citizens.

The Carter County Hazard Mitigation Plan update was developed during several meetings that were held throughout the county from June 2016 thru July 2016 to allow participants the opportunity to provide input for the plan update. The public was invited to the four planning meetings thru a variety of means, to include, social media posts, website postings and postings on community boards within City Halls and other locations. Their contribution to the planning process is listed in the chart above.

Information pertaining to capabilities of the jurisdictions and schools districts was also collected to be incorporated into the plan update.

Several school districts and towns were unable to attend meetings held on the above listed dates. However, phone conferences were conducted with Wilson SD (Eric Smith), Healdton SD (Terry Shaw), Springer SD (Cynthia Hunter), Zaneis SD (Ryan Cole), Town of Gene Autry (Kyle Lawson), and the Town of Springer (Denny Meeks & Steven Leverett).

Discussion was had on the hazards assessment of the County. After reviewing the hazards listed in the 2010 plan, it was decided that the hazards of Landslides and Expansive Soils no longer pose a threat to the County. This determination was based on a lack of previous occurrences and/or documented damages posed by these threats. These hazards will be reviewed again during the next update phase to determine if they still do not pose a threat or if new data suggests that they now pose a threat. These two hazards will be removed from this plan update.

Of the remaining hazards, they were reviewed and determined that they still pose a significant threat to the County and its residents. The top three were determined to be that of Tornados, Wildfire and Flooding. Mitigation actions were reviewed for all hazards and found to be still viable for this plan update. No mitigation actions will be changed at this time.

Other Stakeholders

There are many public agencies, private organizations, and businesses that contend with natural hazards. These entities were contacted; either in person, via email, or phone to collect information on the hazards and to help determine how their programs could best supports the County’s mitigation program. Among the organizations and agencies contacted were:

Neighboring Communities, Businesses, and Non-Profit Agencies Contacted:

- Walmart Supercenter—Store Manager
- Lowes Home Improvement—Store Manager
- Mercy Hospital Ardmore—Lori Smith, Safety
- Mercy Hospital Healdton—Kasie Owens, Nurse
- Healdton Family Center—Kevin Marshal, Owner
- Delbert’s Grocery—Curtis Key, Manager
- Michelin North America—Clarence Perryman, ERT
- Valero Refinery—Ken Goetz, Safety Coordinator
- Chickasaw Nation—Sara Jones, Emergency Manager
- American Red Cross—Shelly Webb, Disaster Program Manager
- The Salvation Army—Nathan Newell, Social Services Director
- Emergency Managers:
 - City of Ardmore—Amber Wilson
 - Garvin County—Bud Ramming
 - Johnston County—Jason Bryant
 - Love County—David Bond
 - Marshall County—Robert Chaney
 - Murray County—Gary Ligon
 - Stephens County—Gary Ball, Gary Curtis

State and Federal Agencies Contacted:

- National Weather Service—Rick Smith, Warning Coordination Meteorologist
- Oklahoma Water Resources Board—State NFIP Coordinator
- Oklahoma Department of Emergency Management—Jim Rosser (Hazard Mitigation Planner)
- Oklahoma Department of Emergency Management—Kim Marshall (Hazard Mitigation Planner)
- Oklahoma Department of Emergency Management—Nicholas Rutledge (Hazard Mitigation Planner)
- Oklahoma Department of Emergency Management—Durward Cook (SE Coordinator)
- Natural Resources Conservation Service—Jim Williams (District Conservationist)
- US Army Corps of Engineers—(Emergency Manager)

Community Mitigation Goals:

During the update of the Carter County Hazard Mitigation Plan, the goals were reviewed and were found to be adequate for the update of the plan.

- Goal 1: Protect public health and safety and property.**
- Goal 2: Continue to improve infrastructure by reducing potential vulnerability to all hazards in Carter County.**
- Goal 3: Continue to identify and reduce repetitive flooding in Carter County.**
- Goal 4: To enhance pre-disaster and prevention activities.**

Existing Plans/Programs:

There are various local, state, and federal agency operational plans, along with private organizations discussed in the Carter County All-Hazard Mitigation Plan, which coordinate or interact with this Hazard Mitigation Plan. Below is a list of the current plans that were reviewed and integrated, where appropriate, into the Carter County All-Hazard Mitigation Plan:

Plan Title	Information Used
Carter County Emergency Operations Plan	Capability Assessment
State Hazard Mitigation Plan	Hazard definitions, previous occurrence data, disaster history and state goals.
School Emergency Action Plans	Wildfire extent, probability, fuel sources. Evacuation and transportation procedures.
Local Records	Evacuation Routes, High risk areas, vulnerable populations.
Arbuckle Dam Emergency Action Plan	Information was reviewed and integrated into the capability assessment, risk assessment, and mitigation strategy.
Caddo Creek Watershed Emergency Action Plans for Dam Nos. 8, 13, 18, 27 & 29.	Information was reviewed and integrated into the capability assessment, risk assessment, and mitigation strategy.

Plan Point of Contact:

Primary

Paul Tucker
35 A ST SW
Ardmore, OK 73401
(580) 223-7937

Secondary

Shelly Stahlbusch
25 A ST NW, Suite 100
Ardmore, OK 73401
(580) 224-9006

Plan Maintenance

Monitoring, Evaluating, and Updating Plan:

The Carter County Emergency Manager will perform any necessary monitoring site visits on an as needed basis. He/she will also be the lead contact for phone calls, scheduling of meetings, and will:

- Monitor and evaluate the hazard analysis for changes and additions.
- Monitor and evaluate the objectives and determine if they meet current and expected hazardous conditions.
- Determine if there were any implementation problems, such as social, technical, administrative, political, legal, economic, and environmental or coordination issues with other agencies.

The mayors, superintendents, and emergency management will be responsible for the monitoring of the plan. The plan will remain an active and relevant document with continued public participation.

The chairperson of the planning team will be responsible for notifying planning team members regarding scheduled meetings and topics. If any planning team members are not able to continue as part of the planning team the lead representative of each plan participant will be responsible to designate a new planning team member to represent their community.

Annually the planning team will meet to evaluate the risk assessment to ensure the hazard information along with the vulnerabilities and impacts originally addressed are still valid for the participating communities. The planning team will also monitor and evaluate then document any changes in the processes and requirements identified in the Carter County Hazard Mitigation Plan. The planning team will submit report at bi-annual meetings summarizing the effectiveness of the ongoing maintenance processes, as well as the incorporation of the Hazard Mitigation Plan into each of the jurisdictions planning mechanisms. In addition to monitoring and evaluating the plan, each representative on the planning team will monitor the progress of the mitigation actions and seek out grant funding as programs announce availability.

Twenty-four months before the plan expiration, the plan update process will begin. The planning team will reconvene quarterly plan development meetings as described in this 2016, Carter County Hazard Mitigation Plan's planning process to discuss the findings of the meetings, update the risk assessment, and revise the strategy and plan components as needed. A draft plan will be submitted to Oklahoma Emergency Management for review twelve months before the plan expiration. Any revisions will be

incorporated into the document as necessary, and the plan resubmitted to FEMA for approval. Once approved, participating jurisdictions will adopt the plan by resolution.

Continued Public Participation and Involvement:

Carter County will involve the public directly in the continual reshaping and updating of the Hazard Mitigation Plan. The Carter County Emergency Management Director with the assistance of the planning committee will conduct an annual review of the Plan. The Plan will be updated every five years. Every attempt will be made to ensure the public will be able to directly comment on and provide feedback about the Plan by utilizing electronic surveys/forms, and e-mails. Meetings will be publicized on the Emergency Management website and social media pages and open to the public for comment. These meetings will provide the public a forum where Carter County residents can express their concerns, opinions, or ideas about the Plan.

A copy of this plan will be available at the Carter County Emergency Management office and the plan will be available to any citizen upon request. Copies of the Plan will be distributed to every City Hall, Emergency Management Director, and School Superintendent.

City and county websites will also be utilized to notify the public and additional stakeholders of the opportunity to comment as well as serving as a tool they can utilize to submit comments for review. Upon completion of the update process, the plan will be resubmitted to the State and FEMA for approval.

A draft copy of this plan has been made available for public review and comment at the Carter County Emergency Management Office.

Section 2

Capabilities Assessment

SECTION 2

Capability Assessment:

Each community has a unique set of capabilities, including authorities, policies, programs, staff, and funding, and other resources available to accomplish mitigation and reduce long-term vulnerability. By reviewing the existing capabilities in each jurisdiction, the planning team identified capabilities that currently reduce disaster losses or could be used to reduce losses in the future, as well as capabilities that inadvertently increase risks in the planning area. The following is a capability assessment for Carter County and participating municipalities. School Districts completed a capability assessment in November 2016. That information is included at the end of this section.

This table provides a summary of the plans, codes, policies, and ordinances currently in place in each participating jurisdiction. Existing programs and policies were reviewed in order to identify those that may weaken or enhance the hazard mitigation objectives outlined in this document. This list does not necessarily reflect every plan, ordinance, or other guidance document within each jurisdiction; however, this is a summary of the guidance documents known to and recommended for review by the members of the planning team. The checkmark (√) indicates that the jurisdiction reported having the authority to implement the specific regulatory tool and that the tool is currently in place.

Legal and Regulatory Capabilities

Jurisdiction	Building Code	Zoning Ordinance	Subdivision Ordinance	Special Purpose Ordinance	Comprehensive Plan	Capital Improvement Plan	Economic Improvement Plan	Emergency Operations Plan	Post Disaster Recovery Plan	Site Plan Review Requirements
Carter County				√				√		
Dickson	√	√	√					√		
Gene Autry				√				√		
Healdton	√	√		√			√	√		√
Lone Grove	√	√	√			√	√	√		
Ratliff City				√				√	√	
Springer								√		
Tatums								√		
Wilson				√				√		

Administrative and Technical Capability

The ability of a local government to develop and implement mitigation projects, policies, and programs is contingent upon its staff and resources. Administrative capability is determined by evaluating whether there are an adequate number of personnel skilled in surveying and Geographic Information Systems.

The table below provides a summary of the administrative and technical capabilities currently in place in each participating jurisdiction. The checkmark (√) indicates that the local government reported maintaining a staff member for the given function.

Administrative and Technical Capability										
Jurisdiction	Planner(s) or Engineer(s) with knowledge of land development and management practices.	Engineer(s) or professional(s) trained in construction practices related to buildings and fire	Planner(s) or Engineer(s) with an understanding of natural and/or human caused hazards	Floodplain Manager	Surveyors	Staff with education or expertise to assess the communities vulnerability to hazards	Personnel skilled in GIS and/or HAZUS	Scientists familiar with the hazards of the community	Emergency Manager	Grant writers
Carter County	Contact Only	Contact Only	√	√	Contact Only	√	√		√	√
Dickson									√	
Gene Autry				√					√	
Healdton	Contact Only	Contact Only		√	Contact Only				√	
Lone Grove				√			√		√	
Ratliff City									√	√
Springer									√	
Tatums									√	
Wilson				√					√	

FLOODPLAIN MANAGEMENT:

By employing floodplain management, the jurisdiction can protect its citizens against much of the devastating financial loss resulting from flood disasters. Careful local management of development in the floodplains results in construction practices that can reduce flood losses and the high cost associated with flood disasters to all levels of government.

Carter County has been a National Flood Insurance Program (NFIP) Community since May 11, 2012, CID # 400030 and has adopted a Flood Damage Prevention Ordinance that restricts development in floodplain areas, through a building development permit system. A copy of this ordinance may be found at the Carter County Emergency Management Office of the County Commissioners and is available

online. Carter County Emergency Management also maintains a copy of the Flood Damage Prevention Ordinances for the towns of Lone Grove and Healdton.

The Town of Gene Autry has been a participant in the NFIP since November 1, 2007, CID # 400032. The Town of Healdton has been participating in the NFIP since January 2, 1986, CID # 400033. The City of Lone Grove has been participating in the NFIP since March 16, 1989, CID # 400395. The Town of Wilson has been participating in the NFIP since July 3, 1985, CID # 400035. Each jurisdiction has in place Flood Damage Prevention Ordinances.

The Town of Dickson, Ratliff City, Springer, and Tatums (no mapped flood zones within town limits) are not listed as participants in the NFIP, but are investigating what needs to be done for their jurisdictions to become NFIP compliant. These jurisdictions are also in the process of identifying a floodplain manager.

There are 2 Repetitive Loss (homes) and 0 Severe Repetitive Loss Properties in Carter County, both are located within the City limits of Healdton.

In total there are only 2 Repetitive Loss Structures (homes) within Carter County.

Carter County, and the towns of Lone Grove, Healdton, Gene Autry and Wilson will continue compliance in the NFIP by having continual education of floodplain managers on a yearly basis.

Financial Capabilities

Financial Capability								
Jurisdiction	Capital Improvements Project Funding	Authority to levy taxes for specific purposes.	Water, Sewer, Gas, or Electric service Fees	Incur fees for new development	Incur debt through general obligation funds	Community Development Block Grant	Federal funding programs	State funding programs
Carter County		√			√		√	√
Dickson								
Gene Autry								
Healdton	√	√	√		√	√		
Lone Grove	√	√	√	√	√			
Ratliff City	√	√	√		√			
Springer								
Tatums								
Wilson								

Education and Outreach Capability

Education & Outreach Capability						
Jurisdiction	Local citizen groups/Non-profit organizations willing to assist with mitigation activities	Ongoing public education or information programs	Natural disaster or safety related programs	StormReady Certification	Fire wise Communities Certification	Public-Private partnership initiatives addressing disaster-related issues
Carter County	√	√	√	√		√
Dickson						
Gene Autry						
Healdton	√	√				
Lone Grove	√	√	√			
Ratliff City	√	√	√	√		√
Springer						
Tatums						
Wilson						

OPPORTUNITIES FOR PUBLIC EDUCATION AND OUTREACH:

Countless education opportunities exist for disseminating emergency preparedness information to diverse populations.

Most, if not all of the following entities/capabilities were identified in Carter County:

- Agribusiness organizations (OSU Extension, Future Farmers of America, CO-OPs).
- Amateur radio organizations.
- Annual calendar promotions—National Preparedness Month, Fire Prevention Week, etc.
- FEMA and other free online training venues.
- Local Emergency Planning Committees (LEPCs).
- National Weather Service storm spotter training.
- Public education campaigns.
- Public lecture series, seminars.
- Public Service Announcements (PSAs) and other media campaigns.
- Schools/student organizations.
- Special events (rodeos, county fair, health fairs, street shows).
- Town Hall meetings or topic specific public forums.
- Volunteer Organizations Active in Disaster.
- Web sites, public white boards, Facebook pages.
- Youth groups (YMCA, Boys & Girls Club, Scouting, and entrepreneurial groups).
- Community Emergency Response Teams (CERTs).

SCHOOL DISTRICT CAPABILITY ASSESSMENT:

The **Oklahoma Department of Education** oversees public K-12 education and public libraries in Oklahoma. Following the ratification of the Oklahoma Constitution in 1907, the governor, secretary of state and the attorney general of Oklahoma served as the State Board of Education. The Department in its current iteration was created by the Oklahoma School Code of 1971, which also established the Oklahoma State Board of Education.

The **Oklahoma public school system** (prekindergarten through grade 12) operates within districts governed by locally elected school boards and superintendents.

