Special Topics

Cleveland County Disaster Resiliency Assessment

The purpose of this section is to assess at the county level key components of disaster resiliency. Housing location and quality as well as planning activities can help reduce impacts from disaster events and allow for faster recovery. Disasters can include tornadoes, extreme weather, high winds, as well as man-made events. These events may largely be inevitable, but the ability to reduce damage and casualties as well recovery can be improved with good planning.

C.0 Comprehensive Plans & Hazard Mitigation Plans

There are 8 cities and towns within the county. Two key cities within the county, Norman and Moore. **Comprehensive plans** are the guiding documents for cities of various sizes to address key aspects of their community from land use, transportation, environment, housing, and economic development. City of Norman and City of Moore have comprehensive plans.

The following is language in the plans that addresses land use decisions that reduce placing housing and businesses within historical areas of risk (e.g. flooding) and other supporting actions to increase disaster resiliency.

City of Norman Comprehensive Plan Elements addressing housing and community resiliency:

- Goal 5, Objective 6: Minimize the amount of development that occurs in the 10-Mile Flats area, in order to preserve the area's character as well as protect residents from hazards associated with flooding.
- Country Residential area – Garber- Wellington Aquifer as the primary recharge zone; recommended for rural or very low density development.

City of Moore Comprehensive Plan Elements addressing housing and community resiliency:

Emergency Management Response:

Fire - Eliminate fire hazards that endanger life and property.

Hazardous Materials - Encourage the proper handling of hazardous materials.

"The Emergency Management Division focuses on identifying and mitigating hazards that could potentially affect the City and coordinating preparedness, response, and recovery efforts for large-scale emergencies and disasters.

Potential hazards that can effect development decisions include:

- The location of the railroad
- The location of electrical substations
- The location of natural gas plants
- Flooding and floodplain issues
- The location of businesses that utilize hazardous chemicals
- The location of highways and other streets carrying hazardous chemicals
- The location of pipelines "

Emergency Management

- **Personnel -** To adequate meet growing numbers of emergency calls and to properly serve the additional fire and police personnel, the Communications Division needs to add three personnel. This will allow the minimum staffing level of the Department to be raised to three from the current level of two. Additional personnel should be phased in over the next five years, coordinated with increases in fire and police staffing.
- **Facility –** A new Emergency Operations/Communications Center is needed. The new facility should be constructed to withstand threats from terrorism and severe weather, as it must be 100% operational at all times. The new facility should be an Emergency Operations Center from which City officials may coordinate the response to all emergencies.
- **Mobile Command Vehicle –** The need to properly command and control the response and recovery efforts to large emergencies also extends to the field. A new mobile command vehicle is needed to properly support police and fire command staff on incident scenes. The current vehicle is too small to adequately house the number of decision and support personnel needed or this mission and is also 26 years old.
- **Radio System –** The City's police and fire personnel will be moving to a new 800 mHz radio system in the summer of 2006. However, the rest of the City departments are currently remaining on their 150 mHz systems and will no longer be able to communicate directly with the public safety personnel during emergencies. The City needs to purchase additional 800 mHz mobile and handheld radios to replace the older systems.
- **Hazard Buffer –** The City should investigate changes to the Subdivision Regulations to include mandatory setbacks from potentially hazardous land uses, such as the railroad, oil and gas operations, and gas pipelines.

  High population densities and residential development should be adequately buffered with open space from these hazards. The buffer should be of adequate size for emergency personnel and equipment to respond to an accident should one occur.

The other key plan for a city to manage, mitigate and plan for recovery related to disasters are county or city **Hazard Mitigation Plans and/or Emergency Management Plans**.

City of Norman and City of Moore both have Hazard Mitigation Plans that provide guidance related to major risks that impact the area and methods to address and mitigate those risks.

Coordination between Norman, Moore, Noble, Lexington, and the county overall Hazard Mitigation Plans and Emergency Operations Plans are explicitly stated in the plan documents.

C.2.1.1. Historical Data on Natural Disasters and Other Hazards

The Cleveland County Hazard Mitigation Plan (2013-2018) had six key goals:

Goal 1: **Protect lives and property.**
Goal 2: To improve or enhance emergency services.
Goal 3: To prevent or reduce the effects of natural hazards/disasters.
Goal 4: To identify and protect critical facilities in Cleveland County.
Goal 5: To develop or improve structures to become a more disaster resistant county.

Goal 6: To provide more public awareness of the natural disaster threat.

The Hazard Identification for the Cleveland County included assessing the risks for the area and the likelihood of occurrence:

Table 3-2

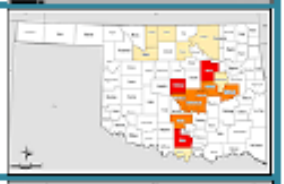
CLEVELAND COUNTY NATURAL HAZARDS

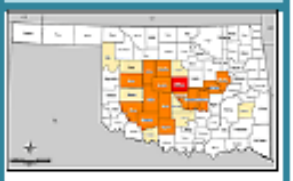
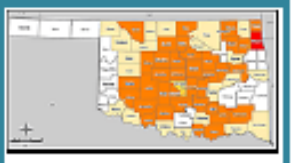
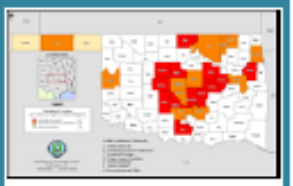
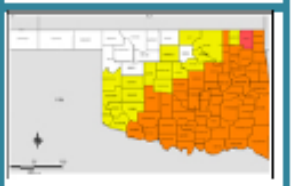
Hazard	How reviewed	Why identified
Dam failure	• Oklahoma Water Resources Board • CCHMPT input • Public Input	There has never been a dam failure in Cleveland County; however, there are six high hazard dams in Cleveland County.
Drought	• Oklahoma Climatological Survey, • Oklahoma Water Resources Bulletin, • Historical Data	Recent episodes of drought.
Earthquake	• Oklahoma Geological Survey • Past Historical Records	Past history, existing nearby faults within central Oklahoma.
Extreme heat	• National Weather Service • Oklahoma Climatological Survey	Oklahoma has prolonged periods of high temperatures and is prone to wide swings of temperature
Flood	• Local Emergency Management Records • Public Input • FEMA Declarations • NCDC	There has been a past history of major flooding in Cleveland County due to heavy rains and inadequate drainage.
Hailstorm	• Local Input • NCDC	Cleveland County experiences hailstorms during severe thunderstorms.
High winds	• NCDC data • Public Input • Team Hazard Survey • Oklahoma Climatological Survey • National Weather Service • Storm Prediction Center	Oklahoma experiences hundreds of severe thunderstorms high winds every year, including downdrafts that have damaged structures.
Lightning	• NCDC data • Public Input • Team Hazard Survey • Oklahoma Climatological Survey • National Weather Service	Oklahoma experiences hundreds of severe thunderstorms with lightning every year.
Tornado	• Local Emergency Management Records • Public Input • FEMA Declarations • NCDC	Oklahoma has a distinction as the epicenter of Tornado Alley. Cleveland County has experienced recent tornados.
Wildfire	• Fire Department Records • Public Input	Local FD records reflect damage from wildfires frequently in Cleveland County.
Winter storm	• Public Input • National Weather Service • FEMA Declarations	Severe ice and snowstorms occur regularly in central Oklahoma. The last occurrence was in 2011.

Historical natural disaster in Cleveland County are documented in Cleveland County Hazard Mitigation Plan (2013-2018). Thirteen natural disasters since 2001 have been formally declared disaster area by the President. Typical hazard disasters in the region include flooding, severe storms, wildfires, severe winter storms, and tornadoes. (Cleveland County Hazard Mitigation Plan 2013-2018)

Table 3-3

Disasters in Cleveland County – 2001 through June 2013

Incident Period	Nature of Disaster	FEMA #	Declaration Date	Declaration Area
May 18 – June 2, 2013	Severe Storms, Tornados	FEMA -DR -4117	May 20, 2013	
May 10, 2010 – May 13, 2010	Severe Storms, Tornados, and Straight-Line Winds	FEMA-1917-DR	May 24, 2010	
January 28, 2010 – January 30, 2010	Severe Winter Storm	FEMA-DR-1883	March 5, 2010	
December 24, 2009 – December 25, 2009	Severe Winter Storm	FEMA-DR-1876	February 25, 2009	
April, 9, 2009 – April 12, 2009	Wildfires	FEMA-DR-1846	June 19, 2009	
December 8, 2007 – January 3, 2008	Severe Winter Storms	FEMA-DR-1735	December 18, 2009	

Disasters in Cleveland County – 2001 through June 2013				
Incident Period	**Nature of Disaster**	**FEMA #**	**Declaration Date**	**Declaration Area**
August 18, 2007 – September 12, 2007	Severe Storms, Tornados, and Flooding	FEMA-DR1718	August 24, 2007	
June 10, 2007 – July 25, 2007	Severe Storms, Tornados, and Flooding	FEMA-DR-1712	July 7, 2007	
January 12, 2007 – January 26, 2007	Severe Winter Storms	FEMA-DR-1678	February 1, 2007	
November 27, 2005 – March 31, 2006	Severe wildfire threat	FEMA-DR-1623	January 10, 2006	
May 8, 2003 – May 31, 2003	Severe Storms and Tornados	FEMA-DR-1465	May 10, 2003	
January 30, 2002 – February 11, 2002	Ice Storm	1401	February 1, 2002	
December 25, 2000 – January 10, 2001	Severe winter storms	1355	January 5, 2001	

www.fema.gov/disasters

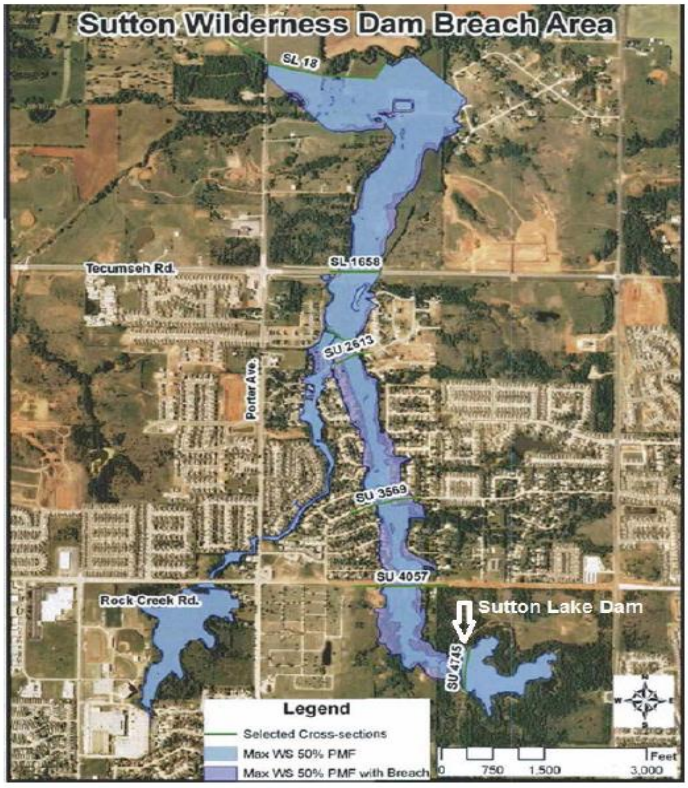
Dam Failure Risks

Historical Context: The 5 dams assessed as part of the HMP included Hall Park, Shadow Lake, Stanley Draper, Summit Lake, Sutton Wilderness Lake (Cleveland County Hazard Mitigation Plan 2013-2018).

