4.0 HAZARD PROFILE

One of the initial tasks in developing a natural disaster mitigation plan, as well as any updates, is to determine a hazard profile for the County. Shelby County has experienced many natural disasters in the past one hundred years. These disasters have ranged from tornadoes and blizzards, to flooding and droughts. With regard to mitigation planning, the first step in developing a workable plan is to focus upon natural disasters that have historically impacted Shelby County. The purpose of this section is to identify those natural disasters most relevant to Shelby County, to describe their occurrences, and to determine the relative probability of their reoccurrence. The following components of this section describe the process of assessing and determining those specific hazards that would be focused upon by the planning group, identifying the historical hazard events that have occurred in Shelby County, as well as providing general background information on each of those hazards.

Also, according to the Ohio EMA, between March 21, 1997 and August 20, 2012, there have been 18 federally declared disasters that have impacted Shelby County. In three of those declared disasters, Shelby County received Federal Public Assistance Grant funds. These three grants provided over $575,500 of funding to the County.

4.1 Initial Hazard Assessment

In order to properly evaluate the natural hazards to which Shelby County may be susceptible, a three-step process was utilized. This three-step process was completed in order to consolidate the hazards for which Shelby County should prepare, and potentially mitigate, in the future. The three steps are described in the following paragraphs.

Step 1 - The initial consideration of those natural disasters most likely to impact Shelby County centered on common knowledge of governmental agency officials, local professionals, and others having an understanding of those hazards that have occurred in the past and considering the likelihood of reoccurrence.

Step 2 - The NCDC database was consulted for those historic natural disasters specifically identified for Shelby County. The NCDC website provides data for natural disasters occurring from 1950 – 2015. Search parameters focused on the natural disasters considered to be most relevant to Shelby County. Those disasters included drought, flood, severe summer and winter storms, and tornado.

Because NCDC information did not address hazards such as earthquakes and dam/levee failure, other sources were contacted for this data. The information pertaining to earthquake susceptibility was attained the Ohio Seismic Network website. Dam/levee failure information was obtained from the ODNR – Dam Safety Program website.

Step 3 - The ODPS Ohio Emergency Management Agency Hazard Identification/Risk Analysis (HIRA) website information, updated in 2011, was researched. The HIRA information was obtained for Shelby County. OEMA HIRA ratings for Shelby County hazard risks are as follows:

Dam/Levee Failure – Low
Drought – Medium
Earthquake – Low
Flood – Excessive
Land Subsidence – None
Severe Summer Storms - Excessive
Tornado – Low
Wildfire – None
Windstorm – Medium
Winter Storms – Excessive

4.2 Risk Assessment Ranking

The Plan Update Committee began the process of risk assessment ranking by collecting historical data as previously mentioned. Once obtained, these data were reviewed and discussed by the Plan Update Committee. Due to variations in the impacts of flooding and winter storms during the latest Plan update period, the Committee decided to rearrange the hazard priorities from the initial Plan. Also taking into consideration the hazard priorities of the initial Core Group, the Plan Update Committee agreed with their prioritization, culminating in the following prioritized list:

Flooding (including dam/levee failure) (previously third priority)
Summer Storms – Thunderstorms, high winds, hail, and lighting
Winter Storms – Snow, Ice, and Extreme Cold (previously top priority)
Tornadoes
Droughts and Extreme Heat
Earthquakes

Please note that the Committee did not address landslides, sinkholes, wildfires, or erosion due to their relative insignificance to Shelby County according to ODPS HIRA information as stated above as well as the Planning Committee.

4.3 Flooding (including Flash Floods, Riverine Floods, and Dam/Levee Failure)

Port Jefferson Flood of 2003

Floods are a naturally recurring event for a river or stream, and are caused by weather phenomena and events that deliver more precipitation to a drainage basin that can be readily absorbed or stored within the basin. Flooding is a localized hazard that is a result of heavy or continuous rainfall exceeding the absorptive capacity of soil and the flow capacity of rivers and streams. Floods can be generally considered in two categories: flash floods, the product of heavy localized precipitation in a short time period over a given location; and riverine floods, caused by precipitation over a longer time period and over a given river basin.

<u>Flash Floods</u>

Flash floods occur within a few minutes or hours of heavy amounts of rainfall, from a dam or levee failure, or from a sudden release of water held by an ice jam. Flash floods can destroy buildings and bridges, uproot trees, and scour out new drainage channels. Heavy rains that produce flash floods can also trigger mudslides. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in a local area, or by heavy rains from hurricanes and tropical storms. Although flash flooding occurs often in higher elevation areas, it is also common in urban areas where much of the ground is covered by impervious surfaces. Roads and buildings generate greater amounts of runoff than typical forested land. Fixed drainage channels in urban areas may be unable to contain the runoff that is generated by relatively small, but intense, rainfall events.

<u>Riverine Floods</u>

Riverine flooding refers to periodic flooding of lands adjacent to non-tidal rivers and streams. It is a natural and inevitable occurrence. When stream flow exceeds the capacity of the normal watercourse, some of the above-normal stream flow spills over onto adjacent lands within the floodplain. Riverine flooding is a function of precipitation levels and water runoff volumes within the watershed of the stream or river. The recurrence interval of a flood is defined as the average time interval, in years, expected to take place between the occurrence of a flood of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Flooding is an important issue for the residents and business owners of Lake Loramie. Whether it was flash floods or riverine flooding events that have occurred in the past, damage has been extensive. Areas that are prone to flooding in Shelby County are along the banks of Lake Loramie and the watersheds of the Great Miami River and Loramie Creek.

Reservoirs and Dams

Reservoirs and dams impound water to reduce the amount of water that reaches an area at one time. A reservoir holds high flows behind a dam or in a storage basin. Water is released at a controlled rate. Reservoirs and dams are generally perpendicular to a stream or river.

Ohio and Federal Dam Classification Systems

Ohio Dam Classification	Description	Corresponding Federal Classification
Class I	Probable loss of life, serious hazard to health, structural damage to high value property (i.e., homes, industries, major public utilities)	High
Class II	Flood water damage to homes, businesses, industrial structures (no loss of life envisioned), damage to state and interstate highways, railroads, only access to residential areas	Significant
Class III	Damage to low-value, non- residential structures, local roads, agricultural crops and livestock	Significant
Class IV	Losses restricted mainly to the dam	Low

According to the ODNR website, Shelby County has two Class I dams, four Class II & III dams, 10 Class IV dams, and 22 “Other” dams. These data can be found on page 153 of the State mitigation plan below.
http://ema.ohio.gov/Documents/OhioMitigationPlan/2011/Section%202_HIRA%20Part%204.pdf.

There are currently two Class I dams in Shelby County, which are classified by the ODNR’s Division of Dam Safety – Lake Loramie Dam and Lockington Dam. Data relating to these dams can be found at: https://gis.ohiodnr.gov/MapViewer/?config=ohiodams (select Shelby County under “County Bookmark”).

