

## **2.0 RISK ASSESSMENT**

A risk assessment analyzes “the potential for damage, loss, or other impacts created by the interaction of hazards with community assets” (FEMA, 2013). This risk assessment section contains information on identified hazards that threaten Columbiana County and the surrounding region and the vulnerability of the area as it relates to the county’s assets.

## 2.0 RISK ASSESSMENT

### 2.1 Hazards Identification

§201.6(c)(2)(i)	[The risk assessment shall include a] description of the...location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
-----------------	---

The committee spent much of its second meeting discussing the hazards it wished to include in the plan. The majority of this discussion focused on the hazard list from previous versions of the mitigation plan. Committee members felt that some hazard considerations needed broadening, such as extreme heat (changed to “extreme temperatures” to enable consideration of extreme cold situations). The committee also decided to add “public health emergencies” to the plan. Health district representatives on the committee felt the inclusion would reflect apparent spikes in communicable disease occurrences as well as align the mitigation plan with preparedness efforts by public health. Additionally, committee members reviewed the results of the public survey during their third and fourth meetings. Based on public responses, the committee felt the revised hazard list was appropriate. The following table lists the hazards considered by the remainder of this risk assessment.

HAZARDS IDENTIFICATION	
<i>Hazard</i>	<i>Description</i>
<b>Natural Hazards</b>	
Drought	Existing. This hazard includes meteorological, agricultural, hydrological, and socioeconomic droughts.
Earthquake	Existing.
Extreme Temperatures (Heat and Cold)	Revised to include extreme cold temperatures as well as extreme heat.
Flooding	Existing. This hazard includes flash flooding.
Public Health Emergencies	New. Added per committee member request.
Severe Thunderstorms and Hail	Existing.
Severe Wind and Tornado	Existing.
Severe Winter Storms	Existing. This hazard includes blizzards, ice storms, and heavy snow.
<b>Technological Hazards</b>	
Dam and Levee Failure	Revised. Levee failure added to this update.
Hazardous Materials Incidents	Existing. This hazard includes chemical, biological, radiological, nuclear, and explosive incidents.

In addition to these ten hazards, there exist other potential hazards this plan does not address. The following list presents those hazards.

- **Avalanche:** Avalanches happen mainly in the western United States and Canada. The terrain and geography of Columbiana County are not rugged or severe enough to have avalanches.
- **Coastal Erosion (and Other Lake Hazards):** Columbiana County does not contain any of the Lake Erie shorelines.
- **Geological Hazards (e.g., Erosion, Subsidence, Etc.):** Several jurisdictional representatives (particularly Salineville and Wellsville) discusses subsidence and erosion as it impacts the transportation infrastructure, levees, etc. However, subsidence and erosion are largely site-specific occurrences in Columbiana County. Committee members felt the focus of the hazard list in this document should be those that could impact larger areas (and larger populations) of the county.
- **Hurricanes:** The Atlantic east coast, where hurricane paths are nearest, is approximately 375 miles away, and the Pacific west coast is approximately 2,200 miles away. Neither would affect Columbiana County. The county may experience wet weather as the remnants of Atlantic hurricanes pass through the area; however, winds would not likely be near a hurricane or tropical storm levels.
- **Sea Level Rise:** Sea level risk occurs in oceans; the Atlantic east coast is approximately 375 miles away, and the Pacific west coast is approximately 2,200 miles away. Neither would affect Columbiana County.
- **Tsunami:** Tsunamis occur in oceans; the Atlantic east coast is approximately 375 miles away, and the Pacific west coast is approximately 2,200 miles away. Neither would affect Columbiana County.
- **Volcano:** The closest monitored volcano is in Yellowstone National Park in Wyoming and is approximately 1,500 miles away. It would not affect Columbiana County.
- **Wildfire:** Though brush fires occur with some regularity in Columbiana County, and those incidents technically align with the National Park Service's definition of wildfire as, "any non-structure fire, other than prescribed fire, that occurs in the wildland," committee members did not feel as if those incidents rise to the level of severity appropriate for inclusion in this plan.

## 2.0 RISK ASSESSMENT

### 2.2 Complicating Variables

Direct, calculable consequences of disasters can include fatalities, injuries, and damages to humans, animals, or property. Disasters do not end there; there are several indirect effects, tangible and intangible, associated with them. Some examples of these include loss of livelihood and income, loss of community and population, mental and psychosocial impacts, costs of rebuilding, repair or replacement, loss of inventory, wages and tax revenue, etc. (Coppola, 2015). All of these also have a cost associated with them, but it is much more difficult to assign a specific dollar value and quantify them accurately. For this plan, the primary focus of loss estimates will be direct consequences of the given hazard.

Countless situations could occur that could result in a disruption to critical systems throughout Columbiana County. Loosely-related variables often considered *cascading hazards*, can complicate some hazards. For example, high winds may cause sporadic damage, but often do not become a significant countywide concern until a large number of residents are without power. In addition to weather-related power outages, cascading hazards in Columbiana County could include (but not be limited to) the following.

- Damage to infrastructure (i.e., roads, bridges, pipes, utility poles, etc.) and residences following flooding
- Flooding of downstream or protected areas in the event of a dam or levee failure
- Drinking water supply shortages and contamination following severe and prolonged drought conditions or floods
- Power outages, ruptured gas lines, etc. following earthquakes or severe weather
- Public health concerns following flooding conditions
- Population displacement before, during, or after an event that may be temporary or permanent

The complicating variables related to each hazard often appear in the hazard profiles. The information presented relates to worst-case scenario events; a single event may not always reach all impacts described. It is important, however, to understand that the impacts of hazards go beyond those seen immediately after the event. The effects of one event can last months or even years, especially where public health, social, economic, environmental, and infrastructure impacts

are concerned. Section 1.4 above references several social vulnerability indicators for Columbiana County; those variables will often appear alongside discussions of complicating variables in the profiles below.

### Hazards and Climate Change

Many natural hazards are related to the climate or weather, such as droughts, severe weather, and floods. There is an important distinction between weather and climate. Weather refers to the atmospheric conditions of a geographical region over a short period, such as days or weeks. Climate, in contrast, refers to the atmospheric conditions of a geographical area over long periods, such as years or even decades (Keller & Devecchio, 2015, pp. 406-407). According to the U.S. Global Change Research Program, there are weather and climate changes already observed in the United States.