Hall Park: A breach of this dam is noted to potentially impact approximately 50 residences, several businesses and the Norman Veterans Center.

Stanley Draper Lake: Robin Hill School and approximately 100 homes, primarily acreages and small farms and ranches, would be inundated until the flood water reached the Little River five miles south of the dam.

Sutton Lake Wilderness: This is a small private lake however is listed as a High Hazard Dam due to its location in an urban area.



There has been one historical dam breach in 2007 in Cleveland County at Reynolds Lake. No structures were impacted by the breach.

Mitigation Strategy / Recommendations from HMP: "Cleveland County has five dams rated as high hazard based on evaluation and ranking by the Oklahoma Water Resources Board. Officials with Oklahoma's conservation districts have said the state's dam control system is flooded with problems and desperately needs money to fix them. Efforts are underway throughout the state to fix the

problems but it takes money that is not currently available." (Cleveland County Hazard Mitigation Plan 2013-2018)

Drought

Historical Context: Drought has cyclically been a problem for the state. Drought is often followed by potential for severe flooding due to absorption rates for soils. There have been six drought years/events (Cleveland County Hazard Mitigation Plan 2013-2018):

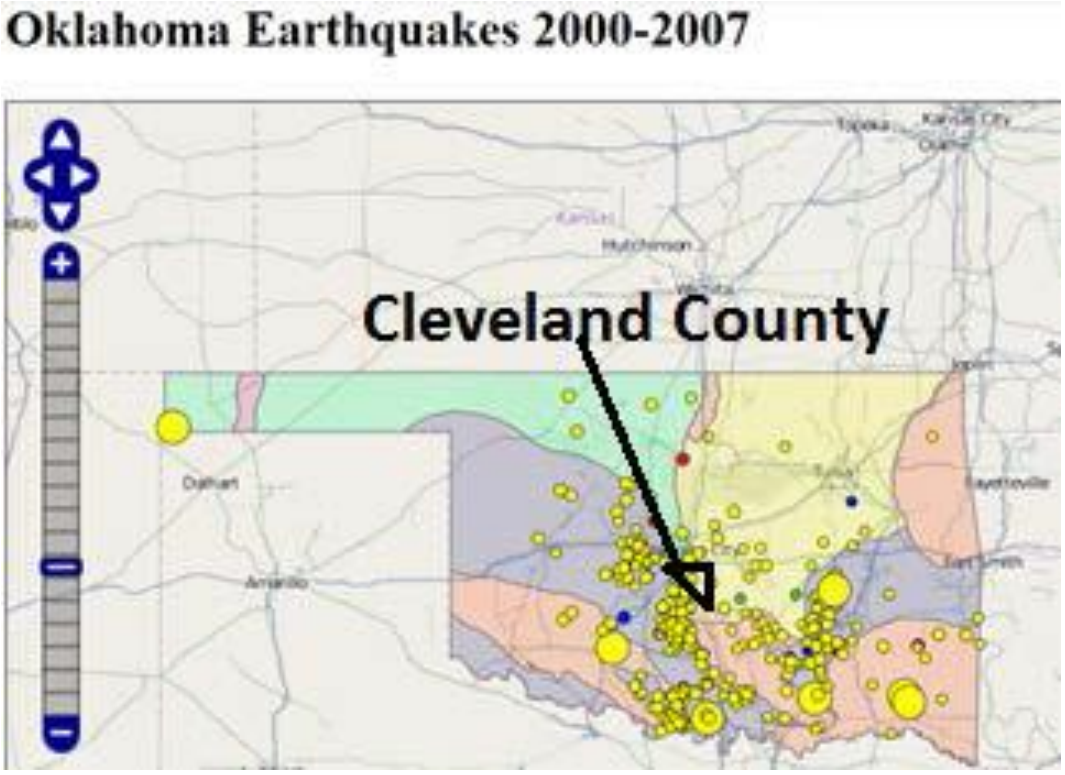
Table 3-6

CLEVELAND COUNTY DROUGHT EVENTS 2007 through January 2013	
Date	**Description**
Jan. – Feb 2013	D3 (extreme) drought continued through the month of January in Cleveland County with persistent dry conditions. D3 (extreme) drought conditions were present at the beginning of the month in Cleveland County, but had improved slightly to D2 (severe) drought by the end of the month due to several winter storms.
July - Dec 2012	As a mid-level ridge of high pressure built into the Southern Plains late in July, few opportunities for rain lead to expanding drought conditions across much of Oklahoma. Abnormally dry conditions were present at the beginning of the month, but D3 (extreme) drought developed by the end of the month with persistent dry conditions.
Mar - Dec 2011	Since Thanksgiving 2010, much of central and western Oklahoma has seen its driest precipitation totals since the 1920s and 30s. The lack of beneficial rainfall, combined with extreme high temperatures continued the drought that had plagued Oklahoma for several months. July 2011 was officially the hottest month on record locally and nationally. High temperatures were over 100 degrees for almost the entire month. Rainfall totals, especially for those over western and southern Oklahoma were little more than a trace. The dry vegetation contributed to several grass fires. Some municipalities had restricted water use, as water levels in area lakes have dropped to very low levels. The exact monetary loss for the crop loss cannot be determined, although it would probably be in the millions.
01 Mar 2007	The drought officially came to an end, thanks to heavy rainfall that fell during the latter half of the month. The drought went from a D2 (extreme) to a D1 (Moderate) on 3/22. Several rounds of heavy rainfall from the 26th through the 30th continued the trend, upgrading the status to D0 (Abnormally Dry).
01 Feb 2007	Severe (D2) drought conditions continued across much of the northern half of Oklahoma during the month of February. Normal rainfall that fell for February did nothing to help the drought, considering precipitation totals are not usually high in February. Water worries continue over this area with lake levels remaining low. Even with beneficial above normal rainfall earlier this year, and the slow improvement of lake levels over the last 3 months, many boat docks and ramps still remained on dry ground. Many people did not venture out on area lakes this month due to prolonged cold spells, so recreation in and around the lake were minimally affected. Water rationing is starting to be considered, although most lakes are still considered at safe levels for everyday living. The agriculture industry continued to be hit hard by the drought.
01 Jan 2007	Severe to extreme (D2-D3) drought conditions were seen however, much needed precipitation during the latter half of the month, mainly in some form of winter precipitation, allowed for these areas to improve to just severe conditions (D2). This also allowed for an improvement to areas farther south that were in D2 drought conditions during the month of December. The winter storm from the 12th through the 14th provided much needed precipitation to improve these areas to D1 or less.

Mitigation Strategy / Recommendations from HMP: Vulnerability with drought is most closely felt by farmers and ranchers through crop and livestock loses (Cleveland County Hazard Mitigation Plan 2013-2018). Oklahoma City, Moore and Norman often coordinate conservation and rationing of water during particularly severe drought conditions.

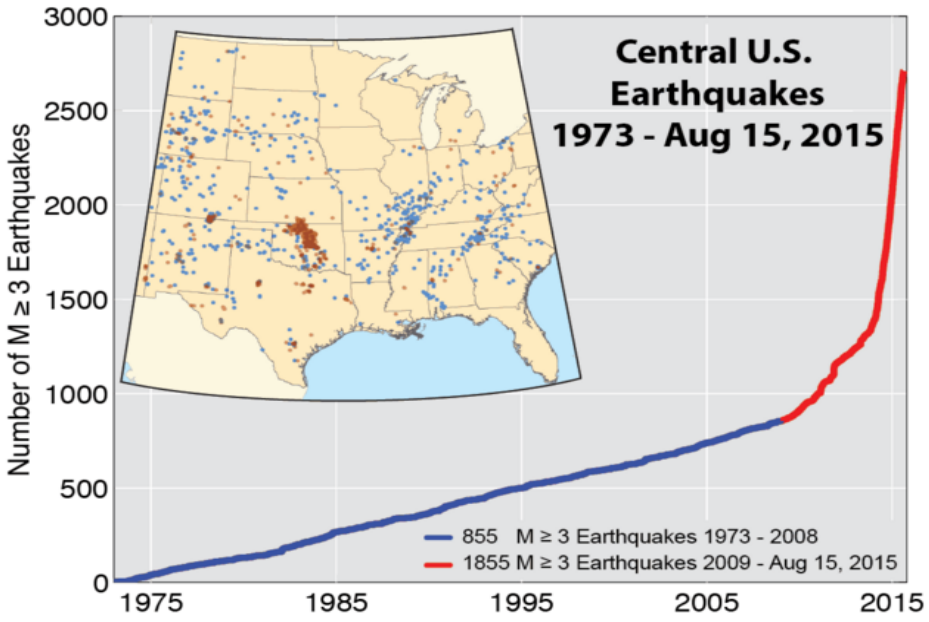
Earthquake

Historical Context: "The largest earthquake experienced in Oklahoma occurred on November 06, 2011 with a magnitude of 5.6. The Geological Survey said the earthquake was shallow, about three miles deep, and that the epicenter was four miles east of Sparks, located about 44 miles northeast of Oklahoma City. The quake followed smaller ones earlier in the day, including one at 2:12 a.m. with a preliminary magnitude of 4.7. Its epicenter was in Prague, about 50 miles east of Oklahoma City. The previous record earthquake was in 1952 when a 5.5 tremor occurred in Canadian County near El Reno." (Cleveland County Hazard Mitigation Plan 2013-2018). Concerns about fracking or fluid injection as part of the process for extraction of oil/ natural gas continues to factor into discussions for risk assessment for building codes and mitigation.