Lake Loramie Dam

According to ODNR’s Division of Engineering, Lake Loramie Dam is part of Lake Loramie State Park located in Shelby County and was built in 1844 to impound a feeder lake to the Miami & Erie Canal. The dam has a maximum height of 23.3 feet that carries a portion of State Route 362.

The dam has a 220-foot-long concrete spillway that discharges water from the lake into Loramie Creek. As a Class I high-hazard potential structure, a sudden failure of Lake Loramie Dam likely would result in the structural collapse of at least one residence or one commercial or industrial business and probable loss of human life. (Hazard ratings refer to the consequences of dam failure, not the dam's condition.)

Investigations of the dam structure reveal the concrete spillway is deteriorated and has a very low safety level. Due to complex issues and a potentially time-consuming process to address all the deficiencies, ODNR has proceeded with an incremental approach by preparing a final design to replace the existing spillway, reduce seepage and increase embankment stability. The new spillway will have similar height and flow characteristics as the existing spillway. Construction began in 2016 and is expected to be complete in the spring of 2018. An emergency action plan will be shared with emergency management officials once the dam is completed. ODNR is working on a draft vulnerability analysis of the population at risk (PAR) and estimated damages in the event of a dam failure.

Lockington Dam

As described by ODNR's Division of Engineering, Lockington Dam is an earthen embankment located across the Loramie Creek in southern Shelby County near the Village of Lockington. The road across the top of the dam is a maintenance road closed to the public. Construction of the dam began in February of 1918 and was completed in October of 1921.

The dam has two concrete conduits through the base of the embankment near the center of the valley. The conduits are sized to discharge floodwaters at a rate that can be handled by the flood protection levees and channels downstream. The remainder of the floodwaters are temporarily stored behind the dam and released over time. An emergency spillway is located directly above the conduits in the same structure.

Dams – Methodology

According to the Ohio Enhanced Mitigation Plan 2011, if a dam fails, the failure will cause flooding downstream, and the flooding will have negative impacts on people or property. Dam failure inundation studies require specialized hydraulic modeling software and experience. Determining the impact of flooding is also difficult for estimating loss of life. Loss of life is a function of the time of day, warning time, awareness of those affected, and particular failure scenario. Many dam safety agencies have used population at risk (PAR), a more quantifiable measurement of the impact to human life, rather than loss of life. PAR is the number of people in structures within the inundation area that would be subject to significant, personal danger, if they took no action to evacuate.

Emergency managers usually categorize dam failures as either sunny day failures or rainy-day failures. Sunny day failures occur during a non-flooding situation with the reservoir near normal pool level. Rainy day failures usually involve periods of rainfall and flooding, and can exacerbate inadequate spillway capacity. Even though both types of failures can be disastrous, it can be assumed that a sunny day failure would be more catastrophic due to its unanticipated occurrence and the lack of time to warn residents downstream.

The following table portion is taken from the State of Ohio Enhanced Mitigation Plan of 2011: (http://ema.ohio.gov/Documents/OhioMitigationPlan/2011/Section%202_HIRA%20Part%204.pdf)

Priority Dam Inventory, Expected Downstream Damage Level, and Minimum Level Population At-Risk (PAR) by County - Region 1					
County	**Dam**	**Sunny Day Damage Level**	**Sunny Day PAR Level**	**Rainy Day Damage Level**	**Rainy Day PAR Level**
Shelby	Lockington Dam	--	Low	Very High	Medium
Shelby	Lake Loramie Dam	Medium	Low	Medium	Low

In terms of damages, the dams upstream of larger populations exhibit higher estimated damages with both the *sunny day* and *rainy day* scenarios. For instance, Lockington Dam shows no evidence of downstream damage during a *sunny day* failure, as the dam does not impound any pool—flood control dam. *Very High* damage estimates should be expected during a large storm event as the channel would most likely be overwhelmed.

The damage level estimates for Loramie Dam are medium for a sunny or rainy day due to the proximity of the Village of Ft. Loramie. However, the minimum level population at risk remains low in both situations.

According to the January 2011 OEMA HIRA, the State does not currently have a means of determining downstream populations impacted and/or potential monetary losses in case of failure of Ohio's Class I dams. Shelby County, in turn, also does not have that capability.

Levees and Floodwalls

Levees and floodwalls restrain the flow of the stream or river. During a flood, the stream or river flow is not reduced; only confined. Levees and floodwalls are generally parallel to the flow of the stream. Currently, Shelby County has no floodwalls within the County.

According to ODNR's Division of Dam Safety, Shelby County does have a designated levee (also considered a Class II dam). This earthen levee is located along the west side of the Great Miami River, starting south of Route 47 to Children's Home Road. Road and is 5,100 feet long and 10.2 feet high. Additional information regarding this levee can be found at: https://gis.ohiodnr.gov/MapViewer/?config=ohiodams.

As a component of OEMA's HIRA, there are no documented instances of levee breaches whereby structures or properties were damaged in Ohio as such data are generally unavailable and undocumented. This does not mean there is minimal risk behind these levees; it means more effort needs to be exerted in the collection of such data. Though there are no data to evaluate potential inundation areas behind levees, as these data are developed, they will become part of this plan.

4.3.1 Special Flood Zone (100-year Floodplain)

Flood Insurance Rate Maps (FIRM) show areas delineated to be special flood hazards. The Base Flood Elevation (BFE) refers to the elevation associated with a special flood zone, or a flood with a 1% chance of occurring in any given year. Areas within a special flood zone area, also known as the 100-year floodplain, have an elevation lower than the BFE and are categorized into zones. Zone "A" is the flood insurance rate zone that corresponds to a special flood zone area that is determined in the Federal Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone. Zone "AE" is the flood insurance rate zone that corresponds to a special flood zone area that is determined in the Federal Flood Insurance Study by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Shelby County has special flood zones identified within the County. All of unincorporated Shelby County is in compliance with state floodplain management standards and participates in the National Flood Insurance Program (NFIP). The County has been involved since September 02, 1982.

4.3.2 Repetitive Loss

In most counties there are areas that periodically suffer damages from floods. They are known as "repetitive loss" properties. Repetitive loss properties are defined as properties with structures that have had two or more insurance claims within a 10-year period. According to FEMA, there are eight properties that have suffered from repeated flooding occurrences in Shelby County. Considerations for these properties are addressed as a part of the Action Matrix found in Appendix J.

