Warren County 2015 Hazard Mitigation Plan (HMP)

An Update to the 2007 Plan

May 2015

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Warren County, Ohio

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Section 1. Introduction

Natural disasters cause death and injuries, as well as significant damage to our communities, businesses, public infrastructure, and environment. The impacts of these damages result in the displacement of people and tremendous costs due to response and recovery dollars, economic loss, and burden. The Warren County Hazard Mitigation Plan (HMP) is an effort undertaken by the community to mitigate the effects of natural hazards and return to "the norm" sooner with fewer impacts to people and infrastructure.

Hazard mitigation planning is the process through which hazards are identified, likely impacts determined, mitigation goals set, and appropriate mitigation strategies determined, prioritized, and implemented. While natural disasters cannot be prevented from occurring, the effects of natural disasters can be reduced or eliminated through a well-organized public education and awareness effort, preparedness activities and mitigation actions.

After disasters, repairs and reconstruction are often completed in such a way as to simply restore to pre-disaster conditions. Such efforts expedite a return to normalcy; however, the replication of pre-disaster conditions results in a cycle of damage, reconstruction, and repeated damage. Hazard mitigation ensures that such cycles are broken and that post-disaster repairs and reconstruction result in increased resiliency for Warren County.

1.1 *Background and Purpose*

Each year in the United States, natural disasters take the lives of hundreds of people and injure thousands more, as well as destroy or severely damage existing buildings, structures, infrastructure, and other facilities. Nationwide, taxpayers pay billions of dollars annually to help communities, organizations, businesses, and individuals recover from disasters. Many disasters cause extreme burden to city governments and small communities throughout Ohio.

In an attempt to reduce the community burden from the effects of natural hazards, Warren County, in partnership with the EMH&T, developed the 2007 Warren County All Natural Hazards Mitigation Plan. As required, the 2007 HMP was developed in accordance with the Disaster Mitigation Act of 2000 (DMA 2000). DMA 2000 provides the legislative basis for the Federal Emergency Management Agency (FEMA) hazard mitigation planning requirements and funding before and after a hazard event. FEMA requires that an HMP be updated every 5 years.

Warren County has experienced numerous natural disasters, resulting in disaster proclamations and disaster declarations. Forty-nine federal declarations have been documented in Warren County, including: Severe storms, high winds, flooding, among others. These recorded natural hazard events provide a hazard footprint across the region which helps mitigation planners understand hazards that could occur in Warren County and their associated risks to life and property. Understanding natural hazard risks provides a foundation for developing solutions to mitigate or eliminate potential impacts through public education and outreach, preparedness activities, and mitigation actions.

For those hazards that can be mitigated, Warren County must be prepared to implement efficient and effective short- and long-term actions where needed. The purpose of the Warren County HMP 2015 Update is to provide the community with a blueprint for hazard mitigation action planning. The plan identifies resources, information, and strategies for risk reduction, and provides a tool to measure the

success of mitigation implementation on a continual basis. The strategies identified in the updated HMP are developed with the following intentions:

- Risk reduction from natural hazards through a set of defined mitigation actions.
- Establishment of a basis for coordination and collaboration among participating agencies and public.
- Assisting in meeting the requirements of federal assistance programs.[1]

The HMP does not supersede current city plans and strategies, but rather enhances the community's ability to communicate and mitigate natural hazard risk. Information in this plan will be used to help guide and coordinate mitigation activities and decisions for staff and citizens. Proactive mitigation planning will help reduce the cost of disaster response and recovery to Warren County and its residents by protecting critical community facilities, reducing liability exposure, and minimizing overall community impacts and disruptions from natural hazards.

1.2 *Authority*

This plan update was prepared pursuant to the requirements of the DMA 2000 (Public Law 106-390) and the implementing regulations set forth by the Interim Final Rule published in the *Federal Register* on February 26, 2002, (44 CFR §201.6) and finalized on October 31, 2007. (Hereafter, these requirements and regulations will be referred to collectively as the Disaster Mitigation Act (DMA) or DMA 2000.)

While the DMA emphasizes the need for mitigation plans and more coordinated mitigation planning and implementation efforts, the regulations establish the requirements local hazard mitigation plans must meet in order for a local jurisdiction to be eligible for certain federal disaster assistance and hazard mitigation funding under the Robert T. Stafford Disaster Relief and Emergency Act (Public Law 93-288). As described in this plan, Warren County is subject to many kinds of hazards; thus, access to these federal disaster assistance and hazard mitigation funding is vital to ensure a more resilient community.

1.3 *Plan Organization*

The HMP is organized into seven sections to reflect the logical procession of activities undertaken to develop the plan and includes all relevant documentation required to meet the necessary criteria for FEMA approval. Each section is briefly described below.

- **Section 1**. **Introduction** describes the background and purpose of the plan, as well as the authority for development of the plan.
- **Section 2. Community Profile** describes the Warren County history, geography, topography, climate, population, economy, housing, and land use and development trends.
- **Section 3. What's New** provides background to the 2007 HMP and the 2015 HMP Update and details the process undertaken by the HMP Update Planning Committee to review, assess, and update the 2007 HMP. This section also describes the changes and additions that have been identified to develop the updated plan.

[1] The HMP is developed to ensure eligibility for federal and state disaster assistance, including Federal Emergency Management Agency's (FEMA) Pre-Disaster Mitigation (PDM), Hazard Mitigation Grant Programs (HMGP), Flood Mitigation Assistance Program (FMA), and other hazard mitigation program dollars from across a wide range of state and federal funding opportunities.

- **Section 4. The Planning Process** describes the 10-Step HMP Planning Process, as well as the meetings and outreach activities undertaken to engage City officials, staff, and the public.
- **Section 5. Natural Hazard Risk Assessment** identifies and prioritizes natural hazards affecting Warren County, and assesses the City's vulnerability from the identified hazards.
- **Section 6. Mitigation Strategy** identifies mitigation goals, assesses the City's capabilities to implement mitigation actions, reviews the status of previously identified mitigation actions, and identifies and prioritizes new mitigation actions.
- **Section 7. Plan Implementation and Maintenance** discusses plan adoption and implementation, as well as the process to monitor, evaluate, update, and maintain the HMP. This section also includes a discussion on continued public involvement.

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Section 2. Community Profile

The Community Profile summarizes the County's history and existing environmental and socioeconomic conditions. Environmental and socioeconomic factors include geography, topography, climate, population, economic, housing, and land use and development trends.

2.1 *Warren County History*

Warren County was established March 24, 1803, by an act of the first General Assembly in Chillicothe, Ohio. This same act gave the County its name in honor of General Warren, who distinguished himself during the War of the Revolution. Warren, Butler and Montgomery counties were formed from territory formerly included in Hamilton County. Warren County was originally made up of three principal land subdivisions. The Virginia Military District comprised the eastern half, the Symmes Purchase made up the southwest corner and the Congress Lands were located in the northwest corner. Warren County was originally divided into four townships: Franklin, Wayne, Deerfield and Hamilton townships. [2]

Christopher Gist first surveyed the County in the winter of 1750 to spring of 1751. Gist was employed by the Ohio Land Company of Virginia. The Virginia Military Lands were opened for entry August 1, 1787. General Nathaniel Massie was also one of the earliest surveyors of Warren County and surveyed portions of the Virginia Military Land. Another early surveyor was Benjamin Stites. Stites gave a description of the Miami Valley that prompted John Cleves Symmes to purchase a large tract of land.

The Symmes' patent included a tract of land that was only 311,682 acres and bounded on the south by the Ohio River, on the east by the Little Miami River and on the west by the Great Miami River. Symmes had sold large quantities of land for which he was unable to secure a deed and consequently could not grant titles to those who had purchased from him. Congress was presented the cases and immediately created an act that would give preference to those who had purchased land that was found to be outside of Symmes' patent with an opportunity to purchase ground for $2 per acre.

When explorers and settlers began migrating through the Miami Valley, they came in contact with the previous inhabitants, the Miami Indians. The Miami tribe of people relinquished their rights to use the land sometime after the Revolutionary War. As the area was settled, they came upon many other tribes. The Shawnees, a southern tribe, relinquished their titles to the lands, including Warren County, by the following treaties: Fort McIntosh (1785), Fort Harmar (1789) and Greenville (1795).

It was nearly 50 years after Christopher Gist first explored the area within Warren County that settlements began to arise. Local historians fix the earliest settlement at Bedle's Station in September of 1795. Bedle and his family migrated from New Jersey. Around this same time, William Mounts was supposed to have settled on the south side of the Little Miami.

The first mill within the limits of Warren County was built about 1799, by William Wood, where the town of Gainesboro was laid out. Ichabod Corwin grew the first crop of corn just outside of what would become Lebanon. Warren County saw one of the first steam railroads built in the state and also witnessed the building of one of the first electric or interurban railways built in

[2] *The History of Warren County, Ohio*, Unknown Author, W. H. Beers Company, Chicago, Illinois, 1882

Ohio. In 1798, the first school was taught by Francis Dunley, near the western limits of Lebanon. Clearcreek Church was the first church in Warren County and was situated about a half mile north of Ridgeville, Ohio.

2.2 *Geography, Topography, and Climate*

2.2.1 Geography

Warren County is located in Southwestern Ohio. The County has a total land area of 400 mi². It is bounded by Montgomery and Greene counties to the north, Butler County to the west, Clermont and Hamilton counties to the south and Clinton County to the east. As of the Census of 2010, there are 212,693 people, 74,624 households and 57,621 families residing in the County. The population density is 538 people/mi². There are 39,301 housing units at an average density of 147 units/mi². There are 11 townships in Warren County. They are Clearcreek, Deerfield, Franklin, Hamilton, Harlan, Massie, Salem, Turtlecreek, Union, Washington and Wayne townships. The incorporated areas of Warren County are Blanchester Village (also in Clinton County), Butlerville Village, Carlisle City (also in Montgomery County), Corwin Village, Franklin City, Harveysburg Village, Lebanon City, Loveland City (also in Clermont and Hamilton counties) Maineville Village, Mason City, Middletown City (also in Butler County) Monroe City (also in Butler County), Morrow Village, Pleasant Plain Village, Springboro City (also in Montgomery County), South Lebanon Village and Waynesville Village. There are also 57 unincorporated communities located in the County. There are 17 school districts located in Warren County. Eight of the 17 are primarily located in Warren County while the remaining nine are primarily located in adjacent counties. The eight school districts primarily located in the County are: Carlisle, Franklin City, Kings, Lebanon City, Little Miami, Mason, Springboro and Wayne Local School Districts. The County is mostly rural in setting and agricultural areas dominate the landscape. The urban component of the County is comprised of a series of cities, villages and unincorporated areas of development, activity centers, and townships of varying population size and transportation and greenway corridors. Interstate 71 runs through the southern and central portions of the County. Interstate 75 traverses the northwest portion of the County. There are two US Routes, US 22 and US 42, which run through the County. State Routes include 3, 28, 48, 63, 73, 122, 123, 132, 350 and 741. Table 2-1 lists the total miles of road throughout Warren County.

Table 2-1 Warren County Road Mileage

Warren County Road Mileage	
Butlerville	0.8 mi
Carlisle	15.3 mi
Corwin	1.5 mi
Franklin	28.5 mi
Harveysburg	2.6 mi
Lebanon	24.1 mi
Loveland	0.04 mi
Maineville	0.4 mi
Mason	21.0 mi
Middletown	3.2 mi
Monroe	1.6 mi
Morrow	4.8 mi
Pleasant Plain	0.8 mi
South Lebanon	6.1 mi
Springboro	11.0 mi
Waynesville	5.1 mi
U.S. & State Highways	217.2 mi
County Highways	915.3 mi
Total Mileage:	**1,259.34 mi**

The County Seat is located in the City of Lebanon. The three-member board of County Commissioners is elected for a four year term and is the legislative and executive body of the County. Warren County Commissioners hold title to all County properties, serve as the sole taxing authority for the County and control county purchasing. Most importantly, the Warren County Board of Commissioners is the budget and appropriating authority for County government, which includes all County agencies and elected officials (Sheriff, Auditor, Treasurer, Courts, etc.).

Despite its large population, there are no daily newspapers published in the County. The Middletown Journal circulates in Franklin, Springboro, Lebanon and Turtlecreek Township. The Dayton Daily News, which is printed in Franklin, circulates in the northern part of the County. The Cincinnati Enquirer circulates through most of the County while the Cincinnati Post abandoned all distribution in the County in 2004. Among its weekly papers are The Western Star, the oldest weekly in the state and the oldest newspaper west of the Appalachian Mountains published under its original name. It, like the Pulse-Journal in Mason and the Star-Press in Springboro, are owned by the parent of the Middletown Journal and the Dayton Daily News, Cox Communications. Other weekly newspapers include the Franklin Chronicle. According to the Ohio Department of Development (ODOD), the County's major employers include Anthem Companies, Blackhawk Automotive Plastics, Cintas Corporation, Federated Department Stores, GE Capital Corporation, Mason Local Board of Education, Meijer Inc., Otterbein Home, Procter & Gamble Health Care, the State of Ohio and Viacom/Cedar Fair/Kings Island.

2.2.2 Topography

Warren County is composed of rolling till plains with local end moraines. The highest elevation of 805 feet plummets to much lower elevation levels with abruptness in only a few points of the County. The County contains 50 different soil types, the majority of which are poorly-drained clays and well-drained loams. The County is situated in the ecoregion known as the Eastern Corn Belt Plain. There are two distinct types of Eastern Corn Belt Plain topography located in Warren County. They are the Loamy High Lime Till Plains and pre-Wisconsinan Drift Plains. The majority of the County is comprised of Loamy High Lime Till Plains.

The western, northern and northeastern portions of Warren County contain the ecoregion known as Loamy High Lime Till Plains. This ecoregion contains soils that developed from loamy, limy, glacial deposits of Wisconsinan age. These soils typically have better natural drainage than those of surrounding ecoregions. Beech forests, oak-sugar maple forests and elm-ash swamp forests once grew on the nearly level terrain. Today, corn, soybean and livestock production is widespread.

The central and southeastern portions of Warren County contain the pre-Wisconsinan Drift Plain ecoregion. This ecoregion is differentiated from the surrounding ecoregions by its deeply leached, acidic, pre-Wisconsinan till and thin loess and widespread areas of nearly flat, very poorly-drained soils with fragipans. In addition, some dissected areas occur. Originally, beech forests and elm-ash swamp forests were dominant. Today, soybeans are common and are well adapted to spring soil wetness. Corn, tobacco and livestock farming also occur.

Warren County has two major drainage basins: the Great Miami River and the Little Miami River. Streams that drain other parts of the County include: Caesar Creek, Todd's Fork, Second Creek, Little Muddy Creek and Clear Creek. The County contains approximately 62,800 water acres, which consists of about 3,450 acres of lakes, and approximately 320 linear miles of streams and rivers. The Little Miami River is the first river in Ohio proposed for protection under the Federal Wild and Scenic Rivers Act, with planned areas for canoeing, picnicking and camping.

2.2.3 Climate

Warren County receives approximately 42 inches of rain per year; the U.S. average is 37. Average snowfall is 18 inches. The number of days with any measurable precipitation is approximately 121 days a year, and on average there are 178 sunny days per year in Warren County. The July average high temperature is around 86 degrees and the January average low temperature is 19 degrees. The Warren County comfort index[3], which is based on humidity during the hot months, is 43 out of 100, while the average comfort index for the U.S. is 44. See Table 2-2 for a complete summary of average climate information.

Table 2-2 Warrant County Climate Summary Table

Climate Measurements	Warren County, Ohio	United States
Avg. Rainfall (in.)	41.6	36.5
Avg. Snowfall (in.)	18.1	25
Avg. Precipitation Days	121	100
Avg. Sunny Days	178	205
Avg. July High	85.8	86.5
Avg. Jan. Low	19.3	20.5
Comfort Index (higher=better)	43	44
UV Index	3.8	4.3
Avg. Elevation FT.	846	1,443

Source: http://www.bestplaces.net/climate/county/ohio/warren

2.3 *Jurisdictions*

2.3.1 Village of Butlerville

The Village of Butlerville is located in Harlan Township. It is situated in southeast Warren County along State Route 132.[4] The Village has a total land area of 0.2 mi². According to the 2010 Census, there are 163 people, 56 households and 41 families residing in the Village. The population density is 1,481.8 people/mi². There are 60 housing units at an average density of 545.5 units/mi².

On April 20, 1838, Butlerville was platted by Abram B. Butler. On September 3, 1839 and May 17, 1841, he made additions to the town. On November 19, 1844, an addition was made by J. W. Soughman, which he named Texas and comprised all that part of the village south of the old patent line. Several industries sprung up, which for many years made it a prosperous and active country town. The Village of Butlerville was incorporated in 1851.

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[3] This comfort index provides a general idea for how comfortable your time outdoors will be. The index is calculated on a number of weather factors, including temperature, probability of precipitation, humidity, wind speed, and cloud cover. The higher the comfort index, the more comfortable the climate is perceived by general populations across the U.S. One would expect to see a higher index with shirt-sleeve temperatures, minimal chances of rainfall, relatively low humidity, light winds, and fair skies. On the contrary, the lower the index values one would see cool, damp, and windy conditions.

[4] *The History of Warren County, Ohio*, Unknown Author, W. H. Beers Company, Chicago, Illinois, 1882

In 1839, the first church built in town was the frame church on Back Street, erected by the Methodist Episcopal organization. Some of the early merchants in Butlerville are Sullivan F. Stevens, Isaac Lemmon, Henry Morgan, William Vaughn, Elias L. Runyan, Hiram L. Runyan and Hiram St. John. In 1882, Butlerville had a hotel, a carriage and wagon shop owned by H.W. Price, a blacksmith shop owned by M. Keller and one general store owned by Daniel S. Bird.

2.3.2 City of Carlisle

The City of Carlisle is located in Franklin Township and extends north along Clear Creek into a portion of Montgomery County. It is situated in northwest Warren County along State Route 123. The City has a total land area of 3.4 mi².[5] According to the 2010 Census, there are 4,915 people, 1,866 households and 1,430 families residing in the City. The population density is 1,392.4 people/mi². There are 2,066 housing units at an average density of 585.3 units/mi².

In the early 1800s, the area of Carlisle became populated with settlers from New Jersey and became known as the "Jersey Settlement". In 1813, the first church was organized and named the New Jersey Presbyterian Church.

By the 1850s, railroads were being laid through the area and some of the farmers sold land to the railroad companies. George B. Carlisle, a railroad man, bought and platted off a large acreage of land and donated a small plat of ground at the west end of his property indicating it was to be used for the benefit of the entire community. In 1856, a group of local men organized the Literary Society and decided to erect a town hall which was built at a grand total cost of $1,200. The building was completed in 1859. Because of Carlisle's influence in the community, the community was known as Carlisle.

In 1958, the residents voted to incorporate Carlisle. The Town Hall became the center of the government. Officials were elected, rules and regulations were established, corporation lines were determined, streets and roads were designated and the Fire and Police Departments were organized.

The first Mayor of Carlisle was John Homan. In 1987, the residents of Carlisle adopted a "home rule" charter that changed the form of the government from a Mayor/Council form to a Council/Manager form. The first Village Manager was Jeffrey E. Repp.

2.3.3 Village of Corwin

The Village of Corwin is located in Wayne Township. It is situated in northeast Warren County along US Route 42 and State Route 73. The Village has a total land area of 0.3 mi².[6] As of the Census of 2010, there are 421 people, 177 households and 131 families residing in the Village. The population density is 1,202.9 people/mi². There are 190 housing units at an average density of 542.9 units/mi².

In 1844, the Village of Corwin was platted by John Johnson and Joel W. Johnson. It was incorporated in 1894, known originally as the Hamlet of Corwin. A prosperous cattle shipping industry that relied on the railway system helped increase the economy and population of the community.

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[5] http://www.carlisleoh.org/

[6] http://www.corwin.waynetownship.us/

2.3.4 City of Franklin

The City of Franklin is located in Franklin Township. It is situated in northwest Warren County along State Route 73. Interstate 75 traverses the eastern portion of the City. The City has a total land area of 9.1 mi². As of the 2010 Census, there are 11,771 people, 4,667 households and 3,162 families residing in the City. The population density is 1,283.6 people/mi². There are 5,026 housing units at an average density of 548.1 units/mi².[7][8]

In 1796, Franklin was platted by General William C. Schenck and named for Benjamin Franklin. Franklin was platted in 24 squares or blocks of poles with each block divided into eight lots. Each lot measured eight poles one way and 12 poles the other way. The streets were four poles wide, except Fourth Street, which was five poles wide. The lots that were numbered 39, 40, 51 and 52 were given to the residents for the purpose of erecting public buildings. The lot at the upper end of Fourth Street was reserved for a church.

The first cabin was built on Front Street. In the spring of 1796, eight cabins were illustrated on the town plat. In 1808, the first church was built, starting as a nondenominational church and eventually becoming Baptist. In 1814, Franklin was incorporated.

In 1840, Franklin contained three churches, a high school, four dry goods stores, two grocery stores, two forwarding and commission houses and had 770 inhabitants. In 1881, the population grew to 2,700 inhabitants and had a printing office, a graded school, three dry goods houses, two notion houses, eight grocery stores, two banks, two hotels, numerous boarding houses, 12 saloons, three harness stores, four shoe stores, two watch makers, two telegraph offices, one telephone exchange and several of the largest manufactories in the Miami Valley. There were also eight church organizations established.

In 1951, Franklin assumed city status. The City operates under a Council/Manager form of government, with seven at-large council members elected on a non-partisan basis to four-year terms. The council elects one of its members as Mayor.

2.3.5 Village of Harveysburg

The Village of Harveysburg is located in Massie Township. It is situated in northeast Warren County along State Route 73. The Village has a total land area of 0.7 mi². According to the 2010 Census, there are 546 people, 204 households and 147 families residing in the Village. The population density is 551.5 people/mi². There are 237 housing units at an average density of 239.4 units/mi².[9][10]

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[7] *The History of Warren County, Ohio*, Unknown Author, W. H. Beers Company, Chicago, Illinois, 1882

[8] http://www.franklinohio.org/

[9] *The History of Warren County, Ohio*, Thomas M. Wales, W. H. Beers Company, Chicago, Illinois, 1882

[10] http://www.harveysburg.org/

On August 6, 1787, the first settler, Colonel Abraham Buford, arrived and bought land in the area of Harveysburg. In 1827, the land was sold to William Harvey, after whom the Village was named. He was responsible for platting the Village in 1828. According to this plat, the Village contained 47 lots and the principal streets were the state road and the road to Middletown. The Village of Harveysburg was incorporated in January 1829.

The first successful industries of Harveysburg were pork packing, wool and grain. The first carding mill was erected along Caesar Creek by Dr. Jesse Harvey. He sold the business to Joseph Cobner, who moved the mill into the town. The first wagon maker was Jesse Paskill, the first harness and collar maker was David Macy and the first shoemaker was William Macy.

The first schools in Harveysburg were taught by Richard Clegg, George Badly, Dr. Jesse Harvey, Simon D. Harvey and Charles Mills. The present schoolhouse was built for a seminary by a stock company. Among its first teachers were Dr. David Burson, Wilson Hobbs, Israel Taylor, Oliver Nixon and William P. Nixon.

In 1831, Elizabeth Harvey opened a free school for African Americans and is said to have been the first free school located in the State of Ohio. In 1839, the first telephone connections were established in conjunction with the jurisdictions of Corwin, Waynesville and Lebanon. Also in 1839, the first post office was established. In 1870, the Village purchased a fire engine and built a large engine house measuring 30 by 50 feet, with a firemen's hall on the second story.

2.3.6 City of Lebanon

[11][12]The City of Lebanon is located in Turtlecreek Township. It is situated in central Warren County along US Route 42 and State Routes 63, 48 and 123. The City has a total land area of 11.8 mi². According to the 2010 Census, there are 20,033 people, 7,436 households and 5,213 families residing in the City. The population density is 1,545.8 people/mi². There are 7,920 housing units at an average density of 611.1 units/mi².[13][14]

In 1802, Lebanon was platted by a surveyor, Ichabod Halsey, on land belonging to Ichabod Corwin, Ephriam Hathaway, Silas Hurin and Samuel Manning. The original plat of the town comprised only 100 lots, which were bounded on the north by Silver Street, on the south by South Street, on the west by Sycamore Street and on the east by the alley between Cherry and East streets. The 100 lots each contained 50 square rods except lots 1, 57, 68 and 97. These lots contained 25 square rods and half were given to the public. Broadway Street was six poles wide and the remainders of the streets were four poles wide. The alleys were 12 feet wide, all of which were constructed due east, west, north and south. Lebanon was incorporated on January 9, 1810.

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[11] *The History of Warren County, Ohio*, Josiah Morrow, W. H. Beers Company, Chicago, Illinois, 1882

[12] http://www.ci.lebanon.oh.us/

[13] *The History of Warren County, Ohio*, Josiah Morrow, W. H. Beers Company, Chicago, Illinois, 1882

[14] http://www.ci.lebanon.oh.us/

[15]The Golden Lamb Inn, located in Lebanon at the intersection of State Routes 63, 123, and 48, is the oldest inn in the State of Ohio. The original license was issued to Jonas Seaman in 1803. It was placed on the National Register of Historic Places (NRHP) in 1978 and declared "Ohio's Oldest Continuous Business" by the Ohio Historical Society. The two story federal style building seen today replaced the original log frame building in 1815.

During 1880 and 1881, a number of telephones were constructed in Lebanon. Telephone connections between Lebanon and Middletown, via Red Lion and Franklin, were completed May 20, 1881.

2.3.7 Village of Maineville

[1617]The Village of Maineville is located in Hamilton Township. It is situated in southwest Warren County along State Route 48. The Village has a total land area of 0.2 mi². As of the Census of 2010, there are 995 people, 401 households and 266 families residing in the Village. The population density is 711.7 people/mi². There are 422 housing units at an average density of 308.0 units/mi².

The first settlers of Maineville were from the town of Phillips, Maine. On March 23, 1850 an act to incorporate the Village of Maineville was drawn up and passed by the General Assembly of the State of Ohio. On April 2, 1850, the first election of officers for the Village took place. In 1854, the first ordinance was passed and involved improving sidewalks throughout the Village. Also in 1854, the first post office opened.

The first utilities of Maineville were installed in the late 1800s. In 1883, the first kerosene street lights were installed and in 1886, the first telephone was installed. In 1902, the kerosene street lights were converted to gasoline. In 1923, electricity was provided to the residents of Maineville.

2.3.8 City of Mason

[18]The City of Mason is located in Deerfield Township. It is situated in southwest Warren County along US Route 42 and State Route 741. Interstate 71 traverses the southeast portion of the City. The City has a total area of 17.6 mi². As of the Census of 2010, there are 30,712 people, 11,016 households and 8,205 families residing in the City. The population density is 1,648.5 people/mi². There are 11,471 housing units at an average density of 615.7 units/mi².