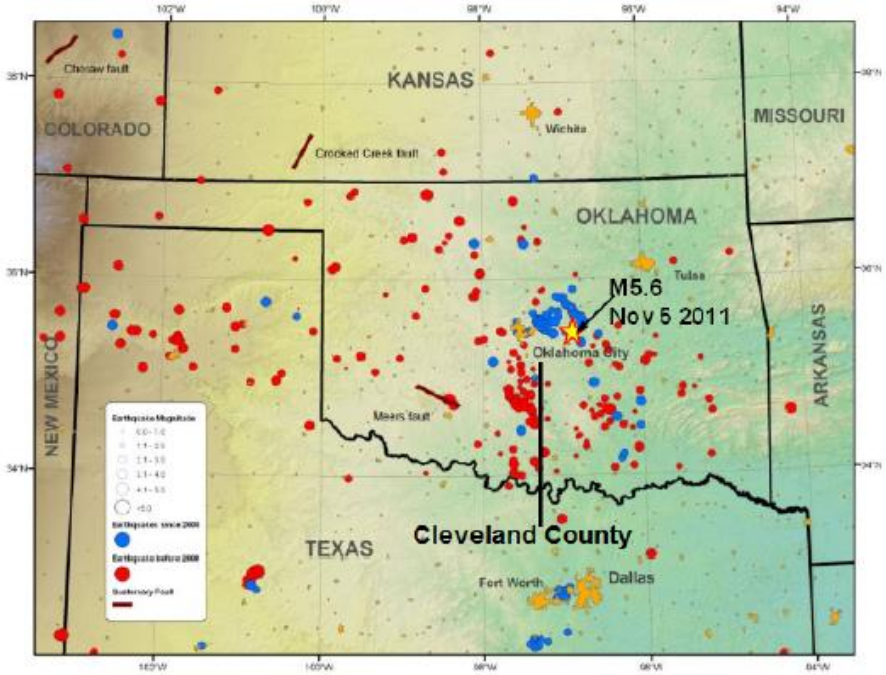
(Cleveland County Hazard Mitigation Plan 2013-2018)

Increasing Rate of Earthquakes Beginning in 2009



Cumulative number of earthquakes with a magnitude of 3.0 or larger in the central and eastern United States, 1970–2015. The long-term rate of approximately 29 earthquakes per year increased sharply starting around 2009.

http://earthquake.usgs.gov/research/induced/



Seismicity in the Oklahoma region since 1973. Events shown in red pre-date January 1, 2008, while events in blue post-date this time. Star shows the epicenter of the 5 November 2011 magnitude 5.6 earthquake. The locations of known Quaternary or younger faults are shown as red lines.

(Cleveland County Hazard Mitigation Plan 2013-2018)

CLEVELAND COUNTY EARTHQUAKE EVENTS 2007 - October 2013 Oklahoma Geological Survey Observatory			
Date	**Location**	**Magnitude**	**Damage**
Apr 16, 2013	Located in the Perkins OK area 76 miles NE of Norman. Depth = 2.3	4.7	None known
Apr 20, 2012	Rural area of 14000 block of Indian Hills Road in north Norman. Depth= 13.0	1.9	None known
Oct 27, 2011	Rural area in 12000 block of N. Banner Road in El Reno. Depth= 5.6	1.9	None known
Nov 5, 2011	Rural area in Lincoln County Depth = unk.	5.6	Minor damage in Cleveland County
Mar 2, 2010	Rural area in the 10121 W Britton Road in Yukon. Depth = 5.0	0.3	None known
Jul 20, 2010	Rural area 10 miles east of 3100 120th Ave SE Norman Depth= 3.35	0.8	None Known
Oct 13, 2010	1509 Westmore Drive in south Oklahoma City NW of Moore. Depth= 11.0	4.7 MMI - IV	Minor damages reported
Oct 13, 2010	West of Moore 13 miles in the Newcastle area Depth= 7.56	1.3	None Known
Oct 13, 2010	NW of Moore in SW Oklahoma City rural area. Depth= 4.54	2.0	None Known
Oct 14, 2010	NW of Moore in SW Oklahoma City rural area. Depth= 5.00	0.8	None Known
Oct 18, 2010	Rural area west of Norman Depth= 1.45	2.4	None Known
Oct 19, 2010	Rural area NW of Norman Depth= 3.98	3.0 MMI - III	None Known
Jun 26, 2009	Rural area of NW Oklahoma City near Piedmont Depth = 5.0	3.7	None Known
Dec 1, 2008	Rural area of NW Oklahoma City Depth = 5.0	2.7	None Known

Mitigation Strategy / Recommendations from HMP: "Data from the Oklahoma Geological Survey and the USGS, along with immediate past history, indicates the potential of damaging earthquakes in Cleveland County is "Likely."" (Cleveland County Hazard Mitigation Plan 2013-2018). New construction is anticipated to handle low level tremors. This risk to areas within the state will likely be an issue to revisit fairly regularly to determine the best course of action.

Extreme Heat

Historical Context: Cleveland County's average maximum temperature according to the Oklahoma Climatological Survey is 72 degrees with the highest recorded temperature occurring in Guthrie (Logan County) on August 10, 1936 when temperatures reached 116 degrees F (Cleveland County Hazard Mitigation Plan 2013-2018). Projections for increased number of the hottest days has been estimated to increase from 7 days (hottest days) to 30 of the hottest days (SCIP).

Mitigation Strategy / Recommendations from HMP: Vulnerable populations include disabled, elderly, the ill and lower incomes where electricity (fans) and air conditioning is not affordable.

Flood

Historical Context: Flooding can be connected to development being permitted too close to stream, rivers and floodplains. Flooding can also have devastating impacts to property owners without flood insurance.

Date	Location	General Description of Incident
6/14/10	Moore	Flash Flood
9/13/10	Lake Thunderbird dam to Slaughterville	Flash Flood - Wind gusts exceeded severe limits, with gusts of 60 to 70 mph reported; Minor damage was reported in Garfield county.
4/10/08	Cleveland County, Norman, Moore	Flood - Other roads around the county were also closed due to high water running over top of them. $5,000 damages were estimated.
9/10/07	Cleveland County, Norman	Flood - Several cars stalled while attempting to drive through the high water. Water also entered a home at SW 199th and Rockwell. **$20,000.00 damages were estimated.**
8/19/07	Norman	Flash Flood - Rainfall amounts exceeded five inches over a large area, with some locations receiving eight to ten inches. A couple of homes were flooded on Lahoma street. Numerous streets were closed due to high water. One road collapsed due to the persistent rainfall. $20,000.00 damages were estimated.
7/10/07	Norman	Flood - Several businesses had water in them as well. Continuous rounds of heavy rainfall proved more than the Reynolds Lake earthen dam could take. A ten-inch pipe in place to help control rising lake levels was not near enough for the rapid increase in the lake level. A 25 to 30 foot diameter and 15 foot deep portion of the dam collapsed, sending water rushing out and over Rock Creek and Alameda Roads. The roads were closed for a couple of days as a result until the water levels that were once over a foot deep receded. **$15,000.00 damages are estimated.**
5/7/07	Cleveland County, Lexington	Flood, Flash Flooding - Three water rescues were made due to water over rising near the top of the cars. Three minor injuries were reported. $15,000.00 damages were estimated.
6/10/03	Moore	Flash Flood- no damage reported
6/27/01	Stella	Flash Flood no damage reported
4/30/00	Moore	Flash Flood- no damage reported
10/20/00	Moore	Flash Flood- no damage reported

(Cleveland County Hazard Mitigation Plan 2013-2018)

Mitigation Strategy / Recommendations from HMP: Moore has identified locations where repeated flooding has occurred and drainage improvements have been modified to decrease potential for flooding. Norman has developed a 50 year Greenbelt and Stormwater Management plan to address past flooding and improve planning practices near floodzones and flood prone areas. Additional drainage and stream restoration projects are also included in the HMP.

Hail

Historical Context:

Date	Location	General Description of Event
5/28/12	Stella	**1.75"- Monetary damages unavailable**
4/14/12	Cleveland County	**1.75"- Monetary damages unavailable**
4/24/11	3 miles SSW of Moore	**1.50"– 1.75" - Monetary damages unavailable**
6/14/11	2 miles SSE of Norman	**1.50" – 1.75" - Monetary damages unavailable**
5/19/10	6 miles SSE of Lake Thunderbird Dam	**2.5" HAIL - Monetary damages unavailable**
5/19/10	2 miles SSE of Noble	**3" HAIL - Monetary damages unavailable**
5/10/10	1 mile ESE of Moore	**2.75" HAIL - Monetary damages unavailable**
5/10/10	1 mile ENE of Moore	**4.6" HAIL - Monetary damages unavailable**
5/10/10	Moore	**2.13" – 2.75" HAIL - Monetary damages unavailable**
4/30/09	2 miles S of Noble	**2.75" HAIL - Monetary damages unavailable**
5/12/09	2 miles E of Norman	**2" HAIL – Monetary damages unavailable**
11/5/08	4 miles WNW of Norman	**1.75 - 2" HAIL - $40,000,000 damage estimated**
6/13/08	Moore	**2" HAIL - Monetary damages unavailable**
7/30/03	Norman	**1.75" Hail - $500,000 damage estimated**
3/24/04	Cleveland County	**1.75" – 2.75" Hail - $50,000 damage estimated**
3/24/01	1 mile NW of Moore	**2.0" – 2,75" HAIL - Monetary damages unavailable**

(Cleveland County Hazard Mitigation Plan 2013-2018)

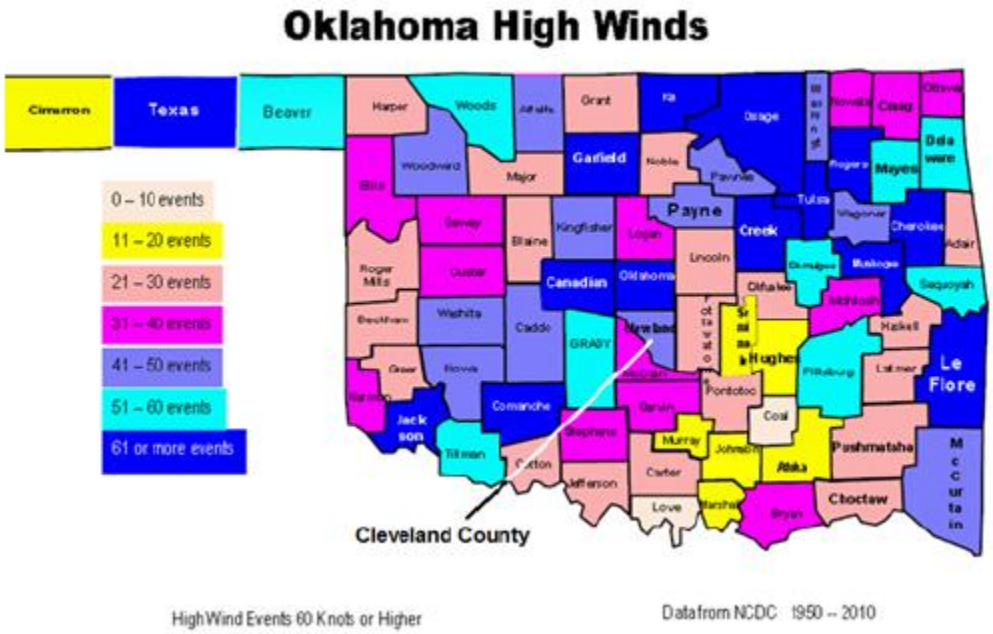
Mitigation Strategy / Recommendations from HMP: "Hail damage to roofs of structures causes roofs to be replaced more frequently than the normal life of roofing material, thus costing insurance companies and property owners millions of dollars annually. Property owners on occasion may have to find temporary housing or business location due to the amount of roof damage on their structure. For businesses, this causes a loss of business and in extreme cases could affect employee jobs. In addition to structural damage, vehicles,

agricultural crops, livestock and wildlife also are threatened by hailstorms most of which cause economic losses. Livestock and wildlife occasionally are injured or killed (especially during large hail events) causing an economic loss." (Cleveland County Hazard Mitigation Plan 2013-2018)