4.3.3 Significant Historic Flooding Events

July 7-9, 2003
Several clusters of heavy thunderstorms moved across western Ohio during the early morning and afternoon on July 7 bringing 2"–4" of rain to an already saturated area. Flooded roads and creeks and small streams rising out of their banks occurred throughout the region. Some of the worst flooding was in Shelby and Logan counties, where evacuations were executed near the swollen Great Miami River, as well as Jackson Center. On July 8, Lake Loramie State Park was evacuated as the lake came out of its banks. Numerous roads were flooded across the northern half of the county. County Road 25A and nearby parkland were underwater in Sidney. One hundred homes near Lake Loramie were flooded. Evacuations occurred near Fort Loramie, Jackson Center, and Port Jefferson. Thunderstorms continued on July 9 as heavy rain moved across portions of western Ohio during the early morning. Another two to three inches fell on many areas that had seen 6 to 12 inches over the past week. This additional rainfall caused many road closures due to high water, and small streams to rise out of their banks again. The most serious flooding occurred from northern Darke County through Shelby and Logan counties. Communities along the swollen Great Miami River from Indian Lake downstream through Lakeview, DeGraff, Port Jefferson and Sidney dealt with flooded homes and businesses. Sandbagging occurred in Port Jefferson in an effort to keep water out of homes.

Sidney – Big 4 Bridge

Port Jefferson

May 21, 2004
An intense line of thunderstorms moved across west central and central Ohio during the afternoon and evening. Torrential rainfall accompanied the storms, with two to four inches falling over much of the region. Numerous roads were flooded and closed due to the heavy rain in Sidney.

January 13, 2005
As weary electric utility crews completed repairs to ice storm-damaged power lines from the December storm another concern was on the rise, Sidney and Shelby County communities turned anxiously to a rising Great Miami River and new threat of flooded roadways. The river went from an elevation of 8.5 feet to 13.5 feet but was expected to crest short of 14 feet. This flooding incident was caused by a winter storm in December of 2004 as described in Section 4.5.4.

December 21-22. 2013
On December 21-22, 2013, Shelby County experienced riverine flooding and county-wide flooding due to extended heavy rainfall and snow melt. The Great Miami River rose to 15.42 feet prompting the activation of the City of Sidney's River Flood Action Plan and opening of the EOC. Residents along the river were notified of possible evacuations and sandbags were set in place. Due to flooding across the county, many roads were closed. There was some wind damage due to the severe thunderstorms. The City of Sidney received $31,747 for damages from the Ohio State Disaster Relief Fund.

4.3.4 Frequency/Probability of Future Occurrence

According to the NCDC, there were 40 flood events recorded in Shelby County from January 1950 thru December 2015. These events caused almost $700,000 in property damage. No deaths or injuries were recorded. In the last 24 years, there were 28 flood events. This equates to a probability of 116.66% (28 events/24 years observed) chance of occurrence per given year.

Past floods are indications of what can happen in the future, but mitigation plans are based on the risk of future flooding. Flood studies interpret historical records to determine the statistical potential that storms and floods of certain magnitude will recur. Such events are measured by their recurrence interval.

Recurrence interval, or frequency of occurrence, is defined as the average number of years between storms of a given intensity. Recurrence intervals commonly used in technical studies and design are 25, 50 and 100 years. Recurrence interval addresses how often a flood of a specific depth will be expected to occur. Structures located within areas considered at higher risk are prioritized at a higher level as it relates to mitigation. Since most of Shelby County is rural in nature, estimated losses were based on just a few higher populous areas, where significant property damage was likely to occur. NCDC listings of flood events can be found in Appendix G

4.4 Summer Storms – Thunderstorms, High Winds, Hail and Lightning

Hazards that fit into the severe storm category include thunderstorms, high winds, hail and lightning. One of the biggest problems associated with severe weather is the lack of public education and awareness. Severe storms can do damage, but are often the precursor for much more severe weather to follow. One example is the direct association of tornadoes with thunderstorms.

4.4.1 Thunderstorms

A severe thunderstorm watch is issued by the National Weather Service (NWS) when the weather conditions are such that damaging winds of 58 mph or more, or hail 3/4 of an inch in diameter or greater, are likely to develop. Citizens should locate a safe place in the home and tell family members to watch the sky and listen to the radio or television for more information. A severe thunderstorm warning is issued when a severe thunderstorm has been sighted or indicated by weather radar. At this point, danger is imminent and citizens should move to a safe place and turn on a battery-operated radio or television and listen for weather updates.

Severe storms are also associated with other hazards such as tornadoes and severe flooding. Since tornadoes and flash flooding are spawned by thunderstorms, people should review what action to take under a tornado warning or a flash flood warning when a "severe thunderstorm warning" is issued. When thunderstorms are forecasted to bring heavy rains (which can cause flash flooding), strong winds, hail, lightning and tornadoes, people should get inside a sturdy building and stay tuned to a battery-operated radio for weather information. People should also be aware that lightning and high winds are also major threats during thunderstorms.

4.4.2 High Winds

Straight-line winds are often responsible for most of the wind damage associated with a thunderstorm. These winds are often confused with tornadoes because of similar damage and wind speeds. However, the strong and gusty winds associated with straight-line winds blow roughly in a straight line unlike the rotating winds of a tornado.

Property damage and loss of life from windstorms are increasing due to a variety of factors. According to the Ohio Manufactured Housing Association, the use of manufactured housing is on an upward trend, and this type of structure provides less resistance to wind than conventional construction. Uniform building codes for wind resistant construction are not adopted by all states, and population trends show rapid growth in the highly-exposed areas.

According to NCDC, a total of 118 thunderstorm and high wind events were recorded in Shelby County and the region from January of 1950 thru December of 2015. Within this time period, the monetary damage totaled $6.7 million in property damage and $5,000 in crop damage.

4.4.3 Hail

Hail is a type of precipitation composed of balls or irregular lumps of ice. It occurs when super-cooled water droplets (remaining in a liquid state despite being below the freezing point, 0 °C/32 °F) in a storm cloud collide with some solid object, such as a dust particle or an already-forming hailstone.

Hail often forms in strong thunderstorms, often along a cold front, where the layer of air on top is much colder than that on the bottom. The smaller hailstones can bounce up and down between the warm and cold layers due to updrafts and gravity. The longer the stones bounce around, the larger they grow. These strong, severe, or even supercell thunderstorms can also produce hail in the summer months, even without a cold front.

Hailstones, while most commonly only a few millimeters in diameter, can sometimes grow to several inches or occasionally even bigger. Such large hailstones can do serious damage, notably to automobiles, skylights, and glass-roofed structures. Pea or golf ball-size hailstones are not uncommon in severe storms. Rarely, massive hailstones have been known to cause concussions or to kill people by causing head trauma.

Forty-six hail events were recorded from January of 1950 through December of 2015 by the NCDC for Shelby County. Hail size ranged from 3/4 inch to two inches. Of those, seven events caused a total of $30,000 in property damage.

4.4.4 Lightning

Lightning kills 75 to 100 people a year. It is the second largest killer of natural hazard events, exceeded only by floods. Lightning strikes can happen anywhere and affect anyone. Only 10% of lightning strikes result in death, leaving the rest with various degrees of disability, most being central nervous system issues.

