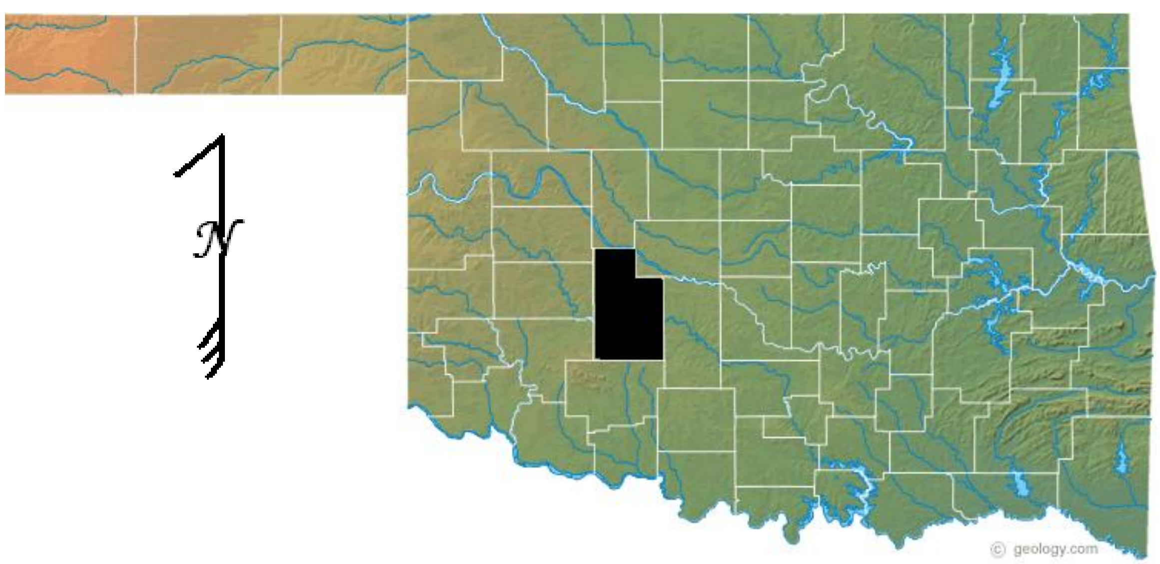
Natural Hazard Mitigation Plan Caddo County, Oklahoma



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CHAPTER ONE - THE PLANNING PROCESS.

1.1. Introduction.

Floods, tornadoes, winterstorms, 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 Caddo County. Incorporated areas are not included within the scope of this plan. It should also be noted that Indian Tribes have lands located within the County and, as separate sovereign entities, are treated like municipalities and are not included in this plan. Caddo County has a completed Capital Improvement Plan and an Emergency Operating Plan. Each of the three conservation districts in Caddo County develops a long term plan in conjunction with the USDA-Natural Resources Conservation Service. These plans were reviewed and where appropriate used in the Caddo County Natural Hazard Mitigation Plan. No other plans, studies or reports were available at the County level and therefore were not included in this plan. This Caddo 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.

Initially this plan was adopted by resolution by the Caddo County Commissioners at their meeting on October 14, 2003. A revised plan was adopted on 01-08-07.

The plan will be reviewed and revised within a five-year cycle with the possibility of updating it into a multi-jurisdictional plan should Caddo 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.

Board of County Commissioners

CADDO COUNTY COURTHOUSE

Post Office Box 1427 • Anadarko, Oklahoma 73005
Telephone: 405/247-3105

BENNY BOWLING District I LOOKEBA BARN 405/457-6373	CRAIG GIBSON District II ANADARKO BARN 405/247-5321	CARLOS SQUIRES District III CARNEGIE BARN 580/654-2294

RESOLUTION

WHEREAS, on this 24th day of September, 2007 the Board of County Commissioners of Caddo County met in regular session with the following members present: Carlos Squires, (Chairman), Craig Gibson, (Member), Benny Bowling (Member) and Patrice Dolch, County Clerk.

MOTION was made by Craig Gibson and seconded by Benny Bowling that the approved Natural Hazard Mitigation Plan for Caddo County, Oklahoma be adopted.

Dated this 24th day of September, 2007.

PATRICE DOLCH
CADDO COUNTY CLERK

BOARD OF COUNTY COMMISSIONERS
CADDO COUNTY, OKLAHOMA

CHAIRMAN

MEMBER

MEMBER

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 assembled by the Association of South Central Oklahoma Governments (ASCOG), through a contract with the Caddo 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.

1. An assessment of the hazards apparent to the 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 jurisdiction's 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.
1. 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.

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 Caddo 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 Caddo County. Caddo County hopes to lessen its vulnerability to disasters caused by natural hazards. The plan is intended to serve as a guide for Caddo County in coordinating and implementing hazard mitigation policies, programs and projects.

1.3.3. The intent of the Caddo County mitigation planning process: Through this planning process, Caddo County hopes to achieve the following:

1. Reduce any repetitive losses from natural hazards in Caddo County.

2. Facilitate responsible development in Caddo 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 Dale Clear (Caddo County safety director).

The Planning Committee was composed of County residents that serve as volunteers in local organizations. Professions include military, registered nurse, farmer-rancher, law enforcement officer, firefighter and emergency medical technician.

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 Caddo 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 Caddo 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: Caddo County Hazard Mitigation Planning Committee Members.

Name	Representing	Tasks
Dale Clear – Caddo County Safety Director	Caddo County	• HMGP Chairman • provided information on Caddo 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 his tasked area
Charles Kendrick Citizen &– Retired Fire Fighter	Crows Roost VFD	• provided Information on Crows Roost VFD and Ft. Cobb Lake Area • 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
Jarrett McRee – Rancher –Citizen – Cogar VFD	Cogar Area	• provided information on Cogar area of Northern Caddo 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
Wayne Spies – Farmer, Rancher - West Caddo Conservation District	Western Caddo County – Conservation Districts	• provided information on Caddo 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
Dale Lasley – Caddo County Flood Plain Manager	Caddo County Flood Plain Board	• provided information on Caddo County Flood Plain Program • 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
John Lyles – Cyril Fire Department – Emergency Management Services	Southern Caddo County - Rural-Urban Interface	• provided information on fire and emergency response • reviewed draft plan • contributed to plan revisions
Stan Rice – Association of South Central Oklahoma Governments (ASCOG) Environmental Services Jim Holland – ASCOG Rural Fire Coordinator	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 Caddo 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 County Commissioner's office. This offer was made public through newspaper articles and area wide newsletters. In the County Commissioners' office a form summarizing the natural hazard threats in Caddo 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. The 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.

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. Caddo County's contractor, ASCOG, contacted them to collect information on the hazards and determine how their programs could best support the 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 County Commissioners' office. This offer was made to neighboring communities thru 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 Area Agency on Aging

County:

1. Caddo County Commissioners
2. North Caddo Conservation District
3. South Caddo Conservation District
4. West Caddo Conservation District

5. Caddo County Health Department
6. Caddo County Rural Fire Departments
7. Caddo County Police Departments and Sheriff
8. Caddo Rural Electric Cooperative
9. Fort Cobb Master Conservancy District
10. Caddo-Kiowa Technology Center
11. Oklahoma State University - Extension Service

Other Communities:
All Caddo County communities were invited to participate in the planning process for the unincorporated areas.

1. Anadarko
2. Apache
3. Bridgeport
4. Carnegie
5. Cement
6. Cyril
7. Eakly
8. Fort Cobb
9. Gracemont
10. Hinton
11. Hydro
12. Lookeba

A draft of the plan was prepared, reviewed and edited by the 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 Caddo County Hazard Mitigation Plan.

Capital Improvement Plan:
Caddo County has a CIP. All physical property and transportation units are listed. Roads and bridges are classified as to needs and repair schedule. This information was used to support action items.

Emergency Operations Plan:
Caddo 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:
Caddo County does not currently have a permitting system in the rural areas except for flood plain permits.

NFIP:
Caddo County participates in the National Flood Insurance Program. (The Caddo County Flood Plain Manager is located with the West Caddo Conservation District.) This was used to locate flood plain areas.

Conservation Districts:
Three Conservation Districts in Caddo County have long-range plans that specifically address drought, flood protection and other natural resources. This information was used in the Caddo County Hazard Mitigation Plan, especially for flooding, drought and rural fires. A member of the West Caddo Conservation District Board serves on the HMP Planning Committee.

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 the County. Next is to list the 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 Caddo County's hazard mitigation meetings, was used to prepare profiles, which assess each of the natural hazards capable of occurring within the 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 the County.

Details of each natural hazard and its impact on the 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-recollections • 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

	• Review NCDC database • Input from County • Public Input	• Heat affects people, animals and crops
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 & 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 the 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 Caddo 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 the 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: Caddo County has had 94 tornadoes recorded in the last 53 years. 94 / 53 = 1.77 average per year, which would make tornadoes "Highly Likely" to occur within the County.

6. Vulnerability.
Vulnerability describes how exposed or susceptible to damage the 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 the County.

8. Overall Summary of Vulnerability and Impacts.
This section summarizes the vulnerability of the 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.

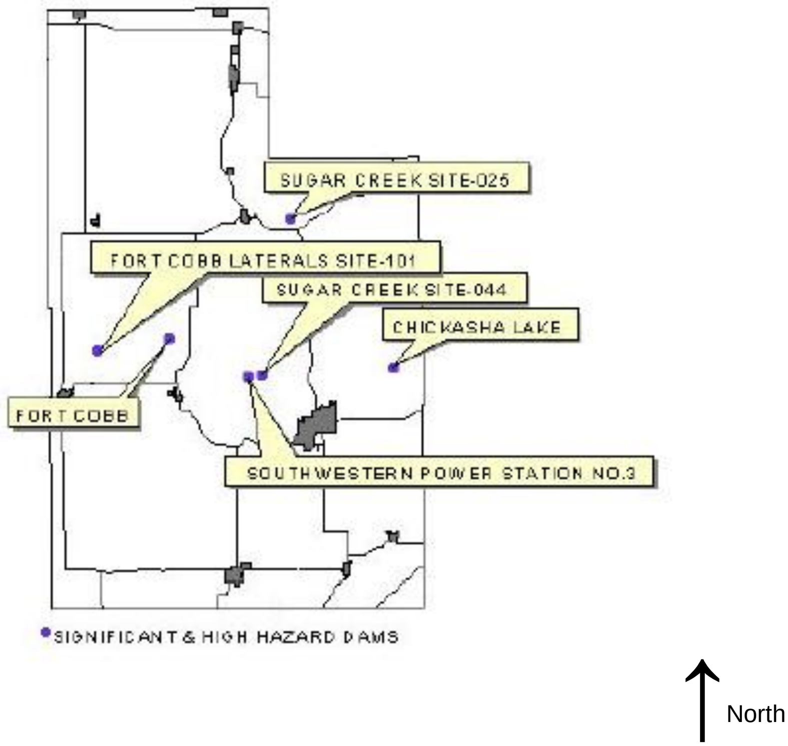
2.3.2. Location.

Six dams exist in Caddo County with an elevated risk designation. Three of the dams are identified as HIGH risk.

IV Table: Caddo County Dams.

DAM NAME	OWNER	RIVER	NEAREST CITY	HAZARD LEVEL
Chickasha Lake	City of Chickasha	Spring Creek	Verden	HIGH
Fort Cobb Lake	Bureau of Reclamation	Cobb Creek	Fort Cobb	HIGH
Southwestern Power Station No#3	Public Service Co. of Oklahoma	Leaper Creek	Anadarko	HIGH
Ft Cobb Laterals Site 101	West Caddo Conservation District	Tributary of Washita River	Carnegie	Significant
Sugar Creek Site- 25	South Caddo Conservation District	Kohnoosky Creek	Binger	Significant
Sugar Creek Site - 44	South Caddo Conservation District	Lost Creek	Anadarko	Significant

V. Figure: Location of Caddo County Dams.



2.3.3. Extent.

Dam failures have not occurred in any years between 1954 and 2003. Damages to personal property are estimated at $0.00.

Three dams in Caddo County are designated as high risk. These dams are 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)

Ft. Cobb Dam is a Federal Bureau of Reclamation structure and is under the federal guidelines for safety.

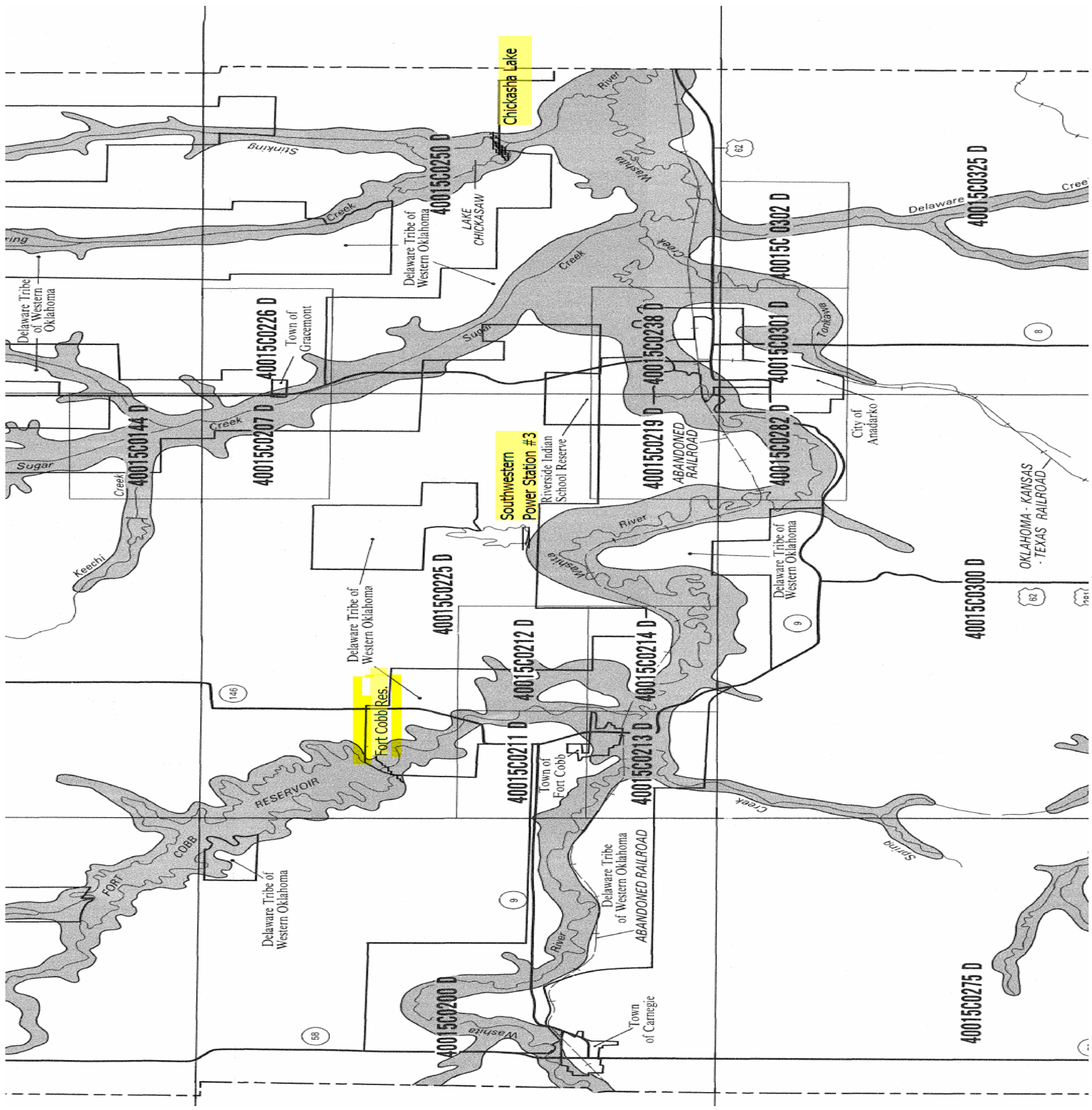
The OWRB coordinates the Oklahoma Dam Safety Program to ensure the safety of the three dams in Caddo County, especially those that could impact downstream life and property.

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

Because many of these dams are old structures and, 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.

VI. Figure: High Hazard Dams.

Map from FEMA-Flood Insurance Rate Map, Caddo County Oklahoma Map depicts high hazard dams and areas of possible flooding in the event of dam failure.



2.3.4. Previous Occurrences.

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

2.3.5. Probability of Future Events.

Since no dam breaks have occurred within the 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 Caddo County. Only three dams in Caddo County are 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 dams, the Corps of Engineers has not conducted such analysis.

The vulnerability of a dam failure in Caddo County would be to the roads, bridges and utilities that are down stream 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 busses, 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 the County. However, the County is responsible for the roads, bridges in the area and also the safety of its citizens.

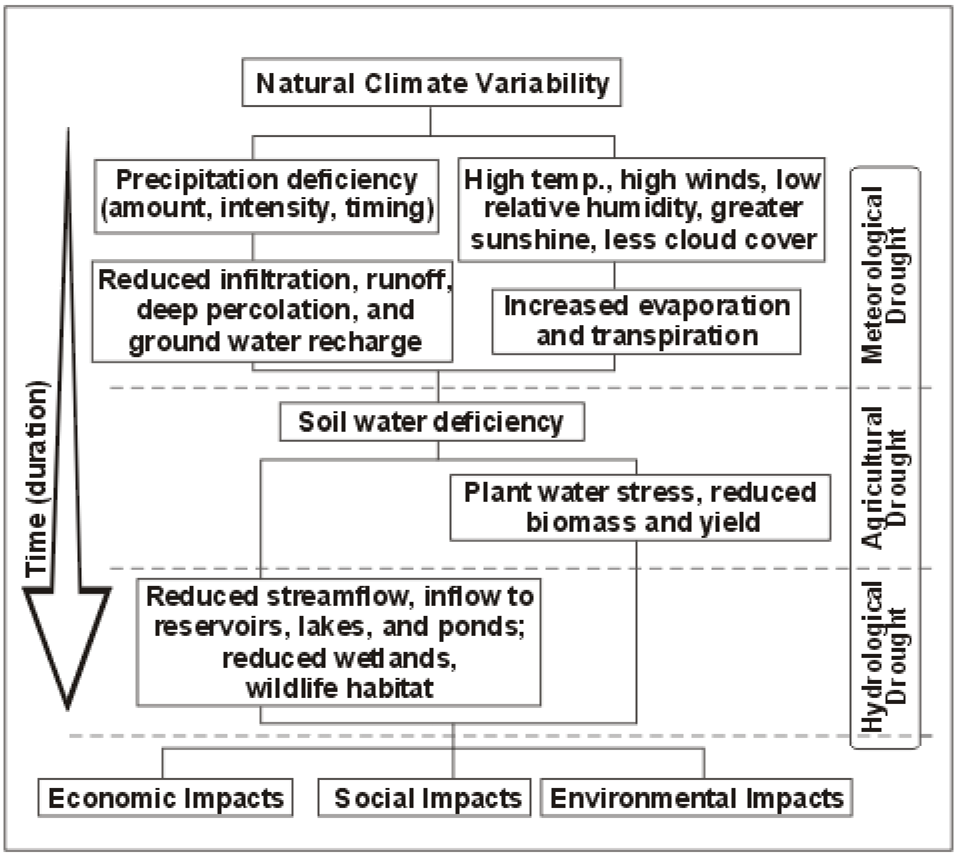
2.4. HAZARD PROFILE-DROUGHT.

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.

VII. Figure: Diagram of Drought.



2.4.2. Location.
All areas of Caddo 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 Oklahoma 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 affect 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.

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.

VIII. Figure: PDSI Classifications.

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. Caddo County had two additional events recorded by the National Climatic Data Center (NCDC) the summers of 2000 and 2001, which were extended periods of high temperatures and low rainfall.

IX. Figure: Drought Events.

12 DROUGHT event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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
				TOTALS:	0	4	31.700M	558.090M

2.4.5. Probability of Future Events.

Given that six drought events have occurred in Oklahoma over the past 50 years and that nine notable droughts occurred nationwide in the 20th century, one may conclude that Caddo 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 Caddo County, the risk for drought is highly likely, with 36.5 of the last 72 years classified as drought.

2.4.6. Vulnerability.

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

2.5.3. Extent.

Caddo 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.