On August 18, 1815, Mason was platted by Major William Mason, but was originally known as Palmyra. In 1832 and 1835 other land additions were made to the town, known as the Mason, Lamb, Wikoff, Cox and Bennett Additions.

A post office in Ohio was also named Palmyra so to avoid confusion, a meeting was called and a committee appointed to adopt a new name for the area. Some suggestions that were given were the name Van Buren, in honor of the newly elected President and the name Mason, in honor of the mayor who first laid out the

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[15] http://www.goldenlamb.com

[16] *Maineville, Ohio History: 100 years as an Incorporated Town 1850-1950*, Robert Brenner, 1950

[17] http://www.mainevilleoh.com/

[18] http://www.imaginemason.org/

town. The name Mason was finally given to both the town and post office, which met the general approval of all.

On March 22, 1840, the first election of officers took place, resulting as follows: Mason Seward, Mayor; J. G. Paulding, Recorder and Felix Welton, L. Murphy, Abe Duvall, Ezra Dawson, Ephraim Meighan, Trustees.

In 1862, James McCormick started the first newspaper, the Mason Democrat, which passed into the hands of Daniel Flanagin, and was discontinued in 1864. In 1878, the Mason Vanguard was started, but did not establish itself and was disconnected.

2.3.9 Village of Morrow

The Village of Morrow is located in Salem Township. It is situated in southeast Warren County along US Route 22 and State Route 123. The Village has a total land area of 1.7 mi².[19][20][21] According to the 2010 Census, there are 1,188 people, 455 households and 298 families residing in the Village. The population density is 615.5 people/mi². There are 522 housing units at an average density of 270.5 units/mi².

In 1844, the Village of Morrow was platted by William H. Clement, George Keck and Clark Williams. The plat originally contained 49 lots. The Village was named in honor of Jeremiah Morrow, a local farmer and state legislator who served as an Ohio Senator, U.S. Congressman, U.S. Senator and Ohio Governor. Morrow was developed on the grounds of a farm owned by James Miranda. It was strategically situated in the rail corridor planned by the Little Miami Railroad.

In 1837, the building of the railroad began and by 1844, the line had reached to South Lebanon. Later that same year, the railroad extended to Morrow. The line was originally constructed of scrap iron and wooden rail. In 1848, E.W. Woodward arrived from England to lay T-rails on the Little Miami Railroad.

The first building constructed in Morrow was the old warehouse just east of the present depot. It was used as a freight depot, warehouse and general store, under the direction of Alfred Watts. In 1844, the second building, the Morrow House, was constructed in Monroe.

The first public school taught in Morrow was in an old brick building which was also used for religious services. It was built on a lot donated by the founders of the town for church and school purposes. The school at this time contained one room and the students were taught by Mr. Reed. In 1849, John Starkey became the teacher.

2.3.10 Village of Pleasant Plain

The Village of Pleasant Plain is located in Harlan Township. It is situated in southeast Warren County along State Route 132. The Village has a total land area of 0.1 mi².[22] As of the Census of 2010, there are 154

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[19] *The History of Warren County, Ohio*, J.J. Mounts, M.D., W. H. Beers Company, Chicago, Illinois, 1882

[20] *The History of Morrow,* Mary Esther Richards, 1942. Salem Twp. Public Library.

[21] http://www.vil.morrow.oh.us/

[22] http://pleasantplainoh.usl.myareaguide.com/

people, 58 households and 42 families residing in the Village. The population density is 962.5 people/mi². There are 61 housing units at an average density of 381.3 units/mi².

On November 18, 1852, Samuel Craig platted the area that originally was named New Columbia. In 1860, the name was changed to Pleasant Plain. On October 2, 1854, Craig made an addition to the plat and on January 28, 1872, Thomas Hill laid out an addition of 11 lots on the east side of the Village. Lastly, on December 5, 1873, Ira Dudley, added seven lots on the south side of the Village.

This Village was established primarily because of the Marietta & Cincinnati Railroad. The founding years of Pleasant Plain contained two churches, a hotel owned by J. M. Fox, a general store owned by Peter C. Spurling, a drug store and a grain warehouse.

2.3.11 Village of South Lebanon

The Village of South Lebanon is located in Union and Hamilton townships. It is situated in southwest Warren County along State Route 48 and Interstate 75. The Village has a total land area of 1.7 mi².[23][24] According to the 2010 Census, there are 4,115 people, 1,533 households and 1,118 families residing in the Village. The population density is 1,552.8 people/mi². There are 1,641 housing units at an average density of 619.2units/mi².

The Village of Deerfield, now South Lebanon, is one of the oldest towns of Warren County. In 1795, the town was platted and the first settlement occurred in the spring of 1796. The plat of the town of Deerfield, was not placed on record at Cincinnati for six or seven years after the town was platted. On December 6, 1800, the Legislature of the Northwest Territory passed an act requiring the original proprietor or proprietors of such towns, as had already been settled in the territory, to produce an accurate map or plat of the same to be recorded in the County Recorder's office, within one year or they would incur a fine of $1,000.

The plats of the three towns which had been laid out within the present limits of Warren County prior to the passage of this act, were received by the County Recorder at Cincinnati for record as follows: Deerfield, April 23, 1802; Waynesville, April 28, 1802 and Franklin, August, 12, 1802.

At the beginning of the 1800s, Deerfield was an important place on the Little Miami River. It was made a stopping point for many of the early settlers in different parts of the County. Early emigrants frequently left their families at Deerfield while the first improvements were being made on their new farms.

The first settlers of Deerfield included Captain Nathan Kelly, Captain Ephraim Kibby and Andrew Lytle. The first tavern in Deerfield was owned and operated by General David Sutton.

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[23] *The History of Warren County, Ohio*, J.J. Mounts, M.D., W. H. Beers Company, Chicago, Illinois, 1882

[24] http://www.southlebanonohio.org/

2.3.12 City of Springboro

The City of Springboro is located in Warren and Montgomery counties, with the majority of area located in Warren County. It is situated in northwest Warren County along State Route 73 and Interstate 75. The City has a total land area of 8.8 mi².[25][26] According to the 2010 Census, there are 17,442 people, 5,996 households and 4,871 families residing in the City. The population density is 1,859.9 people/mi². There are 6,263 housing units at an average density of 669.1 units/mi².

In 1816, Springboro was platted by Johnathan Wright. When the time came to select a name for the place, Wrightstown was suggested in honor of the founder but Wright objected and proposed the name of Springboro, which was adopted. One condition imposed on all who purchased lots in the Village was that no liquor was to be sold on the premises for 10 years. The first school was opened in 1816, by Francis Glass, a classical scholar. By 1882, there was one Methodist, one Universalist, one German Reformed, one United Brethren, one African- American and two Friends churches in Springboro.

In 1978, the City adopted legislation that allows for a Council/Manager form of government. Both the Charter and Council/Manager form of government function cohesively.

2.3.13 Village of Waynesville

The Village of Waynesville is located in Wayne Township. It is situated in northeast Warren County along US Route 42 and State Route 73. The Village has a total land 2.3 mi².[27][28] As of the Census of 2010, there are 2,834 people, 1,128 households and 761 families residing in the Village. The population density is 1,190.8 people/mi²). There are 1,196 housing units at an average density of 502.5 units/mi².

In 1797, the Village of Waynesville was founded by Englishman Samuel Heighway. In 1802, the Village was platted by Heighway, Smith and Banes. The Village was named after General Anthony Wayne, who camped in the area during the Indian Wars. It later became home to a Mr. Palmer who developed the country's first commercially grown chewing tobacco. Waynesville growers shipped vast quantities of locally grown produce on the Miami Canal as well as on flat boats on the Little Miami River.

In the mid-1800s, pearl fisheries were established in the Little Miami River. Dr. Robb's Hippodrome Liniment was created here. In 1877, branch banking was first used when the Waynesville National Bank opened an office in Lebanon.

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[25] *The History of Warren County, Ohio*, Author Unknown, M.D., W. H. Beers Company, Chicago, Illinois, 1882

[26] http://www.ci.springboro.oh.us/

[27] *The History of Warren County, Ohio*, Judge John W. Keys, M.D., W. H. Beers Company, Chicago, Illinois, 1882

[28] http://www.waynesville-ohio.org/

2.4 *Socioeconomic Factors*

The population, economic, and housing factors of the Warren County are described in this section. Understanding these socioeconomic factors is imperative to determining the potential impacts a natural hazard event can have on the community's population and economy.

2.4.1 Population

2.4.1.1 State Population

The State of Ohio's population in 2010 was 11,536,504 and it is projected to climb to 11,615,100 by 2030, an increase of 0.68%. However, it appears that the rate at which
Ohio's population is growing is actually slowly increasing per projected years.

Several factors may be contributing to this slow increase. The birth to death ratio is much smaller than in faster growing states, with Ohio expected to have 4.4 million births and 3.6 million deaths. Net migration is a factor as well. Ohio may gain approximately 247,000 people through in-migration but may lose about 758,000 people through out-migration.

The projected percentage of population change by county in Ohio from 1990 to 2030 is reflected on the map in this section. Counties surrounding a major metropolitan area – Cincinnati, Columbus, and Cleveland – generally will experience higher growth rates. Counties in the north central and eastern region of the state are projected to experience a decline.

2.4.1.2 County Population

According to 2010 Census, the total population of Warren County is 212,693. Warren County is semi-urban in nature and is considered to be part of the Cincinnati-Dayton metropolitan area. The urban nature is shown by comparing the County's inhabitants per square mile to the State's inhabitants per square mile, 397 versus 277 respectively. The area of highest population density is the unincorporated areas of Deerfield Township and the City of Mason with a total of 47,531 people.

The population of Warren County has fluctuated between the years 1810 and 1950 and since then, has steadily increased. Between the years 1950 and 1960, the population increased by 71%, which was the largest percentage change experienced by the County. The largest net change was experienced between the years 1990 and 2000, with an increase of 44,474 residents. Warren County is expected to increase in population to 235,640 by 2030. According to the Warren County Office of Economic Development, Warren County is classified as the fourteenth most populated county in the state. It is currently projected to be show the 11th highest percentage increase in population between the 2010 and 2040 census.

2.4.2 Employment

According to the 2013 American Community Survey 1-Year Estimates, U.S. Census Data, there are 167,340 people over 16 years of age, of which 111,615 are in the labor force. Out of the 111,615 people in the labor force, 102,412 are employed, and 13,554 are unemployed. Of the employed population, 47 percent work in management, business science, and arts occupations; 13 percent work in service occupations; 25 percent work in sales and office occupations; 5 percent work in natural resources, construction, and maintenance; and 10 percent work in production, transportation, and material moving occupations. The median household income in Warren County is $72,055. The major employers are Aisin Seiki/ADVICS Co Ltd, Atrium Medical Center and Cedar Fair/Kings Island.

2.4.3 Housing

According to the Warren County Profile prepared by the Office of Policy, Research and Strategic Planning, there are 80,726 housing units in Warren County. Of the total housing units, 75,875 are occupied and 4,851 are vacant. The majority of homes in Warren County are also owner-occupied (78.5 percent), with the remaining 21.5 percent categorized as renter-occupied units. More than 52% of the homes in Warren County were built between 1990 and 2009. An additional 23% of the homes were built between 1970 and 1989.

2.5 *County Utilities*

2.5.1 Electric, Telephone and Gas

The electric power for Warren County is provided by three utility companies. Dayton Power and Light Company, Duke Gas and Electric and Lebanon Municipal are the providers of electricity. See Map B-1, Service Areas of Ohio Electric Companies, in Appendix B.

Phone companies that service Warren County include Cincinnati Bell, Germantown, Little Miami, SBC Ohio, Sprint and Verizon North. See Map B-2, Telephone Service Areas in Ohio, in Appendix B.

Natural and bottled gas is provided by CGE, Columbia and Vectren. See Map B-3, Public Utilities Commission of Ohio (PUCO) Regulated Natural Gas Companies, in Appendix B.

2.5.2 Water and Wastewater

The two major drainage basins that supply Warren County with a surface water supply are the Great Miami River and the Little Miami River. Streams that drain other parts of the County include Caesar Creek, Todd's Fork, Second Creek, Little Muddy Creek and Clear Creek. The County contains approximately 62,800 water acres, which provide for a large supply of surface water. The water acreage consists of about 3,450 acres of lakes and approximately 320 linear miles of streams and rivers. See Map C-1, Surface Water Resources, in Appendix C.

The primary groundwater source in Warren County is a buried valley aquifer composed of sand and gravel. This aquifer serves as an adequate water supply for both individual and public wells for several large water users in the County, such as Lebanon, Mason, Franklin, Western Water Company and Warren County Water Company. Buried valley aquifers may contain outwash sediments deposited by glacial activity. Outwash deposition occurs throughout the Great Miami River basin where sand and gravel have been deposited in deep valleys cut into the bedrock surface. Glacial meltwater has filled or buried these valleys with sand and gravel deposits to average depths of about 200 feet. See Map C-2, Groundwater Resources, in Appendix C.

Well yields of 500 to 1,000 gallons per minute (gpm) may be developed in the extreme western and northwestern ends of Warren County. The yield potential decreases in the eastward direction and is usually limited to less than 3 gpm. The yield of a well will vary considerably depending on the age and depth of the well, well construction, the diameter of the casing, pump capacity and age and properties of the geologic formation.

Warren County water is principally furnished by three water treatment plants owned and operated by the County, with Ohio Environmental Protection Agency (EPA) rated capacities of 6 million gallons per day (mgd), 2.6 mgd and 1.5 mgd. In addition to the water furnished by the County plants, the County purchases approximately 10,000 gallons per day (gpd) of potable water from the City of Springboro, 5,000 gpd from the Village of Waynesville and 3.0 mgd of potable water from the City of Cincinnati. Pursuant to an agreement with the City of Cincinnati, the City of Cincinnati will provide up to 8.0 mgd to the County if the need arises. In addition to the County's water treatment facilities, the County has six booster stations and nine elevated water storage facilities, with a total storage capacity of 19.5 million gallons and two ground storage facilities, with a total storage capacity of 9.85 million gallons. With the exception of the purchased water, the County's water is supplied from wells. Warren County currently has 17 wells in production and recently entered into a contract for the design of three additional wells within the north well field. The County has approximately 400 miles of water main and approximately 18,000 water customers.

Warren County has emergency water system interconnection with the following cities and/or villages:

- Franklin
- Lebanon
- Mason
- Middletown
- Springboro
- South Lebanon
- Waynesville

Warren County has one major sewage treatment plant, which has a design of 7.2 mgd. There are also two smaller sewage treatment plants with a service range of 16,000 to 80,000 gpd. The County also has agreements with Metropolitan Sewer District, U.S. Filter/Franklin Regional Wastewater Treatment Corporation and the Village of Waynesville to provide sewage treatment for some of the unincorporated areas of the County. There are approximately 12,000 sewer customers and 225 miles of sewer lines

2.6 *Land Use and Future Development Areas*

Warren County contains approximately 260,900 land acres, of which approximately 60% is rural. Sixty-seven percent of the agriculture in Warren County is cropland. Land being used for farmland has increased by 2% from 1997 to 2002. The average size of farms has decreased from 137 acres in 1997 to 122 acres in 2002. Caesar Creek State Park is a popular recreational park that is located between Waynesville and Harveysburg. The park is centered on the 2,830-acre Caesar Creek Lake and totals 4,700 acres. A 2,500-acre wildlife area is adjacent to the park.

2.6.1 Single-Family New House Construction Building Permits

Construction permits can often provide a valuable snapshot into the health of the housing market of a community. The ten-year period from 2000 to 2009 saw the average cost of new homes built increase over $100,000, or 120 percent. After peaking in 2007, the average cost dropped in 2008, mirroring what was occurring in the rest of the U.S. at the time. The number of new buildings being constructed began to drop significantly. As the economy has begun rebounding in recent years, the average cost of new buildings has begun to rise again. The number of buildings being constructed has not returned to pre-

"crash" levels and is not expected to return to those levels for several years. See Table 2-3 for a summary of single family home construction permits.

Table 2-3 Single-Family Construction Permit Summary

Year	Buildings Permits
2000	2353
2001	2649
2002	2650
2003	2467
2004	2328
2005	2241
2006	1524
2007	1081
2008	663
2009	664
2010	432
2011	360
2012	402
2013	564
2014	888

Source: *http://www.city-data.com/county/Warren_County-OH.html*

2.6.2 Warren County Comprehensive Plan

In 2007, the Warren County Planning Commission drafted an updated Comprehensive Plan. This plan included information on land use, transportation, capital improvements, housing, economic development, and parks and recreation. The plan was formally adopted in 2011 by the County Board of Commissioners. Major changes in the plan include:

- A revision of the land use plan for the defunct San Mar Gale project in Turtlecreek Twp. from a planned use development to rural residential.
- Re-designating Franklin Twp. from rural to suburban land use.
- Re-designating western Turtlecreek Twp. west of Ohio 741 from rural to suburban land use.
- Updating changes to the county's thoroughfare plan and incorporating them into the comprehensive plan.

This plan also takes into account Master Plans already in place from other cities, villages and several other townships. Combining land use planning with economic development, thoroughfare planning, and housing plans will allow the County to sensibly move toward the future. The incorporation of data from this mitigation plan into future updates will only strengthen the comprehensive plan. The incorporation of data from this mitigation plan into future updates will only strengthen the comprehensive plan.

The following map illustrates Warren County's land use from the early 1990s.

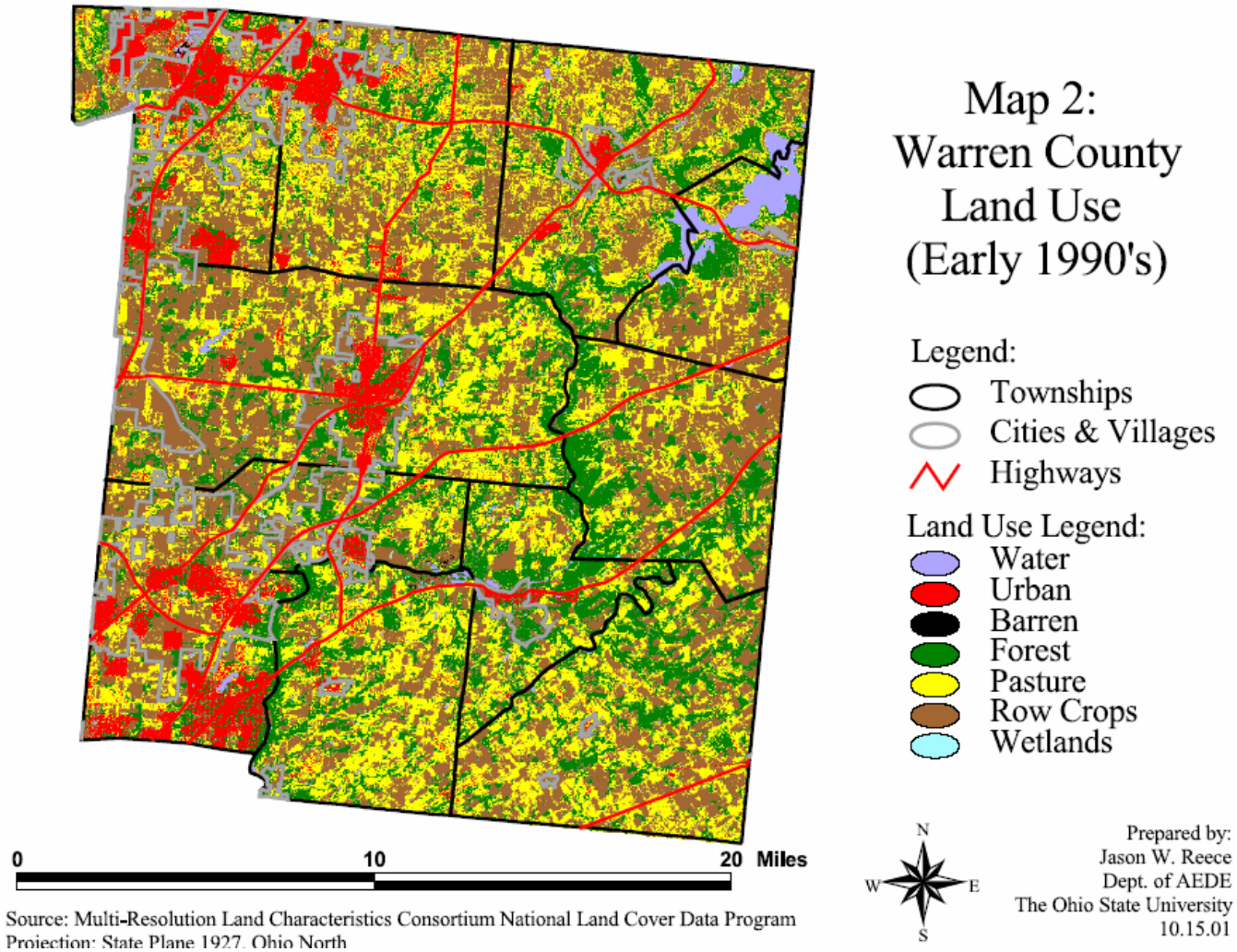

Figure 2-1 Warren County Land Use (Early 1990's)

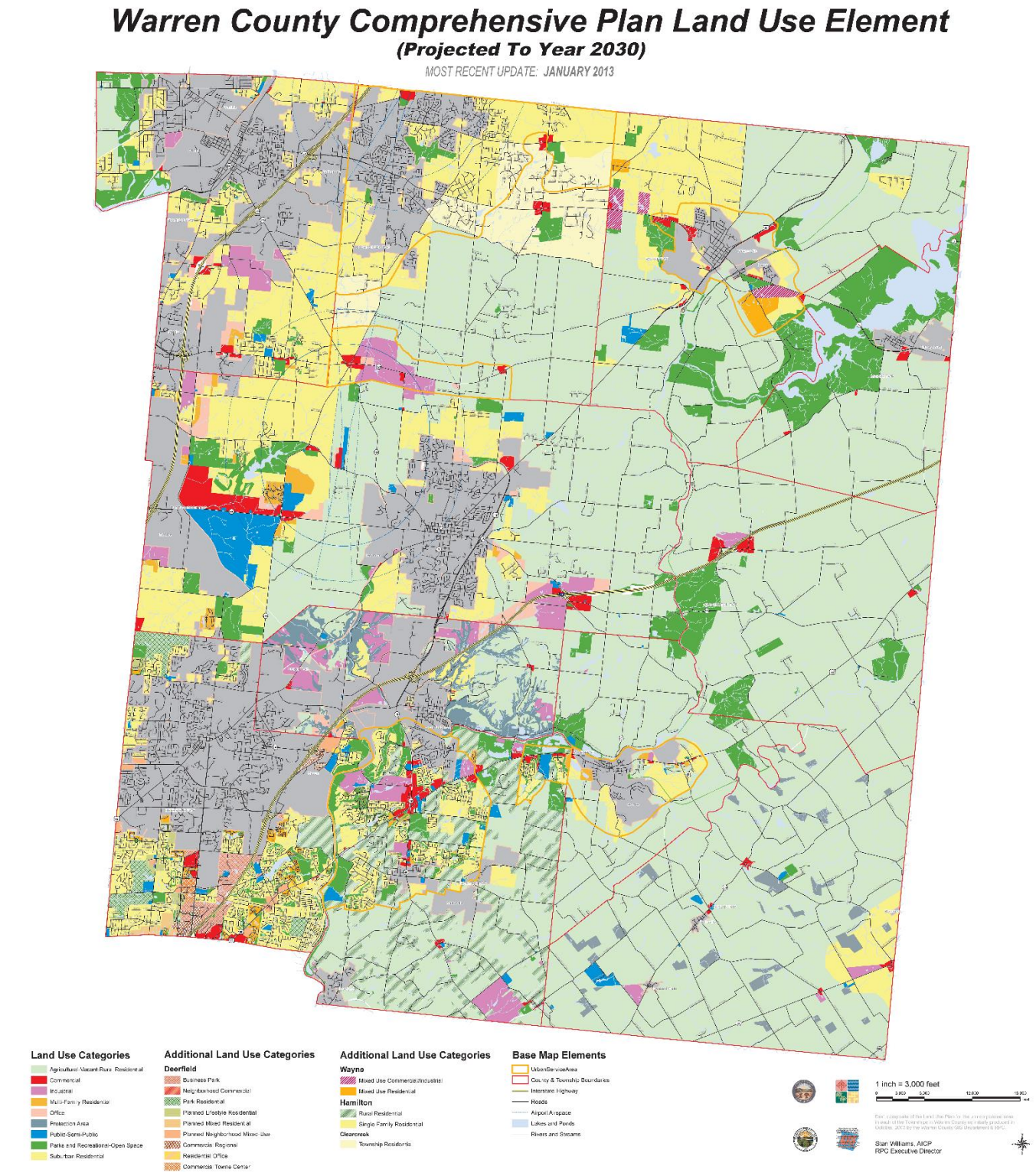

Figure 2-2 2030 Land Use Map

2.6.3 Future Land Use

Warren County is expected to increase in population to 235,640 by 2030. The Cincinnati-Dayton regions are continually expanding into the rural landscape. Suburban and exurban development accounts for the majority of new housing construction in these areas. The result is a continuation of sprawl into the countryside.

The Warren County RPC works to establish a pattern of land use capable of serving and meeting the social, economic and environmental needs of the residents of the County. The planning process developed a series of goals, objectives and policies to meet these needs. The commission developed policies related to the natural environment, and policies related to the man-made environment. The goals and objectives created through this planning process are as follows:

Related to the Natural Environment

Goal: Protect water resources, wetlands, floodplains and woodlands, balancing environmental values and the built environment.

> **Objective**: Direct development to areas of minimum environmental sensitivity--protecting wetlands, floodway, steep slopes and wildlife habitat. These areas shall have a "protection area" designation on future land use mapping.
>
> **Objective**: Manage water resources, both water quality and water quantity, especially through a program of improved stormwater management.

Goal: Provide a broad choice of multi-use recreational opportunities, available to all citizens.

> **Objective**: Preserve open space, both passive and active, sufficient for future needs.

Goal: Air quality that is not harmful or offensive to the natural or man-made environment.

> **Objective**: Encourage the improvement and maintenance of air quality at levels necessary to protect the public health and welfare of the citizens.

Related to the Man-Made Environment

Goal: Establish a balance between development and growth management, maintaining the desired community character.

> **Objective**: Modify development regulations to assure the retention of rural character outside established urban service areas.
>
> **Objective**: Encourage land use intensity within established urban service areas.

Goal: A pattern of land use capable of serving and meeting the social, economic and environmental needs of residents and local institutions.

> **Objective**: Encourage the sensible development of residential areas with housing types and densities to meet the needs of residents--ensuring that a healthy, safe and attractive environment is maintained.

Objective: Establish areas of commercial activity, ensuring a convenient, safe and pleasant environment in meeting the retail and business needs of residents, workers and travelers.