"Little can be done to mitigate damages to crops or livestock, but thanks to technology, mitigation for residents and structures is available today. Window film or hail resistant roofing materials can help alleviate the effects of hail on structures." (Cleveland County Hazard Mitigation Plan 2013-2018)

High winds

Historical Context: 39 High Wind events have caused damage since 2001. In the interest of space, only the eighteen storms which caused structural damage of at least $10,000 or more



Date	Location	General Description of Event
5/29/12	Norman	**61 knots** Damages: $1,000,000 (statewide) ; house, fence and roof damamges
11/7/11	Norman	**61 knots; damages to Max Westheimer Airport**
4/2/10	Norman	**65 knots ; damage to flag poles and fencing**
7/7/09	Slaughterville	**61 knots** Damages: $17,000 Roof and tree damages
7/9/08	Norman	**56 knots**

		Damages:$10,000 ; tree damages
5/31/08	Guthrie	**75 knots** Damages $ 25,000 Power line and tree damage
7/9/07	Norman	**52 knots** Damages $ 12,000 Tree damage
6/19/07	Norman	**52 knots** Damages $15,000. Tree damage
2/24/07	Cleveland County	**50 knots** - Damages $12,000 Power line and tree damage
8/8/06	Norman	**61 knots** Damages $ 20,000. Fence damage
6/12/05	Moore	**61 knots** Damages $ 10,000
7/30/03	Norman	**68 knots** Damages $ 500,000 Garage damage, roof damage, airport damage
5/8/03	Moore	**56 knots** Damages $25,000
6/8/02	Norman	Damages $50,000 Fences, roof and guttering damages
9/16/01	Stella	Damages $40,000 Tree and roof damages
5/18/01	Lexington	Damages $10,000 trees and power lines damages
5/18/01	Norman	Damages $35,000 Roof damage to Tinker Credit Union.
5/18/01	Moore	Damages $25,000 Greenhouse was destroyed at Walmart

Cleveland County Hazard Mitigation Plan 2013-2018

Mitigation Strategy / Recommendations from HMP: This is a regular hazard in the area but typically causes minor damage. No specific actions are called out to address this risk.

Lightning

Historical Context: "While lightning has not caused any known deaths in Cleveland County, it has caused 2 injuries and $1,059,000 in damage since 1993, when the NCDC began keeping records of deaths, injuries, and damage caused by lightning."

Date	Location	General Description of Event
7/10/06	Norman	Lighting causing fire damage; Damage:$110,000
7/10/06	Norman	Lighting fire damage to house; Damages: $100,000
10/31/05	Norman	Lighting fire damage to house; Damages: $150,000
10/10/01	Norman	Injury to a man on a porch
10/10/01	Norman	Lighting fire damage to house; Damages $300,000
09/20/01	Norman	Lighting fire damage to house; Damages: $180,000

Cleveland County Hazard Mitigation Plan 2013-2018

Mitigation Strategy / Recommendations from HMP: Education campaign to lessen impacts on residents by seeking cover during lightning storm.

Tornado

Historical Context:"Moore has experienced 25 tornados since 1890. The May 3, 1999 tornado was one of the costliest natural disasters in US history and ranks among the deadliest in Oklahoma history with May 20, 2013 becoming equal or more devastating"

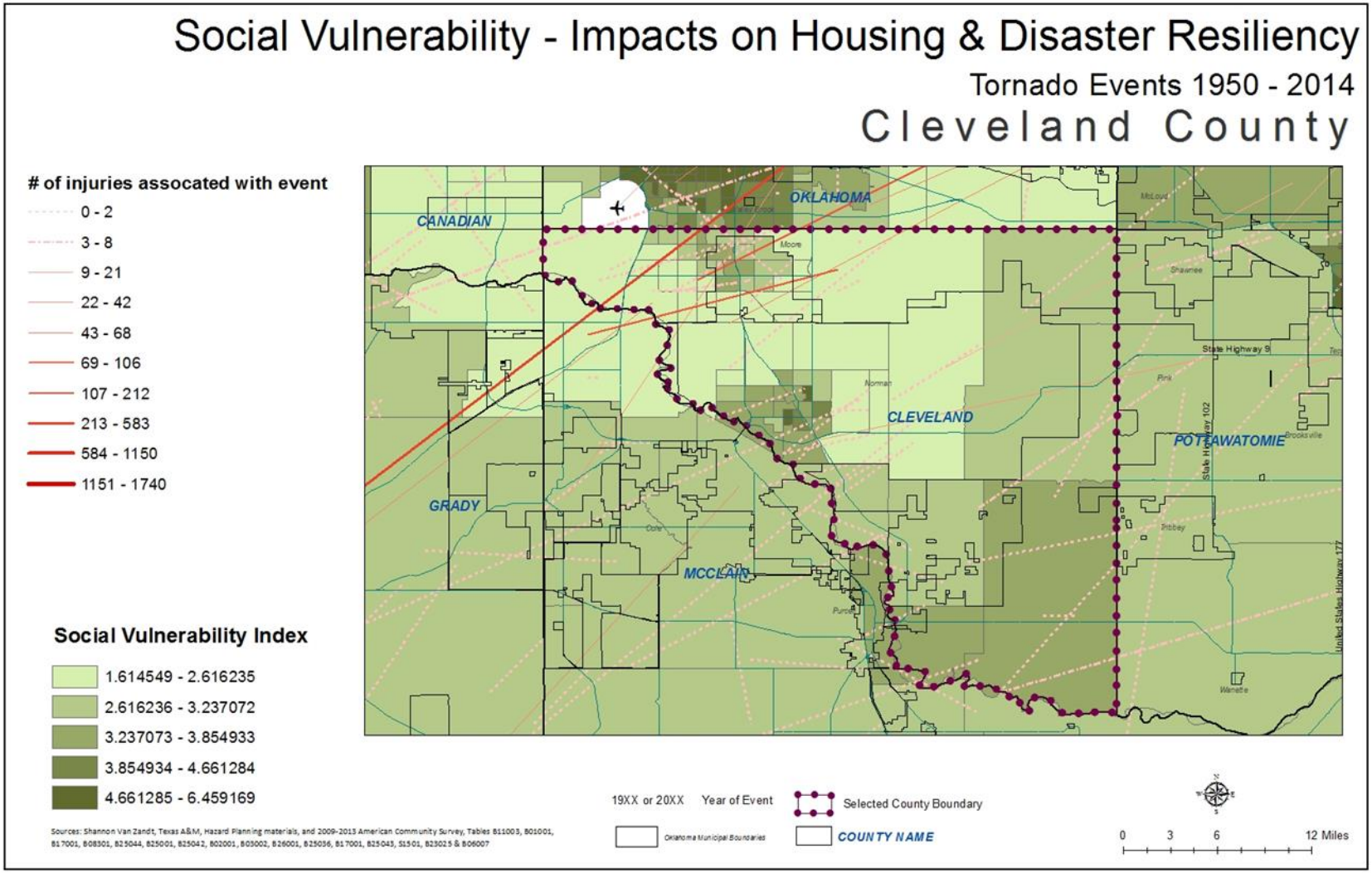
Date	Location	General Description of Event
5/31/13	**Moore**	The 2.6 mile tornado path width is believed to be the widest tornado on record in the united states. (Information taken from NWS Norman investigative report 6-5-2013)
5/20/13	**Moore**	**EF5 -** At 2:56 p.m. CDT, the tornado touched down roughly 4.4 miles (7.1 km) west of Newcastle in Grady County as an EF0. **Early damage estimates exceed two billion dollars. FATALITIES: 51 INJURED**: **350**
4/13/12	Norman and SW Cleveland County	**EF1 ;** There was damage to Jackson Elementary School on Wylie Road just north of Boyd Avenue and roof damage reported all across Norman from Berry Road to Porter Avenue, fire officials said. There was some damage at Norman High School. Several buildings, including one that used to house a paint store, were damaged near downtown. **Injuries: 19 treated for minor injuries at Norman Hospital**
5/24/11	Grady, McClain and Cleveland County	**EF4**
5/10/10	4 to 5 miles E of Lake Thunderbird Dam	**EF2; damages to mobile home park, Country Boy IGA grocery store & service station; INJURIES: 3**