Oklahoma Public School Funding

Ad Valorem Tax Levies

General Fund:

15-mill Levy	15 mills**	Certification of Need
County 4-mill Levy	4 mills	Constitutional
County 15-mill Levy	5 mills	Constitutional
Emergency Levy	5 mills	Majority Vote
Local Support Levy	10 mills	Majority Vote
General Fund = 39 mills		

Building Fund: 5 mills Majority Vote

Sinking Fund: As voted for Bond Issues
and levied for Judgments **

Counties who have done away with their individual personal property tax have been allowed to raise their 15-mill Levy based on a formula in Article X, Section 8A, Paragraph (b) of the Constitution.

In addition to the Ad Valorem the State provides Aid to School districts for salaries and other education needs. Available to schools are additional State and Federal grants too numerous to list.

School Districts were asked to provide information on their capabilities as they relate to those outlined for each participating jurisdiction. Each School Superintendent answered the following questions:

1. Has your school district had positive responses to bond issues?
2. Based on population, is the school district population growing or declining?
3. Has the school district taken any measures to protect students during hazardous events?
4. List any damages your school has experienced during the last 10 years due to weather events or natural disaster.

Integration of the Hazard Mitigation Plan into existing school district plans and programs will be handled as follows:

The Emergency Manager will provide a copy of this plan to each school Superintendent for adoption with their School Board. This document will be reviewed by the School Board when they are evaluating their respective Capital Improvements Plans, and it will be reviewed by each school principal when updating natural hazard response protocols. Each Superintendent will provide an update on mitigation action item progress to the Emergency Manager during the annual HM Planning Team review meetings.

DICKSON PUBLIC SCHOOLS:

1. Yes, latest past in 2015.
2. Slight growth.
3. We are currently working to upgrade security with bond funds and will begin updating safety plan in the fall.
4. Unaware of any damages.

FOX PUBLIC SCHOOLS:

1. Yes.
2. Staying steady.
3. We have emergency plans and conduct emergency drills.
4. Hail and wind damage due to severe storms.

HEALDTON PUBLIC SCHOOLS:

1. Yes
2. Growing
3. We have written emergency plans and conduct emergency drills.
4. We have received some wind damage to our press box at the football field along with damages to the baseball field dugouts. We have also experienced some flooding issues due to heavy rains in 2015.

LONE GROVE PUBLIC SCHOOLS:

1. Yes
2. Maintaining and growing.
3. We have emergency plans and conduct emergency drills.
4. Some damage due to the 2009 tornado and also damages from Tropical Storm Bill in 2015.

SPRINGER PUBLIC SCHOOLS:

1. Yes
2. Small growth.
3. We have emergency plans and conduct emergency drills according to those plans.
4. Lightning damage to the IT system throughout the school. We had also received some flooding damages due to the heavy rains in 2015.

WILSON PUBLIC SCHOOLS:

1. Yes.
2. Slight decline.
3. Emergency plans are in place and emergency drills are conducted regularly. Currently have 3 safe rooms on campus to house students during severe weather.
4. Lightning damage has been received to several A/C units.

ZANEIS PUBLIC SCHOOLS:

1. Have not had any bond issues in over 20 years.

2. Growing
3. Currently have written emergency plans and conduct emergency drills regularly.
4. Have had roof damage due to hail storms.

SOUTHERN OKLAHOMA TECHNOLOGY CENTER:

1. We do not do bond issues.
2. Growing
3. We have emergency plans and conduct emergency drills.
4. None.

Capability Assessment Conclusion:

Mitigation requires capabilities necessary to reduce loss of life and property by lessening the impacts of disasters. Each jurisdiction has demonstrated a set of capabilities unique to their community. The capability assessment finds that Carter County and the participating jurisdictions collectively have a significant level of legal, technical, and fiscal tools and resources necessary to implement hazard mitigation strategies. All of the jurisdictions have the legal capabilities or ordinances and codes in place that might help reduce loss due to a disaster. The jurisdictions including school districts have a range of staff trained or have knowledge about hazards and their impacts. While some jurisdictions lack an emergency manager in their community, there is Carter County Emergency Management that can provide assistance.

All participating jurisdictions have financial resources that can be used toward mitigation. Most of those resources are capital improvement funds or tax bonds. All communities in Carter County have local citizen groups that are willing to assist in emergency management efforts. While most jurisdictions participate in the safety related school programs and the County is StormReady certified; none of the jurisdictions are a Fire Wise community. None of the participating jurisdictions have incorporated a community wildfire plan and solely utilize burn bans. These jurisdictions can expand their capabilities by implementing wildfire plans. The majority of the participating jurisdictions have an Emergency Operations Plan in place.

The Carter County Planning Team put a significant amount of effort into making this plan a useful document. Because the information in this plan is relevant, and was developed by the planning team members directly, the plan will be more easily integrated into the plans and ordinances listed in this section. The Emergency Manager for the county and each jurisdiction, through maintenance of this document, will provide a copy of this plan to parties responsible for other planning processes in the planning area. This document can be integrated into other plans when determining future growth areas, capital improvement projects, building code and ordinance proposals, and prioritizing local funds.

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Section 3

Hazard Assessment

SECTION THREE

Hazard Assessment

Introduction:

The regulations in 44 CFR 201.6(c)(2) outline the specific information that local jurisdictions must consider when completing the hazard assessment portion of the plan. The hazard assessment must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses for identified hazards.

Only natural hazards are profiled in this plan. Other hazards certainly exist, although their occurrence is rare in Oklahoma and they have caused no known damage in Carter County. Future editions of this plan will contain information on those only if an occurrence has a significant impact to the risk of human life or property.

PROBABILITY OF OCCURRENCE—DEFINITION	
4—HIGHLY LIKELY	Event is probable within the calendar year. Event has a 1 in 1 year chance of occurring.
3—LIKELY	Event is probable within the next three years. Event has a 1 in 3 year chance of occurring.
2—POSSIBLE	Event is probable within the next 5 years. Event has a 1 in 5 year chance of occurring.
1—UNLIKELY	Event is possible within the next 10 years. Event has a 1 in 10 year chance of occurring.

The probability of occurrence shown above is the determination, based on past history and consideration of the elements necessary for a specific disaster event to occur. Combined with how many of those factors are present estimates of how likely a hazard is to occur in Carter County can better be estimated.

Review of Natural Hazards:

The Carter County Hazard Mitigation Planning Team has identified 10 hazards that could continue to affect Carter County. (Note: Lightning and High Winds were combined with Severe Thunderstorms and profiled together.) Through reviewing FEMA disaster declarations in the county; NCDC data and reports completed by the County Emergency Management Office, the following list was compiled:

NATURAL HAZARDS FOR CARTER COUNTY		
Hazard	How Reviewed	Why Identified
Dam Failure	<ul style="list-style-type: none"> • Oklahoma Water Resource Board • National Inventory of Dams 	Out of 60 dams in Carter County; only 4 are high hazard. Most are in need of repair or replacement.
Drought	<ul style="list-style-type: none"> • Information from the Oklahoma Climatological Survey • Oklahoma Water Resources Board 	Temperatures in Oklahoma can easily reach over 100 degrees & persist for many days and weeks. History of drought, i.e. ‘Dust Bowl’, and recent episodes of drought.
Earthquake	<ul style="list-style-type: none"> • Information from Oklahoma 	Past history, existing fault lines

	<ul style="list-style-type: none"> Geological Survey Past Historical Records 	within Carter County and surrounding counties.
Extreme Heat	<ul style="list-style-type: none"> National Weather Service Oklahoma Climatological Survey 	Carter County has prolonged periods of high temperatures and is prone to wide swings in temperature.
Flood	<ul style="list-style-type: none"> Local Emergency Management Records FEMA Declarations NCDC 	There is often flooding Carter County due to heavy rains.
Hailstorm	<ul style="list-style-type: none"> NCDC 	Carter County Experiences hailstorms during severe thunderstorms, sometimes causing severe damage.
Severe Thunderstorm/Lightning/High Winds	<ul style="list-style-type: none"> NCDC Oklahoma Climatological Survey NWS-Norman Storm Prediction Center 	Carter County is susceptible to severe thunderstorms, lightning and high winds every year.
Tornado	<ul style="list-style-type: none"> Local Emergency Management Records FEMA Declarations NCDC 	Carter County has experienced 5 tornados since the beginning of 2010.
Wildfire	<ul style="list-style-type: none"> State Fire Marshall Records Local Fire Department Records 	Carter County experiences several wildfires during the dry season.
Winter Storm	<ul style="list-style-type: none"> National Weather Service FEMA Declarations 	Severe ice storms occur regularly in SE Oklahoma including Carter County. The last occurrence was in 2010.

The Hazards of Landslides and Expansive soils were considered by the planning team, but since these hazards haven't affected Carter County since the last update they will not be included in this version, but will be assessed again during the next update.

The information in this chapter includes:

- **Hazard Profile**—A description of each hazard, its effects, frequency of occurrence and how the hazard is measured.
- **Location**—Provides information on the location(s) within Carter County that are primary areas of concern for the profiled hazard.
- **Extent**—The size or intensity of a hazard event.
- **Previous Occurrences**—The known historical occurrences of the hazard in the Carter County area.
- **Probability of Future Occurrences**—Defines the calculated potential of future events occurring in Carter County based on past history; geological or climatological potential.

- **Vulnerability and Impact**—Describes how vulnerable of susceptible to damage the citizens, infrastructure, economy and structure in the jurisdiction are to the profiled hazard and resulting consequences.

Recent Declared Disaster History:

The planning area has experienced 5 natural disasters for which the county has been declared a disaster area by the President. The table below has a detailed summary of the federally declared disaster history of the planning area since 2006.

Carter County Disaster Declarations—10 Year History (Excludes Fire Management Assistance History)		
Date	Nature of Disaster	FEMA #
May 26, 2015	Flooding	DR 4222
May 24, 2010	Tornado	DR 1917
Feb. 25, 2010	Winter Storms	DR 1876
June 19, 2009	Wildfire	DR 1846
Feb. 15, 2009	Tornado	DR 1820

Hazard Profile—Dam Failure:

A dam is defined 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, or other failure of a dam structure resulting in potential downstream flooding. Dam failures typically occur when spillway capacity is inadequate and excess flow overtops the dam, or when internal erosion (piping) through the dam or foundation occurs. The Oklahoma Water Resources Board (OWRB) coordinates a state dam safety program that ensures the safety of more than 4,500 dams in the state, with priority placed on the protection of downstream life and property. The program requires inspections every three to five years for and significant hazard structures, respectively. The program also requires annual inspection of the state’s 165 high-hazard dams, so designated due to the presence of occupied dwellings immediately downstream. Lake of the Arbuckle’s and Lake Murray are the primary lake sources of drinking water for the county however most of the county gets their water from wells and small lakes around the area. The lakes profiled in this plan are primary drinking water for the City of Ardmore (not a part of this plan). They are profiled due to the potential hazard they pose to the residents of Carter County. Because this is a county plan, Ardmore will be included in the inundation maps provided when it would be affected. Inundation Maps for all dams, with the exception of the Arbuckle Lake Dam, are included in Appendix C—(Maps) and are not available for Public Dissemination, but are available on a need-to-know basis only.

Location:

OWRB Classification of Hazard Potential		
Category	Loss of Life	Economic Loss
LOW	None—No probable future development, may be zoned to prevent future development.	Minimal—undeveloped to occasional structure or agriculture.
SIGNIFICANT	None—Potential for future development exists; habitable structures may exist in inflow design floodplain; however, dam failure would not endanger lives that would not be in endangered if structure did not exist.	Appreciable—notable agriculture, industrial or structural.
HIGH	Yes—One or more habitable structures with loss of life due to dam failure likely.	Excessive extensive community, industrial or agricultural losses. Possible loss of life.

According to the Oklahoma Water Resources Board (OWRB) and the National Inventory of Dams (NID), there are 60 dams in Carter County, of which 52 have been classified as LOW HAZARD, 4 as SIGNIFICANT HAZARD and 4 as HIGH HAZARD. There is also a HIGH HAZARD dam in neighboring Murray County. Only the HIGH HAZARD potential dams will be identified in this plan.

ARBUCKLE DAM:

The Arbuckle Dam (NID OK02501) is located in Murray County between the communities of Sulphur and Dougherty. It is owned and maintained by the Department of the Interior (DOI). Construction of the dam was completed in 1962. The dam spans 1,900 feet and holds back 62,571 acre-feet of water from the Lake of the Arbuckle’s.

The Arbuckle Dam has been classified by OWRB and NID as having a HIGH HAZARD potential.

The Arbuckle Dam is required to develop an Emergency Action Plan (EAP), in the event of a dam breach or failure. As part of the EAP, Arbuckle Dam included maps of inundation areas. Maps of these inundation areas are not available for Public Dissemination, but are available on a need to know basis; they will not be included in this plan.

The maps identify a Probable Max Flood (PMF) event of the Arbuckle Dam and the inundation of Carter County. Only portions of the Town of Gene Autry along with unincorporated areas of Carter County would be inundated by an event. Based on inundation maps, approximately 15 residential structures would be impacted by a dam breach. No schools would be affected.

CADDO CREEK DAM NO. 27:

Caddo Creek Dam No. 27 (NID OK00446) is located in north central Carter County. Caddo Creek Dam No. 27 is owned and maintained by the Arbuckle Conservation District. Construction of the dam was completed in 1969 and is located 4.5 miles west of Springer and 1.5 miles north of HWY 53. The dam spans 1,540 feet and holds back 4,634 acre-feet of water.

The Caddo Creek Dam No. 27 has been classified by the OWRB and NID as having a HIGH HAZARD potential.

The Caddo Creek Dam No. 27 is required to develop an Emergency Action Plan by OWRB in the event of a dam breach or failure. As part of the EAP, Arbuckle Conservation District included maps of inundation areas. Maps of inundation areas are not available for Public Dissemination, but are include in Appendix C to this plan on a need to know basis; they will not be available for Public Dissemination. The maps identify a Probable Max Flow event of the Caddo Creek Dam No. 27 and the inundation of Carter County. Only unincorporated areas of Carter County would be inundated by an event. No communities or schools are at risk.

After reviewing the projections of failure of the Caddo Creek Dam No. 27, only those homes (5 residential structures) and roads that are in the flood zones will be affected. Maps will be reviewed at the five-year update to account for any development in the planning area.

CADDO CREEK DAM NO. 13 (Lake Jean Neustadt):

Lake Jean Neustadt Dam (NID OK00433) is located on Richland Road, 1.5 miles west of HWY 77, and is owned and maintained by the City of Ardmore. Construction of the dam was completed in 1969 and spans 5,550 feet and holds back 14,645 acre-feet of water.

Lake Jean Neustadt Dam has been classified by the OWRB and NID as having a HIGH HAZARD potential.

Lake Jean Neustadt Dam is required to develop an Emergency Action Plan by OWRB in the event of a dam breach or failure. As part of the EAP, the City of Ardmore included maps of inundation areas. Maps of inundation areas are not available for Public Dissemination, but are available on a need to know basis; they will not be included in this plan.

The maps identify a Probable Max Flow event of the Lake Jean Neustadt Dam and the inundation of Carter County. Only unincorporated areas of Carter County would be inundated by an event. No communities or schools are at risk.

After reviewing projections of failure of the Lake Jean Neustadt Dam, only those houses and roads that are in flood areas will be affected. Maps will be reviewed at the five-year update to account for any development in the planning area.

CADDA CREEK DAM NO. 18 (Lake Scott King):

Lake Scott King Dam (NID OK00438) is located 6 miles north on Kings Road and .75 miles east on Acorn Road, and is owned and maintained by the City of Ardmore. Construction of the dam was completed in 1979 and spans 1,030 feet and holds back 6,583 acre-feet of water.