Objective: Encourage quality light and high-tech industrial development, necessary to overall economic growth and stability.

Goal: Provide community services adequate to fulfill the social, environmental and economic needs of residents.

Objective: Encourage the provision of a full range of community facilities and services within established urban service areas.

Objective: Encourage the provision of necessary community facilities and services outside established urban service areas.

Goal: An inter-modal transportation system allowing for convenient access for all residents, workers and travelers.

Objective: Provide a variety of transportation modes, designated and designed to meet the differing needs of different people, activities and purposes of travel.

Goal: Coordination and cooperation among local, State and Federal officials in matters relating to land use planning, to create a well-balanced, compatible and complementary arrangement of land uses.

Objective: Resolve problems in rapidly growing areas, by making land use decisions in a logical and meaningful fashion.

Some of the policies they have established will help in future land use planning issues. These policies will be used to meet the goals and objectives listed above. They include the following:

- Discourage small, isolated subdivisions where soil conditions and lot size are not conducive to on-site wastewater disposal systems, where applicable.
- Encourage a logical pattern of residential development where future growth would occur in proximity to existing residential areas within the designated Urban Service Areas of the Township.
- Build multi-family housing at a scale that can accommodate the need, combined with prudent use of the Planned Unit Development process, to accomplish quality development, mitigating the impact of County utilities and other public services.
- Develop adequate, well designed and affordable housing for the elderly population, the handicapped and families with children.
- Give a stronger emphasis to establishing open space/green belt areas, separating developing residential areas from incompatible uses.
- Establish a system to encourage housing maintenance through a coordinated, ongoing inspection program by County and local officials.
- Encourage the repair or removal of dilapidated/substandard structures.
- Identify, document and protect older homes or residential areas of historical and/or architectural significance from unwanted, incompatible land uses.
- Explore the establishment of an historical zoning district to protect individual structures or neighborhoods of historical and/or architectural significance.

- Establish a balance between development and growth management, maintaining the desired community character.
- Implement the recommendations of the Warren County Parks & Open Space Plan.

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Section 3. What's New

This section of the plan includes background information on the 2007 LHMP and the 2015 HMP Updates. The 2007 Mitigation Actions were reviewed and have been changed, updated, and revised to reflect new priorities in the 2015 HMP. The sections below describe the background and planning process for changes and updates.

3.1 *2007 LHMP and 2015 HMP Update Background*

In 2007, Warren County adopted its LHMP, as required by the DMA 2000. The 2007 LHMP provided a high-level overview of the hazards affecting the community. The hazards identified in the LHMP included wildland urban interface fires, drought, extreme temperatures, dam inundation, severe storms and flooding. The plan also included a vulnerability assessment and mitigation actions to decrease the impacts of these hazards to the community.

The update planning process began on July 31st, 2014 with the initial Planning Committee meeting held in Warren County at the Warren County Commissioners Meeting Room. A series of three meetings were subsequently conducted to lead the Planning Committee through the planning process and to gather the information required to develop this plan update.

The 2015 HMP contains many of the same elements as the 2007 LHMP. However, instead of simply updating the data, the Planning Committee has taken this opportunity to strengthen the plan through the use of new research methods and information systems. Geographic Information Systems (GIS) mapping has provided the committee with the tools to develop data sets which are much more comprehensive than featured in the 2007 LHMP.

The 2015 HMP focuses on natural hazards. The 2015 HMP features new mitigation actions which focus on four different classifications. These classifications include:

1. Local Plans and Regulations – intended to reduce the City's vulnerability to future hazard events through the implementation of codes and regulations.
2. Structure and Infrastructure Projects – intended to protect existing structures by retrofitting, relocating, or modifying the structure to withstand a hazard event.
3. Natural Systems – to reduce the effects of hazards on the natural resources within a region by preserving and/or restoring natural areas along with their mitigation functions.
4. Public Information and Awareness – to advise residents, potential buyers, and visitors about hazards, potentially hazardous areas, and mitigation techniques.

3.2 *Successful Mitigation Activities Since 2007*

The 2015 HMP, adopted and approved by the Warren County, has been implemented through various on-going projects, plans and programs. With respect to the mitigation action items and strategy developed, Warren County has been making improvements toward lowering natural hazard risk to life and property within the County. Significant risk reduction efforts have been made for floodplain management, flood damage prevention, and fire hazard abatement. These successful policies, programs, and projects are summarized below.

3.2.1 Storm Ready Certification

One of the recurring strategies that appeared in the 2007 HMP was the County's desire to achieve the Storm Ready Certification. That was accomplished in 2014. This certification reflects Warren County's dedication to protecting its citizens through better planning, education and awareness.

3.2.2 Early Warning Systems

Warren County has worked to improve the early warning systems within the County following the development of the 2007 HMP. In that time, the County has improved the tornado siren coverage. In addition, Warren County is authorized to use the Integrated Public Alert & Warning System (IPAWS). IPAWS users can send emergency messages that activate the Emergency Alert System (EAS) for radio and TV broadcasts, generate Wireless Emergency Alerts (WEA) on wireless devices, and post emergency alert and warning information on other sources such as NOAA's National Weather Service networks and various internet applications and services. Only 18 agencies within the State of Ohio are authorized to access this system (as of May 1, 2015).

3.3 *What's New in the HMP Update*

For the 2015 HMP, the Warren County HMP Planning Committee reviewed and analyzed the 2007 LHMP. This included a review of the planning process, historical disasters, hazard and risk assessment, mitigation goals, mitigation actions, and plan maintenance and updating process sections.

The 2015 HMP has been completely revamped to included Warren County specific hazard information to fully capture the unique hazard environment and focus limited resources on relevant mitigation efforts. These changes include an expanded community profile, specific mitigation actions, and a specific maintenance and updating process for the next five years.

Section 4. The Planning Process

This section describes each stage of the planning process used to develop the 2015 HMP. The planning process provides a framework for document development and follows the FEMA recommended steps. The 2015 HMP follows a prescribed series of planning steps which includes organizing resources, assessing risk, developing the mitigation plan, drafting the plan, reviewing and revising the plan, and adopting and submitting the plan for approval. Each is described in this section.

4.1 *Planning Process*

Hazard mitigation planning in the United States is guided by the statutory regulations described in the DMA 2000 and implemented through 44 Code of Federal Regulations (CFR) Part 201 and 206. FEMA's HMP guidelines outline a four-step planning process for the development and approval of HMPs. Table 4-1 lists the specific CFR excerpts that identify the requirements for approval.

Table 4-1 DMA 2000 CFR Crosswalk

DMA 2000 (44 CFR 201.6)	[YEAR] HMP Plan Section
(1) Organize Resources	Section 4
201.6(c)(1)	Organize to prepare the plan
201.6(b)(1)	Involve the public
201.6(b)(2) and (3)	Coordinate with other agencies
(2) Assess Risks	Section 5
201.6(c)(2)(i)	Assess the hazard
201.6(c)(2)(ii) and (iii)	Assess the problem
(3) Develop the Mitigation Plan	Section 6
201.6(c)(3)(i)	Set goals
201.6(c)(3)(ii)	Review possible activities (actions)
201.6(c)(3)(iii)	Draft an action plan
(4) Plan Maintenance	Section 7
201.6(c)(5)	Adopt the plan
201.6(c)(4)	Implement, evaluate, and revise

For the development of the 2015 HMP, a planning process was customized to address the unique population and demographic. All basic federal guidance documents and regulations are met through the customized process. As shown in Figure 4-1 the HMP planning process (and documented in the corresponding sections) included organizing resources, assessing risk, developing the mitigation action strategy, drafting the plan, reviewing and revising the plan, and adopting and submitting the plan.

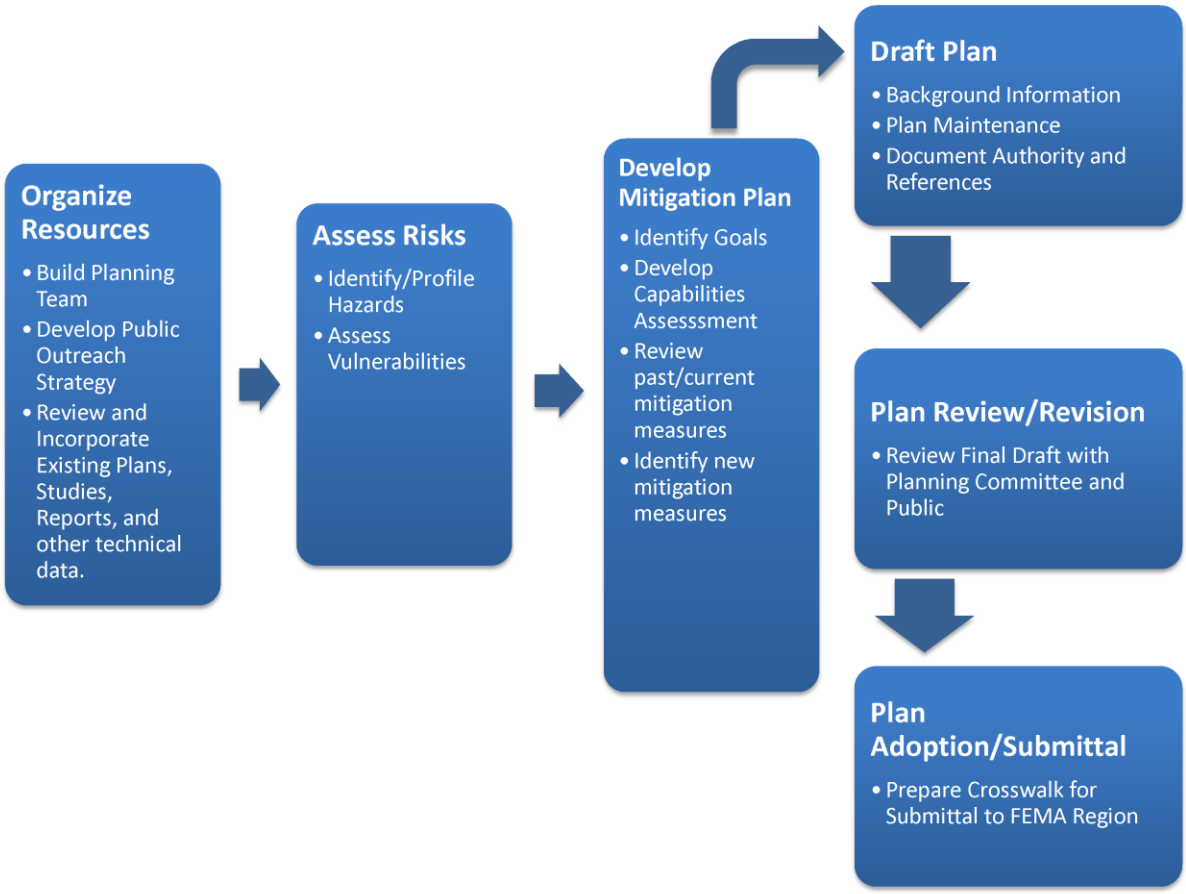
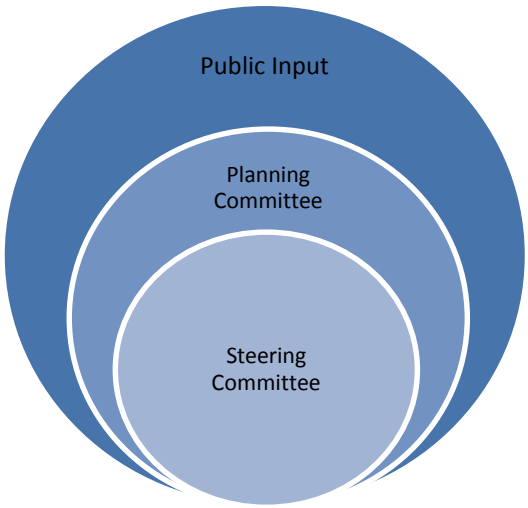


Figure 4-1 Mitigation Planning Process

4.2 *Organize Resources*

This section describes the first step of the 2015 HMP planning process – Organizing Resources. Organizing the resources consists of planning team development and document review tasks.



4.2.1 Building the Planning Team

The Planning Team, key to the back bone of the planning process, was critical for the development of the 2015 HMP. The Planning Team consisted of a Steering Committee, Planning Committee, engaged City Residents, and a HMP consultant used for plan development and facilitation.

4.2.1.1 Steering Committee

At the core of the 2015 HMP planning process is the HMP Steering Committee. The HMP Steering Committee was integral in ensuring the success of the planning process, its implementation, and future maintenance. The community developed a professional services agreement with a HMP consultant

(Michael Baker International) to provide direction for the development of the 2015 update. Members of the MHMP Steering Committee were also a part of the MHMP Planning Committee discussed below.

4.2.1.2 Planning Committee

The 2015 HMP Planning Committee consisted of key decision makers in specific government functions representing County, Regional, and Federal government organizations. The committee included stakeholders who actively participated in the planning process. Planning processes included:

- A series of structured coordination meetings
- Collection of valuable local information and other requested data
- Decision on plan process and content
- Development of mitigation actions for the HMP
- Review and comment on plan drafts
- Coordination of the public input process

The preparation of the 2015 HMP required a series of meetings and workshops intended to facilitate discussion and initiate data collection efforts with local community officials. More importantly, the meetings and workshops prompted continuous input and feedback from local officials throughout the update process.

A range of stakeholders, including agencies, businesses, academia, nonprofits, and other interested parties were invited and encouraged to participate in the development of the Plan. These stakeholders included the Ohio Emergency Management Agency (EMA), Butler County EMA, Hamilton County EMA, Clermont County EMA, Clinton County EMA, Greene County EMA, and Montgomery County EMA. In addition, the Red Cross, local companies and the Miami Conservancy District were invited. Stakeholder involvement was encouraged through the County's invitations to agencies and individuals to participate in Mitigation Planning Committee meetings and the Mitigation Solutions Workshop. These invitations were sent to local educational facilities and businesses. They include: Cedar Fair/Kings Island, Procter & Gamble Co, Aisin/Seiki/ADVICS Co. Ltd, Atrium medical Center and Cintas Corp. Table 4-2 provides a list of the 2015 HMP Planning Committee members.

Table 4-2 2015 HMP Planning Committee

Name	Organization	Title / Role
Tom Ariss	Warren County	Commissioner
Chris Bacster	Warren County Health Department	Emergency Response Coordinator
Brian Baker	Warren Correctional Institution	Lieutenant
Jason Beck	Warren Correctional Institution	Officer
Susan Bitzer	Village of Butlerville	Fiscal Officer
Jim Bolen	Warren County EMA	LEPC Coordinator
Melissa Bour	Warren County Dept. of Emergency Services	Communications Ops Manager
Steve Botts	City of Mason	Deputy Fire Chief
Mike Brammer	Mason City Schools	Assistant Superintendent
Mike Bunner	Warren County Dept. of Emergency Services	Director
Beverly Campbell	Village of Corwin	Clerk

Name	Organization	Title / Role
Pat Clements	City of Lebanon	City Manager
Keven Clouse	Ohio EMA	Field Liaison
Barry Conway	City of Franklin	City Engineer
Gary Copeland	Village of Waynesville	Police Chief/Village Manager
Kathy Wade Dorman	City of Mason	Assistant Pubilc Util Director
Scott Doughman	Village of South Lebanon	Private Citizen
Gus Edwards	Wayne Township	Administrator
Scott Fowler	Sinclair College Police	Admin Lieutenant
Mark Greatorex	Hamilton Township	Fire Chief
Dale Groppenbacher	Village of Pleasant Plain	Mayor
Daniel M. Hall	Kings Island	Chief of Police
Lesli Holt	Atrium Medical Center	EOC Coordinator
Carol Hughes	Springboro Chamber of Commerce	Executive Director
Mike Kemper	Sinclair Courseview	Safety Coordinator
Paul Kindell	Warren County Telecomm	Director
James Lanz	Lebanon Correctional Institution	Intern
Doug Luneke	Lebanon Correctional Institution	Major
Beth Mason	Village of Maineville	Police Lieutenant
Susanne Mason	Warren County Solid Waste	Program Manager
Andy Mitten	Harlan Township	Fire Chief/Administrator
Rick Murray	Warren County EMA	Ops Manager
Vince Murphy	City of Springboro	Director of Services
Carol Nelson	Village of Harveysburg	Clerk
Chris Petris	Warren County Sheriff's Office	Lieutenant
Katherine Piaskowy	Butler County EMA	Emergency Planner
Barry Puskas	Miami Conservancy District	Manager – Technical Services
James Rutherford	City of Springboro	Assistint Service Director
Paul Schaefer	Washington Township	Washington Township Trustee
Joe Schiesler	Warren County Career Center SBDC	Director
Larry Sims	Warren County Sherriff Office	Sheriff
Marilyn Singleton	Bethesda Arrow Springs	Site Manager
Rod Smith	Village of Morrow	Village Administrator
Faith Sorice	Village of Harveysburg	Acting Mayor
Stephen Sorice	Village of Harveysburg	Representative
Jerry Spurling	Warren County Building & Zoning	Chief Building Official
Alan Stanforth	Washington Township	Road Superintendent
Duane Stansbury	Warren County Combined Health	Director
Steve Stiemle	Proctor & Gamble – Mason	Fire Chief
Brandon Teague	Warren Correctional Institution	Officer
Michelle Tegtmeier	Hamilton Township Community Development	Coordinator
Jeff Thomas	Warren County Soil & Water	District Administrator
Brian Tinch	Warren County Sheriff's Office	Operations Commander

Name	Organization	Title / Role
Neil Tunison	Warren County Engineer	County Engineer
Gary Vidmar	Village of South Lebanon	Village Administrator
Steve Waldmann	Kings Local Schools	Business Manager
Greg Wallace	Village of Carlisle	Planning/Zoning
Robert Ware	Warren County Regional Planning Commission	Senior Planner
Stan Williams	Regional Planning Commission	Director
Tim Williams	Harlan Township Fire Department	Chief
Bob Wysong	Warren County Career Center	Director of Facilities

4.2.1.3 HMP Consultant Team

To provide assistance to the HMP Planning Committee, the Warren County enlisted Michael Baker International (Baker) due to its expertise in assisting public sector entities with developing hazard mitigation plans and strategies for particular hazard prone areas. Baker supported the County through facilitation of the planning process, data collection, and meeting material and document development. The HMP Consultant Team, as shown in Table 4-3, consists of a variety of hazard mitigation professionals.

Table 4-3 HMP Consultant Team

HMP Update Project Team	HMP Update Project Team Role
Jason Farrell, CFM	Project Manager
Carver Struve, CFM	Technical Advisor
Benjamin Korson, FAEM, CFM	Planner
Jason Isherwood, GISP	GIS Specialist/Spatial Analyst

4.2.1.4 Planning Committee Meetings

The HMP Planning Committee met throughout the development of the updated HMP document. Table 4-4 provides a summary of the meetings conducted throughout the planning process, including meeting date, type, and topics discussed. Meeting documentation, including agendas, hazard maps, PowerPoint presentations, minutes, sign-in sheets, and other relevant handouts, are provided in Appendix B.

Table 4-4 Meeting Summary

Date	Meeting Type	Topics

July 31, 2014	Planning Committee Meeting #1	▪ *Planning Committee Introductions*
		▪ *Planning Process*
		▪ *Current Plan Overview*
		  ○ *General Overview*
		  ○ *Project Timeline*
		▪ *Review of Existing Mitigation Plan*
		  ○ *5-Year Mitigation Plan Review Round Robin Exercise*
		▪ *Risk Assessment Update*
		  ○ *Risk Assessment Update Exercise*

Date	Meeting Type	Topics
September 25, 2014	Planning Committee Meeting #2	▪ *Risk Assessment Review* ○ *Review Updated Hazard Assessment* ▪ *Update Mitigation Goals & Objectives* ○ *Review current goals and objectives* ▪ *Review Mitigation Techniques* ○ *Categories of Action* ○ *Complete Mitigation Strategy Techniques Matrix*
November 6, 2014	Planning Committee Meeting #3	▪ *Review of Past Meetings and Today's Topics* ○ *Hazard Identification and Risk Assessment (HIRA)* ○ *Mitigation Goals and Objectives* ○ *Mitigation Action Categories* ▪ *Review Existing Mitigation Actions* ▪ *Develop New Actions* ▪ *Develop Mitigation Actions Plan*

4.2.2 Public Outreach

Public outreach is a major and required component of the 2015 HMP. The Warren County HMP Public Outreach Strategy was developed to maximize public involvement in the HMP planning process. The HMP Public Outreach Strategy details the utilization of websites, local media, and community-based services and establishments to engage the public throughout the HMP planning process. This section provides additional information on the project website and workshop process used during the HMP plan development.

4.2.2.1 Publicizing the Plan

The HMP Planning Team issued public notices inviting the public to the kickoff meeting as well as inviting comment on the draft plan. These notices can be seen as figures Figure 4-2 and Figure 4-3.

PUBLIC NOTICE

The Warren County Emergency Management Agency will be conducting a planning meeting to review and update Warren County's Hazard Mitigation Plan. The meeting will be held on 7/31/2014 from 10:30 AM to 1:00 PM at The Warren County Commissioner's Meeting Room located at 406 Justice Drive, Room 406, Lebanon, Ohio 45036. Citizens are invited to attend and participate in the planning effort. Those who wish to attend, please register with the Warren County Emergency Management Agency at the contact number found below.

For more information, contact the Warren County Emergency Management Agency at 513-695-1314.

16833053 7-20/2014

Figure 4-2 Kickoff Meeting Public Notice

PUBLIC NOTICE

The Warren County Emergency Management Agency will be conducting a planning meeting to review and update Warren County's Hazard Mitigation Plan. The meeting will be held on 7/31/2014 from 10:30 AM to 1:00 PM at The Warren County Commissioner's Meeting Room located at 406 Justice Drive, Room 406, Lebanon, Ohio 45036. Citizens are invited to attend and participate in the planning effort. Those who wish to attend, please register with the Warren County Emergency Management Agency at the contact number found below.

For more information, contact the Warren County Emergency Management Agency at 513-695-1314.

16833053 7-20/2014

Figure 4-3 Public Draft Review Notification

The Warren County EMA also sent invitation letters to stakeholders including local officials, adjoining county EMA directors, local schools, local businesses, local non-profits and watershed groups.

Together with the public input received during the Committee Meeting, draft copies of the HMP document were posted on the Warren County website for general public review and comment. The 2015 HMP was also made available for review at the Warren County office. These efforts provided citizens with several opportunities to review the content of the 2015 HMP, to ask questions and suggest possible final revisions.

4.2.3 Review and Incorporate Existing Information

The HMP Planning Committee reviewed and assessed existing plans, studies, and data available from local, state, and federal sources. Documents reviewed and incorporated as part of the HMP planning process are shown in Table 4-5.

Table 4-5 Existing Plans, Studies, Reports, and Other Technical Data/Information

Existing Plans, Studies, Reports, and Other Technical Data/Information	Planning Process / Area of Document Inclusion
Warren County 2007 Hazard Mitigation Plan	Used to assist with problem identification, mitigation goals, strategies and actions

Existing Plans, Studies, Reports, and Other Technical Data/Information	Planning Process / Area of Document Inclusion
Ohio Enhanced Mitigation Plan	This plan was consulted to assist with background information and hazard identification
Warren County Emergency Operations Plan	This plan was consulted to assist with the hazard identification and risk assessment component of the update
Warren County Floodplain Regulations	Used to evaluate the current regulatory environment when drafting the risk assessment and mitigation sections of the plan update
Warren County Comprehensive Plan	Land Use, Housing, Parks & Open Space, Capital Improvement Programming, Economic Development and Transportation sections were used to look at possible future conditions and development
FEMA Hazard Mitigation How-to Guides	2014 Hazard Mitigation Plan Development, Start to Finish
Existing Zoning and Floodplain Management Ordinances	Flood Hazard Regulatory Environment and Mitigation Strategy
NFIP flood insurance policies and claims records.	Flood Hazard Regulatory Environment and Mitigation Strategy
FEMA Local Mitigation Planning Handbook	Local Plan Integration Methods
FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, January 2013	Mitigation Strategy Development
USGS Landslide Types and Processes (White Paper)	Landslide Mitigation Strategy Development
NOAA Record Storm Events	Death and Injuries Report for past disaster declarations

4.2.4 Assess Risks

In accordance with FEMA requirements, the 2015 HMP Planning Committee identified and prioritized the natural hazards affecting Warren County and assessed the vulnerability from them. Results from this phase of the HMP planning process aided subsequent identification of appropriate mitigation actions to reduce risk in specific locations from hazards. This phase of the HMP planning process is detailed in Section 5.

4.2.4.1 Identify/Profile Hazards

Based on a review of past hazards, as well as a review of the existing plans, reports, and other technical studies/data/information, the 2015 HMP Planning Committee determined if the existing hazards were still valid, and identified new hazards that could affect Warren County. Updated content for each hazard profile is provided in Section 5.

4.2.4.2 Assess Vulnerabilities

Hazard profiling exposes the unique characteristics of individual hazards and begins the process of determining which areas within Warren County are vulnerable to specific hazard events. Using these methodologies, vulnerable populations, infrastructure, and potential loss estimates impacted by natural hazards were determined. Detailed information on vulnerability assessment for each hazard is provided in Section 5.

4.2.5 Develop Mitigation Plan

The 2015 HMP was prepared in accordance with DMA 2000 and FEMA's HMP guidance documents. This document provides an explicit strategy and blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and Warren County ability to expand on and improve these existing tools. Developing the mitigation plan involved identifying goals, assessing existing capabilities, reviewing the 2007 mitigation actions, and identifying new mitigation actions. This step of the HMP planning process is detailed in Section 6 and summarized below.

4.2.5.1 Identify Goals

The HMP Planning Committee reviewed the 2007 LHMP goals, hazards profiles, and vulnerability assessments, and developed new goals and objectives for the 2015 HMP based on current and revised information. The Goals and Objectives are presented in Section 1 and again in Section 5.

4.2.5.2 Develop Capabilities Assessment

A capabilities assessment is a comprehensive review of all the various mitigation capabilities and tools currently available to Warren County and its jurisdictions to implement the mitigation actions that are prescribed in the 2015 HMP. The HMP Planning Committee identified the technical, financial, and administrative capabilities to implement mitigation actions, as detailed in Section 5.

4.2.5.3 Identify Mitigation Actions

As part of the 2015 HMP planning process, the HMP Planning Committee reviewed and analyzed the status of the mitigation actions identified in the 2007 LHMP and provided data and information on the status of the existing mitigation actions. Once the review and analysis of the 2007 LHMP mitigation actions was complete, the HMP Consultant Team and HMP Planning Committee worked together to identify and develop new mitigation actions with implementation elements. Mitigation actions were prioritized and detailed implementation strategies were developed during Planning Committee Meeting #3. A detailed approach of the review of the existing mitigation actions, identification, and prioritization of new mitigation actions, and the creation of the implementation strategy is provided in Section 6.