Four lightning events were recorded from January of 1950 thru December of 2015 for Shelby County by the NCDC. One injury was reported in Anna. Property damage associated with these events totaled over $170,000.

4.4.5 Significant Historic Summer Storm Events

August 9, 2000
Numerous trees were downed in Ft. Loramie, Newport and Sidney, and a barn was damaged near Hardin. In Sidney, some trees fell on houses, some falling trees ripped up sidewalks, and a roof was blown from a shed. Two clusters of thunderstorms caused significant damage on the August 9. During the morning hours, a large bow echo raced across the area causing widespread wind damage. During the afternoon and evening hours, a large cluster of storms formed causing widespread wind damage and hail along with some flooding.

September 26, 2003
A strong microburst caused damage to homes across the eastern part of the County near Port Jefferson. One house was torn from of its foundation, and several others sustained major damage. Numerous trees were downed across the area. Maximum wind speeds were estimated between 100 and 120 mph.

November 12, 2003 Several power outages occurred countywide. Trees were reported down on Ohio 66, Fair and Kuther Roads 3 miles southwest of Sidney, Kirkwood-Miami River Road four miles south southwest of Sidney, and Miami-Shelby East Road. Power poles were reported either leaning or downed in the village of Anna. Several counties in west central and portions of central
Ohio experienced damage to trees and power lines due to synoptic wind. A cold front associated with low pressure over the Great Lakes region produced strong winds behind it, averaging 25 to 35 mph with higher gusts.

September 14, 2008
The remnants of Hurricane Ike produced strong winds of 40 to 50 miles per hour. A gust of 73 mph was recorded in Anna. Widespread damage occurred across the region, from trees being blown down on powerlines, to significant crop losses and structural damage amounting to $5.7M. This event resulted in Shelby County receiving over $100,000 in Federal public assistance.

August 19, 2009
A series of severe storms brought damaging winds and hail to the area during the evening hours of August 19th. One tornado was also reported. Thunderstorm winds caused damage to trees, a roof on a mobile home, and windows in Sidney. Nickel to quarter size hail was also reported. Property damage losses were estimated at $23,000.

August 7, 2011
A cluster of storms in Indiana organized into a bow echo during the afternoon and then moved into Ohio. This produced severe weather across the central parts of Ohio. The main threat from these storms was damaging thunderstorm winds. Two power poles and a silo were blown over in an area between Botkins and Jackson Center. One tree was reported down and another was broken. These occurrences were due to damaging thunderstorm winds, causing an estimated $35,000 in property damage.

June 29, 2012
On June 29, 2012, late in the afternoon, a line of fast moving severe thunderstorms with powerful winds swept across the state from west to east. The Derecho storm left widespread damage and downed power lines and poles, leaving thousands without power. NWS reported 80 mph winds during the event. Extreme heat along with the power outage was a great cause for concern for many of the residents in Shelby County. A Red Cross shelter and cooling center were activated, with the focus on those residents who were dependent on medical electronic equipment.

4.4.6 Frequency/Probability of Future Occurrence

According to the NCDC, there were 168 thunderstorm, high wind, hail, and lightning events recorded from January of 1950 thru December of 2015 in Shelby County. These events have caused $6.9 million in property damage, six injuries, and no deaths. Severe storms in Shelby County have caused the most cumulative property damage of any of natural hazard and quantitatively have the highest likelihood of occurring on a yearly basis. Based on historical information, Shelby County can expect to endure at least three severe storms in any given year. All jurisdictions within the County are at risk for summer storms. Current populations and structures within the County, as well as those identified in future projections, are at risk for being negatively impacted by summer storms.

4.5 Winter Storms

A winter storm encompasses several types of storm systems that develop during the late fall to early spring. It deposits any of the following types of precipitation: snow, freezing rain, or ice. Blizzards and ice storms are subcategories of winter storms. A winter storm watch indicates that severe winter weather may affect an area. A winter storm warning indicates that severe winter weather conditions are definitely on the way.

4.5.1 Blizzards

A blizzard warning signifies that large amounts of falling or blowing snow, and sustained winds of at least 35 mph, are expected for several hours. In order to be classified as a blizzard, as opposed to merely a winter storm, the weather must meet several conditions. The storm must decrease visibility to a quarter of a mile for three consecutive hours, include snow or ice as precipitation, and have wind speeds of at least 35 mph. A blizzard is also characterized by low temperatures.

4.5.2 Ice Storms

An ice storm is defined as a weather event containing liquid rain that falls upon cold objects creating 1/4 inch thick or more accumulation of ice buildup. This ice accumulation creates serious damage such as downed trees and power lines, leaving people without power and communication. It also makes for extremely treacherous road conditions.

Occasionally, snow will fall after an ice storm has occurred. With the ice covered, it is nearly impossible to determine which travel areas to avoid. When traveling by car, this snow covered ice causes accidents and when walking it causes people to fall, possibly sustaining injuries.

4.5.3 Extreme Cold

Extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with extreme cold with a wind chill. The impacts include frostbite and hypothermia. The wind chill temperature is how cold people and animals feel when outside. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws
heat from the body, driving down skin temperature and eventually the internal body temperature.
Therefore, the wind makes it feel much colder. If the temperature is 0 degrees Fahrenheit and the wind is blowing at 15 mph, the wind chill is -19 degrees Fahrenheit. At this wind chill temperature, exposed skin can freeze in 30 minutes. The following chart lists wind chill values associated with degrees in Fahrenheit and wind in mph. For information on the Wind Chill Temperature (WCT) index, please visit http://www.nws.noaa.gov/om/winter/windchill.shtml

Wind Chill Chart

Temperature (°F)

Wind (mph) / Calm	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	19	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

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

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

Effective 11/01/01

Frostbite is a severe reaction to cold exposure that can permanently damage its victims. A loss of feeling and a white or pale appearance in fingers, toes, or nose and ear lobes are symptoms of frostbite.

Hypothermia is a condition brought on when the body temperature drops to less than 90 degrees Fahrenheit. Symptoms of hypothermia include uncontrollable shivering, slow speech, memory lapses, frequent stumbling, drowsiness and exhaustion.

4.5.4 Significant Historic Winter Storm Events

January 25 - 27, 1978

The Great Blizzard of '78, termed a "severe blizzard" by the NWS, struck the Ohio Valley and Great Lakes paralyzing the region as transportation, schools, and businesses were shut down for days. The near hurricane force winds heaped snow into enormous drifts covering cars and reaching rooftops and left thousands without power or heat. All air, rail, and highway transportation was at a complete standstill for over 24 hours. I-75 was closed for 3 days. The National Guard was activated to help with snow removal, emergency rescues, food and medicine deliveries.