X. 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.

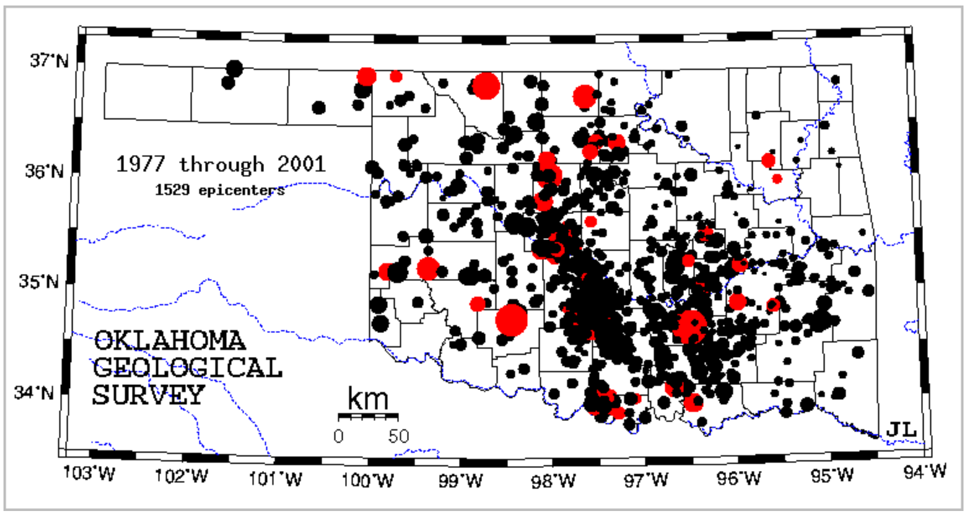
Masonry A: Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

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

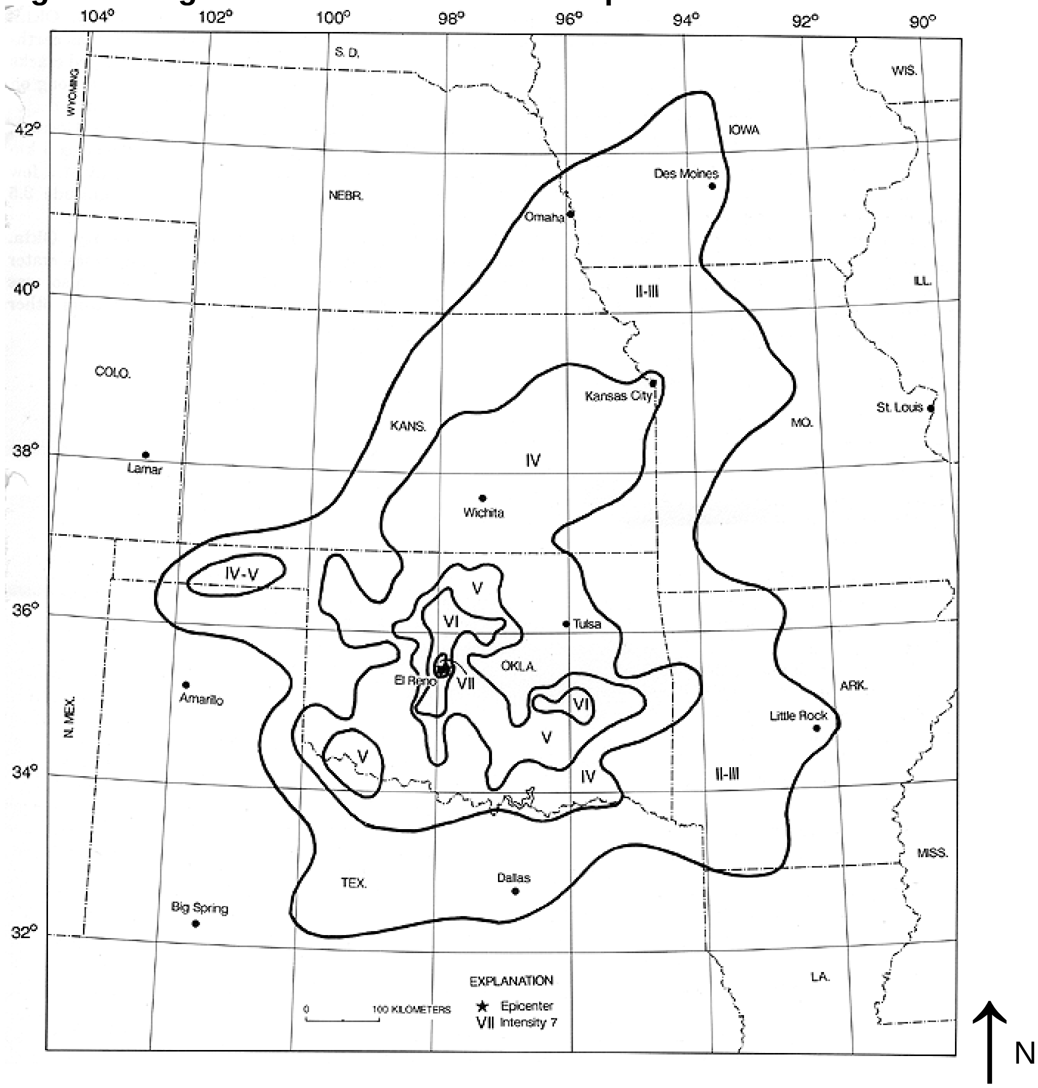
2.5.4. Previous Occurrences.

Earthquakes centered within Caddo 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 Caddo 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.

XI. Figure: Seismographic History of Oklahoma 1977 – 2001.



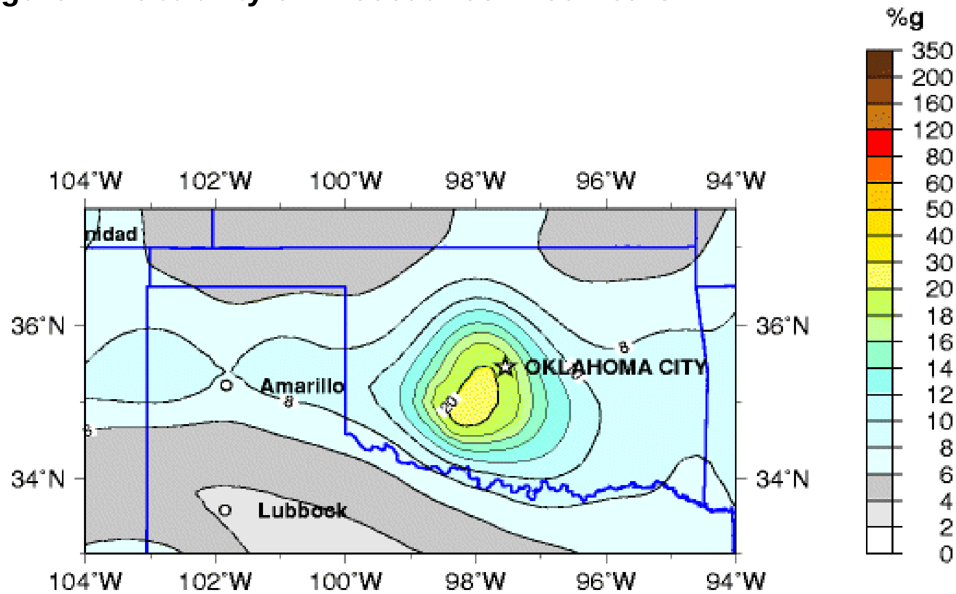
XII. Figure: Diagram of 1952 El Reno Earthquake.



2.5.5. Probability of Future Events.

The 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 the 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 the county is low.

XIII. 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.

Caddo 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 death or injury. Most earthquake-related injuries result from collapsing walls, 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 Caddo 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 the 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 the county.

2.6. HAZARD PROFILE – EXPANSIVE SOILS.

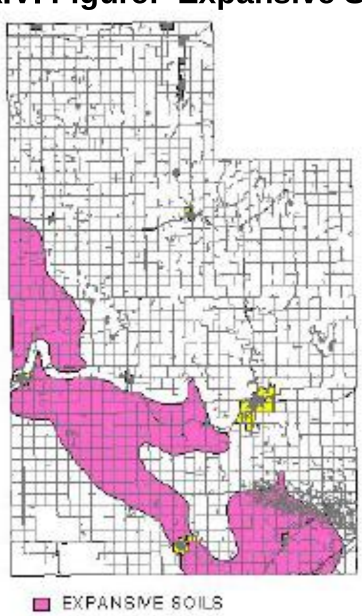
2.6.1. Description.

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 Caddo County have shale as the parent material and are generally south and west of a line from Eakly to Cement, but not including a 15 mile wide and tall triangle in the southwestern corner of the county. The expansive soil area amounts to about 16% of the county.

XIV. Figure: Expansive Soils.



North

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 to 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 the County and many roads are gravel. Approximately 15% of Caddo County is in some way affected by expansive soils.

2.6.4. Previous Occurrences.

Since this hazard develops gradually and seldom presents a threat to life, problems may not be recognized as being related to expansive soils or may be considered only nuisances and therefore never repaired or reported. No records of specific incidences of structure loss due to expansive soils in Caddo 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.

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 soil losses have been recorded in Caddo 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 the 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 10 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.

2.7.3. Extent.

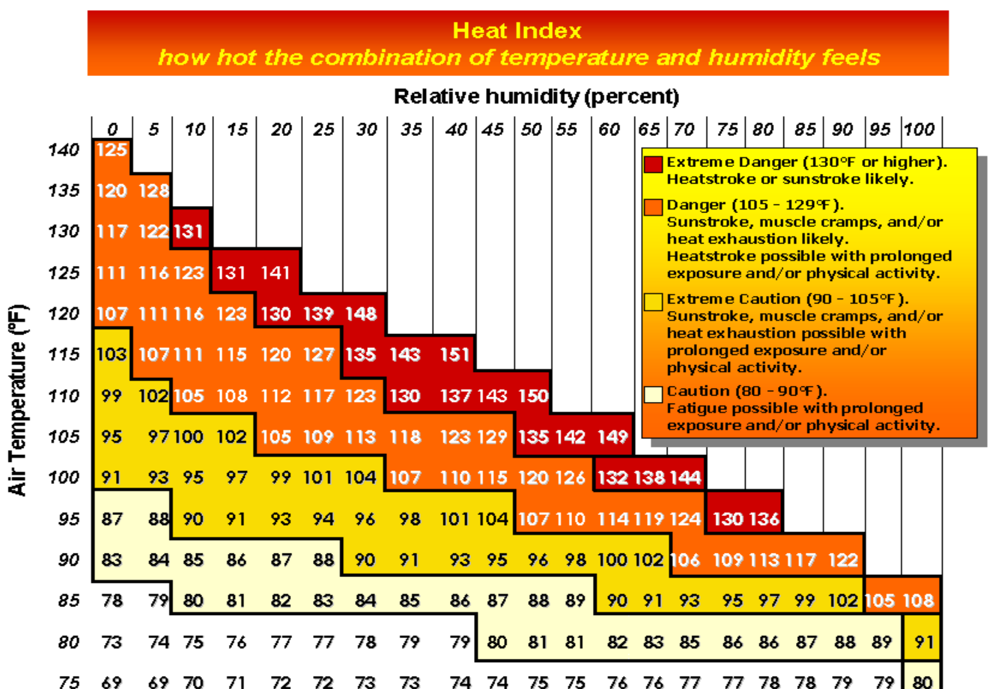
The severity of the extreme heat is dependent on a combination of temperature and humidity. High temperatures, when combined with high humidity can put an area in the “extreme danger” category on the National Weather Service Heat Index scale. When extreme heat is combined with drought, results can include 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.

XV. Figure: Heat Index.



Copyright 2000, Oklahoma Climatological Survey.

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.

XVI. Figure: Extreme Temperature Events.

6 TEMPERATURE EXTREMES event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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>053	01/18/1996	02:00 AM	Extreme Cold	N/A	2	0	0	0
3 OKZ004>053	02/01/1996	12:00 AM	Extreme Cold	N/A	0	0	0	0
4 OKZ004>048 - 050>052	07/04/2001	12:00 AM	Excessive Heat	N/A	8	0	0	0
5 OKZ004>048 - 050>052	07/16/2006	12:00 PM	Heat	N/A	10	100	0	0
6 OKZ004>048 - 050>052	08/01/2006	12:00 AM	Heat	N/A	8	0	10K	0
				TOTALS:	28	100	10K	0

2.7.5. Probability of Future Events.

According to the Oklahoma Climatological Survey, Caddo County averages 18 days per year of daytime high temperatures greater than 100° F. Therefore extreme temperatures are highly likely to occur within the County.

2.7.6. Vulnerability.

In Caddo 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.

Caddo 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 the county for additional road and bridge repairs.

2.8. HAZARD PROFILE – FLOOD.

2.8.1. Description.

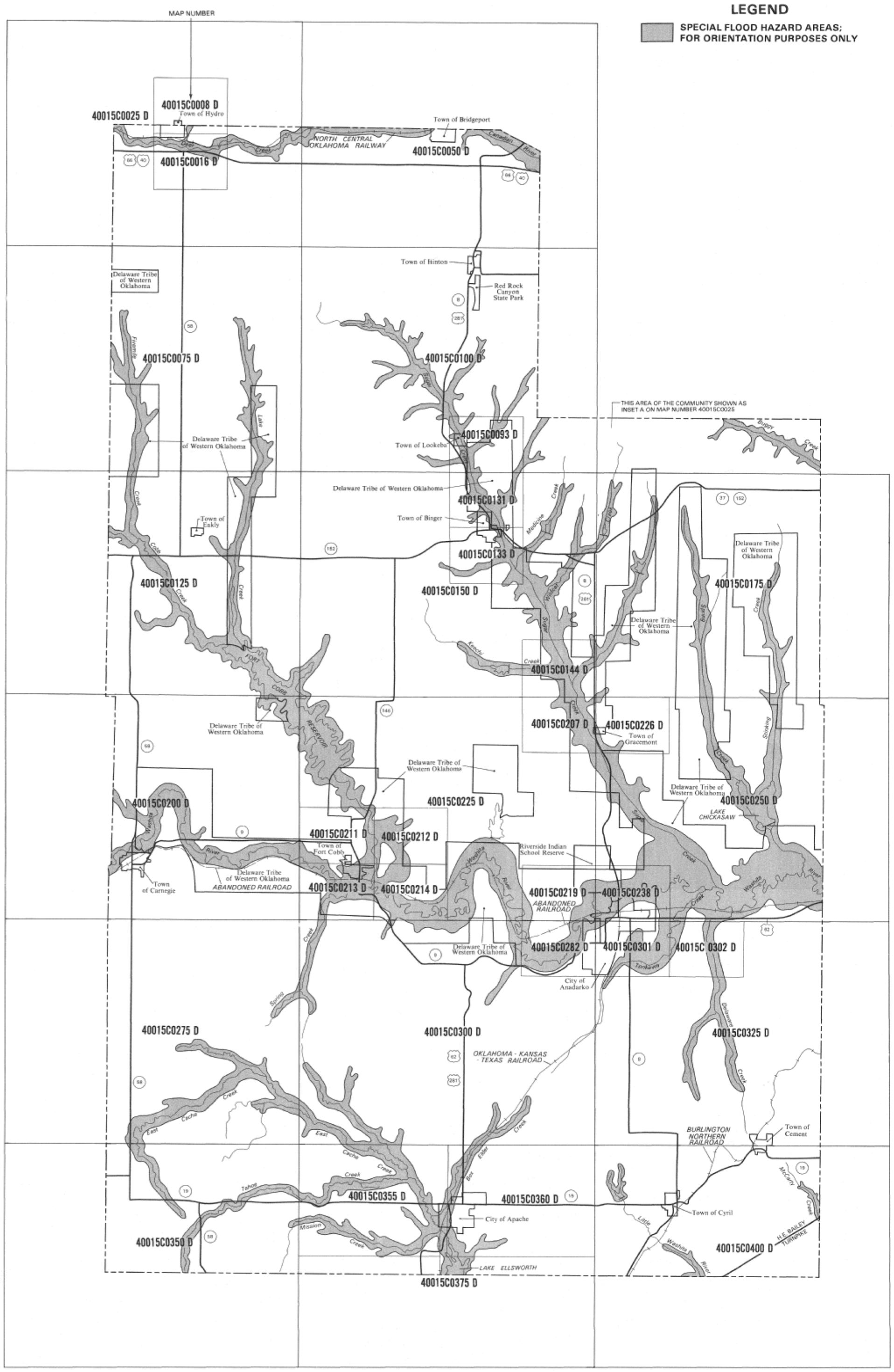
Flooding is the most prevalent and costly disaster in the United States. Flooding occurs any time dams fail, rains or melting snows exceed the flow capacity of rivers, streams or drainage ways. At the point the water concentration exceeds the capacity of the floodway, the water enters the floodplain.

There are two types of floods, both which can occur in Caddo County. First, flash floods, which result from localized heavy rainfalls. 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.

2.8.2. Location.

XVII. Figure: Flood Zones of Caddo County.

Map from FEMA Flood Insurance Rate Map for Caddo County, Oklahoma.



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 the County to rise above flood stage.

National Climatic Data Center storm event statistics record 14 flood events in Caddo County during the 10-year period 1993-2003. The reported damage totaled $6.5 million. According to National Flood Insurance Program statistics, rural Caddo County residents had two reported losses and received payments totaling $47,328 during the years 1978 through 2003. Nine homes southwest of Apache that were subject to recurring flooding were acquired and demolished at a total cost of $1,020,915. (Reference the 100 yr. flood plain map above.)

2.8.4. Previous Occurrences.

National Climatic Data Center storm event statistics record 14 flooding events in Caddo County during 1993-2003. The table below summarizes damages from 1993 to 2003.

XVIII. Figure: Flood Events and Damages.

Location or County	Date	Time	Type	Deaths	Injuries	Property Damages
1 Fort Cobb	4/29/1993	0:15	Flash Flood	0	0	$0.00
2 Countywide	5/8/1993	10:00	Flash Flood	0	0	$500,000.00
3 Eakly And Apache	6/4/1995	3:00	Flash Flooding	0	0	$0.00
4 Anadarko	11/16/1996	16:05	Flash Flood	0	0	$0.00
5 Cyril	7/10/1997	19:00	Flash Flood	0	0	$0.00
6 Cyril	7/10/1997	19:15	Flash Flood	0	0	$0.00
7 Countywide	11/1/1998	12:00	Flood	0	0	$0.00
8 Southeast Portion	6/19/1999	17:15	Flash Flood	0	0	$0.00
9 Hydro	12/8/1999	23:30	Flash Flood	0	0	$0.00
10 Countywide	4/30/2000	18:00	Flash Flood	0	0	$15,000.00
11 North Portion	5/26/2000	19:48	Flash Flood	0	0	$0.00
12 South Portion	10/22/2000	21:00	Flash Flood	0	0	$6,000,000.00
13 Southwest Portion	10/22/2000	11:36	Flash Flood	0	0	$0.00
14 Apache	10/25/2000	10:05	Flash Flood	0	0	$0.00
TOTALS:						$6,515,000.00

XIX. Figure: Flood Events.

22 FLOOD event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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 Fort Cobb	04/29/1993	0015	Flash Flood	N/A	0	0	0	0
2 Countywide	05/08/1993	1000	Flash Flood	N/A	0	0	500K	0
3 Eakly And Apache	06/04/1995	0300	Flash Flooding	N/A	0	0	0	0
4 Anadarko	11/16/1996	04:05 PM	Flash Flood	N/A	0	0	0	0
5 Cyril	07/10/1997	07:00 PM	Flash Flood	N/A	0	0	0	0
6 Cyril	07/10/1997	07:15 PM	Flash Flood	N/A	0	0	0	0
7 Countywide	11/01/1998	12:00 AM	Flood	N/A	0	0	0	0
8 Southeast Portion	06/19/1999	05:15 PM	Flash Flood	N/A	0	0	0	0
9 Hydro	12/08/1999	11:30 PM	Flash Flood	N/A	0	0	0K	0
10 Countywide	04/30/2000	06:00 PM	Flash Flood	N/A	0	0	15K	0
11 North Portion	05/26/2000	07:48 PM	Flash Flood	N/A	0	0	0	0
12 South Portion	10/22/2000	09:00 PM	Flash Flood	N/A	0	0	6.0M	0
13 Southwest Portion	10/22/2000	11:36 AM	Flash Flood	N/A	0	0	0	0
14 Apache	10/25/2000	10:05 AM	Flash Flood	N/A	0	0	0	0
15 OKZ004>008 - 010 - 012 - 017>020 - 023>024 - 026 - 034>035 - 037	03/04/2004	04:30 PM	Flood	N/A	0	3	1.0M	250K
16 Anadarko	10/07/2004	09:00 AM	Flash Flood	N/A	0	0	0	0
17 Cyril	10/07/2004	09:00 AM	Flash Flood	N/A	0	0	0	0
18 Apache	10/07/2004	09:30 AM	Flash Flood	N/A	0	0	0	0
19 OKZ017 - 023>024	06/13/2005	12:00 AM	Flood	N/A	0	0	0	0
20 OKZ023	08/21/2005	12:30 AM	Flood	N/A	0	0	0	0
21 OKZ023	08/22/2005	04:00 AM	Flood	N/A	0	0	0	0
22 OKZ016>017 - 023>024	10/05/2005	07:30 PM	Flood	N/A	0	0	0	0
				TOTALS:	0	3	7.515M	250K

2.8.5. Probability of Future Events.

Caddo 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.

Caddo County has a countywide flood plain ordinance, which regulates the issuing of building permits within flood zones. Since improvements in Caddo County have been directed away from flood plains, an estimated population of 60 people was found to live in flood zones outside municipalities within the County. Geographic Information Software (GIS) was used to help associate population and housing with flood zones to obtain this estimate.

When compared to the county's total population, this resulted in less than 1% of the population living within a flood zone. The county has no residential structures designated as repetitive loss structures. Caddo County Emergency Management concludes that 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, Caddo County is able to activate response personnel in a timely manner to prevent loss of life with a minimal loss to property.

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 Caddo 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 the County. The County's flood-plain ordinance has limited the growth within the flood plains and as a result it is estimated that less than 1% of the County's population live in a flood zone. The County has no structures that are designated as repetitive loss structures. The 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 Caddo 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.

XX. 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 576 hail events occurring in Caddo County between 1957 and 2003. Of these events it is estimated 99 were large hail (>1.5 inch diameter) storms. There were no reported deaths from hail events within the County.

Hail events have been documented in every year from 1957 to 2003. 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.

XXI Figure: Hail Events.