Lake Scott King Dam has been classified by OWRB and NID as having a HIGH HAZARD potential.

Lake Scott King Dam is required by OWRB to develop an Emergency Action Plan in the event of a dam breach or failure. As part of the EAP, the City of Ardmore included maps of inundation areas. Maps of inundation areas are not available for Public Dissemination, but are include in Appendix C to this plan on a need to know basis; they will not be available for Public Dissemination.

The maps identify a Probably Max Flood event of the Lake Scott King Dam and the inundation of Carter County. Only the unincorporated areas of Carter County would be inundated by an event. No communities or schools are at risk.

After reviewing projections of failure of the Lake Scott King Dam, only those houses and roads that are in the flood areas will be affected. Maps will be reviewed at the five-year update to account for any development in the planning area.

CADDO CREEK DAM NO. 29:

Caddo Creek Dam No. 29 (NID OK00448) is located in northeastern Carter County near the town of Gene Autry. The dam is owned and maintained by the Arbuckle Conservation District. Construction of the dam was completed in 1965 and is located .3 miles west of the HWY 53/53A junction. The dam spans 800 feet and holds back 670 acre-feet of water.

The Caddo Creek Dam No. 29 is classified by the OWRB and NIB is having a HIGH HAZARD potential.

The Caddo Creek Dam No. 29 is required by the OWRB to develop an Emergency Action Plan in the event of a dam breach or failure. As part of the EAP, Arbuckle Conservation District included maps of inundation areas. Maps of inundation areas are not available for Public Dissemination, but are include in Appendix C to this plan on a need to know basis; they will not be available for Public Dissemination.

The maps identify a Probably Max Flow event of the Caddo Creek Dam No. 29 and the inundation of Carter County. The town of Gene Autry and unincorporated areas of Carter County are at risk of inundation by an event. Approximately 15 residential structures would be impacted.

After reviewing the projections of failure of the Caddo Creek Dam No. 29, only those houses and roads that are in flood areas will be affected. Maps will be reviewed at the five-year update to account for any development in the planning area.

Extent:

Research of dam locations within Carter County by the Oklahoma Water Resources Board revealed that a dam breach in City Lake or Mountain Lake would not cause disaster conditions in Carter County. There could; however, be some areas within Carter County that would be affected from a major breach in Lake Scott King or Lake Jean Neustadt.

As with any location in which man-made structures are built, potential failure of the structure could place lives and property at risk. The best way to minimize potential failure is to identify structures whose failure could cause the greatest loss of life and/or property, and to require those structures to undergo a rigorous inspection regime. From a hazard management perspective, the most noteworthy structures are those categorized as “high hazard” dams. This designation relates solely to potential impacts of a structural breach; it is not an indication of the quality of construction or maintenance. Dam failures can result from any one or a combination of five reasons:

- Overtopping caused by water spilling over the top of a dam.
- Structural failure of materials used in the construction of the dam.
- Cracking caused by movements like the natural settling of a dam or an earthquake.
- Inadequate maintenance and upkeep such as failure to remove trees or repair internal seepage problems.
- Piping—when seepage through a dam is not properly filtered and soil particles continue to progress and form sink holes in the dam.

Inundation mapping indicates water depths could range from less than one (1) foot to over 12 feet. Carter County considers a dam failure releasing one foot or more of flood waters into homes, businesses or flowing over roads to be of major severity.

Previous Occurrences:

It should be noted there is no history of disaster or accidents involving Carter County regarding a dam breach or failure from dams within the county or outside of the county.

Probability of Future Events:

Even though Carter County has a number of dams in the vicinity, only four are classified as “HIGH HAZARD” which would only have a minimal threat. Dam failure affecting Carter County is UNLIKELY.

Vulnerability and Impact:

The scenario that would have the greatest impact would be a complete loss of a dam structure itself. This would negatively impact the assessed dam inundation zones within the planning area, affecting personal safety, property, traffic flow, power and utilities, recreation, the environment, etc.

With no historical events recorded, and managed by State and National Dam Authorities of the 4 significant and 4 high hazard potential dams within the county, and only 1 high hazard dam located outside the county, the vulnerability is anticipated to be low.

Hazard Profile—Drought:

Drought is a persistent and abnormal moisture deficiency having adverse impacts on vegetation, animals or people. There are dozens of more specific drought definitions used around the world based on the lack of rain over various time periods or measured impacts such as reservoir levels or crop losses. Because of the various ways people measure drought, no one has produced an objective drought definition upon which everyone can agree.

Drought Types: There are three main ways to consider drought.

1. **METEOROLOGICAL** drought is usually based on long-term precipitation departures from normal, though high temperatures often play a role.
2. **HYDROLOGICAL** drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels.
3. **AGRICULTURAL** drought occurs when there isn't enough soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought is typically evident after meteorological drought but before hydrological drought.

When no rain or only a small amount of rain falls, soils can dry out and plants die. When rainfall is less than normal for several weeks, months, or years the flow of streams and rivers decline, water levels in lakes and reservoirs and even aquifers fall, causing the depth of water in wells to decrease. If dry weather persists and water supply problems develop, the dry period can become a drought. The first evidence of drought usually is seen in records of decreased rainfall. Within a short period of time, the amount of moisture in soils can begin to decrease. The effects of a drought on flow in streams and rivers or on water levels in lakes and reservoirs may not be noticed for several weeks or months. Water levels in wells may not reflect a shortage of rainfall for a year or more after the drought begins due to aquifer availability.

The effects of drought can be economic, social or environmental. Lack of rainfall for an extended period of time can be catastrophic to farmers and major metropolitan areas. Typically, cities suffering from drought ask citizens to stop washing their cars, cease watering the grass, and to take other water conservation steps. Counties, because they are largely rural with small communities spotted throughout, generally do not consider such steps, but look at the overall picture related to water, livestock and infrastructure status.

During drought emergencies, the National Weather Service and Oklahoma Emergency Management issues regular updates of drought and wildfire conditions. If conditions are severe enough, updates are issued on a daily basis. Nationally, the National Drought Mitigation Center (NDMC), housed at the University of Nebraska-Lincoln, helps states, institutions, and individuals develop and implement measures to reduce societal vulnerability to drought. The organization's U.S. Drought Monitor (a comprehensive drought monitoring effort between the NDMC, USDA and NOAA/CPC) is an excellent source of national drought news and data. NOAA's Drought Information Center also provides abundant links and information regarding the onset of drought and prospects for dry conditions throughout the U.S.

Meteorologists typically determine the onset and the end of drought by carefully monitoring meteorological and hydrological variables such as precipitation and stream flow. Because there is no single definition for drought, its onset and termination are difficult to determine. We can, however,

identify various indicators of drought, and tracking these indicators provides us with a crucial means of monitoring drought.

Location:

Drought affects the entire planning area.

Extent:

The wide variety of disciplines affected by drought, its diverse geographical and temporal distribution, and the many scales drought operates on make it difficult to develop both a definition to describe drought and an index to measure it. Many quantitative measures of drought have been developed in the United States, depending on the discipline affected, the region being considered, and the particular application. Several indices developed by Wayne Palmer, as well as the Standardized Precipitation Index, are useful for describing the many scales of drought.

Common to all types of drought is that fact that they originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (say, a few weeks or a couple months), the drought is considered short-term. But if the weather or atmospheric circulation pattern becomes entrenched and precipitation deficits last for several months to several years, the drought is considered to be a long-term drought. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that results in short-term wet spells.

The Palmer Drought Severity Index (PDSI) has been widely used by the U.S. Department of agriculture to determine when to grant emergency drought assistance, but the Palmer Index is best used when working with large areas of uniform topography.

Carter County and all participating jurisdictions used the PDSI Scale when considering the effects of drought.

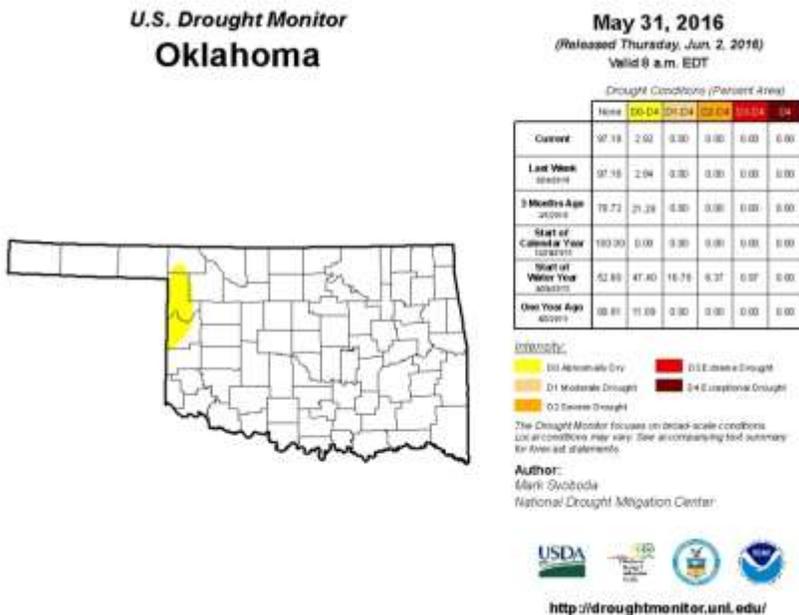
Minor Severity: -2.00 and below.
Major Severity: -3.00 and above.

PDSI Classifications for Dry and Wet Periods	
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

Previous Occurrences:

According to the National Climatic Data Center (NCDC), four drought events affected Carter County from July 2012 through May 2015 with one event lasting an entire year.

Since 2010 Oklahoma and Carter County have been involved in generally a steady drought with a few periods of relief. 2015 and early 2016 have been wetter than normal, therefore relieving Carter County of its drought conditions.



The potential exists however, that another major drought will occur. Following is a history of droughts affecting Carter County.

Carter County Drought Events Data from National Climatic Data Center	
Date	Description
	<p>D3 (extreme) drought continued through the month with persistent dry conditions.</p> <p>May – Some rainfall events occurred during May, but with a heavy bias toward central Oklahoma near the I-35 corridor, where drought conditions continued to improve. D3 (extreme) drought was present at the beginning of the month, but had improved slightly to D1 (moderate) by the end of the month.</p> <p>June – Rainfall for the month of June was generally around average for central and south central Oklahoma. D1 (moderate) drought was present at the beginning of the month, but had improved slightly to D0 (abnormally dry) by the end of the month.</p> <p>July – With little in the way of rainfall, D2 (severe) to D3 (extreme) drought persisted across the county.</p> <p>August – With few rainfall events throughout the month, D2 (severe) drought persisted through the month.</p> <p>September – D1 (moderate) drought continued through the month with persistent dry conditions.</p> <p>October – Rainfall was near to slightly above average across most of the state during October. As a result, drought conditions generally remained similar through the month. The most notable change was the improvement of drought conditions across portions of central, south-central and southeast Oklahoma. D1 (moderate) drought was present at the beginning of the month, but had improved slightly to D0 (abnormally dry) by the end of the month.</p>

2012	<p>July – As a mid-level ridge of high pressure built into the Southern Plains late in July, few opportunities for rain lead to expanding drought conditions across much of Oklahoma. Carter County experienced abnormally dry conditions at the beginning of the month, but D2 (severe) drought developed by the end of the month with persistent dry conditions.</p> <p>August – D2 (severe) drought conditions were present at the beginning of the month, but D3 (extreme) drought developed by the end of the month with persistent dry conditions.</p> <p>September – D3 (extreme) drought continued through the month with persistent dry conditions.</p> <p>October – D3 (extreme) drought conditions were present at the beginning of the month in Carter County, but had improved slightly to D2 (severe) drought by the end of the month.</p> <p>November – D2 (severe) drought conditions were present at the beginning of the month in Carter County, but had worsened to D3 (extreme) drought by the end of the month.</p> <p>December – D3 (extreme) drought continued through the month in Carter County with persistent dry conditions.</p>
2011	<p>March – Severe drought, or D2, either continued or developed over much of Oklahoma by late in the month. Much of Oklahoma continued with another month of below normal precipitation.</p> <p>April - Carter county maintained D3 drought status through the month.</p> <p>May – The dry conditions also gave rise to enhanced fire weather concerns, with the normal increase in wind speeds during the spring months. Carter county maintained D3 drought status through the month.</p> <p>June – D3 status at the beginning of the month worsened to D4 by June 21.</p> <p>July – Rainfall totals, especially for those over western and southern Oklahoma were little more than a trace. The dry vegetation contributed to several grass fires. D4 drought status began July 12th and continued through the rest of the month.</p> <p>August – Although some beneficial rainfall occurred early in the month, it was not near enough to erase the climbing precipitation deficits that began during the late summer and early autumn of 2010.</p> <p>September – D3 (extreme) drought continued through the month with persistent dry conditions.</p> <p>October – D4 drought continued through the month.</p> <p>November – The continuation of much needed rainfall occurred during the month of November, which helped alleviate the devastating drought somewhat. D3 (extreme) drought improved to D2 (severe) by November 15.</p>
2007	<p>February – Dry conditions continued over much of Southern Oklahoma, with well below average precipitation again in February.</p> <p>March – Dry conditions continued over much of southern and western Oklahoma, with average to below average precipitation again in March. A small saving grace was late month thunderstorms and an unseasonably strong winter storm.</p> <p>April – Dry conditions continued over much of southern and western Oklahoma, despite more normal precipitation for April.</p>
2006	<p>January – September – No information available.</p> <p>October – Despite some rainfall the drought continued across much of western and central Oklahoma during October. The area was under severe to exceptional (D2-D4) drought conditions throughout the month. The worst conditions were in south central and southeast Oklahoma where drought conditions were in the extreme to exceptional (D3-D4) drought categories.</p>

	November – Severe to extreme (D2-D3) drought conditions were seen across much of Oklahoma during the month of November despite some precipitation. December – Severe to exceptional (D2-D4) drought conditions were seen across much of Oklahoma during the month of December.
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Probability of Future Events:

Based on past recent history, the probability of future drought events in Carter County is **HIGHLY LIKELY**.

Vulnerability and Impact:

In all droughts, agriculture feels the impact, especially in non-irrigated areas such as dry land farms and rangelands. Other heavy water users, such as landscapers, are also negatively impacted. Water related activities of residential users might be restricted. Droughts also cause power shortages in Oklahoma, because much of the state’s power comes from hydroelectric plants. Heavy power users can be negatively affected by the results of electricity shortages due to drought, such as brownouts, blackouts, and spiking prices.

The primary threat to structures in Carter County from drought is from the secondary impact of drought from Wildfire. See the Wildfire Hazard for more information on this hazard.

Critical facilities most impacted by drought are those that rely upon water to fulfill their primary functions, or to operate at all, such as fire departments, rural water districts, medical and health care facilities, water and wastewater treatment plants, and schools and daycare centers.

In many communities, drought can have impacts on the community’s ability for firefighting, with both wildland and structure fires.

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 vulnerabilities outside those experienced by other County services/facilities.

Drought increases the demand for water and at the same time may impact the availability of raw water. While the towns of Healdton, Ratliff City, Lone Grove, and Wilson are supplied by their own wells. Other areas of the county are supplied by Rural Water Districts or Southern Oklahoma Water Corporation.

Hazard Profile—Earthquakes:

An earthquake (also known as a quake, tremor or temblor) is the perceptible shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's crust that creates seismic waves. Earthquakes can be violent enough to toss people around and destroy whole cities. The seismicity or seismic activity of an area refers to the frequency, type and size of earthquakes experienced over a period of time.

Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter magnitude scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly imperceptible or weak and magnitude 7 and over potentially causes serious damage over larger areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.

At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity.

In its most general sense, the word earthquake is used to describe any seismic event — whether natural or caused by humans — that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

Location:

Earthquakes affect the entire planning area of Carter County. Carter County is located within the USGS 3%g Peak Ground Acceleration (PGA) with 10% probability of exceedance in 50 year seismic maps. Major faults are present in the Arbuckle Mountains located on the northern edge of Carter County. There are also numerous fault lines within Carter County itself. Earthquakes may occur at any or all locations throughout Carter County.



Extent:

The size of an earthquake can be expressed quantitatively as a magnitude and the local strength of shaking as intensity. The inherent size of an earthquake is expressed using a magnitude. The following Richter Scale is the most commonly used scale. Carter County and all participating jurisdictions used the Richter Scale when considering the severity of earthquakes.

Minor Severity: 3.9 and below

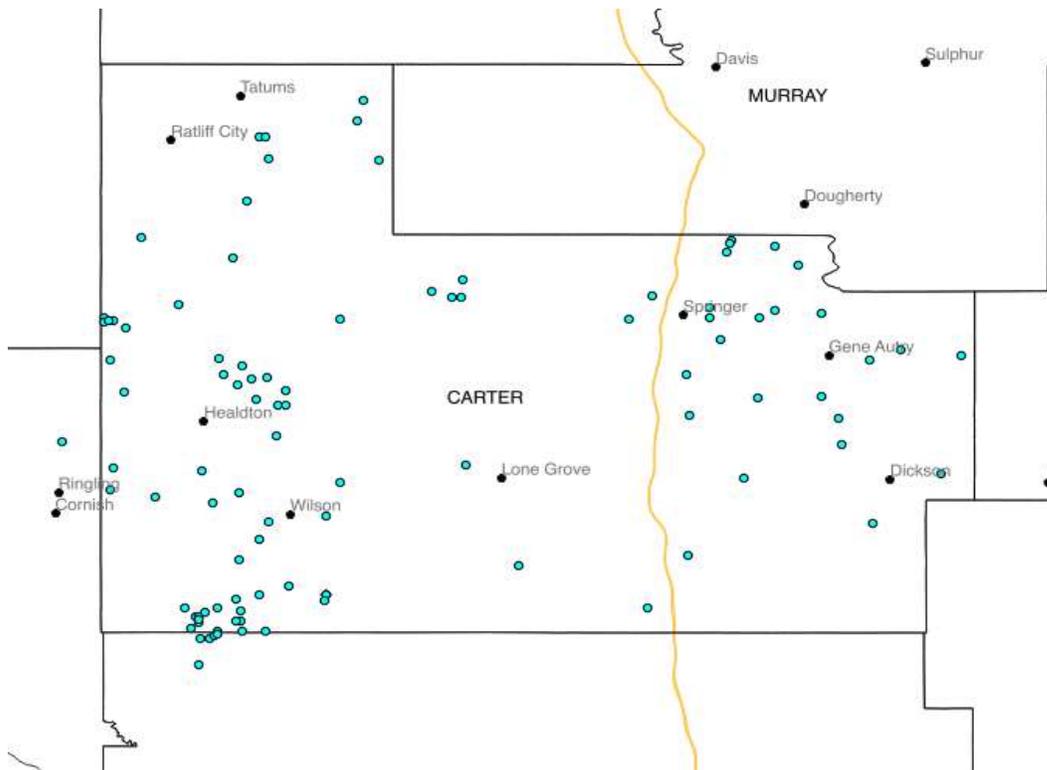
Major Severity: 4.0 and above

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

Previous Occurrences:

Carter County has experienced earthquakes in the past; however, not all are felt by the population. According to the Oklahoma Geological Survey the last earthquake experienced by Carter County was on November 7, 2014, when a 3.0 earthquake occurred in an area 9 miles southwest of the town of Wilson at around 8:00am. Since 1974, Carter County has experienced 102 earthquakes, the largest occurred on September 13, 1975 registering at 3.4. The image below shows locations of earthquakes that have

occurred in Carter County. Only minor damage, such as cracked drywall, or falling pictures has been reported with any of the felt earthquakes.



Probability of Future Events:

The probability of future earthquakes in Carter County based on the Arbutle Mountain range which, as mentioned earlier in this plan, has experienced or has the potential for felt earthquakes. Based on past history of the area around Carter County, it would appear the probability is low of a future damaging earthquake. A review of the map previously shown in the profile of earthquakes shows there have been very little earthquake activity in the immediate area of Carter County when compared with the rest of the State.

Based on the above, Carter County has rated the probability of a future earthquake as POSSIBLE.

Vulnerability and Impact:

In Carter County, including all participating jurisdictions, there are no means to prevent earthquakes and currently no possibility exists to predict short-term occurrence with accuracy in terms of location and size of an earthquake and time of occurrence. The only possibilities to reduce the earthquake damages are appropriate planning and construction measures. Earthquakes usually occur without warning and can impact areas a great distance from their point of origin.

An earthquake exceeding 5.0 in Carter County will cause an assortment of damage depending on the density of population and building and infrastructure construction in the area shaken by the quake. Some areas may be more vulnerable than others based on soil type, the age of the buildings and building codes

in place. Residential and commercial buildings owned by Carter County citizens and infrastructure constructed of unreinforced masonry or any other construction materials having inadequate resistance to lateral forces of ground shaking can result in more severe damage. The degree of exposure is dependent on many factors, including the age and construction type of buildings and the soil type on which buildings are constructed. A building's construction determines how well it can withstand the force of an earthquake. Buildings with foundations resting on unconsolidated landfill or other unstable soil, and mobile homes and trailers that are not tied to their foundations are at a higher risk because they can be shaken off their mountings during an earthquake. Un-reinforced masonry buildings are most at risk during an earthquake because the walls are prone to collapse outward, whereas steel and wood buildings absorb more of the earthquake's energy. The few buildings that are built to seismic codes and standards will have less chances of severe damage from earthquakes. Damages to lifelines such as loss of power, communications facilities and water and gas outages could even impact populations that did not suffer direct damage from the earthquake itself.

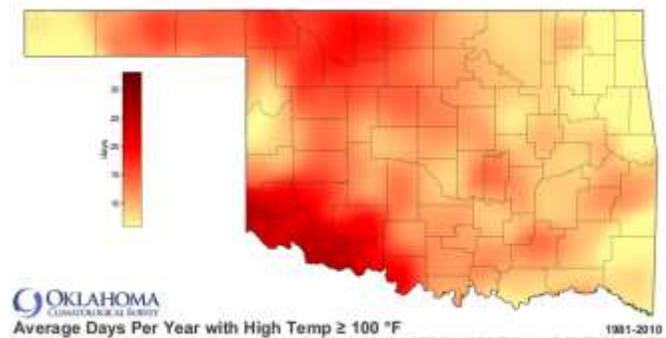
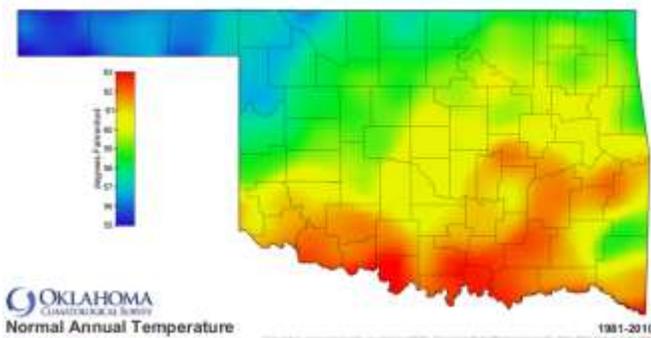
Hazard Profile—Extreme Heat:

Oklahoma, as part of the Southern Great Plains is prone to wide swings of temperature. Summertime temperatures routinely climb above the 100 degree mark. Temperatures that hover 10 degrees or more above the average high temperature for the area and last for several weeks are defined as extreme heat. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a “dome” or high atmospheric pressure traps hazy, damp air near the ground.

The hottest period of the Oklahoma summer extends from mid-July through mid-August. Overall, August, the third and final month of the climatological summer, is Oklahoma’s second hottest, fifth driest, and least windy month. The normal statewide monthly temperature is 80.9 degrees Fahrenheit. Information from the Oklahoma Climatological Survey shows Carter County averages 10-20 days over 100 degrees during the summer.

Temperature:

Average Annual: 63 degrees
Average Maximum: 75 degrees
Average Minimum: 52 degrees
Highest: 115 degrees (Healdton, August 2, 1896)
Days of 90 degrees or Higher: 85



Location:

Carter County experiences 10-20 days of temperatures greater than 100 degrees annually according to the Oklahoma Climatological Survey. All of Carter County and the jurisdictions included in this plan are equally at risk of extreme heat.

Extent:

It is often extremely hot and humid during the summer in the planning area. Extreme heat in the planning area is measured using NOAA’s National Weather Service Heat Index. The heat index is how the heat and humidity in the air combine to make individuals feel. Higher humidity plus higher temperatures often combine to make us feel a superficial temperature that is higher than the actual air temperature. In general, the planning area can experience temperatures up to 115 degrees.

Table 3-10

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	Temperature (°F)															
	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution
 Extreme Caution
 Danger
 Extreme Danger

Legend	
80-89 degrees	Fatigue is possible with prolonged exposure and/or physical activity.
90-104 degrees	Sunstroke, heat cramps and heat exhaustion are possible with prolonged exposure and/or physical activity.
105-129 degrees	Sunstroke, heat cramps and heat exhaustion are likely. Heat stroke is possible with prolonged exposure and/or physical activity.
130+ degrees	Heat stroke/sunstroke is highly likely with continued exposure.

The planning area considers any extended periods of temperatures above 90 degrees to be hazardous and cause for concern with periodic checks on the elderly and other at risk populations.

Minor Severity: 89 degrees and below.

Major Severity: 90 degrees and above.

Previous Occurrences:

Carter County has experienced several heat events over the last 15 years with excessively high temperatures causing significant problems for citizens.

Table 3-11

Significant Carter County Extreme Heat History Information provided by the National Climatic Data Center		
Date	Inj.	Fatal
1 Aug 2006-13 Aug 2006	0	2
16 Jul 2006-31 Jul 2006	0	0
7 Jul 2003	0	1
4 Jul 2001-31 Jul 2001	0	0

Probability of Future Events:

While extreme heat is a hazard for Oklahomans, efforts are being made throughout the state to mitigate the effects of the extreme heat. The National Weather Service is now issuing Excessive Heat warnings by county through the NOAA Weather Radio. They are issued when the combined effect of high temperatures and high humidity's result in daytime heat indices greater than or equal to 105 degrees, and nighttime ambient temperatures great than or equal to 80 degrees that will persist for two days or longer. The entire State of Oklahoma is at risk for extreme heat. In Carter County, based on past history, the probability of a future extreme heat event is LIKELY.

Vulnerability and Impact:

Carter County has a significant extreme heat hazard due to its climate. Summers are hot and usually dry, with daytime highs in the upper 80's to the mid-90's and generally less than 3 inches of rain in July and August.

Power supplies throughout the county are often affected due to high use by the population which causes power "brownouts" or outages. Some elderly citizens either do not have air conditioners or fans that work or do not use them because of electric cost concerns and many become victims of the extreme heat. Extreme heat deaths are usually from that group of citizens, although the handicapped and very young can sometimes be victims of extreme heat also.

Roads are often affected by extreme heat. Some older asphalt roads tend to "melt" or get soft with continued heat. Many of these roads are used by school buses and mail carriers. Concrete roads "explode" and crack due to the heat leading to higher maintenance costs. The damaged roads often cause citizens to find alternate transportation routes.

People working outside in the planning area are susceptible to extreme temperatures. Outdoor sporting and other activities expose students and staff to excessive temperatures where, if not closely monitored, could result in heat related problems such as cramps, heat exhaustion, or heat stroke.

Hazard Profile—Flood:

A flood is an overflow of an expanse of water that submerges land, a deluge. In the sense of “flowing water”, the word may also be applied to the inflow of the tide. Flooding may result from the volume of water within a body of water, such as a river or lake, which overflows, with the result that some of the water escapes its normal boundaries. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, it is not a significant flood unless such escapes of water endangers land areas used by man like a village, city or other inhabited area.



Floods can also occur in rivers, when the strength of the river is so high it flows out of the river channel, particularly at bends or meanders and cause damage to homes and businesses along such rivers. While flood damage can be virtually eliminated by moving away from rivers and other bodies of water, man has lived and worked by the water to seek sustenance and capitalize on the gains of cheap and easy travel and commerce by being near water.

A flash flood is a rapid flooding of geomorphic low-lying areas—washes, rivers and streams. It is caused by heavy rain associated with a thunderstorm, winter snow thaws or tropical storms. Flash floods can also occur after the collapse of human structures, such as a dam, for example.

Location:

Most of the known floodplains in the U.S. have been mapped by FEMA, which administers the National Flood Insurance Program (NFIP). When a flood study is completed for the NFIP, the information and maps are assembled into a Flood Insurance Study (FIS). An FIS is a compilation and presentation of flood risk data for specific water-courses, lakes and coastal flood hazard areas within a community and include causes of flooding.

The FIS report and associated maps delineate Special Flood Hazard Areas (SFHAs), designate flood risk zones, and establish base flood elevations (BFEs), based on the flood has a 1% chance of occurring annually, better known as the 100-year flood.

Carter County maintains current FEMA flood plain mapping for the county. Mapping showing the Special Flood Hazard Areas (SFHA) of Carter County are shown in Appendix C of this plan.

All of Carter County and the jurisdictions included in this plan are equally at risk of flooding, especially within the SFHA.

Extent:

According to Carter County Highway Districts, the county has numerous areas on county roads that consistently flood when there are heavy rains.

According to records there are no repetitive flood loss claims for unincorporated Carter County. Only 2 residential structures within the jurisdiction of Healdton are identified as repetitive loss structures.

Flooding events where vehicles stall and require water rescues create a problem for Carter County officials and 1st Responders. Citizens continue to disregard barriers and signage warning of flooded areas. Public education remains a high priority when communicating the dangers of driving through flood waters. Flooding events in Carter County are not considered a severe event until water starts entering homes. There have been some areas of repetitive flooding forcing citizens to find alternate routes of transportation due to road closings, but is not considered a major problem for Carter County.

Inundation mapping indicates water depths could range from less than one (1) foot to over 12 feet. Carter County considers flood waters of one foot or more in homes, businesses and over roadways to be of major severity.

Previous Occurrences:

Carter County has a history of flash flooding primarily affecting streets and low lying areas. According to local emergency personnel and records, flooding occasionally enters a mobile home or conventional home or business but it is minor and seldom does much damage.

