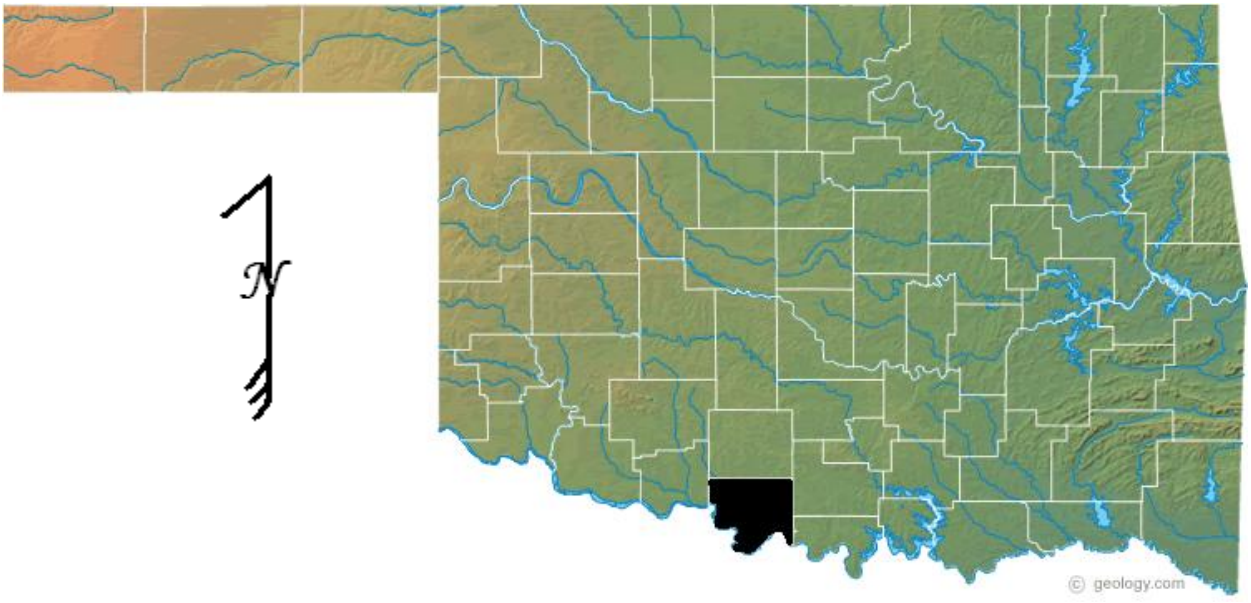
NATURAL HAZARD MITIGATION PLAN

JEFFERSON COUNTY, OKLAHOMA



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CHAPTER ONE - THE PLANNING PROCESS.

1.1. Introduction.

Floods, tornadoes, winter storms, drought and other hazardous events are a part of our world and their natural occurrence is inevitable and cannot be controlled. It is when these natural events intersect the man-made environment that “disasters” occur. Natural hazards cannot be prevented but actions can be taken to reduce their impact upon the human environment so that a disaster is less likely to result.

This hazard mitigation plan is focused on unincorporated areas of Jefferson County. Incorporated areas are not included within the scope of this plan. Jefferson County has an Emergency Operating Plan. The Jefferson County Conservation District develops a long term plan in conjunction with the USDA-Natural Resources Conservation Service. These plans were reviewed, and where appropriate, used in the Jefferson County hazard mitigation plan. No other plans, studies or reports were available at the County level and therefore were not included in this plan.

This Jefferson County Natural Hazard Mitigation Plan will discuss the planning process, provide background information, a hazard and risk assessment for the County, describe mitigation strategies, their implementation and plan maintenance procedures.

1.2. Plan Adoption.

The plan will be reviewed and revised within a five-year cycle with the possibility of updating it into a multi-jurisdictional plan, should Jefferson County municipal governments request this. Municipalities must provide appropriate information for inclusion and be willing to adopt the updated or revised plan. Otherwise, this plan is intended to be used in coordination with any efforts that the municipalities may undertake in the area of natural hazard mitigation planning.

I. Figure: Formal Adoption by Local Jurisdictions.

RESOLUTION

STATE OF OKLAHOMA

COUNTY OF JEFFERSON

WHEREAS, on this 15 day of September, 2009, the County Commissioners of Jefferson County met in regular session with the following members present: Billy Kidd (Chairman) Ty Phillips (Member) Loyd Kimbro (Member) and Gloria England County Clerk.

MOTION was made by Ty Phillips and seconded by Loyd Kimbro that the Natural Hazard Mitigation Plan for Jefferson County, Oklahoma be adopted.

Dated this 15 day of September, 2009

Chairman

Member

Member

COUNTY CLERK

COUNTY CLERK JEFFERSON COUNTY OKLAHOMA

1.3. The Hazard Mitigation Planning Process.

Hazard mitigation involves recognizing and adapting to natural forces and is defined by the Federal Emergency Management Agency (FEMA) as “any sustained action taken to reduce long-term risk to human life and property from natural hazards.” Mitigation is the component of emergency management that has the potential to break the cycle of damage and reconstruction that can occur when a community, is subjected to repeated natural hazards and therefore should be a high priority.

Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5165, enacted under Section 104 of the DMA 2K, P.L. 106-390 establishes new requirements for local hazard mitigation plans. Local governments are required to have a FEMA-approved local hazard mitigation plan in order to be eligible to receive federal funding through FEMA’s Hazard Mitigation Grant Program (HMGP).

This plan was developed by the Association of South Central Oklahoma Governments (ASCOG), through a contract with the Jefferson County Commissioners. Funding for this plan was provided in part through a grant from FEMA.

1.3.1. Development Process.

a. Planning Process. An open public involvement process was established for the public, neighboring communities, regional agencies, businesses, academia, etc; to comment on the plan in the drafting stage as well as prior to plan approval.
b. A comprehensive County approach was taken in developing the plan. In addition, the review and incorporation of appropriate existing plans, studies, reports and technical information into the plan during its drafting.

Perform a Risk Assessment.

An assessment of the hazards apparent to Jefferson County and the risks on the current or future built environment was established. The assessment includes the following:

a. The type, location and extent of all hazards that affect the jurisdiction, both historically and in the future.
b. Description of the jurisdictions vulnerability to those hazards including types and numbers of existing and future buildings, infrastructure and critical facilities in identified hazard areas.
c. Estimate potential dollar losses of those structures considered vulnerable.
d. General description of land uses and development trends for future land use decisions.

Develop a Mitigation Strategy.

Development of a blueprint for reducing the potential losses identified in the risk assessment, this will include:

a. A description of mitigation goals meant to avoid or reduce long-term vulnerabilities.
b. Identification and analysis of a comprehensive or range of mitigation actions and projects.
c. Action plan describing how the mitigation actions and projects will be prioritized, implemented and administered.

Develop a Plan Maintenance Schedule.
Plans must be monitored, evaluated and updated on a five-year cycle, including a review on incorporating the mitigation plan into comprehensive or capital improvement plans.

Adoption by a Governing Body.
A formal adoption by the appropriate governing body of the authoring jurisdiction to codify the mitigation plan.

Approval.
The plan is submitted to the State Emergency Management Agency for review and coordination. Once accepted, it is forwarded to the FEMA regional office for formal review and approval.

1.3.2. Purpose of the Plan. Hazard mitigation planning is a long-term, on-going process.

The primary purpose of this plan is to establish, and document, such a process for areas and assets within the jurisdiction of Jefferson County and in doing so, fulfill the requirements of the Robert T. Stafford Act and FEMA. The plan will address natural hazards that occur within Jefferson County. Jefferson County hopes to lessen its vulnerability to disasters caused by natural hazards. The plan is intended to serve as a guide for Jefferson County in coordinating and implementing hazard mitigation policies, programs and projects.

1.3.3. The intent of the Jefferson County Mitigation Planning Process.

Through this planning process, Jefferson County hopes to achieve the following:

1. **Reduce** any repetitive losses from natural hazards in Jefferson County.
2. **Facilitate** responsible development in Jefferson County so as to reduce or eliminate the potential impacts of natural hazards.
3. **Enhance** public awareness and understanding of natural hazard preparedness.
4. **Develop** mitigation measures for specific hazards.

1.3.4. Hazard Mitigation Planning Committee.

Broad counsel was gained from a planning committee chaired by Steve Goza, (Jefferson County safety director). The planning committee was composed of County residents, some of whom serve as professional advisors and others that serve as volunteers in local organizations.

They participated in open public meetings in which they identified hazards, (Meeting 1), identified goals and action items (Meeting 2), prioritized and compiled the action items into an action plan (Meeting 3).

The Jefferson County Hazard Mitigation Planning Committee was formed to provide guidance during the preparation of this plan. Committee members, along with their affiliation, are listed in Table II. This committee was comprised of private citizens and others from various local organizations, as well as representatives from local governments, businesses and emergency response personnel. Representation was solicited upon recommendations from the Jefferson County Commissioners; however, no one wishing to participate was excluded from doing so. Contacted persons were encouraged to bring interested citizens. The committee meetings were open to the public. The planning process and contacts for plan development were also established. Three public meetings were held during the development of this plan.

II. Table: Jefferson's County Hazard Mitigation Planning Committee Members.

Name	Representing	Tasks
Steve Goza– Jefferson County Safety Director	Jefferson County	• HMGP Chairman • Provided Information on Jefferson County • Serve as liaison to County Commissioners • Contributed Data on Past Disasters • Contributed Expertise on Past Mitigation Strategies & Efforts • Provided Knowledge of Current and Future Development Trends • Reviewed Draft Plan • Contributed to Plan Revisions • Coordinated Public Efforts within Jefferson County
Brad Scott - Citizen	Jefferson County	• Provided Information on private business activities • Contributed Data on Past Disasters • Contributed Expertise on Past Mitigation Strategies & Efforts • Provided Knowledge of Current and Future Development Trends • Reviewed Draft Plan • Contributed to Plan Revisions • Coordinated Public Efforts within his Tasked Area
John Dale – County Commissioner Jefferson County District# 3	County -Wide	• Provided Information on Jefferson County • Contributed Data on Past Disasters • Contributed Expertise on Past Mitigation Strategies & Efforts • Provided Knowledge of Current and Future Development Trends • Reviewed Draft Plan • Contributed to Plan Revisions

		• Coordinated Public Efforts within his Tasked Area
Kenny Wall–Jefferson County Commissioner District #1	Jefferson County	• Provided Information on Jefferson County Natural resources • Contributed Data on Past Disasters • Contributed Expertise on Past Mitigation Strategies & Efforts • Provided Knowledge of Current and Future Development Trends • Reviewed Draft Plan • Contributed to Plan Revisions • Coordinated Public Efforts throughout the County
Evelyn Randolph– Town of Hastings	Jefferson County and Incorporated Towns	• Contributed Data on Past Disasters • Contributed Expertise on Past Mitigation Strategies & Efforts • Provided Knowledge of Current and Future Development Trends • Reviewed Draft Plan • Contributed to Plan Revisions
Stan Rice – Association South Central Oklahoma Governments (ASCOG) Environmental Services	Regional Area	• Lead Contractor • Physically Collect and Process Data • Liaison with ODEM • Worked to Insure Plan Regulation Compliance • Coordinated Regional Information Flow • Provided Information on Jefferson County • Contributed Data on Past Disasters • Contributed Expertise on Past Mitigation Strategies & Efforts • Provided Knowledge of Current and Future Development Trends • Reviewed Draft Plan • Contributed to Plan Revisions

The committee is working as a whole to come up with mitigation solutions.

1.3.5. Public Involvement in the Planning Process: Structured public involvement was accomplished through the County committee described above and discussion at regularly scheduled County commissioner meetings.

1. Opportunities for the public to comment on the plan during the drafting stage and prior to plan approval were created in order to reduce the chance that any concerns would be overlooked. Public comment was sought by publication of notices of meetings, during which the progress of the plan was publicized, in newspaper articles, telephone contact, direct mailings, a calendar and area wide newsletters. Draft copies of the hazard mitigation plan were offered for public comment by posting on the

ASCOG internet site and by copies placed in the Jefferson County Commissioner's office. This offer was made public through newspaper articles and area wide newsletters. In the Jefferson County Commissioner's office, a form summarizing the natural hazard threats in Jefferson County asking for their opinion of the action items then under consideration, and then requesting additional action items was provided along with the draft copy of the hazard mitigation plan. Supporting documentation and added detail of opportunities for public comment have been placed in attachments.

2. All meeting participants received the handout, "Hazard Mitigation Planning for Local Governments Fact Sheet, FEMA dated September 2002." All meeting attendees were encouraged to share their experiences and suggestions for future mitigation activities.

1.3.6. Additional Public Involvement Information in the Planning Process. (See Appendix A – Supporting Documents.)

1. Newsletters.
2. News Coverage.
3. Agendas.
4. Meeting Minutes.
5. Sign In Sheets and Statements of Attendance.

1.3.7. Other Interested Party Involvement in the Planning Process.

There are many public agencies, private organizations and businesses that contend with natural hazards. Jefferson County's contractor, ASCOG, contacted them to collect information on the hazards and determine how their programs could best support the Jefferson County's mitigation program. Copies of the hazard mitigation plan were offered for public comment by posting on the ASCOG internet site and by copies placed in the Jefferson County Commissioner's office. This offer was made to neighboring communities through area wide newsletters and direct mailings.

Among the organizations and agencies contacted were the following: (Each was asked to contribute information on past and potential hazard threats and comment on the planning process and content.)

Federal:

1. Federal Emergency Management Agency (FEMA)
2. US Environmental Protection Agency
3. US Army Corps of Engineers
4. US Department of Agriculture
5. Department of Interior-Bureau of Indian Affairs
6. National Weather Service (NWS)
7. Natural Resource Conservation Service (NRCS)

8. US Fish and Wildlife Service
9. US Geological Survey

National Non-Profit:

1. American Red Cross

State:

1. Oklahoma Department of Civil Emergency Management
2. Oklahoma Water Resources Board
3. Oklahoma Science and Rivers Commission
4. Oklahoma Department of Environmental Quality
5. Oklahoma Department of Commerce
6. Oklahoma Conservation Commission
7. Oklahoma Department of Wildlife Conservation
8. Oklahoma Geological Survey

Regional:

1. Association of South Central Oklahoma Governments
2. Area Agency on Aging

County:

1. Jefferson County Commissioners
2. Jefferson County Conservation District
3. Jefferson County Health Department
4. Jefferson County Rural Fire Departments
5. Jefferson County Police Departments and Sheriff
6. Cotton Electric Cooperative
7. Waurika Lake Master Conservative District
8. Red River Technical Center
9. Oklahoma State University - Extension Service

Other Communities:

All Jefferson County communities were invited to participate in the planning process for the unincorporated areas.

1. Addington
2. Hastings
3. Ringling
4. Ryan
5. Terral
6. Waurika
7. Cornish

A draft of the plan was prepared, reviewed and edited by the Jefferson County Commissioners and other committee members. Once edits were accepted and incorporated into the plan, the draft was discussed and adopted by the County Commissioners at their regularly scheduled meeting held in compliance of the

Oklahoma Public Meeting Act. Once adopted, this draft was submitted to the Oklahoma Department of Emergency Management for State approval.

1.3.8. Review of Existing Plans.

The following plans were reviewed and where appropriate incorporated into the Jefferson County Hazard Mitigation Plan.

Capital Improvement Plan (CIP).

Jefferson County is developing a CIP. All physical property and transportation units are being listed. Roads and bridges are classified as to needs and repair schedule. This information was used to support action items.

Emergency Operations Plan.

Jefferson County has an Emergency Operations Plan (EOP). The EOP is a response planning manual developed by the County and County emergency management director. The EOP is useful post disaster as a guide to emergency response and recovery and is used in analysis and location of shelters and critical facilities.

Permitting-NFIP.

Jefferson County does not currently have a permitting system in the rural areas. Jefferson County does not participate in the National Flood Insurance Program, but is planning to join.

Conservation District.

The Jefferson County Conservation District, and the USDA-Natural resource conservation service, develops a long-range plan that specifically addresses drought, flood protection and other natural resources. This information was used in the Jefferson County Hazard Mitigation Plan, especially for flooding, drought and rural fires.

CHAPTER TWO – HAZARD ASSESSMENT.

2.1. Identifying Hazards.

a. The first step in developing a hazard mitigation plan is to identify and describe all the natural hazards capable of occurring within Jefferson County. Next is to list Jefferson County's vulnerabilities to each hazard so that appropriate action can be taken to mitigate the impact of the hazards, minimize the losses and recover as quickly as possible. It is recognized that all the demands of a disaster situation cannot be anticipated but, by being aware of the areas, major facilities and persons who may be vulnerable to each type of hazard, preventive measures as well as emergency response can be planned.

b. The National Climatic Data Center (NCDC) maintains records regarding weather events since 1950. This database, along with information obtained from Jefferson County's hazard mitigation meetings, was used to prepare profiles, which assess each of the natural hazards capable of occurring within Jefferson County. Several natural hazards were identified by the Hazard Mitigation Planning Committee members and addressed in this plan. Table III lists these natural hazards and explains how and why each was identified as a hazard to Jefferson County.

Details of each natural hazard and its impact on Jefferson County are given in separate profiles for each hazard.

III. Table: Summary of Natural Hazards.

Hazard	How Identified	Why Identified
Dam Failure	• Review past disaster declarations • OWRB database • Local input • Risk Assessment	• Population and buildings below dam are very vulnerable in event of release or dam failure
Drought	• Review past disaster declarations • Drought databases • Review NCDC database • Input from County • Public Input	• Drought is common in County • Drought was one of the most costly past disasters
Earthquake	• USGS Database • Earthquake databases • Review NCDC database • Input from County • Public Input • HAZUS 99	• The largest earthquake in the continental US centered just east of Oklahoma • Major faults run through Oklahoma
Expansive Soils	• Soil databases • Utility data • Input from County • Public Input	• Common to area
Extreme Heat	• Review past disaster declarations • Heat databases	• Prolonged temperatures over 100 degrees Fahrenheit are common in summer months • Heat affects people, animals and crops

	• Review NCDC database • Input from County • Public Input	
Flood	• Review of FIRMS • Input from County • Risk Assessments • Public Input • Review of past disaster declarations • Identification of NFIP repetitive loss properties in the County	• The County contains many rivers and streams • Flash Flooding is common
Hailstorm	• Review past disaster declarations • Hail databases • Review NCDC database • Input from County • Public Input	• Hail is a major economic hazard to this agricultural region • Hail occurs each year
Severe Winter Storms	• Review past disaster declarations • Winter Storm databases • Review NCDC database • Input from County • Public Input	• People can be stranded in isolated areas • Damages to public and private sector caused by heavy snows, etc • Can result in death • Humans and property are not prepared for extended periods of cold in this area • Damages to public and private sector caused by freezing lines • Ice Storms recently caused extensive damages to area • Many populations were without power for extended periods • Damages to public and private sector property
Tornado/high wind	• Review past disaster declaration • Tornado databases • National Weather Service data • Review NCDC database • Input from County • Public Input	• Common to State • Public Concern • Past damages • Damages to public and private sector
Wild Fire	• Review past disaster declarations • Fire databases • Review NCDC database • Input from County • Public Input	• Common to area • Can occur in conjunction with drought and/or lightning • Damages to public and private sector
Thunderstorms/Lightning	• Review past disaster declarations • Wind Storm databases • Review NCDC database • Input from County • Public Input	• Flat terrain allows high velocity winds to occur • Damages to public and private sector • Define “Wind” vs. “Tornado” in public mind

2.2. Natural Hazard Assessments.

The profiles, found later in this chapter, were prepared for each identified natural hazard and assess the hazard per the following eight categories

1. Description.

Explains what the hazard is, how and where it originates.

2. Location.
The geographic area affected by the natural hazard.

3. Extent.
This describes the hazard's impact in terms of how severe of an event the particular hazard is capable of inflicting upon Jefferson County. Due to the limited amount of County-specific documentation, the analysis for determining potential severity is limited to obtaining available documented information and personal recollection of past events from residents, emergency responders and Jefferson County Emergency Management.

4. Previous Occurrences.
The description of the hazard's past episodes and the extent of impact.

5. Probability of Future Events.
Probability of future events describes the probability that the hazard will occur within Jefferson County. Each hazard is assigned a probability of future events rating based on the criteria and methods described below

The Probability of Future Events rating was based on the following definitions

1. Highly likely = event probable in next year (1 event per year; 1/1=1.00)
2. Likely = event probable in next 3 years (1 event per 3 years; 1/3=0.33)
3. Occasional = event probable in next 5 years (1 event per 5 years; 1/5=0.20)
4. Unlikely = event probable in next 10 years (1 event per 10 years; 1/10=0.10)

This results in the following ranges of Probability of Future Events
1. Highly likely = greater than 0.33
2. Likely = greater than .020, but less than or equal to 0.33
3. Occasional = greater than 0.10, but less than or equal to 0.20
4. Unlikely = 0.10 or less

Example: Jefferson County has had 28 tornadoes recorded in the last 53 years. 28 / 53 = 0.52 average per year, which would make tornadoes "Highly Likely" to occur within the County.

6. Vulnerability.
Vulnerability describes how exposed or susceptible to damage Jefferson County is in terms of why and where the hazard can occur within the County.

7. Secondary Hazards.
Lists other hazards often triggered by the identified natural hazard event. Some natural disasters set off other types of catastrophes in a cascade of effects that lead to a highly complex situation. Secondary hazards can be events such as transportation and communications disruptions, fire, hazardous materials dispersion, power outages and other utilities disruptions. These secondary events are identified along with the

associated primary hazard due to how they can dictate the amount of impact a natural hazard event can have on Jefferson County.

8. Overall Summary of Vulnerability and Impacts.
This section summarizes the vulnerability of Jefferson County, and the possible impacts of the natural disaster

2.3. HAZARD PROFILE - Dam Failure.

2.3.1. Description.

1. Dams can fail by several different means. Three general failure models include:

a. Natural disaster related failure, such as when the dam is overtopped by flood waters, which creates a breach through the embankment.
b. Intrinsic structural failure, (including foundation problems) either under sunny-day circumstances or during high reservoir levels.
c. Failure resulting from an act of terrorism or sabotage.

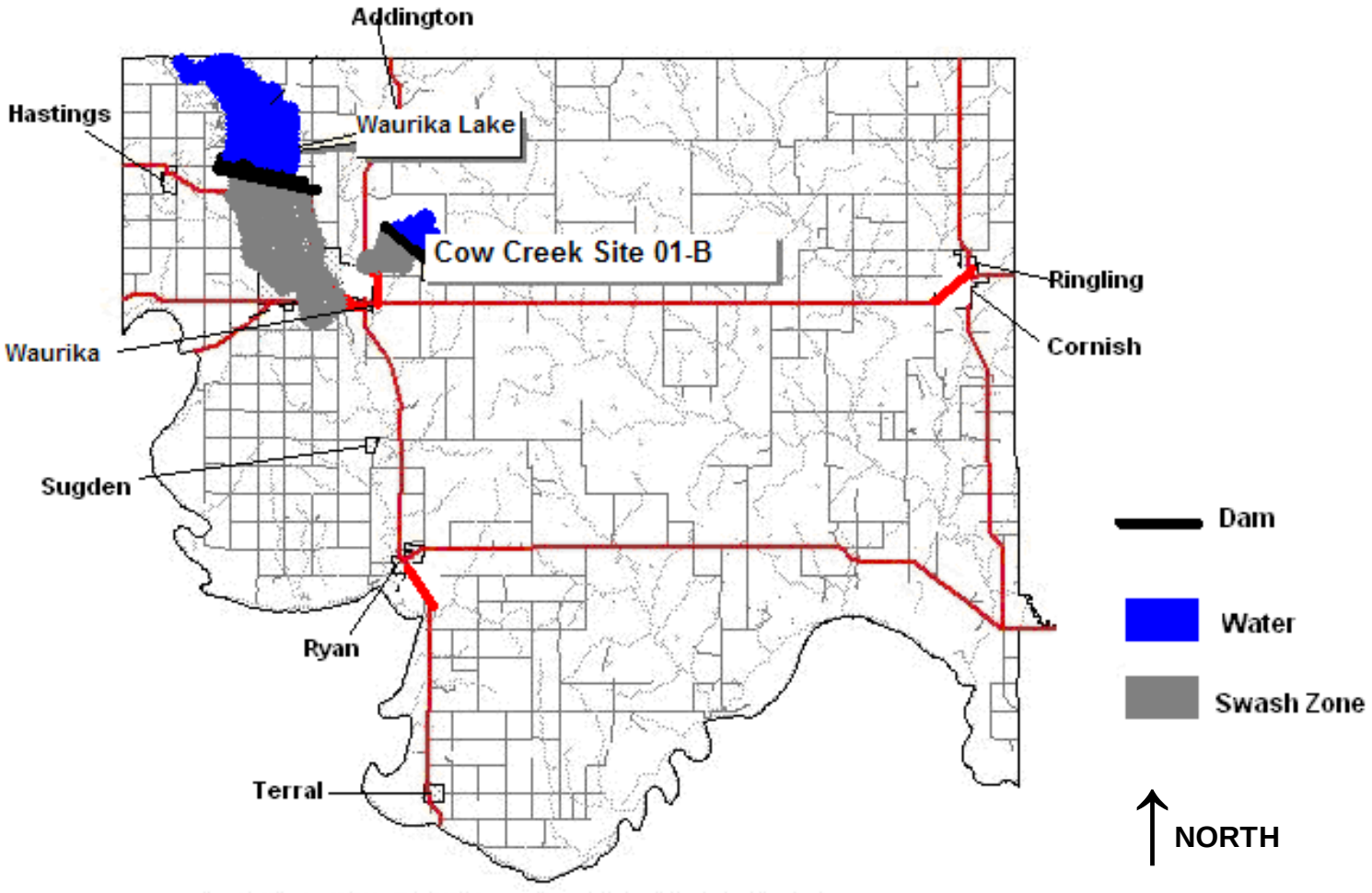
2.3.2. Location.