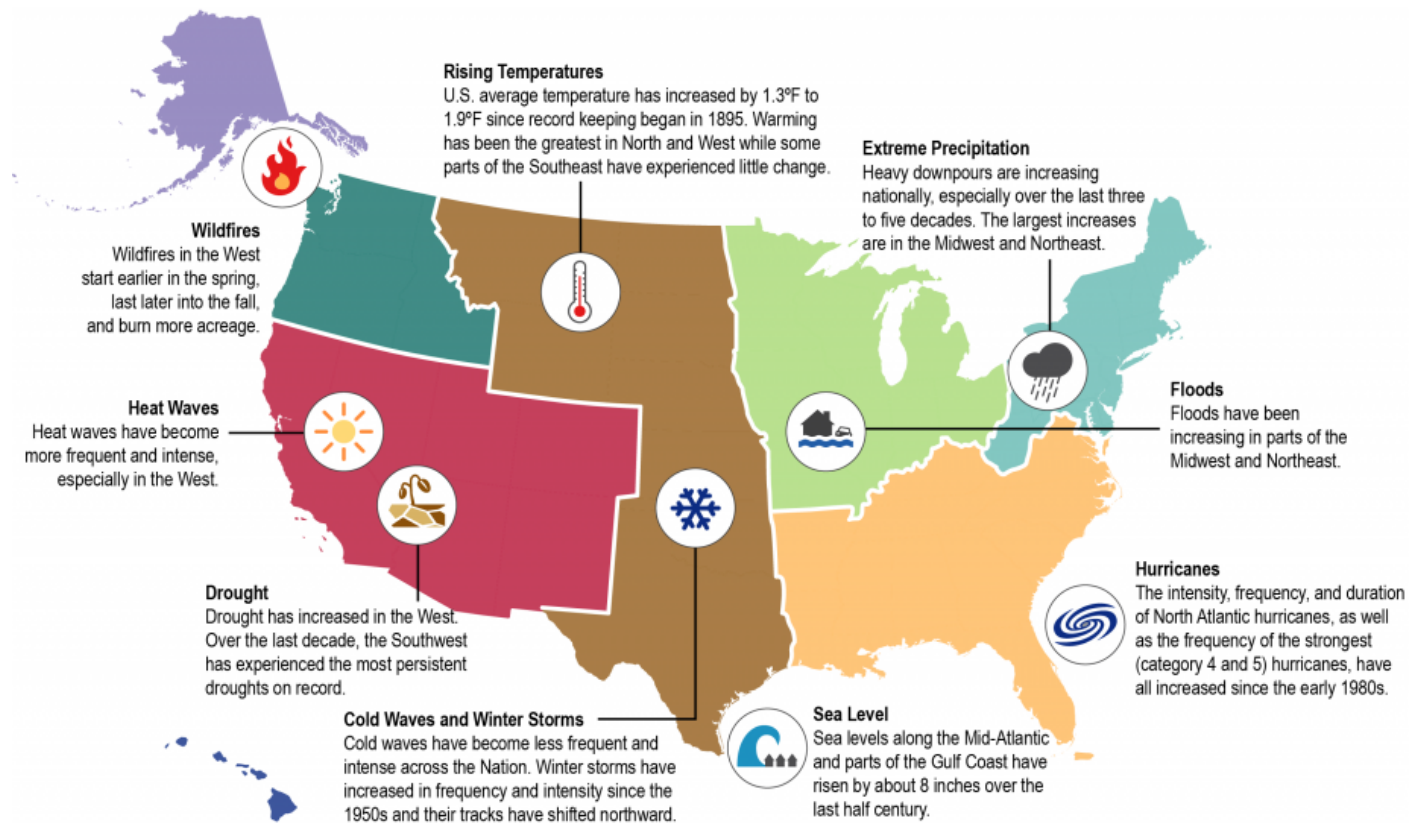
- Since recordkeeping began in 1895, the average U.S. temperature has increased by 1.3°F to 1.9°F, with most of the increase happening since 1970. Also, the first decade of the 2000s was the warmest on record.
- The average precipitation across the U.S. has increased since 1900, with some areas experiencing higher than the national average and some lower. Heavy downpours are increasing, especially over the last 30-50 years.
- Drought events have increased in the west. Changes in precipitation and runoff, combined with changes in consumption and withdrawal, have reduced surface and groundwater supplies in many areas.
- Some types of severe weather events have experienced changes. Heatwaves are more frequent and intense, and cold waves have become less frequent and intense overall.
- The intensity, frequency, and duration of North Atlantic hurricanes have increased since the early 1980s.

Climate change can have a significant impact on human health and the environment. The changes mentioned above can affect the environment by leading to changes in land use, ecosystems, infrastructure conditions, geography, and agricultural production. Extreme heat, poor air quality, reduced food and water supply and quality, changes in infectious agents, and population displacement can lead to public health concerns such as heat-related illnesses, cardiopulmonary illnesses, food, water, and vector-borne diseases and have consequences on mental health and stress (USGCRP, 2016).

The National Climate Assessment (NCA) defined climate trends for national U.S. regions in 2014. The major trends are:

- wildfires and heat waves on the west coast,
- rising temperatures and increased severity and frequency of winter storms in the middle of the country,
- more rain and flooding in the Midwest and northeastern parts of the country, and
- an increase in sea levels in the mid-Atlantic with an increase of hurricane activity in the southeastern states.

The Intergovernmental Panel on Climate Change (IPCC) largely concurs with the above list (IPCC, n.d.). In Ohio, the trend will likely be an increase in flooding, as noted in the graphic below.



### Public Health, Social Vulnerability, and Other General Vulnerability Indicators

Vulnerability is the “measure of the propensity of an object, area, individual, group, community, country, or other entity to incur the consequences of a hazard” (Coppola, 2015, p. 33). Many aspects contribute to the vulnerability of a people; these can include income disparity,

class, race or ethnicity, gender, age, disability, health, and literacy (Thomas & Phillips, 2013, pp. 2-3). As noted, see Section 1.4 above for a discussion of potential social vulnerability indicators in Columbiana County. Understanding the overall health status of the community is important in determining the vulnerability of the population to any given hazard; emergencies and disaster situations can exacerbate existing medical conditions. Vulnerable populations, populations of concern, or populations at risk are those individuals or groups of people who are more exposed to the risks of the impacts of a hazard because of their age, gender, income, occupation, disability, physical or mental health, literacy, religion, education, or ethnicity.

Some groups face several stressors related to both climate and non-climate factors. For example, people living in impoverished urban or isolated rural areas, floodplains, and other at-risk locations are more vulnerable not only to extreme weather and persistent climate change but also to social and economic stressors. Many of these stressors can occur simultaneously or consecutively. Over time, this accumulation of multiple, complex stressors is expected to become more evident as climate impacts interact with stressors associated with existing mental and physical health conditions and with other socioeconomic and demographic factors. Where appropriate (and where information is available), hazard profiles provide further vulnerability details.

## 2.0 RISK ASSESSMENT

### 2.3 Hazard Profiles

The following profiles detail each hazard considered by this plan, which includes discussion on how the hazard impacts the area. Within each profile, research and historical data inform the following elements.

- **Hazard Overview:** Defines the hazard and presents a summary table of the hazard.
- **Location and Extent:** Identifies the physical places in the county that are vulnerable to the hazard and the severity of a hazard in a given location.

§201.6(c)(2)(i)	A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
-----------------	--

- **Impact and Vulnerability:** Describes impacts on different topics such as health, the environment, or infrastructure that may result from the hazard as well as specific populations that may be vulnerable.

§201.6(c)(2)(ii)	A description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. All plans approved after October 1, 2008, must also address NFIP-insured structures that have been repetitively damaged by floods.
------------------	---

- **Historical Occurrences:** Summarizes significant past events related to the hazard.

§201.6(c)(2)(i)	A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.
-----------------	--

- **Loss and Damages:** Outlines the methods used for loss amounts (of deaths, injury, and property damage depending on available information) and estimates based on historical information and vulnerable populations, structures, and infrastructure.