Table 3-12

Carter County Flood History January 1, 2010—December 31, 2015 Information provided by the National Climatic Data Center					
Date	Description	Prop. DMG	Crop DMG	Inj.	Fatal
17 Jun 2015	As tropical storm Bill made its way up through eastern and central Oklahoma through the 17th and 18th, widespread flash flooding ensued. Carter County EM reported at least approximately 225 homes with flooding damage (est. \$20k per home). At least one of these had 6 feet of water. Numerous had 4 feet of water. 1 older building collapsed. 20-40 tinhorns washed out (est. \$20k per tinhorn). 1 bridge out (est. \$180K). A two year old boy was swept away from his father's arms into Hickory Creek. Another individual lost his life when his vehicle was washed from a bridge by flowing water.	5.02M	Unk	Unk	2
19 May 2015	Severe storms developed near a stalled boundary across Oklahoma and the panhandles and moved eastward through the afternoon and evening of the 19th, causing widespread heavy rainfall and additional flooding. Numerous streets and	Unk	Unk	Unk	0

	county roads flooded in and around the Lone Grove and Ardmore areas.				
8 May 2015	Another round of storms developed across the Texas panhandle and developed into a line as it moved eastward across southern Oklahoma. Several vehicles stranded in two to three feet of running water over Commerce Street.	Unk	Unk	Unk	0
6 Nov 2011	A line of thunderstorms with heavy rainfall developed over parts of southern Oklahoma during the evening hours and continued for several hours of the 6th. The line moved little and widespread Rainfall totals of 5-9 inches were reported across parts of Jefferson, Carter and Murray counties. Numerous roadways had to be closed due to them being impassable. A few buildings also took in water, especially near Turner Falls and Sulphur. The rainfall finally moved further north early on the 7th, with less flooding reported. A few streets in the town of Healdton were closed due to high water. Other county roads around town were closed as well.	Unk	Unk	Unk	0

Probability of Future Events:

It should be remembered also that Carter County, although a mountain range lies to the north of the county, is generally a very flat topography. This tends to cause heavy rain to accumulate and not runoff as quickly as it might in other less level terrain and is likely to cause problems with flash flooding. Based on past history, the potential of at least flash flooding in Carter County is **LIKELY**.

Vulnerability and Impact:

In Carter County, people have driven into flooded roadways and have been swept off by the heavy currents, or have driven off into a hole caused by a washed out roadway that was “hidden” by the flood waters, sometimes losing their lives. Flooded roadways often force people to find alternative transportation routes. Farmers and ranchers have lost thousands of dollars’ worth of crops or hay, as well as livestock when flood waters overrun their fields.

Healdton, Springer, and Lone Grove Public Schools received damages from flooding or heavy rains associated with Tropical Storm Bill in 2015. The remaining school districts did not report any damages.

Hazard Profile—Hail:

Hail forms in storms when super cooled water droplets freeze on contact with condensation nuclei, such as dust. The storm's updraft blows the hailstones to the upper part of the cloud. The updraft dissipates and the hailstones fall down, back into the updraft, and are lifted up again. The hailstone gains an ice layer and grows increasingly larger with each ascent. Once a hailstone becomes too heavy to be supported by the storm's updraft, it falls out of the cloud. This movement up and down inside the cloud, through cold then warmer temperatures, causes the droplet to add layers of ice and can become quite large, sometimes round or oval shaped and sometime irregularly shaped. The size ranges from smaller than a

Dime/Penny	0.75
Nickel	0.88
Quarter	1.00
Half Dollar	1.25
Ping Pong	1.50
Golf Ball	1.75
Hen Egg	2.00
Tennis Ball	2.50
Baseball	2.75
Tea Cup	3.00
Grapefruit	4.00
Softball	4.50



pea to as large as a softball and larger, and can be very destructive to buildings, vehicles and crops. Hail is the most expensive by product of thunderstorms. Oklahoma crop losses due to hail average approximately \$2.5 million per year in loss claims alone—not including property/casualty claims. Hail damage to automobiles, roofs, windows and farm crops is staggering. Large hail is also a threat to small mammals and it kills many birds. Large hail is generally one inch in diameter or larger and can cause a great deal of damage. Large hailstones can fall at speeds faster than 100 mph.



The National Weather Service uses a network of Nexrad Doppler radars to detect hail. Hail size and probability can be determined from radar data by a computer by different algorithms. This, in combination with an analysis of the radar display is an accurate way of detecting hail.

Location:

All of Carter County and the jurisdictions included in this plan are equally at risk of hail storms. Usually associated with severe thunderstorms, all structures, wildlife, livestock and the entire population is subject to hail damage.

Extent:

Hail usually last an average of 10 to 20 minutes but may last much longer in some storms and is usually in relatively small coverage areas. Hail causes \$1 billion in damage to crops and property each year in the U.S. Even small hail can cause significant damage to young and tender plants. The peak period in Oklahoma for hail storms is late spring and early summer, which also correlates to the thunderstorm

season in Oklahoma. In general the planning area expects to receive hail to the size of H0 to H5. The planning area has experience at least one H10 event in the past.

The Torro Hail scale below describes the levels of hail possible and the damage that results.

Table 3-13

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	0.00-0.60	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 and crops, damage to glass and plastic structures, paint and wood scored.
H4	Severe	1.20-1.60	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage.
H5	Destructive	1.60-2.00	Silver Dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries.
H6	Destructive	2.00-2.40	Lime or Egg	Aircraft bodywork dented, brick walls pitted.
H7	Very Destructive	2.40-3.00	Tennis Ball	Severe roof damage, risk of serious injuries.
H8	Very Destructive	3.00-3.50	Baseball or Orange	Severe damage to aircraft bodywork.
H9	Super Hailstorms	3.50-4.00	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.
H10	Super Hailstorms	4.00+	Softball and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open.

Carter County considers anything in the magnitude of H3 or higher on this scale significant due to crop losses and economic hardship it creates for farmers and ranchers.

Once the size of hail rises to H3-H4 magnitude it becomes disastrous to equipment that is parked outside due to insufficient cover.

Carter County and all participating jurisdictions used the Combined NOAA/TORRO Hailstorm Intensity Scales when considering the severity of hail.

Minor Severity: H3 and below

Major Severity: H4 and above

Previous Occurrences:

There have been numerous incidents of hail produced by the severe thunderstorms that occur in Carter County each year. The northern half of Carter County reported fewer hail events than the south, however it should be noted that the northern part of the county may not receive reports as often due to lower populations.

Table 3-14

Carter County Major Hail Storm History 2005-2015 (Profiling Events With > 1.00 Inch)		
Date	Location	Hail Size
19 May 2015	Ardmore	1.75 inch
18 Apr 2015	Healdton area	1.75 inch
18 Apr 2015	Wilson	1.25 inch
7 Jun 2014	Springer	1.50 inch
13 Apr 2014	Wilson	1.75 inch
9 Aug 2013	Ardmore	1.50 inch
5 Sep 2012	Gene Autry	1.75 inch
11 Jun 2012	Healdton/Lone Grove/Wilson	1.50 inch
28 May 2012	Healdton	1.25 inch
22 May 2011	Springer/Gene Autry	2.75 inch
22 May 2011	Ardmore/Wilson	1.75 inch
22 May 2011	Lone Grove	4.50 inch
20 Apr 2011	Lone Grove	1.75 inch
10 May 2010	Dickson	1.75 inch
12 Jun 2009	Healdton	1.25 inch
8 May 2009	Lone Grove	1.25 inch
10 Feb 2009	Lone Grove	1.75-2.75 inch
7 May 2008	Dickson	1.25 inch
2 May 2006	Tatums	1.75 inch
9 Mar 2006	Ardmore	1.75 inch
13 Jun 2005	Ratliff City	1.75 inch

Probability of Future Events:

Carter County property and citizens are susceptible to hail storms and will continue to be at risk. Carter County experiences several hailstorms a year, some of them causing damage. Damage usually occurs to structural glass, roofs, vehicles and crops. The entire county is at risk from hail and the probability of future events is LIKELY.

Vulnerability and Impact:



Oklahoma has significant exposure to hail events including Carter County. Hail from H3 to H5 can begin to damage vehicles and roofs and occasionally glass. Hail larger than this is dangerous, severely damaging windows, vehicles and roofs causing the need for expensive repairs. Hail larger than H8 can cause holes in roofs, destroy vehicles and cause extensive structural damage. It can also injure or kill people and animals. Early warning research is ongoing through the National Weather Service and the Oklahoma Climatological Survey to

improve warning and threat information for the public. Hail damage, generally to roofs of structures cause roofs to be replaced more frequently than the normal life of roofs costing insurance companies and property owners thousands of dollars. Property owners on occasion have to find temporary housing or a new business location due to the amount of roof damage done to their structure. For businesses this can result in loss of business and in extreme cases could even affect employee jobs.

School districts will typically suffer the same types of damages as those of businesses and private property. Busses could be damaged, roofs will be damaged, A/C units, and windows could be damaged causing an unsafe condition within the schools itself.

Hazard Profile—Severe Thunderstorms (High Winds/Lightning):



Thunderstorms occur when moist air near the ground becomes heated, especially in the summer, and rises, form cumulonimbus clouds that produce precipitation. Because thunderstorms almost always produce lightning and high winds, these hazards will be profiled as a part of the thunderstorm hazard profile. They will, however meet requirements for Hazard Mitigation Plans individually within the thunderstorm profile. The other element of many thunderstorms, hail, will be profiled independently. The National Weather Service estimates that over 100,000 thunderstorms occur each year in the U.S. Approximately 10% are classified as “severe”.

A severe thunderstorm, as defined by the National Weather Service, is a storm with hail equal to or greater than 1 inch in diameter and convective wind gusts equal to or greater than 58 mph. Lightning, flash flooding, wind-blown hail (even small hail), and downbursts as the thunderstorm collapses pose a threat to life and property. Severe thunderstorms also have the potential of producing a tornado with little or no advanced warning. Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes; however, weather-monitoring reports indicate that coherent thunderstorm systems can travel intact for distances in excess of 600 miles.

Nearly 1,800 thunderstorms are occurring at any moment around the world. Despite their small size, all thunderstorms are dangerous. Severe thunderstorms spawn as many as 1,000 tornados each year throughout the U.S.



High winds are a common feature of thunderstorms, particularly severe thunderstorms. As shown in the picture to the left, of a building at Healdton Elementary In May 2009 provides an example of wind damage. The National Weather Service uses winds in excess of 58 mph as one of the measurements in determining a thunderstorm to be severe. Wind is defined as the motion of air relative to the earth’s surface. High winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems, or gradient winds (high or low pressure systems) moving across Oklahoma. “High winds” are wind

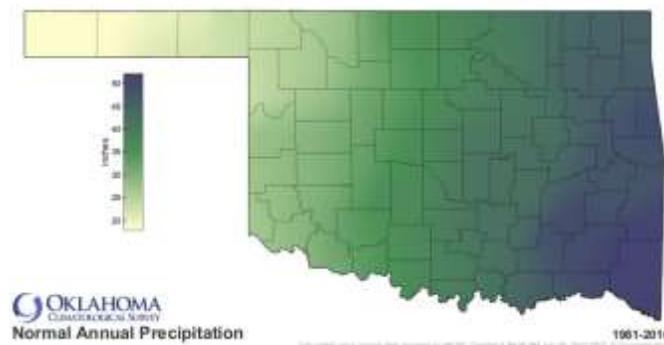
speeds reaching 50 mph or greater, either sustained or gusting. Damage similar to that cause by tornados and other cyclonic windstorms can result from downburst or microburst winds. Microbursts can occur anywhere convective weather conditions (thunderstorms, rain showers, and particularly hail or virga) occur. Virga is rain that evaporates before it reaches the ground and is associated with a dry microburst. Observations suggest that approximately five percent of all thunderstorms produce a microburst and significant wind damage can be related to them. Downdrafts associated with microbursts conversely are typically only a few hundred to a few thousand feet across. When the downdraft reaches the ground, it spreads out horizontally and may form one of more horizontal vortex rings around the downdraft. The outflow is typically 6-12 thousand feet across and the vortex ring may rise 2 thousand feet above the ground. Either can do severe damage to structures and as a result of that damage, have caused injuries and deaths.



Lightning is a result of electrical charges accumulating at the base of the clouds until lightning is discharged. Thunder is caused by the extreme heat associated with the lightning flash. In less than a second, the air is heated from 15,000 to 60,000 degrees. When the air is heated to this temperature, it rapidly expands producing thunder. When lightning strikes very close by, the sound will be a loud bang, crack or snap. Thunder can typically be heard up to 10 miles away. Lightning is a thunderstorm's number two killer each year in the U.S. killing more people annually than tornados. Each year lightning causes an average of 93 deaths and 300 injuries in the U.S. Lightning also causes several million dollars in damage to homes, business, churches, barns, and forests each year.

Location:

Thunderstorms and lightning are underrated killer events experienced in nearly every region of the United States. Oklahoma averages 240 thunderstorms annually, some of which produce tornados. In Carter County, NCDC reports show there have been 272 thunderstorm events since 1950, 54 of those since 2005. A history of Carter County thunderstorm activity is show in the Previous Occurrences section of this profile. All jurisdictions are vulnerable to thunderstorm high winds and lightning.



Oklahoma Average Precipitation per year.

Carter County experiences 40-45 inches per year.

Extent:

Thunderstorms and lightning are underrated killers. They are experienced throughout Oklahoma where people and property are exposed to the elements. They have caused damage to buildings and, due to downed power lines, caused major power outages. Many times businesses have to close due to power outages and lose business as a result. Carter County experiences 21-30 high wind events on average annually. In comparison with thunderstorms, 1/3 to half of the wind events in the county occurs during thunderstorms.

Beaufort Scale

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 broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

The Beaufort Wind Scale is a system of estimating and reporting wind speeds. Officials in Carter County consider anything higher than a force 9 on the Beaufort scale to be high enough to warrant high wind warnings.

Wind events in Carter County are generally associated with thunderstorms, although not always. Wind events can occur without the signature thunderstorm. Microbursts occur often when a thunderstorm is collapsing perhaps miles away from the microburst damage end product. Strong winds can also be produced especially during the winter months from the Arbuckle Mountains that are only 10 miles north of Ardmore. Carter County experiences 21-30 high wind events annually based on NCDC records (winds exceeding 60 knots).

Carter County and all participating jurisdictions use the National Weather Service's severe weather criteria when considering high winds severity.

Minor Severity: less than 58 mph
Major Severity: greater than 58 mph

Lightning in Oklahoma is as frequent as thunderstorms. Unfortunately, NCDC records are not complete concerning lightning events in Carter County. Records are not kept in Carter County on every lightning event unless it causes major damage to structures or starts major fires. Carter County officials consider all events which contain lightning to be severe. Carter County and all participating jurisdictions used the Lightning Activity Level chart when considering lightning severity.

Minor Severity: An LAL3 or less
Major Severity: An LAL4 or higher

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

Previous Occurrences:

There are hundreds of thunderstorm events across Oklahoma each year, most bringing welcome precipitation but many cause significant damage or injury and even death. Carter County experiences a number of thunderstorms every year. Many of those thunderstorms include high wind and lightning. Examples of thunderstorm incidents in the Carter County area are reflected in the table below. There have been numerous thunderstorms with wind and lightning that have occurred causing only tree damage. Those are not listed in the interest of space. The storms listed, cause actual structural damage.