Two dams exist in Jefferson County with an elevated risk designation. One of the dams is identified as HIGH risk.

IV. Table: Jefferson County Dams.

DAM NAME	HAZARD	OWNER	STREAM
Waurika Lake	High	Corps of Engineers	Beaver Creek
Cow Creek Site	Significant	Jefferson County Conservation District	Tributary of Cow Creek

V. Figure: Locations of Jefferson County Dams.



SIGNIFICANT AND HIGH HAZARD DAMS (NOT TO SCALE)

2.3.3. Extent.
Dam failures have not occurred in any years between 1954 and 2006. Damages to personal property are estimated at $0.00.

One dam in Jefferson County is designated as high risk. This dam is classified high risk by the OWRB using criteria established by The Ad Hoc Interagency committee on Dam Safety for Science, Engineering and Technology. The guidelines were prepared in response to a Presidential memorandum of April 23, 1977, and were published on June 25, 1979. Reference: National Engineering Manual (Part 503, subpart D - Dam Safety)

Hazard classifications used by the Oklahoma Water Resources Board (OWRB) to identify dams are based upon their location and the population density located downstream from the structures.

Hazard	Loss of Life	Economic Loss (property)
Low	None (no probable future development)	Minimal (undeveloped, occasional structure or agriculture)
Significant	None (potential for future development exists)	Appreciable (notable agriculture, industrial or structural)
High	Yes (dam failure would likely result in loss of life)	Excessive (extensive community, industrial or agriculture)

The OWRB coordinates the Oklahoma Dam Safety Program to ensure the safety of all dams in Jefferson County, especially those that could impact downstream life and property.

The OWRB coordinates the Oklahoma Dam Safety Program to ensure the safety of the two dams in Jefferson County, especially those that could impact downstream life and property.

The program requires inspections every five and three years for low and significant hazard structures, respectively. It requires annual inspection of the County's high-hazard dam.

Should the dam experience a partial failure or a major seepage releasing one foot of water or less into the swash zone this would be considered a minor event. This release would flow through the agriculture area only and crops would survive. The water would flow on to the nearby creek. A major dam failure classified as a severe event releasing one or more feet of water into the swash zone will ruin crops but flow on to the nearby creek causing no other damage.

Because many of these dams are old structures, as a result, require periodic repair. The OWRB requires submittal and subsequent approval of plans and specifications prior to dam modifications. Staff also coordinates periodic training sessions and workshops on dam safety issues and regulations for dam owners and engineers. The NRCS offers technical assistance in the construction of small farm ponds and related structures.

2.3.4. Previous Occurrences.

There are no previous occurrences of dam failure in Jefferson County.

2.3.5. Probability of Future Events.
Since no dam breaks have occurred within Jefferson County, probability of a dam break is rated as unlikely.

2.3.6. Vulnerability.
As long as dams exist so does the chance for failure. Resources in the flood zones include agricultural, roads, bridges and public utility infrastructure.

2.3.7. Secondary Hazards.
Secondary hazards can include transportation utilities and emergency services Disruption, and possible dispersion of contaminants. Although hazardous materials and other contaminants are not identified in the area, this may need to be addressed in updates to this plan.

2.3.8. Overall Summary of Vulnerability and Impacts.
There is no record of dam failure in the history of Jefferson County. Only one dam in Jefferson County is designated as high hazard.

This designation simply reflects a dam's potential for doing damage downstream if it were to fail and does not mean that a dam is in need of repair. The areas impacted (swash zones) are delineated using dam breach analysis. However, due to the low population downstream of the dam, the Corps of Engineers has not conducted such analysis.

The vulnerability of a dam failure in Jefferson County would be to the roads, bridges and utilities that are downstream of the dam and potential loss of life if vehicles were involved. Damage to or loss of these roads, bridges and utilities would impact the citizens and County through the loss of communication infrastructure, mail, school buses, access for emergency vehicles and utilities such as electrical power. There would be the added expense of taking alternate routes and the cost of repairing the roads and bridges.

There was not an inventory of Tribal, or Trust Lands, potentially affected by dam failure since these lands are not in the jurisdiction of Jefferson County. However, Jefferson County is responsible for the roads, bridges in the area and also the safety of its citizens.

2.4. HAZARD PROFILE – Drought.

2.4.1. Description.
A drought is a period of abnormally dry weather which persists long enough to produce a serious hydrologic imbalance. There are four ways that drought can be defined:

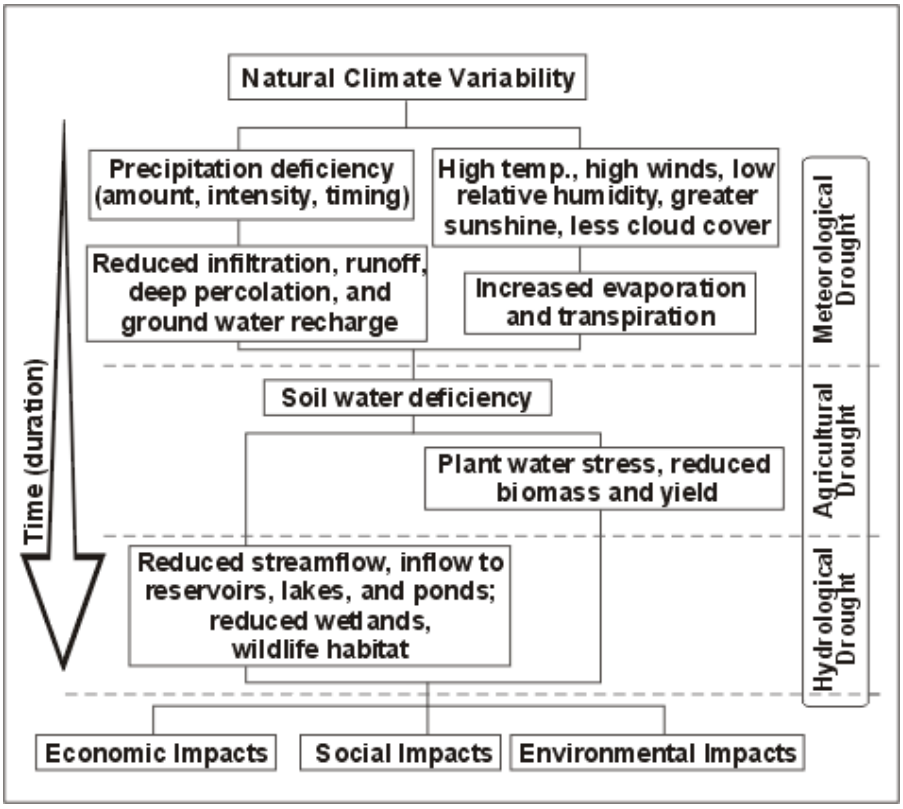
1. **Meteorological.** A measure of departure of precipitation from normal.

2. **Agricultural.** Refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.

3. **Hydrological.** Occurs when surface and subsurface water are below normal.

4. **Socioeconomic.** The situation that occurs when physical water shortage begins to affect people.

VI. Figure: Diagram of Drought.



2.4.2. Location.
All areas of Jefferson County are equally susceptible to drought.

2.4.3. Extent.
Drought impacts in a number of ways, spanning all regions, and is capable of affecting the economy as well as the environment. Specific impacts can include:

1. Reduced crop, rangeland.
2. Increased livestock and wildlife mortality rates.
3. Reduced income for farmers and agribusiness.
4. Increased fire hazard.

5. Reduced water supplies for municipal/industrial, agricultural and power uses.
6. Damage to fish and wildlife habitat.
7. Increased consumer prices for food.
8. Reduced tourism and recreational activities.
9. Unemployment.
10. Reduced tax revenues because of reduced expenditures.
11. Foreclosures on bank loans to farmers and businesses.

The most direct impact of drought is economic rather than loss of life or immediate destruction of property. While drought impacts in Jefferson County are numerous and often dependent upon the timing and length of individual drought episodes, the greatest impacts of drought are usually experienced in the agricultural community. In addition to the obvious direct losses of both crop and livestock production due to a lack of surface and subsurface water, drought is frequently associated with increases in insect infestations, plant disease and wind erosion.

One of the most significant potential impacts of drought relates to public water supply. In metropolitan areas, there may be a need to stop washing cars, cease watering the grass and take other water conservation steps. In smaller communities, reduced flow in rivers and streams can have a significant effect on the water amount allowed for municipal use. Hot weather during the summer increases demand and subsequent use of supplies, as well as evaporation. In turn, increased water demand can stress many smaller and/or antiquated delivery and treatment facilities to the point of collapse. Prolonged drought has a much greater impact on rural communities, which usually rely on relatively small watersheds and are especially vulnerable during such periods.

Water shortages can also affect fire fighting capabilities in both urban and rural settings through reduced water flows and pressures. Most droughts dramatically increase the danger of fires on wild land. When wild lands are destroyed by fire, the resulting erosion can cause heavy silting of streams, rivers, and reservoirs. Serious damage to aquatic life, irrigation and power production then occurs. Although drought can have serious impact during winter months, it is most often associated with extreme heat. Wildlife, pets, livestock, crops and humans are vulnerable to the high heat that can accompany drought. When temperatures reach 90 degrees and above, people and animals are more likely to suffer sunstroke, heat cramps, and heat exhaustion.

Based on the Palmer Index Jefferson County considers a value of 50 to be minor in severity where only the growth of vegetation would be affected. However, a value of -3.00 and above would cause loss in agriculture crops, loss of livestock, increased wildfire danger, water supplies would fall to levels requiring rationing, area streams would run dry and lake levels would fall all of which would be considered major in severity by Jefferson County.

VII. Figure: PDSI Classifications.

Drought: Palmer Index.
Palmer Drought Severity Index (PDSI)

In 1965, Palmer developed an index to "measure the departure of the moisture supply". Palmer based his index on the supply-and-demand concept of the water balance equation, taking into account more than only the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI), as this index is now called, was to provide a measurement of moisture conditions that were "standardized" so that comparisons using the index could be made between locations and between months.

The Palmer Drought Index is based on precipitation and temperature. The Palmer index can therefore be applied to any site for which sufficient precipitation and temperature data is available.

The Palmer Index varies roughly between -4.0 and +4.0. Weekly Palmer Index values are calculated for the Climate Divisions during every growing season and are on the World Wide Web from the Climate Prediction Center.

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

Source: http://drought.unl.edu/whatis/indices.htm

2.4.4. Previous Occurrences.
There are four major statewide droughts based on U.S. Geological Survey, Water Supply Paper 2375. The drought years involved include the periods of 1929-1941; 1951-1957; 1961-1972; and 1975-1982. These were determined from stream flow records. Jefferson County had sixteen additional drought events recorded by the National Climatic Data Center (NCDC) from January 1, 1950 through December 31, 2008 causing $32.495 million dollars of property damage.

16 DROUGHT event(s) were reported in **Jefferson County, Oklahoma** between **01/01/1950** and **12/31/2008**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma								
Location or County	**Date**	**Time**	**Type**	**Mag**	**Dth**	**Inj**	**PrD**	**CrD**
1 OKZ004>048 - 050>052	08/01/2000	12:00 AM	Drought	N/A	0	0	0	399.8M
2 OKZ004>048 - 050>052	07/04/2001	12:00 AM	Drought	N/A	0	0	0	0
3 OKZ019>020 - 023>032 - 035>048 - 050>052	12/01/2005	12:00 AM	Drought	N/A	0	0	10.0M	500K
4 OKZ004>048 - 050>052	01/01/2006	12:00 AM	Drought	N/A	0	0	15.0M	750K
5 OKZ004>048 - 050>052	02/01/2006	12:00 AM	Drought	N/A	0	0	25K	500K
6 OKZ004>048 - 050>052	03/01/2006	12:00 AM	Drought	N/A	0	0	5.0M	500K
7 OKZ004>048 - 050>052	04/01/2006	12:00 AM	Drought	N/A	0	0	1.5M	750K
8 OKZ004>048 - 050>052	05/01/2006	12:00 AM	Drought	N/A	0	0	0	500K
9 OKZ004>048 - 050>052	06/01/2006	12:00 AM	Drought	N/A	0	0	0	151.0M
10 OKZ004>048 - 050>052	07/01/2006	12:00 AM	Drought	N/A	0	0	50K	750K
11 OKZ004>048 - 050>052	08/01/2006	12:00 AM	Drought	N/A	0	4	100K	2.0M
12 OKZ004>032 - 039>048 - 050>052	09/01/2006	12:00 AM	Drought	N/A	0	0	25K	1.0M
13 OKZ004>032 - 039>048 - 050	10/01/2006	00:00 AM	Drought	N/A	0	0	20K	500K
14 OKZ004>032 - 039>048 - 050	11/01/2006	00:00 AM	Drought	N/A	0	0	0K	2.0M
15 OKZ004>032 - 039>048 - 050	12/01/2006	00:00 AM	Drought	N/A	0	0	0K	1.0M
16 OKZ004>032 - 039>048 - 050	01/01/2007	00:00 AM	Drought	N/A	0	0	775K	0K
				TOTALS:	0	4	32.495M	561.590M

2.4.5. Probability of Future Events.

Given that 12 drought events have occurred in Jefferson County one may conclude that Jefferson County can expect a drought every decade and that we can expect droughts to occur more frequently here than in the United States as a whole. However, long-term forecasts of droughts are difficult and inexact. The U.S. Corps of Engineers (USACE) is preparing the *National Drought Atlas* to provide information on the magnitude and frequency of minimum precipitation and stream flow for the contiguous United States. On average the July-to-January period is the lowest six month period of stream flow throughout the U.S. and is used to characterize drought. The mean monthly flow from July to

January has a once-in-20 year's chance of falling below a level that would classify it as a drought. In other words, the average occurrence of drought is once every 20 years, with an occurrence most likely lasting for years. In Jefferson County, the risk for drought is highly likely, with 36.5 of the last 72 years classified as drought.

2.4.6. Vulnerability.

Jefferson County is located in the south central United States. The primary air masses that bring moisture to the state originate in the Gulf of Mexico. Air masses that come into the state from the west are usually stripped of moisture by the Rocky Mountains, and as a result, mean annual precipitation increases from west to east.

2.4.7. Secondary Hazards.

Drought is considered a secondary hazard brought about by extreme heat and low precipitation. Other hazards associated with drought are wild fire and expansive soils.

2.4.8. Overall Summary of Vulnerability and Impacts.

It is difficult to predict drought probabilities for the near future because of the nature and complexity of the hazard. Drought evolves over time as certain conditions are met, and are spread over a large geographical area. Drought severity in Jefferson County depends on its duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. The impact of hazards such as extreme heat, expansive soils and wildfires can be intensified during times of drought. Otherwise, the most direct impact of drought is economic rather than loss of life or immediate destruction of property.

Drought impacts Jefferson County in a number of ways, spanning all regions, and is capable of affecting the economy as well as the environment. Specific impacts can include:

1. Reduced crop, rangeland.
2. Increased livestock and wildlife mortality rates.
3. Reduced income for farmers and agribusiness.
4. Increased fire hazard.
5. Reduced water supplies for municipal/industrial, agricultural and power uses.
6. Damage to fish and wildlife habitat.
7. Increased consumer prices for food.
8. Reduced tourism and recreational activities.
9. Unemployment.
10. Reduced tax revenues because of reduced expenditures.
11. Foreclosures on bank loans to farmers and businesses.

2.5. HAZARD PROFILE – Earthquake.

2.5.1. Description.

An earthquake is a sudden, rapid shaking of the earth caused by the breaking and shifting of rock beneath the earth surface. This sudden motion or trembling is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.

2.5.2. Location.

All of Jefferson County is equally susceptible to earthquakes. Earthquakes are not limited to certain areas of Jefferson County or certain communities. It is regional in nature, covering vast expanses of the country. An extremely devastating earthquake begun several states away could affect Jefferson County. With this characteristic in mind, all buildings and structures are equally susceptible to earthquake and its destruction.

2.5.3. Extent.

Jefferson County has numerous pipelines, producing oil and gas wells and large buildings that are not constructed to earthquake codes. This creates the possibility of a major catastrophe in the event of a major earthquake.

Based on the Mercalli Scale and Richter Scales, Jefferson County considers an earthquake measuring up to a Level V on the Mercalli Scale or up to a 4.8 on the Richter Scale to be minor in severity in which it would be felt outdoors; sleepers would be wakened; liquids are disturbed; small unstable objects are displaced or upset and doors swing, close, open. An earthquake to a Level IX on the Mercalli Scale or up to a 6.9 on the Richter Scale however, would be a major earthquake if experienced by Jefferson County in that masonry is destroyed or seriously damaged; general damage to foundations would be experienced; serious damage to reservoirs would occur and underground pipes would be broken.

VIII. Figure: Earthquake: Richter Scale, Mercalli Scale.

Mercalli/Richter Scale Comparison

Mercalli Scale	Richter Scale	Full Description
I.	**0 – 1.9**	Not felt. Marginal and long period effects of large earthquakes.
II.	**2.0 -2.9**	Felt by persons at rest, on upper floors, or favorably placed.
III.	**3.0 – 3.9**	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV.	**4.0 - 4.3**	Hanging objects swing. Vibration like passing of heavy trucks. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink the upper range of IV, wooden walls and frame creak.
V.	**4.4 - 4.8**	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Pendulum clocks stop, start.

VI.	**4.9 - 5.4**	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Books, etc., off shelves. Pictures off walls. Furniture moved. Weak plaster and masonry D cracked. Small bells ring. Trees, bushes shaken.
VII.	**5.5 - 6.1**	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices. Some cracks in masonry C. Waves on ponds. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII.	**6.2 - 6.5**	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.
IX.	**6.6 - 6.9**	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.
X.	**7.0 - 7.3**	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.
XI.	**.7.4 - 8.1**	Rails bent greatly. Underground pipelines completely out of service.
XII.	**> 8.1**	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

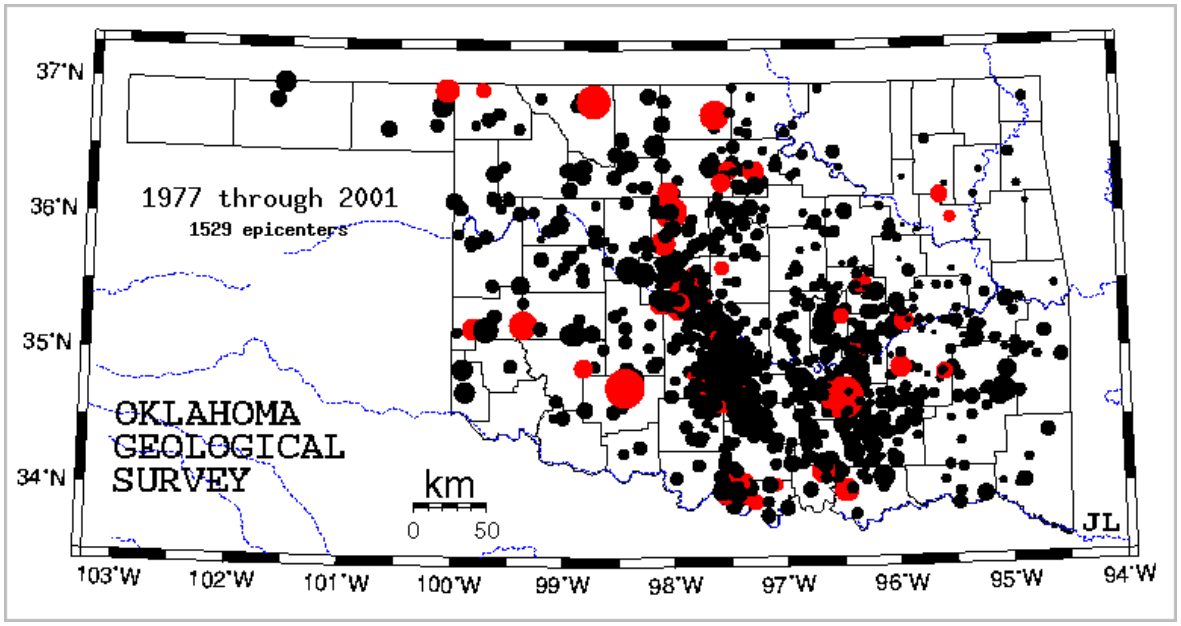
Masonry A: Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.
Masonry B: Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.
Masonry C: Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.
Masonry D: Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

Source: http://www.abag.ca.gov/bayarea/eqmaps/doc/mmigif/m10.html

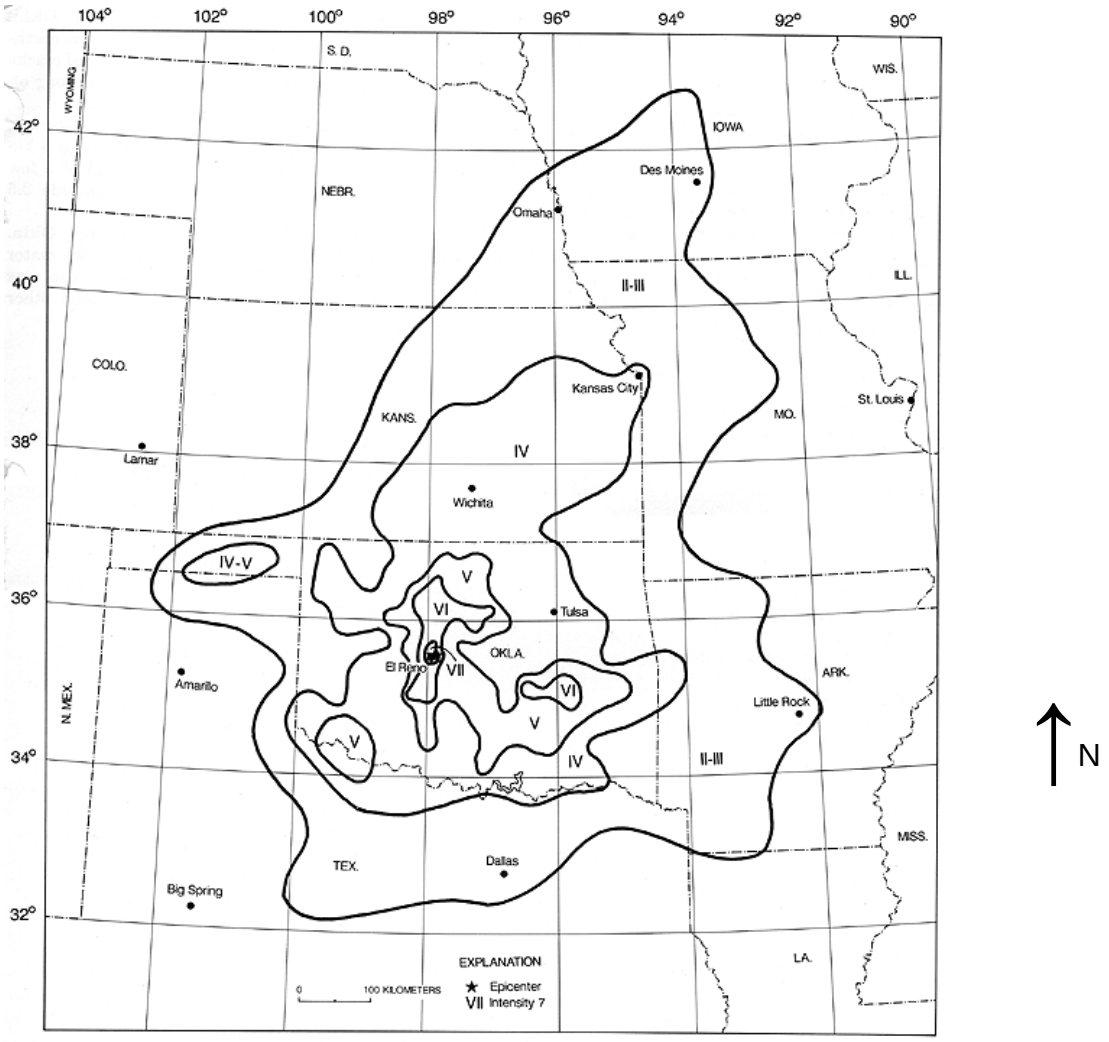
2.5.4. Previous Occurrences.