December 13, 1995

A warm front moving north through Ohio produced mixed precipitation. By mid-morning the freezing precipitation had spread north to Shelby County, causing many accidents, especially on major roads. Numerous power outages also occurred as the ice accumulated to as much as 1/8 inch thick.

December 19, 1995

The first major snowstorm of the season developed over central and west Central Ohio as a deep low-pressure system tracked from the Lower Mississippi Valley to the Mid-Atlantic States. Rain changed to snow, with a period of sleet and freezing rain. Across West Central areas the precipitation fell mainly as snow, and blizzard conditions were experienced. Total snow accumulations for Shelby County ranged between eight and 14 inches. Farther south, Dayton received around five inches of snow, and Columbus received near four inches. Over 60,000 customers were without power at times near and north of Dayton and Columbus. For parts of West Central Ohio this storm was the worst storm since the Blizzard of 1978.

January 2, 1996
Low pressure strengthening in the Tennessee valley passed into southeast of Ohio. The heaviest snow fell near and north of interstate 70, across Shelby County where there was up to one foot of snowfall and blizzard conditions. Wind gusts up to 40 mph were common in this area, with snow drifts between three and five feet. Roads oriented east to west were quite hazardous as strong north winds produced large snow drifts shortly after these roads were plowed. Temperatures during much of this event were in the upper teens and 20s.

December 22-23, 2004
Beginning on December 22, 2004, a winter storm producing heavy snowfall, freezing rain, sleet, and bitterly cold temperatures affected a large swath of Ohio including Shelby County. Snowfall averaged between 14”-20” in the county causing power outages, disrupting transportation and essential services. A state of emergency was declared for Shelby and the surrounding counties. This event caused extreme flooding in January of 2005 as described in Section 4.3.3. These two events resulted in a Federally-declared disaster whereby Shelby County received almost $356,000 in public assistance funding.

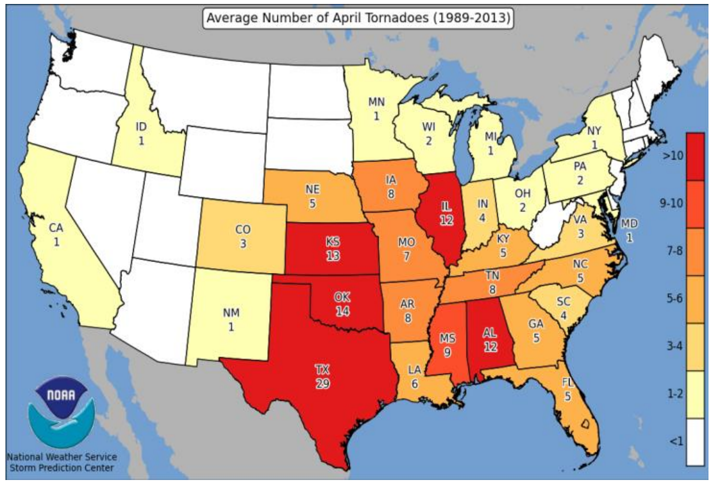
January 5, 2005
On January 5, 2005, a destructive and historic ice storm swept through Shelby County causing severe flooding and heavy ice accumulations. The effects of high water and weight of the ice caused road closures and numerous evacuations. Downed trees, power lines and poles triggered the loss of utilities and electrical power. A shelter was opened at the Sidney High School.

4.5.5 Frequency/Probability of Future Occurrence

According to the most recent version of NCDC, there were 73 recorded winter storm, blizzard, snow, ice, and extreme cold/wind chill events in Shelby County from January 1950 thru December of 2015. There were no records of loss of life or injuries associated with the incidents specific to Shelby County. There were however, eight deaths and nine injuries within the region associated with winter storms. Four events during this time period caused a total of $60,000 in property damage with $540,000 losses due to crop damage specifically associated with Shelby County.

Shelby County can expect to endure at least two winter storm or ice storm events in any given year. All jurisdictions within the County are at risk for winter storms. Current populations and structures within the County, as well as those identified in future projections, are at risk for being negatively impacted by winter storms.

4.6 Tornadoes



Tornadoes are produced from the energy released during a thunderstorm, but account for only a tiny fraction of the overall energy generated. What makes them particularly dangerous is that the energy is concentrated in a small area, perhaps only 100 yards across. Not all tornadoes are the same and science does not yet completely understand how a portion of a thunderstorm's energy becomes focused into something as small as a tornado.

Tornadoes occur mostly in the central plains of North America, east of the Rocky Mountains and west of the Appalachian Mountains. They occur primarily during the spring and summer – the tornado season comes early in the south and later in the north according to the seasonal changes in relation to latitude – usually during the late afternoon and early evening. They have been known to occur in every state in the United States and every continent on the earth, any day of the year, and at any hour.

According to the NWS, the development of Doppler radar has made it possible, under certain circumstances, to detect tornadic winds with radar. However, spotters remain an important part of the system to detect tornadoes, because not all tornadoes occur in situations where the radar can "see" them. Citizen volunteers comprise what is called the SKYWARN (*www.skywarn.org*) network of storm spotters, who work with their local communities to watch out for approaching tornadoes to ensure that appropriate action is taken during tornado events. Spotter information is relayed to the NWS, who operates the Doppler radars and issues warnings, usually relayed to the public by radio and TV, for communities ahead of the storms.

The NWS utilizes all the information they can obtain from weather maps, modern weather radars, storm spotters, monitoring power line breaks, as well as additional sources for issuing tornado warnings.

Although the process by which tornadoes form is not completely understood, scientific research has revealed that tornadoes usually form under certain types of atmospheric conditions. Those conditions can be predicted, but it is not yet possible to predict in advance exactly when and where they will develop, how strong they will be, or precisely what path they will follow.

According to the NWS, there are some "surprises" every year, when tornadoes form in situations that do not look like the right conditions in advance, but these are becoming less frequent. Once a tornado is formed and has been detected, warnings can be issued based on the path of the storm producing the tornado, but even these cannot be perfectly precise regarding who will, or will not, be struck.

Table 4-2 shows that although the State of Ohio may not have the most tornadoes, those that do hit Ohio are significant in damage and have other indication factors of a large-scale tornado.