4.2.5.4 Draft HMP Update

Once the risk assessment and mitigation strategy were completed, information, data, and associated narratives were compiled into the 2015 HMP. Section 3 provides detailed information on "what's new" and updated as part of the 2015 HMP.

4.2.5.5 Plan Review and Revision

Once the "Draft" 2015 HMP was completed, a public and government review period was established for official review and revision. Public comments were accepted, reviewed, and incorporated into this update. Applicable comments from the public have been received and addressed prior to the *"authorization to submit"* to FEMA and Ohio EMA review parties.

4.2.5.6 Plan Adoption and Submittal

This plan has been submitted and approved by FEMA and adopted by Warren County and its jurisdiction **as the official statement of** Warren County **hazards. A copy of the resolution is provided in Appendix A.** ***This section will be completed after approval by Ohio EMA and FEMA Region V.***

4.2.5.7 Plan Maintenance

Updated plan maintenance procedures, found in Section 7, include the measures Warren County and participating agencies will take to ensure the HMP's continuous long-term implementation. The

procedures also include the manner in which the HMP will be regularly monitored, reported upon, evaluated, and updated to remain a current and meaningful planning document.

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Section 5. Natural Hazard Risk Assessment

Natural hazard risk assessment is the process of measuring the potential impact to life, property and economic impacts resulting from natural hazards. The intent of the risk assessment is to identify, as much as practicable given existing/available data, the qualitative and quantitative vulnerabilities of a community. The results of the risk assessment provide a framework for a better understanding of potential impacts to the community and a foundation on which to develop and prioritize mitigation actions (see Section 6). Mitigation actions can reduce damage from natural disasters and an implementation strategy can direct scarce resources to areas of greatest vulnerability described in this section.

This risk assessment follows the methodology described in FEMA publication, *Understanding Your Risks—Identifying Hazards and Estimating Losses* (FEMA 386-2, 2002), which outlines a four-step process:

1) Identify Hazards

2) Profile Hazard Events

3) Inventory Assets

4) Estimate Losses

Information gathered during the Warren County planning process related to the above four steps are incorporated into the following discussions in this chapter.

Section 5.1: Hazard Identification identifies and prioritizes the natural hazards that threaten the City. The reasoning for omitting some hazards from further consideration is also provided in this discussion.

Section 5.3 through Section 5.11: Hazard Profiles describe each of the hazards that pose a threat to the County. Information includes the location, extent/magnitude/severity, previous occurrences, and the likelihood of future occurrences.

Some of the hazard profiles do not contain historical occurrences for the given event. In these cases, there are no recorded events for the hazard through online searches, interviews with planning participants, or agencies that track those events.

5.1 *Identifying the Hazards*

Per FEMA Guidance, the first step in developing the Risk Assessment is identifying the hazards. The HMP Planning Committee reviewed a number of previously prepared hazard mitigation plans and other relevant documents to determine the universe of natural hazards with potential to affect the County and its jurisdictions.

Hazards were ranked in order to provide structure and prioritize the mitigation goals and actions discussed in this plan. Ranking was both quantitative and qualitative. First, the quantitative analysis considered all the GIS and HAZUS data available. Then, a qualitative approach, the Risk Factor (RF) approach, was used to provide additional insights on the specific risks associated with each hazard. This process can also be a valuable cross-check or validation of the quantitative analysis performed.

The RF approach combines historical data, local knowledge, and consensus opinions to produce numerical values that allow identified hazards to be ranked against one another. During the planning process, the Warren County Mitigation Planning Committee compared the results of the hazard profile against their local knowledge to generate a set of ranking criteria. These criteria were used to evaluate hazards and identify the highest risk hazard.

RF values are obtained by assigning varying degrees of risk to five categories for each hazard: *probability, impact, spatial extent, warning time*, and *duration*. Each degree of risk is assigned a value ranging from 1 to 4 and a weighing factor for each category was agreed upon by the Mitigation Planning Committee. Based upon any unique concerns for the planning area, the Mitigation Planning Committee may also adjust the RF weighting scheme. To calculate the RF value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final RF value, as demonstrated in the example equation below:

RF Value = [(Probability x .30) + (Impact x .30) +
(Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

RISK FACTOR CRITERIA				
RISK ASSESSMENT CATEGORY	LEVEL	DEGREE OF RISK LEVEL	INDEX	WEIGHT
PROBABILITY **What is the likelihood of a hazard event occurring in a given year?**	**UNLIKELY**	LESS THAN 1% ANNUAL PROBABILITY	**1**	**30%**
	POSSIBLE	BETWEEN 1 & 10% ANNUAL PROBABILITY	**2**	
	LIKELY	BETWEEN 10 &100% ANNUAL PROBABILITY	**3**	
	HIGHLY LIKELY	100% ANNUAL PROBABILTY	**4**	
IMPACT ***In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?***	**MINOR**	VERY FEW INJURIES, IF ANY. ONLY MINOR PROPERTY DAMAGE & MINIMAL DISRUPTION OF QUALITY OF LIFE. TEMPORARY SHUTDOWN OF CRITICAL FACILITIES.	**1**	**30%**
	LIMITED	MINOR INJURIES ONLY. MORE THAN 10% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE DAY.	**2**	
	CRITICAL	MULTIPLE DEATHS/INJURIES POSSIBLE. MORE THAN 25% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR MORE THAN ONE WEEK.	**3**	
	CATASTROPHIC	HIGH NUMBER OF DEATHS/INJURIES POSSIBLE. MORE THAN 50% OF PROPERTY IN AFFECTED AREA DAMAGED OR DESTROYED. COMPLETE SHUTDOWN OF CRITICAL FACILITIES FOR 30 DAYS OR MORE.	**4**	
SPATIAL EXTENT ***How large of an area could be impacted by a hazard event? Are impacts localized or regional?***	**NEGLIGIBLE**	LESS THAN 1% OF AREA AFFECTED	**1**	**20%**
	SMALL	BETWEEN 1 & 10% OF AREA AFFECTED	**2**	
	MODERATE	BETWEEN 10 & 50% OF AREA AFFECTED	**3**	
	LARGE	BETWEEN 50 & 100% OF AREA AFFECTED	**4**	
WARNING TIME ***Is there usually some lead time associated with the hazard event? Have warning measures been implemented?***	**MORE THAN 24 HRS**	SELF DEFINED	**1**	**10%**
	12 TO 24 HRS	SELF DEFINED	**2**	
	6 TO 12 HRS	SELF DEFINED	**3**	
	LESS THAN 6 HRS	SELF DEFINED	**4**	
DURATION ***How long does the hazard event usually last?***	**LESS THAN 6 HRS**	SELF DEFINED	**1**	**10%**
	LESS THAN 24 HRS	SELF DEFINED	**2**	
	LESS THAN 1 WEEK	SELF DEFINED	**3**	
	MORE THAN 1 WEEK	SELF DEFINED	**4**	

Figure 5-1 Risk Factor Criteria

According to the default weighting scheme applied, the highest possible RF value is 4.0. The methodology illustrated above lists categories that are used to calculate the variables for the RF value.

Table 5-1 provides the risk factor table that details the hazards to be profiled in this plan, as well as the numerical value assigned to that hazard. That Risk Factor is developed through assessing the probability, impact, spatial extent, warning time, and duration of each hazard type.

Table 5-1 Risk Factor Table

	Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		Risk Factor
1	Temperature Extremes	4	1.2	2	0.6	4	0.8	1	0.1	3	0.3	3.0
2	Winter Storms	4	1.2	2	0.6	4	0.8	1	0.1	2	0.2	2.9
3	Earthquakes	1	0.3	3	0.9	4	0.8	4	0.4	4	0.4	2.8
4	Summer Storms	4	1.2	2	0.6	4	0.8	1	0.1	1	0.1	2.8
5	Tornadoes	3	0.9	3	0.9	1	0.2	4	0.4	3	0.3	2.7
6	Drought	2	0.6	3	0.9	3	0.6	1	0.1	4	0.4	2.6
7	Flooding	3	0.9	2	0.6	1	0.2	2	0.2	2	0.2	2.1
8	Wildfire	2	0.6	2	0.6	1	0.2	4	0.4	2	0.2	2
	Technological Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		Risk Factor
1	Dam Failure	1	0.3	4	1.2	4	0.8	4	0.4	4	0.4	3.1

Previous hazard occurrences were used to validate existing hazards and identify new hazard risks. Previous hazard occurrences provide a historical view of hazard risk, and a window into potential hazards that can affect the Warren County in the future. Information about Federal and State disaster declarations in Warren County[29] was compiled from FEMA and Ohio databases, as shown in Table 5-2.

Though not a complete snapshot of hazard incidences in Warren County (since not all hazard events are federally or state declared), Table 5-2 provided the HMP Planning Committee with solidified accounts of disasters affecting areas around Warren County dating back to 1956.

Table 5-2 Federal and State Declared Disasters

Year	*Disaster*	*Disaster#*
1/3/2013	Hurricane Sandy	4098
8/20/2012	Severe Storms And Straight-Line Winds	4077
7/13/2011	Severe Storms And Flooding	4002
10/24/2008	Severe Wind Storm Associated With Tropical Depression Ike	1805
8/27/2007	Severe Storms, Flooding, And Tornadoes	1720

[29] FEMA does not maintain disaster records at the local level for cities, special districts or other municipal organizations.

Year	Disaster	Disaster#
8/1/2006	Severe Storms, Straight Line Winds, And Flooding	1656
7/2/2006	Severe Storms, Tornadoes, Straight Line Winds, And Flooding	1651
2/15/2005	Severe Winter Storms, Flooding And Mudslides	1580
9/19/2004	Severe Storms And Flooding	1556
6/3/2004	Severe Storms And Flooding	1519
1/26/2004	Severe Storms, Flooding, Mudslides, And Landslides	1507
8/1/2003	Tornadoes, Flooding, Severe Storms, And High Winds	1484
7/15/2003	Severe Storms And Flooding	1478
11/18/2002	Severe Storms And Tornadoes	1444
8/27/2001	Severe Storms & Flooding	1390
9/26/2000	Tornado And Severe Storms	1343
8/21/2000	Severe Storms And Flooding	1339
3/7/2000	Severe Storms And Flooding	1321
6/30/1998	Severe Storms, Flooding And Tornadoes	1227
3/4/1997	Severe Storms/Flooding	1164
6/24/1996	Flooding	1122
1/27/1996	Storms/Floods	1097
8/25/1995	Severe Storm, Flooding	1065
8/4/1992	Flooding, Severe Storm, Tornadoes	951
6/6/1990	Flooding, Severe Storm, Tornado	870
6/10/1989	Severe Storms, Flooding	831
7/17/1987	Severe Storms, Flooding	796
6/3/1985	Severe Storms, Tornadoes	738
3/26/1982	Severe Storms, Flooding	653
6/30/1981	Severe Storms, Flooding, Tornadoes	642
8/23/1980	Severe Storms, Flooding	630
9/11/1975	Winds, Tornadoes, Heavy Rains, Flooding	480
7/11/1974	Heavy Rains, Flooding	445
5/31/1974	Severe Storms, Flooding	436
4/4/1974	Tornadoes	421
6/4/1973	Mudslides	390
4/27/1973	Severe Storms, Flooding	377
11/24/1972	Severe Storms, Flooding	362

Year	Disaster	Disaster#
7/19/1972	Tropical Storm Agnes	345
7/15/1969	Tornadoes, Severe Storms, Flooding	266
6/5/1968	Heavy Rains, Flooding	243
5/4/1968	Tornadoes, Severe Storms	238
4/14/1965	Tornadoes, Severe Storms	191
3/24/1964	Severe Storms & Flooding	167
1/23/1959	Floods	90
5/17/1956	Wind Storm	57

Source: FEMA: State Disaster History; Emergency & Disaster Proclamations and Executive Orders by Date

Based on the review of hazards identified in similar and relevant documents, previous incidents, historical knowledge of localized events, and natural hazard trends, the HMP Planning Team developed a preliminary list of hazards of seven natural hazards with significant potential to occur in Warren County: Extreme Temperatures, Winter Storms, Earthquakes, Summer Storms, Tornadoes, Drought, Flooding, Wildfire and Dam Failure. Due to limited resources to implement mitigation actions, a streamlined list of identified hazards ensures that appropriate levels of efforts are allocated to the hazards determined to have the largest potential impacts on Warren County.

5.2 *Hazard Profiles*

Natural hazards are profiled individually in this section in order of priority. The profiles in this section provide a baseline definition and description in relation to Warren County. Hazard profiles are used to develop a vulnerability assessment, where natural hazard vulnerability to the community is quantified in terms of population and assets affected for each hazard deemed significant by the Planning Committee.

5.3 *Extreme Temperatures*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Temperature Extremes	4	1.2	2	0.6	4	0.8	1	0.1	3	0.3	3
HIGH RISK HAZARD (3.0 – 3.9)											

In the State Hazard Mitigation Plan (SHMP), climate change is treated as a condition that will occur and potentially exacerbate the impact of hazardous extreme temperatures. According to the SHMP, extreme heat and heat waves are existing hazards that will be exacerbated by climate change. Heat is one of the leading weather-related killers in the United States, resulting in hundreds of fatalities each year (National Weather Service 2012). Extreme Cold can cause hazardous driving conditions, communications and electrical power failure, community isolation and can adversely affect business continuity. This section provides definitions and profiles for the hazard of extreme heat and extreme cold.

5.3.1 Hazard Identification

5.3.1.1 Extreme Heat

Temperatures that remain at 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. The National Weather Service (NWS) issues an Excessive Heat Warning/Advisory when an extreme heat event (a "heat wave") is expected within 36 hours. The NWS issues these warnings based on a "Heat Index" - a combination of heat and humidity - that is predicted to be 105 degrees or greater for two or more consecutive days. Local weather forecast offices may use different criteria for Excessive Heat Warning/Advisories based on maximum temperatures, nighttime temperatures, and other methods.

Extreme Heat is the number one weather-related killer in the United States. It causes more fatalities each year than floods, lightning, tornadoes and hurricanes combined. In the Midwest, summers tend to combine both high temperature and high humidity. Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating or a chemical (salt) imbalance caused by too much sweating. When the body heats too quickly, to cool itself safely, or when too much fluid is lost through dehydration or sweating, the body temperature rises, and heat-related illnesses may develop.

Extreme temperatures can result in elevated utility costs to consumers and also can cause human risks. Extremely high temperatures cause heat stress which can be divided into four categories (see Table 2-35). Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death.

5.3.1.2 Extreme Cold

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in Warren County. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Wind chill is how cold it "feels" and is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature. For example, if the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this wind chill, exposed skin can freeze in 30 minutes. Wind chill does not affect inanimate objects. (National Weather Service)

Extreme Cold is also responsible for a number of fatalities each year. Threats, such as hypothermia and frostbite, can lead to loss of fingers and toes or cause permanent kidney, pancreas and liver injury and even death. Major winter storms can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall and cold temperatures. Fifty percent of cold-related injuries happen to people over sixty years of age. More than seventy-five percent happen to males, and almost twenty percent occur within the home.

The dangers associated with extreme cold include frostbite and hypothermia. Frostbite is damage to body tissue caused by that tissue being frozen. Frostbite causes a loss of feeling in extremities, such as fingers, toes, ear lobes, or the tip of the nose. Hypothermia, or low body temperature can lead to uncontrollable shivering, memory loss, disorientation, slurred speech, drowsiness, and apparent exhaustion.

5.3.2 Regulatory Environment

There are negligible formal regulations that pertain to generalized extreme temperature events.

5.3.3 Hazard Events

Table 5-3 Extreme Temperature Events in Warren County

Event	DATE	# OF DEATHS	# OF INJURIES	RECORDED CROP DAMAGE	RECORDED PROPERTY DAMAGES
Cold/Wind Chill	02/01/1996	0	0	$0	$30,000
Heat	07/20/1999	0	0	$0	$0
Extreme Heat	08/07/2007	0	0	$0	$0
Extreme Heat	08/23/2007	0	0	$0	$0
Heat	07/01/2012	0	0	$0	$0
	TOTALS	**0**	**0**	**$0**	**$30,000**

5.3.4 Historical Occurrences

February 1, 1996: Arctic high pressure brought the coldest air of the season to the Ohio Valley. Cincinnati broke its record low on the 4th with a temperature of 11 below zero. Cincinnati also experienced its record low maximum temperatures of 7 and 6 degrees on the 3rd and 4th respectively. The extreme cold was entrenched for 5 days, freezing and bursting numerous water pipes. There were at least 2 house fires indirectly related to the cold weather, as space heaters, which were thawing frozen water lines, caught on fire. On the 5th, six thousand customers were without power near Portsmouth as over-usage caused

outages. AAA motor club had an extremely high number of calls during this cold wave when cars would not start.

July 20, 1999: The last part of July was very hot and humid across the state with temperatures reaching into the 90s most days and above 100 for a few days. The dewpoints and overnight lows were in the 70s through much of the period. The excessive heat contributed to 10 deaths in the Cincinnati metro area and 3 in the Dayton metro area.

July 1, 2012: Ongoing daily heat continued into early July across southwestern Ohio. Heat indices in the area generally ranged from 90 to 100 degrees Fahrenheit each day through July 7, 2012.

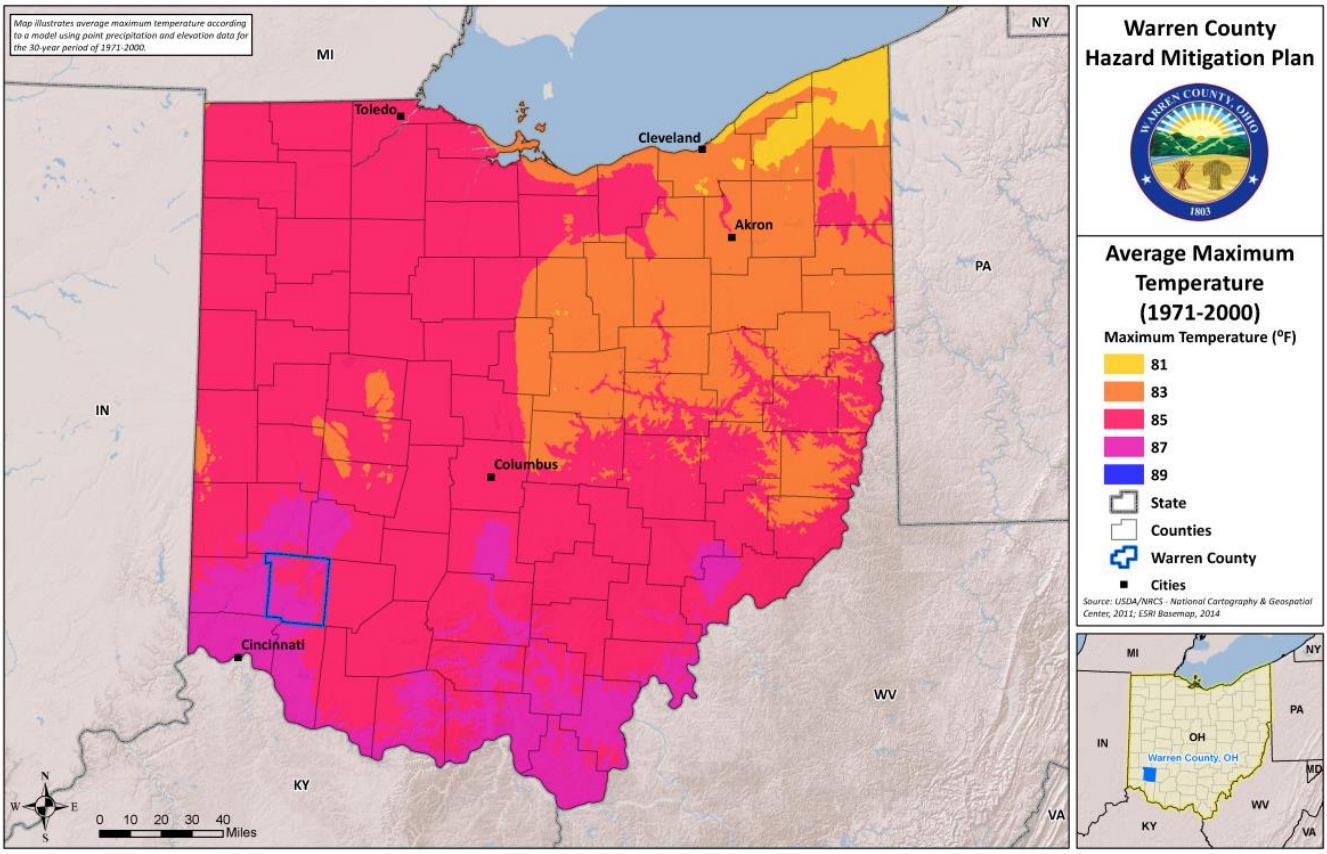


Figure 5-2 Average Maximum Temperature (1971 – 2000)

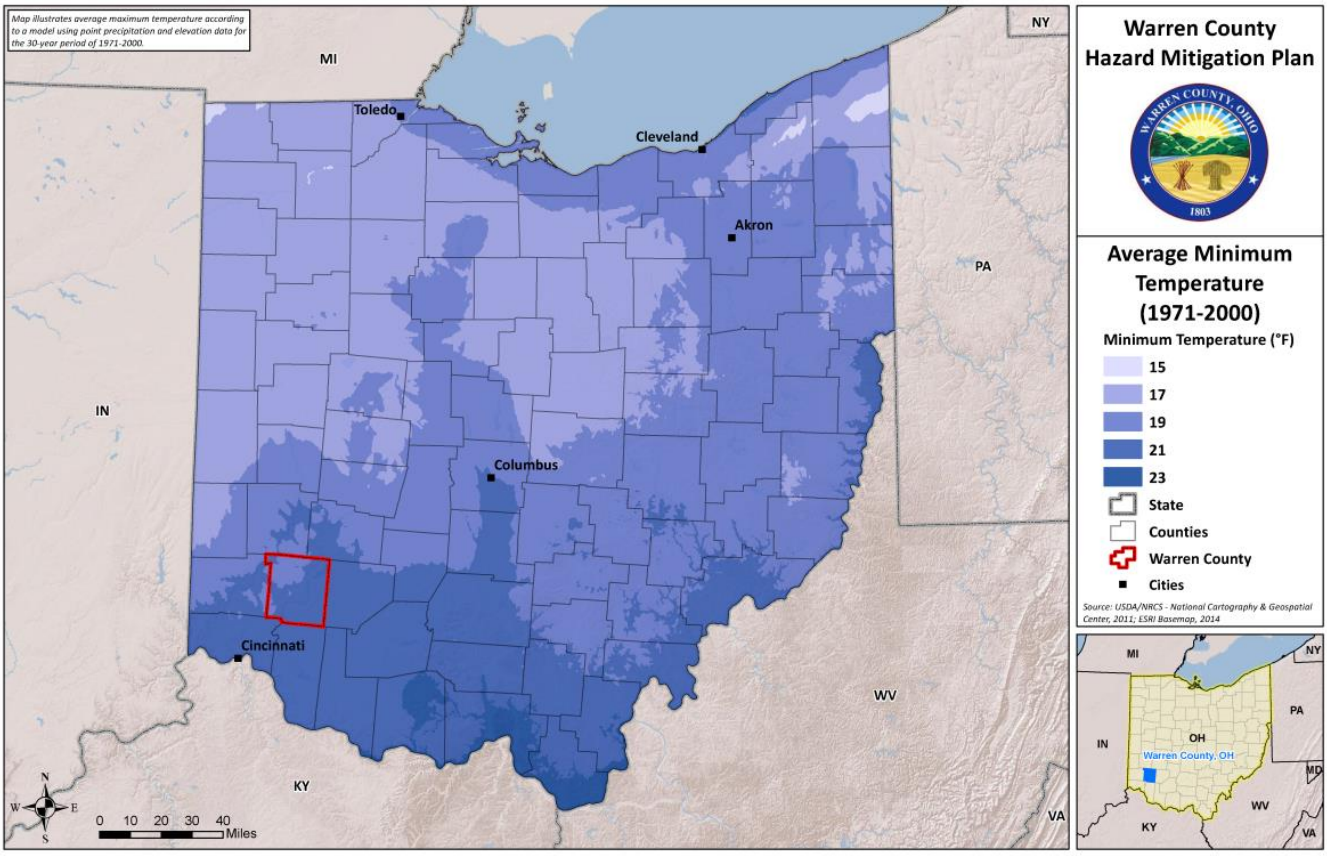


Figure 5-3 Average Minimum Temperature (1970 - 2000)

5.3.5 Magnitude/Severity

While cold temperatures and power losses can render a structure uninhabitable for a time, they are unlikely to cause structural damages. Those people living in these older homes are more likely to need services offered in response to extreme cold.

Extremely high temperatures cause heat stress which can be divided into four categories (See Table 5-4). Each category is defined by apparent temperature. Apparent temperature is the general term for the perceived outdoor temperature, caused by the combined effects of air temperature, relative humidity, and wind speed. Apparent temperature is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, fainting, heat exhaustion, heatstroke, and death. Note that while the temperatures in Table 5-4 serve as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors.

Temperature advisories, watches, and warnings are issued by the National Weather Service relating the above impacts to the range of temperatures typically experienced in Ohio. Exact thresholds vary across the State, but in general *Heat Advisories* are issued when the heat index will be equal to or greater than 100°F, but less than 105°F, *Excessive Heat Warnings* are issued when heat indices will attain or exceed 105°F, and *Excessive Heat Watches* are issued when there is a possibility that excessive heat warning

criteria may be experienced within twelve to forty-eight hours (NOAA NWS, 2010). See Figure 5-4 for a NOAA National Weather Service Heat Index.