465 Hail Events were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006.**

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

Oklahoma

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 CADDO	05/01/1956	0032	Hail	0.75 in.	0	0	0	0
2 CADDO	06/03/1956	0005	Hail	1.75 in.	0	0	0	0
3 CADDO	09/09/1959	1600	Hail	1.75 in.	0	0	0	0
4 CADDO	05/21/1961	1800	Hail	2.75 in.	0	0	0	0
5 CADDO	06/25/1961	2115	Hail	1.75 in.	0	0	0	0
6 CADDO	04/10/1962	0600	Hail	2.00 in.	0	0	0	0
7 CADDO	05/04/1962	0331	Hail	1.50 in.	0	0	0	0
8 CADDO	05/24/1962	2000	Hail	0.75 in.	0	0	0	0
9 CADDO	04/14/1963	2145	Hail	0.75 in.	0	0	0	0
10 CADDO	04/17/1963	2155	Hail	1.25 in.	0	0	0	0
11 CADDO	04/23/1964	1720	Hail	1.25 in.	0	0	0	0
12 CADDO	05/10/1964	1800	Hail	1.00 in.	0	0	0	0
13 CADDO	04/04/1965	1820	Hail	1.00 in.	0	0	0	0

14 CADDO	03/11/1966	2230	Hail	0.75 in.	0	0	0	0
15 CADDO	03/11/1966	2240	Hail	0.75 in.	0	0	0	0
16 CADDO	06/08/1966	1800	Hail	1.00 in.	0	0	0	0
17 CADDO	08/10/1966	2000	Hail	3.00 in.	0	0	0	0
18 CADDO	03/12/1967	2130	Hail	1.25 in.	0	0	0	0
19 CADDO	03/12/1967	2245	Hail	1.75 in.	0	0	0	0
20 CADDO	05/14/1968	1945	Hail	1.50 in.	0	0	0	0
21 CADDO	05/15/1968	0045	Hail	1.50 in.	0	0	0	0
22 CADDO	05/15/1968	0100	Hail	3.00 in.	0	0	0	0
23 CADDO	06/10/1968	1620	Hail	2.75 in.	0	0	0	0
24 CADDO	06/10/1968	1720	Hail	3.00 in.	0	0	0	0
25 CADDO	04/26/1969	1500	Hail	1.75 in.	0	0	0	0
26 CADDO	06/11/1970	1320	Hail	2.50 in.	0	0	0	0
27 CADDO	06/20/1970	1530	Hail	1.00 in.	0	0	0	0
28 CADDO	02/18/1971	1235	Hail	0.75 in.	0	0	0	0
29 CADDO	04/26/1971	1640	Hail	1.00 in.	0	0	0	0
30 CADDO	06/02/1973	1145	Hail	1.75 in.	0	0	0	0
31 CADDO	06/18/1973	1730	Hail	1.75 in.	0	0	0	0
32 CADDO	06/06/1974	1545	Hail	1.75 in.	0	0	0	0
33 CADDO	07/03/1976	1845	Hail	1.50 in.	0	0	0	0
34 CADDO	03/10/1977	1605	Hail	1.00 in.	0	0	0	0
35 CADDO	05/01/1977	1820	Hail	1.50 in.	0	0	0	0
36 CADDO	05/01/1977	1824	Hail	2.75 in.	0	0	0	0

37 CADDO	05/01/1977	1830	Hail	0.75 in.	0	0	0	0
38 CADDO	05/20/1977	1705	Hail	2.00 in.	0	0	0	0
39 CADDO	05/28/1977	2100	Hail	1.50 in.	0	0	0	0
40 CADDO	05/30/1977	2125	Hail	1.75 in.	0	0	0	0
41 CADDO	06/21/1978	1315	Hail	1.75 in.	0	0	0	0
42 CADDO	06/06/1979	1600	Hail	1.75 in.	0	0	0	0
43 CADDO	07/16/1979	1809	Hail	1.75 in.	0	0	0	0
44 CADDO	10/17/1979	0200	Hail	1.00 in.	0	0	0	0
45 CADDO	05/20/1980	2100	Hail	0.75 in.	0	0	0	0
46 CADDO	05/25/1980	1954	Hail	1.75 in.	0	0	0	0
47 CADDO	04/12/1981	2110	Hail	1.75 in.	0	0	0	0
48 CADDO	01/29/1982	1949	Hail	1.75 in.	0	0	0	0
49 CADDO	03/15/1982	1545	Hail	2.00 in.	0	0	0	0
50 CADDO	05/20/1982	1742	Hail	1.75 in.	0	0	0	0
51 CADDO	05/20/1982	1815	Hail	1.75 in.	0	0	0	0
52 CADDO	05/30/1982	1845	Hail	1.00 in.	0	0	0	0
53 CADDO	05/13/1983	2100	Hail	0.75 in.	0	0	0	0
54 CADDO	05/13/1983	2129	Hail	1.75 in.	0	0	0	0
55 CADDO	05/13/1983	2200	Hail	1.25 in.	0	0	0	0
56 CADDO	05/13/1983	2219	Hail	1.75 in.	0	0	0	0
57 CADDO	05/13/1983	2230	Hail	0.75 in.	0	0	0	0
58 CADDO	06/10/1983	2015	Hail	1.00 in.	0	0	0	0
59 CADDO	03/04/1984	0030	Hail	1.00 in.	0	0	0	0

60 CADDO	04/07/1984	1330	Hail	1.00 in.	0	0	0	0
61 CADDO	04/26/1984	1627	Hail	0.75 in.	0	0	0	0
62 CADDO	04/26/1984	1635	Hail	1.75 in.	0	0	0	0
63 CADDO	04/26/1984	2003	Hail	1.75 in.	0	0	0	0
64 CADDO	04/26/1984	2045	Hail	0.75 in.	0	0	0	0
65 CADDO	05/01/1984	1750	Hail	0.75 in.	0	0	0	0
66 CADDO	05/01/1984	1820	Hail	1.00 in.	0	0	0	0
67 CADDO	05/27/1984	1600	Hail	0.75 in.	0	0	0	0
68 CADDO	05/27/1984	1715	Hail	1.00 in.	0	0	0	0
69 CADDO	06/05/1984	1648	Hail	0.75 in.	0	0	0	0
70 CADDO	06/09/1984	2015	Hail	1.75 in.	0	0	0	0
71 CADDO	06/23/1984	1330	Hail	1.75 in.	0	0	0	0
72 CADDO	04/13/1985	1645	Hail	0.75 in.	0	0	0	0
73 CADDO	04/13/1985	1700	Hail	0.75 in.	0	0	0	0
74 CADDO	04/22/1985	1640	Hail	1.00 in.	0	0	0	0
75 CADDO	04/22/1985	1915	Hail	0.75 in.	0	0	0	0
76 CADDO	05/07/1985	0255	Hail	1.75 in.	0	0	0	0
77 CADDO	05/20/1985	1535	Hail	1.75 in.	0	0	0	0
78 CADDO	06/01/1985	1600	Hail	1.00 in.	0	0	0	0
79 CADDO	06/01/1985	1615	Hail	0.88 in.	0	0	0	0
80 CADDO	06/02/1985	1800	Hail	0.75 in.	0	0	0	0
81 CADDO	06/02/1985	1937	Hail	1.75 in.	0	0	0	0
82 CADDO	06/02/1985	2045	Hail	1.75 in.	0	0	0	0

83 CADDO	06/09/1985	1815	Hail	0.75 in.	0	0	0	0
84 CADDO	08/20/1985	1800	Hail	0.75 in.	0	0	0	0
85 CADDO	09/22/1985	2027	Hail	1.75 in.	0	0	0	0
86 CADDO	11/13/1985	1120	Hail	0.75 in.	0	0	0	0
87 CADDO	11/13/1985	1120	Hail	0.75 in.	0	0	0	0
88 CADDO	11/14/1985	1005	Hail	0.75 in.	0	0	0	0
89 CADDO	11/14/1985	1005	Hail	0.75 in.	0	0	0	0
90 CADDO	11/14/1985	1029	Hail	0.75 in.	0	0	0	0
91 CADDO	11/14/1985	1029	Hail	0.75 in.	0	0	0	0
92 CADDO	04/03/1986	0948	Hail	1.75 in.	0	0	0	0
93 CADDO	04/03/1986	0948	Hail	1.75 in.	0	0	0	0
94 CADDO	04/19/1986	1145	Hail	0.88 in.	0	0	0	0
95 CADDO	04/26/1986	1956	Hail	0.75 in.	0	0	0	0
96 CADDO	04/26/1986	1956	Hail	0.75 in.	0	0	0	0
97 CADDO	04/26/1986	2015	Hail	1.00 in.	0	0	0	0
98 CADDO	04/26/1986	2015	Hail	1.00 in.	0	0	0	0
99 CADDO	04/26/1986	2030	Hail	1.00 in.	0	0	0	0
100 CADDO	05/06/1986	1956	Hail	1.75 in.	0	0	0	0
101 CADDO	05/06/1986	1956	Hail	1.75 in.	0	0	0	0
102 CADDO	05/06/1986	2005	Hail	1.25 in.	0	0	0	0
103 CADDO	05/06/1986	2030	Hail	0.75 in.	0	0	0	0
104 CADDO	05/08/1986	1630	Hail	0.75 in.	0	0	0	0
105 CADDO	05/08/1986	1630	Hail	0.75 in.	0	0	0	0

106 CADDO	05/08/1986	1800	Hail	0.75 in.	0	0	0	0
107 CADDO	05/10/1986	1214	Hail	0.75 in.	0	0	0	0
108 CADDO	05/10/1986	1214	Hail	0.75 in.	0	0	0	0
109 CADDO	05/14/1986	1050	Hail	1.75 in.	0	0	0	0
110 CADDO	05/14/1986	1050	Hail	1.75 in.	0	0	0	0
111 CADDO	05/14/1986	1230	Hail	0.75 in.	0	0	0	0
112 CADDO	05/14/1986	1330	Hail	0.75 in.	0	0	0	0
113 CADDO	05/14/1986	1400	Hail	0.75 in.	0	0	0	0
114 CADDO	05/14/1986	1400	Hail	0.75 in.	0	0	0	0
115 CADDO	05/14/1986	1415	Hail	1.75 in.	0	0	0	0
116 CADDO	05/14/1986	1448	Hail	0.75 in.	0	0	0	0
117 CADDO	05/14/1986	1500	Hail	1.00 in.	0	0	0	0
118 CADDO	05/14/1986	1700	Hail	1.75 in.	0	0	0	0
119 CADDO	05/26/1986	1500	Hail	1.00 in.	0	0	0	0
120 CADDO	06/14/1986	1838	Hail	1.25 in.	0	0	0	0
121 CADDO	06/14/1986	1925	Hail	1.75 in.	0	0	0	0
122 CADDO	07/31/1986	1630	Hail	0.75 in.	0	0	0	0
123 CADDO	08/06/1986	1730	Hail	0.75 in.	0	0	0	0
124 CADDO	09/30/1986	2140	Hail	0.88 in.	0	0	0	0
125 CADDO	02/14/1987	1840	Hail	0.88 in.	0	0	0	0
126 CADDO	02/14/1987	2035	Hail	1.00 in.	0	0	0	0
127 CADDO	02/14/1987	2145	Hail	0.75 in.	0	0	0	0
128 CADDO	05/20/1987	1852	Hail	1.75 in.	0	0	0	0

129 CADDO	05/21/1987	1752	Hail	1.75 in.	0	0	0	0
130 CADDO	05/21/1987	2045	Hail	1.00 in.	0	0	0	0
131 CADDO	05/22/1987	0300	Hail	0.75 in.	0	0	0	0
132 CADDO	05/26/1987	2200	Hail	0.75 in.	0	0	0	0
133 CADDO	06/15/1987	1445	Hail	1.75 in.	0	0	0	0
134 CADDO	06/19/1987	1050	Hail	0.75 in.	0	0	0	0
135 CADDO	07/17/1987	1630	Hail	0.75 in.	0	0	0	0
136 CADDO	10/25/1987	2200	Hail	1.75 in.	0	0	0	0
137 CADDO	03/01/1988	1640	Hail	0.75 in.	0	0	0	0
138 CADDO	03/01/1988	1907	Hail	1.00 in.	0	0	0	0
139 CADDO	03/28/1988	1428	Hail	1.75 in.	0	0	0	0
140 CADDO	03/28/1988	1540	Hail	1.75 in.	0	0	0	0
141 CADDO	07/28/1988	1655	Hail	0.75 in.	0	0	0	0
142 CADDO	11/11/1988	2140	Hail	0.75 in.	0	0	0	0
143 CADDO	11/11/1988	2150	Hail	1.75 in.	0	0	0	0
144 CADDO	11/11/1988	2240	Hail	0.75 in.	0	0	0	0
145 CADDO	03/27/1989	1911	Hail	1.25 in.	0	0	0	0
146 CADDO	03/27/1989	1930	Hail	0.75 in.	0	0	0	0
147 CADDO	04/25/1989	2332	Hail	0.75 in.	0	0	0	0
148 CADDO	05/02/1989	0820	Hail	1.00 in.	0	0	0	0
149 CADDO	05/02/1989	1100	Hail	0.88 in.	0	0	0	0
150 CADDO	05/13/1989	2115	Hail	1.00 in.	0	0	0	0
151 CADDO	05/13/1989	2200	Hail	0.75 in.	0	0	0	0

152 CADDO	05/13/1989	2233	Hail	1.00 in.	0	0	0	0
153 CADDO	05/13/1989	2247	Hail	0.75 in.	0	0	0	0
154 CADDO	05/13/1989	2326	Hail	1.00 in.	0	0	0	0
155 CADDO	05/14/1989	0009	Hail	0.75 in.	0	0	0	0
156 CADDO	05/14/1989	0035	Hail	1.00 in.	0	0	0	0
157 CADDO	05/26/1989	0130	Hail	1.25 in.	0	0	0	0
158 CADDO	06/06/1989	1440	Hail	1.00 in.	0	0	0	0
159 CADDO	06/06/1989	1500	Hail	0.75 in.	0	0	0	0
160 CADDO	06/06/1989	2215	Hail	1.75 in.	0	0	0	0
161 CADDO	06/06/1989	2230	Hail	1.00 in.	0	0	0	0
162 CADDO	06/10/1989	1458	Hail	0.88 in.	0	0	0	0
163 CADDO	06/10/1989	1525	Hail	1.00 in.	0	0	0	0
164 CADDO	01/16/1990	2020	Hail	0.75 in.	0	0	0	0
165 CADDO	01/16/1990	2115	Hail	0.75 in.	0	0	0	0
166 CADDO	04/13/1990	1706	Hail	0.75 in.	0	0	0	0
167 CADDO	04/13/1990	1808	Hail	1.00 in.	0	0	0	0
168 CADDO	04/16/1990	2130	Hail	0.88 in.	0	0	0	0
169 CADDO	05/15/1990	1625	Hail	1.75 in.	0	0	0	0
170 CADDO	05/15/1990	2330	Hail	1.75 in.	0	0	0	0
171 CADDO	05/26/1990	2020	Hail	2.75 in.	0	0	0	0
172 CADDO	06/23/1990	2340	Hail	1.00 in.	0	0	0	0
173 CADDO	06/24/1990	0010	Hail	1.00 in.	0	0	0	0
174 CADDO	06/24/1990	0030	Hail	0.75 in.	0	0	0	0

175 CADDO	04/02/1991	2315	Hail	0.75 in.	0	0	0	0
176 CADDO	04/12/1991	1336	Hail	1.00 in.	0	0	0	0
177 CADDO	04/12/1991	1415	Hail	2.00 in.	0	0	0	0
178 CADDO	04/12/1991	1415	Hail	3.00 in.	0	0	0	0
179 CADDO	04/12/1991	1430	Hail	2.00 in.	0	0	0	0
180 CADDO	04/12/1991	1600	Hail	1.00 in.	0	0	0	0
181 CADDO	04/25/1991	2245	Hail	0.88 in.	0	0	0	0
182 CADDO	05/07/1991	1430	Hail	0.75 in.	0	0	0	0
183 CADDO	05/07/1991	1510	Hail	1.00 in.	0	0	0	0
184 CADDO	05/24/1991	2025	Hail	1.75 in.	0	0	0	0
185 CADDO	06/01/1991	2215	Hail	0.75 in.	0	0	0	0
186 CADDO	06/05/1991	1600	Hail	1.00 in.	0	0	0	0
187 CADDO	06/15/1991	1630	Hail	1.00 in.	0	0	0	0
188 CADDO	06/15/1991	1728	Hail	1.75 in.	0	0	0	0
189 CADDO	07/13/1991	1444	Hail	1.00 in.	0	0	0	0
190 CADDO	08/29/1991	2040	Hail	0.80 in.	0	0	0	0
191 CADDO	08/29/1991	2151	Hail	0.75 in.	0	0	0	0
192 CADDO	10/25/1991	1815	Hail	1.00 in.	0	0	0	0
193 CADDO	10/25/1991	2205	Hail	1.00 in.	0	0	0	0
194 CADDO	03/03/1992	2040	Hail	0.88 in.	0	0	0	0
195 CADDO	03/03/1992	2040	Hail	0.88 in.	0	0	0	0
196 CADDO	03/08/1992	1703	Hail	1.00 in.	0	0	0	0
197 CADDO	03/08/1992	1703	Hail	1.00 in.	0	0	0	0

198 CADDO	03/08/1992	1715	Hail	1.75 in.	0	0	0	0
199 CADDO	03/08/1992	1715	Hail	1.75 in.	0	0	0	0
200 CADDO	03/08/1992	1730	Hail	1.00 in.	0	0	0	0
201 CADDO	03/08/1992	1730	Hail	1.00 in.	0	0	0	0
202 CADDO	03/08/1992	1949	Hail	1.00 in.	0	0	0	0
203 CADDO	03/08/1992	1949	Hail	1.00 in.	0	0	0	0
204 CADDO	03/21/1992	2150	Hail	0.75 in.	0	0	0	0
205 CADDO	03/21/1992	2150	Hail	0.75 in.	0	0	0	0
206 CADDO	04/11/1992	2026	Hail	0.88 in.	0	0	0	0
207 CADDO	04/11/1992	2026	Hail	0.88 in.	0	0	0	0
208 CADDO	04/11/1992	2049	Hail	0.88 in.	0	0	0	0
209 CADDO	04/11/1992	2049	Hail	0.88 in.	0	0	0	0
210 CADDO	04/16/1992	1345	Hail	1.00 in.	0	0	0	0
211 CADDO	04/16/1992	1345	Hail	1.00 in.	0	0	0	0
212 CADDO	04/16/1992	1425	Hail	1.00 in.	0	0	0	0
213 CADDO	04/16/1992	1425	Hail	1.00 in.	0	0	0	0
214 CADDO	04/16/1992	1530	Hail	1.00 in.	0	0	0	0
215 CADDO	04/16/1992	1530	Hail	1.00 in.	0	0	0	0
216 CADDO	04/16/1992	1630	Hail	1.00 in.	0	0	0	0
217 CADDO	04/16/1992	1630	Hail	1.00 in.	0	0	0	0
218 CADDO	04/28/1992	1947	Hail	1.75 in.	0	0	0	0
219 CADDO	04/28/1992	1947	Hail	1.75 in.	0	0	0	0
220 CADDO	05/10/1992	1800	Hail	0.88 in.	0	0	0	0

221 CADDO	05/10/1992	1800	Hail	0.88 in.	0	0	0	0
222 CADDO	07/30/1992	1605	Hail	0.88 in.	0	0	0	0
223 CADDO	07/30/1992	1605	Hail	0.88 in.	0	0	0	0
224 CADDO	07/30/1992	1635	Hail	1.00 in.	0	0	0	0
225 CADDO	07/30/1992	1635	Hail	1.00 in.	0	0	0	0
226 CADDO	08/01/1992	1835	Hail	0.75 in.	0	0	0	0
227 CADDO	08/01/1992	1835	Hail	0.75 in.	0	0	0	0
228 CADDO	08/01/1992	1905	Hail	0.75 in.	0	0	0	0
229 CADDO	08/01/1992	1905	Hail	0.75 in.	0	0	0	0
230 CADDO	09/05/1992	2245	Hail	1.75 in.	0	0	0	0
231 CADDO	09/05/1992	2245	Hail	1.75 in.	0	0	0	0
232 CADDO	09/06/1992	0025	Hail	0.75 in.	0	0	0	0
233 CADDO	09/06/1992	0025	Hail	0.75 in.	0	0	0	0
234 CADDO	10/07/1992	1403	Hail	1.00 in.	0	0	0	0
235 CADDO	10/07/1992	1403	Hail	1.00 in.	0	0	0	0
236 CADDO	10/28/1992	1810	Hail	0.75 in.	0	0	0	0
237 CADDO	10/28/1992	1810	Hail	0.75 in.	0	0	0	0
238 CADDO	11/10/1992	1700	Hail	0.75 in.	0	0	0	0
239 CADDO	11/10/1992	1700	Hail	0.75 in.	0	0	0	0
240 Boone	04/28/1993	2145	Hail	0.88 in.	0	0	0	0
241 Hinton	05/07/1993	2115	Hail	0.88 in.	0	0	0	0
242 Cyril	05/07/1993	2120	Hail	0.75 in.	0	0	0	0
243 Lookeba	05/17/1993	1940	Hail	0.75 in.	0	0	0	0