Earthquakes centered within Jefferson County are rare. The few events that have been recorded are largely unfelt and are seismically rated at or below a level 2. Records maintained by the Oklahoma Geological Survey and dating back to 1897 indicate that six occurrences of seismic activity have been recorded in Jefferson County. On April 9, 1952, a large earthquake centered near El Reno (in Canadian County) affected most of Oklahoma and extending as far north as Iowa.

IX. Figure: Seismographic History of Oklahoma 1977 - 2001.



X. Figure: Diagram of 1952 El Reno Earthquake.

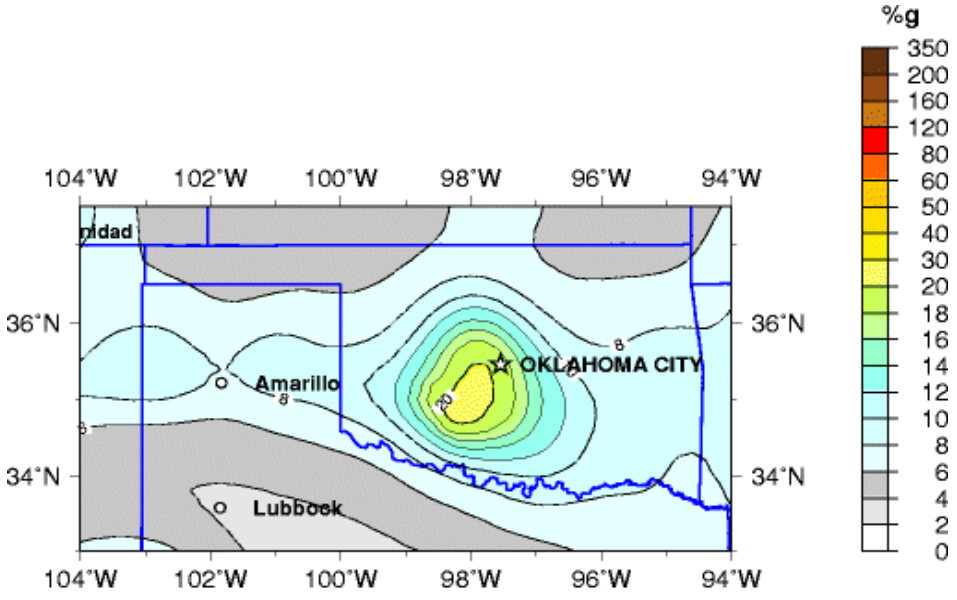


2.5.5. Probability of Future Events.

Jefferson County has a Peak Ground Acceleration (PGA) value between 3.5% - 5% probability of expedience in 50 years. This earthquake measure indicates that there is a probability (10% chance in 50 years) of an earthquake at the severity level of 3.5- 5 occurring within Jefferson County. With this rating, and since records dating back to 1897 indicate that six occurrences of seismic activity have been recorded, the probability of an earthquake occurring within Jefferson County is unlikely.

The Jefferson County Hazard Mitigation Planning Committee has determined Earthquakes do not present a severe threat to Jefferson County and therefore decided not to adapt any action item for this hazard.

XI. Figure: Probability of Exceedance in 50 Years.



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
site: NEHRP B-C boundary
National Seismic Hazard Mapping Project

2.5.6. Vulnerability.

Jefferson County has beneath its surface the Nemaha Ridge which connects with the New Madrid fault, one of the nation's most seismic active zones. The installation of a statewide earthquake-station network of seismograph stations greatly improved earthquake detection and location. Oklahoma has experienced, on average, 50 earthquakes each year since the Oklahoma Geological Survey has kept records. Most of these earthquakes are so small that people do not feel them. However, according to Kathleen Shingledecker, earthquake project manager with the Oklahoma Department of Emergency Management, these

unfelt earthquakes could adversely affect the integrity of the infrastructure and lifelines within the impacted areas.

2.5.7. Secondary Hazards.

Secondary hazards can include fire explosions collapse or structural failure of bridges, overpasses, roads and disruption of economic activity across the region. Dispersion of contaminants could also occur. Hazardous materials and other contaminants were not identified in the area, but may need to be addressed in updates of this plan.

Ground movement during an earthquake is seldom the direct cause of flying glass and falling objects as a result of the ground shaking, or people trying to move more than a few feet during the shaking.

2.5.8. Overall Summary of Vulnerability and Impacts.

As the Earth's crust moves and bends, stresses are built up, sometimes for years before suddenly breaking or slipping. This abrupt release of accumulated tension can be devastating to human communities. The destructiveness of an earthquake depends upon the magnitude of the tremor, direction of the fault, distance from the epicenter, regional geology, local soils and the design characteristics of buildings and infrastructure. Earthquakes centered in Jefferson County are rare and the few events that have occurred were largely unfelt. There is concern as to what the long term affects of the unfelt earthquakes have on the integrity and infrastructure of the numerous pipelines associated with the oil and gas industries located within Jefferson County.

The vulnerability for earthquake is the damage to or failure of homes and other structures. Structural failure of bridges, overpasses, roads, pipe lines and utilities would also be at risk or vulnerable to earthquakes. The impact from this would be displacement of people from their homes, loss of water and utilities, and the disruption to the infrastructure of Jefferson County.

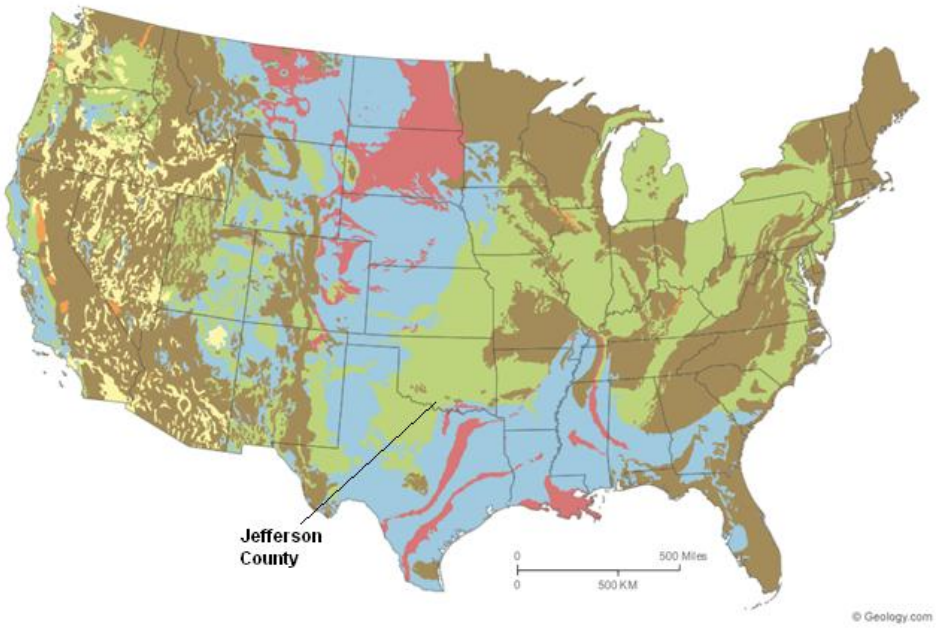
2.6. HAZARD PROFILE - Expansive Soils.

2.6.1. Description.

Expansive soils are soils with relatively high percentages of clay colloids that are subject to volumetric changes as water is present or absent. These volume changes can impact the integrity of structures built on, or within, the surface of such soils. Expansive soils present no problem in their natural state.

2.6.2. Location.

Expansive soils in Jefferson County have shale as the parent material and are generally in central and eastern Jefferson County. The expansive soil area amounts to about 20% of Jefferson County.



Over 50 percent of these areas are underlain by soils with abundant clays of high swelling potential.

Less than 50 percent of these areas are underlain by soils with clays of high swelling potential.

Over 50 percent of these areas are underlain by soils with abundant clays of slight to moderate swelling potential.

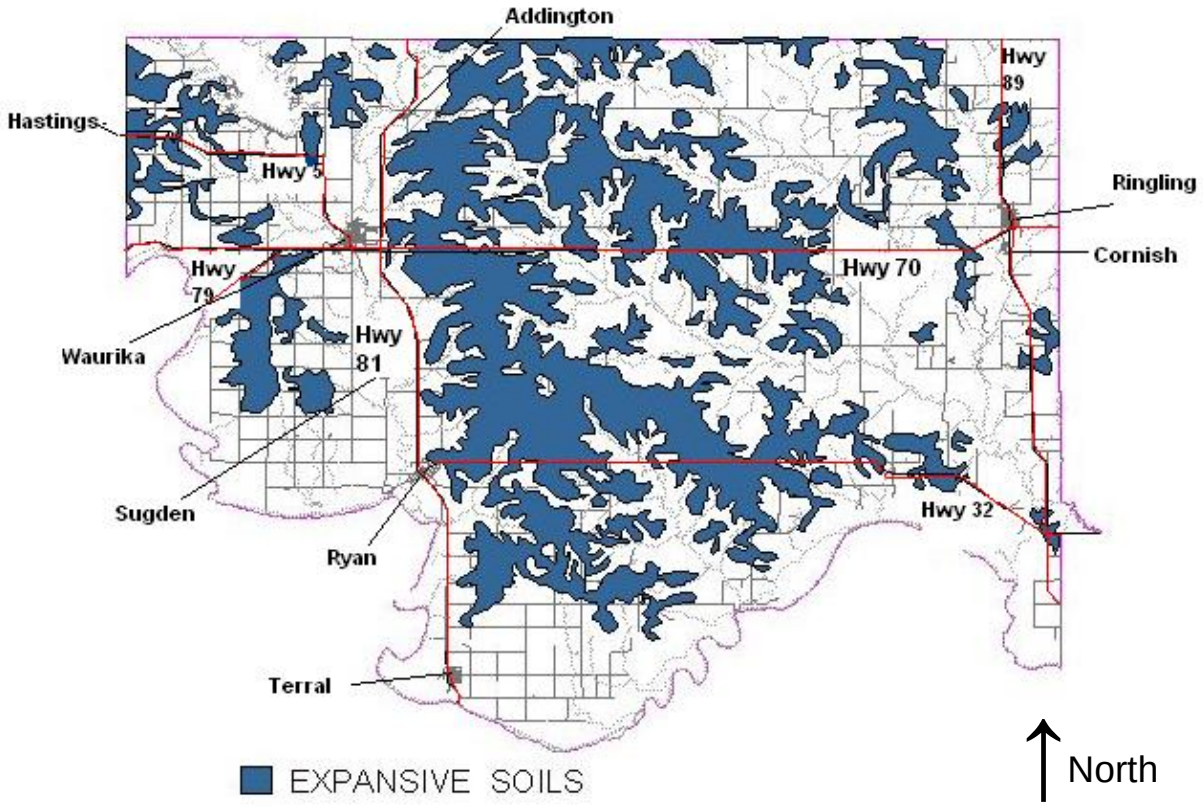
Less than 50 percent of these areas are underlain by soils with abundant clays of slight to moderate swelling potential.

These areas are underlain by soils with little to no clays with swelling potential.

Data insufficient to indicate the clay content or the swelling potential of soils.

Source: Geology.com The map above is based upon "Swelling Clays Map of the Conterminous United States" by W. Olive, A. Chleborad, C. Frahme, J. Shlocker, R. Schneider and R. Schuster. It was published in 1989 as Map I-1940 in the USGS Miscellaneous Investigations Series.
Land areas were assigned to map soil categories based upon the type of bedrock that exists beneath them as shown on a geologic map. In most areas, where soils are produced "in situ", this method of assignment was reasonable. However, some areas are underlain by soils which have been transported by wind, water or ice. The map soil categories would not apply for these locations.

XII. Figure: Expansive Soils.



2.6.3. Extent.

Extensive damage from expansive soils can occur to highways and streets. Homes, buildings and other structures can have damage resulting in sticking doors, uneven floors and cracks in the foundation, floors, walls and ceilings. The greatest damage occurs when structures are constructed when clays are dry (such as during a drought) and then subsequent soaking rains swell the clay. Damage can become so severe that the cost of repair can exceed the value of the building.

Both public and private structures can develop extreme foundation problems during times of shrink-swell events. The most common signs of damage are cracks in foundations, brick exteriors, drywall interiors, sidewalks and other concrete structures within the building.

Sewer and water lines are also affected by shrink-swell soils. The action of the movement of the soils can damage water and sewer lines, producing a minimum of social discomfort and a maximum of a serious health and welfare risk.

The expansive tendency of a soil is a function of its shrink-swell potential. NRCS sorts this shrink-swell potential soil property into five categories; very low, low,

moderate, high and very high. This is the range of magnitude of an expansive soils hazard. Shrink-swell potential categories are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The categories are very low, a change of less than 1%; low, 1 -3%; moderate, 3 - 6%; high, 6 - 9%; and very high, greater than 9%. Soils in the low to moderate category may be modified using lime to stabilize the soil. High to very high expansive soils not only are treated with lime but, structures must be built in such a way to resist damage from the high shrink-swell soils. For this reason few homes are built in this area of Jefferson County and many roads are gravel. Approximately 32% of Jefferson County is in some way affected by expansive soils.

In regards to expansive soils, according to the NRCS which sorts the shrink-swell potential soil property into five categories very low, a change of less than 1%; low, 1 -3%; moderate, 3 - 6%; high, 6 - 9%; and very high, greater than 9%, Jefferson County considers a change of less than 1% to be minor in severity and this is also in relation to the Palmer Index which classifies the soil as being in mild stages of drought. Jefferson County considers a change of 6% and higher to be major in severity and according to the Palmer Index would classify the soil as being in severe drought stages.

2.6.4. Previous Occurrences.
Since this hazard develops gradually and seldom presents a threat to life, it is considered only a nuisance and therefore never repaired or reported. No records of specific incidences of structure loss due to expansive soils in Jefferson County were found.

2.6.5. Probability of Future Events.
Since no records of specific incidences of loss associated with expansive soils were found, no future event losses were calculated. The Jefferson County Hazard Mitigation Planning Committee has determined Expansive Soils do not present a severe threat to Jefferson County and therefore decided not to adapt any action item for this hazard.

2.6.6. Vulnerability.
The effects of expansive soils are most prevalent in regions of moderate to high precipitation subject to prolonged periods of drought. Other cases of damage result from increases in moisture volume from such sources as broken or leaking water and sewer lines. Areas capable of these changes in soil volume present a hazard to buildings, roads and other structures built over them and to the pipelines buried in them. Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings which, because of expense, have mitigation measures taken before construction starts. No incidences of expansive soils have been recorded in Jefferson County.

2.6.7. Secondary Hazards.

Depending on the use of the pipeline, contamination of soils and groundwater could occur should buried pipelines become damaged by expansive soils.

2.6.8. Overall Summary of Vulnerability and Impacts.

Changes in soil volume present a hazard to structures built on top of expansive soils. Damages occur as clay moisture content expands or shrinks the soil volume causing the structure to move. There are no records of specific incidences of loss within Jefferson County due to expansive soils. For large areas of the United States, little information is reported other than field observations of the physical characteristics of clay in a particular stratigraphic unit. As a result, fixed criteria for determining the swelling potential have not been devised. The impact is financial in that foundations shift and can require extensive and costly repairs.

2.7. HAZARD PROFILE - Extreme Heat.

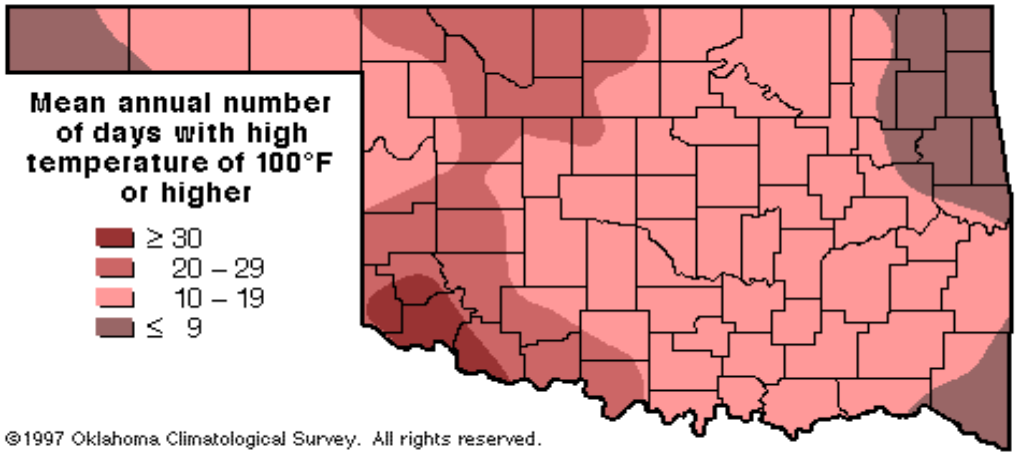
2.7.1. Description.

Temperatures that hover ten degrees or more above the average high temperature for the region, and last for several weeks, are defined as extreme heat. Humid or muggy conditions, which add to the discomfort of high temperature, occur when a “dome” of high atmospheric pressure traps hazy, damp air near the ground.

2.7.2. Location.

Extreme heat events are regional in nature. The entire County is equally affected by extreme heat.

XIII. Figure: High Temperature Averages for Oklahoma.



2.7.3. Extent.

The severity of the extreme heat is dependent on a combination of temperature and humidity. High temperatures, when combined with high humidity can put an area in the “extreme danger” category on the National Weather Service Heat Index scale. When extreme heat is combined with drought, results can include not only excessively dry hot conditions that contribute to a high risk of life-threatening heat related illnesses, but can also provoke dust storms with low visibility.

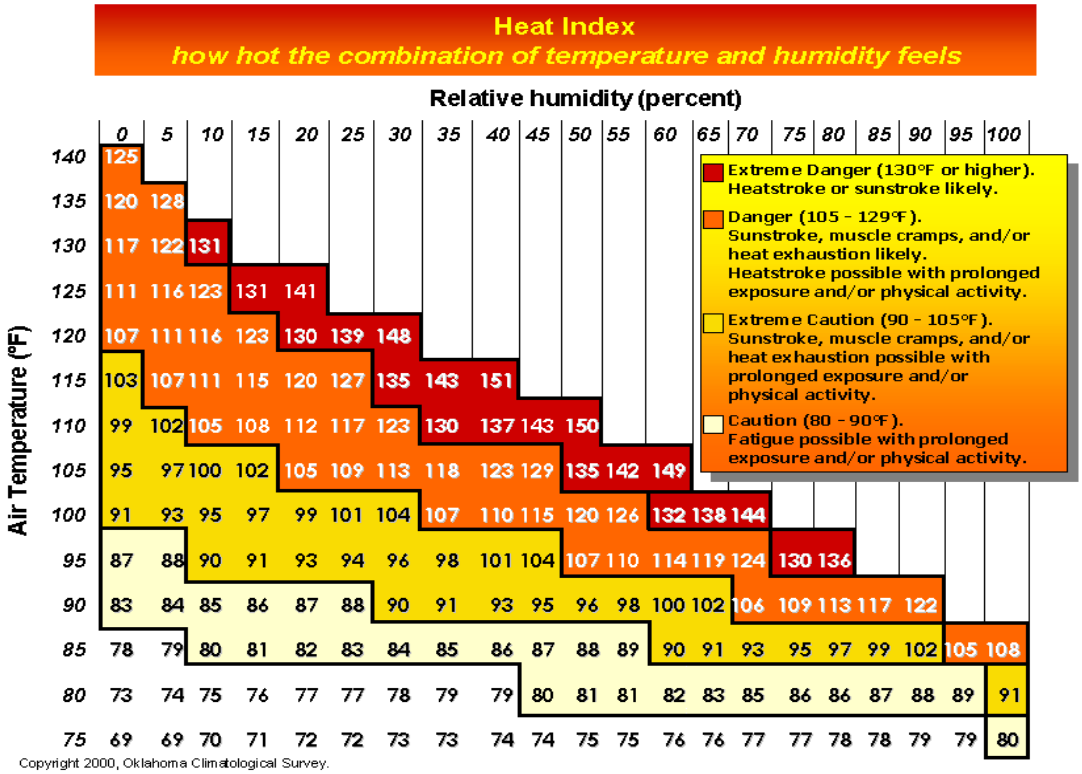
Heat kills by pushing the human body beyond its limits. Under normal conditions, the body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature.

Most heat disorders occur because the victim has been overexposed to heat or has over exercised for his or her age and physical condition. Other conditions that can induce heat-related illnesses include stagnant atmospheric conditions and poor air quality.

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages of resources. Moreover, food shortages may occur if agricultural production is damaged or destroyed by a loss of crops or livestock.

According to the Heat Index Scale Jefferson County considers a reading of 91 on the heat index as minor in severity and would consider a reading of 118 major in severity.

XIV. Figure: Heat Index.



2.7.4. Previous Occurrences.

In a normal year, approximately 175 Americans die from extreme heat. Between 1936 and 1975, nearly 20,000 people succumbed to the effects of heat and solar radiation. From 1979-1999, excessive heat exposure caused 8,015 deaths in the United States. On average, approximately 400 people die each year from exposure to heat. In Oklahoma, July is generally the hottest month of the year, followed by August. Jefferson County had four additional extreme heat events recorded by the National Climatic Data Center (NCDC) from January 1, 1950 through December 31, 2008 causing ten thousand dollars of property damage.

4 TEMPERATURE EXTREME event(s) were reported in **Jefferson County, Oklahoma** between **01/01/1950** and **12/31/2008**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Western And Central O	06/27/1994	1200	Excessive Heat	N/A	0	0	0	0
2 OKZ004>048 - 050>052	07/04/2001	12:00 AM	Excessive Heat	N/A	8	0	0	0
3 OKZ004>048 - 050>052	07/16/2006	12:00 PM	Heat	N/A	10	100	0	0
4 OKZ004>048 - 050>052	08/01/2006	12:00 AM	Heat	N/A	8	0	10K	0
				TOTALS:	26	100	10K	0

2.7.5. Probability of Future Events.

According to the Oklahoma Climatological Survey, Jefferson County averages 27 days per year of daytime high temperatures greater than 100° F. Therefore extreme temperatures are highly likely to occur within Jefferson County.

2.7.6. Vulnerability.

In Jefferson County, young children, elderly people and those who are sick or overweight are more likely to become victims to extreme heat. Other conditions that can limit the ability to regulate temperature include fever, dehydration, heart disease, mental illness, poor circulation, sunburn, prescription drug use and alcohol use. Another segment of the population at risk is those whose jobs consist of strenuous labor outside. Livestock and crops can also become stressed, decreasing in quality or in production during times of extreme heat.

2.7.7. Secondary Hazards.

Extreme high temperatures can cause water shortages, increase fire danger and prompt excessive demands for energy. Another secondary hazard is air pollution in summer months resulting from consistent high temperatures and reduced airflows.