Table 5-4 Four Categories of Heat Stress (FEMA, 1997)

DANGER CATEGORY	HEAT DISORDERS	APPARENT TEMPERATURE (°F)
I (Caution)	Fatigue possible with prolonged exposure and physical activity.	80 to 90
II (Extreme Caution)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.	90 to 105
III (Danger)	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105 to 130
IV (Extreme Danger)	Heatstroke or sunstroke imminent.	>130

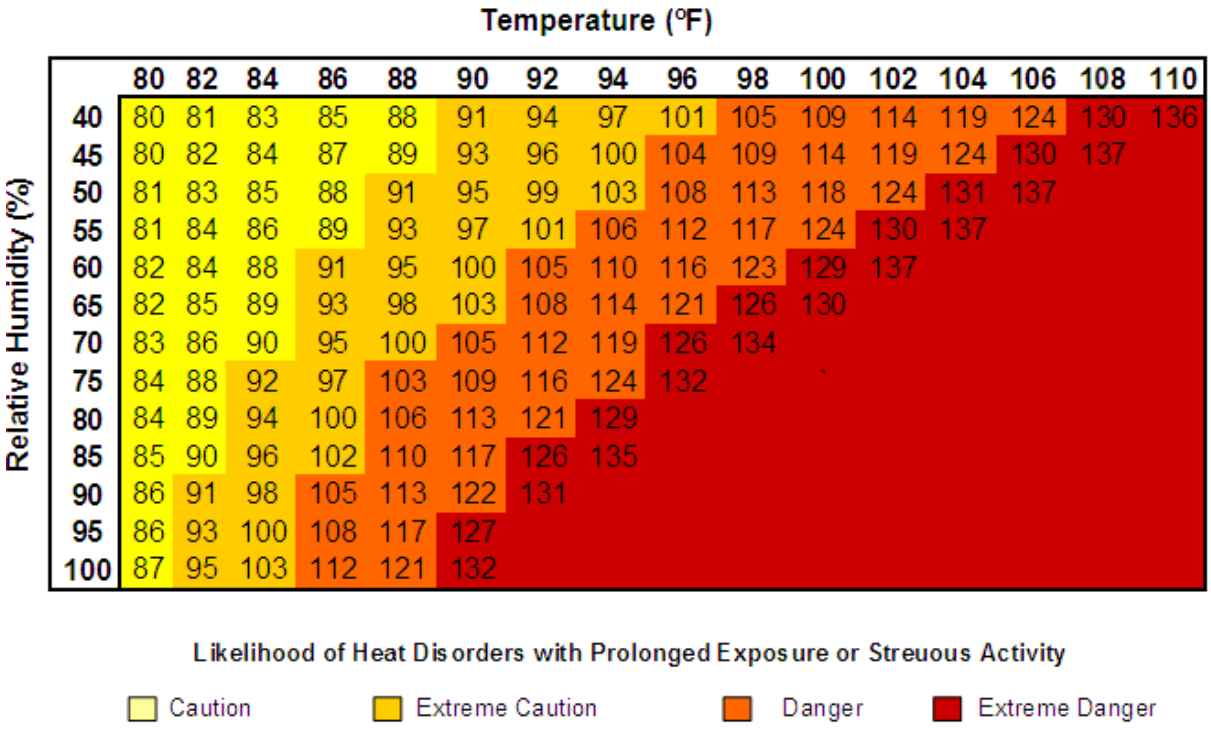


Figure 5-4 NOAA's National Weather Service Heat Index

Excessive Cold Threat Level	Threat Level Descriptions
Extreme	**"An Extreme Threat to Life and Property from Excessive Cold."**

	It is likely that wind chill values will drop to -35º F or below for 3 hours or more. Or, lowest air temperature less than or equal to -20º F.
High	**"A High Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -28º F to -35 º F for 3 hours or more. Or, lowest air temperature -15º to -20º F.
Moderate	**"A Moderate Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -20º F to -28 º F or below for 3 hours or more. Or, lowest air temperature -10º to -15º F.
Low	**"A Low Threat to Life and Property from Excessive Cold."** It is likely that wind chill values will drop to -15º F to -20 º F or below for 3 hours or more. Or, lowest air temperature -5º to -10º F.
Very Low	**"A Very Low Threat to Life and Property from Excessive Cold."** It is likely that that wind chill values will drop to -10º F to -15 º F or below for 3 hours or more. Or, lowest air temperature zero to -5º F.
Non-Threatening	**"No Discernable Threat to Life and Property from Excessive Cold."** Cold season weather conditions are non-threatening.

Figure 5-5 Extreme Cold Temperature and Associated Threat Level

5.3.6 Frequency/Probability of Future Occurrences

The probability of the County and its municipalities experiencing an extreme temperature event can be difficult to quantify, however, climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. The length of days above 100 degree will also extend significantly.

Reported extreme temperature events over the past 18 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County and its municipalities experiencing an extreme cold event can be difficult to quantify, but based on historical record of 5 extreme cold events since 1996, it can reasonably be assumed that this type of event has occurred once every 3.80 years from 1996 through 2014.

[(Current Year) 2015] subtracted by [(Historical Year) 1996] = 19 Years on Record

[(Years on Record) 19] divided by [(Number of Historical Events) 5] = 3.80

Furthermore, the historic frequency calculates that there is a 26.32% chance of this type of event occurring each year.

5.3.7 Inventory Assets Exposed to Extreme Temperatures

Vulnerability for extreme heat was classified as areas having a maximum average temperature over 85 degrees, according to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) study. This range falls within the upper limits of FEMA's heat stress index, Caution Category 1. Extreme heat does not generally impact buildings; instead, they primarily impact people. Nonetheless, facilities need to be maintained to ensure that they operate in appropriate conditions for people.

Additionally, vulnerability for extreme cold was classified as areas having a minimum average temperature less than 14 degrees, according to the USDA NRCS study. Extreme cold does not generally impact buildings; instead, they primarily impact people. Nonetheless, facilities need to be maintained to ensure that they operate in appropriate conditions for people.

5.3.8 Potential Losses from Temperature Extremes

As stated above, since 1996, the NCDC reported 5 extreme temperature events in Warren County. It's evident that extreme temperatures are dangerous and can cause death. Therefore it's important to understand how many people are exposed to such conditions, and how many buildings exist, where potential problems could arise should power be lost. Additionally, extreme cold can cause damage to structures; for example, burst pipes will damage buildings and will necessitate repairs. It is unlikely that an entire building would be impacted in an extreme cold event.

There is no way to predict an area that will be impacted by extreme temperatures. As a result, all property located within the County must be viewed as susceptible to the effects of extreme temperatures. While temperature extremes are not usually thought of as damaging to structures, they can make structures unusable. The 2013 American Community Survey (1-Year Estimates) indicates that 6.7% of Warren County's population was under the age of 5 in 2013, and that 10.7% was over the age of 65. These groups are likely to be the most susceptible to the effects of temperature extremes. The age of a structure is also important to consider when discussing temperature extremes. Older homes are more susceptible to the effects of temperature extremes, due to the prevalent construction methods used at the time.

Table 5-5 Homes in Warren County by Year of Construction

Year Built	# of Homes	Percentage
2010 or Later	1,114	1.4%
2000 to 2009	21,579	26.5%
1990 to 1999	20,734	25.5%
1980 to 1989	9,325	11.5%
1970 to 1979	9,202	11.3%
1960 to 1969	6,384	7.8%
1950 to 1959	6,858	8.4%
1940 to 1949	1,939	2.4%
1939 or earlier	4,235	5.2%

5.3.9 Multi-Jurisdictional Differences

Warren County is subject to temperature extremes. They are a countywide hazard and effect all areas of the county and its jurisdictions. The effect temperature extremes will have on the County will vary due to population density, age of population, and the age of structures. Older homes are generally less insulated than newer construction. In addition, the use of modern windows and doors can improve a structure's ability to resist extreme temperatures. Older structures and infrastructure are likely to be more susceptible to both heat waves and freezes.

5.3.9.1 Urban Heat Island

The urban heat island effect results from the change in surfaces. Those areas that were permeable and moist become dry. On a hot, sunny day, the sun can heat surfaces, such as roofs and pavement, to higher temperatures than the surrounding air. The heat island phenomenon is not only a daytime effect. At night, as the infrastructure releases the heat it has accumulated during the day, raising the air temperature.

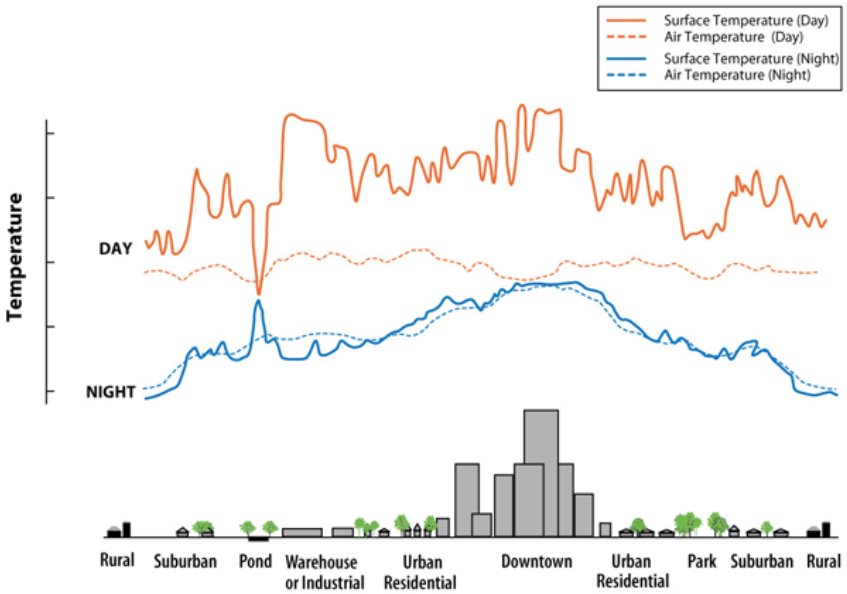


Figure 5-6 EPA Urban Heat Island Image

Warren County's most populous municipalities are Mason, Lebanon and Franklin. That means that they are the most likely to suffer from heat island effects. Industrial complexes are also susceptible to these effects. This means areas like Red Lion, and industrial areas along Interstate 71 are also susceptible to these effects.

5.3.10 Land Use & Development Trends

The elderly just like small children are more susceptible to temperature extremes. Additionally buildings of significant age may be more susceptible to temperature extremes. It is important to identify building stock and special needs populations so that those who have to respond to an emergency will be better prepared

5.3.11 Temperature Extreme HIRA Summary

Temporary periods of extreme hot or cold temperatures typically do not have significant environmental impact. However, prolonged periods of hot temperatures may be associated with drought conditions and

can damage or destroy vegetation, dry up rivers and streams, and reduce water quality. Prolonged exposure to extremely cold temperatures can kill wildlife and vegetation.

5.4 *Winter Storms*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Winter Storms	4	1.2	2	0.6	4	0.8	**1**	**0.1**	**2**	**0.2**	**2.9**
MEDIUM RISK HAZARD (2.0 – 2.9)											

5.4.1 Hazard Identification

Warren County has been impacted by varying degrees of winter weather over the last century; however; the occurrence of severe winter weather in the county is relatively infrequent, even during winter months. Severe winter weather can cause hazardous driving conditions, communications and electrical power failure, community isolation and can adversely affect business continuity. This type of severe weather may include one or more of the following winter factors:

Blizzards, as defined by the National Weather Service, are a combination of sustained winds or frequent gusts of 35 mph or greater and visibilities of less than a quarter mile from falling or blowing snow for 3 hours or more. A blizzard, by definition, does not indicate heavy amounts of snow, although they can happen together. The falling or blowing snow usually creates large drifts from the strong winds. The reduced visibilities make travel, even on foot, particularly treacherous. The strong winds may also support dangerous wind chills. Ground blizzards can develop when strong winds lift snow off the ground and severely reduce visibilities.

Heavy snow, in large quantities, may fall during winter storms. Six inches or more in 12 hours or eight inches or more in 24 hours constitutes conditions that may significantly hamper travel or create hazardous conditions. The National Weather Service issues warnings for such events. Smaller amounts can also make travel hazardous, but in most cases, only results in minor inconveniences. Heavy wet snow before the leaves fall from the trees in the fall or after the trees have leafed out in the spring may cause problems with broken tree branches and power outages.

Ice storms develop when a layer of warm (above freezing), moist air aloft coincides with a shallow cold (below freezing) pool of air at the surface. As snow falls into the warm layer of air, it melts to rain, and then freezes on contact when hitting the frozen ground or cold objects at the surface, creating a smooth layer of ice. This phenomenon is called freezing rain. Similarly, sleet occurs when the rain in the warm layer subsequently freezes into pellets while falling through a cold layer of air at or near the Earth's surface. Extended periods of freezing rain can lead to accumulations of ice on roadways, walkways, power lines, trees, and buildings. Almost any accumulation can make driving and walking hazardous. Thick accumulations can bring down trees and power lines.

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in Warren County. Heating systems compensate for the cold outside. Most people limit their time outside during extreme cold conditions, but common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop.

Wind chill is how cold it "feels" and is based on the rate of heat loss on exposed skin from wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature, and eventually, internal body temperature. Therefore, the wind makes it feel much colder than the actual temperature. For example, if the temperature is 0°F and the wind is blowing at 15 mph, the wind chill is -19°F. At this

wind chill, exposed skin can freeze in 30 minutes. Wind chill does not affect inanimate objects. (National Weather Service)

The science of meteorology and records of severe weather are not quite sophisticated enough to identify what areas of the county are at greater risk for damages. Therefore, all areas of the county are assumed to have the same winter weather risk.

Severe winter weather can result in the closing of primary and secondary roads, particularly in rural locations, loss of utility services, and depletion of oil heating supplies. Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up, and/or high winds which can break limbs or even bring down large trees. Gradual melting of snow and ice provides excellent groundwater recharge; however, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flash flooding.

The State of Ohio does have an extensive history of severe winter weather. In the winter of 2005, the state was hit by a series of winter storms. These storms included ice storms, followed by unseasonably high temperatures and high rainfall totals, all of which resulted in extensive flooding and mudslides. This series of storms resulted in Presidential Declaration FEMA-DR-1580-OH. This declaration provided over one-hundred and forty million dollars in recovery funds. These funds included Individual assistance, Public assistance, Hazard Mitigation Grant Funds, and a state match to the federal hazard mitigation funds.

More specifically, winter weather is a common occurrence in Ohio throughout the winter, and early spring months. According to the National Climatic Data Center, there have been 73 winter events in Warren County since 1996.

Due to the nature of winter storms, it is extremely difficult to predict, but through identifying various indicators of weather systems, and tracking these indicators, it provides us with a crucial means of monitoring winter weather. Understanding the historical frequency, duration, and spatial extent of winter weather assists in determining the likelihood and potential severity of future occurrences. The characteristics of past severe winter events provide benchmarks for projecting similar conditions into the future. The probability of Warren County and its municipality experiencing a severe winter storm event can be difficult to quantify, but based on historical record of 73 events since 1996, it can reasonably be assumed that this type of event has occurred once every .26 years from 1996 through 2015.

Heavy Snow Storms can immobilize a region and paralyze a city. These events can strand commuters, close airports, stop supplies from reaching their destinations and disrupt emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Homes and farms may be isolated and unprotected livestock may be lost. The cost of snow removal, repairing damages, and the loss of business can have economic impacts on cities and towns.

5.4.2 Regulatory Environment

There are negligible formal regulations that pertain to generalized severe winter weather events.

5.4.3 Hazard Events

Table 5-6 Winter Storm Events in Warren County

DATE	TYPE	INJURIES	FATALITIES	PROPERTY DAMAGE	AGRICULTURAL DAMAGE
1/4/1996	Heavy Snow	0	0	$4,000	$0
1/6/1996	Winter Storm	0	0	$500,000	$0
1/11/1996	Heavy Snow	0	0	$1,000	$0
3/6/1996	Ice Storm	0	0	$0	$0
3/19/1996	Winter Storm	0	0	$0	$0
1/24/1997	Ice Storm	0	0	$0	$0
2/3/1998	Winter Storm	0	0	$0	$0
1/1/1999	Winter Storm	0	0	$0	$0
1/7/1999	Winter Storm	0	0	$0	$0
1/13/1999	Winter Storm	0	0	$0	$0
3/9/1999	Heavy Snow	0	0	$0	$0
1/19/2000	Heavy Snow	0	0	$0	$0
12/13/2000	Ice Storm	0	0	$0	$0
12/5/2002	Winter Storm	0	0	$0	$0
2/15/2003	Winter Storm	0	0	$0	$0
2/16/2003	Winter Storm	0	0	$0	$0
1/25/2004	Winter Storm	0	0	$0	$0
3/16/2004	Winter Storm	0	0	$0	$0
12/22/2004	Winter Storm	0	0	$0	$0
1/20/2005	Winter Storm	0	0	$0	$0
1/22/2005	Winter Storm	0	0	$0	$0
12/8/2005	Winter Storm	0	0	$0	$0
3/21/2006	Winter Storm	0	0	$0	$0
2/6/2007	Heavy Snow	0	0	$0	$0
2/13/2007	Ice Storm	0	0	$0	$0
4/6/2007	Frost/freeze	0	0	$0	$540,000
12/4/2007	Winter Weather	0	0	$0	$0
12/7/2007	Winter Weather	0	0	$0	$0
1/1/2008	Winter Weather	0	0	$0	$0
2/12/2008	Winter Storm	0	0	$0	$0
2/21/2008	Winter Storm	0	0	$0	$0
2/22/2008	Winter Weather	0	0	$0	$0
3/7/2008	Winter Storm	0	0	$0	$0
1/27/2009	Heavy Snow	0	0	$0	$0
2/3/2009	Heavy Snow	0	0	$0	$0
1/7/2010	Winter Weather	0	0	$0	$0
2/5/2010	Heavy Snow	0	0	$0	$0
2/9/2010	Heavy Snow	0	0	$0	$0
2/15/2010	Heavy Snow	0	0	$0	$0
2/26/2010	Winter Weather	0	0	$0	$0
12/12/2010	Winter Weather	0	0	$0	$0

12/16/2010	Winter Storm	0	0	$0	$0
1/11/2011	Heavy Snow	0	0	$0	$0
1/20/2011	Heavy Snow	0	0	$0	$0
2/1/2011	Ice Storm	0	0	$0	$0
1/2/2012	Winter Weather	0	0	$0	$0
1/20/2012	Winter Storm	0	0	$0	$0
2/10/2012	Winter Weather	0	0	$0	$0
3/5/2012	Winter Weather	0	0	$0	$0
12/26/2012	Winter Storm	0	0	$0	$0
12/28/2012	Winter Storm	0	0	$0	$0
1/21/2013	Winter Weather	10	0	$1,500,000	$0
1/25/2013	Winter Weather	0	0	$0	$0
2/21/2013	Winter Weather	0	0	$0	$0
3/5/2013	Winter Storm	0	0	$0	$0
3/24/2013	Winter Storm	0	0	$0	$0
12/6/2013	Winter Storm	0	0	$0	$0
12/10/2013	Winter Weather	0	0	$0	$0
12/14/2013	Winter Weather	0	0	$0	$0
12/16/2013	Winter Weather	0	0	$0	$0
1/2/2014	Winter Storm	0	0	$0	$0
1/17/2014	Winter Weather	0	0	$0	$0
1/18/2014	Winter Weather	0	0	$0	$0
1/20/2014	Winter Weather	0	0	$0	$0
2/4/2014	Winter Storm	0	0	$0	$0
2/14/2014	Winter Storm	0	0	$0	$0
2/17/2014	Winter Weather	0	0	$0	$0
3/2/2014	Winter Storm	0	0	$0	$0
3/12/2014	Winter Weather	0	0	$0	$0
11/16/2014	Winter Storm	0	0	$0	$0
11/22/2014	Winter Weather	0	0	$0	$0
1/5/2015	Winter Storm	0	0	$0	$0
1/25/2015	Winter Weather	0	0	$0	$0
2/4/2015	Winter Weather	0	0	$0	$0
2/14/2015	Winter Weather	0	0	$0	$0
2/15/2015	Winter Weather	0	0	$0	$0
2/20/2015	Winter Weather	0	0	$0	$0
2/21/2015	Winter Storm	0	0	$0	$0
3/4/2015	Winter Weather	0	0	$0	$0
TOTALS		**10**	**0**	**$2,005,000**	**$540,000**

Since 1956, 2 federally or state declared severe winter weather events have occurred in Warren County as shown in Table 5-7. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1956 to present), these events include: severe winter storms, winter storms, flooding, landslides, and mud flows.

Table 5-7 Severe Winter Weather Federal Declarations

Disaster Number	Declaration Date	Disaster Type
1580	2/15/2005	Severe Winter Storms, Flooding and Mudslides

Since 1996, seventy-three severe winter events occurred, of which only four have caused any significant damage or injury.

Table 5-8 Significant Winter Events Since 1996

LOCATION	DATE	MAGNITUDE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
WARREN CO.	1/4/1996	Heavy Snow	0	0	4.00K	0.00K
WARREN CO.	1/6/1996	Winter Storm	0	0	500.00K	0.00K
WARREN CO.	4/6/2007	Frost/freeze	0	0	0.00K	540.00K
WARREN CO.	1/21/2013	Winter Weather	0	10	1.500M	0.00K
		TOTALS:	**0**	**10**	**$2,004,000**	**$540,000**

5.4.4 Historical Occurrences

January 6, 1996: The Blizzard of '96 developed near the Gulf Coast and moved up the East Coast. This massive system produced the greatest total and 24 hour snowfall at Greater Cincinnati\Northern Kentucky airport. This one storm brought 14.3 inches of snowfall to the airport which normally receives 23 inches for an entire season. The heaviest snow fell near the Ohio River in the extreme south.

The worst blizzard conditions occurred over West Central areas as dry and powdery snow was blown around by high winds causing whiteouts. Some areas had more than 30 continuous hours of snowfall, and many people in Southern Ohio felt this was the worst winter storm since the Blizzard of '78. In Fayette County, the airport reported a wind gust to 56 mph during the height of the storm. By the end of the storm many homes and businesses had their roof collapse or partially collapse from the weight of the new snow, and snow from a storm earlier in the week. By late in the day on the 7th arctic air was pouring into the region. A 47 year old man died of exposure under an overpass in Miami County. A 76 year old man died of exposure on his front porch in Montgomery County.

April 6, 2007: Unseasonably warm temperatures for an extended period of time in March allowed much of the Ohio Valley to begin its agricultural growing season early. In early April, a cold snap with low temperatures dropping into the low 20s threatened agricultural interests across the region. The full effect of these weather extremes is still yet to be known, and will not be known until the fall harvest can be compared with yields from previous years. The initial estimate of 16.74 million in crop damage was split evenly between 31 Ohio counties.

January 21, 2013: A highly unstable air mass produced deep convective snow showers that produced snow squalls during the late morning into the afternoon. These isolated squalls caused whiteout conditions on area roadways. Three major pileups and one minor pileup resulted in over 175 vehicle crashes on the interstate system, causing numerous injuries and one fatality. A 52 car pileup on I-75

between Cincinnati and Dayton occurred between the Middletown and Monroe exits and injured 10 people.

February 20, 2015: A winter storm that dropped up to 7" in the Warren County area resulted in a downed power line in the Waynesville area. This line caused more than 2,100 customers in Waynesville and Spring Valley to lose power. The power restored within 5 hours of the crews being dispatched.

5.4.5 Magnitude/Severity

The National Weather Service uses different terminology for winter weather events, depending on the situation.

Outlook - Winter weather that may cause significant impact in the day 3 to 7 forecast time period and eventually lead to the issuance of a watch or warning is contained in the Hazardous Weather Outlook. More scientific discussion on the event can also be found in the Area Forecast Discussion. Forecasts in the day 3 to 7 time period typically have a lot of forecast uncertainty. Uncertainty is generally in the 30 to 50% range that the event will occur and reach warning criteria. It is intended to provide information to those who need considerable lead time to prepare for the event.

Watch - A watch is generally issued in the 24 to 72 hour forecast time frame when the risk of a hazardous winter weather event has increased (50 to 80% certainty that warning thresholds will be met). It is intended to provide enough lead time so those who need to set their plans in motion can do so. A watch is issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast. It will change the color, as shown in the table below, of the counties on the NWS front page map according to what type of watch has been issued.

Watch Type	Description
Blizzard Watch	Conditions are favorable for a blizzard event in the next 24 to 72 hours. Sustained wind or frequent gusts greater than or equal to 35 mph will accompany falling and/or blowing snow to frequently reduce visibility to less than 1/4 mile for three or more hours.
Lake Effect Snow Watch	Conditions are favorable for a lake effect snow event to meet or exceed local lake effect snow warning criteria in the next 24 to 72 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulation to 7 or more inches in 12 hours or less. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger a watch (i.e. 5 to 8 inches of snow = watch).
Wind Chill Watch	Conditions are favorable for wind chill temperatures to meet or exceed local wind chill warning criteria in the next 24 to 72 hours. Wind chill temperatures may reach or exceed -25°F.

Winter Storm Watch	Conditions are favorable for a winter storm event (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow or a combination of events) to meet or exceed local winter storm warning criteria in the next 24 to 72 hours. Criteria for snow is 7 inches or more in 12 hours or less; or 9 inches or more in 24 hours covering at least 50 percent of the zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger a watch (i.e. 5 to 8 inches of snow = watch). Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.

Figure 5-7 Winter Storm Watch Definitions

Warning - These products are issued when a hazardous winter weather event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). A warning is used for conditions posing a threat to life or property. Warnings are issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast. It will change the color, as shown in the table below, of the counties on the NWS front page map according to what type of warning/advisory has been issued.

Warning Type	Description
Blizzard Warning	Blizzard event is imminent or expected in the next 12 to 36 hours. Sustained wind or frequent gusts greater than or equal to 35 mph will accompany falling and/or blowing snow to frequently reduce visibility to less than 1/4 mile for three or more hours.
Ice Storm Warning	An ice storm event is expected to meet or exceed local ice storm warning criteria in the next 12 to 36 hours. Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.
Lake Effect Snow Warning	A lake effect snow event is expected to meet or exceed local lake effect snow warning criteria in the next 12 to 36 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulation to 7 or more inches in 12 hours or less. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger warning (i.e. 5 to 8 inches of snow = warning).
Wind Chill Warning	Wind chill temperatures are expected to meet or exceed local wind chill warning criteria in the next 12 to 36 hours. Wind chill temperatures may reach or exceed -25°F.
Winter Storm Warning	A winter storm event (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow or a combination of events) is expected to meet or exceed local winter storm warning criteria in the next 12 to 36 hours. Criteria for snow is 7 inches or more in 12 hours or less; or 9 inches or more in 24 hours covering at least 50 percent of the

	zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger warning (i.e. 5 to 8 inches of snow = warning). Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.

Figure 5-8 Winter Storm Warning Definitions

Advisory - These products are issued when a hazardous winter weather event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). An advisory is for less serious conditions that cause significant inconvenience and, if caution is not exercised, could lead to situations that may threaten life and/or property. Advisories are issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast. It will change the color, as shown in the table below, of the counties on the NWS front page map according to what type of advisory has been issued.

Advisory Type	Description
Winter Weather Advisory	A winter storm event (sleet, snow, freezing rain, snow and blowing snow, or a combination of events) is expected to meet or exceed local winter weather advisory criteria in the next 12 to 36 hours but stay below warning criteria. Criteria for snow is 4 inches or more in 12 hours or less covering at least 50 percent of the zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger advisory (i.e. 2 to 5 inches of snow = advisory). Criteria for ice is any ice accumulation less than 1/2 inch over at least 50 percent of the zone or encompassing most of the population. Winter Weather Advisory can also be issued for black ice. This is optional.
Freezing Rain Advisory	Any accumulation of freezing rain is expected in the next 12 to 36 hours (but will remain below 1/2 inch) for at least 50 percent of the zone or encompassing most of the population.
Lake Effect Snow Advisory	A lake effect snow event is expected to meet or exceed local lake effect snow advisory criteria in the next 12 to 36 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulating to 4 or more inches in 12 hours or less, but remain less than 7 inches. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger advisory (i.e. 2 to 5 inches of snow = advisory).
Wind Chill Advisory	Wind chill temperatures are expected to meet or exceed local wind chill advisory criteria in the next 12 to 36 hours. Wind chill temperatures may reach or exceed -15°F.