244 Stecker	09/12/1993	1730	Hail	0.88 in.	0	0	0	0
245 Apache	11/13/1993	1123	Hail	0.75 in.	0	0	0	0
246 Apache	03/07/1994	2110	Hail	1.00 in.	0	0	0	0
247 Apache	03/07/1994	2115	Hail	1.00 in.	0	0	0	0
248 Cyril	03/26/1994	0933	Hail	0.88 in.	0	0	0	0
249 Cogar	04/10/1994	1215	Hail	0.75 in.	0	0	0	0
250 Carnegie	04/10/1994	2205	Hail	0.75 in.	0	0	0	0
251 W Carnegie	04/10/1994	2205	Hail	1.75 in.	0	0	0	0
252 Eakly	04/11/1994	0205	Hail	0.75 in.	0	0	0	0
253 Binger	04/11/1994	0215	Hail	1.00 in.	0	0	0	0
254 Carnegie	04/25/1994	1030	Hail	1.00 in.	0	0	0	0
255 Anadarko	04/25/1994	1040	Hail	0.75 in.	0	0	0	0
256 Hydro	04/25/1994	1240	Hail	0.75 in.	0	0	0	0
257 Hinton	04/25/1994	1310	Hail	0.75 in.	0	0	0	0
258 Anadarko	04/27/1994	0828	Hail	0.75 in.	0	0	0	0
259 Nr Albert	04/27/1994	0857	Hail	0.88 in.	0	0	0	0
260 Cogar	04/27/1994	1400	Hail	0.88 in.	0	0	0	0
261 Apache	04/27/1994	1630	Hail	1.00 in.	0	0	0	0
262 Carnegie	04/27/1994	1730	Hail	0.75 in.	0	0	0	0
263 Ft Cobb	04/27/1994	1738	Hail	1.75 in.	0	0	0	0
264 Anadarko	07/07/1994	1933	Hail	0.75 in.	0	0	0	0
265 Anadarko	07/07/1994	1950	Hail	1.00 in.	0	0	0	0
266 Cyril	07/07/1994	1952	Hail	0.75 in.	0	0	0	0

267 Cyril	07/07/1994	1955	Hail	1.00 in.	0	0	0	0
268 Cyril	07/07/1994	2009	Hail	0.88 in.	0	0	0	0
269 W Anadarko	08/17/1994	1650	Hail	0.88 in.	0	0	0	0
270 To 3.25	08/17/1994	1650	Hail	1.00 in.	0	0	0	0
271 Anadarko	08/17/1994	1706	Hail	0.75 in.	0	0	0	0
272 Anadarko	08/17/1994	1716	Hail	0.75 in.	0	0	0	0
273 Anadarko	05/06/1995	1130	Hail	0.88 in.	0	0	0	0
274 Binger	06/03/1995	1910	Hail	1.75 in.	0	0	0	0
275 Cogar	06/03/1995	1920	Hail	1.25 in.	0	0	0	0
276 Eakly	06/03/1995	2240	Hail	0.75 in.	0	0	0	0
277 Cyril	06/04/1995	0223	Hail	1.00 in.	0	0	0	0
278 Nr Cement	07/20/1995	1432	Hail	0.88 in.	0	0	0	0
279 Binger	07/21/1995	1856	Hail	0.75 in.	0	0	0	0
280 Binger	07/21/1995	1925	Hail	0.88 in.	0	0	0	0
281 Binger	07/21/1995	2030	Hail	0.88 in.	0	0	0	0
282 Cement	10/02/1995	0732	Hail	0.88 in.	0	0	0	0
283 Cement	03/24/1996	11:00 AM	Hail	0.75 in.	0	0	0	0
284 Carnegie	04/03/1996	06:45 PM	Hail	0.75 in.	0	0	0	0
285 Cyril	04/21/1996	05:40 PM	Hail	1.00 in.	0	0	0	0
286 Cyril	04/21/1996	06:30 PM	Hail	1.00 in.	0	0	0	0
287 Alfalfa	05/26/1996	03:40 PM	Hail	1.50 in.	0	0	0	0
288 Binger	05/26/1996	03:45 PM	Hail	1.75 in.	0	0	0	0
289 Anadarko	06/06/1996	04:00 PM	Hail	1.00 in.	0	0	0	0

290 Bridgeport	06/13/1996	04:33 PM	Hail	0.88 in.	0	0	0	0
291 Hinton	06/13/1996	04:39 PM	Hail	1.00 in.	0	0	0	0
292 Bridgeport	06/13/1996	04:42 PM	Hail	1.75 in.	0	0	0	0
293 Bridgeport	06/13/1996	05:30 PM	Hail	1.75 in.	0	0	0	0
294 Stecker	11/16/1996	03:50 PM	Hail	1.00 in.	0	0	0	0
295 Anadarko	11/16/1996	04:00 PM	Hail	0.88 in.	0	0	0	0
296 Anadarko	11/16/1996	04:05 PM	Hail	0.88 in.	0	0	0	0
297 Carnegie	05/01/1997	06:48 PM	Hail	0.75 in.	0	0	0	0
298 Carnegie	05/01/1997	06:53 PM	Hail	0.75 in.	0	0	0	0
299 Hinton	05/01/1997	09:02 PM	Hail	1.75 in.	0	0	0	0
300 Apache	05/25/1997	04:05 PM	Hail	1.00 in.	0	0	0	0
301 Apache	06/09/1997	02:36 PM	Hail	0.75 in.	0	0	0	0
302 Apache	08/13/1997	07:45 PM	Hail	1.75 in.	0	0	0	0
303 Alfalfa	10/08/1997	04:35 PM	Hail	1.00 in.	0	0	0	0
304 Cyril	10/08/1997	07:57 PM	Hail	0.88 in.	0	0	0	0
305 Carnegie	04/14/1998	03:15 PM	Hail	0.88 in.	0	0	0	0
306 Apache	04/14/1998	03:29 PM	Hail	0.75 in.	0	0	0	0
307 Cement	04/14/1998	03:43 PM	Hail	0.88 in.	0	0	0	0
308 Apache	04/14/1998	03:49 PM	Hail	1.50 in.	0	0	0	0
309 Apache	04/14/1998	03:54 PM	Hail	0.88 in.	0	0	0	0
310 Cyril	04/14/1998	03:56 PM	Hail	1.00 in.	0	0	0	0
311 Cyril	04/14/1998	04:02 PM	Hail	0.88 in.	0	0	0	0
312 Cyril	04/14/1998	04:11 PM	Hail	0.75 in.	0	0	0	0

313 Hinton	06/08/1998	02:39 PM	Hail	1.75 in.	0	0	0	0
314 Hinton	06/08/1998	02:41 PM	Hail	1.75 in.	0	0	0	0
315 Anadarko	06/08/1998	04:01 PM	Hail	0.75 in.	0	0	0	0
316 Hydro	06/13/1998	05:35 PM	Hail	0.88 in.	0	0	0	0
317 Binger	06/13/1998	07:05 PM	Hail	1.75 in.	0	0	0	0
318 Binger	06/19/1998	05:31 PM	Hail	1.75 in.	0	0	0	0
319 Hinton	06/19/1998	06:00 PM	Hail	3.50 in.	0	0	0	0
320 Eakly	06/19/1998	06:43 PM	Hail	1.75 in.	0	0	0	0
321 Cogar	06/19/1998	07:18 PM	Hail	0.88 in.	0	0	0	0
322 Cogar	06/19/1998	07:35 PM	Hail	1.75 in.	0	0	0	0
323 Lookeba	06/19/1998	07:40 PM	Hail	1.00 in.	0	0	0	0
324 Lookeba	06/19/1998	07:50 PM	Hail	0.88 in.	0	0	0	0
325 Hinton	06/20/1998	05:50 PM	Hail	1.00 in.	0	0	0	0
326 Alfalfa	07/07/1998	06:53 PM	Hail	0.75 in.	0	0	0	0
327 Lookeba	10/01/1998	08:05 PM	Hail	0.88 in.	0	0	0	0
328 Apache	10/04/1998	04:25 PM	Hail	1.75 in.	0	0	0	0
329 Cyril	10/04/1998	04:34 PM	Hail	0.88 in.	0	0	0	0
330 Apache	10/04/1998	04:50 PM	Hail	1.75 in.	0	0	0	0
331 Cement	10/04/1998	05:10 PM	Hail	0.88 in.	0	0	0	0
332 Hydro	03/22/1999	11:00 PM	Hail	1.75 in.	0	0	0	0
333 Hinton	03/22/1999	11:20 PM	Hail	0.88 in.	0	0	0	0
334 Lookeba	03/22/1999	11:50 PM	Hail	0.88 in.	0	0	0	0
335 Hinton	04/26/1999	07:02 PM	Hail	1.75 in.	0	0	0	0

336 Hinton	04/26/1999	07:05 PM	Hail	2.75 in.	0	0	0	0
337 Cogar	04/26/1999	07:40 PM	Hail	1.00 in.	0	0	0	0
338 Cogar	04/26/1999	07:45 PM	Hail	1.75 in.	0	0	0	0
339 Anadarko	04/26/1999	08:05 PM	Hail	1.00 in.	0	0	0	0
340 Anadarko	05/03/1999	03:54 PM	Hail	0.75 in.	0	0	0	0
341 Anadarko	05/03/1999	03:56 PM	Hail	1.00 in.	0	0	0	0
342 Apache	05/03/1999	03:57 PM	Hail	1.75 in.	0	0	0	0
343 Anadarko	05/03/1999	03:58 PM	Hail	0.75 in.	0	0	0	0
344 Cyril	05/03/1999	04:05 PM	Hail	1.00 in.	0	0	0	0
345 Cyril	05/03/1999	04:11 PM	Hail	1.75 in.	0	0	0	0
346 Anadarko	05/03/1999	04:23 PM	Hail	1.75 in.	0	0	0	0
347 Washita	05/03/1999	06:04 PM	Hail	2.75 in.	0	0	0	0
348 Carnegie	05/09/1999	08:00 PM	Hail	0.75 in.	0	0	0	0
349 Cyril	05/09/1999	08:36 PM	Hail	1.00 in.	0	0	0	0
350 Gracemont	06/19/1999	04:55 PM	Hail	0.75 in.	0	0	0	0
351 Apache	12/02/1999	06:10 PM	Hail	0.75 in.	0	0	0	0
352 Apache	12/02/1999	06:10 PM	Hail	1.75 in.	0	0	0	0
353 Cyril	12/02/1999	06:40 PM	Hail	0.75 in.	0	0	0	0
354 Anadarko	12/08/1999	10:05 PM	Hail	0.88 in.	0	0	0	0
355 Anadarko	02/22/2000	06:00 PM	Hail	0.75 in.	0	0	0	0
356 Anadarko	03/02/2000	02:45 PM	Hail	0.75 in.	0	0	0	0
357 Cyril	03/07/2000	06:40 PM	Hail	0.75 in.	0	0	0	0
358 Carnegie	04/30/2000	12:45 PM	Hail	0.75 in.	0	0	0	0

359 Carnegie	05/24/2000	07:15 PM	Hail	1.00 in.	0	0	0	0
360 Carnegie	05/24/2000	07:20 PM	Hail	1.75 in.	0	0	0	0
361 Carnegie	05/24/2000	07:35 PM	Hail	2.00 in.	0	0	0	0
362 Anadarko	05/24/2000	07:59 PM	Hail	0.75 in.	0	0	0	0
363 Anadarko	05/24/2000	08:02 PM	Hail	1.00 in.	0	0	0	0
364 Gracemont	05/24/2000	08:45 PM	Hail	1.00 in.	0	0	0	0
365 Carnegie	05/24/2000	10:30 PM	Hail	2.75 in.	0	0	0	0
366 Ft Cobb	05/24/2000	10:30 PM	Hail	1.50 in.	0	0	0	0
367 Anadarko	05/24/2000	10:55 PM	Hail	0.88 in.	0	0	0	0
368 Gracemont	05/25/2000	08:45 PM	Hail	1.00 in.	0	0	0	0
369 Hydro	05/26/2000	06:00 PM	Hail	1.00 in.	0	0	0	0
370 Bridgeport	05/26/2000	06:12 PM	Hail	0.75 in.	0	0	0	0
371 Hydro	05/26/2000	07:30 PM	Hail	1.25 in.	0	0	0	0
372 Hydro	05/26/2000	08:20 PM	Hail	0.75 in.	0	0	0K	0
373 Cyril	10/22/2000	04:45 PM	Hail	0.75 in.	0	0	0	0
374 Cyril	03/11/2001	09:48 PM	Hail	0.88 in.	0	0	0	0
375 Apache	04/14/2001	04:42 PM	Hail	1.00 in.	0	0	0	0
376 Cyril	04/14/2001	05:10 PM	Hail	0.88 in.	0	0	0	0
377 Hydro	04/22/2001	12:40 PM	Hail	0.88 in.	0	0	0	0
378 Hydro	05/05/2001	08:05 PM	Hail	1.00 in.	0	0	0	0
379 Apache	05/30/2001	01:15 AM	Hail	1.25 in.	0	0	0	0
380 Cyril	05/30/2001	01:17 AM	Hail	0.88 in.	0	0	0	0
381 Cyril	05/30/2001	01:18 AM	Hail	0.75 in.	0	0	0	0

382 Cogar	10/09/2001	06:34 PM	Hail	1.00 in.	0	0	0	0
383 Cogar	10/09/2001	06:50 PM	Hail	2.00 in.	0	0	0	0
384 Gracemont	04/12/2002	08:30 AM	Hail	0.75 in.	0	0	0	0
385 Cyril	04/12/2002	09:30 AM	Hail	1.00 in.	0	0	0	0
386 Binger	05/06/2002	12:00 AM	Hail	0.88 in.	0	0	0	0
387 Cogar	05/17/2002	12:20 AM	Hail	0.75 in.	0	0	0	0
388 Cyril	05/26/2002	02:55 AM	Hail	0.88 in.	0	0	0	0
389 Ft Cobb	06/08/2002	07:10 PM	Hail	1.25 in.	0	0	0	0
390 Boone	09/18/2002	05:20 PM	Hail	4.50 in.	0	0	0	0
391 Anadarko	09/18/2002	06:20 PM	Hail	0.88 in.	0	0	0	0
392 Hinton	09/18/2002	07:30 PM	Hail	0.75 in.	0	0	0	0
393 Hinton	03/12/2003	09:00 PM	Hail	1.00 in.	0	0	0	0
394 Carnegie	03/12/2003	10:00 PM	Hail	0.75 in.	0	0	0	0
395 Anadarko	03/12/2003	10:44 PM	Hail	0.88 in.	0	0	0	0
396 Anadarko	03/12/2003	10:58 PM	Hail	0.75 in.	0	0	0	0
397 Apache	03/12/2003	11:03 PM	Hail	1.00 in.	0	0	0	0
398 Apache	03/12/2003	11:09 PM	Hail	1.75 in.	0	0	0	0
399 Eakly	03/17/2003	04:25 PM	Hail	1.00 in.	0	0	0	0
400 Binger	03/17/2003	04:45 PM	Hail	1.00 in.	0	0	0	0
401 Cyril	03/17/2003	05:25 PM	Hail	0.75 in.	0	0	0	0
402 Carnegie	04/03/2003	05:51 PM	Hail	1.25 in.	0	0	0	0
403 Carnegie	04/03/2003	05:52 PM	Hail	3.00 in.	0	0	0	0
404 Ft Cobb	04/03/2003	06:25 PM	Hail	1.25 in.	0	0	0	0

405 Ft Cobb	04/03/2003	06:28 PM	Hail	2.25 in.	0	0	0	0
406 Ft Cobb	04/03/2003	06:31 PM	Hail	2.50 in.	0	0	0	0
407 Lake Chickasha	04/03/2003	07:19 PM	Hail	0.75 in.	0	0	0	0
408 Eakly	05/07/2003	11:41 PM	Hail	1.00 in.	0	0	0	0
409 Binger	05/07/2003	11:54 PM	Hail	1.25 in.	0	0	0	0
410 Carnegie	05/09/2003	05:05 PM	Hail	1.50 in.	0	0	0	0
411 Binger	05/13/2003	10:45 PM	Hail	1.00 in.	0	0	0	0
412 Hinton	05/13/2003	10:45 PM	Hail	1.25 in.	0	0	0	0
413 Hydro	05/13/2003	11:20 PM	Hail	1.00 in.	0	0	0	0
414 Cogar	05/14/2003	02:30 AM	Hail	0.75 in.	0	0	0	0
415 Cyril	05/14/2003	12:38 AM	Hail	0.88 in.	0	0	0	0
416 Cyril	05/14/2003	12:40 AM	Hail	1.00 in.	0	0	0	0
417 Cyril	05/14/2003	12:48 AM	Hail	0.75 in.	0	0	0	0
418 Cyril	05/14/2003	12:55 AM	Hail	0.88 in.	0	0	0	0
419 Cyril	05/14/2003	12:55 AM	Hail	1.25 in.	0	0	0	0
420 Cyril	05/14/2003	12:58 AM	Hail	1.50 in.	0	0	0	0
421 Hinton	06/10/2003	05:20 PM	Hail	0.88 in.	0	0	0	0
422 Anadarko	06/10/2003	12:10 AM	Hail	0.75 in.	0	0	0	0
423 Lookeba	04/23/2004	04:25 PM	Hail	1.00 in.	0	0	0	0
424 Cyril	04/23/2004	07:42 PM	Hail	1.00 in.	0	0	0	0
425 Cyril	04/23/2004	07:43 PM	Hail	1.00 in.	0	0	0	0
426 Cyril	04/30/2004	07:06 PM	Hail	1.75 in.	0	0	0	0
427 Cyril	04/30/2004	07:09 PM	Hail	1.75 in.	0	0	0	0

428 Anadarko	05/13/2004	11:54 AM	Hail	0.75 in.	0	0	0	0
429 Hydro	05/24/2004	04:40 PM	Hail	0.88 in.	0	0	0	0
430 Lookeba	05/24/2004	05:30 PM	Hail	0.88 in.	0	0	0	0
431 Binger	05/24/2004	05:58 PM	Hail	1.75 in.	0	0	0	0
432 Binger	05/24/2004	06:00 PM	Hail	1.75 in.	0	0	0	0
433 Ft Cobb	05/24/2004	06:13 PM	Hail	1.00 in.	0	0	0	0
434 Anadarko	05/24/2004	06:16 PM	Hail	0.88 in.	0	0	0	0
435 Anadarko	05/24/2004	06:30 PM	Hail	2.25 in.	0	0	0	0
436 Gracemont	05/24/2004	06:30 PM	Hail	1.25 in.	0	0	0	0
437 Gracemont	05/24/2004	06:45 PM	Hail	1.00 in.	0	0	0	0
438 Hinton	05/26/2004	04:45 PM	Hail	1.75 in.	0	0	0	0
439 Hinton	05/26/2004	04:46 PM	Hail	1.00 in.	0	0	0	0
440 Gracemont	07/01/2004	08:25 AM	Hail	1.00 in.	0	0	0	0
441 Cyril	05/08/2005	03:32 PM	Hail	1.00 in.	0	0	0	0
442 Cyril	05/08/2005	04:32 PM	Hail	1.00 in.	0	0	0	0
443 Cyril	05/08/2005	04:39 PM	Hail	1.75 in.	0	0	0	0
444 Cyril	05/08/2005	04:41 PM	Hail	1.00 in.	0	0	0	0
445 Cement	05/08/2005	04:54 PM	Hail	1.00 in.	0	0	0	0
446 Hydro	05/13/2005	07:50 PM	Hail	0.75 in.	0	0	0	0
447 Cogar	05/31/2005	03:25 PM	Hail	1.00 in.	0	0	0	0
448 Hinton	06/03/2005	06:53 AM	Hail	1.00 in.	0	0	0	0
449 Anadarko	06/04/2005	07:03 PM	Hail	0.75 in.	0	0	0	0
450 Carnegie	09/14/2005	09:55 PM	Hail	1.00 in.	0	0	0	0

451 Cyril	09/30/2005	09:07 PM	Hail	0.75 in.	0	0	0	0
452 Ft Cobb	09/30/2005	11:30 PM	Hail	1.00 in.	0	0	0	0
453 Anadarko	03/30/2006	12:27 PM	Hail	0.75 in.	0	0	0	0
454 Carnegie	04/24/2006	04:55 PM	Hail	0.75 in.	0	0	0	0
455 Washita	04/24/2006	05:32 PM	Hail	0.75 in.	0	0	0	0
456 Washita	04/24/2006	05:35 PM	Hail	1.00 in.	0	0	0	0
457 Anadarko	04/24/2006	05:46 PM	Hail	3.00 in.	0	0	0	0
458 Anadarko	04/24/2006	05:52 PM	Hail	0.75 in.	0	0	0	0
459 Anadarko	04/24/2006	05:53 PM	Hail	0.88 in.	0	0	0	0
460 Anadarko	04/24/2006	06:15 PM	Hail	0.88 in.	0	0	0	0
461 Cyril	04/24/2006	06:50 PM	Hail	0.75 in.	0	0	0	0
462 Anadarko	06/17/2006	03:33 PM	Hail	0.75 in.	0	0	0	0
463 Anadarko	06/17/2006	03:55 PM	Hail	0.88 in.	0	0	0	0
464 Anadarko	06/17/2006	04:00 PM	Hail	0.75 in.	0	0	0	0
465 Carnegie	08/03/2006	02:32 PM	Hail	0.88 in.	0	0	0	0
				TOTALS:	0	0	0	0

2.9.5. Probability of Future Events.

Based on the previous occurrences of 99 large hail events recorded in the last 46 years, an average of 2.10 events occurs per year. Therefore the probability of large-hail (equal to or greater than 1.50 “in diameter) occurring within Caddo County each year is highly likely.

2.9.6. Vulnerability Section.

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 Caddo 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.

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 the 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 4 inches in depth in 12 hours or less, or snowfall accumulation to 6 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 Caddo County are susceptible to severe winter storms.

2.10.3. Extent.

Based on past occurrence, Caddo 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, Caddo 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. Caddo 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.

XXII. 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 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 20 years (1984 - 2003), the National Climatic Data Center has recorded that Caddo County has experienced 23 significant winter storm events. Some examples of past winter storm events in Caddo 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 1 to 2 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.