2.7.8. Overall Summary of Vulnerability and Impacts.

Jefferson County can expect to experience extreme heat every summer which is most likely to occur during the months of July and August. The severity of the extreme heat is dependent on temperature and humidity. High temperatures and high humidity can result in dangerous conditions that expose people to an increased risk of heat stroke and other heat related illnesses. The most vulnerable population is the elderly, young children and those who are sick, overweight, or who work outside. Extreme heat can also cause stress on livestock and other agricultural productions. With periods of extended extreme heat, water supplies are exhausted, roads are damaged and crops fail. The impact of extreme heat ranges from increased medical problems and loss of life to loss of income for farmers and ranchers and increased expense to Jefferson County for additional road and bridge repairs.

2.8. HAZARD PROFILE – Flood.

2.8.1. Description.

Flooding is the most prevalent and costly disaster in the United States. Flooding occurs any time dams fail, rains or melting snows exceed the capacity the flow capacity of rivers, streams or drainage ways. At the point the water concentration exceeds the capacity of the floodway, the water enters the floodplain.

There are two types of floods, both which can occur in Jefferson County. First, flash floods, which result from localized heavy rain falls. Flash floods occur rapidly with little warning. Dam failures are a unique form of flash flood. Flash flooding is the most common cause of death by natural disaster in the United States. Second, riverine floods occur after extended periods of rain over several days or weeks. Riverine floods generally can be forecast in advance and proper precautions taken to save lives and mitigate some, though certainly not all, property losses.

Flood: 100 year flood area;

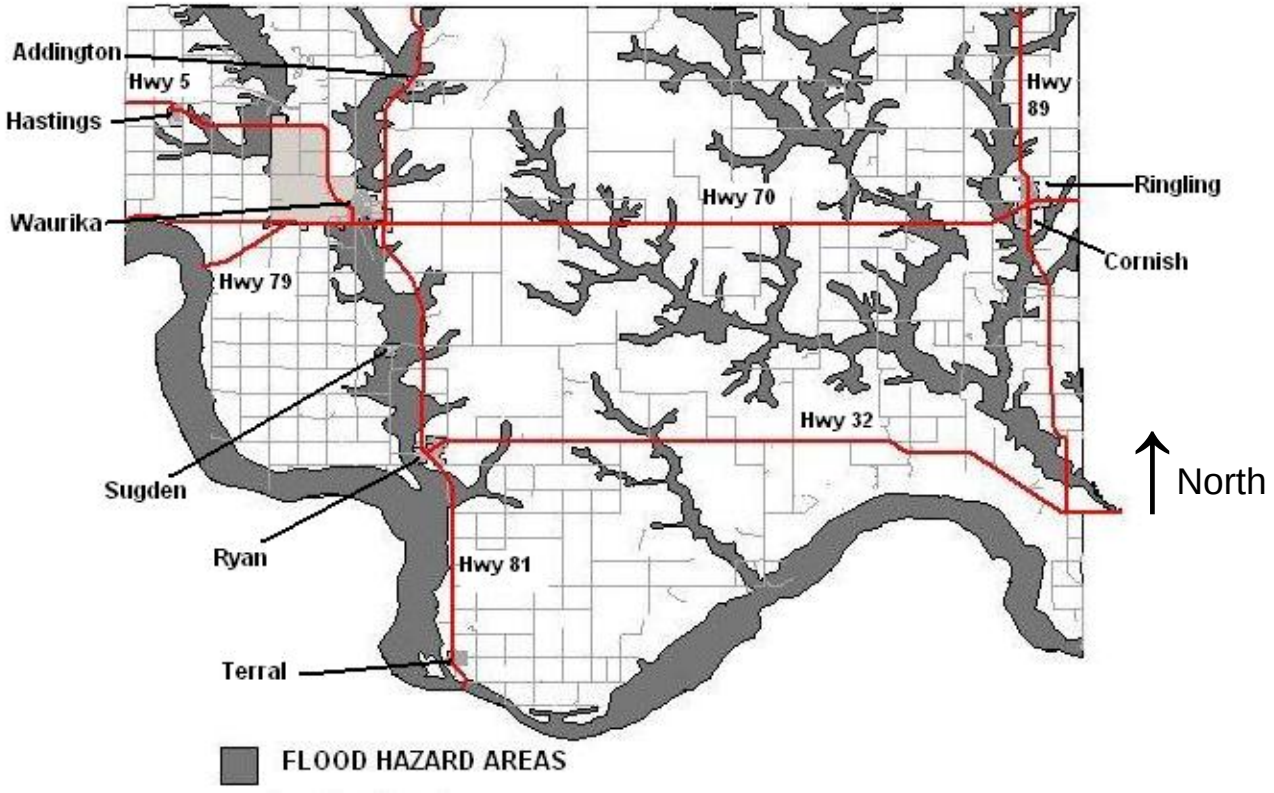
Use the local flood maps.

Flood Zones		
Zone A	The 100-year or Base Floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the firm shows a BFE (old format).
	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFE's are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
	AR	The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection
Zone V and VE	**V**	The coastal area subject to velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and the 500-year floods. B zones are also used to designate base floodplains or lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.	

Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depiction FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.
Zone D	Area of undetermined but possible flood hazards.
Source: Understanding Your Risks, identifying hazards and estimating losses, FEMA 386-2	

2.8.2. Location.

XV. Figure: Flood Zones of Jefferson County.



2.8.3. Extent.

Severity of flooding is determined by several factors including rainfall intensity, duration and location. Flash floods are most dangerous since they can occur suddenly and begin before the rain stops. A maximum flood threat could result if soils are saturated and wide spread heavy rains begin to fall. Such an event could cause all streams and rivers within Jefferson County to rise above flood stage.

National Climatic Data Center storm event statistics record 23 flood events in Jefferson County during the 14-year period 1993-2007. The reported damage totaled $5.5 million.

Jefferson County considers a flood occurring with a two inch an hour rainfall to be a minor hazard, in that street flooding would occur but no serious damage would be incurred. A flood that occurs due to a six inch an hour rainfall would be a major hazard in that structures would be flooded and water levels would be raised dramatically.

2.8.4. Previous Occurrences.

National Climatic Data Center storm event statistics record 23 flooding events in Jefferson County during 1993-2007. The table below summarizes damages from 1993 to 2007.

XVI. Figure: Flood Events.

23 FLOOD event(s) were reported in **Jefferson County, Oklahoma** between **01/01/1993** and **03/31/2007**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Jefferson County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Addington	03/29/1993	2305	Flash Flood	N/A	0	0	0	0
2 Waurika	03/30/1993	0000	Flash Flood	N/A	0	0	5.0M	0
3 Countywide	05/08/1993	1730	Flash Flood	N/A	0	0	500K	0
4 Ryan	05/23/1993	1130	Flash Flood	N/A	0	0	0	0
5 Waurika	05/23/1993	1215	Flash Flood	N/A	0	0	0	0
6 Waurika	11/04/1994	1100	Flash Flooding	N/A	0	0	0	0
7 Waurika	04/26/1998	07:00 PM	Flash Flood	N/A	0	0	0	0
8 Addington	06/18/1998	07:45 PM	Flash Flood	N/A	0	0	0	0
9 Waurika	06/19/1999	03:15 PM	Flash Flood	N/A	0	0	1K	0
10 Ringling	10/26/2000	08:20 PM	Flash Flood	N/A	0	0	0	0
11 Addington	10/26/2000	09:15 AM	Flash Flood	N/A	0	0	0	0
12 Waurika	04/30/2004	02:50 PM	Flash Flood	N/A	0	0	0	0
13 OKZ045	06/10/2004	12:25 AM	Flood	N/A	0	0	0	0
14 OKZ039 - 045 - 048	11/01/2004	12:00 AM	Flood	N/A	0	0	0	0
15 OKZ030 - 039 - 045	11/17/2004	01:30 AM	Flood	N/A	0	0	0	0

16 OKZ039 - 045	11/25/2004	11:00 PM	Flood	N/A	0	0	0	0
17 OKZ039 - 041 - 043 - 045 - 045>046	01/03/2005	12:00 AM	Flood	N/A	0	0	0	0
18 OKZ039 - 045	02/07/2005	07:45 AM	Flood	N/A	0	0	0	0
19 Grady	08/14/2005	10:30 PM	Flash Flood	N/A	0	0	0	0
20 Ringling	08/14/2005	10:30 PM	Flash Flood	N/A	0	0	0	0
21 South Portion	10/17/2006	06:00 AM	Flood	N/A	0	0	0K	0K
22 Ryan	03/30/2007	01:50 PM	Flash Flood	N/A	0	0	0K	0K
23 Waurika	03/30/2007	01:50 PM	Flash Flood	N/A	0	0	0K	0K
				TOTALS:	0	0	5.501M	0

2.8.5. Probability of Future Events.

Jefferson County receives abundant rainfall mainly in the spring and fall. Consequently, rivers and creeks overflow their banks during these seasons. Many of these floods are of small consequence; however, the number of major floods in the last 20 years warrants a highly likely probability rating.

2.8.6. Vulnerability.

Since improvements in Jefferson County have been directed away from flood plains, an estimated population of seven people were found to live in 100 year flood zones outside municipalities within Jefferson County. Geographic Information Software (GIS) was used to help associate population and housing with flood zones to obtain this estimate.

When compared to Jefferson County's total population, this resulted in less than 1% of the population living within a flood zone. Jefferson County Emergency Management concludes that Jefferson County citizens who live in affected areas are aware of the dangers, thus resulting in the low human casualty rate. With early warning from the National Weather Service, Jefferson County is able to activate response personnel in a timely manner to prevent loss of life with a minimal loss to property. Jefferson County plans to become part of the National Flood Insurance Program (NFIP). Since Jefferson County does not participate in the National Flood Insurance Program, there are no repetitive loss structures.

2.8.7. Secondary Hazards.

Secondary hazards include transportation disruptions, dam failure, dispersion of contaminants and threatened water supplies. Hazardous materials (and other possible sources of contaminants) are not identified in the area but may need to be addressed in updates to this plan.

2.8.8. Overall Summary of Vulnerability and Impacts.

In Jefferson County spring and fall rains can result in a rise in the County's rivers and creeks resulting in floods that vary in intensity. Severity of flooding is determined by several factors including rainfall intensity, duration and location. Flash floods are most likely to close small roads and some major highways within Jefferson County. Jefferson County's roadways, bridges, and some farmland remain most vulnerable to floods. The impact is during times of flooding and inundation, roads become impassible and emergency response becomes very limited. Roads that become impassible create a financial and time hardship to citizens; school districts and others in that they must find alternate routes around flooded areas.

2.9. HAZARD PROFILE – Hailstorm.

2.9.1. Description.

Due to Oklahoma's rapidly changing climate, large-scale hailstorms are especially prevalent. Hail is formed by actions of wind and rain at freezing temperatures, which cause water particles to become frozen and condense into particles ranging from very small to grapefruit size. Hailstones may be spherical, conical or irregular in shape. The size and shape of hailstones is determined by the strength of wind within the storm cell. Each lifting, falling recoating cycle produces a larger hailstone until finally the weight of the stone causes it to fall to earth.

Hail is associated with severe thunderstorms. Powerful updrafts produce cumulonimbus clouds that tower tens of thousands of feet above the ground. Air temperature in the upper levels of these clouds may be -50°F or below. Hailstones grow as ice pellets, are lifted by updrafts and collect super cooled water droplets. As they grow, hailstones become heavier and begin to fall. Sometimes, they are caught by successively stronger updrafts and are circulated through the cloud again and again; growing larger each time the cycle is repeated. Eventually, the updrafts can no longer support the weight of the hailstones. As hailstones fall to the ground, they produce a hail streak that may be more than a mile wide and a few miles long. A single thunderstorm can produce several hail streaks.

Note, that although hail is associated with thunderstorms, this plan profiles hail equal to or larger than 1.50" in diameter as a separate natural hazard event. Based on previous occurrences, when hail gets this large, it can be particularly damaging to cars, roofs and windows but can also hurt people.

2.9.2. Location.

All parts of Jefferson County are equally vulnerable to hailstorms.

2.9.3. Extent.

The severity of damage caused by hailstorms depends on the hailstone sizes (average and maximum), number of hailstones per unit area, and associated winds. Storms that produce high winds in addition to hail are most damaging and can result in numerous broken windows and damaged siding.

Hailstorms can cause extensive property damage affecting both urban and rural landscapes. Fortunately, most hailstorms produce marble-size or smaller hailstones. These can cause damage to crops, but they normally do not damage buildings or automobiles. Larger hailstones can destroy crops, livestock and wildlife and can cause extensive damage to buildings, including roofs, windows and outside walls. Vehicles can be total losses. When hail breaks windows, water damage from accompanying rains can also be significant. A major hailstorm can easily cause damage running into the millions of dollars.

Nationwide, hail is responsible for over $1 billion in property and crop damages per year.

Hailstorms occurring in Jefferson are based on the Combined NOAA/TORRO Hailstorm Intensity Scales. Based on this scale hail code a code of H1 is considered by Jefferson County to be a minor hazard in that there would be slight damage to plants and crops. Jefferson County would also consider a hail code of H5 and higher as a major hazard due to the damage occurring would range from the wholesale destruction of glass, damage to tiled roofs and significant risk of injuries to aircraft bodywork dented, brick walls pitted and roofs being severely damaged.

XVII. Figure: Hail: NWS/TORRO Hail Scale.

Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	up to 0.33	Pea	No damage
H1	Potentially Damaging	0.33-0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored

H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

Sources: www.noaa.gov and www.torro.org

2.9.4. Previous Occurrences.

National Climatic Data Center documented a total of 226 hail events occurring in Jefferson County between 1955 and 2007. Of these events it is estimated 60 were large hail (>1.5 inch diameter) storms. There were no reported deaths from hail events within Jefferson County.

Hail events have been document in every year from 1955 to 2007. Damages to personal property are usually insured losses, therefore not reported publicly. All structures are equally acceptable to hail damage. Crops are especially vulnerable to hail damage.

2.9.5. Probability of Future Events.

Based on the previous occurrences of 20 large-hail events out 87 total events recorded in the last 10 years, an average of 2 large-hail events occurs each year. Therefore, the probability of large-hail (equal to or greater than 1.50” in diameter) occurring within Jefferson County each year is highly likely.

2.9.6. Vulnerability.

Vulnerability is difficult to evaluate since hail occurs in random locations and creates relatively narrow paths of destruction. Hail is capable of causing considerable damage to crops, buildings, and vehicles, and occasionally death to farm animals. Hail can also strip leaves and small limbs from non-evergreen trees. While large hail poses a threat to people caught outside in a storm, it seldom causes loss of human life.

1. Costs and losses to agricultural and livestock producers.
2. Reduced yields and crop loss.
3. Injuries or loss of livestock.
4. Damage to barns and other farm buildings.
5. Damage to farm machinery.
6. Damage to wood fences.
7. Loss from timber production.
8. Damage to trees resulting in increased susceptibility to disease.
9. Urban, residential, and commercial.
10. Damage to and destruction of buildings.
11. Roofs.
12. Windows.
13. Siding, stucco, brick, and other exterior building materials.
14. Loss of trees and landscaping.
15. Damage to automobiles, trucks, trains, airplanes, etc.
16. Disruptions to local utilities and services.
17. Power.
18. Communications.
19. Transportation.
20. Health.
21. Injuries.
22. Fatalities.
23. Mental and physical stress.
24. General economic effects.
25. Revenue loss from lost production in business and industry.
26. Negative impact of economic multipliers.
27. Environmental Impacts.
28. Damage to trees and bushes resulting in increased susceptibility to disease.
29. Losses of wildlife, with particular emphasis on birds.

2.9.7. Secondary Hazards.

Deep hail can easily worsen a flash flood situation by clogging drainage-ways, culverts and bridges.

2.9.8. Overall Summary of Vulnerability and Impacts.

Hail can occur in any strong thunderstorm. However, the size of the hailstones is a direct function of the severity and size of the storm. Hail, larger than 1.5“, can cause serious damage to cars, roofs, walls, windows, and inflict serious bodily injury as well. All of Jefferson County has a significant exposure to hailstorms, and virtually all buildings and automobiles are at risk. Crops are also at risk since the peak periods for hailstorms occur during early spring and late fall, which coincide with critical agricultural seasons.

The impact of hail is mainly financial resulting in repairs to cars, roofs, walls, and windows. The loss of crops and livestock can be devastating to farmers and the economy in lost revenues.

XVIII. Figure: Hail Events.

87 HAIL event(s) were reported in **Jefferson County, Oklahoma** between **01/01/1997** and **03/31/2007**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Ringling	03/25/1997	12:30 AM	Hail	0.88 in.	0	0	0	0
2 Ringling	04/20/1997	06:00 PM	Hail	0.88 in.	0	0	0	0
3 Ringling	06/09/1997	05:25 PM	Hail	0.88 in.	0	0	0	0
4 Ringling	08/17/1997	03:30 PM	Hail	1.00 in.	0	0	0	0
5 Addington	08/17/1997	04:29 PM	Hail	0.88 in.	0	0	0	0
6 Waurika	08/17/1997	06:00 PM	Hail	1.75 in.	0	0	0	0
7 Addington	10/08/1997	05:28 PM	Hail	1.75 in.	0	0	0	0
8 Waurika	03/18/1998	09:45 PM	Hail	0.75 in.	0	0	0	0
9 Hastings	04/26/1998	07:35 AM	Hail	0.88 in.	0	0	0	0
10 Ringling	06/09/1998	06:01 PM	Hail	1.00 in.	0	0	0	0
11 Addington	06/18/1998	06:00 PM	Hail	1.75 in.	0	0	0	0
12 Addington	06/18/1998	06:18 PM	Hail	0.75 in.	0	0	0	0
13 Ringling	06/18/1998	07:05 PM	Hail	1.75 in.	0	0	0	0
14 Ringling	06/18/1998	07:16 PM	Hail	1.75 in.	0	0	0	0
15 Addington	06/18/1998	08:15 PM	Hail	0.88 in.	0	0	0	0
16 Addington	06/18/1998	08:45 PM	Hail	1.75 in.	0	0	0	0

17 Addington	06/18/1998	09:45 PM	Hail	0.75 in.	0	0	0	0
18 Ringling	03/28/2000	05:02 PM	Hail	1.00 in.	0	0	0	0
19 Waurika	04/15/2000	07:58 PM	Hail	1.00 in.	0	0	0	0
20 Waurika	05/05/2000	10:05 AM	Hail	1.75 in.	0	0	0	0
21 Ringling	10/26/2000	06:22 PM	Hail	0.88 in.	0	0	0	0
22 Addington	03/11/2001	08:18 PM	Hail	0.75 in.	0	0	0	0
23 Ringling	03/23/2001	08:00 PM	Hail	0.75 in.	0	0	0	0
24 Waurika	04/14/2001	03:25 PM	Hail	1.75 in.	0	0	0	0
25 Waurika	04/14/2001	03:28 PM	Hail	0.75 in.	0	0	0	0
26 Ryan	04/14/2001	03:40 PM	Hail	1.00 in.	0	0	0	0
27 Hastings	05/27/2001	10:30 PM	Hail	0.75 in.	0	0	0	0
28 Sugden	06/14/2001	02:15 PM	Hail	1.75 in.	0	0	0	0
29 Waurika	06/14/2001	02:40 PM	Hail	0.75 in.	0	0	0	0
30 Waurika	09/08/2001	07:48 PM	Hail	1.00 in.	0	0	0	0
31 Terral	10/12/2001	05:20 PM	Hail	0.88 in.	0	0	0	0
32 Ringling	03/25/2002	06:56 AM	Hail	1.00 in.	0	0	0	0
33 Ringling	04/12/2002	11:05 AM	Hail	0.75 in.	0	0	0	0
34 Ringling	04/12/2002	11:25 AM	Hail	1.25 in.	0	0	0	0
35 Ringling	04/12/2002	12:52 PM	Hail	0.88 in.	0	0	0	0
36 Terral	04/13/2002	08:16 AM	Hail	1.00 in.	0	0	0	0
37 Terral	04/13/2002	08:30 AM	Hail	0.88 in.	0	0	0	0
38 Ryan	04/13/2002	09:30 AM	Hail	0.75 in.	0	0	0	0
39 Terral	04/16/2002	06:28 PM	Hail	0.75 in.	0	0	0	0
40 Waurika	12/30/2002	08:05	Hail	0.75 in.	0	0	0	0

		AM						
41 Hastings	04/23/2003	07:20 PM	Hail	1.75 in.	0	0	0	0
42 Waurika	04/23/2003	07:55 PM	Hail	0.75 in.	0	0	0	0
43 Addington	05/08/2003	12:01 AM	Hail	0.88 in.	0	0	0	0
44 Addington	05/08/2003	12:01 AM	Hail	0.88 in.	0	0	0	0
45 Grady	05/10/2003	01:03 PM	Hail	0.75 in.	0	0	0	0
46 Ringling	05/19/2003	06:25 PM	Hail	1.50 in.	0	0	0	0
47 Addington	05/19/2003	10:06 PM	Hail	0.88 in.	0	0	0	0
48 Addington	05/19/2003	10:15 PM	Hail	1.00 in.	0	0	0	0
49 Grady	05/19/2003	11:00 PM	Hail	0.75 in.	0	0	0	0
50 Waurika	03/04/2004	01:55 PM	Hail	0.75 in.	0	0	0	0
51 Waurika	04/29/2004	08:15 PM	Hail	0.75 in.	0	0	0	0
52 Waurika	04/30/2004	01:30 PM	Hail	1.75 in.	0	0	0	0
53 Sugden	04/30/2004	01:37 PM	Hail	0.75 in.	0	0	0	0
54 Waurika	04/30/2004	01:45 PM	Hail	1.75 in.	0	0	0	0
55 Waurika	04/30/2004	01:53 PM	Hail	0.88 in.	0	0	0	0
56 Sugden	04/30/2004	01:55 PM	Hail	1.25 in.	0	0	0	0
57 Waurika	04/30/2004	01:55 PM	Hail	0.75 in.	0	0	0	0
58 Waurika	04/30/2004	01:56 PM	Hail	0.88 in.	0	0	0	0
59 Sugden	04/30/2004	02:24 PM	Hail	1.75 in.	0	0	0	0
60 Grady	04/30/2004	03:01 PM	Hail	1.75 in.	0	0	0	0
61 Terral	04/30/2004	07:30 PM	Hail	1.00 in.	0	0	0	0
62 Ryan	04/30/2004	11:37 AM	Hail	0.88 in.	0	0	0	0
63 Ryan	04/30/2004	11:56 AM	Hail	0.88 in.	0	0	0	0

64 Ryan	04/30/2004	12:01 PM	Hail	1.75 in.	0	0	0	0
65 Grady	05/13/2004	11:43 AM	Hail	0.75 in.	0	0	0	0
66 Ryan	06/01/2004	05:17 PM	Hail	1.00 in.	0	0	0	0
67 Waurika	06/02/2004	05:10 PM	Hail	0.88 in.	0	0	0	0
68 Waurika	06/02/2004	05:45 PM	Hail	1.00 in.	0	0	0	0
69 Addington	06/07/2004	03:40 AM	Hail	0.75 in.	0	0	0	0
70 Grady	08/25/2004	06:30 PM	Hail	0.75 in.	0	0	0	0
71 Hastings	04/20/2005	11:39 PM	Hail	1.75 in.	0	0	0	0
72 Addington	05/14/2005	02:12 AM	Hail	0.75 in.	0	0	0	0
73 Ringling	06/04/2005	08:45 PM	Hail	0.75 in.	0	0	0	0
74 Waurika	06/13/2005	06:19 PM	Hail	1.00 in.	0	0	0	0
75 Ringling	06/13/2005	07:01 PM	Hail	0.88 in.	0	0	0	0
76 Waurika	03/08/2006	11:34 PM	Hail	0.88 in.	0	0	0	0
77 Ringling	03/08/2006	11:39 PM	Hail	1.00 in.	0	0	0	0
78 Waurika	05/02/2006	02:30 AM	Hail	2.75 in.	0	0	0	0
79 Waurika	05/02/2006	08:22 AM	Hail	0.75 in.	0	0	0	0
80 Waurika	05/02/2006	08:40 AM	Hail	1.00 in.	0	0	0	0
81 Waurika	05/02/2006	08:50 PM	Hail	0.75 in.	0	0	0	0
82 Waurika	05/10/2006	04:37 AM	Hail	1.75 in.	0	0	0	0
83 Ryan	05/10/2006	04:39 AM	Hail	1.75 in.	0	0	0	0
84 Ryan	05/10/2006	04:40 AM	Hail	0.75 in.	0	0	0	0
85 Waurika	12/29/2006	06:39 PM	Hail	0.88 in.	0	0	0K	0K
86 Waurika	12/29/2006	06:44 PM	Hail	0.88 in.	0	0	0K	0K
87 Hastings	03/11/2007	04:15	Hail	1.00 in.	0	0	0K	0K

		PM						
				TOTALS:	0	0	0	0

2.10. HAZARD PROFILE – Severe Winter Storm.

2.10.1. Description.

This plan defines a winter storm as a single or combination of the following winter weather types occurring over a wide area of Jefferson County.