Table 3-15

Carter County Thunderstorm History 2005-2015 (Profiles only structural damage and winds exceeding 58 knots.) (City of Ardmore is not part of this plan but is in Carter County.)			
Date	Location	Description	Est. Damage
28 May 2015	Fox	65 knots.	\$3,000.00
20 May 2013	Gene Autry	Roof blown off of Old Gene Autry Gym. 61 knots.	\$25,000.00
5 Sep 2012	Ardmore/Lone Grove	A weak cold front moved into Oklahoma during the afternoon, initiating scattered thunderstorms mainly south of interstate 40. Several storms produced severe wind gusts, along with some large hail. Storm chaser reported trees uprooted at the intersection of US-70 and Myall road on the west side of Ardmore. 61-68 knots.	\$3,000.00
8 Nov 2011	Dickson	Power poles and lines were blown down. A few outbuildings were damaged and a utility trailer rolled. 61 knots.	Unknown
24 May 2011	Lone Grove	The roof was blown off of a trailer home. Monetary damages were estimated. 61 knots.	\$6,000.00
22 May 2011	Ratliff City	The afternoon of May 22nd was characterized by a sharp dry line which mixed to just east of the I-35 corridor by late afternoon. A cold front surged southward into central Oklahoma during the late afternoon. The dew point temperatures were in the mid-60s and the temperatures were in the low to mid 90s ahead of the two boundaries. This coupled with a stout capping inversion for much of the day allowed for extreme instability to build across much of southern and eastern Oklahoma, and south into northern Texas. Once storms developed in the late afternoon, many of them quickly became severe. Steep lapse rates throughout the atmosphere lead to the threat for very large hail with an attendant threat of damaging winds. The hail sizes reached over four inches near Lone Grove, with golf-ball to baseball size over several other locations. The wind gust was measured on Highway 76 near Ranch Road. 63 knots.	Unknown

17 Jun 2005	Springer	Power lines were downed. A two mile stretch of utility poles were also downed. One of the poles fell on a house. 69 knots.	\$37,500.00
<i>Data from the National Climatic Data Center.</i>			

Probability of Future Events:

Carter County will continue to have thunderstorms with high winds and lightning, some being severe. There will continue to be damage from thunderstorm high winds and lightning. Considering the averages experienced over the last 58 years, there could be considerable thunderstorm activity in the next few years. The probability of thunderstorms with high winds and lightning in Carter County is **HIGHLY LIKELY**.

Vulnerability and Impact:

Many residents of Carter County have built safe rooms or underground tornado shelters, but many still do not have the means to complete such a project. All of the schools in Carter County have locations to help remove students and staff from danger but are not safe rooms and provide minimal protection. Wilson Schools and Dickson Schools have safe rooms on their campuses. Additional safe rooms are needed in Carter County school districts.

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.

Also at an increased risk for these events are members of the hard-of-hearing/deaf community, people for whom English is not their primary language 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 individuals, there are still a large number of residents facing these challenges unable to receive vital warnings in a timely manner.

All critical facilities within Carter County should be considered vulnerable to the effects of a tornado event. Structural integrity may be compromised if in the direct path of the storm, in addition to secondary impacts, such as power disruption, water damage from accompanying rain, injury to workers/residents, etc.

Carter County’s primary electrical service is provided by Oklahoma Gas & Electric (OG&E) based in Oklahoma City, with service in the southern portion of the county provided by Red River Valley Rural Electric, with offices in Marietta.

Given the climatic environment in this jurisdiction, all demographic groups located within Carter County are vulnerable to the effects and potential damages of hailstorm events. Particularly vulnerable are those pursuing farming and/or ranching activities, as crop damage is the highest percentage of reported hail damages. In addition, people engaged in outdoor recreational activities, such as team sports, golfing or camping, may find themselves without sufficient shelter.

Severe hailstorms cause considerable damage to buildings and (increasingly) to automobiles, but rarely results in loss of life. Given its significant exposure to hailstorms, virtually all buildings and structures in the jurisdiction are at risk. The entirety of Carter County and Carter County school districts are vulnerable to the damaging effects of hail.

All critical facilities are vulnerable to hail damage. Hail, however, is unlikely to render a critical facility non-operational.

During a hail event, public vehicles may sustain damage. If severe enough—such as a “Very destructive” H8 event, there could be some loss of functionality, possibly disrupting normal County operations.

Fire, Police and Medical Services would all be similarly at risk to the secondary effects of a hail event. Response vehicles in the open would likely be exposed to window and/or windshield damages. A secondary effect could be an increased call and work volume for County services.

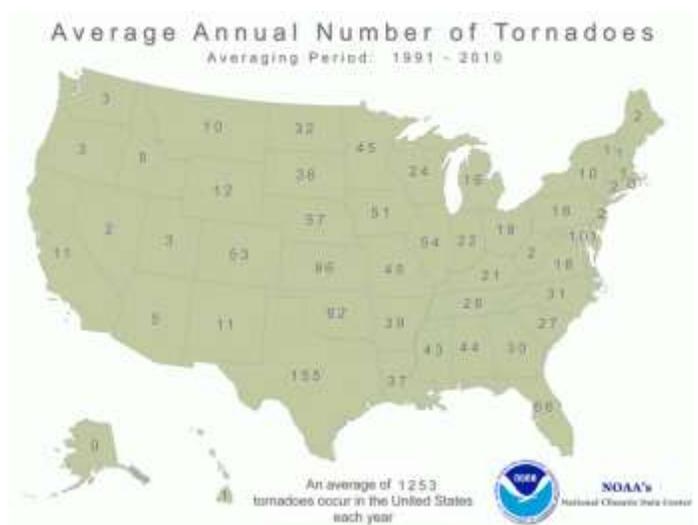
If a major hail event were to occur between 7:30 – 8:30 am or 5 – 6 pm on any weekday, the risk of commuters being caught in the event is substantially higher. Drivers seeking to pull under bridges to escape vehicle damage could cause accidents and injuries.

Hazard Profile—Tornado:



Tornados are defined as violently rotating columns of air extending from thunderstorms to the ground. Funnel clouds are rotating columns of air **not** in contact with the ground; however, the violently rotating column of air may reach the ground very quickly—becoming a tornado. A tornado is spawned by a thunderstorm when cool air overrides a layer of warm air, forcing the warm air to rise rapidly. The damage from a tornado is a result of the high wind velocity and wind-blown debris. Tornado season is generally April through June in Oklahoma, although tornados can occur at any time of the year. Over 80% of all tornados strike between 3:00 pm and 9:00 pm, but can occur at any time of day or night. Tornados are found most frequently in the United States east of the Rocky Mountains.

Tornados are among the most unpredictable of weather phenomena. While tornados can occur almost anywhere in the world, they are most prevalent in the United States. Tornados can occur in any state but are more frequent in the Midwest, southeast, and southwest. Oklahoma averages 62 tornados annually. NCDC documents that Carter County has experienced 54 tornados since 1950. According to the NCDC, only 8 tornados have affected Carter County since 2005.



Tornado season is generally April through June in Oklahoma, although tornados can occur at any time of the year. They tend to occur in the afternoons and evenings: over 80% of all tornados strike between 3:00 pm and 9:00 pm, but can occur at any time of day or night.

The most violent tornados are capable of tremendous destruction, with wind speeds in excess of 300 miles per hour. Damage paths can exceed one mile wide and be several hundred miles long. According to the National Weather Service, about 42 people are killed each year because of tornados.

Location:

The entire state of Oklahoma is at risk for tornados including all of Carter County’s jurisdictions and public school districts. Carter County is located in the infamous “Tornado Alley”. Tornado Alley is an area of states generally making up the primary area of the United States in which significant tornados occur most often. It is a region from Iowa to Oklahoma to Mississippi, with the highest threat in Oklahoma. In addition, this area has a consistent season each year—from April through mid-June, with the most tornados normally occurring in May.



These two facts—the conjunction of high frequency of strong and violent tornados and the relative consistency of the season from year to year from north Texas up into western Iowa—provide a natural, objective way to define Tornado Alley.

Extent:

Tornado wind speeds are estimated after the fact based on the damage they produce. In 1971, Dr. Theodore Fujita devised a scale to classify U.S. tornados into six intensity categories. These categories are based upon the estimated maximum winds occurring within the tornado. The Fujita Scale has subsequently become the definitive scale for estimating wind speeds within tornados, based upon the damage done to buildings and structures. It is used by meteorologists to estimate the speed of winds after a tornado by studying the damage caused by the tornado to structures.

The Enhanced Fujita Scale replaced the original Scale on February 1, 2007 which made wind speed estimates become more accurate than the previous scale. All events after 2/1/2007 are estimated using the enhanced scale. References to older storms will still rely on the original scale.

FUJITA SCALE			DERIVED EF SCALE		OPERATIONAL EF SCALE	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Tornado wind speeds are estimated after the fact based on the damage they produce. Tornados are categorized on a scale of EF0 (weakest) to EF5 (strongest) according to the Enhanced Fujita Scale. Carter County may experience any of these levels at any time during the year. The following pictures are examples of the damages experienced in the various levels of tornadic winds. Carter County and all participating jurisdictions used the Enhanced Fujita Scale when considering tornado severity.

Minor Severity: An EF2 or below

Major Severity: An EF3 or above



EF0 damage



EF1 damage



EF2 damage



EF3 damage



EF4 damage



EF5 damage

Previous Occurrences:

Table 3-18

Carter County Tornadoes 2005-2015					
Date	Location	Description	Injuries	Fatal	Damages
19 May 2015	Wilson area	A tornado was observed approximately 8 miles southwest of Wilson. No damage was reported. EF0	0	0	None
13 Oct 2013	Healdton	A sheriff's deputy encountered a rain-wrapped tornado near Healdton that was embedded within a larger area of severe thunderstorm winds. The tornado developed approximately 3 miles southwest of Healdton and moved northeast toward Healdton Lake. Trees and power lines were damaged along the path. The most significant damage occurred at Healdton Lake where five mobile homes were destroyed. Two injuries reported in one of these homes. The tornado likely dissipated over or just northeast of Healdton Lake. EF1	2	0	Unknown
8 Sep 2010	Lone Grove	The remnants of Tropical Storm Hermine moved north into southern and central Oklahoma, bringing with it heavy rain and three tornadoes. The most significant impact with this storm came from three tornadoes. The most significant	0	0	\$20,000.00

		tornado occurred near Colbert in Bryan County. Two homes sustained moderate damage and two trucks were overturned. One of the drivers sustained minor injuries while in the truck. Photographic evidence and radar data suggests a tornado developed between Prairie Valley and Rolling Hills Roads. Two homes sustained minor damage. EF0			
10 May 2010	Lone Grove	At least 4 mobile homes and 1 foundation home were destroyed by a large tornado. Other homes and outbuildings sustained minor to moderate damage. Widespread tree and power line damage was also noted along its track, and some high tension lines were downed. EF3	0	0	Unknown
10 May 2010	Healdton	Mobile homes were destroyed and seriously damaged and significant tree damage occurred as a tornado moved from 4 miles south-southwest of Healdton to 2 miles north-northwest of Wilson. EF2	0	0	Unknown
9 Feb 2009	Lone Grove	This long track tornado developed over far southeast Jefferson County, near the Red River, and continued northeast into Love County crossing through rural farmland north of Courtney, Rubottom and Oswalt. The tornado then crossed into Carter County, with sporadic damage noted in the sparsely populated areas in the southwest part of the county. The tornado appeared to reach its maximum width and intensity as it approached and moved through Lone Grove. The tornado destroyed or severely damaged numerous mobile homes, homes and businesses in and around	46	8	\$3,000,000.00

		<p>Lone Grove. Numerous mobile homes were completely obliterated with few recognizable pieces left. EF4 damage was noted at two locations, one in Lone Grove and the other in the Majestic Hills area north of Ardmore. Numerous vehicles were rolled or thrown, some for considerable distances. Six of the fatalities occurred in mobile homes and one in a well-built home that sustained EF4 damage. The eighth fatality occurred when a truck driving south on Interstate 35 was hit by the tornado killing the driver.</p> <p>The tornado continued northeast; with major damage reported in the Majestic Hills addition and crossing Interstate-35 about a mile and a half north of the Prairie Valley Road exit. At least eight homes and a small private school were destroyed in the Majestic Hills neighborhood. It moved through rural areas of Northeast Carter County to the east of Springer. Approximately 46 people were injured, with 14 seriously injured. Eight people died in the Lone Grove area. At least 114 homes were damaged or destroyed, with at least 3500 losing power in and around Carter county. Debris from this tornado was picked up as far away as Sulphur. EF4</p>			
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Probability of Future Events:

Based on the location of Oklahoma between the warm humid air from the Gulf of Mexico, and arid hot air from New Mexico and the cool air from the Rocky Mountains, conditions are right as proven by the history of tornados in Oklahoma and threaten Carter County.

Fortunately, better construction practices can limit the damage potential from all but the most violent tornados. The residences and businesses of today are more likely to withstand the damaging winds of weaker tornados than those structures built fifty years ago however there are still many older homes in the county and as was demonstrated in Lone Grove in 2009, even the stronger modern structures are not immune to major tornados. The map on the previous page reflects the tornados in Carter County from 1950—2015.



The National Weather Service is also taking steps to improve warning time. The next step in NOAA’s long-time weather radars is phased array radar. Available in the next few years, these radars, using electronic controls of beams and frequencies, can scan more quickly, thereby increasing lead times for tornado warnings.

The potential for future tornados in Carter County is **LIKELY**.

Vulnerability and Impact:

Many residents of Carter County have built safe rooms or underground tornado shelters, but many still do not have the means to complete such a project. All of the schools in Carter County have locations to help remove students and staff from danger but are not safe rooms and provide minimal protection. Wilson Schools and Dickson Schools have safe rooms on their campuses. Additional safe rooms are needed in Carter County school districts.

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.

Also at an increased risk for these events are members of the hard-of-hearing/deaf community, people for whom English is not their primary language 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 individuals, there are still a large number of residents facing these challenges unable to receive vital warnings in a timely manner.

All critical facilities within Carter County should be considered vulnerable to the effects of a tornado event. Structural integrity may be compromised if in the direct path of the storm, in addition to secondary impacts, such as power disruption, water damage from accompanying rain, injury to workers/residents, etc.

Carter County’s primary electrical service is provided by Oklahoma Gas & Electric (OG&E) based in Oklahoma City, with service in the southern portion of the county provided by Red River Valley Rural Electric, with offices in Marietta.

Fire, Police and Medical Services are all similarly at risk to secondary effects of a tornado, such as downed power lines or debris blocking county and community roads and streets. Excessive debris in the streets could lead to damage to emergency vehicles, potentially reducing the number of vehicles available for response. Medical Services (including treatment facilities) could be strained in responding to large numbers of injuries.

Hazard Profile—Wildfires:

A wildfire is often a raging inferno that rapidly spreads out of control. It happens most frequently in the summer, fall, and even winter when the brush is dry and flames can move unchecked through wooded or heavily grassed areas. During years of drought, wildfires can become a problem anytime due to the unusually dry conditions. A fire often begins unnoticed and spreads quickly, lighting brush, trees and eventually homes or outbuildings. It may be started by a campfire that was not extinguished properly, a tossed cigarette, burning debris, lightning or arson.

Wildfire is a natural part of Oklahoma’s ecosystem. Before Carter County was settled, wildfires, usually started by lightning, ran across the plains, or through the forests replenishing nutrients to the soils and controlling invasive plant species. With settlement, however, the interaction of wildfire and the environment has changed. Now, people, towns and structures are at risk from flames spreading across Carter County. Today, Carter County has many wild lands, creating an urban-wild land interface that is at risk of uncontrolled burns.

The development of such urban-wild land interfaces is part of a growing national problem. Fire losses and suppression costs have skyrocketed over the past decade. As homes and businesses have edged into valleys, forestlands and canyons, often far away from water sources that can be used to extinguish flames, costs of fire control have increased for local fire departments. Carter County Fire Departments are mostly volunteer fire departments doing an outstanding job. Carter County has experienced numerous wildland fires, many of them being long term.

Location:

The entire planning area is affected by wildfires. (See Wildland Interface Maps in Appendix C.)

Extent:

Carter County is threatened by a variety of grassfire and wildfire conditions found in the Keetch-Byram Drought Index (KBDI).

Keetch-Byram Drought Index (KBDI Fire Danger Rating System	
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 rapidly 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 soils. 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.

Carter County and all participating jurisdictions considered the severity of wildfires.