December 4, 2002 - A winter storm affected the northwest half of Oklahoma during the afternoon and evening of the 3rd and early morning of the 4th. The precipitation started as freezing rain and sleet across portions of west central and northwest Oklahoma, including Harper, Ellis, Woodward, Woods, Alfalfa and Major Counties, and then quickly changed to snow. Total accumulations were between four and eight inches. The highest totals were nine inches in Arnett (Ellis County), eight inches in Mutual (Woodward County) and eight inches in Buffalo (Harper County). Southeast of this area, a mixture of freezing rain, sleet and snow fell, with ice accumulations ranging from a trace to one half inch, and snow accumulations between two and three inches. The greatest amount of ice fell from about Stillwater (Payne County), southwestward to about Guthrie (Logan County), Bethany (Oklahoma County), Weatherford (Custer County) and Elk City (Beckham County). Nearly 50,000 residences were without power during the peak of the winter storm.

XXIII. Figure: Ice and Snow Events.

30 SNOW & ICE event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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 Panhandle And North O	02/24/1993	0900	Snow/ice	N/A	0	0	0	0
2 Eastern And	11/25/1993	0900	Ice	N/A	0	0	0	0
3 OKZ031 - 032 042 - 043 047>049 051>053	01/16/1994	0630	Ice	N/A	0	0	0	0
4 Northern Oklahoma	03/08/1994	0445	Heavy Snow	N/A	0	0	0	0
5 Oklahoma	02/13/1995	2230	Freezing Drizzle And Freezing	N/A	0	0	0	0
6 Southern And Central	02/16/1995	0600	Freezing Rain And Sleet	N/A	0	0	0	0
7 Oklahoma, Western, Central	12/19/1995	1330	Heavy Snow & Ice	N/A	0	0	0	0
8 OKZ004>053	01/08/1997	11:50 PM	Heavy Snow	N/A	0	0	0	0
9 OKZ004>019 - 021>025 - 027	02/06/1997	11:00 PM	Heavy Snow	N/A	0	0	0	0
10 OKZ004>007 - 009>012 - 014>017 - 021>023 - 027 - 038	12/23/1997	11:00 PM	Heavy Snow	N/A	0	0	0	0
11 OKZ023 - 039>041 - 046	12/26/1997	12:00 AM	Heavy Snow	N/A	0	0	0	0
12 OKZ004>048 - 050>052	12/20/1998	04:00 PM	Ice Storm	N/A	0	0	0	0
13 OKZ004>040 - 042 - 044	01/07/1999	06:00 AM	Ice Storm	N/A	0	0	0	0
14 OKZ004>032 - 040 - 042	01/27/2000	06:00 AM	Heavy Snow	N/A	0	0	0	0
15 OKZ006 - 011 - 014>019 - 021>047 - 050>051	12/13/2000	06:00 AM	Winter Storm	N/A	0	0	0	0
16 OKZ023>032 - 037>048 - 050>052	12/26/2000	03:00 AM	Ice Storm	N/A	0	0	74.3M	0
17 OKZ006>008 - 011>013 - 015>024 - 033>036	01/28/2001	10:00 AM	Ice Storm	N/A	0	0	0	0
18 OKZ023>032 - 037>047	02/14/2001	09:00 PM	Freezing Rain	N/A	0	0	0	0
19 OKZ023 - 035>038 - 044	11/27/2001	10:00 PM	Heavy Snow	N/A	0	0	0	0
20 OKZ004>029 - 033>035 - 038	01/30/2002	01:00 AM	Ice Storm	N/A	0	0	300.0M	0
21 OKZ014>020 - 022>032 - 035 - 037>042 - 044>046	03/01/2002	08:00 PM	Ice/snow	N/A	0	0	0	0
22 OKZ019>020 - 023>030 - 033>036 - 038	12/03/2002	06:00 PM	Ice Storm	N/A	0	0	0	0
23 OKZ004>026 - 034>035	12/23/2002	10:00 AM	Heavy Snow	N/A	0	0	0	0
24 OKZ004 - 009>011 - 015>018 -	02/06/2003	09:30 AM	Heavy Snow	N/A	0	0	0	0

022>024								
25 OKZ014>026	12/12/2003	06:00 AM	Winter Storm	N/A	0	1	0	0
26 OKZ004>021 - 023>026 - 030	01/25/2004	10:00 PM	Winter Weather/mix	N/A	0	0	0	0
27 OKZ004 - 013>025	02/04/2004	05:00 AM	Winter Weather/mix	N/A	0	0	0	0
28 OKZ021>023 - 027>048 - 050>052	12/22/2004	05:30 AM	Winter Weather/mix	N/A	0	0	0	0
29 OKZ004>029 - 033>035	01/04/2005	09:30 AM	Winter Storm	N/A	0	0	100K	0
30 OKZ004>024 - 033	01/28/2005	06:00 AM	Heavy Snow	N/A	0	0	0	0
				TOTALS:	0	1	374.350M	0

XXIV. Figure: Temperature Extremes.

6 TEMPERATURE EXTREMES event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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>053	01/18/1996	02:00 AM	Extreme Cold	N/A	2	0	0	0
3 OKZ004>053	02/01/1996	12:00 AM	Extreme Cold	N/A	0	0	0	0
4 OKZ004>048 - 050>052	07/04/2001	12:00 AM	Excessive Heat	N/A	8	0	0	0
5 OKZ004>048 - 050>052	07/16/2006	12:00 PM	Heat	N/A	10	100	0	0
6 OKZ004>048 - 050>052	08/01/2006	12:00 AM	Heat	N/A	8	0	10K	0
				TOTALS:	28	100	10K	0

2.10.5. Probability of Future Events.

Based on previous occurrences, some 23 snow and/or ice events have occurred in the last 20 years. This would indicate that the probability of a winter storm occurring within Caddo 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.
12. 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 are 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 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 Caddo County’s, where moist Gulf air collides with artic 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, 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 – TORNADO/HIGH WINDS.

2.11.1. Description.

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

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.

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.

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

High Winds:

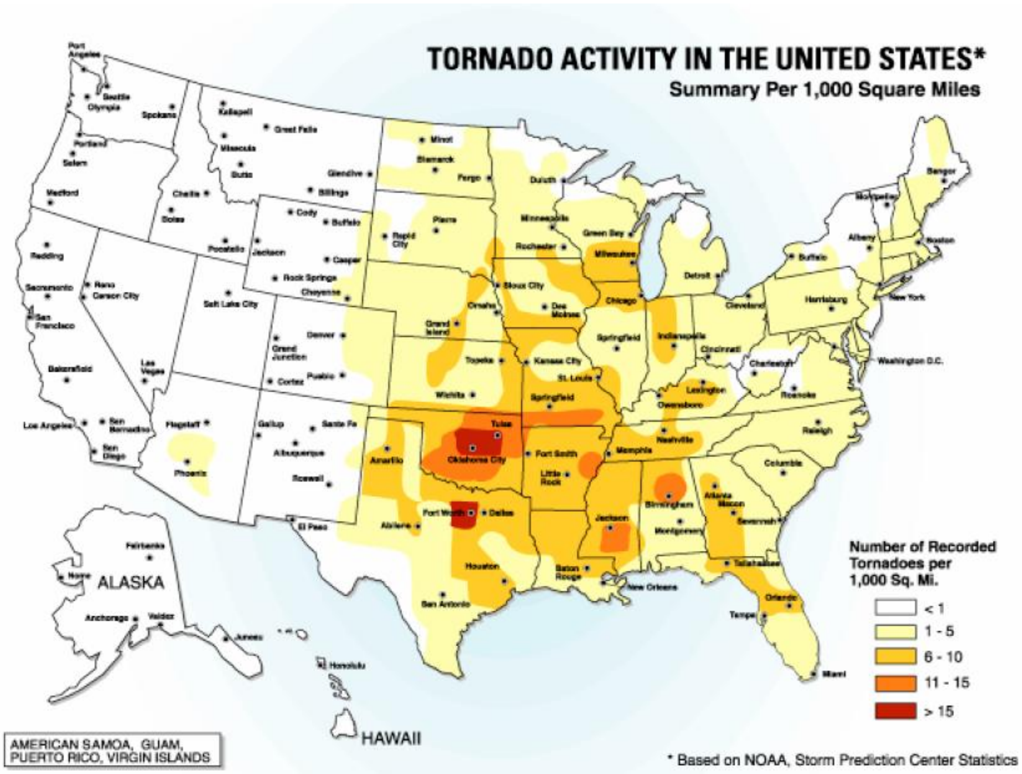
GENERAL DEFINITION: Wind is defined as the motion of air relative to the earth's surface. High winds can result from thunderstorm inflow and outflow, or downburst winds when the storm cloud collapses, and can result from strong frontal systems or gradient winds (high or low pressure systems) moving across 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 2 ½ 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 Caddo County can be caused by thunderstorms, but high winds can also occur without a thunderstorm event, such as a severe pressure gradient.

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

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.

XXV. Figure: Tornado Activity in the United States.



2.11.3. Extent.

The most severe impact by a tornado would be the result of an F5 tornado moving through the county and hitting several communities.

Tornadoes which drop in areas of low development cause little damage. Conversely, tornadoes, which drop in heavily populated areas can cause extreme loss of property and loss of human life. Winds of such velocity can lift even the most solidly built structure. Mature trees can be uprooted and flung across fields or into homes or businesses. Automobiles can be lifted and projected into other structures. Smaller projectiles made of glass shards, splintered lumber or metal have been documented to pierce trees, homes and other property. Death can result from any debris at this speed.

XXVI. Figure: Tornado: 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

2.11.4. Previous Occurrences.

Oklahoma, Texas and Kansas are the most common areas for tornado formation, though they can occur anywhere on the world. The United States as a whole has more large and intense tornadoes than any other country. Tornadoes have occurred in every state of the union. Nearly 900 occur each year. In the last 50 years 9,000 deaths were caused by tornadoes.

XXVII. Figure: Tornados Reported.

95 TORNADO(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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

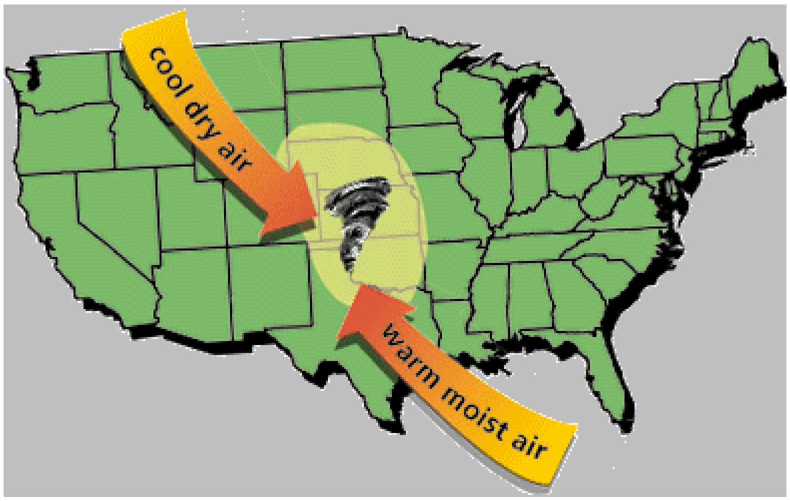
Oklahoma								
Location or County	**Date**	**Time**	**Type**	**Mag**	**Dth**	**Inj**	**PrD**	**CrD**
1 CADDO	02/19/1951	1830	Tornado	F2	0	5	25K	0
2 CADDO	03/24/1954	1530	Tornado	F2	0	0	25K	0
3 CADDO	04/26/1954	1800	Tornado	F0	0	0	0K	0
4 CADDO	05/01/1954	1650	Tornado	F2	0	0	25K	0
5 CADDO	04/26/1955	1815	Tornado	F0	0	0	0K	0
6 CADDO	04/26/1955	1815	Tornado	F2	0	0	250K	0
7 CADDO	04/26/1955	1830	Tornado	F2	0	0	25K	0
8 CADDO	06/04/1955	1900	Tornado	F2	0	0	25K	0
9 CADDO	04/22/1957	2000	Tornado	F3	0	1	250K	0
10 CADDO	04/22/1957	2015	Tornado	F2	0	0	250K	0
11 CADDO	05/12/1957	2200	Tornado	F0	0	0	0K	0
12 CADDO	04/02/1958	1755	Tornado	F1	0	1	25K	0
13 CADDO	05/16/1958	1048	Tornado	F0	0	0	0K	0
14 CADDO	06/06/1958	1855	Tornado	F1	0	0	3K	0
15 CADDO	11/17/1958	0700	Tornado	F2	0	0	0K	0
16 CADDO	03/25/1959	1448	Tornado	F0	0	0	3K	0
17 CADDO	07/22/1959	1900	Tornado	F1	0	0	0K	0
18 CADDO	04/28/1960	1900	Tornado	F3	0	0	25K	0
19 CADDO	05/19/1960	1600	Tornado	F0	0	0	0K	0
20 CADDO	05/19/1960	1600	Tornado	F1	0	0	3K	0
21 CADDO	05/23/1960	1830	Tornado	F2	0	0	0K	0
22 CADDO	05/23/1960	1830	Tornado	F2	0	0	0K	0

23 CADDO	05/23/1960	1830	Tornado	F2	0	1	25K	0
24 CADDO	05/21/1961	1733	Tornado	F	0	0	0K	0
25 CADDO	06/16/1963	0430	Tornado	F1	0	0	0K	0
26 CADDO	05/06/1964	0100	Tornado	F0	0	0	3K	0
27 CADDO	05/10/1964	1745	Tornado	F2	0	1	25K	0
28 CADDO	04/05/1965	1000	Tornado	F1	0	0	3K	0
29 CADDO	04/07/1965	2350	Tornado	F2	0	0	2.5M	0
30 CADDO	06/01/1965	2209	Tornado	F0	0	0	0K	0
31 CADDO	06/08/1966	1730	Tornado	F1	0	0	25K	0
32 CADDO	06/08/1966	1920	Tornado	F0	0	0	0K	0
33 CADDO	04/20/1967	1340	Tornado	F3	0	0	0K	0
34 CADDO	12/18/1968	0830	Tornado	F2	0	0	25K	0
35 CADDO	06/18/1973	1645	Tornado	F3	0	0	250K	0
36 CADDO	06/18/1973	1800	Tornado	F2	0	0	250K	0
37 CADDO	04/17/1976	0412	Tornado	F4	0	6	2.5M	0
38 CADDO	05/20/1977	1647	Tornado	F2	0	0	250K	0
39 CADDO	05/20/1977	1710	Tornado	F2	0	0	250K	0
40 CADDO	04/01/1978	1900	Tornado	F1	0	0	25K	0
41 CADDO	06/06/1979	1700	Tornado	F1	0	0	3K	0
42 CADDO	04/30/1981	2000	Tornado	F1	0	0	250K	0
43 CADDO	05/22/1981	1812	Tornado	F2	0	0	0K	0
44 CADDO	05/22/1981	1829	Tornado	F0	0	0	0K	0
45 CADDO	05/22/1981	1849	Tornado	F4	0	0	2.5M	0
46 CADDO	05/22/1981	1855	Tornado	F2	0	0	0K	0
47 CADDO	06/01/1981	1900	Tornado	F0	0	0	0K	0
48 CADDO	05/20/1982	1904	Tornado	F1	0	0	250K	0
49 CADDO	05/27/1982	1920	Tornado	F1	0	0	2.5M	0
50 CADDO	05/27/1982	1925	Tornado	F2	0	13	250K	0
51 CADDO	05/30/1982	1825	Tornado	F0	0	0	0K	0
52 CADDO	05/30/1982	1830	Tornado	F1	0	0	25K	0
53 CADDO	05/30/1982	1930	Tornado	F0	0	0	0K	0
54 CADDO	05/13/1983	2145	Tornado	F2	0	0	250K	0
55 CADDO	05/13/1983	2150	Tornado	F0	0	0	0K	0
56 CADDO	05/13/1983	2210	Tornado	F2	0	0	25K	0
57 CADDO	06/10/1983	1939	Tornado	F0	0	0	0K	0
58 CADDO	06/10/1983	2100	Tornado	F0	0	0	0K	0

59 CADDO	06/13/1983	1830	Tornado	F0	0	0	3K	0
60 CADDO	06/13/1983	1845	Tornado	F0	0	0	0K	0
61 CADDO	05/16/1986	2035	Tornado	F1	0	0	25K	0
62 CADDO	05/16/1986	2130	Tornado	F0	0	0	0K	0
63 CADDO	02/14/1987	1805	Tornado	F1	0	0	0K	0
64 CADDO	05/26/1990	1900	Tornado	F3	0	0	250K	0
65 CADDO	05/26/1990	1955	Tornado	F2	0	0	25K	0
66 Cyril	08/21/1996	03:35 PM	Tornado	F0	0	0	0	0
67 Apache	11/16/1996	04:00 PM	Tornado	F0	0	0	0	0
68 Cyril	05/25/1997	04:27 PM	Tornado	F0	0	0	0	0
69 Cyril	10/04/1998	05:45 PM	Tornado	F0	0	0	7K	0
70 Apache	05/03/1999	04:20 PM	Tornado	F3	0	3	50K	0
71 Cyril	05/03/1999	04:26 PM	Tornado	F0	0	0	0	0
72 Anadarko	05/03/1999	04:38 PM	Tornado	F0	0	0	0	0
73 Cement	05/03/1999	04:46 PM	Tornado	F2	0	0	75K	0
74 Apache	05/03/1999	05:20 PM	Tornado	F0	0	0	0	0
75 Ft Cobb	05/03/1999	05:38 PM	Tornado	F1	0	0	20K	0
76 Anadarko	05/03/1999	05:56 PM	Tornado	F0	0	0	0	0
77 Anadarko	05/03/1999	06:12 PM	Tornado	F0	0	0	0	0
78 Gracemont	05/03/1999	06:20 PM	Tornado	F0	0	0	0	0
79 Gracemont	05/03/1999	06:34 PM	Tornado	F0	0	0	0	0
80 Cogar	05/03/1999	06:37 PM	Tornado	F1	0	0	1K	0
81 Eakly	05/26/2000	06:28 PM	Tornado	F0	0	0	0K	0
82 Eakly	05/26/2000	06:47 PM	Tornado	F0	0	0	0K	0
83 Binger	05/26/2000	06:57 PM	Tornado	F0	0	0	0	0
84 Binger	10/22/2000	03:14 PM	Tornado	F0	0	0	2K	0
85 Alfalfa	10/09/2001	05:18 PM	Tornado	F1	0	0	150K	0
86 Carnegie	10/09/2001	05:28 PM	Tornado	F0	0	0	0K	0
87 Albert	10/09/2001	05:57 PM	Tornado	F1	0	0	1K	0
88 Binger	10/09/2001	06:05 PM	Tornado	F1	0	0	125K	0
89 Gracemont	10/09/2001	06:15 PM	Tornado	F0	0	0	20K	0
90 Spring Creek	10/09/2001	06:20 PM	Tornado	F1	0	0	75K	0
91 Eakly	05/09/2003	07:50 PM	Tornado	F0	0	0	0	0
92 Binger	05/09/2003	08:00 PM	Tornado	F1	0	0	40K	0
93 Cogar	05/09/2003	08:17 PM	Tornado	F0	0	0	5K	0
94 Alfalfa	05/24/2004	05:21 PM	Tornado	F1	0	0	40K	0

95 Eakly	05/24/2004	05:27 PM	Tornado	F1	0	0	50K	0
				TOTALS:	0	31	14.079M	0

XXVIII. 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.

In Oklahoma, Caddo County is located within this area and tornadoes have a history of development and destruction throughout the 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 94 tornadoes were recorded.

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 4:00 PM to 6:00 PM. Four Tornadoes within Caddo County have varied in intensity from F0 to F5 on the Fujita Scale. Out of the 94 total, two were rated as F4, seven as F3, and twenty-six were rated as F2, and 59 were F1 or F0 on the Fujita Scale.

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

May 3, 1999 – 14 Tornadoes reported in a 7-hour period. Beginning north of Fort Sill in Comanche County, the tornadoes traveled across Caddo, Grady and McClain Counties into the Oklahoma City metropolitan area and beyond. The first tornado of the outbreak touched down on US 62, two miles north of Interstate 44 in Comanche County at 3:51 PM.

The second tornado formed approximately three miles west of Elgin in Comanche County. No damage was observed. The third tornado touched down in a rural area three miles east of Apache in Caddo County. As the tornado moved northward to near Anadarko in Caddo County, one house was destroyed near the community of Stecker in Caddo County, with its roof ripped off and several walls knocked down. Three persons inside the house were injured. Damage was estimated at $50,000.

The fourth tornado was seen three miles northwest of Cyril in Caddo County just west of SH 8. No damage was reported.

The fifth tornado formed two miles south of Anadarko in Caddo County. No damage was reported. The sixth tornado developed about three miles north-northeast of Cement near the Caddo/Grady County border, and quickly intensified to a strong tornado with associated damage rated at the high end of the F3 scale. Damage was estimated at $75,000.

The most notable tornado was rated F5 and formed over Grady County near Amber and tracked northeast for 37 miles eventually into the Oklahoma City metropolitan area after 6:00 P.M. Bridgecreek in Grady County, Oklahoma City (Oklahoma County) , Moore (Oklahoma County), Del City (Oklahoma County) and Midwest City (Oklahoma County) suffered tremendous damage.

March 7, 2000 Anadarko--Minor roof damage was reported. In addition, signs were blown down; storefront windows were broken, trees were downed, a 60-foot antenna was blown off the roof of a fire department, and the roof of Bill's Dollar Store was blown completely off. Damage was estimated at $65,000.

October 22, 2000 - This tornado developed east of Binger in Caddo County, about two miles south of the Highway 152/Highway 281 intersection. It tracked northward for four miles before dissipating, blowing over two old wooden barns, a medium-sized tree and damaging another medium-sized tree. Damage was estimated at $2,000.