1. **Ice storm.** Described by the National Weather Service (NWS), as an occasion when damaging accumulations of ice are expected during freezing rain situations. Significant ice accumulations are usually accumulations of 0.25 inches or greater.
2. **Heavy snow.** Defined as either a snowfall accumulating to four inches in depth in 12 hours or less, or snowfall accumulation to six inches or more in depth in 24 hours or less.
3. **Freezing rain or freezing drizzle.** An occasion when rain or drizzle freezes on surfaces such as trees, power lines, highways, etc.
4. **Extreme Cold.** Cold temperatures for extended periods of time.

2.10.2. Location.

All parts of Jefferson County are susceptible to severe winter storms.

2.10.3. Extent.

Based on past occurrence, Jefferson County winter storms have not been shown to have significant impact on agricultural and loss of life, but there has been property and economic damage.

Winter storms such as blizzards can strike unexpectedly and can create hazardous travel conditions and utility outages. Dangerous driving conditions can play roles in both community, economic, and social hardships.

Fortunately, Jefferson County is not affected by blizzard as often as other parts of the state. Damages usually occur in loss of water due to frozen water lines and loss in agricultural revenue due to loss of livestock. During times of more than average accumulation, structures can collapse due to the added weight of snow and ice. Ice dams can cause additional roof damage.

Extremely cold temperatures can cause property damages and death. Jefferson County is not well equipped for extended periods of below freezing and colder temperatures. Water pipes can freeze and crack. Individuals may not be prepared with proper clothing. These individuals can underestimate the wind chill or can become trapped in cold temperatures due to car failure or other unexpected events.

Based on the National Weather Service and NOAA wind chill chart Jefferson County would consider a minor hazard as being -19 and a -35 reading as being a major hazard.

XIX. Figure: Winter Storm: Wind Chill (extreme cold), Volume of Ice and Volume of Snow.

The Wind Chill temperature you have undoubtedly heard of is simply a measure of how cold the wind makes real air temperature feel to the human body. Since wind can dramatically accelerate heat loss from the body, a blustery 30° day would feel just as cold as a calm day with 0° temperatures. The index was created in 1870, and on November 1, 2001, the National Weather Service released a more scientifically accurate equation, which we use today. Here is a chart for calculating wind chill. (Please note that it is not applicable in calm winds or when the temperature is over 50°.)

Wind Chill Chart

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

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

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

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

Effective 11/01/01

Source: National Weather Service and NOAA.

2.10.4. Previous Occurrences.

Over the past 23 years (1984 - 2007), the National Climatic Data Center has recorded that Jefferson County has experienced 6 significant winter storm

events. Some examples of past winter storm events in Jefferson County include the following:

January 5-7, 1988 - Significant snowfall amounts were reported across Oklahoma. The storm totals exceeded 6-inches over virtually the entire state, except a few areas near the Red River and the far western Oklahoma Panhandle.

November 24, 1996 - Ice accumulated up to 1/2 inch thick mainly southeast of a line from Shawnee in Pottawatomie to Chickasha, in Grady County to Frederick in Tillman County. Power was out to a large portion of the area due to icing of power lines and tree limbs. It took as long as 3 days to restore power to some customers.

December 20, 1998 - Light-freezing rain produced a thin layer of ice on most roads. Across the entire state, there were 13 fatal traffic accidents and 100 injury-related traffic accidents.

January 30, 2002 - Ice accumulations of one to two inches. The worst damage occurred in a 60-mile wide band, extending from near Ponca City, in Kay County southwestward toward Anadarko in Caddo County and Hobart in Kiowa County. Dozens of towns were left completely without power for days, with some residents without power for weeks. The damage was catastrophic in places, with thousands of utility poles, along with thousands of trees, brought down by the weight of the ice.

2.10.5. Probability of Future Events.

Based on Previous Occurrences, some six snows and/or ice events have occurred in the last 23 years. This would indicate that the probability of a winter storm occurring within Jefferson County is highly likely.

2.10.6. Vulnerability.

Cold waves pose a variety of threats to individuals and communities. These threats are sometimes compounded by accumulations of ice or snow. The delivery of public services and maintenance of infrastructure are often disrupted by cold waves. Frozen and burst water lines are a common problem. Increased consumption of heating fuel can lead to energy shortages and higher prices. People and animals are subject to health risks from extended exposure to cold air. The list below summarizes some of the most common impacts of cold waves.

Costs and losses to livestock producers:

1. Loss of livestock due to exposure.
2. Greater mortality due to increased vulnerability to disease.
3. Increased feed costs.
4. Reduced milk production.

5. Cost of supplemental water for livestock if onsite ponds and streams are frozen.
6. Machinery and farm vehicles that will not operate in cold weather.
7. Urban, residential, and commercial impacts.
8. Availability of water for municipal use due to frozen and burst water lines.
9. Homes with alternative energy sources.
10. House fires from overburdened chimneys. Carbon monoxide poisoning from exhaust produced by heaters and generators.
11. Vehicles that will not operate in cold weather. Cost of keeping transportation lines clear of ice and snow.

Health:

1. Mental and physical stress in the form of "cabin fever".
2. Frostbite and hypothermia.
3. Disruption of services.
4. Government offices and schools closed.
5. Garbage collection halted.

General economic effects:

1. Revenue loss from lost production in business and industry.
2. Negative impact of economic multipliers.
3. Higher energy costs.
4. Damage to animal species.
5. Loss of wildlife, particularly if cold wave is coupled with prolonged snow cover that makes sources of food unavailable.
6. Greater mortality due to increased vulnerability to disease.
7. Loss of trees and woody shrubs that is not hardy enough to survive prolonged exposure to cold temperatures, especially when soil moisture is low.
8. Pollution from increased energy production.

A major winter storm can be lethal. Preparing for cold weather conditions and responding to them effectively can reduce the dangers caused by winter storms.

Mitigating ice storm damage to power lines must be a joint effort by Jefferson County and city workers, private landowners and utility companies. Regular trimming by all levels of participants can substantially reduce the damage caused by future episodes.

2.10.7. Secondary Hazards.

Secondary hazards can include traffic accidents due to snow and ice covered roads, and death from hypothermia due to prolonged exposure to cold. Wind-driven snow can result in “whiteout” conditions that can also make driving extremely dangerous. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternate heating sources. Fires

during winter storms also present a greater danger because water supplies may freeze and impede firefighting efforts.

2.10.8. Overall Summary of Vulnerability and Impacts.

A winter storm can range from accumulating snow and/or ice over a few hours to blizzard conditions with blinding, wind-driven snow lasting several days. In latitudes like Jefferson County, where moist Gulf air collides with arctic temperatures from the north, winter storms - particularly ice storms - have the potential to cause significant property damage, transportation problems and utility service failure over large areas of the state. The aftermath of a winter storm can continue to impact a region for weeks, and even months. Houses, roads, electrical poles and lines, water systems, people and cattle are all vulnerable to severe winter storms. Houses are damaged from the weight of the ice, roads buckle and or become slick and hazardous, electrical poles and lines break, and people loose electricity and heat, water lines freeze and burst due to the cold weather and people and livestock have no water. People and livestock are susceptible to frostbite and death from exposure.

2.11. Hazard Profile – Tornadoes/High Winds.

2.11.1. Description.

Tornadoes and high winds are combined in profile because of similarities in potential damage and mitigation measures.

Tornadoes:

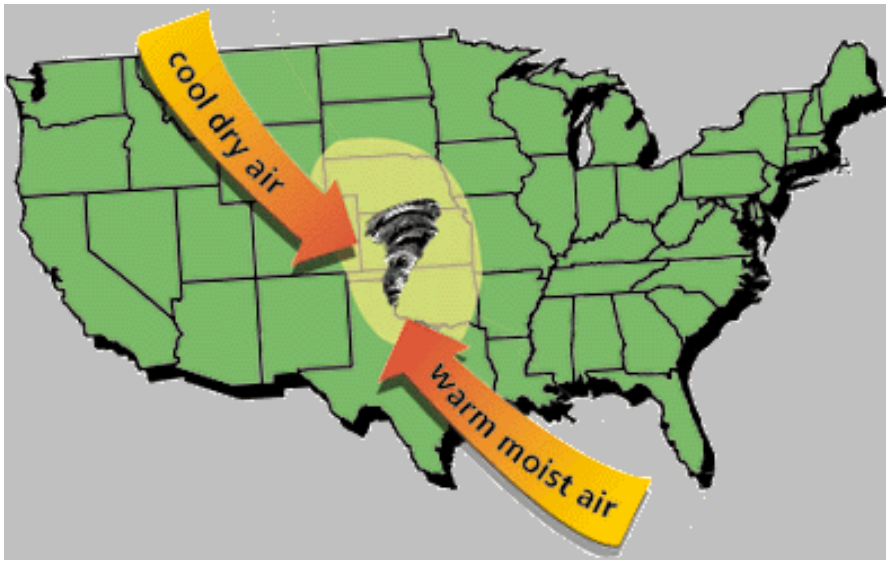
A tornado is a violent whirling wind, characteristically accompanied by a funnel-shaped cloud. Tornadoes are the result of great instability in the atmosphere and are often associated with severe thunderstorms or in advance of cold fronts. Note that although tornadoes and high winds are associated with thunderstorms, tornadoes and high winds are profiled in this plan as a separate event.

High Winds:

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 speeds reaching 50 mph or greater, either sustaining or gusting. Downdraft winds are from a strong thunderstorm downburst that causes damaging winds on or near the ground, and can extend to as little as 2½ miles or extend over a hundred miles. These speeds can range from light breezes to sustained speeds of 80 to 100 mph.

High winds in Jefferson County can be caused by thunderstorms, but high winds can also occur without a thunderstorm event, such as a severe pressure gradient.

XX. Figure: Tornado Alley.



Tornadoes are most common on the Great Plains and in the part of the United States often called *Tornado Alley.* According to NOAA data, this area of the United States is the most tornado prone in the country. The area has a reported concentration of more than 11 tornadoes per 1000 square miles. According to NOAA data, this area of the United States is the most tornado prone in the country. The area has a reported concentration of more than 11 tornadoes per 1000 square miles. In Oklahoma, Jefferson County is located within this area and tornadoes have a history of development and destruction throughout Jefferson County. Tornadoes occur most often in spring during the late afternoon or early evening. Based on records kept by the National Climatic Data Center (NCDC) since 1950, a total of 28 tornadoes were recorded.

2.11.2. Location.

All of Jefferson County is equally susceptible to tornado and high wind damages. Due to the County wide probability every structure has equal probability to be struck by a tornado or high wind.

May to August is the predominate tornado season, though again, they can occur any time of year. Over 80% of tornadoes occur between noon and midnight, one quarter from 4:00PM. to 6:00 PM. Tornadoes within Jefferson County have varied in intensity from F0 to F5 on the Fujita Scale. Out of the 28 total, none were rated F5, one was rated as F4, two as F3, three were rated as F2, and twenty two were F1 or F0 on the Fujita Scale.

XXI. Figure: Tornado: Fujita Scale, Enhanced Fujita Scale.

Fujita Scale

F-Scale Number	Intensity Phrase	Wind Speed	Type of Damage
F0	Gale tornado	40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
F1	Moderate tornado	73-112 mph	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	Significant tornado	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe tornado	158-206 mph	Roof and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted
F4	Devastating tornado	207-260 mph	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible tornado	261-318 mph	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel reinforced concrete structures badly damaged.
F6	Inconceivable tornado	319-379 mph	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies

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-	162-209	3	138-167	**3**	**136-165**

	207					
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

Source: http://en.wikipedia.org/wiki/Fujita_scale

On February 1, 2007, the Fujita scale was decommissioned in favor of the more accurate Enhanced Fujita Scale, which replaces it. None of the tornadoes recorded on or before January 31, 2007 will be re-categorized. Therefore maintaining the Fujita scale will be necessary when referring to previous events.

Examples of other tornado events are listed in the following table.

Based on the Enhanced Fujita Scale a tornado reading a F1 on the scale would be a minor hazard in Jefferson County, this reading is capable of peeling the surface off roofs, mobile homes can be pushed off foundations or overturned, moving autos are capable of being pushed off the roads and attached garages may be destroyed. A reading of F4 would be considered a major hazard in Jefferson County due to the fact that well-constructed houses would be leveled, structures with weak foundations would be blown off some distance and cars would be thrown and large missiles would be generated.

XXII. Figure: Tornadoes Reported.

28 TORNADO(s) were reported in **Jefferson County, Oklahoma** between **01/01/1956** and **03/31/2003**.

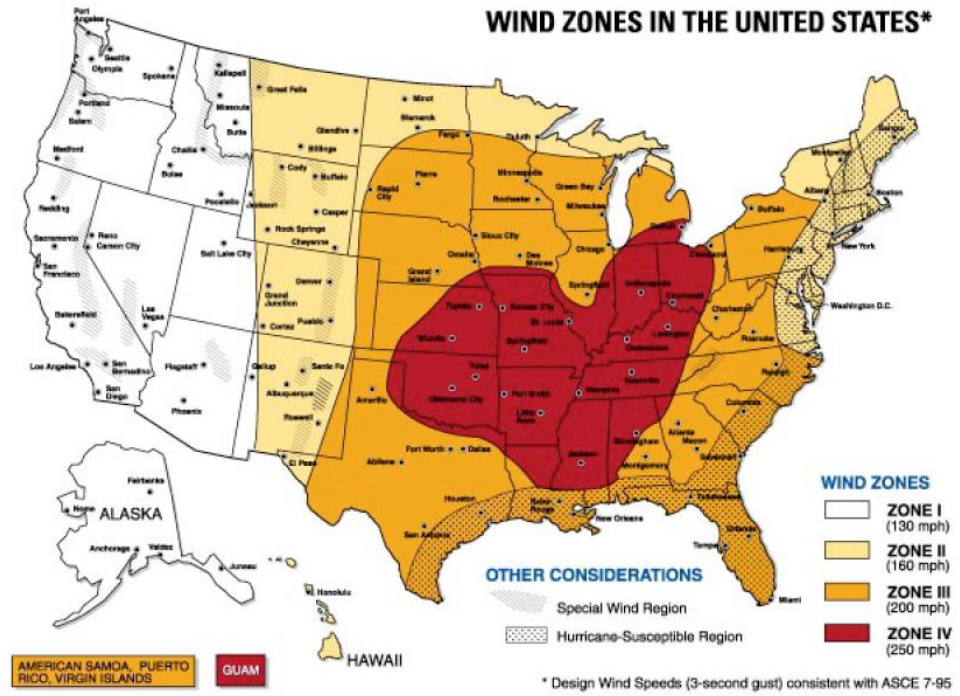
Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 JEFFERSON	04/28/1956	1600	Tornado	F2	0	0	0K	0
2 JEFFERSON	08/07/1956	1600	Tornado	F1	0	0	3K	0
3 JEFFERSON	04/02/1957	1530	Tornado	F1	0	0	3K	0
4 JEFFERSON	03/25/1959	1730	Tornado	F1	0	0	3K	0
5 JEFFERSON	05/26/1959	2010	Tornado	F1	0	0	25K	0
6 JEFFERSON	04/14/1965	1700	Tornado	F1	0	0	3K	0
7 JEFFERSON	05/07/1968	1315	Tornado	F0	0	0	3K	0
8 JEFFERSON	05/16/1968	1800	Tornado	F0	0	0	0K	0

9 JEFFERSON	05/06/1969	1715	Tornado	F0	0	0	0K	0
10 JEFFERSON	03/13/1973	1250	Tornado	F0	0	0	3K	0
11 JEFFERSON	03/24/1973	1340	Tornado	F0	0	0	0K	0
12 JEFFERSON	04/20/1974	1633	Tornado	F3	0	0	250K	0
13 JEFFERSON	04/19/1976	1425	Tornado	F2	0	0	25K	0
14 JEFFERSON	05/30/1976	1631	Tornado	F1	0	0	0K	0
15 JEFFERSON	05/30/1976	1800	Tornado	F1	0	0	25K	0
16 JEFFERSON	04/10/1979	1830	Tornado	F4	0	0	250K	0
17 JEFFERSON	04/22/1981	1715	Tornado	F0	0	0	3K	0
18 JEFFERSON	10/17/1981	0345	Tornado	F1	0	2	0K	0
19 JEFFERSON	05/13/1983	1725	Tornado	F0	0	0	0K	0
20 JEFFERSON	03/13/1990	1801	Tornado	F1	0	0	0K	0
21 JEFFERSON	03/13/1990	1858	Tornado	F3	0	0	2.5M	0
22 Ryan	05/08/1993	1625	Tornado	F0	0	0	0	0
23 Ryan	05/08/1993	1648	Tornado	F0	0	0	0	0
24 Ringling	05/08/1993	1735	Tornado	F1	0	0	5K	0
25 Addington	04/19/1995	1840	Tornado	F0	0	0	0	0
26 Ringling	04/21/1996	05:30 PM	Tornado	F1	0	0	0	0
27 Ringling	08/11/1996	05:30 PM	Tornado	F0	0	0	0	0
28 Cornish	05/08/2003	12:32 AM	Tornado	F2	0	0	70K	0
				TOTALS:	0	2	3.168M	0

XXIII. Figure: Wind Zones in the United States.



2.11.3. Extent of damaging winds.

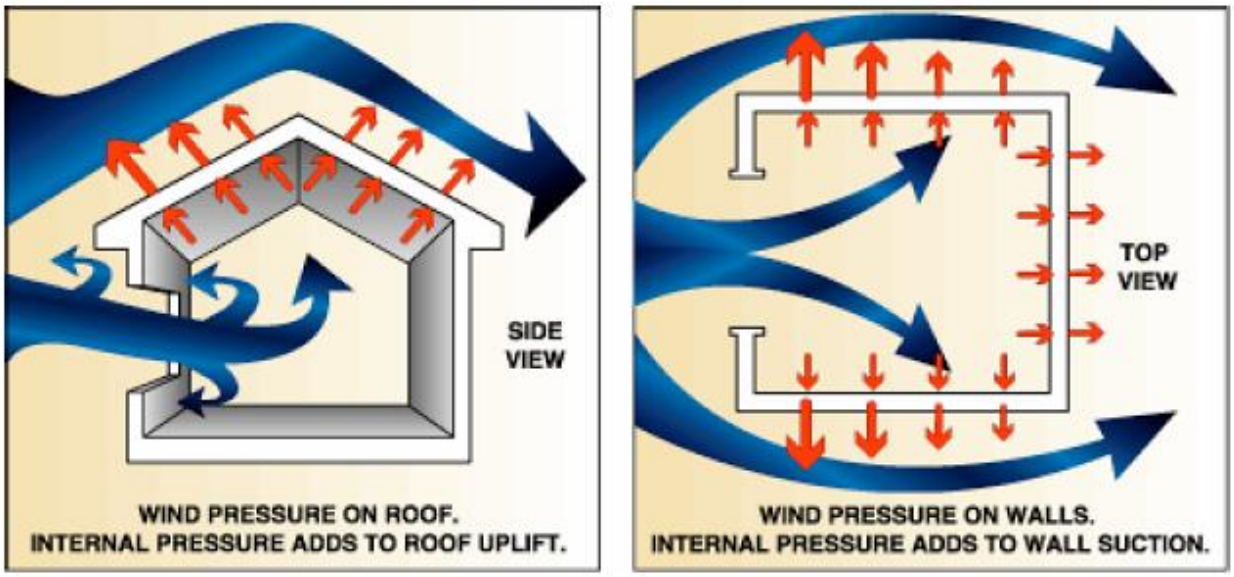
A worst-case scenario involving thunderstorms would be a solid or redeveloping line, of severe thunderstorms that move through the entire County. These storms can result in heavy rains causing wide spread flooding and road closures. Large economic loss to agriculture and/or major damage to buildings and other property can result if such storms are accompanied by hail and high winds. High winds and lightning associated with such storms can also down trees and highline poles and result in power outages capable of affecting large areas of Jefferson County.

Extreme winds can cause several kinds of damage to a building. Figure XXIV below shows how extreme winds affect a building and helps explain why these winds cause buildings to fail.

Wind speeds, even in these extreme wind events, rapidly increase and decrease. An obstruction, such as a house, in the path of the wind causes the wind to change direction. This change in wind direction increases pressure on parts of the house. The combination of increased pressures and fluctuating wind speeds creates stress on the house that frequently causes connections between building components to fail. For example, the roof or siding can be pulled off or the windows can be pushed in.

Based on the Beaufort Scale a Beaufort number of 9, which would have winds measuring at 47-53 mph, would be considered a minor hazard by Jefferson County. These strong gale winds would be capable of producing structure and roof damage. A Beaufort number of 10 would have winds measuring 55-63 mph and would be considered a major hazard by Jefferson County due to the fact that trees would be damaged along with structures.

XXIV. Figure: Diagram of Windstorm Effects.



Buildings that fail under the effects of extreme winds often appear to have exploded, giving rise to the misconception that the damage is caused by unequal wind pressures inside and outside the building. This misconception has led to the myth that during an extreme wind event, the windows and doors in a building should be opened to equalize the pressure. In fact, opening a window or door allows wind to enter a building and increases the risk of building failure.

Damage can also be caused by flying debris (referred to as windborne missiles). If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, walls, or the roof. For example, an object such as a 2” x 4” wood stud weighing 15 pounds, when carried by a 250-mph wind, can have a horizontal speed of 100 mph and enough force to penetrate most common building materials used in houses today. Even a reinforced masonry wall will be penetrated unless it has been designed and constructed to resist debris impact during extreme winds. Because missiles can severely damage and even penetrate walls and roofs, they threaten not only buildings but the occupants as well.

XXV. Figure: Beaufort Scale.

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.

2.11.4. Previous Occurrences.

Since 1963 the National Climatic Data Center (NCDC) recorded 125 thunderstorm events in Jefferson County. 64 of these storms had wind speeds above 50 kts. Due to the rural nature of Jefferson County, most reports of thunderstorms and any associated damage are from cities and towns.