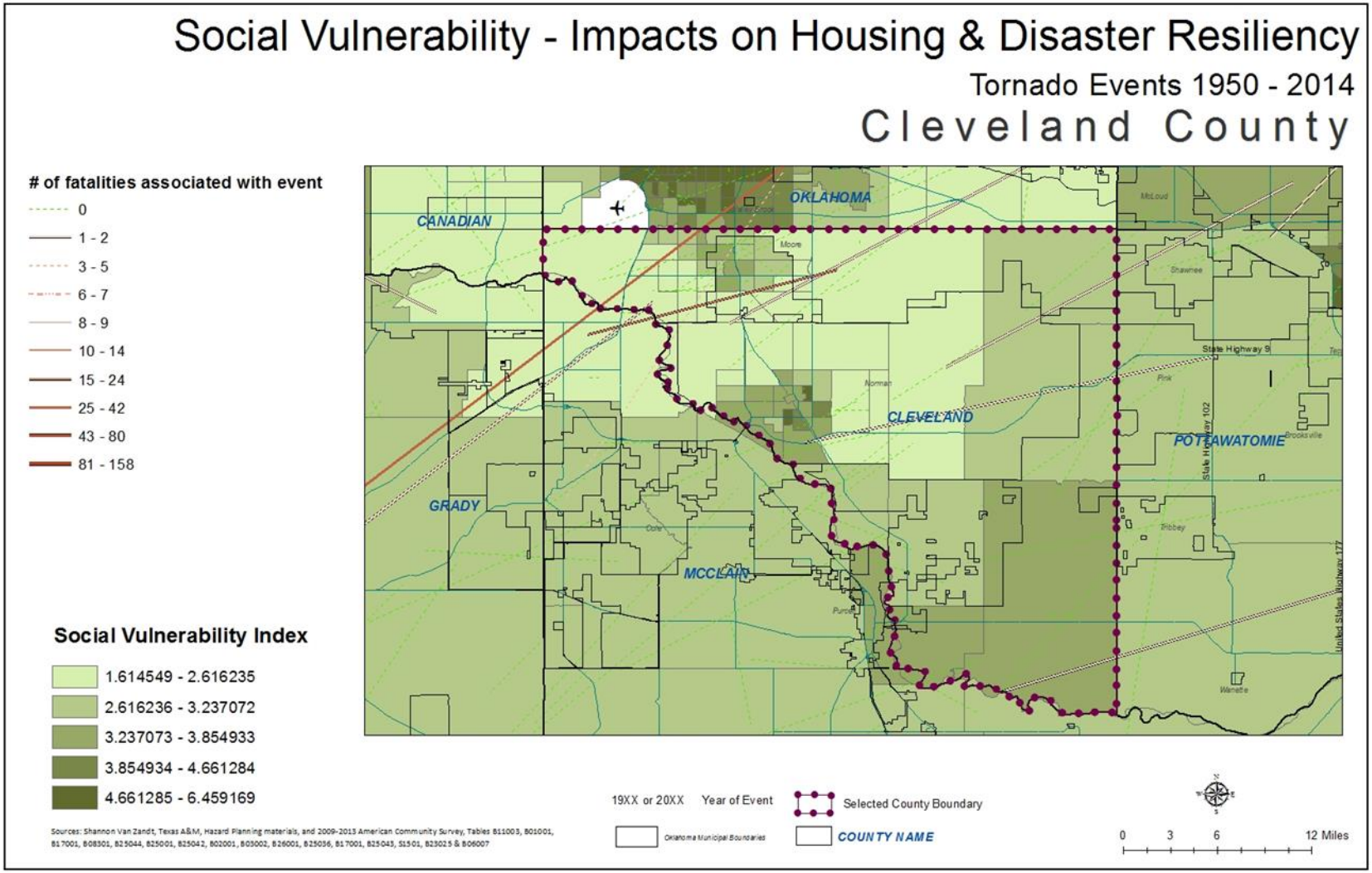
2/10/10	4 miles NNE of Noble	**EF1;** tree damage
5/10/10	5 miles ENE of Lake Thunderbird Dam	**EF4;** severe damage occurred from the Little Axe School; tree damage, Considerable structural damage also occurred, as some foundation homes were mostly destroyed. In addition to the damage, one person lost their life as a result of the tornado. **Fatalities: 1, Injuries: 32**
5/10/10	4 miles WSW of Stanley Draper Lake	**EF1; roof damage**
5/10/10	4 miles ENE of Moore	**EF1;** Power poles and a house were damaged; shingle damage
5/10/10	4 miles NE of Stanley Draper Lake	**F3;** Several homes also sustained damage, roof damage, siding damage, fence damage, tree damage. A few mobile homes in this area were also completely destroyed. Where the tornado crossed I-40, a gas station and drive-in restaurant sustained up to EF3 damage. **Injuries: 20**
6/12/09		
5/13/09		
5/7/08		
6/9/04		
5/8/03		
5/8/03		

Mitigation Strategy / Recommendations from HMP: The HMP "Action Projects" listed to address safety of residents due to tornados and other events includes (p. 216):

- Safe room rebate program
- Outdoor warning devices and repair of older devices
- Emergency generators for critical facilities
- Safe rooms in community and schools (various locations)
- Weather monitoring equipment
- Tone Alert Radio Warning System
- Mass Communications System

For all the county profiles for this study we are providing maps of the historic tornados mapped over the developed social vulnerability index. This is in addition to the data prepared and summarized from the HMP in this section.

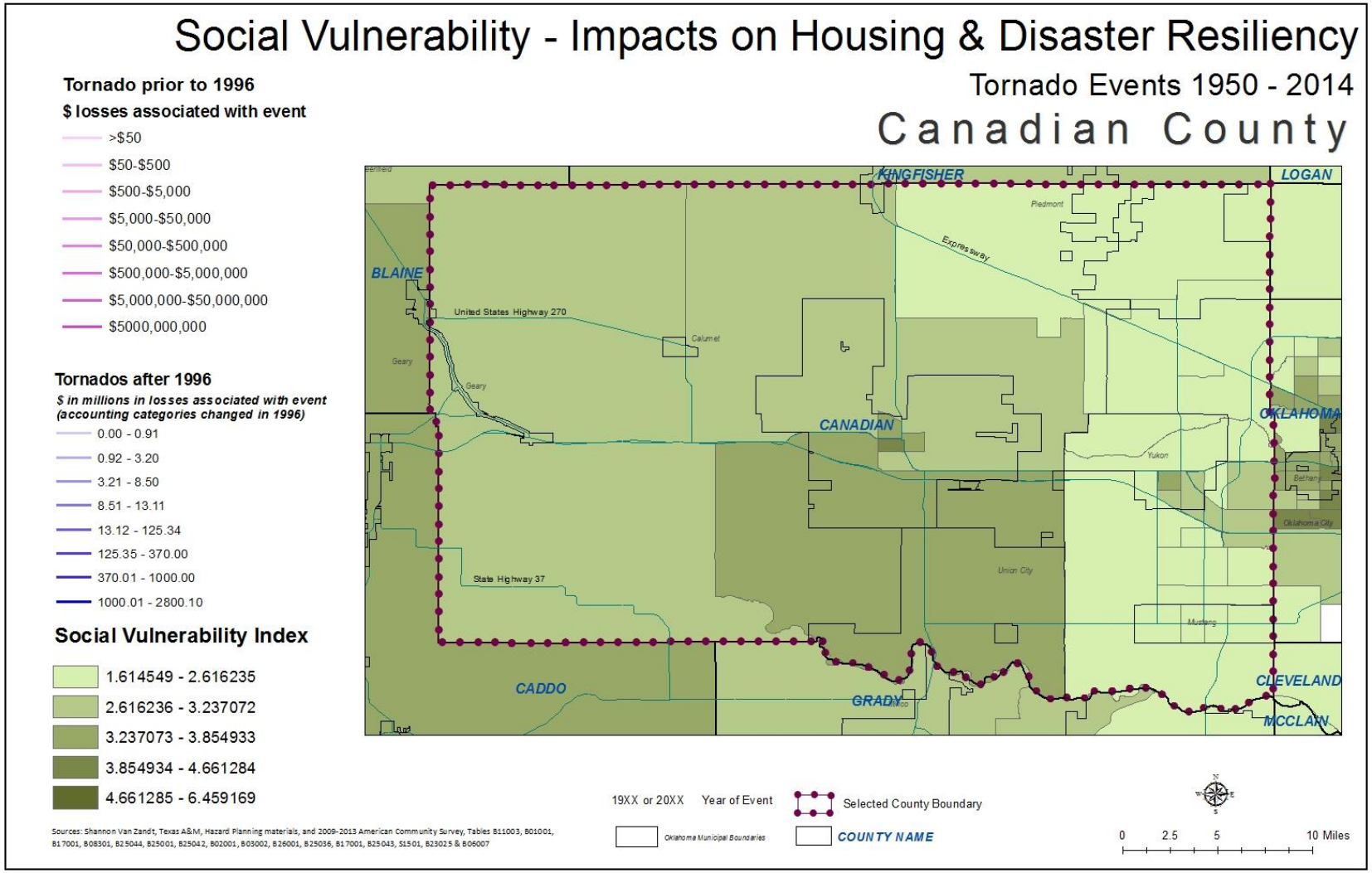

Social Vulnerability - Impacts on Housing & Disaster Resiliency
Tornado Events 1950 - 2014
Cleveland County
# of injuries assocated with event
0 - 2
3 - 8
9 - 21
22 - 42
43 - 68
69 - 106
107 - 212
213 - 583
584 - 1150
1151 - 1740
CANADIAN
OKLAHOMA
CLEVELAND
POTTAWATOMIE
GRADY
MCCLAIN
Social Vulnerability Index
1.614549 - 2.616235
2.616236 - 3.237072
3.237073 - 3.854933
3.854934 - 4.661284
4.661285 - 6.459169
19XX or 20XX Year of Event
Selected County Boundary
Oklahoma Municipal Boundaries
COUNTY NAME
0 3 6 12 Miles
Sources: Shannon Van Zandt, Texas A&M, Hazard Planning materials, and 2009-2013 American Community Survey, Tables B11003, B01001, B17001, B08301, B25044, B25001, B25042, B02001, B03002, B26001, B25036, B17001, B25043, S1501, B23025 & B06007


Social Vulnerability - Impacts on Housing & Disaster Resiliency
Tornado Events 1950 - 2014
Cleveland County
# of fatalities associated with event
0
1 - 2
3 - 5
6 - 7
8 - 9
10 - 14
15 - 24
25 - 42
43 - 80
81 - 158
CANADIAN
OKLAHOMA
CLEVELAND
POTTAWATOMIE
GRADY
MCCLAIN
Social Vulnerability Index
1.614549 - 2.616235
2.616236 - 3.237072
3.237073 - 3.854933
3.854934 - 4.661284
4.661285 - 6.459169
19XX or 20XX Year of Event
Selected County Boundary
Oklahoma Municipal Boundaries
COUNTY NAME
0 3 6 12 Miles

Social Vulnerability - Impacts on Housing & Disaster Resiliency

Tornado Events 1950 - 2014

Canadian County



Wildfires

Historical Context: Wildfires are a regular occurrence in many counties, including Cleveland County.

Table 3-21

2010 - No report available

Cleveland County Wildfire Events 2005-2009 (only data available)												
Fire Dept.	Number of Events						Approx. # Acres Lost					
	2005	2006	2007	2008	2009	2011	2005	2006	2007	2008	2009	2011
Cedar Country FD	24	48	4	14	27	42	356	580	125	30	2706	156

(Cleveland County HMP pg. 173)

Mitigation Strategy / Recommendations from HMP: The Wildland Urban Interface was mapped for all the major cities in the county in order to understand where the potential for wildfires and loss of property and lives could occur. Protection of critical infrastructure such as fire stations, transportation routes and electrical transmissions is a priority both in terms of planning for wildfire events and strategies of fighting the fires during an event. Maintaining firefighters in the cities and county and public education regarding fire safety are the main methods for mitigation.