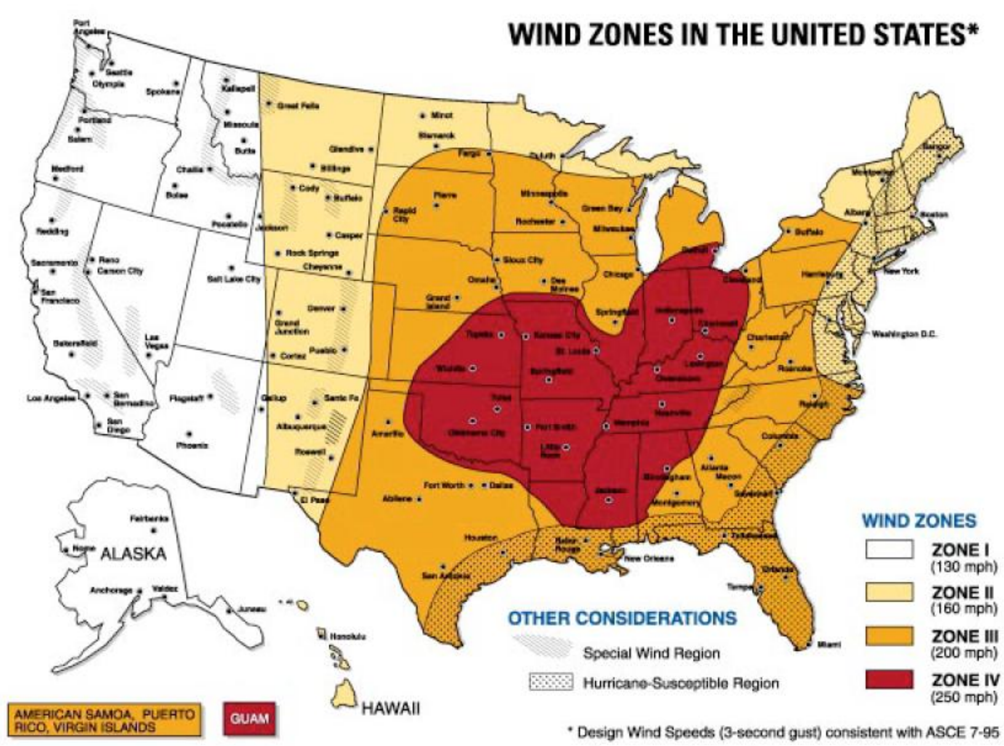
May 27, 2001, 9:00 PM, Carnegie--The high school and junior high school roofs were partially blown off. Additional roof damage was observed on homes. Trees four-feet in diameter were also blown down. Damage was estimated at $200,000.

October 9, 2001 - The Green Acres Fire Station, seven miles south of Binger in Caddo County, had its sheet-metal roof blown off, with the remaining building partially destroyed. Two brick homes suffered minor damage. A mobile home was destroyed, another with minor damage. Several pieces of farm equipment and hundreds of trees were also blown over. Damage was estimated at $125,000.

October 10, 2002 - A single-floor home was unroofed with the debris completely displaced from its foundation. An outer wall of the home was also blown out. Also along the tornado path, sections of irrigation equipment were either toppled or destroyed and several trees were snapped at the base of the trunk.

May 9, 2003 – This is the first segment of a tornado that started in Caddo County and moved east-northeast before dissipating just after crossing into Grady County, nine miles west-northwest of Minco. The tornado began near the intersection of EW115 Road and NS274 Road then traveled 1.2 miles dissipating just to the northeast of the location a quarter mile north of EW115 Road on the county line road of NS275 Road. A homestead was damaged with tree limbs snapped, stockade fence blown over, a camper trailer blown sideways, a trampoline lofted and swing set blown over. This occurred shortly before the tornado crossed the County line. This brief F1 tornado began a quarter of a mile north of Highway 152 on NS267 Road then moved east for a mile dissipating a half a mile south of Highway 152 on NS268 Road. The tornado launched a pickup camper 150 yards, snapped large tree limbs and blew a cotton trailer 50 yards. The tornado crossed Highway 152 and damaged a mobile home.

XXIX. Figure: Wind Zones in the United States.



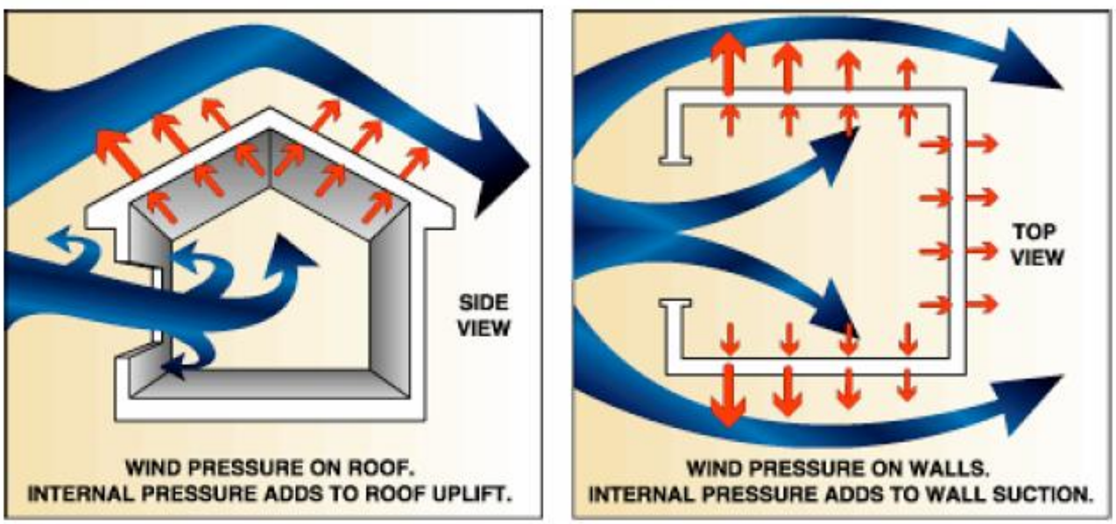
2.11.5. Extent of Damaging Winds.

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 Caddo County.

Extreme winds can cause several kinds of damage to a building. Figure XXX 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.

XXX. Figure: Diagram of Windstorm Effects.

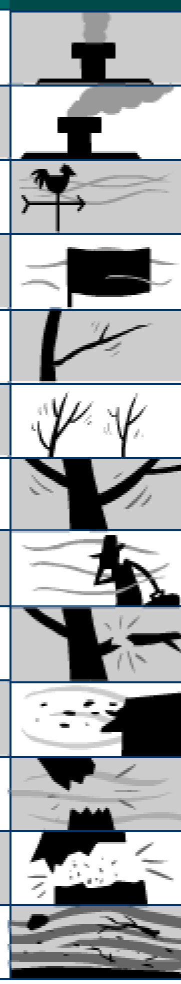


Buildings that fail under the effects of extreme winds often appear to have exploded, giving rise to the misconception that the damage is caused by unequal wind pressures inside and outside the building. This misconception has led to the myth that during an extreme wind event, the windows and doors in 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.

XXXI. 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.

2.11.6. Previous Occurrences.

Since 1983 the National Climatic Data Center (NCDC) recorded 104 thunderstorm events in Caddo County. Due to the rural nature of the County, most reports of thunderstorms and any associated damage, are from cites and towns.

XXXII. Figure: High Wind Events.

228 HIGH WINDS event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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 CADDO	04/02/1957	2100	Tstm Wind	0 kts.	0	0	0	0
2 CADDO	04/15/1957	2153	Tstm Wind	0 kts.	0	0	0	0
3 CADDO	08/28/1957	1400	Tstm Wind	0 kts.	0	0	0	0
4 CADDO	07/12/1959	1530	Tstm Wind	0 kts.	0	0	0	0
5 CADDO	06/25/1961	2115	Tstm Wind	0 kts.	0	0	0	0
6 CADDO	09/03/1961	1700	Tstm Wind	0 kts.	0	0	0	0
7 CADDO	04/10/1962	0600	Tstm Wind	0 kts.	0	0	0	0
8 CADDO	05/24/1962	2000	Tstm Wind	0 kts.	0	0	0	0
9 CADDO	05/26/1962	2000	Tstm Wind	0 kts.	0	0	0	0
10 CADDO	03/04/1963	0600	Tstm Wind	0 kts.	0	0	0	0
11 CADDO	06/23/1963	0330	Tstm Wind	0 kts.	0	0	0	0
12 CADDO	05/26/1965	0200	Tstm Wind	0 kts.	0	0	0	0
13 CADDO	05/26/1965	0215	Tstm Wind	0 kts.	0	0	0	0
14 CADDO	08/20/1965	1500	Tstm Wind	0 kts.	0	0	0	0
15 CADDO	06/10/1968	1720	Tstm Wind	0 kts.	0	0	0	0
16 CADDO	06/15/1968	1530	Tstm Wind	0 kts.	0	0	0	0
17 CADDO	06/15/1968	1600	Tstm Wind	0 kts.	0	0	0	0
18 CADDO	06/15/1968	1645	Tstm Wind	0 kts.	0	0	0	0
19 CADDO	06/15/1968	1645	Tstm Wind	0 kts.	0	0	0	0
20 CADDO	05/31/1969	2345	Tstm Wind	0 kts.	0	0	0	0
21 CADDO	06/11/1970	1330	Tstm Wind	78 kts.	0	0	0	0
22 CADDO	06/20/1970	1530	Tstm Wind	0 kts.	0	0	0	0
23 CADDO	06/07/1971	1910	Tstm Wind	0 kts.	0	0	0	0
24 CADDO	06/06/1975	2200	Tstm Wind	0 kts.	0	0	0	0

25 CADDO	05/30/1977	2010	Tstm Wind	51 kts.	0	0	0	0
26 CADDO	05/30/1977	2128	Tstm Wind	62 kts.	0	0	0	0
27 CADDO	07/15/1977	1730	Tstm Wind	0 kts.	0	0	0	0
28 CADDO	06/21/1978	1315	Tstm Wind	61 kts.	0	0	0	0
29 CADDO	03/22/1979	0125	Tstm Wind	0 kts.	0	0	0	0
30 CADDO	08/31/1979	0200	Tstm Wind	52 kts.	0	0	0	0
31 CADDO	03/23/1980	1556	Tstm Wind	0 kts.	0	0	0	0
32 CADDO	04/30/1981	2030	Tstm Wind	0 kts.	0	0	0	0
33 CADDO	05/20/1982	1742	Tstm Wind	70 kts.	0	0	0	0
34 CADDO	05/27/1982	1925	Tstm Wind	0 kts.	0	0	0	0
35 CADDO	05/27/1982	1955	Tstm Wind	0 kts.	0	0	0	0
36 CADDO	05/30/1982	2040	Tstm Wind	70 kts.	0	0	0	0
37 CADDO	08/27/1982	1512	Tstm Wind	0 kts.	0	0	0	0
38 CADDO	08/27/1982	1519	Tstm Wind	0 kts.	0	0	0	0
39 CADDO	09/12/1982	1510	Tstm Wind	0 kts.	0	0	0	0
40 CADDO	05/13/1983	2200	Tstm Wind	0 kts.	0	0	0	0
41 CADDO	06/13/1983	1915	Tstm Wind	0 kts.	0	0	0	0
42 CADDO	06/27/1983	1930	Tstm Wind	0 kts.	0	0	0	0
43 CADDO	06/27/1983	1943	Tstm Wind	52 kts.	0	0	0	0
44 CADDO	05/27/1984	1715	Tstm Wind	52 kts.	0	0	0	0
45 CADDO	06/23/1984	1400	Tstm Wind	0 kts.	0	0	0	0
46 CADDO	03/03/1985	1845	Tstm Wind	0 kts.	0	0	0	0
47 CADDO	03/03/1985	1850	Tstm Wind	0 kts.	0	0	0	0
48 CADDO	03/03/1985	1900	Tstm Wind	0 kts.	0	0	0	0
49 CADDO	03/03/1985	1910	Tstm Wind	0 kts.	0	0	0	0
50 CADDO	06/01/1985	1600	Tstm Wind	0 kts.	0	0	0	0
51 CADDO	06/02/1985	1937	Tstm Wind	61 kts.	0	0	0	0
52 CADDO	07/15/1985	1410	Tstm Wind	0 kts.	0	0	0	0
53 CADDO	07/15/1985	1500	Tstm Wind	52 kts.	0	0	0	0
54 CADDO	04/17/1986	2255	Tstm Wind	0 kts.	0	0	0	0

55 CADDO	05/06/1986	1945	Tstm Wind	52 kts.	0	0	0	0
56 CADDO	05/08/1986	1610	Tstm Wind	0 kts.	0	0	0	0
57 CADDO	05/16/1986	2115	Tstm Wind	0 kts.	0	0	0	0
58 CADDO	07/31/1986	1545	Tstm Wind	0 kts.	0	0	0	0
59 CADDO	05/19/1987	1700	Tstm Wind	0 kts.	0	0	0	0
60 CADDO	05/20/1987	1830	Tstm Wind	0 kts.	0	0	0	0
61 CADDO	06/17/1987	2050	Tstm Wind	56 kts.	0	0	0	0
62 CADDO	06/17/1987	2140	Tstm Wind	52 kts.	0	0	0	0
63 CADDO	06/19/1987	1005	Tstm Wind	65 kts.	0	0	0	0
64 CADDO	06/19/1987	1106	Tstm Wind	55 kts.	0	0	0	0
65 CADDO	10/25/1987	2115	Tstm Wind	52 kts.	0	0	0	0
66 CADDO	04/24/1988	2225	Tstm Wind	59 kts.	0	0	0	0
67 CADDO	04/24/1988	2300	Tstm Wind	52 kts.	0	0	0	0
68 CADDO	04/24/1988	2335	Tstm Wind	52 kts.	0	0	0	0
69 CADDO	08/09/1988	1430	Tstm Wind	56 kts.	0	0	0	0
70 CADDO	11/15/1988	1025	Tstm Wind	0 kts.	0	0	0	0
71 CADDO	11/15/1988	1025	Tstm Wind	0 kts.	0	0	0	0
72 CADDO	11/15/1988	1025	Tstm Wind	52 kts.	0	0	0	0
73 CADDO	06/03/1989	1505	Tstm Wind	56 kts.	0	0	0	0
74 CADDO	06/04/1989	2130	Tstm Wind	0 kts.	0	0	0	0
75 CADDO	06/10/1989	2230	Tstm Wind	0 kts.	0	0	0	0
76 CADDO	06/13/1989	0115	Tstm Wind	0 kts.	0	0	0	0
77 CADDO	10/05/1989	2145	Tstm Wind	0 kts.	0	0	0	0
78 CADDO	04/16/1990	2209	Tstm Wind	61 kts.	0	0	0	0
79 CADDO	05/25/1990	0015	Tstm Wind	0 kts.	0	0	0	0
80 CADDO	05/29/1990	1858	Tstm Wind	52 kts.	0	0	0	0
81 CADDO	05/29/1990	1940	Tstm Wind	52 kts.	0	0	0	0

82 CADDO	05/29/1990	1940	Tstm Wind	54 kts.	0	0	0	0
83 CADDO	05/29/1990	2330	Tstm Wind	61 kts.	0	0	0	0
84 CADDO	04/26/1991	0209	Tstm Wind	54 kts.	0	0	0	0
85 CADDO	05/07/1991	1600	Tstm Wind	52 kts.	0	0	0	0
86 CADDO	05/23/1991	2245	Tstm Wind	52 kts.	0	0	0	0
87 CADDO	05/23/1991	2315	Tstm Wind	52 kts.	0	0	0	0
88 CADDO	05/23/1991	2340	Tstm Wind	52 kts.	0	0	0	0
89 CADDO	06/01/1991	1910	Tstm Wind	52 kts.	0	0	0	0
90 CADDO	06/01/1991	1930	Tstm Wind	52 kts.	0	0	0	0
91 CADDO	06/01/1991	1937	Tstm Wind	52 kts.	0	0	0	0
92 CADDO	06/12/1991	2025	Tstm Wind	54 kts.	0	0	0	0
93 CADDO	07/21/1991	1607	Tstm Wind	52 kts.	0	0	0	0
94 CADDO	08/29/1991	2203	Tstm Wind	0 kts.	0	0	0	0
95 CADDO	08/29/1991	2225	Tstm Wind	52 kts.	0	0	0	0
96 CADDO	06/19/1992	2130	Tstm Wind	0 kts.	0	0	0	0
97 CADDO	07/30/1992	1745	Tstm Wind	53 kts.	0	0	0	0
98 CADDO	09/05/1992	2355	Tstm Wind	0 kts.	0	0	0	0
99 CADDO	09/20/1992	1815	Tstm Wind	52 kts.	0	0	0	0
100 Hydro	05/07/1993	1800	Thunderstorm Winds	N/A	0	0	0	0
101 Hydro	05/07/1993	1940	Thunderstorm Winds	N/A	0	0	0	0
102 Hydro	05/07/1993	1945	Thunderstorm Winds	N/A	0	0	0	0
103 Hinton	05/07/1993	2100	Thunderstorm Winds	N/A	0	0	0	0
104 CADDO	05/07/1993	2140	Thunderstorm Winds	N/A	0	0	5K	0
105 Eakley	05/17/1993	1908	Thunderstorm Winds	N/A	0	0	50K	0

106 Hinton	05/17/1993	1922	Thunderstorm Winds	N/A	0	0	0	0
107 Stecker	09/12/1993	1730	Thunderstorm Winds	N/A	0	0	5K	0
108 Anadarko	09/12/1993	1741	Thunderstorm Winds	N/A	0	0	0	0
109 Anadarko	12/12/1993	1843	Thunderstorm Winds	N/A	0	0	1K	0
110 CADDO	03/08/1994	1250	Thunderstorm Winds	N/A	0	0	0	0
111 Bridgeport	05/25/1994	1839	Thunderstorm Winds	N/A	0	0	0	0
112 Hydro	05/25/1994	1855	Thunderstorm Winds	N/A	0	0	0	0
113 Alfalfa	06/11/1994	0700	Thunderstorm Winds	N/A	0	0	0	0
114 Carnegie	06/11/1994	0710	Thunderstorm Winds	N/A	0	0	0	0
115 Ft Cobb	06/11/1994	0730	Thunderstorm Winds	N/A	0	0	0	0
116 Hinton	06/29/1994	2110	Thunderstorm Winds	N/A	0	0	0	0
117 Hinton	06/29/1994	2115	Thunderstorm Winds	N/A	0	0	0	0
118 Anadarko	06/29/1994	2240	Thunderstorm Winds	N/A	0	0	5K	0
119 Hinton	07/26/1994	0350	Thunderstorm Winds	N/A	0	0	0	0
120 W Anadarko	08/17/1994	1650	Thunderstorm Winds	N/A	0	0	0	0
121 Verden	05/07/1995	1015	Thunderstorm Winds	N/A	0	0	0	0
122 Gracemont	06/03/1995	1922	Thunderstorm Winds	N/A	0	0	0	0
123 Eakly	06/03/1995	2240	Thunderstorm Winds	N/A	0	0	50K	0
124 Nr Cement	07/20/1995	1432	Thunderstorm Winds	N/A	0	0	0	0
125 Eakly	07/21/1995	2000	Thunderstorm Winds	N/A	0	0	0	0
126 Carnegie	07/22/1995	2222	Thunderstorm Winds	N/A	0	0	0	0
127 Apache	07/22/1995	2300	Thunderstorm Winds	N/A	0	0	0	0
128 OKZ004>053	01/17/1996	09:30 PM	High Wind	45 kts.	0	0	3K	0

129 OKZ023	05/22/1996	07:30 PM	High Wind	65 kts.	0	0	0	0
130 Anadarko	05/26/1996	05:27 PM	Tstm Wind	57 kts.	0	0	0	0
131 Bridgeport	05/31/1996	10:30 PM	Tstm Wind	0 kts.	0	0	0K	0
132 Hinton (mesonet)	06/15/1996	02:35 PM	Tstm Wind	51 kts.	0	0	0	0
133 Cyril	07/02/1996	05:25 PM	Tstm Wind	65 kts.	0	0	6K	0
134 Hinton	11/16/1996	02:26 PM	Tstm Wind	57 kts.	0	0	0	0
135 Hinton	11/16/1996	02:26 PM	Tstm Wind	57 kts.	0	0	0	0
136 Anadarko	11/16/1996	04:05 PM	Tstm Wind	52 kts.	0	0	0	0
137 Apache	11/16/1996	04:10 PM	Tstm Wind	0 kts.	0	0	0	0
138 Binger	05/07/1997	09:50 PM	Tstm Wind	0 kts.	0	1	60K	0
139 Cogar	07/10/1997	06:15 PM	Tstm Wind	0 kts.	0	0	20K	0
140 Ft Cobb	08/22/1997	04:10 AM	Tstm Wind	60 kts.	0	0	0	0
141 Carnegie	08/22/1997	04:15 AM	Tstm Wind	0 kts.	0	0	50K	0
142 Ft Cobb	08/22/1997	04:15 AM	Tstm Wind	0 kts.	0	0	12K	0
143 Anadarko	08/22/1997	04:20 AM	Tstm Wind	0 kts.	0	0	1K	0
144 Cyril	08/22/1997	04:30 AM	Tstm Wind	0 kts.	0	0	1K	0
145 Apache	09/09/1997	07:20 AM	Tstm Wind	54 kts.	0	0	0	0
146 Carnegie	03/27/1998	04:30 AM	Tstm Wind	0 kts.	0	0	5K	0
147 Apache	04/14/1998	03:49 PM	Tstm Wind	52 kts.	0	0	0	0
148 Hinton	05/25/1998	03:26 AM	Tstm Wind	60 kts.	0	0	0	0
149 Hinton	06/08/1998	02:41 PM	Tstm Wind	52 kts.	0	0	0	0
150 Eakly	07/07/1998	06:49 PM	Tstm Wind	0 kts.	0	0	15K	0
151 Alfalfa	07/07/1998	06:53 PM	Tstm Wind	0 kts.	0	0	3K	0
152 Apache	08/10/1998	02:30 PM	Tstm Wind	0 kts.	0	0	1K	0
153 Cyril	10/04/1998	05:45 PM	Tstm Wind	52 kts.	0	0	0	0
154 OKZ004>048 - 050>052	02/11/1999	07:00 AM	High Wind	0 kts.	0	0	2K	0
155 OKZ018>020 - 022>031 - 033>042 - 044>046 - 050	03/02/1999	12:00 PM	High Wind	0 kts.	0	0	0	0
156 OKZ004>031 - 033>038 - 044	03/08/1999	02:00 PM	High Wind	0 kts.	0	0	16K	0