XXVI. Figure: High Wind Events.

60 THUNDERSTORM & HIGH WINDS event(s) were reported in **Jefferson County, Oklahoma** between **01/01/1997** and **03/31/2007**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Ringling	08/22/1997	06:10 AM	Tstm Wind	54 kts.	0	0	0	0
2 Waurika	03/27/1998	06:00 AM	Tstm Wind	0 kts.	0	0	2K	0
3 Waurika	06/09/1998	05:30 PM	Tstm Wind	61 kts.	0	0	0	0
4 Ringling	06/09/1998	06:01 PM	Tstm Wind	74 kts.	0	0	0	0
5 Ringling	06/09/1998	06:05 PM	Tstm Wind	69 kts.	0	0	30K	0
6 Ryan	06/09/1998	06:05 PM	Tstm Wind	0 kts.	0	0	10K	0
7 Waurika	06/11/1998	12:30 AM	Tstm Wind	0 kts.	0	0	0K	0
8 Waurika	06/18/1998	06:35 PM	Tstm Wind	52 kts.	0	0	0	0
9 Ringling	06/18/1998	06:40 PM	Tstm Wind	75 kts.	0	0	0	0
10 Claypool	06/18/1998	06:45 PM	Tstm Wind	0 kts.	0	0	2K	0
11 Ringling	06/18/1998	06:45 PM	Tstm Wind	65 kts.	0	0	0	0
12 Ringling	06/18/1998	07:05 PM	Tstm Wind	52 kts.	0	0	0	0
13 OKZ004>048 - 050>052	02/11/1999	07:00 AM	High Wind	0 kts.	0	0	2K	0
14 OKZ018>020 - 022>031 - 033>042 - 044>046 - 050	03/02/1999	12:00 PM	High Wind	0 kts.	0	0	0	0
15 OKZ004>040 - 042 - 044>045 - 052	04/14/1999	05:00 PM	High Wind	64 kts.	0	0	57K	0

16 Waurika	06/19/1999	03:15 PM	Tstm Wind	0 kts.	0	0	2K	0
17 Waurika	06/19/1999	03:25 PM	Tstm Wind	52 kts.	0	0	0	0
18 OKZ005>008 - 010>048 - 050>052	04/10/2001	09:00 PM	High Wind	44 kts.	0	0	33K	0
19 Terral	05/04/2001	05:55 PM	Tstm Wind	0 kts.	0	0	1K	0
20 Waurika	05/18/2001	02:05 AM	Tstm Wind	52 kts.	0	0	0	0
21 Ringling	05/27/2001	10:20 PM	Tstm Wind	57 kts.	0	0	0	0
22 Ringling	05/27/2001	10:20 PM	Tstm Wind	0 kts.	0	0	1K	0
23 Hastings	05/27/2001	10:30 PM	Tstm Wind	52 kts.	0	0	0	0
24 Ringling	05/27/2001	11:05 PM	Tstm Wind	52 kts.	0	0	0	0
25 OKZ004>005 - 008>048 - 050>052	03/08/2002	07:00 PM	High Wind	45 kts.	0	0	0	0
26 OKZ004>042 - 044>046	04/02/2002	08:00 AM	Strong Winds	N/A	0	0	0	0
27 Addington	04/13/2002	09:15 AM	Tstm Wind	52 kts.	0	0	0	0
28 OKZ045>046 - 050>052	05/07/2002	11:00 PM	High Wind	0 kts.	0	0	0	0
29 OKZ024 - 027 - 036>039 - 044>045	05/08/2002	10:50 PM	High Wind	56 kts.	0	0	0	0
30 Waurika	06/15/2002	09:30 PM	Tstm Wind	51 kts.	0	0	0	0
31 Addington	06/15/2002	09:33 PM	Tstm Wind	52 kts.	0	0	0	0
32 Ringling	08/27/2002	04:25 AM	Tstm Wind	55 kts.	0	0	0	0
33 Waurika	08/27/2002	04:40 AM	Tstm Wind	69 kts.	0	0	0	0
34 Grady	04/15/2003	11:10 PM	Tstm Wind	52 kts.	0	0	0	0
35 Waurika	04/23/2003	07:25 PM	Tstm Wind	87 kts.	0	0	400K	0
36 Ringling	05/08/2003	12:45 AM	Tstm Wind	50 kts.	0	0	0	0
37 Ringling	05/16/2003	01:40 AM	Tstm Wind	55 kts.	0	0	0	0
38 Waurika	06/10/2003	08:40 PM	Tstm Wind	52 kts.	0	0	0K	0
39 Ryan	08/09/2003	06:30	Tstm	52	0	0	0	0

		AM	Wind	kts.				
40 Waurika	03/04/2004	01:49 PM	Tstm Wind	65 kts.	0	0	0	0
41 Waurika	03/04/2004	01:50 PM	Tstm Wind	69 kts.	0	0	25K	0
42 Waurika	03/04/2004	01:55 PM	Tstm Wind	56 kts.	0	0	0	0
43 Cornish	03/04/2004	02:13 PM	Tstm Wind	61 kts.	0	0	60K	0
44 Ringling	03/04/2004	02:15 PM	Tstm Wind	61 kts.	0	0	0	0
45 Ringling	03/04/2004	02:20 PM	Tstm Wind	53 kts.	0	0	0	0
46 Ryan	04/30/2004	02:15 PM	Tstm Wind	52 kts.	0	0	0	0
47 Addington	06/02/2004	04:45 PM	Tstm Wind	52 kts.	0	0	0	0
48 Addington	06/07/2004	03:40 AM	Tstm Wind	56 kts.	0	0	2K	0
49 Waurika Lake	06/04/2005	09:45 PM	Tstm Wind	61 kts.	0	0	15K	0
50 Waurika	06/05/2005	10:06 PM	Tstm Wind	52 kts.	0	0	0	0
51 Waurika	06/13/2005	06:14 PM	Tstm Wind	58 kts.	0	0	0	0
52 OKZ033 - 035 - 039 - 044>045	06/16/2005	11:15 PM	High Wind	56 kts.	0	0	1K	0
53 OKZ023 - 037>038 - 042 - 045>047	03/20/2006	03:30 PM	High Wind	61 kts.	0	0	60K	0
54 Addington	05/02/2006	08:15 PM	Tstm Wind	52 kts.	0	0	0	0
55 Ryan	05/10/2006	04:30 AM	Tstm Wind	56 kts.	0	0	5K	0
56 Ryan	05/10/2006	04:39 AM	Tstm Wind	61 kts.	0	0	40K	0
57 Ryan	05/10/2006	04:40 AM	Tstm Wind	52 kts.	0	0	1K	0
58 Grady	05/10/2006	04:55 AM	Tstm Wind	52 kts.	0	0	0	0
59 Grady	05/10/2006	05:00 AM	Tstm Wind	52 kts.	0	0	0	0
60 OKZ004 - 008 - 014 - 017 - 025 - 029>030 - 033>039 - 041>042 - 045>047 - 050>052	02/24/2007	11:55 AM	High Wind	55 kts.	0	0	389K	0K
				TOTALS:	0	0	1.136M	0

2.11.5. Probability of Future Events.

In the last 53 years Jefferson County had 28 tornadoes and 125 high wind events and, resulting in an average of 0.52 tornadoes and 2.35 high wind events per year. Therefore the probability of a tornado or high wind occurring within Jefferson County each year is highly likely.

2.11.6. Vulnerability.

Located in the central part of Oklahoma, Jefferson County is in an active part of tornado alley and has a designated wind speed rating of a Zone IV. Zone IV is associated with 250 mph wind speeds. Historically the average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Consequently, vulnerability of humans and property is difficult to evaluate since tornadoes form at different strengths, in random locations and create relatively narrow paths of destruction. Residents most vulnerable to tornadoes and high winds are those living in mobile homes.

Education about and preparedness for this threat is a perpetual process and many Jefferson County residents are aware that they live in tornado alley and take appropriate precautions during tornado and high wind warnings. Warning systems, as well as trained spotters, exist in all areas of Jefferson County. As a result, there is a low casualty rate. With peak tornado season in the spring there is a slight risk of crop loss in the tornado path.

Advances in meteorology and the use of Doppler radar allow efficient prediction of tornado formation before they occur. Networks of storm watchers attempt to identify funnel clouds and report to various networks to alert the population. Even though these advances have significantly improved the available response time, tornadoes can still occur unexpectedly and without warning.

The use of better building techniques and the availability of affordable home storm shelters have helped to mitigate losses in Jefferson County.

2.11.7. Secondary Hazards.

Secondary hazards in Jefferson County can include fire, power outages, communications disruption and failure of municipal services. Peripheral damages can occur caused by the accompanying thunder/rain storm activity. Lighting can cause fire. Rain can cause flooding. Tornadoes often affect areas not directly struck by the tornadic event. Loss of power and telephone service due to downed lines within the system can lead to a wide range of problems. Debris can cause damage ranging from minor inconvenience to major transportation problems. The resulting “building rush” following a major event can lead to material shortages and price increases.

2.11.8. Overall Summary of Vulnerability and Impacts.

Located in “Tornado Alley”, Oklahoma is hit by more tornadoes each year, on average, than any other state except Texas. Texas has twice as many tornadoes, but it also is more than twice the size of Oklahoma.

Oklahoma has experienced an average of 60 tornadoes per year over the past 50 years. They are most likely to occur between March and June within the afternoon hours of 3:00PM. to 7:00PM. A tornado can generate winds exceeding 300 mph. The path width of a tornado is generally less than a half-mile, but path length can vary from a few hundred yards to dozens of miles. Therefore the impact on human life and property can be substantial. Based on wind speed and type of damage done, tornado intensity is rated using the Fujita Scale of F0 to F5. In the last 53 years Jefferson County has experienced tornadoes of various intensities, with 25 tornadoes rated as an F2 or under and 3 tornadoes rated as F3 or F4. Tornado’s damage and destroy houses and other structures often displacing people from their homes and sometimes causing businesses to close (whether permanent or temporary) costing lost revenues and incomes. Less common with today’s early warning systems but sometimes loss of life occurs.

Damage from high wind created by a thunderstorm, frontal passage or microburst is similar to damages from a tornado. Straight line winds can, and do, reach speeds in excess of 100 mph. This would correspond to an F1 tornado.

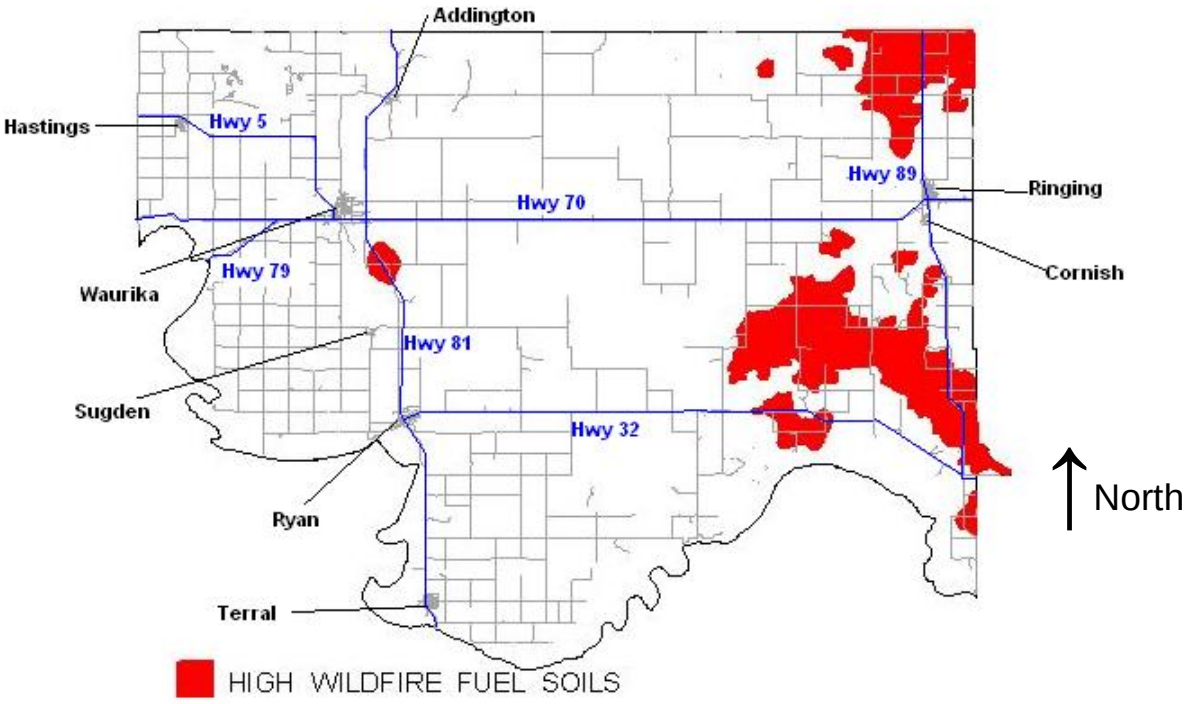
High winds, especially those associated with a frontal passage, often cause severe wind erosion to exposed soil creating a safety and health problem due to visibility and particulate matter. This is in addition to crop losses and long term damage to the soil.

2.12. HAZARD PROFILE – Wildfire.

2.12.1. Description.

A wildfire is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the air for miles around. A “Wild Land” fire is a fire in an area in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities. An “Urban-Wild Land Interface” fire is a wildfire in a geographical area where structures and other human development meet or intermingle with wild land or vegetative fuels.

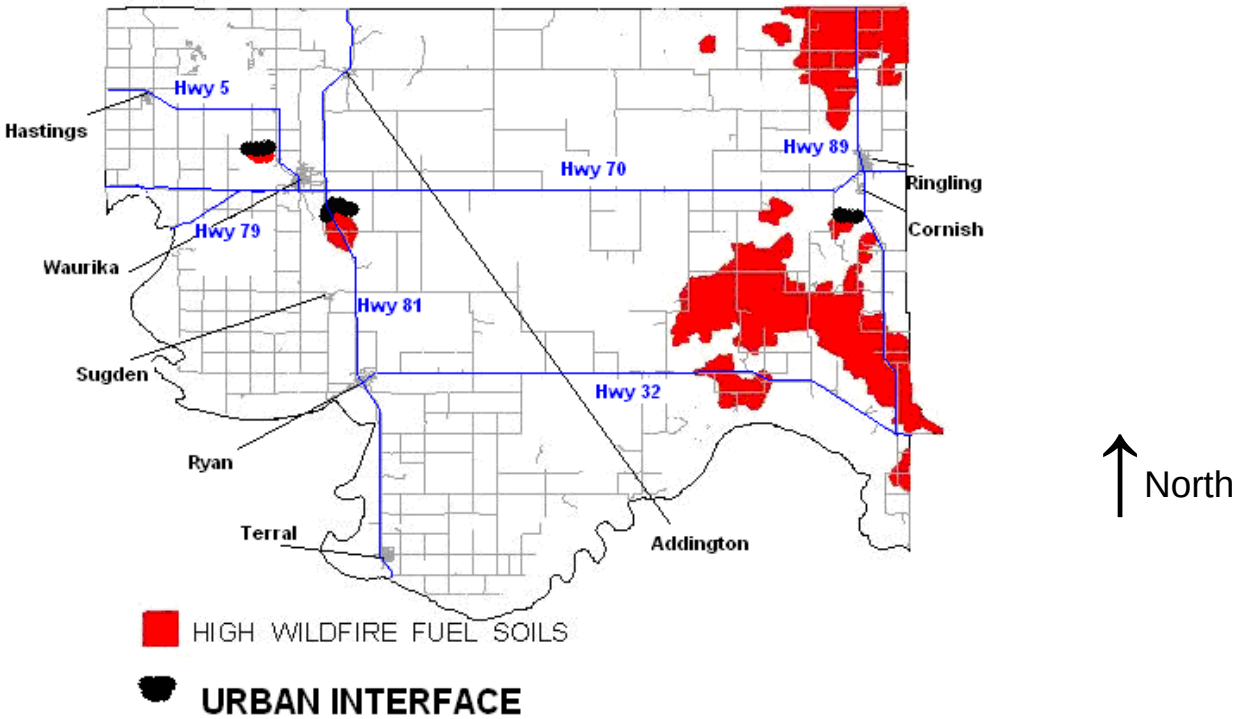
XXVII. Figure High Wildfire Fuel Area.



2.12.2. Location.

Wild fires can occur anywhere throughout Jefferson County but will occur most often in the wild land urban interface areas due to the combination of dry burnable ground cover and lightning storms. See the Wild land /Urban interface map below.

XXVIII. Figure: Wild land Urban Interface Map.



2.12.3. Extent.

Dry conditions, high temperatures, low humidity and high winds can increase the potential and severity of a wildfire. In such conditions, wildfires can spread quickly, affecting large areas in a short amount of time. A worst-case scenario would be multiple wildfires started simultaneously by lightning during dry thunderstorms that move across an area experiencing drought conditions.

On average, fires kill nearly 5,500 Americans each year. Over 30,000 people are injured in fires annually. In the United States, someone dies in a fire every 40 minutes. Most often, victims are children or the elderly. Children playing with fire start 25 percent of the fires that kill young children. Approximately 1,300 senior citizens die in fires annually. Approximately three-quarters of all fire fatalities occur in residential dwellings.

Each year in the US, fire causes over $2 billion worth of damage to homes.

On the Fire Danger Rating System developed by the WFAS a Class 3: High Danger (H) Color Code of yellow is considered by Jefferson as a minor hazard in that fires can start easily and spread at a rapid rate. Class 5: Extreme (E) Color Code of Red is considered to be a major hazard in Jefferson County due to the fire situation being explosive and it can result in extensive property damage.

XXIX. Figure: Fire.

Keetch-Byram Drought Index, fire danger rating system, acres burned, fuel load.

The Keetch-Byram Drought Index (KBDI) is basically a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. This system was originally developed for the southeastern United States and is based primarily on recent rainfall patterns.

The KBDI is the most widely used drought index system by fire managers in the south. It is also one of the only drought index systems specifically developed to equate the effects of drought with potential fire activities.

The result of this system is a drought index number ranging from 0 to 800 that accurately describes the amount of moisture that is missing. A rating of zero defines the point where there is no moisture deficiency and 800 is the maximum drought possible.

These numbers correlate with potential fire behavior as follows:

0 - 200 Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.

200 - 400 Fires more readily burn and will carry across an area with no gaps. Heavier fuels will still not readily ignite and burn. Also, expect smoldering and the resulting smoke to carry into and possibly through the night.

400 - 600 Fire intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.

600 - 800 Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn thorough the night and heavier fuels will actively burn and contribute to fire intensity.

Source: http://www.wfas.us/content/view/32/49/

XXX. Figure: Fire Danger.

Fire Danger Rating System		
rating	**basic description**	**detailed description**
CLASS 1: Low Danger (L) COLOR CODE: **Green**	fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.
CLASS 2: Moderate Danger (M) COLOR CODE: **Blue**	fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.
CLASS 3: High Danger (H) COLOR CODE: **Yellow**	fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
CLASS 4: Very High Danger (VH) COLOR CODE: **Orange**	fires start very easily and spread at a very fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: **Red**	fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.
source: http://www.wfas.net/content/view/34/51/		

2.12.4. Previous Occurrences: Wild Fires Occur Every Year.

People start more than four out of every five wildfires, usually as debris burns, arson or carelessness. Lightning strikes are another cause of wildfires. Other sources of ignition include railroads, catalytic converters on automobiles and

spontaneous ignition of hay bales. Wildfires that do not encounter a human population are difficult to calculate damages. Homes and businesses that are burned in naturally occurring fires are usually privately owned. No data exists for structural losses on the non-incorporated Jefferson County level. According to data collected by the State fire marshal, rural and small town fire departments made an average of 785 fire runs per year. Sampling of fire run reports of these fire departments show that 75% of their fire runs are to suppress wild land fires and 50% are in mutual aid of another fire department for the same fire. Applying the 75% and 50% factor yields 294 fire runs to suppress wild land fires per year. There are 9 volunteer fire departments in Jefferson County that respond to wildfires. On average each department responds to 33 wildfires per year.

2.12.5. Probability of Future Events.

There are wildfires in Jefferson County every year. There are seasonal maximums of wildfires during late winter and late summer when fuel and weather conditions are best for fire propagation. The basic land use, urban interface and weather patterns are not expected to change appreciably; however, implementation of planned action items such as Action Item #WF-3 implementing the Firewise program, Action Item #1 promoting educational programs, Action Item #WF-1allowing the purchase of tanker trucks and Action Item #WF-2 which provides dry hydrants in rural areas are expected to lessen the impact and dangers of wildfires and would help make these rural fire departments more effective. The likelihood of wildfires in Jefferson County is highly likely.

2.12.6. Vulnerability.

Periods of drought, dry conditions, high temperatures, wind and low humidity set the stage for wildfires in Jefferson County. Areas along railroads and people whose homes are in woodland settings in rural areas have an increased risk of wildfire. The sparsely populated tall grass rangelands are capable of experiencing large sweeping fires. Ironically, fire suppression is capable of creating larger fire hazards, because live and dead vegetation is allowed to accumulate in areas where fire has been excluded.

2.12.7. Secondary Hazards.

The loss of groundcover from fire makes areas more susceptible to soil erosion from rainstorms. Water quality can also deteriorate as runoff from burned areas carries mud, agriculture-related chemicals and other debris onto roadways, clog bridges and impair waterways.

2.12.8. Overall Summary of Vulnerability and Impacts.

Arson, debris burns, lightning strikes, railroads, catalytic converters on autos and carelessness can cause wildfires. Fire can increase erosion and result in a deterioration of watercourses, disrupt transportation and affect soil and water quality. Houses and other structures that are amongst the wild land/urban interface are vulnerable to wild fire. The impact from houses burning is people being displaced from their homes.

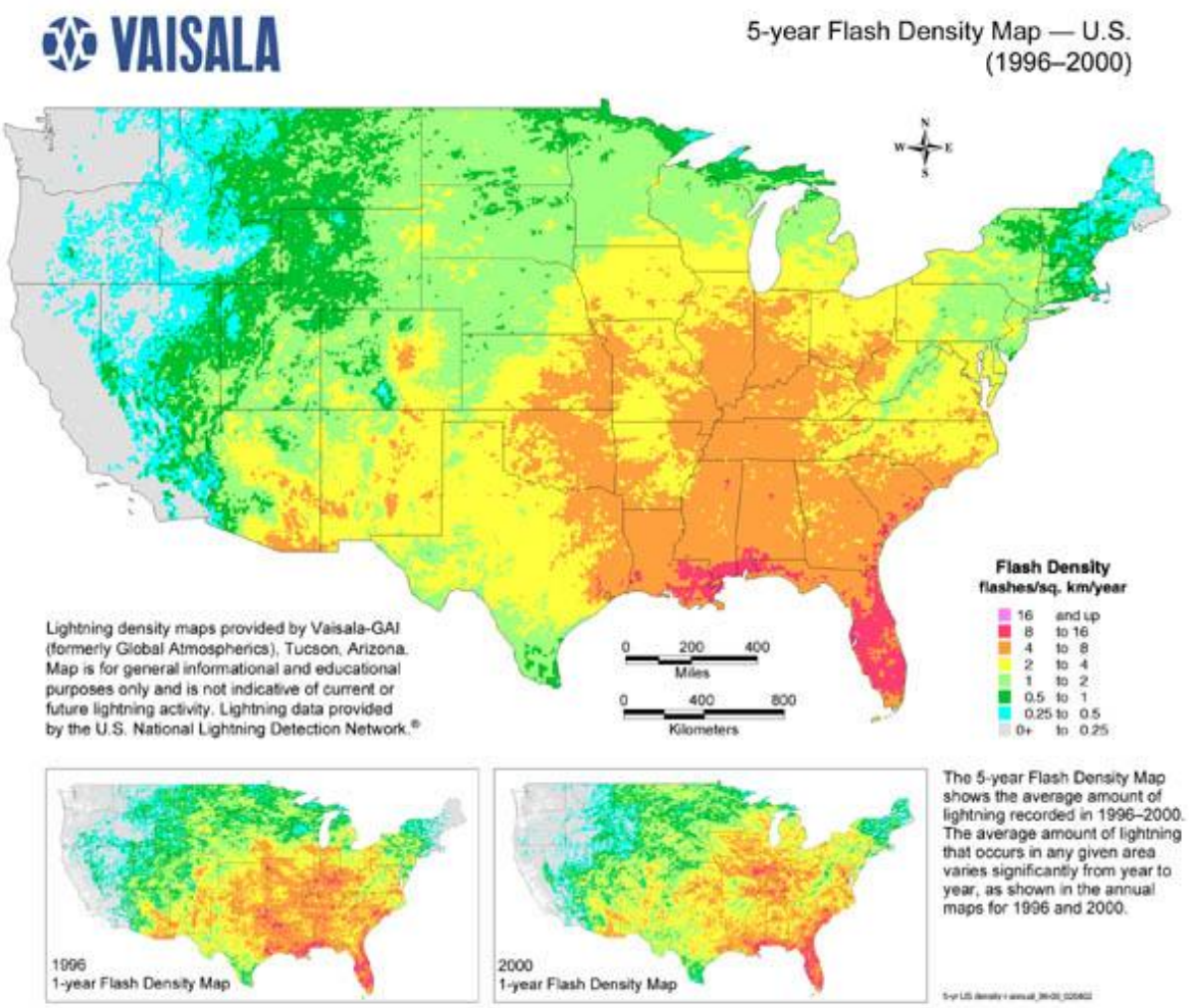
2.13. HAZARD PROFILE – Thunderstorms/Lightning.