§201.6 (c)(2)(ii)(B)	An estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.
----------------------	--



- **Risk Assessment:** Details methods for calculating the probability and severity of each hazard.
- **Maps and Assets:** Graphically shows the geographic locations or populations in the county that are vulnerable to each hazard. This subsection also identifies the assets that fall under the hazard risk area. Although there is not a defined title for this subsection in the profiles, assets and maps appear where they are most fitting within the narrative.


§201.6(c)(2)(ii)(A)	The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.
§201.6(c)(2)(iii)	For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction's risks where they vary from the risks facing the entire planning area.

Hazard profiles appear in the following order, loosely grouped by “type” (i.e., natural or technological).

- Natural
  - 2.3.1 Drought
  - 2.3.2 Earthquake
  - 2.3.3 Extreme Temperatures (Heat and Cold)
  - 2.3.4 Flooding
  - 2.3.5 Public Health Emergencies
  - 2.3.6 Severe Thunderstorms and Hail
  - 2.3.7 Severe Wind and Tornado
  - 2.3.8 Severe Winter Storms
- Technological
  - 2.3.9 Dam and Levee Failure
  - 2.3.10 Hazardous Materials Incident

## 2.0 RISK ASSESSMENT

### 2.3.1 Drought

A drought is a period of abnormally dry weather which persists long enough to produce a serious hydrological imbalance.				
	Vulnerability	Period of Occurrence:	At any time, typically after a period of prolonged absence of precipitation	Hazard Index Ranking: Low
	HIGH	Warning Time:	Over 24 hours	State Risk Ranking: 2 – Low
	MEDIUM	Probability:	Possible	Severity: Limited
	LOW	Type of Hazard:	Natural	Disaster Declarations: USDA FSA S3384 USDA FSA S4165
	LOWEST			

#### Hazard Overview

“Drought” is a period of abnormally dry weather, which persists long enough to produce a serious hydrological imbalance. Drought is a term used in relation to who or what is affected by the lack of moisture. Drought can be a result of multiple causes, including global weather patterns that produce persistent, upper-level high-pressure systems with warm, dry air resulting in less precipitation. Droughts develop slowly; typically, they are already underway when officially identified. There are several types of droughts (Sears, 2017, p. 138).

- **Meteorological Drought:** Differences from the streamflow precipitation amounts. Because not every area receives the same amount of rainfall, a drought in one place might not be considered a drought in another.
- **Agricultural Drought:** Moisture deficiency seriously injurious to crops, livestock, or other agricultural commodities. Parched crops may wither and die. Pastures may become insufficient to support livestock. Effects of agricultural droughts are difficult to measure because many variables may impact production during the same growing season.
- **Hydrological Drought:** Reduction in groundwater, lake and reservoir levels, depletion of soil moisture, and a lowering of the groundwater table. Consequently, there is a decrease in groundwater discharge to streams and lakes. A prolonged hydrological drought will affect the water supply.
- **Socioeconomic Drought:** A lack of water that begins to affect people’s daily lives.

Precipitation falls in uneven patterns across the country; the amount of precipitation at a particular location varies from year to year, but over years, the average amount is fairly constant. The amount of rain and snow also varies with the seasons. Even if the total amount of rainfall for a year is about average, rainfall shortages can occur during a period when moisture is critically necessary for plant growth, such as in the early summer. When little or no rain falls, soils can dry out, and plants can die. When rainfall is less than normal for several weeks, months, or years the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought (USGS, n.d.).

### Location and Extent

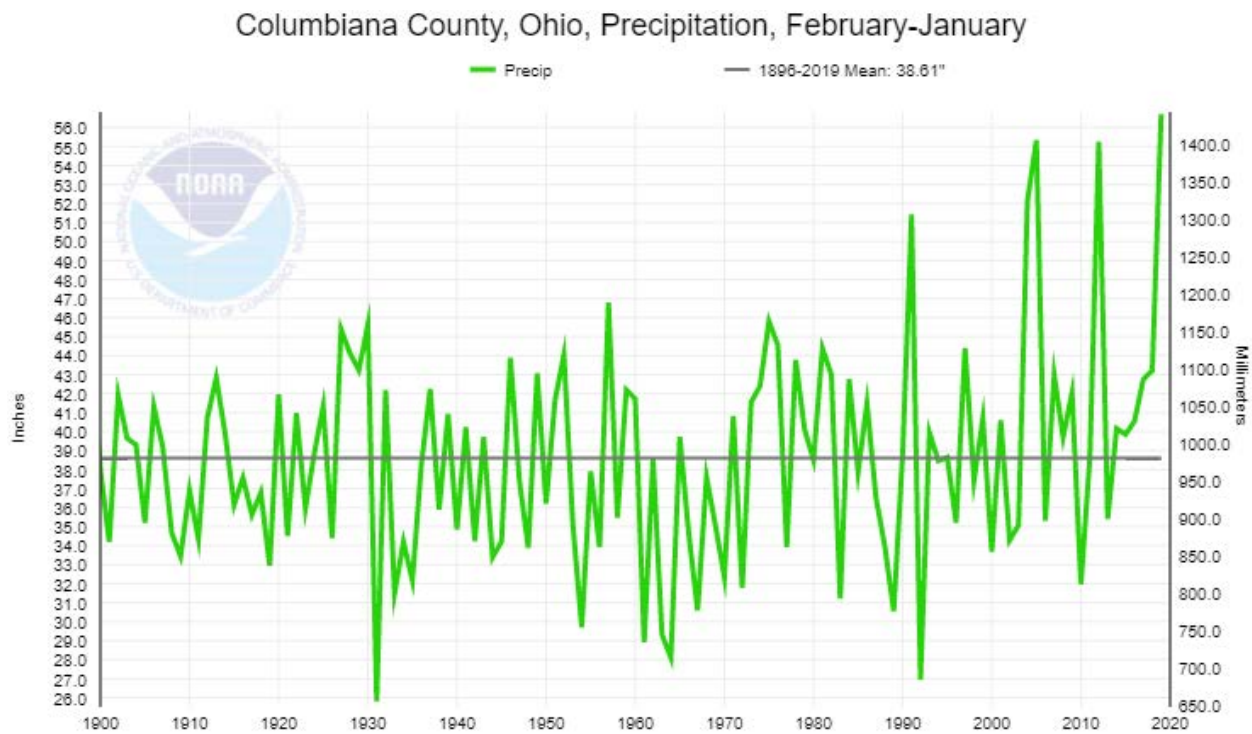
Droughts are a region-wide hazard that can affect all areas and jurisdictions within the region. Droughts are widespread events that may extend to several states in varying degrees of severity. Within Columbiana County, the extent of a drought would be equal or very similar, given the region's geography and environmental qualities. A drought can vary in severity throughout the year; what starts as a mild drought can reach severe or extreme drought status and then return to a mild drought. This process could take weeks or even months, and the effects could be felt even months after the drought conditions are over.