Figure 5-9 Winter Storm Advisory Definitions

5.4.6 Frequency/Probability of Future Occurrences

Reported winter events over the past 19 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County and its

municipalities experiencing a winter storm event can be difficult to quantify, but based on historical record of 73 winter storm events since 1996, it can reasonably be assumed that this type of event has occurred more than three every year from 1996 through 2014.

[(Current Year) 2015] subtracted by [(Historical Year) 1996] = 19 Years on Record

[(Years on Record) 19] divided by [(Number of Historical Events) 73] = 0.26

Furthermore, the historic frequency calculates that there is a 100% chance of this type of event occurring each year.

5.4.7 Inventory Assets Exposed to Winter Storms

A timely forecast may not be able to mitigate the property loss, but could reduce the casualties and associated injury. In severe winter storm events, buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees

Winter storms affect the entire planning area of Warren County and its jurisdictions, including all above-ground structures and infrastructure. Although losses to structures are typically minimal and covered by insurance, there can be impacts with lost time, maintenance costs, and contents within structures.

All property located within the County must be viewed as susceptible to the effects of a severe winter storm. A Winter Storms would easily be able to impact the Cities of Mason and Lebanon. As the table below shows, more than 50,000 people and more than 14,000 homes would be impacted by such an event. The table below also reflects the average value and total value of residential properties within these two cities.

Table 5-9 Property Vulnerable to Winter Storms

LOCATION	POPULATION	# HOMES	AVERAGE VALUE	POTENTIAL PROPERTY LOSSES
City of Mason	31,282	8,127	$221,489	$1,800,041,103
City of Lebanon	20,476	6,205	$165,394	$1,026,269,770
TOTALS	**51,758**	**14,332**		**$2,826,310,873**

5.4.8 Potential Losses from Winter Storms

All assets located in Warren County can be considered at risk from severe winter storms. This includes 219,169 people, or 100 percent of the County's population and all buildings and infrastructure within the County. Damages primarily occur as a result of cold temperatures, heavy snow or ice and sometimes strong winds. Due to their regular occurrence, these storms are considered hazards only when they result in damage to specific structures or cause disruption to traffic, communications, electric power, or other utilities.

A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of oil heating supplies. Most structures, including the county's critical facilities, should be able to provide adequate protection the structures could suffer

damage from snow load on rooftops and large deposits of ice. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

Winter weather and related storms do not generally have a negative impact on structures. While cold temperatures and power losses can render a structure uninhabitable for a time, they are unlikely to cause structural damages. However, snow and ice accumulation can impact structures and infrastructure. Older structures, in particular are more susceptible to the impacts from winter weather due to older construction and insulation methods. As can be seen in the table below, the majority of homes in Warren County were constructed between 1990 and 2009. These homes are likely to withstand the effects of winter storms very well. However, the County does have almost 25% of its housing stock being constructed before 1970. These homes are more likely to suffer from the effects of winter storms due to their age. Those people living in these older homes are more likely to need services offered in response to severe winter weather.

Table 5-10 Homes in Warren County by Year of Construction

Year Built	# of Homes	Percentage
2010 or Later	1,114	1.4%
2000 to 2009	21,579	26.5%
1990 to 1999	20,734	25.5%
1980 to 1989	9,325	11.5%
1970 to 1979	9,202	11.3%
1960 to 1969	6,384	7.8%
1950 to 1959	6,858	8.4%
1940 to 1949	1,939	2.4%
1939 or earlier	4,235	5.2%

While it is unlikely that non-residential property or critical facilities will suffer structural damages resulting from winter storm damage, they can suffer from loss of use. Winter storms can result in lost power, impassable roads and employee unavailability. Should any of these occur, there would be an impact to the operations of these facilities. Loss of operations can have a long-lasting effect. Should manufacturing plants be impacted, then that can affect the entire supply chain of a given product. Warehousing operations are critical to the movement of goods throughout the country. Should these industries be impacted, there can be significant financial losses. Governmental buildings being shuttered following the loss of power, or because of an inability of employees to get to work can hinder the operations of a given jurisdiction.

Table 5-11 Non-Residential and Critical Facility Vulnerability

Jurisdiction	Non-Residential Type	Number of Properties	Value	Critical Facility Type	Number of Properties	Value
Warren County	Medium Manufacturing & Assembly	22	$76,255,340	County-Owned Structures	71	$50,242,170

City of Franklin	Industrial Warehouses	35	$31,044,030	Municipal Structures	78	$14,183,180
City of Lebanon	Light Manufacturing & Assembly	25	$18,098,190	Board of Education	31	$6,031,730
City of Mason	Light Manufacturing & Assembly	34	$90,625,400	Board of Education	13	$81,662,130
Village of South Lebanon	Foundries & Heavy Manufacturing	1	$1,031,190	Municipal Structures	42	$4,333,870

5.4.9 Multi-Jurisdictional Differences

In the case of severe winter storms, population and building density has a correlation with hazard vulnerability and loss. Winter storms are a countywide hazard and affect all areas of the county and its jurisdictions. Local impacts, including roadway closures can far-reaching impacts. Warren County Interstates 71 and 75 that pass through it. Heavy snow and winter conditions may not only impact local residents, but also impact travelers through the region. Both of these interstates are heavily traveled commercial routes. Winter storms can slow their progress through a region, and in turn impact the locals who rely on these routes to travel to/from jobs, schools, etc. The interstates are laid out so that they do not go directly through Mason, Lebanon or Franklin. However, in the Southern part of the County, there are many commercial developments that front Interstate 71.

Clearing roads within the County can be daunting. Jurisdictions need to maintain equipment and chemicals to clear and treat the roads. The winter of 2014/2015 saw low temperatures that impacted response efforts. Salt isn't as effective in low temperatures, so road crews are forced to use a beet juice/calcium chloride mix to help with melting. Winds lead to more drifting and blowover across the roads. Salt usage in 14/15 was generally down compared to the previous winter. However, in relation to the winters of 2011/12 and 2012/13, the usage was up.

5.4.10 Land Use & Development Trends

As stated above, in severe winter storm events, buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees. Environmental impacts often include damage shrubbery and trees due to heavy snow loading, ice build-up and/or high winds which can break limbs or even bring down large trees. An indirect effect of winter storms is the treatment of roadway surfaces with salt, chemicals, and other de-icing materials which can impair adjacent surface and ground waters. This is particularly a concern in urban areas such as the Cities of Mason and Lebanon. Another important secondary impact for winter storms is building or structure collapses; if there is a heavy snowfall or a significant accumulation over time, the weight of the snow may cause building damage or even collapse.

Winter storms have a positive environmental impact as well; gradual melting of snow and ice provides excellent groundwater recharge. However, abrupt high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flooding.

5.4.11 Winter Storm HIRA Summary

Warren County is subject to severe winter storms which have the potential to be hazard as a result of cold temperatures, heavy snow or ice and sometimes strong winds. Severe winter storm hazards can cause a range of damage to structures that will depend on the magnitude and duration of storm events. Losses may be as small as lost productivity and wages when workers are unable to travel or as large as sustained roof damage or building collapse. The severe winter storms profile is primarily concerned with past and future damages from cold temperatures, heavy snow or ice and sometimes strong winds.

5.5 *Geologic Hazards*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Geologic Hazards	1	0.3	3	0.9	4	0.8	4	0.4	4	0.4	**2.8**
MEDIUM RISK HAZARD (2.0 – 2.9)											

Geologic hazards pose a substantial danger to residents and property. Geologic hazards exist in Warren County due to naturally occurring geologic events and geologic hazards accelerated by human development. Common geologic hazards present throughout Warren County include seismic shaking or "earthquake".

5.5.1 Earthquake

The term "earthquake" refers to the vibration of the Earth's surface caused by movement along a fault, by a volcanic eruption, or even by manmade explosions. The vibration can be violent and cause widespread damage and injury, or may be barely felt. Most destructive earthquakes are caused by movements along faults. An earthquake is both the sudden slip on an active earth fault and the resulting shaking and radiated seismic energy caused by the slip (USGS 2009). Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface. Seismic shaking is typically the greatest cause of loss to structures during earthquakes.

Earthquakes may also cause landslides, particularly during the wet season, in areas of high water or saturated soils. The most likely areas for earthquake-induced landslides correlate to areas of high landslide potential discussed later in this section.

Ohio lies on the outermost boundaries of the New Madrid fault, centrally located at New Madrid, Missouri. This particular fault has created significant activity over the last 200 years. The most intense activity occurred in the years 1811-1812. Two earthquakes estimated to be 7's on the Richter scale hit the New Madrid Fault. Damage to chimneys was reported as far north as Cincinnati, Ohio.

Ohio has recorded 170 earthquakes with a magnitude of 2.0 or greater since 1776. Of these earthquakes, 15 were reported to have caused noticeable to moderate damage. Two (2) major centers of seismic activity in Ohio are 1) the Anna Seismogenic Area located in Shelby and Auglaize Counties, and 2) the northeast area of the state on the eastern side of Lake Erie, which is referred to as the Akron Magnetic Boundary. The Anna area has been home to 40 earthquakes since the late 1770's while northeastern Ohio has recorded 60. None of these earthquakes were reported to cause major damage or loss of life. Most sources in the geology science predict that the largest magnitude earthquake that might occur in the state of Ohio would register no higher than five (5). However, some sources state that a magnitude of six (6), maybe higher, could be registered in the Anna region. An event of this intensity would most probably be felt in Warren County. However, predicting the amount of damage would be difficult due to lack of historic activity in the village.

The lack of noticeable activity in Warren County can be partly attributed to the Peak Ground Acceleration (PGA). PGA is partly determined by what soils and bedrocks are present in the area. In regards to Warren County, the PGA is relatively low.

As noted by the Ohio Seismic Network, when the peak acceleration nears .1g, damage may be caused to poorly constructed buildings while acceleration nearing .2 would create loss of balance and greater damage to lesser quality structures. As mentioned previously, Warren County has peak acceleration much below that number, thus providing a buffer from most seismic activity. On a local basis, community members within Warren County and its jurisdictions have made reports of ground shakings. With this in mind, seismic activity will be a lessened priority in this plan. Environmental impacts of earthquakes can be numerous, widespread, and devastating, particularly if indirect impacts are considered. Some examples are shown below, but are unlikely to occur in Warren County:

- Induced flooding and landslides;
- Poor water quality;
- Damage to vegetation; and
- Breakage in sewage or toxic material containments

5.5.1.1 Earthquake Mechanics

Regardless of the source of the earthquake, the associated energy travels in waves radiating outward from the point of release. When these waves travel along the surface, the ground shakes and rolls, fractures form, and water waves may be generated. Earthquakes generally last a matter of seconds but the waves may travel for long distances and cause damage well after the initial shaking at the point of origin has subsided.

Breaks in the crust associated with seismic activity are known as “faults” and are classified as either active or inactive. Faults may be expressed on the surface by sharp cliffs or scarps or may be buried below surface deposits.

“Foreshocks,” minor releases of pressure or slippage, may occur months or minutes before the actual onset of the earthquake. “Aftershocks,” which range from minor to major, may occur for months after the main earthquake. In some cases, strong aftershocks may cause significant additional damage, especially if the initial earthquake impacted emergency management and response functions or weakened structures.

5.5.1.2 Factors Contributing to Damage

The damage associated with each earthquake is subject to four primary variables:

- The nature of the seismic activity
- The composition of the underlying geology and soils
- The level and quality of development of the area struck by the earthquake
- The time of day

Seismic Activity: The properties of earthquakes vary greatly from event to event. Some seismic activity is localized (a small point of energy release), while other activity is widespread (e.g., a major fault letting lose all at once). Earthquakes can be very brief (only a few seconds) or last for a minute or more. The depth of release and type of seismic waves generated also play roles in the nature and location of damage; shallow quakes will hit the area close to the epicenter harder, but tend to be felt across a smaller region than deep earthquakes.

Geology and Soils: The surface geology and soils of an area influence the propagation (conduction) of seismic waves and how strongly the energy is felt. Generally, stable areas (e.g., solid bedrock) experience less destructive shaking than unstable areas (e.g., fill soils). The siting of a community or even individual buildings plays a strong role in the nature and extent of damage from an event.

Development: A small earthquake in the center of a major city can have far greater consequences than a major event in a thinly populated place.

Time of Day: The time of day of an event controls the distribution of the population of an affected area. On work days, the majority of the community will transition between work or school, home, and the commute between the two. The relative seismic vulnerability of each location can strongly influence the loss of life and injury resulting from an event.

5.5.1.2.1 Types of Damage

While damage can occur by movement at the fault, most damage from earthquake events is the result of shaking. Shaking also produces a number of phenomena that can generate additional damage:

- Ground displacement
- Landslides and avalanches
- Liquefaction and subsidence
- Seiches

Shaking: In minor events, objects fall from shelves and dishes are rattled. In major events, large structures may be torn apart by the forces of the seismic waves. Structural damage is generally limited to older structures that are poorly maintained, constructed, or designed in all but the largest quakes. Un-reinforced masonry buildings and wood frame homes not anchored to their foundations are typical victims.

Loose or poorly secured objects also pose a significant hazard when they are loosened or dropped by shaking. These “non-structural falling hazard” objects include bookcases, heavy wall hangings, and building facades. Home water heaters pose a special risk due to their tendency to start fires when they topple over and rupture gas lines. Crumbling chimneys may also be responsible for injuries and property damage.

Dam and bridge failures are significant risks during stronger earthquake events, and due to the consequences of such failures, may result in considerable property damage and loss of life. In areas of severe seismic shaking hazard, Intensity VII or higher can be experienced even on solid bedrock. In these areas, older buildings especially are at significant risk.

Ground Displacement: Often, the most dramatic evidence of an earthquake results from displacement of the ground along a fault line. Utility lines and roads may be disrupted but damage directly attributable to ground displacement is generally limited. In rare instances, structure located directly on the fault line may be destroyed by the displacement.

Landslides and Avalanches: Even small earthquake events can cause landslides. Rock falls are common as unstable material on steep slopes is shaken loose, but significant landslides or even debris flows can be generated if conditions are ripe. Roads may be blocked by landslide activity, hampering response and recovery operations.

Liquefaction and Subsidence: Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils can lead to possibly widespread structural damage. The oscillation and failure of the soils may result in increased water flow and/or failure of wells as the subsurface flows are disrupted and sometimes permanently altered. Increased flows may be dramatic, resulting in geyser-like water spouts and/or flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

Seiches: Seismic waves may rock an enclosed body of water (e.g., lake or reservoir), creating an oscillating wave referred to as a "seiche." Although not a common cause of damage in past Ohio earthquakes, there is a potential for large, forceful waves similar to tsunami ("tidal waves") to be generated on the large lakes of the state. Such a wave would be a hazard to shoreline development and pose a significant risk on dam-created reservoirs. A seiche could either overtop or damage a dam leading to downstream flash flooding.

5.5.2 Regulatory Environment

Ohio building codes generally do not focus on construction relative to earthquake loads. In such instances where earthquakes of seismic events are mentioned, it is usually in relation to truss design and anchoring of appliances in structures.

5.5.3 Hazard Events

Warren County has not been the site of an earthquake epicenter. However, the effects from earthquakes in other parts of the state, as well as other parts of the nation have been felt within Warren County.

5.5.4 Historical Events

Figure 5-10 shows epicenters in the State of Ohio from 1970 – 2014

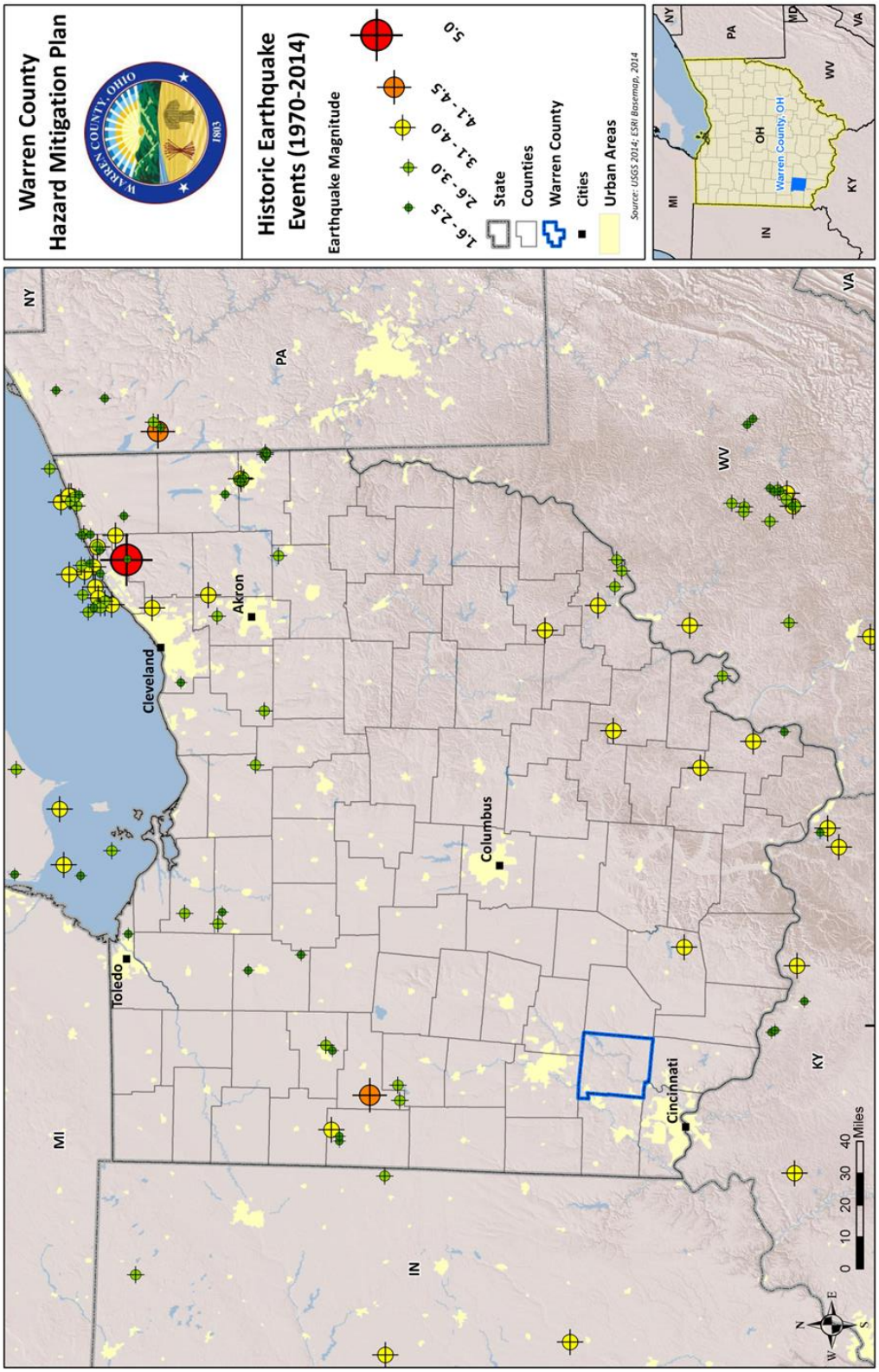


Figure 5-10 Historic Earthquake Events in Ohio

5.5.5 Magnitude/Severity

5.5.5.1 Earthquake

The most common method for measuring earthquakes is magnitude, which measures the strengths of earthquake. Although the Richter Scale is known as the measurement for magnitude, the majority of scientists currently use either the M_w Scale or Modified Mercalli Intensity (MMI) Scale. The effects of an earthquake in a particular location are measured by intensity. Earthquake intensity decreases with increasing distance from the epicenter of the earthquake.

The magnitude of an earthquake is related to the total area of the fault that ruptured, as well as the amount of offset (displacement) across the fault. As shown in Table 5-12 Moment Magnitude Scale there are seven earthquake magnitude classes, ranging from great to micro. A great class of magnitude can cause tremendous damage to infrastructure in Warren County, compared to a micro class, which results in minor damage to infrastructure.

Table 5-12 Moment Magnitude Scale

Earthquake Magnitude Classes		
Magnitude Class	Magnitude Range (M = Magnitude)	Probable Damage Description
Great	M > 8	Tremendous damage
Major	7 <= M < 7.9	Widespread heavy damage
Strong	6 <= M < 6.9	Severe damage
Moderate	5 <= M < 5.9	Considerable damage
Light	4 <= M < 4.9	Moderate damage
Minor	3 <= M < 3.9	Rarely causes damage.
Micro	M < 3	Minor damage

The MMI Scale measures earthquake intensity as shown in Table 5-13, the MMI Scale has 12 intensity levels. Each level is defined by a group of observable earthquake effects, such as ground shaking and/or damage to infrastructure. Levels I through VI describe what people see and feel during a small to moderate earthquake. Levels VII through XII describe damage to infrastructure during a moderate to catastrophic earthquake.

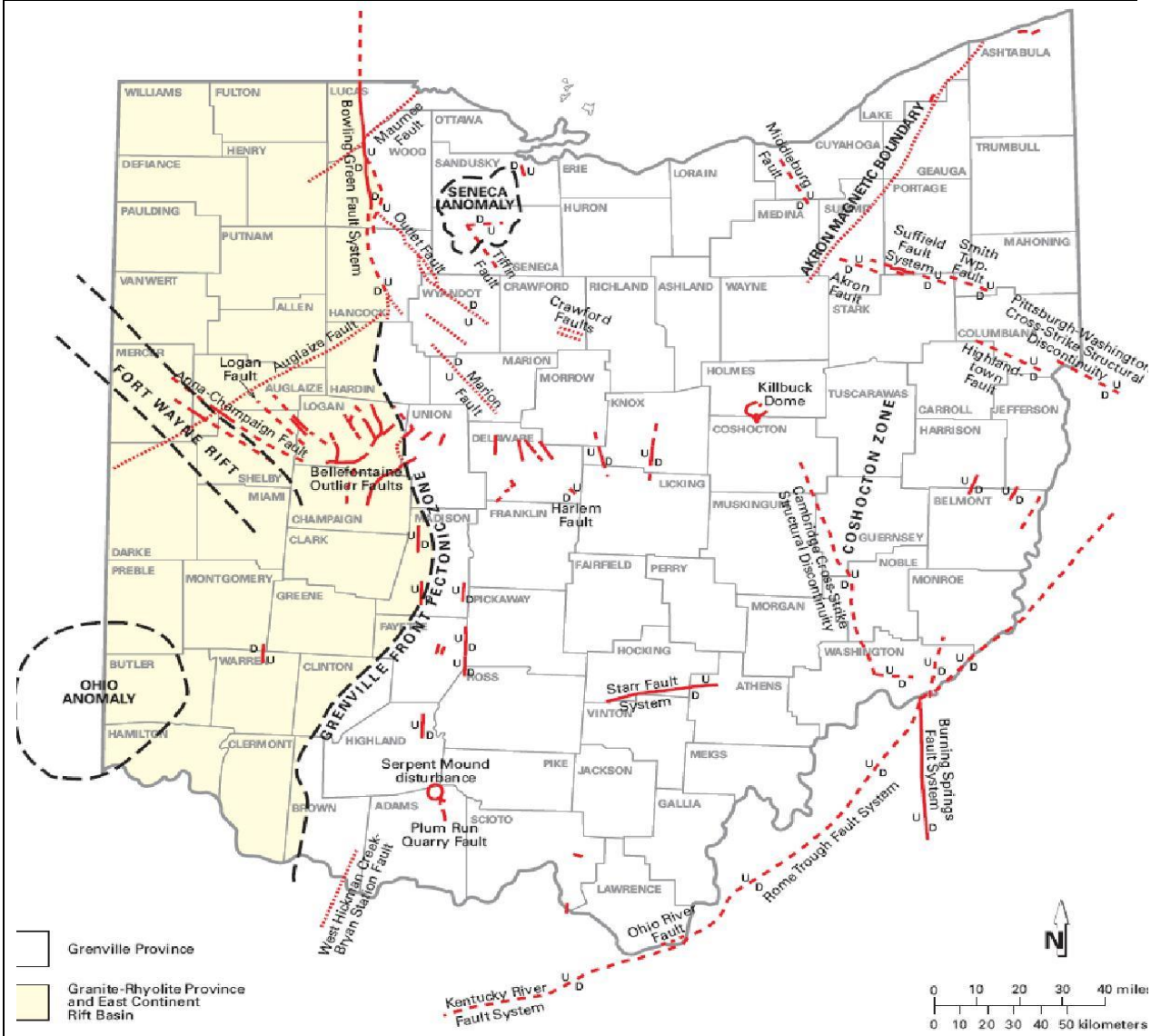
Table 5-13 Modified Mercalli Scale

Earthquake Magnitude and Intensity		
Magnitude (M_w)	Intensity (Modified Mercalli Scale)	Description
1.0 – 3.0	I	I. Not felt except by very few people under especially favorable conditions.
3.0 – 3.9	II – III	II. Felt by a few people, especially those on upper floors of buildings. Suspended objects may swing.
		III. Felt quite noticeably indoors. Many do not recognize it as an earthquake. Standing motorcars may rock slightly.

Earthquake Magnitude and Intensity		
Magnitude (M_w)	Intensity (Modified Mercalli Scale)	Description
4.0 – 4.9	IV – V	IV. Felt by many who are indoors; felt by a few outdoors. At night, some awakened. Dishes, windows, and doors rattle.
		V. Felt by nearly everyone; many awakened. Some dishes and windows broken; some cracked plaster; unstable objects overturned.
5.0 – 5.9	VI – VII	VI. Felt by everyone; many frightened and run outdoors. Some heavy furniture moved; some fallen plaster or damaged chimneys.
		VII. Most people alarmed and run outside. Damage negligible in well-constructed buildings; considerable damage in poorly constructed buildings.
6.0 – 6.9	VII – IX	VIII. Damage slight in special designed structures; considerable in ordinary buildings; great in poorly built structures. Heavy furniture overturned. Chimneys, monuments, etc. may topple.
		IX. Damage considerable in specially designed structures. Buildings shift from foundations and collapse. Ground cracked. Underground pipes broken.
7.0 and Higher	VIII and Higher	X. Some well-built wooden structures destroyed. Most masonry structures destroyed. Ground badly cracked. Landslides on steep slopes.
		XI. Few, if any, masonry structures remain standing. Railroad rails bent; bridges destroyed. Broad fissure in ground.
		XII. Virtually total destruction. Waves seen on ground. Objects thrown into the air.