2.13.1. Description.

Produced by a cumulonimbus cloud, a thunderstorm is an atmospheric disturbance with lightning and thunder. Lightning is generated by the buildup of charged ions in a thundercloud. When that buildup interacts with the best conducting object or surface on the ground, the result is a discharge of a lightning bolt. Thunder is the sound of the shock wave produced by the rapid heating and cooling of the air near the lightning bolt. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes and may also be accompanied by high winds, rain and hail. A thunderstorm is considered severe if it produces hail at least ¾ inch in diameter, or high damaging winds 58 mph or greater. The high winds may be in the form of straight-line winds or microburst's. While thunderstorms are capable of producing tornados, high winds, hail and rain causing floods, this Hazard Mitigation plan profiles these events as separate natural hazards.

2.13.2. Location.

All parts of Jefferson County are at risk for thunderstorms. Lightning killed 98 people and injured 243 in Oklahoma during the 1959- 2003. Secondary effects from lightning include fires, power disruption, and damage to objects struck by the flash. Lightning data provided by the U.S. National Lightning Detection Network show the average amount of lightning recorded during 1996-2000 in Jefferson County to be 4-flashes/square kilometer/year. A lightning strike within 10 yards of a building may cause damage.



NOAA Technical Memorandum NWS SR-193 reports concerning insurance covered lightning losses. “Those losses were paid for insurance claims by homeowners and some small businesses. Over a third of the insurance losses were between $251 and $1000, and a few were over $5000.”

Each thunderstorm is capable of generating multiple cloud-to-ground lightning strikes. While the onset of a particular lightning strike is instantaneous, a thunderstorm cloud is always present. Usually a storm with cloud to ground lightning can be seen approaching.

2.13.3. Extent.

Lightning data provided by the U.S. National Lightning Detection Network show the average amount of lightning recorded during 1996-2000 in Jefferson County to be 4-flashes/square kilometer/year as shown on the Vaisala scale below. A lightning strike within 10 yards of a building may cause damage or death to people or livestock.

Jefferson County considers no strikes a minimum severity and one or more strikes a major severity.

2.13.4. Previous Occurrences of Lightning.

July 8, 1994 - Thunderstorms in south-central Oklahoma during the early morning hours on the 8th produced damaging lightning which started a fire that destroyed a home three miles east of Hastings in Jefferson County. Damage was estimated at $50,000.

June 10, 1995 - In southern Oklahoma lightning struck an oil storage tank at Addington in Jefferson County, blowing the lid off and igniting a fire. Two fire fighters assisting from Texas were killed while fighting the blaze. Damage was estimated at $2.5 million.

According the NCDC since 1950 until 2008 there have been 4 lightning events that produced 5.050 million dollars of property damage.

4 LIGHTNING event(s) were reported in **Jefferson County, Oklahoma** between **01/01/1950** and **12/31/2008**.

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Waurika	03/29/1993	2300	Lightning	N/A	0	0	0	0
2 Ringling	10/12/1993	1925	Lightning	N/A	0	0	0	0
3 Hastings	07/08/1994	0345	Lightning	N/A	0	0	50K	0
4 Addington	06/10/1995	1515	Lightning	N/A	0	0	5.0M	0
				TOTALS:	0	0	5.050M	0

2.13.5. Probability of Future Events.

Considering the previous occurrences and the high number of recorded thunderstorm events, the probability that at least one severe thunderstorm event will occur within Jefferson County each year is highly likely.

2.13.6. Vulnerability.

Vulnerability is difficult to evaluate since thunderstorms can occur at different levels of strength, in random locations, and create relatively narrow paths of destruction. Due to the randomness of this event, the entire population of Jefferson County remains vulnerable to possible injury and/or property loss from lightning. Lightning can strike 10 miles out from the rain column, enabling

injurious lightning strikes to people to occur under a clear sky ahead of the storm, as they tend to wait to seek shelter until the last minute.

2.13.7. Secondary Hazards.

Secondary hazards can include fires and power failures. Hail, flooding and high winds/tornadoes, although associated with thunderstorms, are profiled as separate events with their own secondary hazards.

2.13.8. Overall Summary of Vulnerability and Impacts.

All of Jefferson County has a significant exposure to thunderstorms. In addition to lightning, thunderstorms are capable of producing tornadoes, hail, and rain causing floods. This plan profiles lightning with thunderstorms. Overall, lightning is the most constant and widespread threat to people and property during the thunderstorm season. The impact or result could be people displaced from their homes, financial loss due to wildfire and electronic equipment damaged.

CHAPTER THREE – ASSESSING VULNERABILITY.

3.1. Hazard Summary.

This summary identifies the major natural hazards that could occur, and includes previous occurrences and probability of future events of them occurring, within Jefferson County.

XXXI. Table: Hazard Summary.

Hazard	Previous Occurrences	Probability of Future Events
Dam Failure	No record of this occurring.	Unlikely
Drought	16 major events *in State* since 1929.	Highly Likely
Earthquake	6 recorded since 1897.	Unlikely
Expansive Soils	Due to limited or non-existent data, no specific occurrences could be found documented.	Occasional
Extreme Heat	4 events since 1950.	Highly Likely
Flood	23 events from 1993 to 2000.	Highly Likely
Hailstorm	60 large-hail events recorded since 1955.	Highly Likely
Severe Winter Storm	18 snow and/or ice events since 1950.	Highly Likely
Tornado/high winds	28 tornado and 125 wind events recorded since 1963.	Highly Likely
Wildfire	294 wild land fire responses per year.	Highly Likely
Thunderstorm/Lightning	64 severe thunderstorm events recorded since 1983.	Highly Likely

The Jefferson County Hazard Mitigation Planning Committee has determined Expansive Soils and Earthquakes do not present a severe threat to the County and therefore decided not to adapt any action items for these hazards.

3.2. Types and Numbers of Existing Structures Affected by the Flood Hazard.

Table XXXII attempts to estimate the proportion and value of buildings that are located in a 100 year flood plain.

XXXII. Table: Types and Numbers of Existing Structures Affected by Flood Hazard.

Existing Assets Vulnerable to Flood Damage			
Asset	Number	Unit Valuation	Vulnerable Asset Valuation
Buildings – Housing Units	3	$ 64,300 ea.	$192,900
Buildings - Commercial	0	-	$0
Critical Facility – Courthouse	0	-	$0
Critical Facility – County Barns	0	-	$0
Infrastructure – County Bridges	103	2678 ft @ $2500/ft	$6,695,000
TOTALS	106	-.	$6,887,900

There are no planned developments in the flood hazard area in rural Jefferson County. County assets affected by floods are roads and bridges. Roads and bridges throughout Jefferson County may require cleanup and repairs after flood events. Total costs associated with the cleanup and repairs were not available. However, Jefferson County intends to include specific road and bridge projects as mitigation actions in updates to Jefferson County's Hazard Mitigation Plan. At that time the projects will be prioritized and costs associated with the repairs/cleanup versus the cost of the mitigation action will be compared.

3.3. Types and Numbers of Existing Structures Affected-All Other Hazards-100% Susceptible.

Table XXXII estimates the proportion and values of buildings and the population that are located in areas affected by all other hazards, which is the entire County area. Table XXXIII is also an inventory of specific critical facilities identified in this plan that can be damaged by all hazards mentioned except flood. Total unincorporated areas population of Jefferson County in the according to the 2000 US Census is 1710.

XXXIII. Table: Types and Numbers of Existing Structures Affected by All Other Hazards – 100% Susceptibility.

Existing Assets Vulnerable to all Hazards except Floods			
Asset	Number	Unit Valuation	Vulnerable Asset Valuation
Buildings – Housing Units	788	$ 44,300 ea.	$34,909,216
Buildings - Commercial	24	$135,000	$3,240,000
Critical Facility – Courthouse	1	$10,000,000	$10,000,000
Critical Facility – County	3	$600,000	$1,800,000

Barns			
TOTALS	816	-	$49,949.216

3.4. Identifying Assets.

The Jefferson County Hazard Mitigation plan identifies critical facilities located within Jefferson County and the hazards to which these facilities are susceptible. A critical facility is defined as a facility that provides essential products or services to the general public and is necessary to the preservation of the welfare and quality of life in Jefferson County. In this initial County plan, the Hazard Mitigation Planning Committee agreed that the following basic facilities should be considered critical: Courthouse, County maintenance barns and County maintained bridges. In future updates of this plan, other facilities may be added.

Committee members and others helped locate the facilities. GIS software was used to map the facilities and determine which are most likely to be affected by hazards. According to the guidelines in the FEMA document "Understanding Your Risks Identifying Hazards and Estimating Losses," the use of a truncated inventory with cost estimates of critical facilities and residential properties is sufficient for providing a very broad picture of the potential extent of damage likely from a hazard event. According to information provided by the Jefferson County Assessor Tables XXXII and XXXIII were prepared to estimate the proportion and value of buildings that are located in hazard areas of the unincorporated area of Jefferson County.

3.5. Estimating Potential Dollar Loss.

Potential dollar loss was estimated for each hazard based on losses recorded from previous natural hazard events. The total recorded loss was divided by the number of events to obtain an average potential dollar loss per event. An attempt was made to estimate losses for all hazards profiled in this plan; however, due to limited resources, detailed data for estimating County-specific potential dollar loss for some of the natural hazards were not available. Where specific County data was available, benefit-cost ratios were developed for each action item using the frequency damage method. Benefit-Cost estimates were made using specific hazard occurrence frequency and past damage estimates.

Potential growth is estimated to be 14 single-family dwellings in the next ten years built at random throughout Jefferson County. This data is based on previous growth trends. No new commercial growth is expected.

3.5.1. Potential Dollar Loss and Vulnerability for Each Hazard.

Dam Failure.

There is no record of dam failure occurring within Jefferson County and although the County has two high and/or significant hazard dams.

Expansive Soils.
No damages have been recorded; therefore this hazard is not included in the action items.

Drought.
In the state of Oklahoma, four severe drought events have been recorded. Any estimates of dollar losses cannot reflect total loss since damages resulting from drought are not fully compensated. Potential losses are not static due to drought severity and commodity value fluctuation, therefore potential dollar loss is impossible to estimate.

Earthquake.
There have been no significant historical damages recorded; potential dollar loss was not estimated. This hazard not included in action items.

Extreme Heat.
County-specific data pertaining to dollar loss resulting from extreme heat was not found. Therefore, estimates for potential loss could not be derived. Such loss is likely to include livestock and crop damage, but it is most likely to be associated with drought, rather than extreme heat.

Flood.
According to the National Climatic Data Center (NCDC), Jefferson County experienced 23 flood events that resulted in approximately $5,500,000 in flood damages from 1993-2007. Therefore the average potential dollar loss is estimated at $250,000 event. Dollar loss specific to flood damages experienced in Jefferson County *outside municipalities* was not found.

Hail.
According to the NCDC, Jefferson County experienced 20 large-hail events since 1997. Since most hail losses are insured or go unreported, no loss figures are estimated for those events.

Potential dollar loss estimates may be made by assuming the same hail storm frequency in the future as in the past and estimating the amount of damage to structures in the unincorporated area.

Estimates of Dollar Losses Due to Hail.
To make a 10-year potential loss estimate from a hailstorm these assumptions or factors were used.

- The average damage to a housing unit from a hailstorm is $3,500.
- The average damage to commercial buildings and County barns from a hail is $14,000.
- The damage to the Courthouse from a hailstorm is $140,000.
- All buildings are equally likely to experience hail.
- The probability of hail damage in a decade is 5%.

Thunderstorms/Lightning.
It was found documented that Jefferson County had 125 thunderstorms since 1963 recorded with damages totaling $6,786,000. Although this dollar loss recorded by NCDC includes damages that resulted in loss occurring within municipalities, these values were used to estimate loss for Jefferson County. Therefore, based on these values, it is concluded that Jefferson County can experience an estimated potential dollar loss of $54,288 for each thunderstorm event that includes high wind, hail and/or lightning.

Tornadoes/High Winds.
Overall, in the state of Oklahoma, the average cost in tornado damages per year is $23,221,264. According to the National Climatic Data Center, Jefferson County and its communities have experienced 28 tornado events that resulted in approximately $3,168,000 in damages in the last 53 years. Therefore the average potential dollar loss per event is estimated to be approximately $113,142 dollars per event.

Jefferson County averages 4.3 high wind events per year. At an average loss of $5,975 per thunderstorm-wind event, an annual loss of $25,692 can be expected.

Since this plan covers only the rural, unincorporated areas of Jefferson County, a tornado scenario is not appropriate. Most damage caused by tornadoes is incurred when their path intersects a densely populated area. Tornadoes setting down in unincorporated Jefferson County would have a relatively small monetary impact.

Wildfire.
According the 2002 annual report by the Oklahoma State Fire Marshall, in the State of Oklahoma, there were a total of 1,427 wild land fires reported, which burned approximately 25,804 acres and resulted in total estimated dollar losses of $25,804,000. No costs estimates are available for Jefferson County.

Winter Storms.
The County has experienced many winter storms of varied intensities that consisted of snow and/or ice. Snow-blocked and ice-covered roads not only make travel dangerous, but the removal and clearing of snow and ice can be costly. Downed electrical lines and the resulting loss of power to homes, businesses and water systems not only increase hardships and hinder recovery, but can also increase potential dollar losses during and after winter storm events.

In late December 2000, a winter storm caused an estimated $74,250,000 in damages in the surrounding area. Therefore, based on past damages, potential dollar loss per event can be substantial.

3.6. Development Trends.

At this time, there is no major planned housing or commercial developments, County critical facility expansions or County infrastructure changes in the unincorporated area of Jefferson County other than those required to meet immediate County transportation needs. Existing substandard County bridges are to be rebuilt to higher standards as funding allows. Extrapolating the change of the decade of the 1990s and present outlook, a net of gain of 14 houses can be expected to be constructed randomly throughout the unincorporated areas of Jefferson County during the next decade. No new commercial growth is expected.

Awareness of natural hazards in Jefferson County and acceptable mitigation measures will be made available to home owners and builders.

Future buildings, infrastructure and critical facilities are not expected to be any different from existing structures. The Committee was unable to approximate costs for future structures other than housing units.

The State of Oklahoma has not granted to counties broad regulatory powers to enact and enforce building codes, building inspections, subdivision regulations and growth management initiatives. Jefferson County does have power to regulate all platting of land, all construction of dwelling units or commercial or industrial structures and all future development within a delineated floodplain area, except land held in trust by the United States for Native Americans.

CHAPTER FOUR – MITIGATION STRATEGY.

4.1. Hazard Mitigation Goals.

Goal 1. Protection from loss of life and personal injury.
Goal 2. Protection of critical facilities and infrastructure.
Goal 3. Protection of personal property and reduction of economic injury due to hazards.
Goal 4. Minimize the costs of disaster response.

These goals were developed by Jefferson County's Hazard Mitigation Planning team through public input and in consultation with County Commissioners and emergency response personnel.

4.2. Comprehensive Range of Mitigation Actions and Cost-Benefit Ratios.

To meet Jefferson County's overall goals, the following actions as they relate to specific natural hazards were developed through discussions and a consensus reached at the public meetings that included the Hazard Mitigation Committee members and any other interested party. Cost-benefit ratios were made using the frequency-damage method by known occurrences compared to past damages. Those mitigating the effects of more than one hazard are analyzed only once. Some of the actions being considered are so inter-related that the analysis of one duplicates the analysis of another.

These identified actions and projects not only address reducing the effects of hazards on new and existing buildings, but also infrastructure as well.

HAZARD: Dam Failure, Drought, Extreme Heat, Flood, Hailstorm, Severe Winter Storm, Tornado/High Winds, Wildfire, Thunderstorm/Lightning.

Action Item #1: Educating the Public about Various Dangers Associated with Natural Hazards.

This Item is general in nature and addresses all hazards. It is intended to be reoccurring on an annual basis.

1. Comments: People are sometimes injured because of lack of knowledge of the danger of natural hazards.
2. Action: Educate the public about various dangers associated with natural hazards. Education can be accomplished by sponsoring professional programs, school poster contests, essays and other activities through workshops, public meetings, and various support groups (child care, senior citizens centers, public schools, 4-H, etc).
3. Participating Jurisdiction: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $1,000 per year for 5 years.
6. Funding: County budget, grants.

7. Implementation Timeline: 2008-2012.
8. Cost - Benefit Ratio: Potential life saving. Implementation of this item would also have a great impact on not only educating the public and but will provide ideas for future action items. Cost-benefit ratio greater than 1:1.

Action Item #2: Develop a database to gather historical data and future potential dollar losses on Dams, Drought, Expansive Soils, Earthquakes, Extreme Heat, Flood, Hailstorm, Severe Winter Storm, Tornado/High Winds, Wildfire and Thunderstorm/Lightning.

1. Comments: Develop a database to gather historical data and forecast future potential dollar losses in Jefferson County.
2. Action: Work to develop a database that would track each hazardous event and estimate potential dollar loss. The database would include a map showing the location of those at risk residents so that the appropriate action will be achieved to ensure their safety or evacuation if so required.
3. Participating Jurisdiction: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $135,000.
6. Funding: County budget and grants.
7. Implementation Timeline: 12 months.
8. Cost - Benefit Ratio: Good public support. Potential life saving. The use of volunteers could save costs.

HAZARD: Dam Failures.

Action Item #DF 1: Identify vulnerable structures, potentially vulnerable new structures susceptible flooding from dam failures.

1. Comments: There are currently no maps of structures vulnerable to flooding from dam failures.
2. Action: Develop maps of dam inundation zones vulnerable to flooding from dam failures.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $28,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 2008-2010.
8. Cost - Benefit Ratio: The cost-benefit ratio is thought to be 1:1. There is strong public support.

Action Item # DF 2: Provide dam monitoring equipment.

1. Comments: No dam monitoring equipment is in place to give warning of changes that may cause dam failure.
2. Action: Provide dam monitoring equipment in the form of high water sensors and electronic warning devices for residents and vehicular traffic in the floodplain.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $48,600.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 2008-2010.
8. Cost - Benefit Ratio: Benefit to cost ratio thought to be greater than 1:1. Potential life saving item.

HAZARD: Drought.

Action Item # DR 1: Drill Additional Water Wells.

1. Comments: Long periods of drought tax the water supply in Jefferson County.
2. Action: Drill additional water wells ensuring that an adequate water supply is available for residents of Jefferson County.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Conservation District - USDA/NRCS.
5. Estimated Cost: $210,000.
6. Funding Sources: County budget, Water Resources Board, USDA.
7. Implementation Timeline: 2009-2011.
8. Cost - Benefit Ratio: Thought to be of high benefit to cost ratio. Good public support.

Action Item # DR 2: Build Reservoirs.

1. Comments: Expansion of water reserves is required to provide for cattle and farm animals.
2. Action: Build reservoirs to contain rain and runoff water for agricultural use.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County.
5. Estimated Cost: $150,000.
6. Funding Sources: USDA-NRCS, Jefferson County Conservation District.
7. Implementation Timeline: 2009-2011.
8. Cost - Benefit Ratio: 1:1 benefit to cost ratio. Good public support.

HAZARD: Extreme Heat.

Action Item # EH 1: Public Education of Dangers Associated With Extreme Temperature Events.

1. Comments: Many citizens die each year from extreme heat.
2. Action: Work with Jefferson County on developing and implementing a public education campaign informing Citizens of the dangers associated with extreme temperature events such as, heat exhaustion and heat stroke, etc.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Hospital.
5. Estimated Cost: $8,000.
6. Funding Sources: County budget.
7. Implementation Timeline: 2008-2010.
8. Cost Benefit Ratio: Benefits thought to be quite high compared to cost. Great public support.

Action Item # EH 2: Protective Film on windows in all County buildings.

1. Comments: This action item is also listed as Hail Storm Item #3. The protective film will be Low-E, tinted film to lower heat gain in the buildings.
2. Action: Install on all building office space.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $25,000.
6. Funding Sources: County budget, HMG grant.
7. Implementation Timeline: 2009.
8. Cost-Benefit Ratio: Greater than 1:1.

HAZARD: Flooding.

Action Item #F 1: See Action Item 1 General Education for all hazards common to Jefferson County.

Action Item # F 2: Implement flood plain program to insure NFIP compliance.

1. Comments: NFIP participation is necessary to fully participate in the Hazard Mitigation process and provide flood insurance to those in need.
2. Action: Implement program to insure NFIP compliance.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County, Flood Plain Manager.
5. Estimated Cost: $100,000.
6. Funding Sources: County budget, HMG grants.
7. Implementation Timeline: 2008-2013.
8. Cost - Benefit Ratio: Benefits would be high compared to costs.

HAZARD: Hail Storms.

Action Item # HS 1: Building Material Awareness - Insurance Agents, Contractors and Citizens.

1. Comments: Homes and Businesses are damaged by hail storms causing large financial loss to members of the community.
2. Action: Public education - Promote the use of hail resistant shingles and building materials for retrofit or new construction to the public (Insurance agents, Homeowners associations, contractors, and citizens) using brochures and the media.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $5,000.
6. Funding Sources: Grants, Jefferson County budget.
7. Implementation Timeline: 2008-2009.
8. Cost - Benefit Ratio: The benefit to cost thought to be quite high since the mitigation would lower insurance rates. Would affect both new and existing structures.

Action Item # HS 2: Provide new shelters for County owned vehicles to protect from hail damage.

1. Comments: Vehicles parked in uncovered areas are subject to hail damage causing additional expense for repairs.
2. Action: Provide new shelters for County owned vehicles to protect from hail damage.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $600,000.
6. Funding Sources: Jefferson County budget, HMG grants.
7. Implementation Timeline: 2009-2010.
8. Cost - Benefit Ratio: Good benefits to cost ratio. Good support from the public. Good protection of critical infrastructure.

Action Item # HS 3: Protective Film on windows in all County buildings.

1. Comments: Hail storms cause broken windows and flying glass causes bodily injuries.
2. Action: Install Protective Film on windows in all County buildings.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $25,000.
6. Funding Sources: County budget, HMG grant.
7. Implementation Timeline: 2009.
8. Cost - Benefit Ratio: Thought to have favorable benefit-cost ratio.

HAZARD: Thunderstorms/Lightning.

Action Item # L1: Purchase Lightning Prediction Systems for Jefferson County Critical Facilities.

1. Hazard: Lightning.
2. Comments: Lightning causes death, injury and property damage.
3. Action: Provide lightning detection systems for Jefferson County Critical facilities.
4. Participating Jurisdictions: Jefferson County.
5. Lead Agencies; Jefferson County Emergency Management.
6. Estimated Cost: $18,000.
7. Funding Sources: Grants, County budget.
8. Implementation Timeline: 2008-2010.
9. Cost - Benefit Ratio: Thought to have good benefits to cost ratio. There should be strong public support. Potential life saving.

Action Item # L2: Lightning Suppression Systems at Critical Facilities.

1. Comments: Lighting protection and suppression systems protecting radios and other essential equipment at existing and new critical facilities throughout the County.
2. Action: Install lighting protection and suppression systems protecting radios and essential equipment at critical facilities throughout the County.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County emergency management.
5. Estimated Cost: $150,000.
6. Funding Sources: Hazard Mitigation Grand Program, County budget.
7. Implementation Timeline: 2009-2011.
8. Cost - Benefit Ratio: Thought to have benefit to cost ratio greater than 1:1.

HAZARD: Tornado-High Winds.

Action Item # T-HW1: Develop Emergency Operation Plan for Tornadoes.

1. Comments: This plan would reduce the chances of loss of life and lower property damage.
2. Action: Develop emergency operation plan to implement mitigation, response and recovery phases of an event. This plan would reduce the chances of loss of life and lower property damage.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $3,500.
6. Funding: County budget, FEMA Grants.
7. Implementation Timeline: 2008-2009.

8. Cost - Benefit Ratio: The Countywide Emergency Operation Plan is a response and recovery plan mandated to the County. Additional actions for natural hazards would be of great benefit at a low cost.

Action Item # T-HW 2: Educate the public in the benefits of installing residential and commercial storm shelters and safe rooms.

1. Comments: The public must be encouraged to install Safe Rooms to reduce the loss of life.
2. Action: Educate the public through public meetings and through the media.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $500 per year.
6. Funding Sources: County budget and grants.
7. Implementation Timeline: 2009.
8. Cost – Benefit Ratio: Thought to have favorable cost -benefit ratio. Potential life saving measure.