The Palmer Drought Severity Index (PDSI) is a widely used measure of drought to track moisture conditions. The PDSI is “an interval of time, generally in months or years in duration, during which the actual moisture supply at a given place rather consistently falls short of the climatically expected or climatically appropriate moisture supply.” The range of PDSI is from -4.0 (extremely dry) to +4.0 (excessively wet), with the central half (-0.5 to +0.5) representing the normal or near-normal conditions. In the United States, the USDA, National Drought Mitigation Center at University of Nebraska-Lincoln, U.S. Department of

USDM AND PDSI COMPARISON			
U.S. Drought Monitor		Palmer Drought Severity Index	
N/A		> 4.0	Extreme moist spell
		3.0 to 3.99	Very moist spell
		2.0 to 2.99	Unusual moist spell
		1.0 to 1.99	Moist spell
		0.50 to 0.99	Incipient moist spell
		-0.49 to 0.49	Near normal
		-0.5 to -0.99	Incipient dry spell
D0	Abnormally dry	-1.0 to -1.99	Mild drought
D1	Moderate drought	-2.0 to -2.99	Moderate drought
D2	Severe drought	-3.0 to -3.99	Severe drought
D3	Extreme drought	< -4.0	Extreme drought
D4	Exceptional drought	N/A	

Commerce, and NOAA developed another measurement of droughts named the U.S. Drought Monitor (USDM). The table above shows the two scales and how they compare.

The following National Weather Service graphic depicts precipitation levels in Columbiana County from 1900 through 2019. Though precipitation totals often fluctuate, the graphic indicates that precipitation is generally increasing. The “high” totals are greater (beginning in approximately 1990); even recent “low” years (e.g., 2010 and the periods between approximately 2005 and 2013) show generally greater precipitation than previous “low” years.



Though it is difficult to anticipate exactly where drought conditions will occur in the future, Columbiana County can estimate the chances of experiencing drought conditions generally. NOAA’s Earth System Research Laboratory (ESRL) has divided the U.S. into “climate divisions.” ESRL further maintains data for each of these areas, including historical Palmer Drought Severity Index (PDSI) values for all months between 1895 and 2018. Columbiana County’s climate division, the Northeast Hills, experienced drought conditions (i.e., incipient, mild, moderate, severe, or extreme drought per the PDSI) in 41.87% of the months between 1895 and 2018. The region experienced severe or extreme drought conditions (defined per the PDSI values in the table above) during 5.51% of the months (i.e., 82 out of 1,488 months). The following map displays this information graphically and compares it to the remainder of Ohio.

## COLUMBIANA COUNTY HAZARD MITIGATION PLAN

### ESRL Climate Divisions & Months Spent in Drought

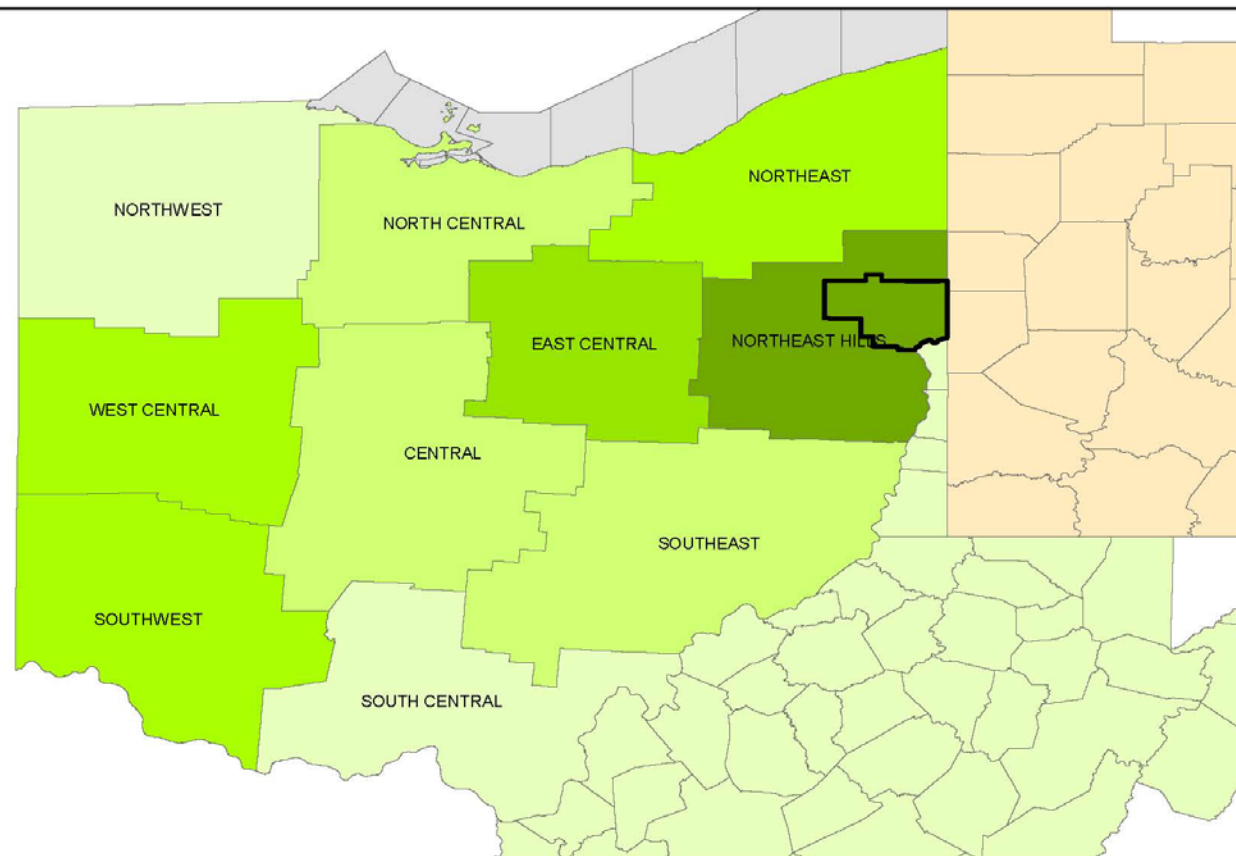
Data Source(s):  
NOAA Earth System Research Laboratory

*DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.*



#### Months in Severe/Extreme Drought

- 5.51%
- 5.51% - 6.38%
- 6.38% - 7.26%
- 7.26% - 7.80%
- 7.80% - 8.27%



### Impacts and Vulnerability

Droughts can impact drinking water both in terms of availability and demand. According to the U.S. Environmental Protection Agency (EPA), as temperatures rise, people and animals need more water to maintain health. Additionally, a large number of economic activities require abundant water sources such as energy production and growing food crops. As droughts reduce available water sources, local officials will need to monitor water usage closely to maintain enough for critical uses. According to the U.S. Drought Monitor, there are possible impacts from each level of drought, which appear in the graphic below.