Table 4-2
State Tornado Ranking

Rank	Total Number of Tornadoes	Deaths per 10,000 sq. miles	Number of Killer Tornadoes	Total Tornado Path Length per 10,000 sq. miles	Killer Tornadoes as a % of all Tornadoes	Annual Tornadoes per 10,000 sq. miles
1	Texas	Massachusetts	Texas	Mississippi	Tennessee	Florida
2	Oklahoma	Mississippi	Oklahoma	Alabama	Kentucky	Oklahoma
3	Florida	Indiana	Arkansas	Oklahoma	Arkansas	Indiana
4	Kansas	Alabama	Alabama	Iowa	**Ohio**	Iowa
5	Nebraska	**Ohio**	Mississippi	Illinois	Alabama	Kansas
6	Iowa	Michigan	Illinois	Louisiana	Mississippi	Delaware
7	Missouri	Arkansas	Missouri	Kansas	North Carolina	Louisiana
8	Illinois	Illinois	Indiana	Indiana	Michigan	Mississippi
9	S Dakota	Oklahoma	Louisiana	Nebraska	New York	Nebraska
10	Louisiana	Kentucky	Tennessee	Wisconsin	Massachusetts	Texas

Although the number of tornadoes in Ohio does not rank high compared to other states in the United States, the State does average around 14 tornadoes a year. Ohio's peak tornado season runs from April through July, with most tornadoes occurring between 2 p.m. and 10 p.m. Even though June has been the month with the most tornado occurrences, many of the State's major tornado outbreaks have taken place in April and May. However, history has shown that tornadoes have occurred with some frequency during autumn months but can occur during any month of the year and at any time of the day or night.

Tornadoes are considered the most violent atmospheric phenomenon on the face of the earth with their strength being measured by the Enhanced Fujita Scale as described in Table 4-3. This scale is the mechanism used to determine the potential type of tornado that may have affected a particular community. It is based on velocity of wind and the type of damage the tornado caused. Many EF0 and EF1 tornadoes have touched down in Ohio, but Ohio has also been struck by some of the most destructive (EF5) tornadoes ever, including the April 3, 1974 tornado which devastated Xenia, killing over 30 people and destroying 2,000 buildings.

Enhanced Fujita Scale for Tornadoes

Scale	Wind Speed	Typical Damage
EF-0 Weak	40-72 miles per hour (mph)	Light Damage: Some chimneys damaged, twigs and branches broken off trees, shallow-rooted trees pushed over, signboards damages, some windows broken.
EF-1 Weak	73-112 mph	Moderate Damage: Surface of roofs peeled off, mobile homes pushed off foundations or overturned, outbuildings demolished, moving autos pushed off the roads, trees snapped or broken; beginning of hurricane speed winds.
EF-2 Strong	113-157 mph	Considerable Damage: Roofs torn off frame houses, mobile homes demolished, frame houses with weak foundations lifted and moved, large trees snapped or uprooted, light-object missiles generated.

Scale	Wind Speed	Typical Damage
EF-3 Strong	158-206 mph	Severe Damage: Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forecast uprooted, heavy cars lifted off the ground and thrown, weak pavement blown off the roads.
EF-4 Violent	207-260 mph	Devastating Damage: Well-constructed houses leveled, structures with weak foundations blown off the distance, cars thrown and disintegrated, trees in forest uprooted and carried some distance away.
EF-5 Violent	261-318 mph	Incredible Damage: Strong frame houses lifted off foundations and carried considerable distance to disintegrate, automobile-sized missiles fly through the air in excess of 300 feet, trees debarked, incredible phenomena will occur.

4.6.1 Significant Historic Tornado Events

April 11, 1965
The Palm Sunday tornado cut a devastating path though the County, wrecking farmsteads and injuring several residents. This tornado was rated an EF4 on the Enhanced Fujita Scale. This tornado alone caused $2.5 million in property damages, 50 injuries and three deaths.

4.6.2 Frequency/Probability of Future Occurrence

Shelby County has had six tornadoes from January of 1950 to December of 2015 according to the NCDC. One tornado that occurred in 1965 was rated an EF4 on the Enhanced Fujita Scale. This tornado alone caused $2.5 million in property damages, 50 injuries and three deaths. The other tornadoes caused over $500,000 worth of property damage, 24 injuries and no deaths. Based on historical information, Shelby County can expect to endure one tornado every eight to nine years. All jurisdictions within the County are at risk for tornadoes. Current populations and structures within the County, as well as those identified in future projections, are at risk for being negatively impacted by tornadoes.

4.7 Droughts and Extreme Heat

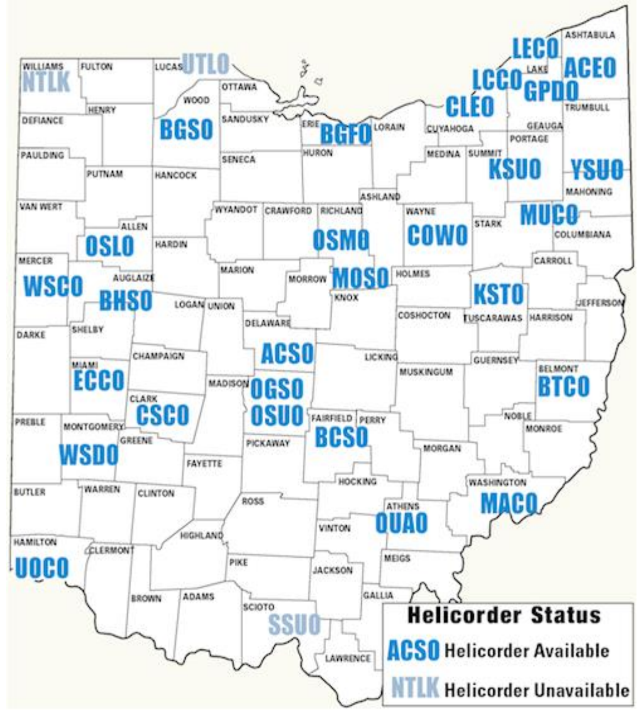
A drought is a period of abnormally dry weather that persists long enough to produce a serious hydrologic imbalance (i.e., crop damage, water supply shortage, etc.) The severity of the drought depends upon the degree of moisture deficiency, the duration and the size of the affected area.

The worst drought in 50 years affected 35 states, including Ohio, during the long, hot summer of 1988, when some areas had been suffering from lack of rainfall since 1984. Rainfall totals in 1988 throughout the mid-west, Northern Plains and the Rockies were 50% to 85% below normal.

4.7.1 Significant Historic Drought Events

July 1- August 1999
Dry conditions that began in the spring and early summer continued into July. Excessive heat contributed to substantial crop loss across much of the Buckeye state. Rainfall was widely scattered and did little to help farmers. Drought conditions continued across the Ohio Valley through August with most areas receiving well below normal rainfall for the month. In some areas around 50% of crops were considered total losses. Most counties in southwest Ohio were declared Federal Disaster Areas by the US Department of Agriculture. At the time of this writing, no monetary estimates were available concerning the crop loss.

4.7.2 Frequency/Probability of Future Occurrence



In Shelby County, there were two droughts and no extreme heat events recorded from 1950 thru 2015 according to the NCDC. There was no property damage, crop damage, or injuries recorded for any of these events. The County suffers varying amounts of crop damage during severe heat and dry conditions that may not be categorized as a drought.