Winter Storms

Historical Context: Heavy snow and extreme temperatures can impact structures and can be a threat to human lives.

Winter storms regularly occur but damages directly connected to winter storms are not recorded as frequently. In Dec 2007 winter weather of 4-6 inches caused $8,000 damages. In Jan 2007 freezing rain, snow and sleet resulted in numerous traffic accidents,14 indirect fatalities, and $50,000 in damages.

Mitigation Strategy / Recommendations from HMP: Moving power lines underground would help protect from loss of power during these events, which may be even more critical to rural residents (p.210).

C.2.1.2; C.2.1.6; C.2.1.7;C.2.1.8 Shelters from Disaster Event

Most jurisdictions have elected to not have public shelters in order to discourage people from leaving safe places and ultimately be caught on the road trying to reach a public shelter (**http://www.cityofmoore.com/storm-shelters**). Efforts and funding are continuing to be pursued to install shelters in schools and allow residence to have places to shelter in place for example:

The Red Cross Red Cross has released $6.5 Million for Oklahoma Storm Shelters (**http://www.emergencymgmt.com/disaster/Red-Cross-6-Million-Oklahoma-Storm-Shelters.html**)

Moore passed $204 million for storm shelters for the 23 schools still in needed in the area.

Cleveland County keeps an online form for registering locations of private shelters: http://www.clevelandcountyok.com/FormCenter/Storm-Shelter-Registration-3/Storm-Shelter-Registry-43

C.2.1.3 Public Policy and Governance to Build Disaster Resiliency

Building Codes for Lexington, Little Axe Public Schools, Noble, Norman follow the standard 2009 International Building Codes. Recently Moore, OK has updated their Building Codes to address recent tornados and storm events: "Moore's new residential building codes include requiring roof sheathing, hurricane clips or framing anchors, continuous plywood bracing and wind-resistant garage doors. The homes would be built to withstand winds up to 135 miles per hour rather than the accepted standard building requirements of 90 miles per hour" (http://www.cityofmoore.com/node/2111) . County resolutions are reviewed and coordinated with the Hazard Mitigation Plan. Fire Department ISO ratings are set within the Hazard Mitigation Plan.

Site Plan review requirements are included for hazards/risks in Lexington, Moore, Noble, Norman, and Slaughterville. Floodplain related provisions are included in the Zoning Ordinance and Subdivision Ordinances for Lexington, Moore, Noble, Norman, Slaughterville.

Cleveland County Hazard Mitigation Planning Team includes representation by: Cleveland County, Etowah, Lexington, Lexington Public Schools, Little Axe Public Schools , Moore, Moore Public Schools, Noble, Noble Public Schools, Norman, Norman Public Schools, Slaughterville, and the University of Oklahoma.

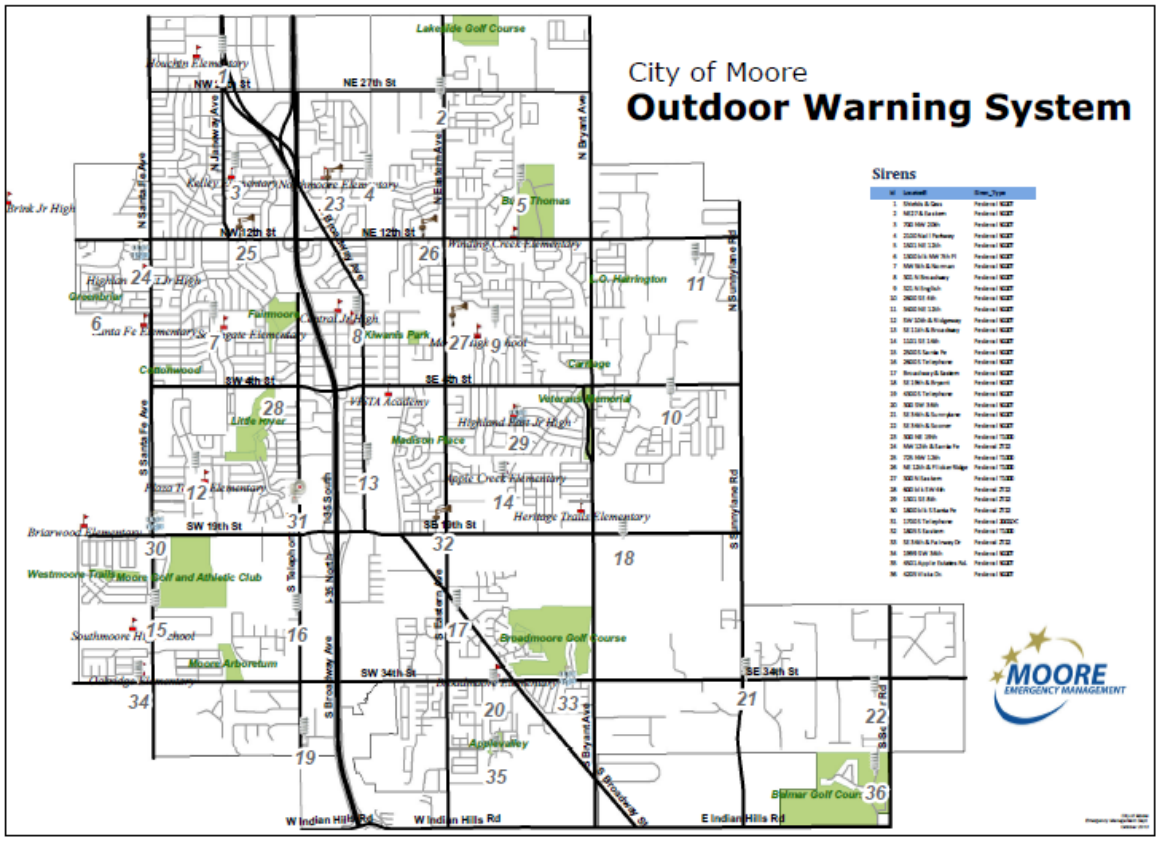
C.2.1.4 Local Emergency Response Agency Structure

The 2013 Emergency Operations Systems Plan, City of Moore clearly identifies that local resilience to risks starts with prepared individuals. The EOP for the City of Moore has a detailed table of task assignments and responsibilities. The tasks outlined include for example "access control of restricted areas, disaster declarations, food supply inspection, emergency medical triage, and recovery services. Clear roles are assigned in primary and assisting roles.

C.2.1.5 Threat & Hazard Warning Systems

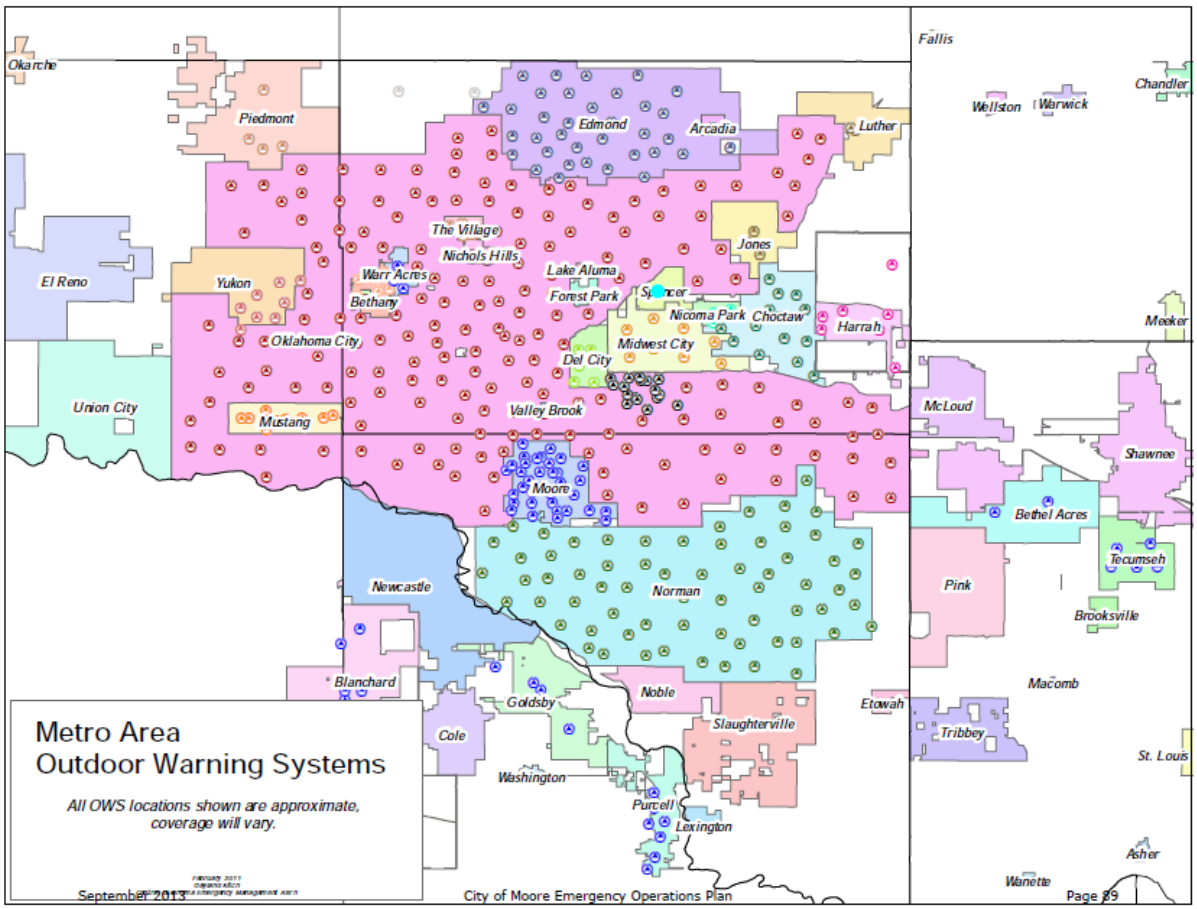
Warning Systems are in place in Lexington (outdoor public address), Lexington Public Schools has internal alert systems as does the Little Axe Public Schools.

Moore has dense outdoor warning system (37 sirens) and mass notification, including social media outlets. Twenty-six of the sirens have the capability to not only sound a siren tone and several other tones, but also provide live or pre-recorded voice..Twenty-eight of the sirens operate from battery power, so commercial power outages do not affect the operation of most of our system. Moore Public Schools utilize mass calling/texting/and email system with some outdoor warning sirens. All Moore Schools have NOAA weather radios.