D0 Abnormally Dry	<p><i>Going into drought:</i></p> <ul style="list-style-type: none"> <li>• short-term dryness slowing planting, growth of crops or pastures</li> </ul> <p><i>Coming out of drought:</i></p> <ul style="list-style-type: none"> <li>• some lingering water deficits</li> <li>• pastures or crops not fully recovered</li> </ul>
D1 Moderate Drought	<ul style="list-style-type: none"> <li>• Some damage to crops, pastures streams, reservoirs, or wells low, some water shortages developing or imminent</li> <li>• Voluntary water-use restrictions requested</li> </ul>
D2 Severe Drought	<ul style="list-style-type: none"> <li>• Crop or pasture losses likely</li> <li>• Water shortages common</li> <li>• Water restrictions imposed</li> </ul>
D3 Extreme Drought	<ul style="list-style-type: none"> <li>• Major crop/pasture losses Widespread water shortages or restrictions</li> </ul>
D4 Exceptional Drought	<ul style="list-style-type: none"> <li>• Exceptional and widespread crop/pasture losses</li> <li>• Shortages of water in reservoirs, streams, and wells creating water emergencies</li> </ul>

### Historical Occurrences

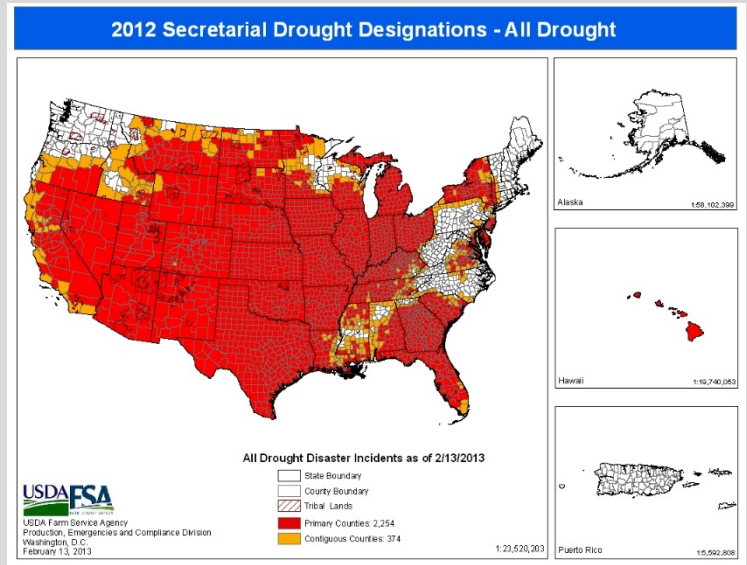
Data sources suggest four droughts have impacted Columbiana County, though the drought of 1999 appears as two of these occurrences. Columbiana County received drought-related disaster declarations from the Secretary of the U.S. Department of Agriculture in 2012 and 2016 (USDA Farm Services Agency, 2019).



## 2012 DROUGHT (Excessive Heat)

### USDA FSA Designation: S3384 (Primary)

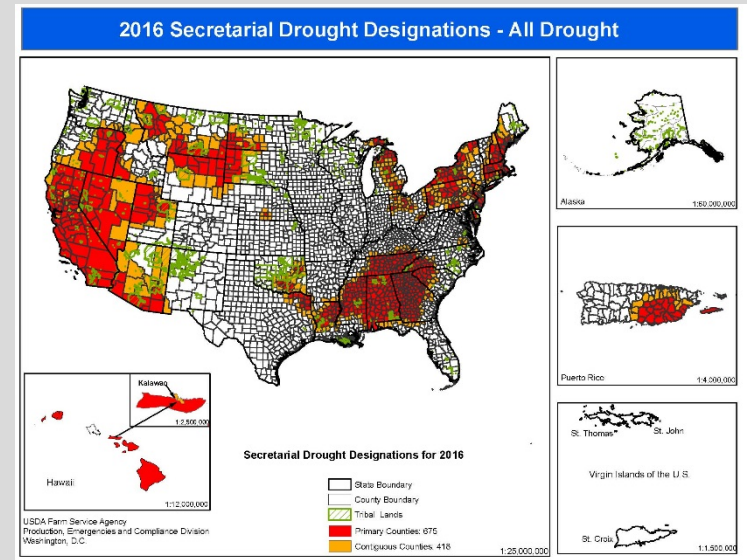
Most locations ended the winter season of 2011-2012 with near-normal precipitation and below-normal snowfall, which led to below-normal snowmelt. March experienced much-above-normal, record-breaking temperatures, which led to above-normal evapotranspiration and an early start to the growing season. This condition, combined with lack of snowmelt in the winter, led to abnormally dry conditions across the region by the middle of April. Given much-below-normal rainfall in April and May, topsoil preconditioned for drought, and already low streamflow across area streams, rivers, and lakes, drought conditions developed across the Midwest region by May. With high pressure remaining in control outside of some fast-moving low-pressure systems, dry weather ruled the summer months. Record-breaking heat combined and a lack of substantial precipitation brought on devastating drought conditions. By the middle of July, all of the local area was in at least D2 or severe drought conditions with a large portion of the area in D3 or extreme drought conditions (on a scale from D0 to D4 drought severity). These conditions lasted until the middle of August.



## 2016 DROUGHT

### USDA FSA Designation: S4165 (Contiguous)

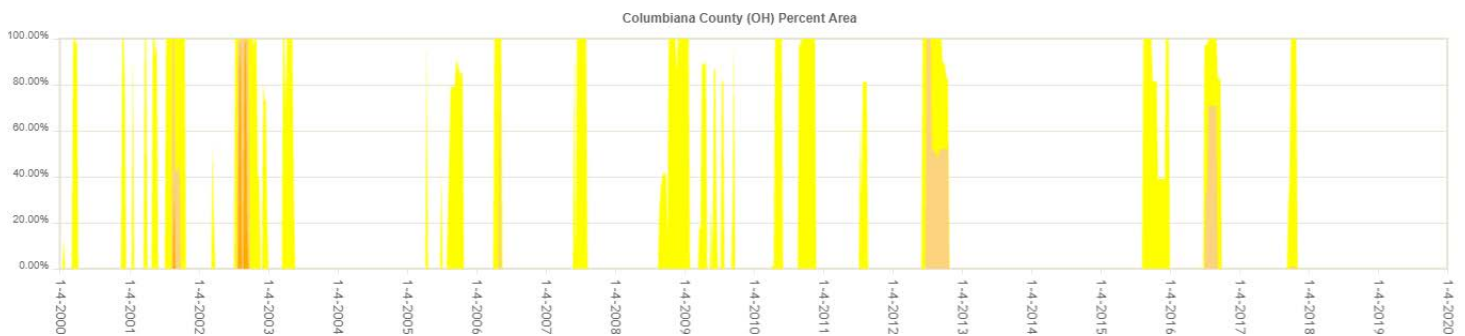
Based on the Palmer Drought Index, severe to extreme drought affected approximately 7% of the contiguous United States at the end of July 2016. About 22% of the contiguous U.S. fell in the moderate to extreme drought category. Columbiana County experienced moderate drought conditions. Columbiana County received a secretarial designation on April 5, 2017, for the period of May 1, 2016, through December 10, 2016.



The Storm Events Database from the NOAA National Centers for Environmental Information lists the 1999 historical occurrences.

DROUGHT HISTORICAL OCCURRENCES (Source: NCEI Storm Events Database)				
<i>Begin Date</i>	<i>Deaths</i>	<i>Injuries</i>	<i>Property Damage</i>	<i>Crop Damage</i>
8/1/1999	0	0	\$0	\$0
9/1/1999	0	0	\$0	\$0

The U.S. Drought Monitor, kept by the University of Nebraska-Lincoln, provides more detailed information about drought since 2000. The illustration below is a graphical representation of the time and severity of droughts presented in Columbiana County between 2000 and 2019.