As indicated earlier, just as there are multiple sources of seismic activity in Ohio, the location of seismic activity varies as well. Many earthquakes do occur along faults. Information about faults can be obtained from the Ohio Seismic Network at:
http://www.dnr.state.oh.us/geosurvey/default/tabid/8144/Default.aspx

Ohio Fault lines



Basement structures in Ohio (modified from Division of Geological Survey Map PG-23, 2002). This map portrays a number of deep faults and other structures that have been identified by a variety of geologic studies. Some faults are well known, whereas others are speculative. Very few of them are visible at the surface. The Fort Wayne (Anna) rift in western Ohio is the site of numerous historic earthquakes.

Figure 5-11 Fault Lines in the State of Ohio

5.5.6 Frequency/Probability of Future Occurrences

Reported flood events over the past 44 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County and its municipalities being the epicenter for a seismic event can be difficult to predict, but based on historical record of 0 earthquake epicenters since 1970, it can reasonably be assumed that this type of event has not occurred from 1970 through 2014.

[(Current Year) 2014] subtracted by [(Historical Year) 1970] = 44 Years on Record

[(Years on Record) 44] divided by [(Number of Historical Events) 0] = 0.0

Furthermore, the historic frequency calculates that there is a 0% chance of this type of event occurring each year.

5.5.7 Inventory Assets Exposed to Seismic/Earthquake Activity

The method used in determining the types and numbers of potential assets exposed to flooding was conducted using a loss estimation model called HAZUS-MH. HAZUS-MH is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Buildings Sciences (NIBS). For this Plan, a 5.0 magnitude earthquake was modeled and the results are presented below.

5.5.7.1.1 HAZUS-MH 5.40 EARTHQUAKE

HAZUS estimates that about 7,384 buildings will be at least moderately damaged. This is over 12.00 % of the total number of buildings in the region. There are an estimated 262 buildings that will be damaged beyond repair. The tables below summarize the expected damage by general occupancy for the buildings and the expected building damage by building type in the study region.

Table 5-14 HAZUS-MH Earthquake Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	181	0.44	58	0.50	55	0.95	21	1.55	3	1.24
Commercial	1,847	4.45	556	4.83	426	7.41	142	10.40	23	8.86
Education	56	0.13	15	0.13	12	0.21	3	0.25	1	0.28
Government	43	0.10	16	0.14	15	0.26	4	0.31	1	0.38
Industrial	709	1.71	207	1.80	177	3.08	64	4.65	10	3.68
Other Residential	4,878	11.75	1,546	13.43	946	16.44	257	18.74	45	17.33
Religion	178	0.43	52	0.45	38	0.66	13	0.94	2	0.94
Single Family	33,629	80.99	9,060	78.72	4,084	70.98	865	63.15	177	67.28
Total	**41,522**		**11,509**		**5,754**		**1,369**		**262**	

Table 5-15 HAZUS-MH Earthquake Expected Building Damage by Building Type

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	31,277	75.33	8046	69.91	2,819	48.99	311	22.74	25	9.56
Steel	887	2.14	245	2.13	281	4.88	114	8.31	15	5.66
Concrete	247	0.60	64	0.56	53	0.93	16	1.14	1	0.56
Precast	237	0.57	54	0.47	69	1.19	33	2.41	3	1.06
RM	162	0.39	27	0.23	30	0.53	12	0.85	1	0.19
URM	8,386	20.20	2856	24.82	2,193	38.11	771	56.34	202	76.84
MH	325	0.78	216	1.88	309	5.37	112	8.21	16	6.12
Total	**41,522**		**11,509**		**5,754**		**1,369**		**262**	

5.5.7.2 HAZUS-MH 5.40 EARTHQUAKE Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.22 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 58.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 8,840 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

5.5.7.2.1 HAZUS-MH 5.40 EARTHQUAKE Displacement and Shelter Requirements

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 403 households to be displaced due to the earthquake. Of these, 246 people (out of a total population of 158,383) will seek temporary shelter in public shelters

5.5.8 Potential Losses from Seismic Events

5.5.8.1 Earthquake

The risk of seismic hazards to residents of Warren County is based on the approximate location of earthquake faults within and outside the region. And the According to the USGS Fault Zone Maps, Warren County is not near any active fault zones. However, there are several Fault Zones has been identified as the closest active and possibly a hazardous fault to Warren County residence and property: Bellefontaine Outlier Faults, Anna-Champaign Fault, Plum Run Quarry Fault, West Hickson Creek – Bryan Station Fault, & Starr Fault System.

As noted by the Ohio Seismic Network, when the peak acceleration nears .1g, damage may be caused to poorly constructed buildings while acceleration nearing .2 would create loss of balance and greater damage to lesser quality structures. Figure 5-12 shows that Warren County is only exposed to peak acceleration of 0.06.

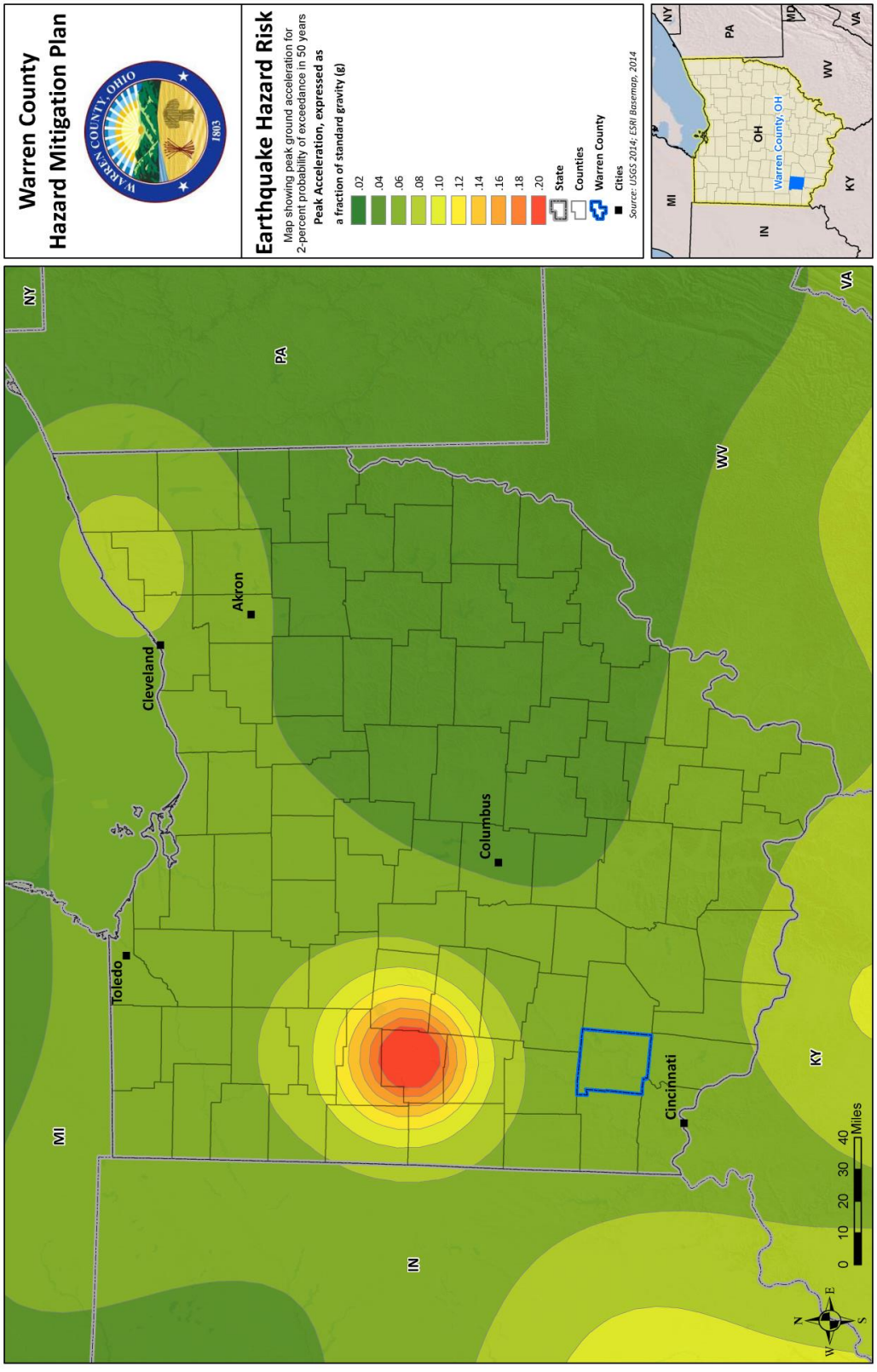


Figure 5-12 Earthquake Hazard Risk Map

Warren County is historically at a very low vulnerability to seismic activity. The nearest major fault (New Madrid) is hundreds of miles away. Most sources indicate that even a major event on this fault (8.0 on Richter scale) would not be felt in Warren County. The lack of historical events in the County, along with the relatively low PGA associated with the lands around the area put seismic events very low in the category of probability of occurrence. With this in mind, the probability for a seismic event in the County is low. However, if for some reason an event was to occur with the County near the epicenter, there is no way to comprehend the amount of damage that could be sustained by the municipalities within the County.

Table 5-16 HAZUS Earthquake Loss Estimation Summary

Building Type	Number of Buildings	Exposure in Study Region
Residential	5,126	$1,048,034,633.48
Non-Residential	2,169	$525,896,428.57
Critical Facilities	89	$21,578,968.25
Totals:	7,384	$1,595,510,030.31

5.5.9 Multi-Jurisdictional Differences

Warren County, on the whole, is at risk to the potential damages resulting from a seismic event. Geologic hazards are a countywide hazard and can affect all areas of the county and its jurisdictions. Should an event have its epicenter within the County, all of the jurisdictions within Warren County would be at risk to damages. Building codes in Ohio generally do not include provisions for seismic hazards.

5.5.10 Land Use & Development Trends

The effects of an earthquake (if the hazard exists) could potentially be anything from detected only on seismographs to ground water wells collapsing to total destruction, trees falling, ground rises and falls in waves. Continued enforcement of the unified construction code should mitigate this vulnerability.

5.5.11 Earthquake HIRA Summary

Most sources in the geology science predict that the largest magnitude earthquake that might occur in the state of Ohio would register no higher than five (5). However, some sources state that a magnitude of six (6), maybe higher, could be registered in the Anna region. An event of this intensity would most probably be felt in Warren County. However, since the area has not been the epicenter to an earthquake or seismic event it is difficult to estimate the damage that could occur.

5.6 *Summer Storms*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Summer Storms	4	1.2	2	0.6	4	0.8	1	0.1	1	0.1	**2.8**
MEDIUM RISK HAZARD (2.0 – 2.9)											

5.6.1 Hazard Identification

Extreme weather conditions can exist during any season in Ohio. Thunderstorms, associated with strong winds, heavy precipitation, and lightning strikes can all be hazardous under the right conditions and locations. Strong winds and tornadoes can take down trees, damage structures, tip high profile vehicles, and create high velocity flying debris. Large hail can damage crops, dent vehicles, break windows, and injure or kill livestock, pets, and people. Coastal storms, which include hurricanes, tropical storms, and nor'easters, are among the most devastating naturally occurring hazards in the United States and its territories. Past events reveal the magnitude of damage that is possible. In 2005, Hurricane Katrina resulted in the highest total damage of any natural disaster in U.S. history, an estimated $90 billion, eclipsing many times the damage wrought by Hurricane Andrew in 1992.

Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. Despite their small size, all thunderstorms are dangerous. The typical thunderstorm is 15 miles in diameter and lasts an average of 30 minutes. Of the estimated 100,000 thunderstorms that occur each year in the United States, about 10 percent are classified as severe. The National Weather Service considers a thunderstorm severe if it produces hail at least 3/4 inch in diameter, winds of 58 MPH or stronger, or a tornado. Every thunderstorm needs three basic components: (1) moisture to form clouds and rain (2) unstable air which is warm air that rises rapidly and (3) lift, which is a cold or warm front capable of lifting air to help form thunderstorms.

Lightning, although not considered severe by the National Weather Service definition, can accompany heavy rain during thunderstorms. Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder.

Hail develops when a super cooled droplet collects a layer of ice and continues to grow, sustained by the updraft. Once the hail stone cannot be held up any longer by the updraft, it falls to the ground. Nationally, hailstorms cause nearly $1 billion in property and crop damage annually, as peak activity coincides with peak agricultural seasons. Severe hailstorms also cause considerable damage to buildings and automobiles, but rarely result in loss of life.

Table 5-17 Hail Size Comparison Table

COMMON OBJECT	SIZE IN DIAMETER
Pea	0.25 Inch
Penny or Dime	0.75 Inch
Quarter	1.00 Inch
Half Dollar	1.25 Inch
Golf Ball	1.75 Inch
Tennis Ball	2.50 Inch
Baseball	2.75 Inch
Grapefruit	4.00 Inch

Severe summer storms can be defined as any destructive summer weather event with the potential to damage property or cause loss of life. For example, excessive localized precipitation over a short period of time may result in related flash floods that threaten life and property. In regards to the City, severe weather usually occurs as localized storms that can bring heavy rains, hail and occasionally high winds.

Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph), which can be destructive to roofs, buildings, automobiles, vegetation, and crops.

Since 1956, 45 federally or state declared severe summer storm weather events have occurred in Warren County as shown in Table 5-18. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1956 to present), these events include: severe storms, heavy rain, high winds, flooding, landslides, and mud flows.

Table 5-18: Severe Weather Federal Declarations

Disaster Number	Declaration Date	Disaster Type
4098	1/3/2013	Severe Storms And Flooding
4077	8/20/2012	Severe Storms And Flooding
4002	7/13/2011	Severe Storms, Flooding, Mudslides, And Landslides
1805	10/24/2008	Tornadoes, Flooding, Severe Storms, And High Winds
1720	8/27/2007	Severe Storms And Flooding
1656	8/1/2006	Severe Winter Storm
1651	7/2/2006	Severe Storms And Tornadoes
1580	2/15/2005	Severe Storms & Flooding
1556	9/19/2004	Tornado And Severe Storms
1519	6/3/2004	Severe Storms And Flooding
1507	1/26/2004	Severe Storms And Flooding
1484	8/1/2003	Severe Storms, Flooding And Tornadoes
1478	7/15/2003	Severe Storms/Flooding
1453	3/14/2003	Flooding

1444	11/18/2002	Storms/Floods
1390	8/27/2001	Severe Storm, Flooding
1343	9/26/2000	Flooding, Severe Storm, Tornadoes
1339	8/21/2000	Flooding, Severe Storm, Tornado
1321	3/7/2000	Severe Storms, Flooding
1227	6/30/1998	Severe Storms, Flooding
1164	3/4/1997	Severe Storms, Tornadoes
1122	6/24/1996	Severe Storms, Flooding
1097	1/27/1996	Severe Storms, Flooding, Tornadoes
1065	8/25/1995	Severe Storms, Flooding
951	8/4/1992	Winds, Tornadoes, Heavy Rains, Flooding
870	6/6/1990	Heavy Rains, Flooding
831	6/10/1989	Severe Storms, Flooding
796	7/17/1987	Tornadoes
738	6/3/1985	Mudslides
653	3/26/1982	Severe Storms, Flooding
642	6/30/1981	Severe Storms, Flooding
630	8/23/1980	Tropical Storm Agnes
480	9/11/1975	Tornadoes, Severe Storms, Flooding
445	7/11/1974	Heavy Rains, Flooding
436	5/31/1974	Tornadoes, Severe Storms
421	4/4/1974	Tornadoes, Severe Storms
390	6/4/1973	Severe Storms & Flooding
377	4/27/1973	Floods
362	11/24/1972	Wind Storm
345	7/19/1972	Severe Storms And Flooding
266	7/15/1969	Severe Storms And Flooding
243	6/5/1968	Severe Storms, Flooding, Mudslides, And Landslides
238	5/4/1968	Tornadoes, Flooding, Severe Storms, And High Winds
191	4/14/1965	Severe Storms And Flooding
167	3/24/1964	Severe Winter Storm
90	1/23/1959	Severe Storms And Tornadoes
57	5/17/1956	Severe Storms & Flooding

***Events may have occurred over multiple counties, so damage may represent only a fraction of the total event damage and may not be specific to Warren County**

5.6.2 Regulatory Environment

There are negligible formal regulations that pertain to summer storm events.

5.6.3 Hazard Events

Dangerous and damaging aspects of a severe storm are tornadoes, hail, lightning strikes, flash flooding, and winds associated with downbursts and microbursts. Reported severe weather events over the past 62 years provides an acceptable framework for determining the magnitude of such storms that can be

expected and planned for accordingly. FEMA places this region in Zone IV (250 MPH) for structural wind design (Federal Emergency Management Agency, 2004b.

5.6.3.1 Hail Events in Warren County

Large hail can damage structures, break windows, dent vehicles, ruin crops, and kill or injure people and livestock. Based on past occurrences, hail sizes greater than 3 inches in diameter are possible and should be accounted for in future planning activities. Non-tornadic, thunderstorm and non-thunderstorm winds over 100 mph should also be considered in future planning initiatives. These types of winds can remove roofs, move mobile homes, topple trees, take down utility lines, and destroy poorly-built or weak structures.

There have been 62 recorded hail events associated with thunderstorms that have either directly or indirectly impacted Warren County and its jurisdictions since 1974.

Table 5-19 Warren County Hail Events Since 1974

DATE RANGE	# OF EVENTS	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
1974 - 2014	62	0	0	$2,558,000	$50,000
	TOTALS:	**0**	**0**	**$2,558,000**	**$50,000**

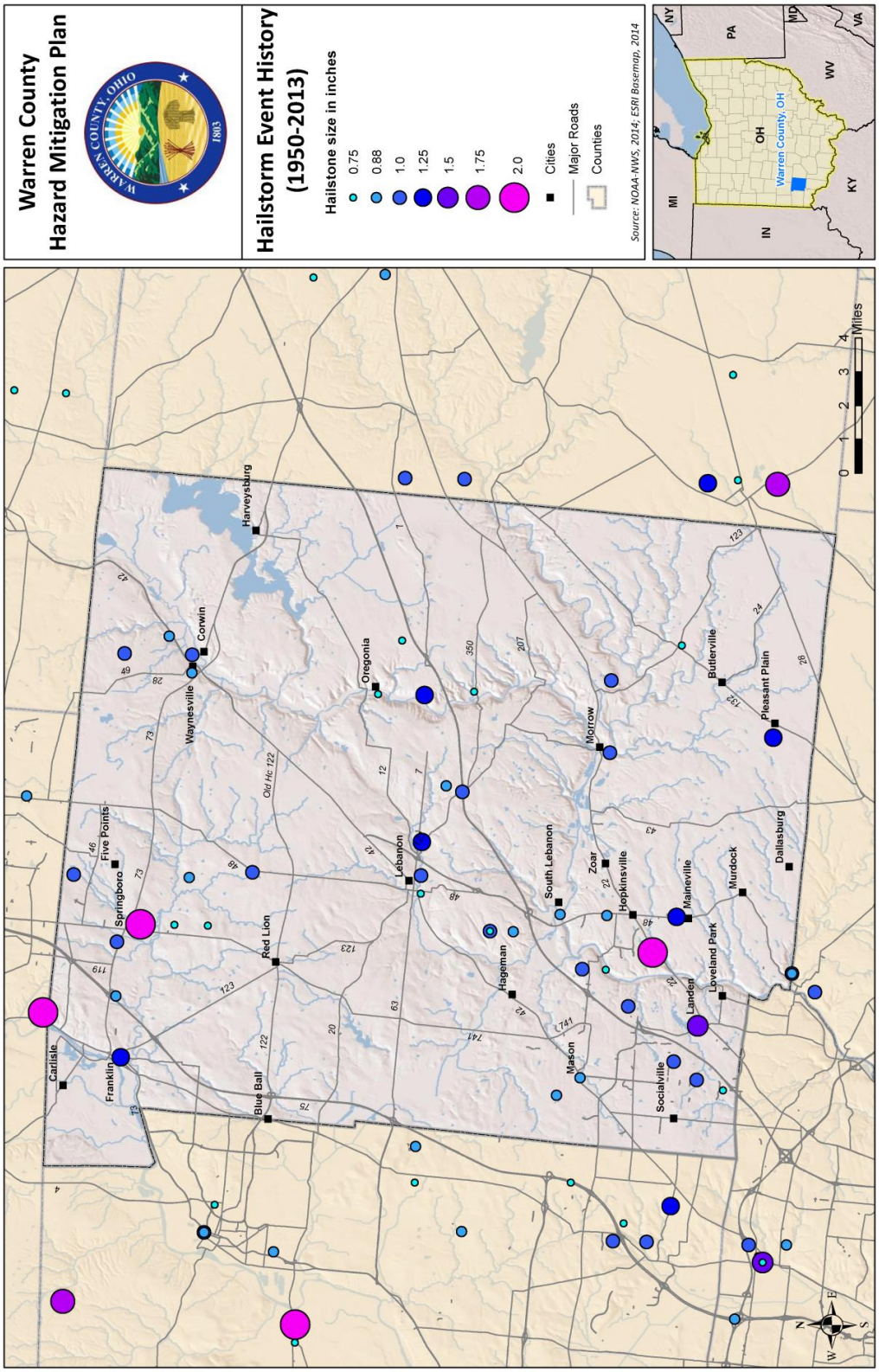


Figure 5-13 Recorded Hail Events in Warren County

Reported hail events over the past 40 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of Warren County experiencing a hail event associated with damages or injury can be difficult to quantify, but based on historical record of 62 hail events since 1974, it can reasonably be assumed that this type of event has occurred once every .65 years from 1974 through 2014.

[(Current Year) 2014] subtracted by [(Historical Year) 1974] = 40 Years on Record

[(Years on Record) 40] divided by [(Number of Historical Events) 62] = 0.65

Furthermore, the historic frequency calculates that there is a 100% chance of this type of event occurring each year.

5.6.3.2 Thunderstorm Wind Events in Warren County

There have been 153 recorded severe wind events associated with thunderstorms that have either directly or indirectly impacted Warren County and its jurisdictions since 1950.

Table 5-20 Thunderstorm Wind Events in Warren County Since 1964

DATE RANGE	# OF EVENTS	TYPE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
1964 - 2014	153	Thunderstorm Wind	0	4	$6,042,000	$0
		TOTALS:	**0**	**4**	**$6,042,000**	**$0**

Reported thunderstorm winds over the past 50 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of Warren County experiencing thunderstorm winds associated with damages or injury can be difficult to quantify, but based on historical record of 153 thunderstorm wind events since 1964, it can reasonably be assumed that this type of event has occurred once every 1.00 years from 1950 through 2014.

(Current Year) 2014] subtracted by [(Historical Year) 1964] = 50 Years on Record

[(Years on Record) 50] divided by [(Number of Historical Events) 153] = .33

Furthermore, the historic frequency calculates that there is a 100% chance of this type of event occurring each year.

5.6.3.3 Lightning Events in Warren County

Except in cases where significant forest or range fires are ignited, lightning generally does not result in disasters. For the period of 1998 to 2014, NOAA had five reported events for Warren County (as shown in the Table 5-21). These events resulted in one death, 2 injuries and $750,000 in property damages.

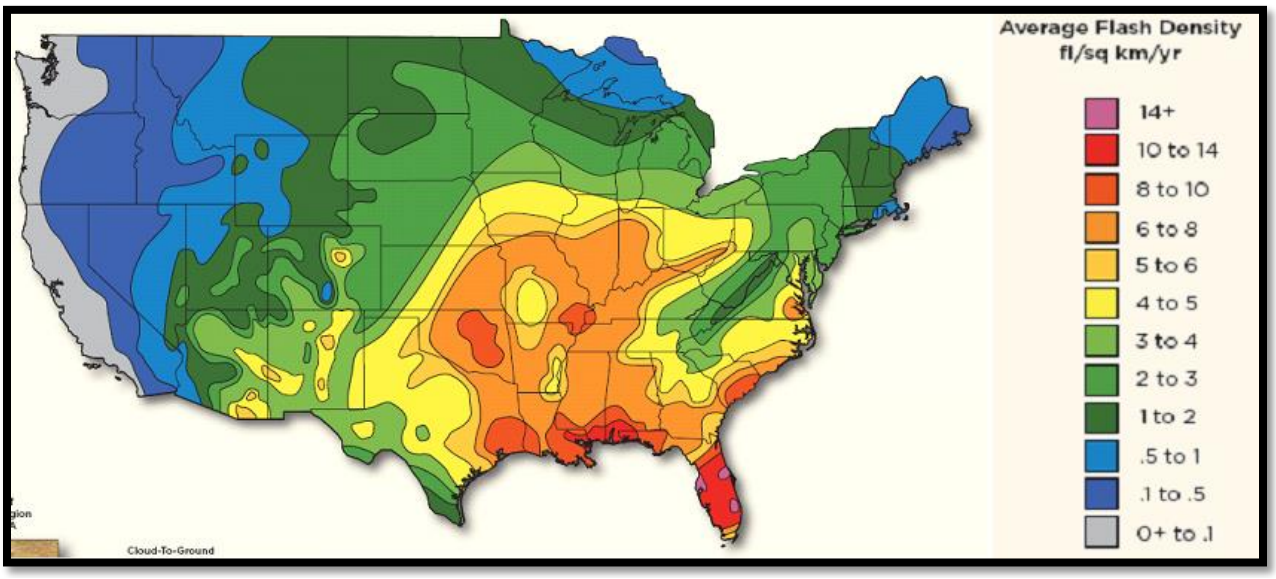


Figure 5-14 Flash Density associated with Lightning Strikes. Source: www.lightningsafety.noaa.gov

Table 5-21 Lightning Strikes in Warren County Since 1998

DATE RANGE	# OF EVENTS	# OF INJURIES	# OF FATALITIES	PROPERTY DAMAGES	CROP DAMAGE
1998 - 2014	5	1	2	**$750,000**	**$0**
TOTAL		**0**	**0**	**$750,000**	**$0**

Reported lightning strikes over the past 16 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of Warren County experiencing a lightning strike associated with damages or injury can be difficult to quantify, but based on historical record of 5 lightning strikes since 1998 that have either caused damages to buildings and infrastructure or resulted in an injury or death, it can reasonably be assumed that this type of event has occurred once every 64 years from 1998 through 2014.

[(Current Year) 2014] subtracted by [(Historical Year) 1998] = 16 Years on Record

[(Years on Record) 16] divided by [(Number of Historical Events) 5] = 3.20

Furthermore, the historic frequency calculates that there is a 31.25% chance of this type of event occurring each year.

5.6.4 Historical Occurrences

5.6.4.1 Hail Occurrences

April 15, 1994: Trees were downed in a number of locations throughout the County. A funnel cloud was sighted in Kings Mills, however no touchdown was reported. Roof damage occurred to an auto dealership, and golf ball sized hail fell in areas throughout the County.