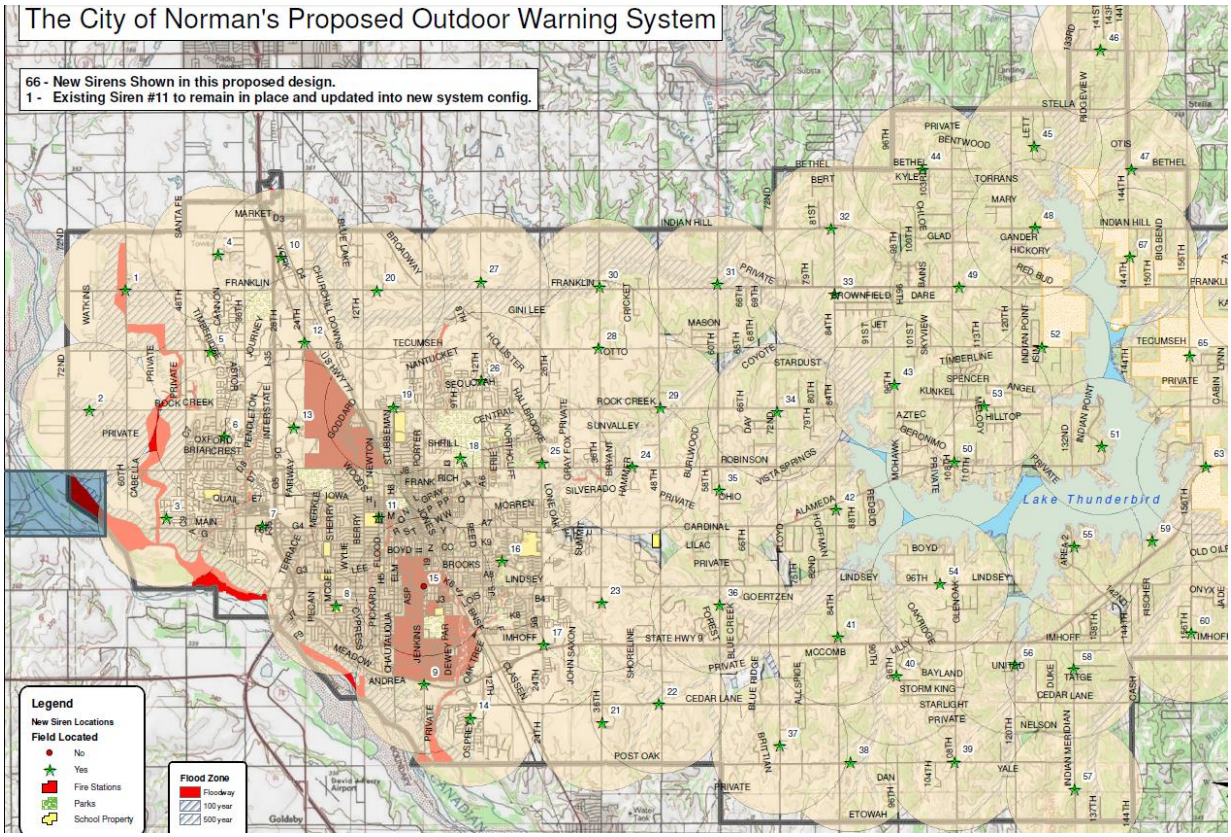


2013 Emergency Operations Plan, City of Moore, OK

Noble has 5 warning sirens. Noble Public Schools have an internal alert system. Norman has 68 warning sirens, with 67 sirens that have voice capabilities. Norman Public Schools have an internal alert system.



2013 Emergency Operations Plan, City of Moore, OK


The City of Norman's Proposed Outdoor Warning System
66 - New Sirens Shown in this proposed design.
1 - Existing Siren #11 to remain in place and updated into new system config.
Legend
New Siren Locations
Field Located
No
Yes
Fire Stations
Parks
School Property
Flood Zone
Floodway
100 year
500 year
Lake Thunderbird

\

Social Vulnerability

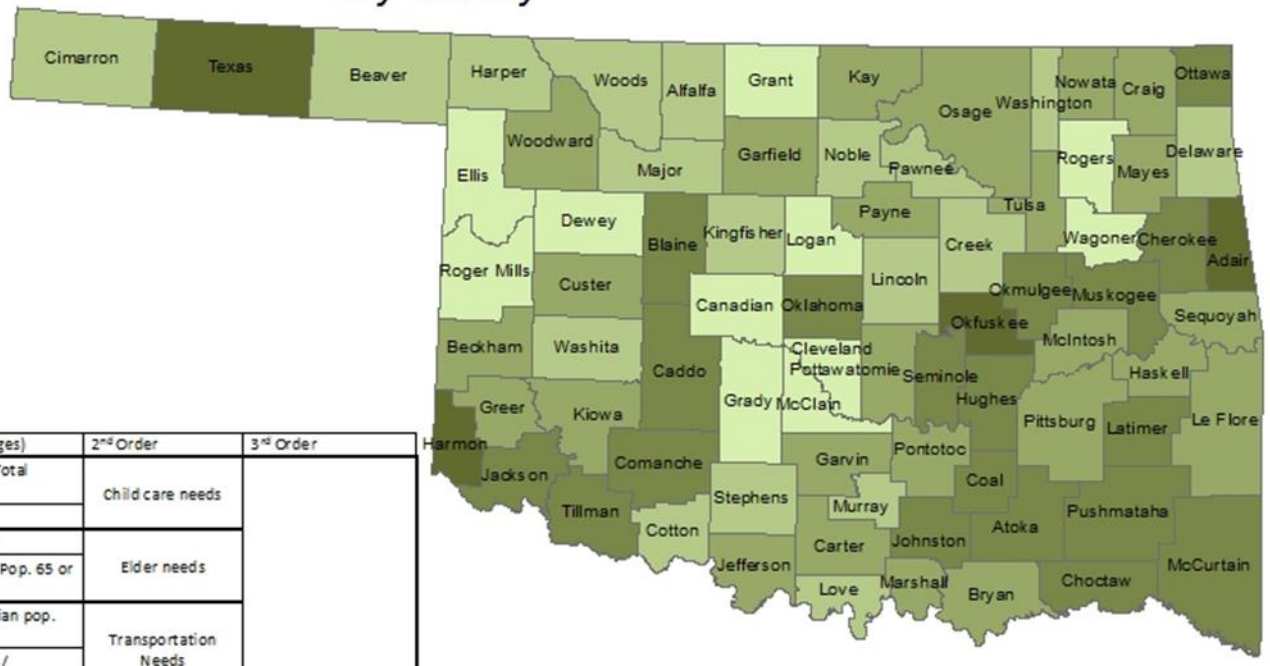
Based on the research work done by the Texas A&M University Hazard Reduction and Recovery Center, an added component is being included in this section. Social vulnerability can place households at a further disadvantage during and after a disaster. This analysis is assessing for the county the levels of social vulnerability based on demographic indicators to highlight 'hotspots' or counties that have higher social vulnerability. That combined with Hazard Mitigation Plans – or lack thereof – can highlight places where additional work is needed to reduce impacts on households.

Levels of Social Vulnerability Analysis

Social Vulnerability Analysis - Cleveland County			
Base Social Vulnerability Indicators (%)		**2nd Order**	**3rd Order**
1.) Single Parent Households	13.35%	0.197 (Child Care Needs)	**2.933 Social Vulnerability 'Hotspot' or Area of Concern**
2.) Population Under 5	6.31%		
3.) Population 65 or Above	10.66%	0.17 (Elder Needs)	
4.) Population 65 or Above Poverty Rate	6.38%		
5.) Workers Using Public Transportation	0.49%	0.039 (Transportation Needs)	
6.) Occupied Housing Units w/o Vehicle	3.45%		
7.) Housing Unit Occupancy Rate	91.23%	2.33 (Temporary Shelter and Housing Recovery Needs)	
8.) Rental Occupancy Rate	32.61%		
9.) Non-White Population	25.02%		
10.) Population in Group Quarters	4.30%		
11.) Housing Units Built Prior to 1990	60.24%		
12.) Mobile Homes, RVs, Vans, etc.	6.77%		
13.) Poverty Rate	12.87%		
14.) Housing Units Lacking Telephones	1.59%	0.196 (Civic Capacity Needs)	
15.) Age 25+ With Less Than High School Diploma	9.10%		
16.) Unemployment Rate	5.48%		
17.) Age 5+ Which Cannot Speak English Well or Not At All	3.43%		
Sources: Shannon Van Zandt, Texas A&M, Hazard Planning materials, and 2009-2013 American Community Survey, Tables B11003, B01001, B17001, B08301, B25044, B25001, B25042, B02001, B03002, B26001, B25036, B17001, B25043, S1501, B23025 & B06007			

Social Vulnerability Index

By County



Levels of Social Vulnerability Analysis

Base Social Vulnerability Indicators (Percentages)	2nd Order	3rd Order
1. Single parent households with children/ Total Households	Child care needs	Social vulnerability "Hotspot" or area of concern
2. Population 5 or below/Total Population		
3. Population 65 or above/Total Population	Elder needs	
4. Population 65 or above & below poverty/Pop. 65 or above		
5. Workers using public transportation/Civilian pop. 16+ and employed	Transportation Needs	
6. Occupied housing units without a vehicle / Occupied housing units (Hus)		
7. Occupied housing units / Total housing units	Temporary Shelter and housing Recovery needs	
8. Persons in renter occupied housing units/ Total housing units		
9. Non-white population/Total population		
10. Population in group quarters / Total population		
11. Housing units built 20 years ago / Total housing units		
12. Mobile Homes/ Total housing units		
13. Persons in poverty / Total population		
14. Occupied housing units without a telephone/ Total occupied HU	Civic Capacity needs	
15. Population above 25 with less than high school/ Total pop above 25		
16. Population 16+ in labor force an unemployed/ Pop in Labor force 16+		
17. Population above 5 that speak English not well or not at all / Pop >5		

Source: Shannon Van Zandt, Texas A&M, Hazard Planning materials; 2008-2013 American Community Survey, Tables B11003, B01001, B17001, B08201, B25044, B25091, B25043, B01001, B08007, B16001, B25026, B17001, B25043, B15001, B19053 & B08007