### Loss and Damages

The USDA maintains data about agricultural activities through five-year censuses. The following table is from the 2007, 2012, and 2017 efforts.

USDA CENSUS OF AGRICULTURE DATA – COLUMBIANA COUNTY					
<i>Year</i>	<i>Farms</i>	<i>Land in Farms (acres)</i>	<i>Harvested Cropland (acres)</i>	<i>Average Harvested Cropland per Farm (acres)</i>	<i>Market Value of Agricultural Products Sold</i>
2007	1,056	130,952	79,340	75.13	\$76,360,000
2012	1,045	127,846	78,489	75.11	\$99,298,000
2017	1,227	142,422	87,597	71.39	\$106,666,000

There can be no correlation drawn between the presence of farms and drought risk; however, the market value of agricultural products sold provides evidence of total agricultural economic activity exposed to losses from droughts (an average of \$94,108,000). Data on historical occurrences shows no crop damage. For planning purposes, utilizing research on average crop yield losses provides the basis for a mathematical loss calculation. Kuwayama (2019) focused on corn and soybeans and found that a week of drought in non-irrigating counties



results in average crop yield reductions ranging from 0.1% to 1.2%. The average market value of agricultural products sold annually (i.e., across 52 weeks) suggests an average weekly value of approximately \$1,617,500 (for a potential exposure ranging from \$1,618 to \$19,410). The declared incidents cited above note the length of the 2012 drought as from April through August (five months) and the 2016 drought as from May through December (eight months). The average length of historical droughts (receiving a secretarial designation) in Columbiana County is thus 6.5 months (or 26 weeks). Combining these calculations suggests a range of exposure of \$42,055 to \$504,660 per drought.

### Risk Assessment

This section summarizes the risk to Columbiana County from drought. The following map image graphically depicts potential risk areas in Columbiana County.


## COLUMBIANA COUNTY HAZARD MITIGATION PLAN

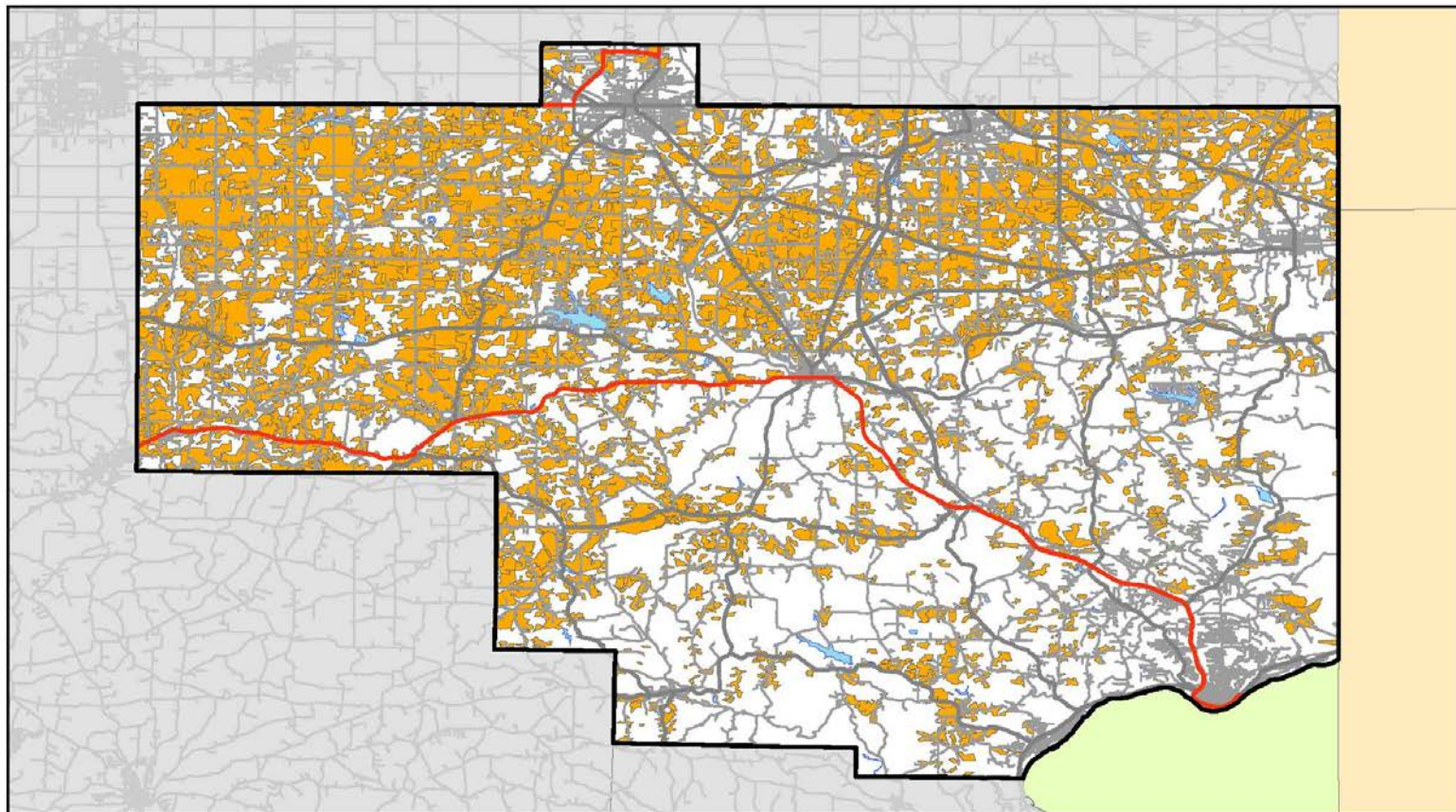
### Columbiana County Drought Risk Map

Data Source(s):  
U.S. Geological Survey

*DISCLAIMER: Data is meant for use as reference only.  
Some sources may be intended to be used at national  
or regional scales and are thus used beyond their  
original intent for demonstrative purposes.*



 Drought Risk Areas




The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

DROUGHT RISK SUMMARY			
<i>Category</i>	<i>Points</i>	<i>Description</i>	<i>Notes</i>
Frequency	2	Low	Four events in 20 years (i.e., 1999-2019) yields an estimate of 0.20 incidents per annum.
Response	4	Less than half a day	Though the agricultural response may be extensive and much longer, it is a response that is not as acute as many other emergency responses.
Onset	1	Over 24 hours	Drought conditions occur following an extended period of specific hydrological conditions.
Magnitude	3	Critical (25-50% of land area affected)	Columbiana County has a land area of 531.89 mi <sup>2</sup> (Census, 2019) (or 340,409.6 acres). Given 142,422 acres in farmland (2017 Census of Agriculture), approximately 41.84% of the county's land area of agricultural.
Business	1	Less than 24 hours	Drought is not likely to necessitate business closure.
Human	1	Minimum (minor injuries)	Drought is not likely to result in injuries.
Property	1	Less than 10% of property affected	Though a significant amount of the land area could be impacted, drought conditions do not affect personal property as severely.
<b>Total</b>	<b>13</b>	<b>Low</b>	

## 2.0 RISK ASSESSMENT

### 2.3.2 Earthquake

An earthquake is the movement or shaking of the Earth's tectonic plates.			
 Vulnerability HIGHEST HIGH MEDIUM LOW LOWEST	Period of Occurrence:	At any time	Hazard Index Ranking: Low
	Warning Time:	Little to none	State Risk Ranking: 2 - Low
	Probability:	Highly unlikely	Severity: Limited
	Type of Hazard:	Natural	Disaster Declarations: None

#### Hazard Overview

Earth consists of four major layers: the inner core (innermost layer), outer core, mantle, and crust (outermost layer). Further, the crust consists of many tectonic plates that are slowly moving, sliding past, and bumping into one another. Most earthquakes originate along the edges of these tectonic plates, called fault lines. The rough edges of the tectonic plates become lodged against each other. When a plate moves enough, the edges become dislodged, causing an earthquake. The epicenter of the earthquake is the location directly above the ruptured fault.