157 OKZ004>040 - 042 - 044>045 - 052	04/14/1999	05:00 PM	High Wind	64 kts.	0	0	57K	0
158 Cyril	05/31/1999	08:23 PM	Tstm Wind	61 kts.	0	0	0	0
159 Hinton	08/03/1999	04:20 PM	Tstm Wind	53 kts.	0	0	0	0
160 Hinton	08/03/1999	04:25 PM	Tstm Wind	58 kts.	0	0	0	0
161 Hinton	10/29/1999	06:25 PM	Tstm Wind	52 kts.	0	0	0	0
162 Cyril	03/07/2000	06:30 PM	Tstm Wind	55 kts.	0	0	0	0
163 Anadarko	03/07/2000	06:34 PM	Tstm Wind	0 kts.	0	0	65K	0
164 Cyril	03/07/2000	06:35 PM	Tstm Wind	60 kts.	0	0	0	0
165 Carnegie	05/24/2000	07:20 PM	Tstm Wind	61 kts.	0	0	0K	0
166 Anadarko	05/24/2000	08:02 PM	Tstm Wind	0 kts.	0	0	2K	0
167 Hydro	05/26/2000	07:30 PM	Tstm Wind	61 kts.	0	0	0	0
168 Anadarko	07/22/2000	03:30 AM	Tstm Wind	0 kts.	0	0	1K	0
169 Apache	07/22/2000	03:40 AM	Tstm Wind	53 kts.	0	0	0	0
170 Apache	07/22/2000	03:45 AM	Tstm Wind	54 kts.	0	0	0	0
171 Anadarko	10/22/2000	04:52 PM	Tstm Wind	52 kts.	0	0	0	0
172 OKZ004>006 - 009>011 - 014>017 - 022>023 - 033>038	03/15/2001	09:40 AM	High Wind	50 kts.	0	0	101K	0
173 OKZ004>006 - 009>011 - 015>017 - 020>023 - 033>038 - 044	04/06/2001	06:00PM	High Wind	52k.	0	0	20K	0
174 OKZ005>008 - 010>048 - 050>052	04/10/2001	09:00PM	High Wind	44kts.	0	0	33K	0
175 Boone	04/22/2001	01:15PM	Tstm Wind	52kts.	0	0	0	0
176 Bridgeport	05/05/2001	08:00 PM	Tstm Wind	0 kts.	0	0	10K	0
177 Ft Cobb	05/18/2001	01:05 AM	Tstm Wind	57kts.	0	0	0	0
178 Ft Cobb	05/18/2001	01:10 AM	Tstm Wind	53 kts.	0	0	0	0
179 Apache	05/18/2001	01:38 AM	Tstm Wind	0 kts.	0	0	1K	0
180 Hinton	05/18/2001	12:50 AM	Tstm Wind	57 kts.	0	0	0	0
181 Hinton	05/27/2001	08:40 PM	Tstm Wind	59 kts.	0	0	0	0
182 Carnegie	05/27/2001	09:00 PM	Tstm Wind	0 kts.	0	0	200K	0

183 Ft Cobb	05/27/2001	09:05 PM	Tstm Wind	50 kts.	0	0	0	0
184 Hinton	05/27/2001	09:05 PM	Tstm Wind	54 kts.	0	0	0	0
185 Anadarko	05/27/2001	09:17 PM	Tstm Wind	52 kts.	0	0	0	0
186 Cyril	05/27/2001	09:21 PM	Tstm Wind	52 kts.	0	0	0	0
187 Hinton	05/29/2001	10:50 PM	Tstm Wind	0 kts.	0	0	20K	0
188 Hydro	05/30/2001	03:00 AM	Tstm Wind	0 kts.	0	0	0K	0
189 Hinton	06/12/2001	09:40 PM	Tstm Wind	51 kts.	0	0	0	0
190 Hinton	06/12/2001	09:45 PM	Tstm Wind	50 kts.	0	0	0	0
191 Anadarko	07/16/2001	04:10 PM	Tstm Wind	0 kts.	0	0	0K	0
192 Apache	08/22/2001	03:35 PM	Tstm Wind	51 kts.	0	0	0	0
193 OKZ004>006 - 009>011 - 014>017 - 021>023 - 033>036	10/15/2001	10:00 AM	High Wind	39 kts.	0	0	0	0
194 OKZ004>005 - 008>048 - 050>052	03/08/2002	07:00 PM	High Wind	45 kts.	0	0	0	0
195 OKZ004>042 - 044>046	04/02/2002	08:00 AM	Strong Winds	N/A	0	0	0	0
196 Ft Cobb	06/08/2002	07:00 PM	Tstm Wind	73 kts.	0	0	0	0
197 Albert	06/08/2002	07:05 PM	Tstm Wind	0 kts.	0	0	5K	0
198 Ft Cobb	06/08/2002	07:05 PM	Tstm Wind	64 kts.	0	0	0	0
199 Ft Cobb	06/08/2002	07:10 PM	Tstm Wind	57 kts.	0	0	2K	0
200 Anadarko	06/08/2002	07:30 PM	Tstm Wind	0 kts.	0	0	0K	0
201 Hydro	06/15/2002	07:05 PM	Tstm Wind	52 kts.	0	0	0	0
202 Hinton	06/15/2002	07:25 PM	Tstm Wind	56 kts.	0	0	0	0
203 Ft Cobb	06/15/2002	07:40 PM	Tstm Wind	55 kts.	0	0	0	0
204 Anadarko	06/15/2002	07:55 PM	Tstm Wind	52 kts.	0	0	0	0
205 Apache	06/15/2002	08:05 PM	Tstm Wind	51 kts.	0	0	0	0
206 Apache	06/15/2002	08:10 PM	Tstm Wind	51 kts.	0	0	0	0
207 Anadarko	06/15/2002	08:20 PM	Tstm Wind	61 kts.	0	0	0	0

208 Hinton	07/29/2002	01:20 AM	Tstm Wind	52 kts.	0	0	0	0
209 Lookeba	07/29/2002	01:45 AM	Tstm Wind	0 kts.	0	0	0K	0
210 Hinton	08/27/2002	01:20 AM	Tstm Wind	55 kts.	0	0	0	0
211 Stecker	08/27/2002	02:00 AM	Tstm Wind	0 kts.	0	0	0K	0
212 Cyril	04/06/2003	04:12 AM	Tstm Wind	52 kts.	0	0	0	0
213 Hinton	06/10/2003	05:20 PM	Tstm Wind	52 kts.	0	0	0	0
214 Gracemont	06/11/2003	07:55 PM	Tstm Wind	61 kts.	0	0	1K	0
215 Anadarko	06/11/2003	08:02 PM	Tstm Wind	56 kts.	0	0	2K	0
216 Cement	06/11/2003	08:21 PM	Tstm Wind	61 kts.	0	0	1K	0
217 Anadarko	03/04/2004	02:30 PM	Tstm Wind	52 kts.	0	0	0	0
218 Anadarko	07/07/2004	02:00 AM	Tstm Wind	61 kts.	0	0	1K	0
219 Alfalfa	05/12/2005	11:25 PM	Tstm Wind	52 kts.	0	0	0	0
220 Anadarko	06/04/2005	06:54 PM	Tstm Wind	52 kts.	0	0	0	0
221 Anadarko	06/04/2005	06:56 PM	Tstm Wind	61 kts.	0	0	0	0
222 Lookeba	06/12/2005	05:58 PM	Tstm Wind	69 kts.	0	0	0	0
223 Eakly	06/16/2005	10:17 PM	Tstm Wind	69 kts.	0	0	5K	0
224 Anadarko	06/16/2005	10:56 PM	Tstm Wind	52 kts.	0	0	5K	0
225 Hinton	07/01/2005	03:45 AM	Tstm Wind	56 kts.	0	0	0	0
226 Hinton	07/04/2005	12:35 AM	Tstm Wind	52 kts.	0	0	0	0
227 OKZ023 - 037>038 - 042 - 045>047	03/20/2006	03:30 PM	High Wind	61 kts.	0	0	60K	0
228 Apache	04/01/2006	08:40 PM	Tstm Wind	56 kts.	0	0	5K	0
				TOTALS:	0	1	904K	0

2.11.7. Probability of Future Events.

In the last 53 years Caddo County had 94 tornadoes and 228 high wind events and, resulting in an average of 1.77 tornadoes and 4.3 high wind events per year. Therefore the probability of a tornado or high wind occurring within the county each year is highly likely.

2.11.8. Vulnerability.

Located in the central part of Oklahoma, Caddo 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 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 the 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 Caddo County.

2.11.9. Secondary Hazards.

Secondary hazards in Caddo 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.

2.11.10. 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 Caddo County has experienced tornadoes of various intensities, with 85 tornadoes rated as an F2 or under and nine tornadoes rated as F3 or F4. Tornadoes 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.

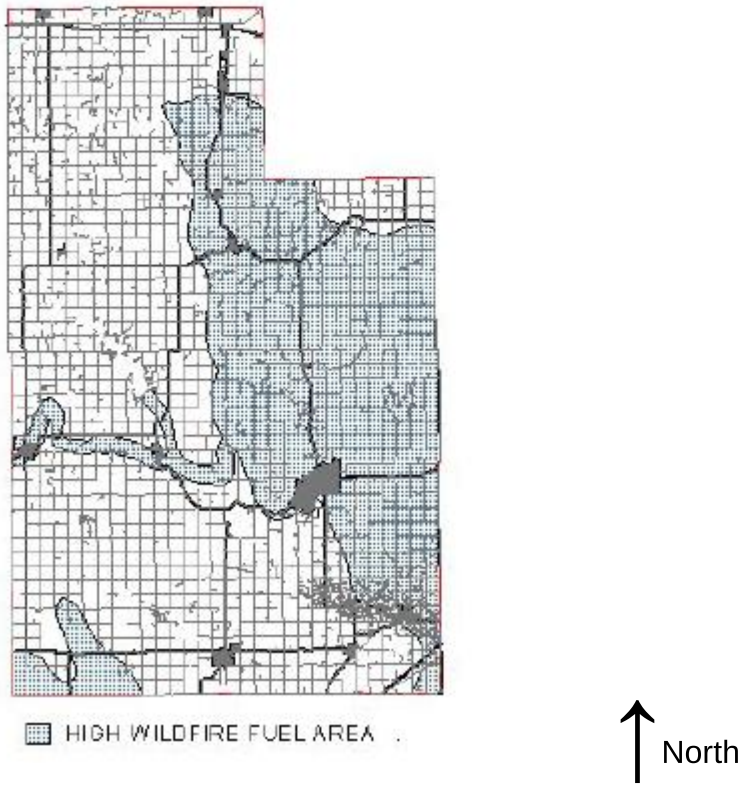
High winds, especially those associated with a frontal passage, often cause severe wind erosion to exposed soil creating a safety and health problem due to visibility and particulate matter. This is in addition to crop losses and long term damage to the soil.

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.

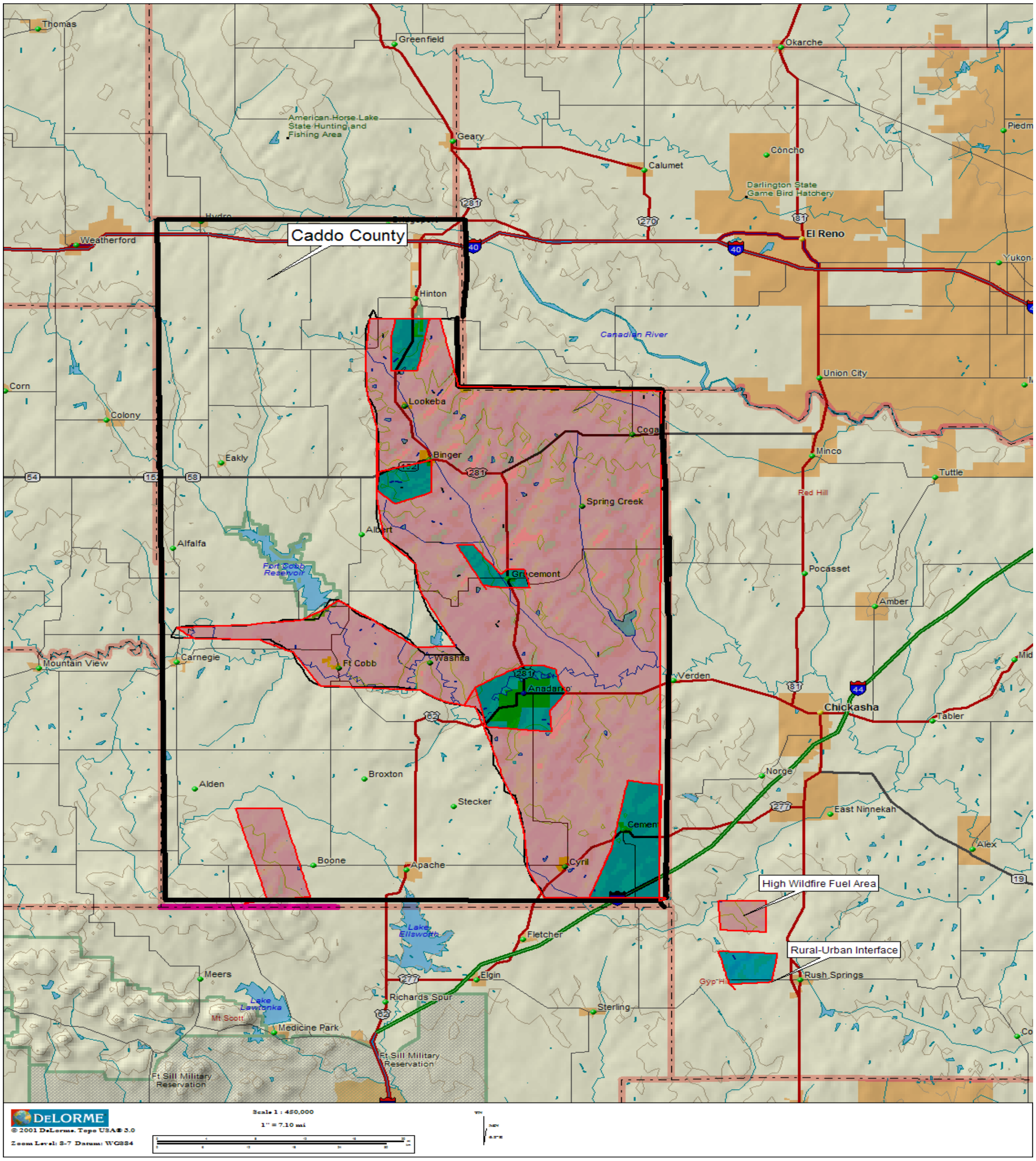
XXXIII. Figure: High Wildfire Fuel Area.



2.12.2. Location.

Wild fires can occur throughout Caddo County due to the combination of dry burnable ground cover and lightning storms. See the Wild Land /Urban interface map below.

XXXIV. Figure: Wild land Urban Interface Map.



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.

XXXV. 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/

XXXVI. 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 vary fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
CLASS 5: Extreme (E) COLOR CODE: **Red**	fire situation is explosive and can result in extensive property damage	Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.
source: 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 Caddo County level.

XXXVII. Figure: Fire Events.

1 WILD & FOREST FIRES event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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 Binger	08/20/2000	12:00 PM	Wild/forest Fire	N/A	0	0	200K	0
				TOTALS:	0	0	200K	0

2.12.5. Probability of Future Events.

There are wildfires in Caddo 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. 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.

2.12.6. Vulnerability.

Periods of drought, dry conditions, high temperatures, wind and low humidity set the stage for wildfires in Caddo County. Areas along railroads and people whose homes are in woodland settings (especially Eastern Red Cedar woodlands) 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 microbursts. 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 Caddo 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 Caddo 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.

XXXVIII. Figure: Lightning Events.

6 LIGHTNING event(s) were reported in **Caddo County, Oklahoma** between **01/01/1950** and **10/31/2006**.

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 E Anadarko	09/12/1993	1700	Lightning	N/A	0	0	0	0
2 Anadarko	06/11/1994	0747	Lightning	N/A	0	0	50K	0
3 Anadarko	07/14/1994	1300	Lightning	N/A	0	0	1K	0
4 Gracemont	11/09/1998	08:05 PM	Lightning	N/A	0	2	2K	0
5 Cyril	11/09/1998	08:15 PM	Lightning	N/A	0	0	1K	0
6 Apache	09/03/2001	04:00 PM	Lightning	N/A	0	0	300K	0
				TOTALS:	0	2	354K	0

a. **November 9, 1998** - Lightning then struck a fence in Gracemont in Caddo County, destroying it. Two young boys who were playing next to the fence were injured and needed to be hospitalized.

b. An oil tank battery exploded 5 miles north of Cyril, also in Caddo County, when lightning struck it. A small fire then started, but was quickly extinguished. Damage was estimated at $2,000.

c. September 3, 2001 - Lightning struck a storage facility complex at Sexton Office Supplies in Apache in Caddo County causing a fire that consumed four buildings. Damage was estimated at $300,000.

2.13.3. 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 the County each year is highly likely.

2.13.4. 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 Caddo County remains vulnerable to possible injury and/or property loss from lightning. Lightning can strike ten 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.

2.13.5. 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.

2.13.6. Overall Summary of Vulnerability and Impacts.
All of Caddo 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 Caddo County.

XXXIX. Figure: Hazard Summary.

Hazard	Previous Occurrences	Probability of Future Events
Dam Failure	No record of this occurring.	Unlikely
Drought	6 events *in State* since 1929.	Likely
Earthquake	6 recorded since 1897.	Unlikely
Expansive Soils (1)	Due to limited or non-existent data, no specific occurrences could be found documented.	Occasional
Extreme Heat	Annually	Highly Likely
Flood	14 events from 1994 to 2003.	Highly Likely
Hailstorm	99 large-hail events recorded since 1957.	Highly Likely
Severe Winter Storm	23 snow and/or ice events since 1984.	Highly Likely
Tornado/high winds	94 tornado and 228 wind events recorded since 1950.	Highly Likely
Wildfire	294 wild land fire responses per year.	Highly Likely
Thunderstorm/Lightning	104 severe thunderstorm events recorded since 1983.	Highly Likely

(1)The Caddo County Hazard Mitigation Planning Committee have determined Expansive Soils do not present a severe threat to the county and therefore decided not to adapt any action items for the hazard.

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

Table XXXX attempts to estimate the proportion and value of buildings that are located in a 100 year flood plain. Note that the number of residential units within the flood plain is strictly an approximate value.

XXXX. 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	26	$ 44,300 ea.	$1,151,800
Buildings - Commercial	0	-	$0
Critical Facility – Courthouse	0	-	$0
Critical Facility – County Barns	0	-	$0
Infrastructure – County Bridges	48	1392 ft @ $2500/ft	$5,150,000
TOTALS	74	-.	$6,301,800

There are no planned developments in the flood hazard area in rural Caddo County. Three County road segments are occasionally underwater for hours after heavy rains because the streambed in that location is broad and shallow with little channel capacity, making the road segment part of the waterway at times. The segments are identified below.

XXXXI. Table: Road Segments Subject to Flooding.

County Road Segments Subject to Frequent Flooding
County Road N2750 north of Verden on the Caddo-Grady County boundary between County Road E1320 and County Road E1330.
County Road N2550 in the Boone community between State Highway 19 and County road E1450.
County Road N2500 west of Fort Cobb Lake between County Road E1230 and County Road E1220

Mitigation will need to be limited to educating the residents who live in the flood plain on flood proofing options. However the Buyout Program may be considered in updates should the program requirements change or the county budget allow for such an expense.

Other County assets affected by floods are roads and bridges. Roads and bridges throughout the County may require cleanup and repairs after flood events. Total costs associated with the cleanup and repairs were not available. However, the County intends to include specific road and bridge projects as mitigation actions in updates to the 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 XXXXII 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 XXXXII is 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 Caddo County in the according to the 2000 US Census is 13,527.

XXXXII. 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	5907	$ 44,300 ea.	$261,680,100
Buildings - Commercial	130	$116,000	$15,080,000
Critical Facility – Courthouse	1	$10,000,000	$10,000,000
Critical Facility – County Barns	3	$600,000	$1,800,000
Infrastructure – County Bridges	48	1392 ft @ $2500/ft	$5,150,000
TOTALS	6089	-.	$293,710,100

3.4. Identifying Assets.

The Caddo County Hazard Mitigation plan identifies critical facilities located within the 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 the 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 Caddo County Assessor, Tables XXXXI and XXXXII were prepared to estimate the proportion and value of buildings that are located in hazard areas of the unincorporated area of Caddo 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. B-C estimates were made using specific hazard occurrence frequency and past damage estimates. Potential growth is estimated to be 146 single-family dwellings in the next ten years. This data is based on previous growth trends. No new commercial growth is expected.

3.5.1. Potential Dollar: Loss for Each Hazard.

1. Dam Failure.

There is no record of dam failure occurring within the county and although the County has three high hazard dams, no swash zone studies exist. Therefore, potential dollar loss for dam failure was not estimated.