Minor Severity: KBDI of 399 and below.

Major Severity: KBDI of 400 and above.

Previous Occurrences:

In recent years, Carter County has experienced numerous wildland fires. As stated earlier, Carter County has an abundance of prairie land, forests and heavily wooded areas as well as mountainous terrain. Some of the county, particularly in the mountainous areas, create hazardous and often inaccessible areas for firefighters. Frequently, aerial support from the Oklahoma National Guard has to be requested in order to access the fire area. Sometimes, the fires have to “come out” to an area where the firefighters can access it. The table below lists the most serious fires in the county since 2005.

Carter County Wildfire Complexes 2005-2015			
Date	Complex Name	FEMA Declaration Date	Declaration #
9 Apr 2009	Healdton, Carter County	19 Jun 2009	DR-1846
13 Jan 2006	Ratliff City Fire	23 Apr 2006	DR-1623

Probability of Future Events:

The State of Oklahoma and Carter County have a significant wildfire hazard due to the climate, the types of fuels present and the cultural practices used. Carter County is south of the Snow Belt, leaving its grassy fuels exposed and vulnerable to fire in the dormant season. It is far enough north of the Gulf of Mexico that it is influenced by the continental climate in the winter. Summers are hot and usually dry, with daytime highs in the mid-90s and generally less than 4 inches of rain in July and August. Oklahoma recognizes 10 months as fire season. Wild land fuels are prone to burning from July through April. Only May and June are not considered “fire season”, however during droughts such as was recently present in Carter County, grass and wild land fire is more likely. Most at risk are those people who make their homes in woodland settings in or near forests and the rural areas of Carter County. Carter County has homes and businesses located in woodland and grassy areas complicated by mountainous terrain. Adding to the natural problem is an abundance of cedar and pine trees which along with the natural winds cause fires to spread quickly. Based on past experience and the fact that Carter County experiences dry conditions during fall and winter months as well as during our hot dry summers especially during July and August, and due to the fact Carter County has experienced a number of major wildfires the probability of future wildland fires is HIGHLY LIKELY.

Vulnerability and Impact:

Though wildfires can potentially impact anywhere in the planning area, the combination of pastureland, brush, and trees around the schools of Fox, Zaneis, Springer, and Dickson call for concern. These schools have all had several close calls in the past 10 years. The schools should continue to maintain defensible space around the facilities.

As evidenced by the 2005-2006 wildfire outbreaks, all rural and urban/wildland interface areas of Carter County are vulnerable to the wildfire hazard.

Any structures/buildings constructed within the wildland/urban interface area or on ranches/farms situated in grassy/wooded areas should be considered at risk to the effects of a wildfire event.

Critical facilities such as medical care facilities, resident care homes, daycare facilities, and utility out-stations located in these high-risk areas should be considered vulnerable to the effects of wildfires.

The largest threat to the delivery of electrical service would be the destruction/damage of power poles/lines, and flashovers from line to ground via smoke.

Roadway inaccessibility would be the largest vulnerability posed to the transportation system during a Wildfire event. During a wildfire located near a major highway, it may become necessary to close a section of highway or divert traffic along that route, as occurred on Interstate 35 during the wildfires of April 8-10, 2009. Roads and bridges in Carter County would be at risk during a widespread event as they are located in closer proximity to fields/grasslands that could become involved in a wildfire.

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. Residential developments in the wildland/urban interface areas of Carter County, along with any businesses/utilities supporting them in the immediate area, are especially at risk in the event of a large wildfire event.

Hazard Profile—Winter Storms:

A winter storm can range from moderate snow over a few hours to blizzard conditions with high winds, or can be freezing rain or sleet, heavy snowfall with blinding wind-driven snow and extremely cold temperatures that last several days. Winter storms vary in size from affecting several states to affecting only a small part of one state.

Flurries are snow events with light snow falling for short durations. No accumulation or only a light dusting is all that is expected with little or no effect on the population of the state.

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

Winter Storm refers to a combination of winter precipitation, including snow, sleet, freezing rain, etc.

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

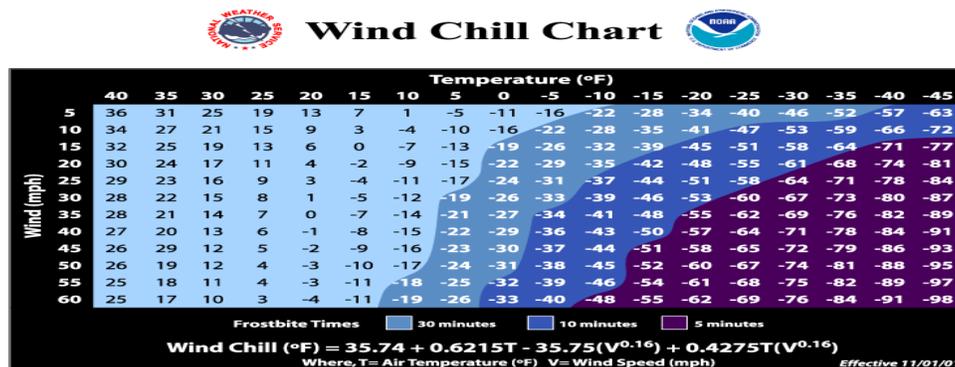
Blizzards though infrequent in Oklahoma, are due to winds over 35 mph with snow and blowing snow reducing visibility to near zero.

Ice Storms occur when freezing rain or sleet falls and freezes immediately on impact.

Freezing Rain is rain that falls onto a surface with a temperature below freezing. This causes it to freeze to surfaces such as trees, cars, and roads, forming a coating or glaze of ice. Even small accumulations of ice can cause a significant hazard.

Sleet is rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. However, it can accumulate like snow and cause a hazard to motorists.

Wind Chill is used to describe the relative discomfort and danger to people from the combination of cold temperatures and wind. The wind chill chart below from the National Weather Service shows the wind chill derived from both wind speed and temperature. The Wind Chill Index was created in 1870. On November 1, 2001, the National Weather Service released a more scientifically accurate equation, which we use today. The table gives a range of physical intensities from winter storms along with the potential effect.

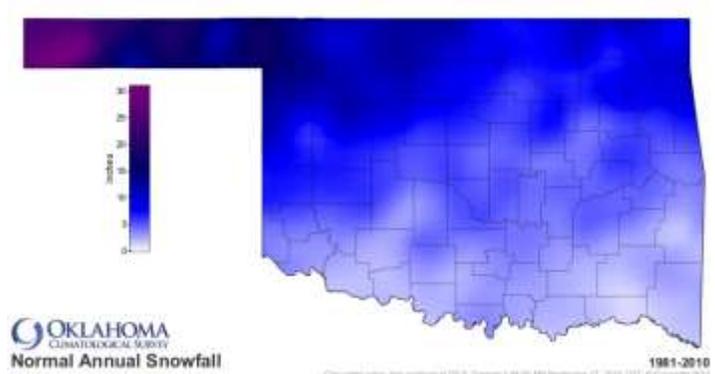


Location:

Oklahomans have been plagued with a series of major ice storms during the last decade. Ice storms are extended freezing rain events, lasting several hours to days with heavy ice accumulations. The icy cover downs power lines and tree limbs, causing millions of dollars in damage and widespread power outages. These events, which generally last several days or weeks, are extremely paralyzing to the communities and citizens affected. All of Carter County, including public school districts, is at risk for winter storms.

Extent:

Heavy snow can immobilize an area and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency services. Accumulations of snow, in rare instances, can collapse buildings and more frequently knock down trees and power lines. The cost of snow removal, repairing damages, and loss of business can have a large economic impact on cities and towns.



Carter County snow storms range generally from 3-6 inches annually. Wind chills also play a huge part in Carter County severe winter weather since the welfare of the public is directly related to wind chill. When wind chills warnings are issued by the National Weather Service, Carter County also issues a warning for Carter County citizens warning them to take extra precautions. Wind chill is the combination of wind and temperature that serves as an estimate of how cold it actually feels to exposed human skin. Carter County considers wind chill values below -19 degrees extremely dangerous to the population although hypothermia can occur at higher temperatures and cause deaths. Since wind can dramatically accelerate heat loss from the body, a blustery 30 degree day would feel just as cold as a calm day with 0 degree temperatures.

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

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

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

Carter County and all participating jurisdictions considered the severity of snow and ice.

Minor Severity: less than a quarter inch of ice or 3 inches of snow

Major Severity: more than a half inch of ice or 4 inches of snow

Previous Occurrences:

Carter County was affected by a major ice storm in the last decade. In December of 2007 ice storms caused major damage throughout the area. Snow storms have also affected the area.

Carter County Winter Storm History

Date	Location	Description
4 Mar 2015	Carter County	A strong cold front surged through Oklahoma early on the 4th, bringing an Arctic air mass into much of the Southern Plains. As this occurred, a large scale upper level trough shifted eastward across the Southern and Central Plains region, resulting in widespread wintry precipitation. Several inches of snow and sleet fell, with significant impacts to travel. Light rain transitioned over to freezing rain and sleet briefly, before transitioning to all snow during the evening hours. Snow became heavy at times, with up to 4 inches measured at Ardmore, and around 2 inches at Healdton.
5 Dec 2013	Carter County	A double shot of winter weather impacted Oklahoma during the day on the 5th and continuing into the 6th. Initially, wintry precipitation came in all forms, with freezing rain, sleet and snow. The second round of winter weather came as primarily snow, though some sleet and freezing rain

		continued into the morning hours of the 6th. Substantial snow, sleet and ice accumulations occurred over a large part of central, southern and western Oklahoma. A mixture of sleet and freezing rain occurred during the evening hours of the 5th. This continued into the morning of the 6th, with snow mixed in before the system moved east. By the time the storm had ended, Ardmore had received an inch or more of sleet with a dusting of snow, and areas east of Healdton reported 1.5 inches of snow and sleet.
1 Feb 2011	Carter County	Three inches of snow was measured at Healdton. Wind gusts over 35 mph also created considerable blowing and drifting of the snowfall, which reduced visibilities. The event began during the evening hours of 1/31.
31 Jan 2011	Carter County	A powerful winter storm began to take shape during the evening hours of the 31st and continued into the 1st of February. Most of the accumulating snow occurred on February 1, but thunder-sleet and snow did affect many locations after dark on the 31st. The wintry precipitation combined with increasing wind speeds began what was to end up as a powerful winter storm. Snow and sleet accumulations were minimal early on, but continued to deteriorate as the night progressed. Thunder sleet, freezing rain, and snow began during the late evening, with wind gusts increasing to over 30 mph by midnight. The majority of the storm occurred on 2/1.
28 Jan 2010	Carter County	Up to a quarter of an inch of glaze accumulated on elevated surfaces. The glaze resulted in some tree and power line damage. The majority of the accumulations occurred over the northern half of the county.
26 Jan 2009	Carter County	About 3/8 of an inch of glaze accumulated on trees and power lines near Ratliff City, causing sporadic power outages around town. In Ardmore, about a quarter of an inch of glaze had accumulated on trees, power lines, and elevated surfaces. At least 12 accidents occurred in Ardmore as result of the slick streets. No injuries were reported. Monetary damages were not given.
12 Jan 2007	Carter County	A strong winter storm crippled much of Oklahoma from January 12th through the 14th, spreading snow, freezing rain and sleet across the state. The snow and sleet was confined to northern and western Oklahoma. The freezing rain and sleet occurred mainly over central and southwest Oklahoma, with mainly freezing rain over the southeast. The hardest hit areas with freezing rain were Atoka, Bryan, Coal, Cotton, Hughes, Seminole, and Johnston counties. The wintry precipitation caused numerous traffic accidents with numerous indirect injuries and 14 indirect fatalities. Many trees and powers lines were downed with thousands of residents without power, mainly over southern and eastern Oklahoma. The severe cold that accompanied this storm also allowed for water main breaks in Clinton and Lawton. Other damage included school gymnasium roofs collapsed in Del City, Newcastle, two awnings collapsed in Allen and Ada, and four greenhouse roofs collapsed in McClain county. Also, the prolonged period of wintry precipitation closed airports, schools, malls, and other places of business. The slick

		and hazardous roads caused many schools to remain closed for several days after the winter precipitation had ended.
29 Nov 2006	Carter County	A strong cold front brought cold arctic air to the region. A strong upper level storm system then translated across the region over the arctic air causing winter precipitation. Winter precipitation fell in the form of freezing rain, sleet, and snow beginning on November 29 and ended during the evening of November 30. Thunderstorms also occurred with the sleet and freezing rain. Strong north winds combined with the snow causing blizzard or blizzard-like conditions across parts of the area on November 30, with the worst conditions occurring in north central Oklahoma where the greatest snowfall fell. Before the precipitation ended, most locations across approximately the western two-thirds of Oklahoma received some snow. However, many locations received other winter precipitation before changing over to snow. From northwest to southeast across the area the precipitation fell as all snow, a mix of sleet and snow, and a mix of sleet and freezing rain. Snowfall amounts ranged from less than an inch up to 12 inches. Most of the snowfall that was 4 inches or greater fell across the northern two-thirds of the area, with the greatest amounts occurring in north central Oklahoma where widespread amounts of 9 to 12 inches were reported. The highest total of 12 inches was reported in Newkirk in Kay county. Several inches of sleet fell across parts of central and southern Oklahoma. Ice glaze accumulations of up to 1/2 an inch were also reported across parts of central and southern Oklahoma. The winter precipitation caused hazardous travel across the area with numerous accidents reported.

Probability of Future Events:

Oklahoma’s location between the cold winter temperatures of the Rocky Mountains and the moisture from the Gulf of Mexico gives Oklahoma the potential for further ice and snow events. The probability of future winter storms in Carter County is LIKELY.

Vulnerability and Impact:

Residents of Carter County have been plagued with a series of major ice and snow storm during the last decade. Ice storms typically last several hours to days with heavy ice accumulations.

Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chills. Strong winds with these intense storms can knock down trees, utility poles, and power lines. Heavy accumulations of ice also bring down trees, electrical wires, telephone poles and lines, and communications towers. Most electric and telephone line in Carter County are above ground although some are underground. There are two major electric suppliers in Carter County (Oklahoma Gas & Electric (OG&E) and Red River Valley Rural Electric Association (REA)). Communications and power can be disrupted for days and weeks while utility companies work to repair the extensive damage. In extreme cases especially those involving elderly, handicapped or very young it is necessary to move them to shelters where they can stay until they return home. These shelters are typically operated by the American Red Cross, local churches and emergency

response agencies (with support from the Red Cross). Most residents make arrangements with friends or relatives in unaffected areas to stay with them. This is not only inconvenient but the temporary loss of population along with inaccessible roads for essential services and shopping cause critical shortages to businesses that are able to open.

Extreme cold often accompanies a winter storm or is left in its wake. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and the elderly are most susceptible. Freezing temperatures can cause severe damage to crops and other critical vegetation. Water pipes may freeze and burst in homes and businesses that are poorly insulated or without adequate heat leading to expensive repairs.

Structure fires occur more frequently in the winter due to lack of proper safety precautions and present a greater danger because water supplies may freeze and impede firefighting efforts. Icy roads may also impede firefighting leading to higher replacement or repair costs especially during more severe events.

People die of hypothermia because of prolonged exposure to the cold. Indigent and elderly people are most vulnerable to winter storms and account for the largest percentage of hypothermia victims largely due to improperly vented or unheated homes, but the leading cause of death during winter storms is from automobile or other transportation accidents. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians often leading to traffic accidents and major expense for medical bills and auto repairs.