#### Location and Extent

Earthquake intensity ranges from between “small to feel” and violent incidents that cause significant damage. The U.S. Geological Service (USGS) uses the Modified Mercalli Intensity (MMI) scale to measure the intensity of earthquakes. The MMI scale characterizes the intensity of an earthquake at a given location by the severity of ground shaking at that location and the effects of the shaking on people, manmade structures, and the landscape. Two other common ways to measure earthquakes include the Richter scale and peak ground acceleration (PGA).

- **Richter Scale:** The Richter scale, developed in 1935, measures the scale and severity of an earthquake. The magnitude of an earthquake can range between 0 and 10. The effects of an earthquake can extend far beyond the site of its occurrence.
- **Peak Ground Acceleration (PGA):** PGA is “the maximum ground acceleration that occurred during earthquake shaking at a location. PGA is equal to the amplitude of the

largest absolute acceleration recorded on an accelerogram at a site during a particular earthquake” (Douglas, 2003).

The graphic below outlines the MMI scale and compares it to the Richter (magnitude) scale.

MODIFIED MERCALLI AND MAGNITUDE SCALE COMPARISON		
	<i>Modified Mercalli Scale</i>	<i>Magnitude Scale</i>
I	Felt by few people under especially favorable conditions.	1.5
II	Felt by few persons at rest, especially on upper floors of buildings.	2.0
III	Felt quite noticeably indoors, especially on upper floors of buildings. Many do not recognize it as an earthquake. Standing vehicles may rock slightly. Vibration feels like passing truck.	2.5
IV	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation of a heavy truck striking building; standing vehicles rock noticeably.	3.0
V	Felt by nearly everyone; many awakened. Some dishes and windows broken. Unstable objects overturned.	3.5
VI	Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.	4.0
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by vehicle drivers.	4.5
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse; damage great in poorly built structures; fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned. Disturbs	5.0
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Underground pipes broken.	5.5
X	Some well-built wooden structures are destroyed; most masonry and frame structures with foundations destroyed; train rails bent.	6.0
XI	Few, if any, masonry structures remain standing. Bridges destroyed. Underground pipelines taken out of service. Train rails bent greatly.	6.5
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level are distorted. Objects thrown into the air.	7.0

The area of greatest seismic activity in the United States is along the Pacific Coast, in the states of California and Alaska; however, as many as 40 states have moderate earthquake risk. Although most people do not think of Ohio as an earthquake-prone state, at least 170 earthquakes with epicenters in Ohio have occurred since 1776, and 14 of those have caused “minor to moderate” damage. Generally, the number of earthquakes in the central U.S. has increased over the past decade (USGS, n.d.). From 1973 to 2008, there were approximately 25 earthquakes per year of magnitude three or larger. Since 2009, that number has increased to 362 per year.

Regulators and researchers have documented earthquakes induced by human activity in the United States, Japan, and Canada (USGS, [https://www.usgs.gov/natural-hazards/earthquake-hazards/induced-earthquakes?qt-science\\_support\\_page\\_related\\_con=4#qt-science\\_support\\_page\\_related\\_con](https://www.usgs.gov/natural-hazards/earthquake-hazards/induced-earthquakes?qt-science_support_page_related_con=4#qt-science_support_page_related_con)). The cause of these human-caused earthquakes was injection of fluids into deep wells for waste disposal and secondary recovery of oil, and filling large reservoirs for water supplies. Deep mining and nuclear testing can also cause small to moderate quakes. A common misconception is that hydraulic fracturing, or “fracking,” is causing *all* of the induced earthquakes. In reality, fracking “is directly causing a small percentage of the felt-induced earthquakes observed in the United States. Most induced earthquakes in the United States are a result of the deep disposal of fluids (wastewater) related to oil and gas production” (Rubinstein and Mahani, 2015).

### Impacts and Vulnerability

The direct effects of earthquakes include ground movement and ground failure. Cascading effects can include structural damage and utility and communication system outages. The risk of fire also increases after an earthquake due to potentially-damaged gas pipelines and electrical lines. The greatest human risk during an earthquake is structure movement and collapse. Contents within structures may fall or fail and injure or kill the people inside.

### Historical Occurrences

No earthquakes have occurred centered in Columbiana County, though several have taken place in Mahoning County to the north. The following is a graphic from the ODNR Division of Geological Survey, Ohio Seismic Network, which shows earthquake epicenters in Ohio. The northeastern portion of the state is an area of high earthquake activity.