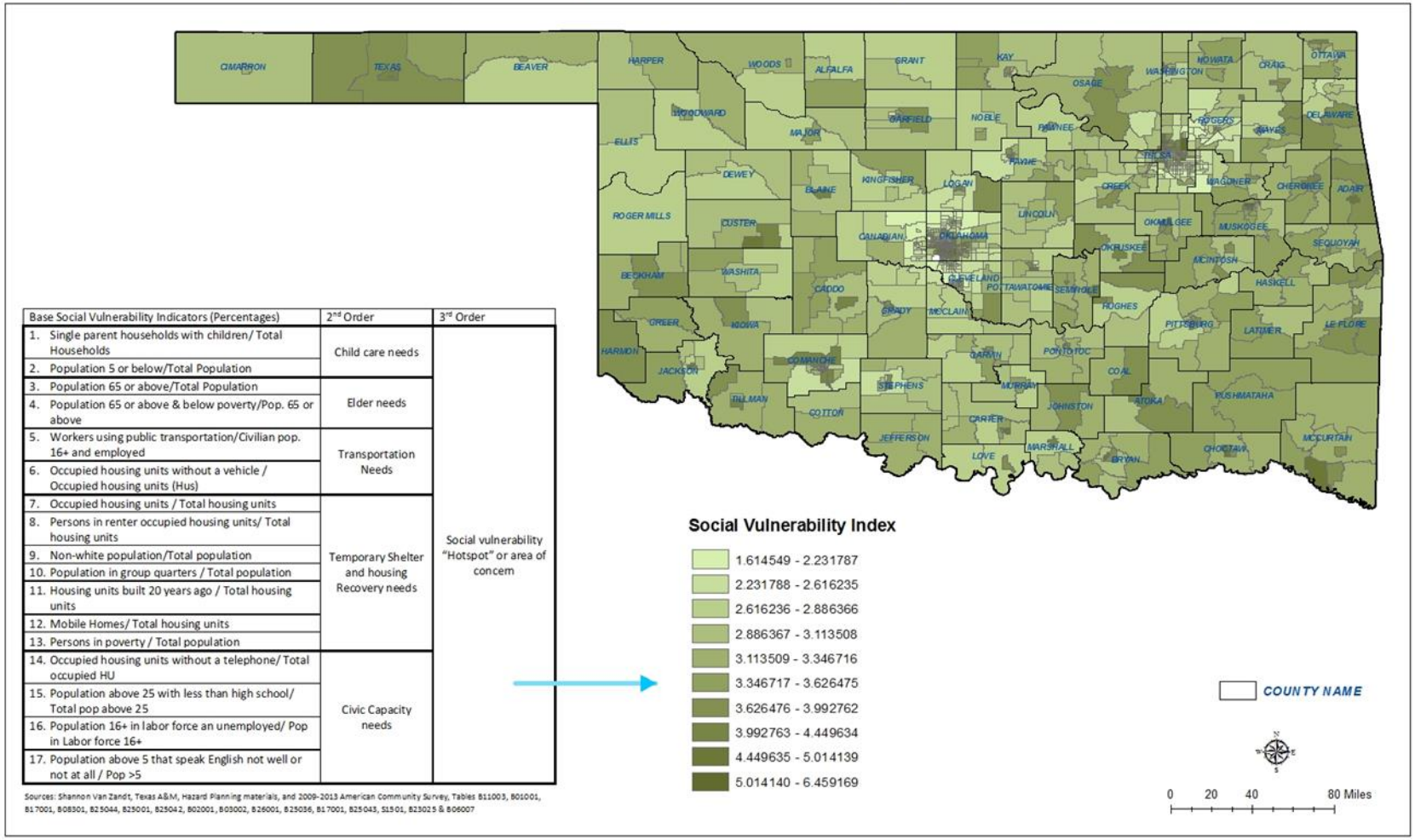
Legend

Social Vulnerabiity "Hot Spots"

- 2.6340 - 2.9760
- 2.9761 - 3.2170
- 3.2171 - 3.4180
- 3.4181 - 3.6370
- 3.6371 - 3.9500

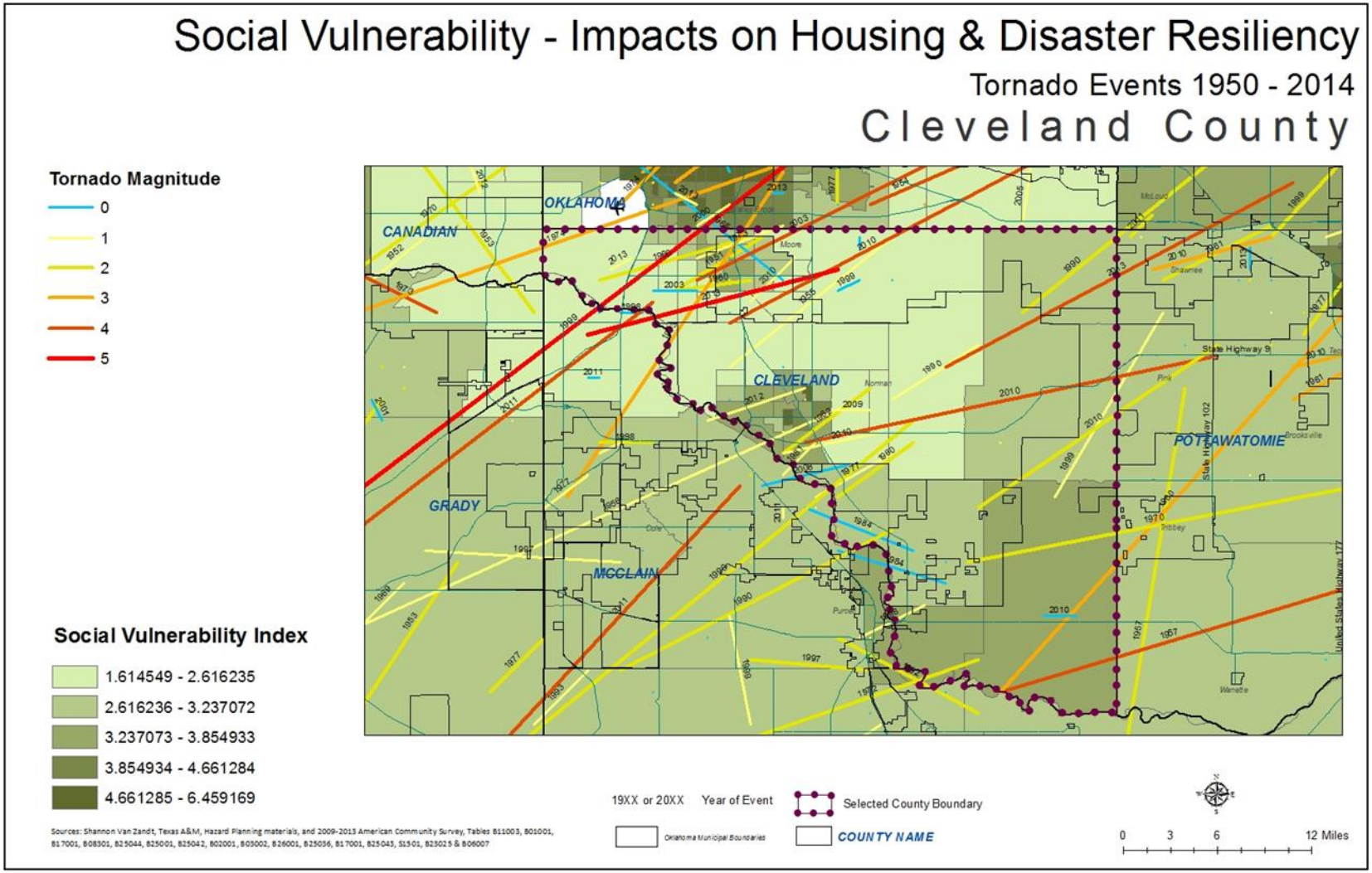
0 25 50 100 Miles

Social Vulnerability - Impacts on Housing & Disaster Resiliency



Base Social Vulnerability Indicators (Percentages)	2nd Order	3rd Order
1. Single parent households with children/ Total Households	Child care needs	Social vulnerability "Hotspot" or area of concern
2. Population 5 or below/Total Population		
3. Population 65 or above/Total Population	Elder needs	
4. Population 65 or above & below poverty/Pop. 65 or above		
5. Workers using public transportation/Civilian pop. 16+ and employed	Transportation Needs	
6. Occupied housing units without a vehicle / Occupied housing units (Hus)		
7. Occupied housing units / Total housing units	Temporary Shelter and housing Recovery needs	
8. Persons in renter occupied housing units/ Total housing units		
9. Non-white population/Total population		
10. Population in group quarters / Total population		
11. Housing units built 20 years ago / Total housing units		
12. Mobile Homes/ Total housing units		
13. Persons in poverty / Total population		
14. Occupied housing units without a telephone/ Total occupied HU	Civic Capacity needs	
15. Population above 25 with less than high school/ Total pop above 25		
16. Population 16+ in labor force an unemployed/ Pop in Labor force 16+		
17. Population above 5 that speak English not well or not at all / Pop >5		

Sources: Shannon Van Zandt, Texas A&M, Hazard Planning materials, and 2009-2013 American Community Survey, Tables B11003, B01001, B17001, B08301, B25044, B25001, B25042, B02001, B03002, B26001, B25036, B17001, B25043, S1501, B23025 & B06007


Social Vulnerability - Impacts on Housing & Disaster Resiliency
Tornado Events 1950 - 2014
Cleveland County
Tornado Magnitude
0
1
2
3
4
5
OKLAHOMA
CANADIAN
CLEVELAND
GRADY
MCCLAIN
POTTAWATOMIE
State Highway 9
Social Vulnerability Index
1.614549 - 2.616235
2.616236 - 3.237072
3.237073 - 3.854933
3.854934 - 4.661284
4.661285 - 6.459169
Sources: Shannon Van Zandt, Texas A&M, Hazard Planning materials, and 2009-2013 American Community Survey, Tables B11003, B01001, B17001, B08301, B25044, B25001, B25042, B02001, B03002, B26001, B25036, B17001, B25043, S1501, B23025 & B06007
19XX or 20XX Year of Event
Selected County Boundary
Oklahoma Municipal Boundaries
COUNTY NAME
0 3 6 12 Miles

Social vulnerability combined with the devastating impacts of a natural or man-made disaster can compound a household's ability to recover and in fact can place those individuals at an even great gap or disadvantage prior to the event (Shannon Van Zandt, Texas A&M, Hazard Planning materials).

As a county, Cleveland county ranks as less vulnerable than other counties in the state. However, looking at the census tracts portions of the central area of the county near Norman and Moore and the southeast portion of the county have populations that are more socially vulnerable and therefore can experience greater negative impacts in recovery after a disaster event.

Recommendations for this county:

- Continue to update and maintain the county HMP and include attention to areas within the county that in addition to physical vulnerability may have compounding social vulnerability factors. Working through the priorities and projects within the Cleveland County HMP will help strengthen the ability to reduce loss of life and property as well as recover more effectively after an event.
- Efforts to strengthen building codes related to tornadoes and natural disasters should be considered.
- Planning for shelters from disaster events for multifamily, HUD and LIHTC units, in addition to all housing in the community should be incorporated with any effort to increase housing.