During the development of the Plan update, the Update Committee concluded that this damage is not always recorded but still has a detrimental effect on the County. The Update Committee also concluded that, unlike other hazards such as flooding or tornadoes, there is little mitigation that can be preplanned to reduce the amount of agricultural damage caused by a drought. All jurisdictions within the County are at risk for droughts to occur. Current populations and structures within the County, as well as those identified in future projections, are at risk for being negatively impacted by drought conditions.

4.8 Earthquakes

4.8.1 Earthquakes in Ohio

The problem with earthquakes is that major earthquakes are a low probability, high consequence event. It is because of the potential high consequences that geologists, emergency planners and other government officials have taken a greater interest in understanding the potential for earthquakes in some of the areas of the eastern United States and educating the population as to the risk in their areas. Although there have been great strides in increased earthquake awareness in the eastern United States, the low probability of such events makes it difficult to convince most people that they should be prepared.

Although the New Madrid Line is in close proximity to the State of Ohio, there has not been an earthquake of any significance since 1875 caused by this fault line. An earthquake on June 18, 1875 caused damage in western Ohio, and affected a total area estimated at over 40,000 square miles. Walls were cracked and chimneys thrown down in Sidney and Urbana. The shock was felt sharply at Jeffersonville, Indiana. The affected area included parts of Illinois, Indiana, Kentucky and Missouri. Northeastern Ohio, east of Cleveland, is the second most active area of the state. At least 20 earthquakes have been recorded in the area since 1836, including a 5.0 magnitude event in 1986 that caused moderate damage. A broad area of southern Ohio has experienced more than 30 earthquakes.

According to OhioSeis, there have been 22 earthquakes in Shelby County since 1925 exceeding a magnitude of 2.0 on the Richter Scale and above an intensity of II on the Mercalli Scale The largest historic earthquake in Ohio was centered in Shelby County in 1937. This event, estimated to have had a magnitude of 5.4 on the Richter scale and VIII on the Mercalli Scale, caused considerable damage in Anna and several other western Ohio communities, where at least 40 earthquakes have been felt since 1875.

4.8.2 Monitoring of Earthquakes

The ODNR Division of Geological Survey has established a 29-station cooperative network of seismograph stations throughout the State in order to continuously record earthquake activity. The network, which went on line in January 1999, ended a five-year gap during which there was only one operating station in Ohio. The State was dependent on seismographs in Kentucky and Michigan to record Ohio earthquakes.

The 29 stations of the new seismograph network, which is called OhioSeis, are distributed across the State, but are concentrated in the most seismically active areas or in areas that provide optimal conditions for detecting and locating very small earthquakes that are below the threshold of human notice. These small micro earthquakes are important because they occur more frequently and help to identify the location of faults that may periodically produce larger, potentially damaging earthquakes.

The OhioSeis seismograph stations are located at colleges, universities and other institutions, employing new technology that not only makes them very accurate, but also relatively inexpensive and easy to operate and maintain. In contrast to the old technology, in which a pen made a squiggly line on a paper drum, the new system is entirely digital and uses a desktop computer to continuously record and display data. Two other innovations have made the system unique. An inexpensive Global Positioning System (GPS) receiver is used to keep very precise time on the continuously recorded seismogram, and each station's computer is connected to the Internet for rapid data transfer.

Each OhioSeis station is a cooperative effort. Seismometers, the instrument that detects Earth motions and other seismic components were purchased by the Division of Geological Survey with funds provided by FEMA through the OEMA, as part of the National Earthquake Hazards Reduction Program. The computers and Internet connection were purchased and provided by the cooperating institutions.

4.8.3 Measuring Earthquakes

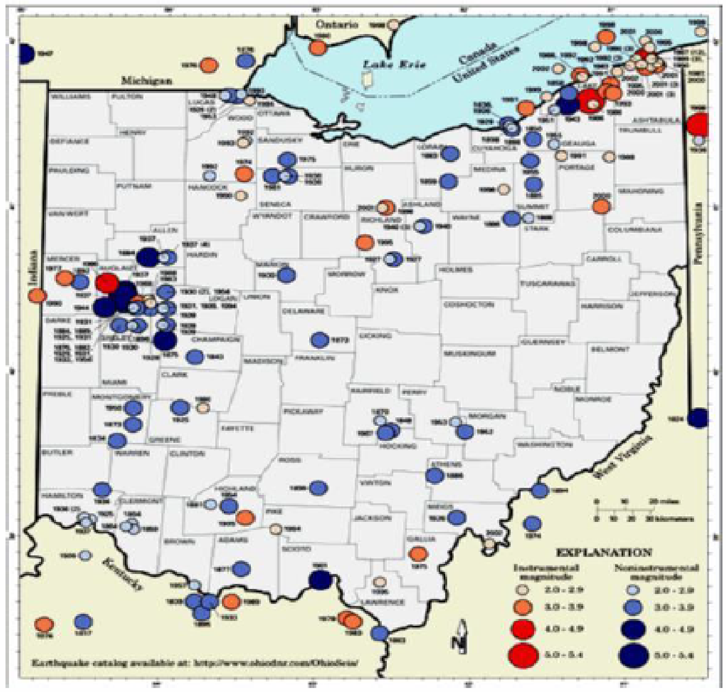
The current measurements of earthquakes have been utilized since the early 1930s using both the Mercalli Scale and the Richter Scale. The Mercalli Scale was developed in 1931 and measures earthquake intensity using a Roman numeric scale to designate increasing levels of

intensity. The Richter Scale was developed in 1935, measuring earthquake magnitude using a numerical logarithmic scale. Detailed explanations of each scale can be found at: http://en.wikipedia.org/wiki/Mercalli_intensity_scale and http://en.wikipedia.org/wiki/Richter_magnitude_scale.

A comparison of these two scales is as follows:

Magnitude (Richter Scale)	Type	Mercalli intensity	Average earthquake effects	Average frequency of occurrence (estimated)
Less than 2.0	Micro	I	Micro-earthquakes, not felt, or felt rarely by sensitive people. Recorded by seismographs	Continual/several million per year
2.0–2.9	Minor	I to II	Felt slightly by some people. No damage to buildings.	Over one million per year
3.0–3.9		II to IV	Often felt by people, but very rarely causes damage. Shaking of indoor objects can be noticeable.	Over 100,000 per year
4.0–4.9	Light	IV to VI	Noticeable shaking of indoor objects and rattling noises. Felt by most people in the affected area. Slightly felt outside. Generally causes none to minimal damage. Moderate to significant damage very unlikely. Some objects may fall off shelves or be knocked over.	10,000 to 15,000 per year
5.0–5.9	Mod.	VI to VIII	Can cause damage of varying severity to poorly constructed buildings. At most, none to slight damage to all other buildings. Felt by everyone. Casualties range from none to a few.	1,000 to 1,500 per year
6.0–6.9	Strong	VII to X	Damage to a moderate number of well-built structures in populated areas. Earthquake-resistant structures survive with slight to moderate damage. Poorly designed structures receive moderate to severe damage. Felt in wider areas; up to hundreds of miles/kilometers from the epicenter. Strong to violent shaking in epicentral area. Death toll ranges from none to 25,000.	100 to 150 per year
7.0–7.9	Major	VIII or greater	Causes damage to most buildings, some to partially or completely collapse or receive severe damage. Well-designed structures are likely to receive damage. Felt across great distances with major damage mostly limited to 250 km from epicenter. Significant death toll.	10 to 20 per year
8.0–8.9	Great		Major damage to buildings, structures likely to be destroyed. Will cause moderate to heavy damage to sturdy or earthquake-resistant buildings. Damaging in large areas. Felt in extremely large regions. Death toll in the thousands.	One per year
9.0 and greater			Near or at total destruction - severe damage or collapse to all buildings. Heavy damage and shaking extends to distant locations. Permanent changes in ground topography. Death toll can surpass 10,000.	One per 10 to 50 years

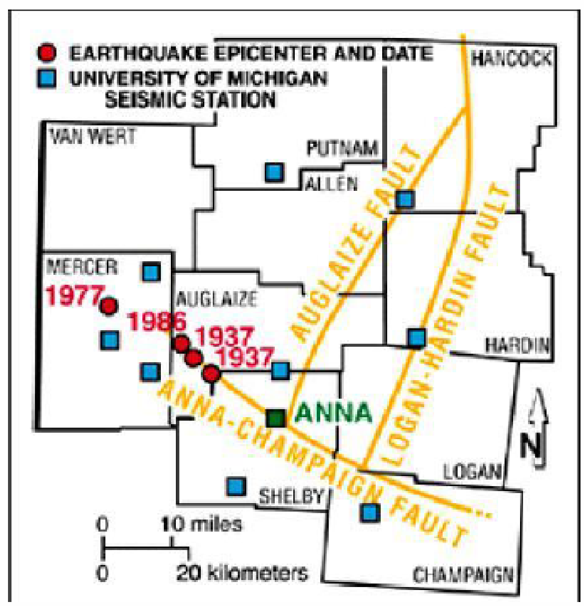
The Division of Geological Survey is coordinating the seismic network and has established the Ohio Earthquake Information Center at the Horace R. Collins Laboratory at Alum Creek State Park, north of Columbus. This facility functions as a repository and laboratory for rock core and well cuttings, but has a specially constructed room for earthquake recording. The seismograph system allows for very rapid location of the epicenter and calculation of the magnitude of any earthquake in the State. The earthquake records, or seismograms, from at least three seismograph stations are needed to determine earthquake locations (epicenters). These records can be downloaded from the internet at any station on the network, and location and magnitude can be determined. Small earthquakes were in many cases not even detected by distant, out-of-date seismograph stations.



Epicenters of past earthquakes in Ohio

The OhioSeis network provides a whole new dimension of understanding about the pulse of the Earth beneath Ohio. Although the new seismograph network will not predict earthquakes or provide an alert prior to an event, it will provide insight into earthquake risk in the State so that intelligent decisions about building and facility design and construction, insurance coverage and other planning decisions can be made by individuals, business and industry, and governmental agencies.

There has been speculation that Anna received the brunt of damages from the 1937 earthquakes because the community is located directly above the sediment-filled valley of the pre-glacial Teays River. This ancient river apparently followed the trace of the Anna-Champaign fault until it was obliterated by an early Pleistocene glacier and its valley was filled with nearly 500 feet of glacial sediment. The speculation is that ground motion is amplified by these unconsolidated sediments in the Teays River valley and that Anna, located over the buried valley, receives a greater degree of shaking than nearby communities located on shallow bedrock.



Faults in Shelby County

Although the Anna area is the seismically most active region of the state, geologists currently have only minimal understanding of the geology of basement rocks in the region. There is some speculation that the Anna-Champaign fault is associated with a proposed failed rift zone in western Ohio. However, until additional data is derived from future earthquakes, deep drilling, and other investigations of basement geology in western Ohio, the cause of earthquakes in this area will remain speculative.

4.8.4 Significant Historic Earthquake Events

June 18, 1875
This earthquake was felt throughout an area of at least 40,000 square miles and was most intense at Sidney and Urbana (Champaign County), where masonry walls were cracked and chimneys toppled. It has been interpreted to have had a Modified Mercalli Intensity (MMI) of VIII, which equates to a 4.1-5.4 magnitude on the Richter scale.

September 30, 1930
This earthquake cracked plaster and toppled a chimney in Anna. An epi-central MMI of VII and a magnitude of 4.2 have been assigned to this event.

March 2 and 9, 1937
These two earthquakes are the most damaging to have struck Ohio. Maximum intensities were experienced at Anna; where a MMI of VII was associated with the March 2 event and an MMI of VIII was associated with the March 9 event. In Anna, chimneys were toppled, organ pipes were twisted in the Lutheran Church, the masonry school building was so badly cracked that it was razed, water wells were disturbed and cemetery monuments were rotated. Both earthquakes were felt throughout a multi-state area. Analysis of seismograms from these earthquakes by the USGS assigned magnitudes of 4.7 and 4.9, respectively, to these events.

1981-1983
In 1980 and 1981, six small earthquakes occurred in eastern Shelby County. In 1983, four earthquakes occurred in the same location; two on November 4. The 1983 quakes, along with the earlier ones, all measured about 2.0 or less on the Richter scale—too small to be felt locally. The significance of this cluster of micro earthquakes is uncertain, but this general area has been the source of at least 35 earthquakes that were felt by local residents, including two damaging events in March 1937.

July 12, 1986
Minor damage, consisting primarily of cracked windows and plaster and fallen bricks from chimneys, was reported when an earthquake with a MMI of VI occurred, centered northwest of Anna, near St. Mary's, in Auglaize County. It had a magnitude of 4.5. Significant events pertaining to Shelby County were identified by utilizing the procedures stated above. Descriptions of past significant events are found in Appendix H with the NCDC listings of specific historical events found in Appendix I. Included in this Appendix Js a listing of earthquakes in Shelby County since 1925 exceeding a magnitude of 2.0 on the Richter Scale and above an intensity of II on the Mercalli Scale.

4.8.5 Frequency/Probability of Future Occurrence

As stated previously, Shelby County is one of the most active sites in Ohio for earthquake occurrence. Notwithstanding, even though the entire County may be at risk for the occurrence of earthquakes, the probability of a major earthquake occurring the County remains low. However, current populations and structures within the County, as well as those identified in future projections, are at risk for being negatively impacted by earthquakes. In the last 50 years, there were four earthquake events. This equates to a probability of 8% (4 events/50 years observed) chance of occurrence per given year.