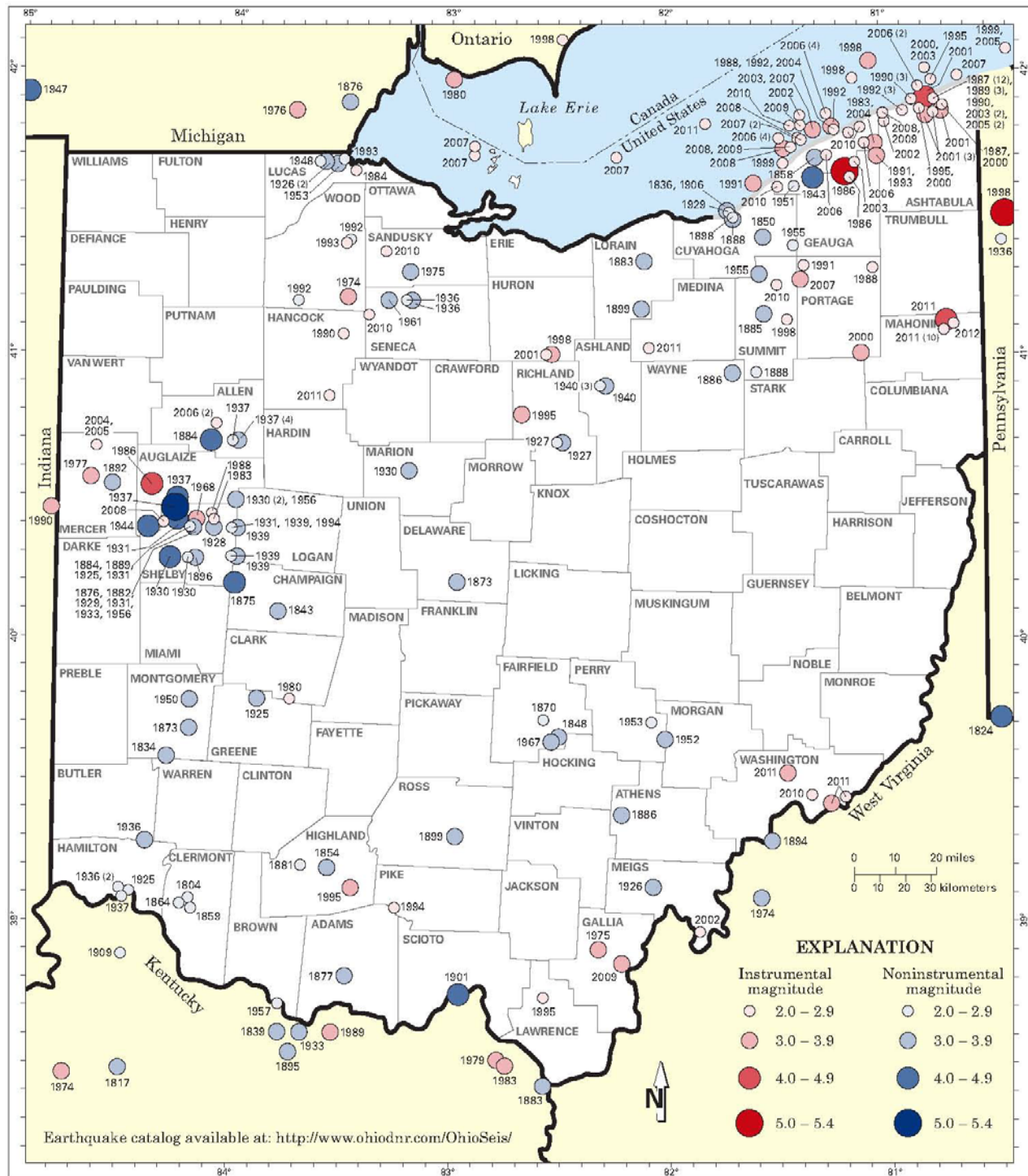


STATE OF OHIO

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGICAL SURVEY

# EARTHQUAKE EPICENTERS IN OHIO AND ADJACENT AREAS



Recommended citation: Ohio Division of Geological Survey, 2012, Earthquake epicenters in Ohio and adjacent areas—color version: Ohio Department of Natural Resources, Division of Geological Survey Map EG-2, generalized page-size version, 1 p., scale 1:2,000,000.



## **New Madrid Incidents**

On December 16, 1811, and January 23 and February 7, 1812, the largest earthquakes on record in the central United States occurred at New Madrid, Missouri. Residents reportedly felt these earthquakes throughout much of the U.S., including all of Ohio.

## **December 2012**

In December of 2012, a series of minor earthquakes hit northeastern Ohio. The most significant in the series was a 4.0 magnitude event originating in McDonald, outside Youngstown. There were reports of feeling these quakes as far away as Columbiana County and parts of western Pennsylvania.

## **Loss and Damages**

Planners utilized the HAZUS-MH program from the Federal Emergency Management Agency to analyze the effects of a potential earthquake striking Columbiana County. The scenario depicts a 5.0 earthquake (the lowest possible magnitude to use in the program) located at Lisbon, the county seat. The following tables describe the expected building damages by occupancy type and the building-related economic loss estimates.



COLUMBIANA COUNTY EXPECTED BUILDING DAMAGE BY OCCUPANCY (HAZUS)										
	None		Slight		Moderate		Extensive		Complete	
	Count	%	Count	%	Count	%	Count	%	Count	%
Agriculture	161.03	0.50	53.19	0.63	56.09	1.20	26.58	1.86	6.11	1.89
Commercial	1,523.33	4.76	494.79	5.83	423.91	9.04	165.67	11.56	37.30	11.57
Education	50.05	0.16	16.08	0.19	14.47	0.31	5.08	0.35	1.32	0.41
Government	48.20	0.15	17.88	0.21	18.96	0.40	6.97	0.49	1.99	0.62
Industrial	446.12	1.39	144.06	1.70	142.80	3.04	61.89	4.32	13.13	4.07
Other Residential	3,085.00	9.64	1,189.80	14.02	1,240.53	26.44	482.46	33.67	98.21	30.47
Religion	208.87	0.65	57.99	0.68	43.41	0.93	16.84	1.18	3.89	1.21
Single Family	26,489.56	82.75	6,513.19	76.74	2,751.46	58.65	667.39	46.58	160.40	49.76
<b>TOTAL</b>	<b>32,012</b>		<b>8,487</b>		<b>4,692</b>		<b>1,433</b>		<b>322</b>	

COLUMBIANA COUNTY HAZUS BUILDING-RELATED ECONOMIC LOSS ESTIMATES (MILLIONS OF DOLLARS)							
Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	0.00	1.2335	20.0817	2.1733	1.7611	25.2496
	Capital Related	0.00	0.5252	15.7951	1.3718	0.4753	18.1674
	Rental	7.5646	4.3074	9.1759	0.7056	0.8659	22.6194
	Relocation	26.6398	5.4739	15.4488	3.1409	7.2036	57.9070
	Subtotal	34.2044	11.5400	60.5015	7.3916	10.3059	123.9434
Capital Stock Losses	Structural	40.7226	10.6778	20.4894	11.0113	10.0979	92.9990
	Non-Structural	153.5268	43.6785	52.2665	32.7143	22.6844	304.8705
	Content	60.5567	11.9506	30.2114	23.5464	13.3777	139.6428
	Inventory	0.00	0.00	0.9196	4.9712	0.3160	6.2068
	Subtotal	254.8061	66.3069	103.8869	72.2432	46.4760	543.7191
<b>TOTAL</b>		<b>289.01</b>	<b>77.85</b>	<b>164.39</b>	<b>79.63</b>	<b>56.78</b>	<b>667.66</b>

To complete the SHARPP vulnerability assessment, the Ohio EMA's "loss estimate workbook for HAZUS results" provided the figures included in the following table.

EARTHQUAKE LOSS ESTIMATE – SHARPP DATA ENTRY		
Structure Type	Number	Loss Estimate
Residential	3,579	\$820,599,500
Non-Residential	2,690	\$839,472,200
Critical Facilities	113	\$35,240,400
<b>TOTALS</b>	<b>6,382</b>	<b>\$1,695,312,100</b>

### Risk Assessment

This section summarizes the risk to Columbiana County from earthquakes. The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

EARTHQUAKE RISK SUMMARY			
Category	Points	Description	Notes
Frequency	2	Unlikely to occur in a year	There have been very few earthquakes in Columbiana County.
Response	2	1 Day	Historical data indicate that earthquakes have caused little to no damage in Columbiana County; thus, a response would be minimal.
Onset	4	Less than 6 hours	Earthquakes occur with little or no warning.
Magnitude	1	Less than 10% of land area affected	No earthquakes have occurred in Columbiana County; those that have occurred in neighboring counties affected all of Columbiana County but resulted in little to no damage.
Business	1	Less than 24 hours	No historical earthquakes disrupted the county's economy.
Human	1	Minimum/minor injuries	Past earthquakes near Columbiana County have been low magnitude and have not caused any human injuries or deaths.
Property	1	Less than 10% of property affected	Earthquakes near Columbiana County have been low magnitude and caused little to no damage.
<b>Total</b>	<b>12</b>	<b>Low</b>	