Heavy snow usually immobilizes transportation facilities stranding travelers, stopping the flow of supplies, and disrupting emergency services. Accumulations of snow can collapse weaker buildings and knock down trees and power lines. In rural areas, homes may be isolated for days. The cost of snow removal, repairing damages, and loss of business can have large impacts on Carter County often delaying other important projects and plans.

Long Range Growth and Post Disaster Redevelopment:

Carter County is located in the south-central part of Oklahoma, and the population is equally split between urban and rural settings. Land uses within the county consist basically of agricultural, industrial, commercial, recreational and residential. Zoning ordinances only exist in the incorporated jurisdictions.

While Carter County continues to grow at a comfortable rate, Carter County does not anticipate any major changes in land use. New land that might be brought into the cities and towns will be zoned based on policies currently in place.

Analyzing Development Trends:

The Emergency Manager obtained the property assessment from the County Assessor in order to provide a building inventory. These properties were reviewed utilizing FEMA guidelines to estimate losses using the condensed inventory with cost estimates to provide a broad view of the extent of damages that could occur in any event. This methodology of estimating percentages for damage estimates was determined by the team members on expected damages for each disaster in a worst case scenario. (Appendix D—Critical Infrastructure).

Any post disaster redevelopment caused by an event would follow normal development procedures. The availability of utilities and roads and zoning policies would show very little permanent change in the redevelopment criteria. The stability of the historic data indicates redevelopment would occur in the same geographic locations.

Section 4

Mitigation Strategies

SECTION FOUR

Mitigation Action Strategies:

The Carter County Hazard Mitigation Planning Team reviewed, analyzed and prioritized the risk assessment studies. The STAPLEE guide was used to prioritize the action items and insure that an appropriate Cost Benefit performance is maintained. The goals, SECTION 1, Page 1-3, and objectives listed below were determined to be those that would have the greatest benefit in hazard reduction to the County. This priority remains the same from the previous plan, and will be readdressed in the five-year update to account for any growth and development in the planning area:

Prioritization and Review Criteria:

Evaluation Category	
Social	Based on the idea that community consensus is a necessary precondition for successful implementation of mitigation measures (i.e., measures should be supported and accepted by the entire community). This also means that measures should not affect adversely a particular segment of the population or a particular neighborhood, or adversely impact local cultural values or resources.
Technical	Addresses the technical feasibility of the proposed measures, in terms of effectiveness, secondary impacts, and the technical capabilities of a community to implement and sustain these measures.
Administrative	Addresses the administrative capabilities required to implement each mitigation measure. For example, does the jurisdiction have the necessary organization, staff, and funding sources to implement and sustain the mitigation process?
Political	Considers the need for political support for mitigation measures. This means that all stakeholders in the political process, especially political organizations and institutions both inside and outside of the community, should support the measure.
Legal	Used to determine the appropriate legal authority necessary to implement each mitigation measure and whether such an authority can be delegated. In addition, it will examine the mitigation measure from the standpoint of current statutes, codes, ordinances, and other regulations, as well as the possible legal ramifications of the measure's implementation.
Economic	Addresses the cost-effectiveness of the proposed measure and its economic impact on the community. It is only reasonable to expect that the benefits of implementation will exceed the costs incurred. Economic considerations also consider the economic impact on the community's future development. Special emphasis was placed on the need to consider the economic cost—benefit analysis of each project.
Environmental	Has become an important consideration in examining mitigation options. Although most mitigation measures are usually beneficial for the environment, some measures may have adverse effects, which must be considered and addressed.

Progress of 2010 Mitigation Strategy:

- All communities currently have their own warning devices. Carter County has installed 14 early warning devices throughout unincorporated areas of the county. (Action Item 1)
- Generators have been installed at all county barns and at Sneed Volunteer Fire Department. (Action Item 5)
- Carter County uses NIXLE for its emergency notification system. (Action Item 7)
- Several Individual Saferoom Rebate programs have been administered in Carter County allowing for the installation of 406 individual saferooms. (Action Item 14)
- The low water crossing on Radar Road has been replaced with a bridge. (Action Item 16)
- Two low water crossings on Buckskin Road have been replaced with bridges. (Action Item 19)
- Carter County has current flood mapping, both paper and digital. (Action Item 20)
- Carter County equipment is now sheltered. (Action Item 23)

Mitigation Actions:

Action Item 1	Early Warning Devices
Hazards Addressed	Severe thunderstorms, tornadoes, hail storms.
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Install early warning devices throughout the cities, towns, and county where needed to provide adequate advanced warning of a hazardous event.
Responsible Party	Local officials, Carter County Emergency Management
Potential Implementation Timeline	Ongoing as funding becomes available.
Cost	\$30,000.00 per unit.
Potential Funding Sources	HMPG, Local Budget, REAP

Action Item 2	Community/School Saferooms
Hazards Addressed	Severe Thunderstorms, tornadoes, hail storms.
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Build Safe Rooms to provide citizens living in mobile homes, substandard housing, or working in businesses without protected areas, citizens caught in a storm in their vehicle, school students and staff with a safe place to go.
Responsible Party	School Administrators, County and Local Emergency Management
Potential Implementation Timeline	12—18 months once funded.
Cost	\$250,000.00 - \$300,000.00 (Cost varies per individual saferoom location). \$170.00 per sq. ft. average.
Potential Funding Sources	HMPG, County and Local Budgets

Action Item 3	Firewise Program
Hazards Addressed	Wildfire
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Provide information on fire safety and the Firewise program to the public and to school children with materials to take home.
Responsible Party	County and Local Emergency Management, Local Fire Departments
Potential Implementation Timeline	Ongoing
Cost	\$25,000.00 annually
Potential Funding Sources	HMPG, County and Local Budgets, USDA, Forestry, AFG

Action Item 4	Weather Radio Program
Hazards Addressed	Dam Failure, Earthquake, Extreme Heat, Flood, Hail Storm, Lightning, Severe Thunderstorm, Tornadoes, Wildfire, Winter Storm
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Purchase, program, and giveaway weather radios to individual households, schools, critical facilities, and other facilities that contain large number of people at any one given time.
Responsible Party	County and Local Emergency Management
Potential Implementation Timeline	Ongoing
Cost	\$40.00 per receiver.
Potential Funding Sources	HMPG, County and Local Budgets

Action Item 5	Generators for Critical Facilities
Hazards Addressed	Dam Failure, Earthquake, Extreme Heat, Flood, Hail Storm, Lightning, Severe Thunderstorm, Tornadoes, Wildfire, Winter Storm
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Purchase and install generators on critical facilities to ensure continuity of government and critical services during disaster events and long periods of power outages.
Responsible Party	Municipal jurisdictions, County Commissioners, Schools Districts, Rural Water Districts.
Potential Implementation Timeline	3-6 Months after funding.
Cost	\$40,000.00 - \$80,000.00 ea.
Potential Funding Sources	HMPG, County and Local Budgets

Action Item 6	Saferooms in Mobile Home Parks
Hazards Addressed	Severe Thunderstorms, Tornadoes.
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, and Wilson.
Action	Pass resolutions recommending mobile home parks to have a Community Saferoom within walking distance of all residents.
Responsible Party	County Commissioners, Mayors, Town Councils.
Potential Implementation Timeline	1 year.
Cost	No anticipated cost to jurisdictions.
Potential Funding Sources	Local

Action Item 7 Emergency Notification System	
Hazards Addressed	Dam Failure, Earthquake, Extreme Heat, Flood, Hail Storm, Lightning, Severe Thunderstorm, Tornadoes, Wildfire, Winter Storm
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Purchase and install an emergency notification system such as Reverse 911.
Responsible Party	Emergency Management
Potential Implementation Timeline	1 year.
Cost	\$75,000,00
Potential Funding Sources	HMPG, Local Budget

Action Item 8 Surge Protection in Critical Facilities	
Hazards Addressed	Severe Thunderstorms, tornadoes.
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Install surge protection—battery backup devices on all electronic systems in critical facilities.
Responsible Party	Municipal Governments, School Administrators
Potential Implementation Timeline	Ongoing
Cost	\$300.00 per installation.
Potential Funding Sources	HMPG, Local Budget

Action Item 9	Water Source Storage Towers
Hazards Addressed	Drought, Wildfire
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Install new water storage towers in water system.
Responsible Party	Municipal Governments, Water Districts
Potential Implementation Timeline	Ongoing
Cost	To be determined.
Potential Funding Sources	CDBG

Action Item 10	Lightning Detectors
Hazards Addressed	Severe Thunderstorms
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Purchase Lightning Detectors for use at outdoor events and recreational areas.
Responsible Party	Municipal Governments, School Administrators, Emergency Management
Potential Implementation Timeline	One Year Once Funded
Cost	\$750 - \$10,000 depending on detection unit and type of installation.
Potential Funding Sources	HMPG, Local Budget

Action Item 11 Water Wells	
Hazards Addressed	Drought, Wildfire
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Drill for additional water wells.
Responsible Party	Municipal Governments, Water Districts
Potential Implementation Timeline	Ongoing
Cost	\$100,000 - \$150,000+
Potential Funding Sources	OWRB, CDBG

Action Item 12 Fan and Air Conditioning Program	
Hazards Addressed	Extreme Heat
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Provide fans and/or air conditioners to those in need; identify candidates.
Responsible Party	Local Volunteer Organizations
Potential Implementation Timeline	Ongoing
Cost	\$10,000 Annually
Potential Funding Sources	Senior Citizens Centers, VOAD Agencies

Action Item 13 Public Education Book	
Hazards Addressed	All Hazards
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Design and produce a booklet for public distribution to provide information on all the different hazards Carter County, communities, and schools are at risk of. Provide information on how to prepare for and respond in the event a hazard should occur.
Responsible Party	Emergency Management
Potential Implementation Timeline	Ongoing
Cost	\$25,000 Annually
Potential Funding Sources	HMPG, Local Budget

Action Item 14 Individual Safe Rooms	
Hazards Addressed	Hail, Severe Thunderstorms and Tornadoes
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Provide a safe room rebate program for persons installing a safe room in or near their residence.
Responsible Party	County and Municipal Emergency Management
Potential Implementation Timeline	36 months once funded.
Cost	\$3,000 per individual safe room.
Potential Funding Sources	HMPG, Local Budget

Action Item 15 Repetitive Flooding on Airport Road	
Hazards Addressed	Flood
Jurisdictions Affected	Carter County, Healdton, and the Public School districts of Healdton.
Action	Perform a study to determine whether raising the road surface or installing tin horns would resolve repetitive flooding problems along a two and one half mile area that involves thirty three structures in the Healdton area.
Responsible Party	Healdton Municipality, Carter County
Potential Implementation Timeline	3 years
Cost	3,000,000
Potential Funding Sources	RFC, PDM, SRL, HMGP, FMA, Local Budget

Action Item 16 Participation in the National Flood Insurance Program (NFIP)	
Hazards Addressed	Dam Failure, Flood
Jurisdictions Affected	Dickson, Healdton, Ratliff City, Springer, and Tatums.
Action	Complete NFIP applications for jurisdictions that are not already members. Member jurisdictions will continue to participate in the NFIP program.
Responsible Party	Cities, Towns, and County
Potential Implementation Timeline	Continuing Annually
Cost	\$0.00
Potential Funding Sources	N/A

Action Item 17 Bridge on Woodford Road	
Hazards Addressed	Dam Failure, Flood
Jurisdictions Affected	Carter County and the Public School Districts of Lone Grove and Springer. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Build a bridge on Woodford Road to allow access and egress during flooding events
Responsible Party	DOT
Potential Implementation Timeline	18 months once funded.
Cost	\$1,000,000
Potential Funding Sources	HMGP, RFC, SRL, DOT

Action Item 18 New Lake Water Source	
Hazards Addressed	Drought, Wildfire
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Study to find best location for additional water supply. Additional 6,000 acre lake located in the area identified by the study to enhance water availability for both drinking water and firefighting.
Responsible Party	Carter County Commissioners, OWRB
Potential Implementation Timeline	2 Years
Cost	\$150,000 - \$300,000
Potential Funding Sources	OWRB, USACE, NRCS, CDBG

Action Item 19 Flooding homes on Memorial Road	
Hazards Addressed	Dam Failure, Flooding
Jurisdictions Affected	Carter County, Lone Grove, Wilson and the Public School Districts of Lone Grove and Wilson. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Perform a study to determine the best course of action to eliminate repetitive flooding of homes on Memorial Road. Citizens are stranded by flooded road. Two or more homes are affected by this flooding
Responsible Party	Municipal Governments, County Commissioners
Potential Implementation Timeline	3 years once funded.
Cost	To be Determined
Potential Funding Sources	RFC, SRL, Local Budget

Action Item 20 Stream Monitoring Gages	
Hazards Addressed	Dam Failure, Flooding
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Install water monitoring device down stream of local dams.
Responsible Party	Commissioners, Emergency Management, USACE, OWRB, NRCS
Potential Implementation Timeline	6 mo. With funding
Cost	\$300,000 ea.
Potential Funding Sources	HMPG, Local Budget, OWRB, NRCS

Action Item 21 Window Film	
Hazards Addressed	Extreme Heat, Hail, Severe Thunderstorm, Tornado
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center.
Action	Install window film on new and existing critical facilities and school buildings. This would reduce the amount of damage from impacts of hail and small grade tornadoes. Therefore reducing the risk of flying glass within classrooms.
Responsible Party	Municipal Governments, School Administrators, Emergency Management
Potential Implementation Timeline	6 mos. Once funded.
Cost	\$1,000 - \$10,000 depending on facility and # of windows.
Potential Funding Sources	HMPG, Local Budget

Action Item 22 Compliance with the Local Floodplain Ordinance	
Hazards Addressed	Dam Failure, Flood
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Encourage compliance with the existing regulations of the Carter County and Municipal Flood Hazard Area Ordinances for proper development in the flood prone areas.
Responsible Party	Flood Plain Managers
Potential Implementation Timeline	Ongoing
Cost	N/A
Potential Funding Sources	Local Budget

Action Item 23 Flood Erosion on Dead River Road	
Hazards Addressed	Dam Failure, Flooding
Jurisdictions Affected	Carter County, Springer and Dickson School Districts. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Apply riprap materials to stabilize bank and prevent erosion during high water flood events.
Responsible Party	County Commissioners, USACE, NRCS
Potential Implementation Timeline	One Year Once Funded
Cost	\$1,000,000
Potential Funding Sources	HMPG, Local Budget, NRCS

Action Item 24 Repetitive Flooding	
Hazards Addressed	Dam Failure, Flooding
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Identify and reduce repetitive loss properties.
Responsible Party	Municipal Governments, County Commissioners
Potential Implementation Timeline	Ongoing
Cost	To be determined by actions taken.
Potential Funding Sources	HMPG, RFC, SRL, Local Budget

Action Item 25	Educate Insurance Agents, Realtors and Lenders Regarding Flood Insurance and the NFIP
Hazards Addressed	Dam Failure, Flooding
Jurisdictions Affected	Carter County, Dickson, Gene Autry, Healdton, Lone Grove, Ratliff City, Springer, Tatums, Wilson and the public school districts of Dickson, Fox, Healdton, Lone Grove, Springer, Wilson, Zaneis and Southern Oklahoma Technology Center. Only Gene Autry and Carter County are affected by Dam Failure.
Action	Host educational workshops regarding flood insurance and the NFIP for insurance agents, Realtors, and lenders in Carter County.
Responsible Party	Floodplain Administrators
Potential Implementation Timeline	Continuing Annually.
Cost	None anticipated.
Potential Funding Sources	Local Budget, OWRB

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