2. Drought.

In the State of Oklahoma, six 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.

3. Earthquake.

There have been no significant historical damages recorded; potential dollar loss was not estimated.

4. 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.

5. Flood.

According to the National Climatic Data Center (NCDC), Caddo County experienced 14 flood events that resulted in approximately $6,500,000 in flood damages since 1994. Therefore the average potential dollar loss is estimated at $464,286 event. Dollar loss specific to flood damages experienced in Caddo County *outside municipalities* was not found.

6. Hail.

According to the NCDC, Caddo County experienced 99 large-hail events since 1950. 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:

- 1a. The average damage to a housing unit from a hailstorm is $35,000.
- 2a. The average damage to commercial buildings and County barns from hail is $14,000.
- 3a. The damage to the courthouse from a hailstorm is $140,000.
- 4a. All buildings are equally likely to experience hail.
- 5a. The probability of hail damage in a decade is 5%.

7.Thunderstorms/Lightning.

It was found documented that Caddo County had 104 thunderstorm recorded with damages totaling $1,362,400. Although this dollar loss, recorded by NCDC, includes damages that resulted in loss occurring within municipalities, these values were used to estimate loss for the County. Therefore, based on these values, it is concluded that the County can experience an estimated potential dollar loss of $13,100 for each thunderstorm event that includes high wind, hail and/or lightning.

8.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, Caddo County and its communities have experienced 94 tornado events that resulted in approximately $13,485,600 in damages in the last 53 years. Therefore the average potential dollar loss per event is estimated to be approximately $14,493 dollars per event. Caddo County averages 4.3 high wind events/year. At an average loss of $13,100/thunderstorm-wind event, an annual loss of $63,330 can be expected.

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

9. Wildfire.
According the 2002 annual report by the OK 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 Caddo County.

10. 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 County and surrounding areas. Therefore, based on past damages, potential dollar loss per event can be substantial.

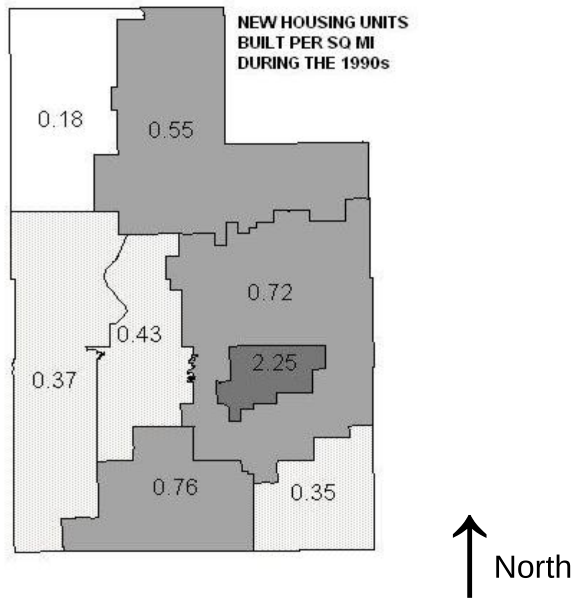
3.6. Development Trends.
At this time, there is no major planned housing or commercial developments, County critical facility expansions or County infrastructure changes in the unincorporated area of Caddo County other than those required to meet immediate County transportation needs. Existing substandard 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 146 houses can be expected to be constructed randomly throughout the unincorporated areas of Caddo County during the next decade. No new commercial growth is expected.

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. The 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.

There is a detectable trend in where the new housing units are being built. Most new growth is occurring within the city of Anadarko. Housing and population count are increasing in the city of Hinton. This growth continues as the economic sway of the Oklahoma City metropolitan area increases into Caddo County. The same phenomenon is also occurring in the town of Apache where the economic sway of the Lawton metropolitan area increases.

XXXXIII. Figure: New Housing Growth Areas.



Small cities and towns have been growing slowly. Those nearest Oklahoma City and Lawton are increasing in land area while development density is decreasing as fewer people live in each house and new construction happens at the edge of the locality.

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 the 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 the 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.

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

Action Item #1.
This Item is general in nature and addresses all hazards. It is intended to be reoccurring on an annual basis. Educating the Public about Various Dangers Associated with Natural Hazards.

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: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $1,000 per year for 5 years.
6. Funding: County budget, Grants.
7. Implementation Timeline: 2008.
8. Cost-Benefit Review: 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 is greater than 1:1.

HAZARD: Dam Failures.

Action Item # DF1- Identify vulnerable structures, or potentially vulnerable new structures and 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: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $28,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 24 months.
8. The cost-benefit ratio: Is thought to be 1:1.There is strong public support.

Action Item # DF2 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: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $48,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 24 months.
8. Cost -Benefit Review: thought to be greater than 1:1. Potential life saving item.

HAZARD: Drought

Action Item # DR1-Drill Additional Water Wells.

1. Comments: Long periods of drought tax the water supply in Caddo County.
2. Action: Drill additional water wells ensuring that an adequate water supply is available for residents of Caddo County.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Conservation District - USDA /NRCS.
5. Estimated Cost: $210,000.
6. Funding Sources: County budget, Water Resources Board, USDA.
7. Implementation Timeline: 36 months.
8. Cost - Benefit Ratio: Thought to be high benefit to cost ratio. Good public support.

Action Item # DR2-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 run-off water for agricultural use.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County.
5. Estimated Cost: $150,000.
6. Funding Sources: USDA-NRCS, Conservation Districts, Caddo County.
7. Implementation Timeline: 48 months.
8. Cost - Benefit Ratio: 1:1 benefit to cost ratio. Good public support .

Hazard: Earthquakes

Action Item # EQ1-Map the fault areas which may be affected by Earthquakes.

1. Comments: Major earthquakes have been predicted for Caddo County..
2. Action: Develop detailed fault maps of Caddo County to determine areas to be most likely effected by earthquakes.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County emergency management.
5. Estimated Cost: $8,000.
6. Funding Sources: County budget.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: Existing material available. Need to distribute material throughout county. Thought to have marginal benefit – cost ratio.

Action Item # EQ2-Work with utility companies to retrofit commercial power facilities, or address specific needs of new infrastructure to be more earthquake resistant.

1. Comments: Earthquakes can cause power outages because facilities are not built to withstand earthquakes.
2. Action: Work with Caddo Electric Cooperative to have their facilities upgraded to meet earthquake engineering standards.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County, Caddo Electric Cooperative.
5. Estimated Cost: $8,000.
6. Funding Sources: County budget, REC, HMG grants.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: Private benefits. Not much public support. Since there have been no previous occurrences this item will have less than a 1:1 benefit-cost ratio.

Hazard: Extreme Heat

Action Item # EH1-Provide cooling stations to allow citizens to come in out of the heat to cool down.

1. Comments: Many citizens are affected each year from extreme heat. Caddo County has numerous public events celebrating the area's Native American heritage. These events are usually held during hot weather and attract large crowds from numerous states and also many foreign countries.
2. Action: Work with Caddo County and other public building owners to establish a program that will allow citizens who are over heated to come into public areas of buildings to cool down. This will protect them from the dangers associated with extreme temperature events such as heat stroke, dehydration etc.
3. Participating Jurisdictions: Caddo County, Anadarko Hospital.
4. Lead Agencies: Anadarko Hospital.
5. Estimated Cost: $8,000.
6. Funding Sources: County budget.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: Costs thought to be high compared to benefits. Public support would be lacking.

Action Item # EH2-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 County building office space.
3. Participating Jurisdictions: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $25,000.
6. Funding Sources: County budget, HMG Grant.
7. Implementation Timeline: 24 months.
8. Cost-Benefit Ratio: Greater than 1:1.

HAZARD: Flooding

Action Item # F1-Elevate At-Risk Structures in Flood Plain.

1. Comments: Structures were built in the flood plain areas that have the potential to be damaged in floods.
2. Action: Elevate those structures in the flood plain that are thought to be at risk of receiving damage or being destroyed from a flooding event.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County flood plain manager.
5. Estimated Cost: $165,000.
6. Funding Sources: Hazard Mitigation grant program, County Budget.
7. Implementation Timeline: 24 months.

8. Cost – Benefit Ratio: Cost- benefit would be 1:1. Property acquisition would reduce flood losses.

Action Item # F2-Update and provide continual administration to insure NFIP compliance is maintained.

1. Comments: NFIP participation is necessary to fully participate in the Hazard Mitigation process and provide flood insurance to those in need.
2. Action: Update and provide continual administration to insure NFIP compliance is maintained.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County flood plain manager.
5. Estimated Cost: $100,000.
6. Funding Sources: County budget, HMG grants.
7. Implementation Timeline: 60 months.
8. Cost – Benefit Ratio: Benefits would be high compared to costs.

Action Item # F3-Elevate 3 County roads and bridges to provide flood protection and safe corridors for the public and emergency vehicles during floods.

1. Comments: Three segments of County roads are impassable during floods
2. Action: Raise roadbed and construct new bridges and approaches.
3. Participating Jurisdiction: Caddo County.
4. Lead Agency: Caddo County flood plain manager.
5. Costs: $1,500,000.
6. Funding Source: Caddo County budget, FEMA.
7. Implementation Timeline: 60 months.
8. Costs – Benefit Ratio: Multiple benefits and great public support. Long term cost-benefits thought to greater than 1.1

HAZARD: Hail Storms

Action Item # HS1-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 association, contractors and citizens) using brochures and the media.
3. Lead Agencies: Caddo County**.**
4. Participating Jurisdiction: Caddo County emergency manager.
5. Estimated Cost: $5,000.
6. Funding Sources: Grants, Caddo County budget.
7. Implementation Timeline: 18 months.

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 # HS2-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: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $600,000.
6. Funding Sources: Caddo County budget, HMG Grants.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: Good benefits to cost ratio. Good support from the public. Good protection of critical infrastructure.

Action Item # HS3-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: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $25,000.
6. Funding Sources: County budget, HMG Grant.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: Thought to have favorable benefit-cost ratio.

Action Item # HS4-Install a steel roof on the Caddo County Courthouse in Anadarko.

1. Comments: The flat roof is damaged on a regular basis by hail storms.
2. Action: Install a steel gable roof on the Caddo County Courthouse in Anadarko to protect from hail damage.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $300,000.
6. Funding Sources: County budget- HMG grants.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: High initial cost, but favorable long term benefits. Benefit-cost thought to be 1:1.

HAZARD: THUNDERSTORMS/LIGHTNING

Action Item # L1-Purchase Lightning Prediction Systems for Caddo County Critical Facilities.

1. Hazard: Lightning.
2. Comments: Lightning causes death, injury and property damage.
3. Action: Provide THORGUARD Detection systems for Caddo County critical facilities.
4. Participating Jurisdictions: Caddo County.
5. Lead Agencies: Caddo County Emergency Management.
6. Estimated Cost: $18,000.
7. Funding Sources: Grants, County Budget.
8. Implementation Timeline: 30 months.
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 would be beneficial.
2. Action: Install lighting protection and suppression systems protecting radios and other essential equipment at critical facilities throughout the County.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $150,000.
6. Funding Sources: Hazard Mitigation grand program, County budget.
7. Implementation Timeline: 24 months.
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 changes 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 changes of loss of life and lower property damage.
3. Participating Jurisdictions: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $3,500.
6. Funding: County Budget, FEMA Grants.
7. Implementation Timeline: 2006-2008.

8. Cost - Benefit Review: 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 on 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 the information channel on the cable system and help secure funding through FEMA grants when they are available.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $500 per year.
6. Funding Sources: County budget, Grants.
7. Implementation Timeline: 2006.
8. Cost – Benefit Ratio: Thought to have favorable cost -benefit ratio. Potential life saving measure.

Action Item # T-HW3-Mobile Communications System.

1. Comments: Storm spotters need a common communications System.
2. Action: Obtain mobile communications equipment for spotters and emergency response teams.
3. Participating Jurisdictions: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $18,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 24 months.
8. Cost - Benefit Ratio: Great public support. Potential life saving.

Action Item # T-HW4-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, hospital, nursing homes and other public facilities.
3. Participating Jurisdictions: Caddo County
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $2,000.
6. Funding Sources: Caddo County budget, Hazard Mitigation grant program.
7. Implementation timeline: 24 months.
8. Cost - Benefit Ratio: Extremely low cost for the benefit received.

Action Item # T-HW5-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: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $500,000.
6. Funding Sources: County budget and grants.
7. Implementation Timeline: 2006.
8. Cost - Benefit Ratio: Demand from the public will be great potential life saving.

Action Item # T-HW6-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 obtain the County emergency manager.
3. Participating Jurisdiction: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $5,000.
6. Funding Sources: Caddo County budget, Hazard Mitigation Grant.
7. Implementation Timeline: 12 months.
8. Cost - Benefit Ratio: Limited audience, but very important to participants. Potential life saving.

Action Item # T- HW8-Review the Caddo 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: Review the Caddo County severe weather plan and warning system will promote readiness and will change with the needs of Caddo County as new businesses and infrastructure are developed.
3. Participating Jurisdiction: Caddo County.
4. Lead Agency: Caddo County Emergency Management.
5. Estimated Cost: $500.
6. Funding: County budget, grants.
7. Implementation Timeline: 2007.
8. Cost - Benefit Ratio: Important action for the cost.

Hazard: Wildfires

Acton Item # WF1-Purchase of Tanker Fire Trucks – Wildfire Protection.

1. Comments: Wildfires are a serious hazard in Caddo County.
2. Action: Purchase of two tanker fire trucks to protect structures Caddo County.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $100,000.
6. Funding Sources: Grants - County budget.
7. Implementation Timeline: 36 months.
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 # WF2-Provide Dry Hydrants for Wildfire Protection.

1. Comments: Wildfires are a serious hazard in Caddo County.
2. Action: Provide 50 Dry Hydrants for wildfire protection.
3. Participating Jurisdictions: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $50,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 36 months.
8. Cost - Benefit Ratio: Public support is high and the cost is low compared to the benefit.

Action Item # WF3-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 Caddo 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: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $50,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 36 months.
8. Cost-Benefit Ratio: Good public support. High benefit for the cost.

HAZARD: Winter Storms

Action Item # WS1-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 Caddo County such as the Courthouse, county barns, rural water districts, sewer systems, public shelters, nursing home, etc.
3. Participating Jurisdictions: Caddo County.
4. Lead agencies: Caddo County Emergency Management.
5. Estimated Cost: $250,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 36 months.
8. Cost - Benefit Ratio: Good public support. Favorable cost-benefit ratio.

Action Item # WS2-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 Caddo County 911 database, 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: Caddo County.
4. Lead Agencies: Caddo County Emergency Management.
5. Estimated Cost: $135,000.
6. Funding Sources: Grants, County budget.
7. Implementation Timeline: 24 months.
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 County residents prioritized each potential action item as to how to implement them in the best interest of the county residents. After careful consideration and with consultation from the Caddo 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 the 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)

XXXXIV Table: Summary of Categories and Scales used to determine priority ranking of Mitigation Actions.

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	17	4	4	10	35	1
Identify vulnerable dams	$28,000	13	1	0	1	15	13
Provide dam monitors	$48,600	12	1	1	1	15	13
Drill additional water wells	$210,000	6	2	2	1	11	15
Build reservoirs	$150,000	8	2	2	1	13	14
Map earthquake fault areas	$8,000	16	4	0	1	21	8
Retrofit for earthquake damage reduction	$8,000	16	4	0	1	21	8
Public education on extreme heat	$8,000	16	4	4	1	25	5
Provide cooling stations	$8,000		1	4	1	22	7
Elevate at risk structures in flood plain	$165,000	9	1	0	1	11	15
Provide support to flood plain board	$100,000	12	1	4	1	16	12

Provide protective storage for county equipment	$600,000	2	4	4	3	13	14
Increase public awareness of concepts such as “survivable space” and “firewise”	$ 50,000	15	4	4	1	20	9
Provide generators needed to power water pumps, sewage systems and emergency communications	$250,000	5	4	4	3	16	12
Raise county roads in three areas to eliminate water on county roads	$1,500,000	1	2	4	1	8	16
Installation of NOAA Weather Radios in critical facilities	$2,000	19	1	4	4	28	3
Building material awareness	$5,000	17	2	4	1	24	6
Protective film on windows	$25,000	14	1	4	1	20	9
Steel roof on courthouse	$300,000	4	4	4	1	13	14
Lightning detectors	$18,000	15	1	4	1	21	8
Lightning suppression	$150,000	8	4	4	1	17	12
Develop EOP for tornadoes	$3,500	18	4	4	1	27	4
Storm shelter education	$2,500	19	4	4	1	28	3
Storm spotter communication system	$18,000	15	4	4	2	25	5
Storm shelters	$500,000	3	2	4	2	11	15
Mobile home tie-down - education program	$5,000	17	1	4	2	24	6
Review weather response plan	$500	20	4	4	4	32	2
Purchase of fire trucks	$100.000	10	3	4	1	18	11
Install dry hydrants	$50,000	11	3	4	1	19	10
Database of special needs population (Winter Storm)	$135,000	9	4	4	1	18	11

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.

XXXXV 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	Annualy for five years	1
Review weather response plan	$500	County Funds	County DEM	!2 Months	2

Storm shelter education	$500	County Funds	County DEM	24 Months	3
Installation of NOAA Weather Radios in critical facilities	$2,000	County	County DEM	Ongoing	3
Develop EOP for Tornadoes	$3500	County Funds	County DEM	24 mos.	4
Storm spotter communication system	$18,000	County	County Funds Grants	Ongoing	5
Public education on extreme heat	$8,000	County Funds	County DEM Anadarko Hospital	24 Mos.	5
Building material awareness	$5,000	County Funds Grants	County DEM	18 Mos.	6
Mobile home tie-down - education program	$5,000	County Funds HMG	County DEM	12 Mos.	6
Provide cooling stations	$8,000	Grants	County DEM Anadarko Hospital	24 Mos.	7
Map earthquake fault areas	$8,000	County Funds	County DEM	24 Mos.	8
Retrofit for earthquake damage reduction	$8,000	County Funds Electric Coop.	County DEM	24 Mos.	8
Lightning detectors	$18,000	Grants County Funds	County DEM	30 Mos.	8
Increase public awareness of concepts such as “survivable space” and “firewise”	$50,000	County Funds Grants	County DEM	36 Mos.	9
Install dry hydrants	$50,000	County DEM Conservation Districts Rural Fire Dept.	County DEM	36 Mos.	10
Database of special needs population (Winter Storm)	$135,000	County Funds	County DEM	12 Months	11
Purchase of fire trucks	$100,000	County Funds Ok. State Dept. of Agri.	County DEM Rural Fire Depts.	36 Mos.	11
Lightning suppression	$150,000	HMGP County Funds	County DEM	24 Mos.	12
Provide generators needed to power water pumps, sewage systems and emergency communications	$250,000	County Funds Grants	County Commissioners	30 Months	12
Provide support to flood plain board- NFIP compliance	$100,000	County Funds HMG Grants	County DEM	36 Mos.	12
Identify vulnerable dams	$28,000	County Funds	County DEM Conservation Districts	24 Mos.	13
Provide dam monitors	$48,600	County Funds Oklahoma Water Resources Board	County DEM Conservation Districts	24 Mos.	13
Build reservoirs	$150,000	County Funds USDA-NRCS-Conservation	County DEM	48 Mos.	14

		Districts			
Provide protective storage for county equipment	$600,000	County Funds HMG Grants	County Commissioners	24 Mos.	14
Steel roof on courthouse	4300,000	County Funds HMG Grants	County DEM	24 Mos.	14
Drill additional water wells	$210,000	County Funds Grants	County DEM Conservation Districts	36 Mos.	15
Elevate at risk structures in flood plain	$165,000	HMGP County Funds	County DEM – Flood Plain Manager.	24 Mos.	15
Storm shelters	$500,000	County Funds	County DEM	2009	15
Raise county roads in three areas to eliminate water on County roads	$1,500,000	County Funds HMGP Grant	County Commissioners	60 Mos.	16

CHAPTER FIVE - PLAN MAINTENANCE PROCESS

The plan maintenance section of this document describes the formal process that will insure that the Caddo 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 the County. The plan will be resubmitted for State and Federal review every five years. Caddo 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 Caddo County Board of Commissioners for adoption.

5.1. Plan Monitoring.

The County Emergency Management Director will be responsible for monitoring the plan. A monitoring report will be written and submitted to the 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 Clerks office housed inside the Caddo County Courthouse in Anadarko. The County Commissioners' will house the official plan at the Caddo County Courthouse. Any interested party may request a copy of the plan via County Clerk or the Emergency Management Director.

The Caddo County Hazard Mitigation Committee has identified hazard mitigation projects to be included in the Hazard Mitigation Plan. The Caddo 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 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 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. The County will resubmit the plan for State and Federal review every five years.

The Caddo 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.
4. Evaluate how other agencies and partners have participated.
5. 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 Caddo 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.

Caddo County will establish resolutions to incorporate the hazard mitigation plan into all other 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 County government implement the hazard mitigation plan into any future projects. The County will continue to work closely with the three Conservation Districts in the areas of flood plain management, drought and rural fire protection.

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

Caddo County currently utilizes capital improvement planning to guide development in the County. After the 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, the County will suggest that local municipalities address natural hazards in their respective planning processes. Specifically, one of the goals in the Mitigation Plan directs County and local governments to protect life and property from natural disasters and hazards. The County Commissioners' will conduct periodic review of the 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 three Conservation Districts in Caddo County have long-range plans that are 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. Caddo County is dedicated to generating public interest in the updates of the 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 Caddo County Courthouse located in Anadarko. 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 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 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.

Caddo County DEM
Caddo County Courthouse
Anadarko, Ok
(405) 247-9525