Action Item # T-HW 3: Mobile Communications System.

1. Comments: Storm spotters need a common communications system
2. Action: Obtaining mobile communications equipment for spotters and Emergency Response Teams.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $18,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 2008-2011.
8. Cost - Benefit Ratio: Great public support. Potential life saving.

Action Item # T-HW 4: Installation of NOAA Receivers in Public Facilities.

1. Comments: The public must have timely warnings of severe weather events.
2. Action: Purchase and install NOAA Weather Radio receivers in schools, hospitals, nursing home and other public facilities.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $2,000.
6. Funding Sources: Jefferson County budget, Hazard Mitigation grant program.
7. Implementation Timeline: 2008-2011.
8. Cost - Benefit Ratio: Extremely low cost for the benefit received.

Action Item # T-HW 5: Install residential and commercial storm shelters.

1. Comments: Tornadoes and high winds take lives unless people have adequate protection.
2. Action: 20 new Storm Shelters installed to reduce the loss of life.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $500,000.
6. Funding Sources: County budget and grants.
7. Implementation Timeline: 2009.
8. Cost - Benefit Ratio: Demand from the public will be great. Potential life saving.

Action Item # T-HW 6: Tie-Down – Mobile Homes & Other Structures Education Program.

1. Comments: Mobil homes and other mobile buildings suffer wind damage.
2. Action: Promote the benefits of tie downs to secure existing and future mobile homes and other mobile structures helping reduce damage from high winds or tornados. This action will be implemented through public information meetings and information packets developed, or obtained, by the County Emergency Management.
3. Participating Jurisdiction: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Manager.
5. Estimated Cost: $5,000.
6. Funding Sources: Jefferson County budget- Hazard Mitigation grant.
7. Implementation Timeline: 2010.
8. Cost - Benefit Ratio: Limited audience but very important to participants. Potential life saving.

Action Item # T-HW 7: Educate the public in the benefits of installing residential and commercial storm shelters and safe rooms.

1. Comments: The public must be encouraged to install safe rooms to reduce the loss of life.
2. Action: Educate the public through public meetings, and media outlets.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $2,500.
6. Funding Sources: County budget, Grants.
7. Implementation Timeline: 24 months.
8. Cost – Benefit Ratio: Thought to have favorable cost -benefit ratio. Potential life saving measure.

Action Item # T- HW 8: Review the Jefferson County Severe Weather Response Plan and Warning System on an Annual Basis.

1. Comments: An outdated plan can increase the risk of damage and injury.

2. Action: Reviewing the Jefferson County severe weather plan and warning system will promote readiness and will change with the needs of Jefferson County, as new businesses, and infrastructure are developed.
3. Participating Jurisdiction: Jefferson County.
4. Lead Agency: Jefferson County Emergency Management.
5. Estimated Cost: $500.
6. Funding: County budget and grants.
7. Implementation Timeline: 2009.
8. Cost - Benefit Ratio: Important action for the cost.

HAZARD: Wildfires.

Action Item # WF 1: Purchase of Tanker Fire Trucks – Wildfire Protection.

1. Comments: Wildfires are a serious hazard in Jefferson County.
2. Action: Purchase of two tanker fire trucks to protect structures Jefferson County from wildfires.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Manager.
5. Estimated Cost: $100,000.
6. Funding Sources: Grants - County budget .
7. Implementation Timeline: 2009-2010.
8. Cost Benefit Ratio: Great public support. Potential is high for both property and life saving benefits. Thought to have high benefit-cost ratio.

Action Item # WF 2: Provide Dry Hydrants for Wildfire Protection.

1. Comments: Wildfires are a serious hazard in Jefferson County.
2. Action: Provide 50 Dry Hydrants for Wildfire Protection.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Manager.
5. Estimated Cost: $50,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 2009-2010.
8. Cost - Benefit Review: Public support is high and the cost is low compared to the benefit.

Action Item # WF 3: Implement the Fire Wise program to provide Wildfire Protection by making the public aware of the need for defensible spaces.

1. Comments: Wildfires are a serious hazard in Jefferson County.
2. Action: Create an awareness program to inform the public of the dangers of wild fires and the need to provide defensible spaces around structures.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Manager.
5. Estimated Cost: $50,000.

6. Funding Sources: Grants County budget.
7. Implementation Timeline: 2008-2010.
8. Cost Benefit Review: Good public support. High benefit for the cost.

HAZARD: Winter Storms.

Action Item # WS 1: Purchase and Installation of Generators to Power Critical Facilities.

1. Comments: Ice storms break power lines leaving areas without electricity.
2. Action: Purchase and install generators for critical facilities in Jefferson County such as the Jefferson County Court House, County Barns, rural water districts, sewer systems, public shelters, nursing homes, etc.
3. Participating Jurisdictions: Jefferson County.
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $250,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 2008-2011.
8. Cost - Benefit Ratio: Good public support. Favorable cost-benefit ratio.

Action Item # WS 2: Database and Map of Special Needs Population.

1. Comments: Develop a plan to notify citizens with special needs who may be adversely affected by extreme cold events.
2. Action: Work with senior citizens centers and the public in creating a database of citizens with special needs who may be adversely affected by extreme cold events. The database would include a map showing the location of at risk residents with contact information so their welfare can be verified.
3. Participating Jurisdictions: Jefferson County .
4. Lead Agencies: Jefferson County Emergency Management.
5. Estimated Cost: $135,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 2009.
8. Cost - Benefit Ratio: Good public support. Could reduce costs using volunteers.

4.3. Implementation of Mitigation Actions.

4.3.1. Prioritization.

The Hazard Mitigation Planning Committee and Jefferson County residents prioritized each potential action item as to how to implement them in the best interest of Jefferson County residents. After careful consideration and with consultation from the Jefferson County Commissioners, the mitigation items were given a priority ranking in order to expedite their implementation in the order of effectiveness and cost. Effectiveness of the mitigation item takes into consideration the population served, the probability and intensity of the hazard occurring, and the number of hazards mitigated by the action. Since subjective

rankings are dynamic as public perception changes, these rankings are subject to be modified as items are implemented, the needs of Jefferson County changes, hazards are recognized differently by the public and new technologies dealing with these hazards become available.

The following scales were used for each category:

Cost

Cost was ranked, starting with the value of 1 to indicate the MOST expensive Action Example

1 = Most expensive Action
2 = Next expensive Action
3 = Next…..etc.

Citizens Potentially Served

1 = A few individuals (less than 24%)
2 = A fourth of the County (25%-49%)
3 = Half the County (50%-99%)
4 = Entire County (100%)

Probability of Future Events of Natural Hazard that Requires the Action

1 = Unlikely (1 event per 10 years)
2 = Occasional (1 event per 5 years)
3 = Likely (1 event per 3 years)
4 = Highly likely (1 event per year)

XXXIV Table: Summary of Categories and Scales Used to Determine Priority Ranking of Mitigation Actions by Cost, Benefits and Citizens Served.

The higher the TOTAL, the higher the PRIORITY.

Actions or Projects	Cost	Cost Rank	Citizens Served	Probability of Future Events	# of hazards mitigated	TOTAL	PRIORITY
Educating the public about natural hazards	$5,000	15	4	4	10	33	1
Identify vulnerable dams	$28,000	11	1	0	1	13	15
Provide dam monitors	$48,600	10	1	1	1	13	15
Drill additional water wells	$210,000	4	2	2	1	9	19
Build reservoirs	$150,000	6	2	2	1	11	17
Implement and support flood plain board	$100,000	8	1	4	1	14	14
Provide protective storage for County equipment	$600,000	1	4	4	3	12	16
Increase public awareness of concepts such as “survivable space” and “fire wise”	$ 50,000	9	4	4	1	18	10
Provide generators needed to power water pumps, sewage systems and	$250,000	3	4	4	3	14	14

emergency communications							
Installation of NOAA Weather Radios in critical facilities	$2,000	18	1	4	4	27	3
Building material awareness	$5,000	15	2	4	1	22	8
Lightning detectors	$18,000	3	1	4	1	10	9
Lightning suppression	$150,000	6	4	4	1	15	13
Develop EOP for tornadoes	$3,500	16	4	4	1	25	5
Storm shelter education	$2,500	17	4	4	1	26	4
Storm spotter communication system	$18,000	13	4	4	2	23	7
Storm shelters	$500,000	2	2	4	2	10	18
Mobile home tie-down - education program	$5,000	15	1	4	2	22	8
Review weather response plan	$500	19	4	4	4	31	2
Purchase of fire trucks	$100.000	8	3	4	1	16	12
Install dry hydrants	$50,000	9	3	4	1	17	11
Database of special needs population (Winter Storm)	$135,000	7	4	4	1	16	12
Protective film on windows	$25,000	12	1	4	1	18	10
Public education on extreme heat	$8,000	18	4	4	1	27	6
Develop Database to track Hazards and Potential Dollar Loss	$135,000	7	4	4	10	25	5

4.3.2. Implementation and Administration.

Following the prioritization of the hazard actions and projects, the committee then determined possible sources of funding and finally initialized an implementation schedule.

XXXV Table: Summary of Selected Actions and Their Priority Ranking.

Actions or Projects	Cost	Funding Sources	Who will Implement Action	Schedule	PRIORITY
Educating the public about natural hazards	$5,000	County Funds	County DEM	2008-2012	1
Review weather response plan	$500	County Funds	County DEM	2009	2
Storm shelter education	$500	County Funds	County DEM	2008	4
Installation of NOAA Weather Radios in critical facilities	$2,000	County	County DEM	2008-2011	3
Develop EOP for Tornadoes	$3,500	County Funds	County DEM	2008-2009	5
Storm spotter communication system	$18,000	County	County Funds Grants	2008-2011	7
Public education on	$8,000	County Funds	County DEM	2008-2010	6

extreme heat			Jefferson Co. Hospital		
Building material awareness	$5,000	County Funds Grants	County DEM	2008-2009	8
Mobile home tie-down - education program	$5,000	County Funds HMG	County DEM	2010	8
Lightning detectors	$18,000	Grants County Funds	County DEM	2008-2010	9
Increase public awareness of concepts such as "survivable space" and "fire wise"	$50,000	County Funds Grants	County DEM	2008-2010	10
Protective Film on Windows	$25,000	County Funds HGM	County DEM	2009	10
Install dry hydrants	$50,000	County DEM Conservation Districts Rural Fire Dept.	County DEM	2009-2010	11
Database of special needs population (Winter Storm)	$135,000	County Funds	County DEM	2009	12
Purchase of fire trucks	$100,000	County Funds Ok. State Dept. of Agri.	County DEM Rural Fire Depts.	2009-2010	12
Lightning suppression	$150,000	HMGP County Funds	County DEM	2009-2011	13
Provide generators needed to power water pumps, sewage systems and emergency communications	$250,000	County Funds Grants	County Commissioners	2008-2011	14
Implement flood plain board- NFIP compliance	$100,000	County Funds HMG Grants	County DEM	2008-2013	14
Identify vulnerable dams	$28,000	County Funds	County DEM Conservation Districts	2008-2010	15
Provide dam monitors	$48,600	County Funds Oklahoma Water Resources Board	County DEM Conservation Districts	2008-2010	15
Build reservoirs	$150,000	County Funds USDA-NRCS-Conservation Districts	County DEM	2009-2011	17
Provide protective storage for County equipment	$600,000	County Funds HMG Grants	County Commissioners	2009-2010	16
Drill additional water wells	$210,000	County Funds Grants	County DEM Conservation Districts	2009-2011	19
Storm shelters	$500,000	County Funds	County DEM	2009	18
Storm Shelter Education	$2,500	County Funds	County DEM	24 months	4
Develop Database to Track Hazards and Potential Dollar Loss	$135,000	County Funds	County DEM	12 Mos.	5

CHAPTER FIVE - PLAN MAINTENANCE PROCESS.

The plan maintenance section of this document describes the formal process that will insure that the Jefferson County Natural Hazard Mitigation Plan remains an active and relevant document with continued public participation. The plan maintenance process includes annual evaluations and revisions or updates, as needed by Jefferson County. The plan will be resubmitted for State and Federal review every five years. Jefferson County's Department of Emergency Management, along with the Hazard Mitigation Planning Committee, will be responsible for evaluating and updating the plan. Plan updates or revisions will be submitted to the Jefferson County Board of Commissioners for adoption.

5.1. Plan Monitoring.

The Jefferson County Emergency Management Director will be responsible for monitoring the plan. A monitoring report will be written and submitted to the Jefferson County Commissioners on a yearly basis. The Commissioners may request a quarterly report following a period of rapid growth or other unexpected event.

The Emergency Management director will perform any necessary site visits on a monthly basis. The Emergency Management director will also be the lead contact for phone calls and scheduling meetings.

The Natural Hazard Mitigation Plan will be kept on record in the County Clerk's Office housed inside the Jefferson County Courthouse in Waurika, OK. The County Commissioners will house the official plan at the Jefferson County Courthouse. Any interested party may request a copy of the plan via County Clerk or the Emergency Management director.

The Jefferson County Hazard Mitigation Committee has identified hazard mitigation projects to be included in the Hazard Mitigation Plan. The Jefferson County Emergency Planning Committee will work with the public and local elected officials to evaluate potential projects. Each project will be judged and ranked according to Jefferson County priorities and impact. When necessary, the Committee will also look at past occurrences and historical trends to aid in assigning priority.

5.2. Plan Evaluating.

The Jefferson County Emergency Management director and the County's Hazard Mitigation Planning Committee will evaluate the Natural Hazard Mitigation Plan every year to determine the effectiveness and/or progress of mitigation actions and the implementation of other actions.

Plan evaluation should address the following questions

1. Do actions address current and expected hazardous conditions?
2. Has the nature or magnitude of risks changed?

3. Are the current resources appropriate for implementing mitigation actions?
4. Are there any implementation problems, such as technical, political legal, or coordination issues with other agencies?
5. Did outcome of mitigation actions occur as expected?

The Committee and Emergency Management director will have three months, from the date of the evaluation meeting, to update the plan with any changes needed. Jefferson County will resubmit the plan for State and Federal review every five years.

The Jefferson County Commissioners, Emergency Management director and the Hazard Mitigation Committee will evaluate the Natural Hazard Mitigation Plan every year to determine the effectiveness and/or progress of mitigation actions and the implementation of other actions.

Items covered during the evaluation process should include:

1. Evaluate magnitude of risk and determine if it has changed.
2. Evaluate current resources and determine if they are appropriate for implementing mitigation actions.
3. Determine if there were any implementation problems, such as technical, political, legal, or coordination issued with other agencies.
3. Evaluate how other agencies and partners have participated.
4. Evaluate mitigation actions and determine if outcome occurred as expected.
    a. Was the intended purpose of the original mitigation action met?
    b. Was the mitigation action met in the proposed timeline?
    c. Did the listed agencies participate in the mitigation action?
    d. Did mitigation action stay within proposed budget?

The evaluation process assesses goals, objectives and current/expected conditions; change in the nature or magnitude of risks; current resources for implementation; mitigation action item outcomes; and whether agencies and other partners participated as originally proposed.

5.3. Plan Updating.

The plan will continue to be evaluated and updated annually during the five-year cycle process and anytime there is a disaster. Beginning on the fourth year, the Jefferson County Commissioners, Emergency Management director and the Hazard Mitigation Committee will make all plan revisions to be finalized and be approved by FEMA before the end of the fifth year so that the jurisdiction will maintain eligibility. The plan will be resubmitted for State and Federal review every five years.

5.4. Incorporation into Existing Planning Mechanisms.

Jefferson County will establish resolutions to incorporate the hazard mitigation plan into all other Jefferson County planning mechanisms. The resolutions will require each plan manager to contact the Hazard Mitigation officer on an annual basis to incorporate the changes and additions of other plans they administer into the Hazard Mitigation Plan.

The town will have all divisions of Jefferson County government implement the hazard mitigation plan into any future projects. Jefferson County will continue to work closely with the Jefferson County Conservation District in the areas of flood plain management, drought and rural fire protection.

Jefferson County currently utilizes the Emergency Operations Plan to guide recovery in the County. After Jefferson County officially adopts the Hazard Mitigation Plan, these existing mechanisms will have hazard mitigation strategies integrated into them.

Jefferson County currently utilizes capital improvement planning to guide development in the County. After Jefferson County officially adopts the Hazard Mitigation Plan, these existing mechanisms, which are updated annually, will have hazard mitigation strategies integrated into them.

After adoption of the Mitigation Plan, Jefferson County will suggest that local municipalities address natural hazards in their respective planning processes. Specifically, one of the goals in the Mitigation Plan directs Jefferson County and local governments to protect life and property from natural disasters and hazards. The County Commissioners will conduct periodic review of Jefferson County's amendments, and provide technical assistance to other local municipalities in implementing these requirements.

Any capital improvement planning that occurs in the future will also contribute to the goals in the Hazard Mitigation Plan. The respective Emergency Management director will work with the capital improvement planners to secure high-hazard areas for low risk uses.

Incorporating goals of other planning activities into the Hazard Mitigation Plan will occur as each of these plans is updated.

The Jefferson County Conservation District has a long-range plan that is updated annually and specifically address drought, flood protection and other natural resources. These local units of governments have been and will continue to be active advisors to the Hazard Mitigation Planning Committee.

Within six months of the formal adoption of the Mitigation Plan, the policies listed above will be incorporated into the process of existing planning mechanisms.

5.5. Continued Public Participation.

While the Hazard Mitigation Planning Committee represents the public to some extent, the public will be able to directly comment on and provide feedback about the plan. Jefferson County is dedicated to generating public interest in the updates of the Jefferson County Hazard Mitigation Plan. Efforts to do so may include:

1. Distributing information about the existence and purpose of the Hazard Mitigation Plan to community groups, units of County government, and other public gatherings.

2. Questionnaires periodically being made available to the public to collect information on what mitigation activities the citizens would like to see implemented.

3. Posting information about the Hazard Mitigation Plan on the ASCOG web page, along with an email address for questions and input.

Meeting notices will be posted in accordance with the policies for open meetings at the Jefferson County Court House, located in Waurika. An ad in the local newspapers (official legal notice) will inform the public about the meetings. These meetings will provide the public a forum where residents can express their concerns, opinions or ideas about the plan. Citizen's comments and concerns will be discussed at the annual evaluation to determine if changes to the plan need to be made.

Listed below is the address and phone number of the Jefferson County Emergency Management Director who is responsible for keeping track of public comments on the plan. Copies of the plan will be kept at the County Department of Emergency Management and at the Jefferson County Clerk's office where the public can review the plan. The public will also be invited to, and included in, the Hazard Mitigation Planning Committee's annual evaluation of the plan. This meeting will provide the public with a forum for which they can express their concerns, opinions or ideas about the plan.

Jefferson County DEM
Jefferson County Courthouse
Waurika, OK

(580) 313-0965

APPENDIX

Public Participation

NOTICE
Hazard Mitigation Meeting

The public is invited to a meeting at the Waurika City Commissioners Room at Waurika City Hall at 9:00 A.M. on Tuesday July 23, 2002.
This meeting is for public input on a County-wide Hazard Mitigation plan to be developed by the Jefferson County Commissioners.
Discussion items will include floods, wildfires, tornados and other natural hazards that affect Jefferson County.

Natural Hazard Mitigation Meeting
Jefferson County Courthouse
Waurika, Oklahoma

9:00 A.M. July 23, 2002

Kenny Wall, County Commissioner, opened the meeting by introduction of attendees and stating the purpose of the meeting was to identify those hazards likely to affect Jefferson County.

Attendees:

Kenny Wall	County Commissioner
Jack Tipton	County Commissioner
John Dale	County Commissioner
Doris Pilgreen	County Clerk
Gloria English	County Commissioner Secretary
Steve Goza	Emergency Management Director
Evelyn Randolph	Citizen
Brad Scott	Citizen
Jim Holland	ASCOG
Stan Rice	ASCOG

Meeting was turned over to Jim Holland and Stan Rice from ASCOG.

A general list of common hazards and their effect on the County was handed to all present. Discussions centered on the common natural hazards and the County's vulnerability to those hazards. The upcoming public meeting was discussed. All agreed a working group consisting of Steve Goza, Brad Scott, John Dale and Evelyn Randolph be appointed to oversee the plan development. Steve Goza was appointed Chair.

10:00 A.M. Meeting adjourned

Hon. Mayor, Fire Chief------
City/Town of ----

Re: Natural Hazard Mitigation Planning – 1 p.m., Wednesday, Feb.7, '03

Dear

A working meeting to further develop the County-wide natural hazard mitigation plan will be held at 1 p.m., Wednesday, Feb. 7th in Waurika City Hall (City Commissioners Chambers). (We hope to be finished by 3 p.m.)

Several weeks ago, ASCOG staff and County and community representatives met and developed a list of hazards that might affect the Cotton County area. Since that meeting, ASCOG staff have been assessing those identified hazards and their potential impact on the County.

The next step in the process is for County and community representatives to consider the vulnerability in terms of persons, buildings, infrastructure and critical facilities in hazard areas and to estimate potential dollar loss to vulnerable structures.

From that data the group will develop mitigation goals and identify action items necessary to reduce the effects of the hazards.

Your evaluation of the identified hazards and participation in analyzing vulnerability and developing mitigation goals and action

items is essential. If you or a representative will be unable to attend, please call me, Jim Holland or Stan Rice at ASCOG.

See you at the meeting.

Sincerely,

Blaine H. Smith, Jr.
Executive Director

Natural Hazard Mitigation Meeting
City of Waurika Commissioners Room
Waurika, Oklahoma

9:00 A.M. Feb. 7, 2003

Steve Goza, Emergency Operations Manager opened the meeting by introduction of attendees and stating the purpose of the meeting.
Attendees: Steve Goza, E.M. Director, John Dale, County Commissioner, Evelyn Randolph, Citizen, Roy Bartling, Citizen, Brad Scott, Citizen, Gloria English, County Commissioner Secretary, Margaret Walters, Cotton County Commissioner Secretary, Ken Ferreira, Waurika City Manager, Toni Hopper, Waurika News-Democrat, Mike Moore, Citizen, Bill Southard, Citizen, Doris Pilgreen, County Clerk, and Stan Rice, Jim VanZant, Rodney Love, Jim Holland from ASCOG.

A list of previously identified hazards was handed to each participant. The group was asked to add or discuss elimination of each hazard on the list.

Meeting was turned over to Jim Holland and Stan Rice.

Previously identified natural hazards and the vulnerability to those hazards were reviewed.
Each participant was asked to complete a worksheet personally ranking the hazards and the County's vulnerability to each hazard. After much discussion the group was given the assignment of developing action items for the working group and commissioner's consideration.

12:00 Meeting adjourned

PUBLIC NOTICE
HAZARD MITIGATION MEETING
December 29, 2003

The public is invited to a public participation meeting at the Jefferson County Courthouse.
The meeting is scheduled to start at 10:30 A.M., or immediately following the regularly scheduled County Commissioners meeting.
The purpose is to discuss potential mitigation projects to be included in the Jefferson County Hazard Mitigation plan.

12/29/03
Jefferson County Commissioner's meeting room
Waurika, Ok.
10:30 A.M.

The Meeting was called to order by Jack Tipton.
Attendees: John Dale, County Commissioner, Kenny Wall, County Commissioner, Gloria English, County Commissioner Secretary, Doris Pilgreen, County Clerk, Steve Goza, Emergency Management Director, Stan Rice and Jim Holland, ASCOG.

A list of previously developed action items were presented for discussion. A ranking system, with weights for goal, cost-benefit, the number of people affected, and likelihood of occurrence was tabulated. Action items were then prioritized. Potential funding sources were also discussed.

11:30 A.M. meeting adjourned

For Immediate Release

Brenda Biffle
Public Information Director
O: 800-658-1466
H: 580-252-3362

A draft copy of the Jefferson County Natural Hazard Mitigation Plan is available for public review at the County Commissioner's office located in the Jefferson County Courthouse. The plan identifies natural hazards that threaten your community such as floods, tornadoes, high winds, ice storms, and wildfires.

Public input is encouraged in the planning process and is especially valued in formulating the action steps necessary to lessen the effect of hazards. The local mitigation plan represents community commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of hazards. For more information, contact your local County Commissioner's office.

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