April 19, 2002: Extensive hail damage to homes, cars and businesses occurred across the southern part of the county from Twenty Mile Stand, through Maineville to near Morrow and Pleasant Plain. This storm generated roughly $2,500,000 in damages.

April 16, 2013: Thunderstorms developed in the vicinity of a cold front during the afternoon. Some of these storms became severe. The main threat from these storms was large hail, with isolated threats for damaging winds.

5.6.4.2 Lightning Occurrences

April 16, 1998: A warm front remained across southwestern Ohio through the overnight hours providing the focus for thunderstorms which produced 2-4 inches of rain in 6-8 hours. Lightning struck a home which caused a fire. The home was completely destroyed by the fire.

May 31, 2004: A thunderstorm in the Warren County area produced lightning which struck and killed a 35 year old man at the Cozzadale Campgrounds.

June 12, 2010: A severe Mesoscale Convective System tracked from Indiana into much of Ohio during the late evening hours. This storm generated lightning that ignited a 62-foot tall statue of Jesus at the Solid Rock Church, in Monroe. This fire spread into the main building, but was confined to the attic area.

5.6.4.3 Thunderstorm Wind Occurrences

June 17, 1994: A storm system passed through Warren County, resulting in a number of downed trees. These trees fell on power lines, cars and buildings. The damages were estimated at $50,000 as a result of this storm.

September 27, 2003: An intense microburst caused extensive damage to homes and businesses across the southern part of the county. Several buildings sustained major damage along Mason-Montgomery Road. Up to fifty windows were blown out at Kings Junior High School. Portions of the roof were damaged and a wall was blown in at the junior high school as well. Numerous buses near the junior high school were severely damaged by flying debris and a nearby shed was destroyed. The fifty foot marquee at Kings Island Amusement Park was blown down and completely destroyed. 36 homes suffered roof damage in Kings Mills. In South Lebanon, a small church and 75 homes sustained damage, including five that were severely damaged. Fifteen vehicles were struck by fallen trees. Trees and power poles were downed in a widespread area. Maximum wind speeds were estimated between 80 and 100 mph. This storm resulted in $4,000,000 in damages. This is by far the most damaging storm, as recorded by NOAA.

October 31, 2013: A potent low pressure system moved across the region, bringing strong winds aloft across the Ohio Valley. Showers that developed along and ahead of a cold front associated with this storm system were capable of producing damaging winds and isolated weak tornadoes. This line of showers producing the damage across southwestern Ohio continued past midnight on October 31st and into the early morning hours of November 1st. A semi-truck was overturned on Interstate 75 due to thunderstorm winds. The driver sustained minor injuries.

5.6.5 Magnitude/Severity

Thunderstorm watches and warnings are issued by the National Weather Service. There are no watches or warnings for lightning. Figure 5-15 explains the difference between watches and warnings, as used by the NWS.

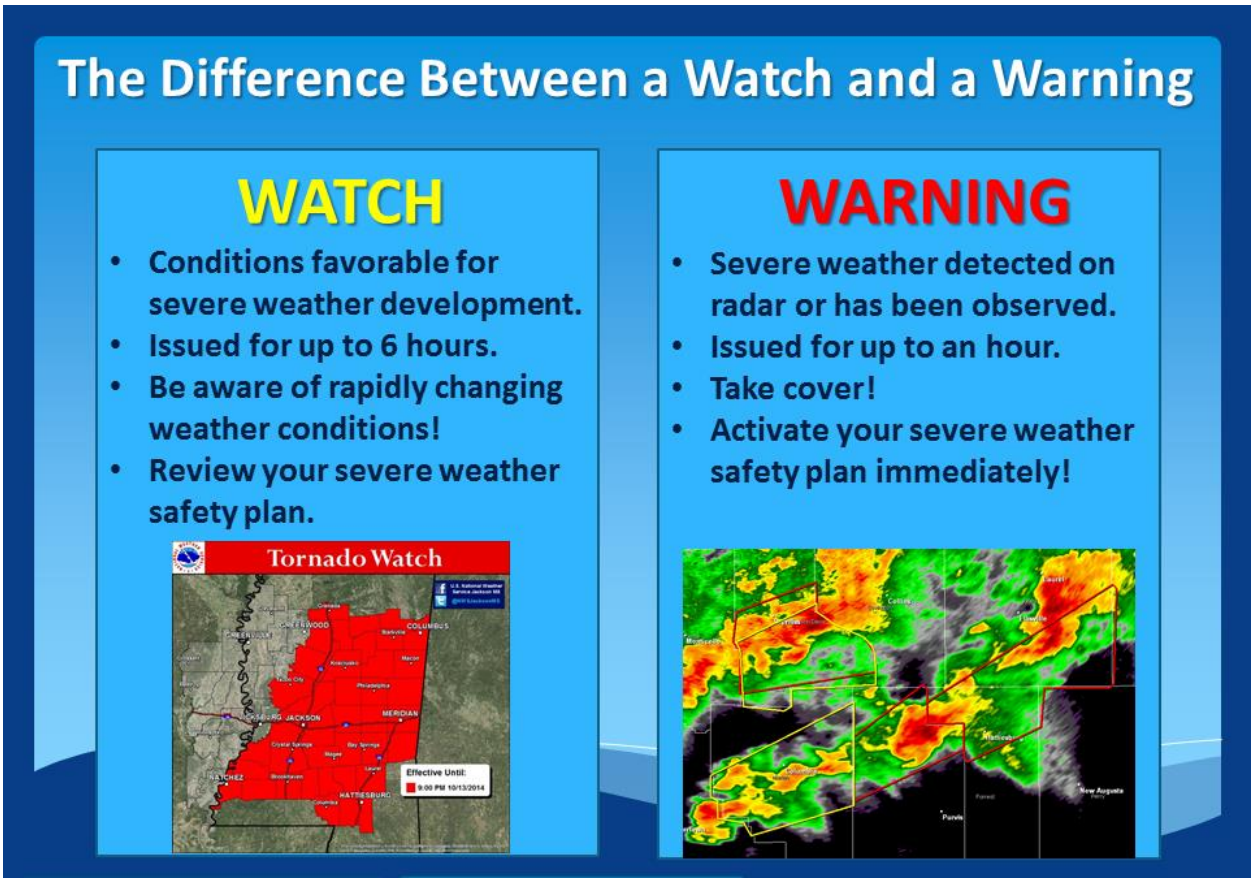


Figure 5-15 National Weather Service Watch vs Warning

5.6.6 Frequency/Probability of Future Occurrences

Table 5-22 Probability of Summer Storm Events in Warren County

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Historic Recurrence Interval (years)	Historic Frequency (% chance/year)
Thunderstorm Wind	153	50	0.33	100%
Hail	62	40	0.65	100%
Lightning	5	16	3.20	31.25%

5.6.7 Inventory Assets Exposed to Summer Storms

Inventory assets exposed to severe thunderstorms is dependent on the age of the building, type, construction material used, and condition of the structure. Heavy wind loads on structures can cause poorly constructed roofs to fail, and hail is known to damage roofs and siding of structures, rendering the building more susceptible to water damage.

All assets located in Warren County can be considered at risk from severe thunderstorms. This includes 212,693 people, or 100 percent of the County's population and all buildings and infrastructure within the County. Damages primarily occur as a result of high winds, lightning strikes, hail, and flooding. Most structures, including critical facilities, should be able to provide adequate protection from hail but the structures could suffer broken windows and dented exteriors. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out.

Thunderstorm winds, hail and lightning can all contribute to structural damage of fixed facilities. Warren County has seen similar incidents in the past, as shown in the event narratives. In addition, strong winds can lead to downed power lines, which impact businesses and services in other ways. Facilities are susceptible to lost power, as seen during the 2012 Derecho. Losing power can result in a variety of slow-downs and lost production time for commercial facilities. Because of that, it is important to look at some of the potential impacts on local businesses and services that can be impacted by summer storms.

Table 5-23 Non-Residential and Critical Facilities vulnerable to Summer Storms

Jurisdiction	Non-Residential Type	Number of Properties	Value	Critical Facility Type	Number of Properties	Value
Warren County	Medium Manufacturing & Assembly	22	$76,255,340	County-Owned Structures	71	$50,242,170
City of Franklin	Industrial Warehouses	35	$31,044,030	Municipal Structures	78	$14,183,180
City of Lebanon	Light Manufacturing & Assembly	25	$18,098,190	Board of Education	31	$6,031,730
City of Mason	Light Manufacturing & Assembly	34	$90,625,400	Board of Education	13	$81,662,130
Village of South Lebanon	Foundries & Heavy Manufacturing	1	$1,031,190	Municipal Structures	42	$4,333,870

5.6.8 Potential Losses from Summer Storms

A timely forecast may not be able to mitigate the property loss, but could reduce the casualties and associated injury. It appears possible to forecast these extreme events with some skill, but further research needs to be done to test the existing hypothesis about the interaction between the convective storm and its environment that produces the extensive swath of high winds. Severe thunderstorms will remain a highly likely occurrence for the County. Lightning and hail may also be experienced in the area due to such storms.

Table 5-24 Damage Estimates for Summer Storms in Warren County

CATEGORY	TIME PERIOD ON RECORD	# EVENTS	DAMAGES	AVG. DAMAGE PER EVENT
Thunderstorm Winds	1964-2014	153	$6,042,000	$39,490
Hail	1974-2014	62	$2,558,000	$41,258
Lightning	1998-2014	5	$750,000	$150,000

There is no way to predict an area that will be impacted by thunderstorm winds, hail storms or lightning strikes. An individual thunderstorm is unlikely to damage large numbers of structures on its own. However, the side effects of a thunderstorm (hail, winds and lightning), have the ability to cause damage to structures and property within the County. Insurance claims resulting from hailstorm damage increased 84% (467,602 to 861,579) from 2010 to 2012 according to the National Insurance Crime Bureau. Hail can damage homes and vehicles, as well as crops. Hail is the third leading cause of crop failure in the United States. While drought was by far the leading cause of crop failures in 2012, at 79%, thunderstorms and their hazards accounted for over $1 Billion in losses nationwide in 2012. These losses, resulting from thunderstorms, can be difficult to overcome. Insurance policies offer some relief from the losses, both for homeowners and farmers.

5.6.9 Multi-Jurisdictional Differences

Thunderstorms and their related hazards (hail and lightning) generally impact large areas. Summer storms are a countywide hazard and can affect all areas of the county and its jurisdictions. As a result, no one jurisdiction is more susceptible to the effects of a summer storm than any other in Warren County. Thunderstorms can span hundreds of miles, and the impacts can vary across multiple jurisdictions, counties and even states.

5.6.10 Land Use & Development Trends

All future structures built in the County will likely be exposed to severe thunderstorm damage. Warren County and its jurisdictions need to adhere to building codes, and therefore, new development can be built to current standards. Additionally, as homes go up in the rural areas of the County, accessing those rural residents may become difficult should sheltering or emergency services be needed.

5.6.11 Summer Storm HIRA Summary

Warren County is subject to severe storms ranging from thunderstorms to tropical storms which have the potential to cause flash flooding, tornadoes, downbursts, and debris. The severe summer storms profile is primarily concerned with past and future damages from high winds, lightning, and hail. Heavy precipitation and subsequent flooding will be profiled as a separate hazard.

Mitigation of building damage has been most successful where strict building codes for high-wind influence areas and designated special flood hazard areas have been adopted and enforced by local governments, and the builders have complied. Proven techniques are available to reduce lightning damage by grounding techniques for buildings.

Post-disaster mitigation efforts include buyout programs, relocations, structural elevations, improved open-space preservation, and land use planning within high-risk areas. Due to the significant risk from severe storms, Warren County will remain proactive in its mitigation efforts to help build sustainability.

5.7 *Tornado*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Tornado	3	0.9	3	0.9	1	0.2	4	0.4	4	0.4	**2.8**
MEDIUM RISK HAZARD (2.0 – 2.9)											

5.7.1 Hazard Identification

Wind Can Be defined as the motion of air relative to the earth's surface. The horizontal component of the three-dimensional flow and the near-surface wind phenomenon are the most significant aspects of the hazard. Extreme windstorm events are associated with extra tropical and tropical cyclones, winter cyclones, and severe thunderstorms and accompanying mesoscale offspring such as tornadoes and downbursts. Winds vary from zero at ground level to 200-mph in the upper atmospheric jet stream at 6 to 8 miles above the earth's surface.

Figure 5-16 Example of a Tornado Funnel Cloud

The damaging effects of windstorms associated with hurricanes may extend for distances in excess of 100 miles from the center of storm activity. For coastal areas from Texas to Maine, tropical cyclone winds may exceed 100 mph. Severe thunderstorms can produce wind downbursts and microbursts, as well as tornadoes. Severe windstorms result in as many as 1,000 tornadoes annually.

A **tornado** is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour. They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touchdown briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2002).

Strong winds can also occur outside of tornadoes, severe thunderstorms, and winter storms. These winds typically develop with strong pressure gradients and gusty frontal passages. The closer and stronger two systems (one high pressure, one low pressure) are, the stronger the pressure gradient, and therefore, the stronger the winds are.

Downburst winds, which can cause more widespread damage than a tornado, occur when air is carried into a storm's updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be

supported up by the storm's updraft, or an exceptional downdraft develops, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage. These types of strong winds can also be referred to as straight-line winds. Downbursts with a diameter of less than 2.5 miles are called microbursts and those with a diameter of 2.5 miles or greater are called macrobursts. A derecho, or bow echo, is a series of downbursts associated with a line of thunderstorms. This type of phenomenon can extend for hundreds of miles and contain wind speeds in excess of 100 mph.

5.7.2 Regulatory Environment

There are negligible formal regulations that pertain to summer storm events. While there are suggested protective measures, especially for mobile/modular homes, these are generally not required in local codes.

5.7.3 Hazard Events

Warren County may experience intense winds from thunderstorms, tornadoes, and even the remnants of hurricanes and tropical storms. Tornadoes can occur any time of the year, though, peak tornado occurrences are in March through October as past county records indicate. The county has been subjected to 22 tornadoes, according to the Tornado History Project.

Table 5-25: Tornado History Since 1964

LOCATION	DATE	MAGNITUDE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
Warren Co.	6/26/1956	F1	0	0	$2,500	$0
Warren Co.	5/22/1959	F0	0	0	$2,500	$0
Warren Co.	5/10/1969	F3	0	10	$250,000	$0
Warren Co.	4/3/1974	F4	0	0	$250,000	$0
Warren Co.	4/3/1974	F2	0	9	$2,500,000	$0
Warren Co.	5/18/1974	F1	0	0	$25,000	$0
Warren Co.	4/2/1975	F2	0	3	$2,500,000	$0
Warren Co.	6/24/1976	F0	0	0	$250,000	$0
Warren Co.	10/1/1977	F0	0	0	$250,000	$0
Warren Co.	6/2/1990	F4	0	0	$25,000,000	$0
Warren Co.	9/14/1990	F2	0	4	$2.500.000	$0
Warren Co.	8/20/1991	F0	0	0	$25,000	$0
Warren Co.	7/12/1992	F1	0	0	$250,000	$0
Loveland Park	4/9/1999	F1	0	0	$3,000,000	$0
Maineville	4/9/1999	F2	0	0	$2,500,000	$0
Cozzadale	8/24/1999	F0	0	0	$25,000	$0
Morrow	8/30/2005	F0	0	0	$25,000	$0
Carlisle	7/11/2006	F1	0	0	$200,000	$0
Maineville	7/11/2006	F0	0	0	$10,000	$0
Blackhawk	3/23/2012	EF0	0	0	$20,000	$0
Lebanon Warren Co Area	5/1/2012	EF0	0	0	$5,000	$0
Genntown	5/1/2012	EF0	0	0	$10,000	$0
		TOTALS:	**0**	**26**	**$39,595,000**	**$0**

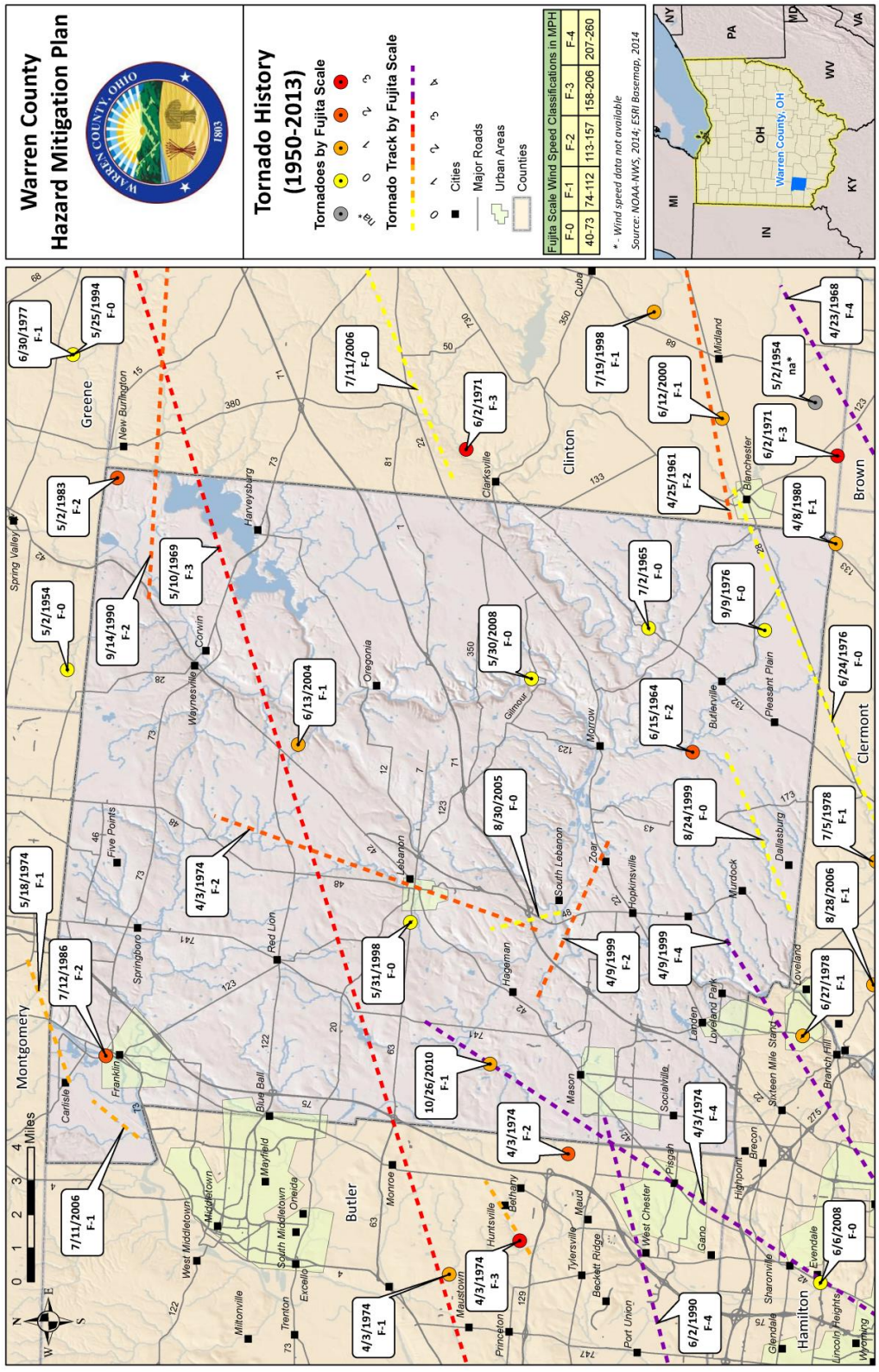


Figure 5-17 Tornadoes Impacting Warren County

5.7.4 Historical Occurrences

June 2, 1990: On June 2-3, 1990, the largest outbreak of tornadoes since the super outbreak of April 3-4, 1974, produced 64 tornadoes in parts of the Midwest, great lakes and Ohio River Valley. The most heavily damaged area was from southeastern Illinois through southern Indiana to southwestern Ohio and north-central Kentucky. In the four Lower Ohio River Valley states of Illinois, Indiana, Ohio, and Kentucky, there were 55 tornadoes. These tornadoes produced damage paths totaling nearly 500 miles, killed nine people and injured over 250. One particular tornado developed 2 miles west of Bright, Indiana and crossed into Ohio at 2214 EST. In Hamilton County, the tornado destroyed 32 homes and 5 businesses. Between 800 and 900 homes, 31 businesses and three schools were damaged in Hamilton County. The tornado crossed into southwest Warren County at 2300 EST and lifted about 1 mile southwest of Mason. Minor damage occurred to homes and buildings in Warren County.

April 9, 1999: A tornado touched down in eastern Hamilton Township causing heavy damage to a farmstead. The roof of the house and an extension to a barn were destroyed. Further down the path, a house was skewed from its foundation.

July 11, 2006: A tornado touched down in Franklin Township and moved northeast near the city of Carlisle, ending near State Route 123. Several homes and one business sustained minor damage. Numerous trees were uprooted and knocked down along the path of the tornado.

5.7.5 Magnitude/Severity

The Enhanced Fujita Scale, also known as the "EF-Scale," measures tornado strength and associated damages. The EF-Scale is an update to the earlier Fujita scale that was published in 1971. It classifies United States tornadoes into six intensity categories, as shown in table below, based upon the estimated maximum winds occurring within the wind vortex. The EF-Scale has become the definitive metric for estimating wind speeds within tornadoes based upon the damage done to buildings and structures since it was implemented through the National Weather Service in 2007.

Table 5-26: Enhanced Fujita Scale and Associated Damage

EF-SCALE NUMBER	WIND SPEED (MPH)	TYPE OF DAMAGE POSSIBLE
EFO	65-85	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	86-110	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.

EF3	136-165	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

The Storm Prediction Center has developed damage indicators to be used with the Enhanced Fujita Scale for different types of buildings but can be also be used to classify any high wind event. Some of the indicators for different building types are shown in tables below.

Table 5-27: Institutional Buildings

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	59-88 MPH (72 MPH)
Loss of roof covering (<20%)	72-109 MPH (86 MPH)
Damage to penthouse roof & walls, loss of rooftop HVAC equipment	75-111 MPH (92 MPH)
Broken glass in windows or doors	78-115 MPH (95 MPH)
Uplift of lightweight roof deck & insulation, significant loss of roofing material (>20%)	95-136 MPH (114 MPH)
Façade components torn from structure	97-140 MPH (118 MPH)
Damage to curtain walls or other wall cladding	110-152 MPH (131 MPH)
Uplift of pre-cast concrete roof slabs	119-163 MPH (142 MPH)
Uplift of metal deck with concrete fill slab	118-170 MPH (146 MPH)
Collapse of some top building envelope	127-172 MPH (148 MPH)
Significant damage to building envelope	178-268 MPH (210 MPH)

Source: Storm Prediction Center, 2009

Table 5-28: Educational Institutions (Elementary)

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	55-83 MPH (68 MPH)
Loss of roof covering (<20%)	66-99 MPH (79 MPH)
Broken windows	71-106 MPH (87 MPH)
Exterior door failures	83-121 MPH (101 MPH)
Uplift of metal roof decking; significant loss of roofing material (>20%); loss of rooftop HVAC	85-119 MPH (101 MPH)
Damage to or loss of wall cladding	92-127 MPH (108 MPH)
Collapse of tall masonry walls at gym, cafeteria, or auditorium	94-136 MPH (114 MPH)
Uplift or collapse of light steel roof structure	108-148 MPH (125 MPH)
Collapse of exterior walls in top floor	121-153 MPH (139 MPH)
Most interior walls of top floor collapsed	133-186 MPH (158 MPH)

Total destruction of a large section of building envelope	163-224 MPH (192 MPH)

Source: Storm Prediction Center, 2009

Table 5-29: Metal Building Systems

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	54-83 MPH (67 MPH)
Inward or outward collapsed of overhead doors	75-108 MPH (89 MPH)
Metal roof or wall panels pulled from the building	78-120 MPH (95 MPH)
Column anchorage failed	96-135 MPH (117 MPH)
Buckling of roof purlins	95-138 MPH (118 MPH)
Failure of X-braces in the lateral load resisting system	118-158 MPH (138 MPH)
Progressive collapse of rigid frames	120-168 MPH (143 MPH)
Total destruction of building	132-178 MPH (155 MPH)

Source: Storm Prediction Center, 2009

Table 5-30: Electric Transmission Lines

DAMAGE DESCRIPTION	WIND SPEED RANGE (Expected in Parentheses)
Threshold of visible damage	70-98 MPH (83 MPH)
Broken wood cross member	80-114 MPH (99 MPH)
Wood poles leaning	85-130 MPH (108 MPH)
Broken wood poles	98-142 MPH (118 MPH)

Improved and consistent building codes have been considered as a key measure to mitigate life and property losses associated with tornadoes and wind events. All of Warren County is equally at risk to tornado damage.

5.7.6 Frequency/Probability of Future Occurrences

Reported tornado events over the past 58 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County and its municipalities experiencing a tornado event, although infrequent, can be difficult to quantify, but based on historical record of 22 tornado events since 1956, it can reasonably be assumed that this type of event has occurred once every 2.52 years from 1956 through 2014.

[(Current Year) 2014] subtracted by [(Historical Year) 1956] = 58 Years on Record

[(Years on Record) 58] divided by [(Number of Historical Events) 22] = 2.52

Furthermore, the historic frequency calculates that there is a 39.66% chance of this type of event occurring each year.

5.7.7 Inventory Assets Exposed to Tornadoes

All assets located in the county can be considered at risk from tornadoes and wind events. This includes 212,693 residents, or 100% of the County's population and all critical facilities, structures, and infrastructure. There is no way to predict the path that will be impacted by tornadoes. As a result, all property located within the County must be viewed as susceptible to the effects of a tornado.

There are an estimated 39,301 housing units in Warren County. The average value of a single-family detached home within the County is almost $170,000.

5.7.8 Potential Losses from Tornadoes

Table 5-31 Potential Losses from Tornado Damage in Warren County

LOCATION	POPULATION	# HOMES	AVERAGE VALUE	POTENTIAL PROPERTY LOSSES
Mason	31,282	8,127	$203,525	$1,654,047,675
Lebanon	20,476	6,025	$174,793	$1,053,127,825
Franklin	11,829	4,823	$116,163	$560,254,149
Village of South Lebanon	4,216	1,068	$112,237	$119,869,116
TOTALS	**67,803**	**20,043**	**$151,680 (Avg.)**	**$3,387,298,765**

Table 5-32 Potential Non-Residential Losses from Tornado Damage in Warren County

LOCATION	Non-Residential	Value	Governmental	Value
Mason	365	$406,585,080.00	259	$237,192,350.00
Lebanon	289	$165,307,490.00	333	$162,446,700.00
Franklin	274	$151,285,040.00	206	$47,655,480.00
Village of South Lebanon	22	$4,024,810.00	101	$19,570,240.00

While all assets are considered at risk from this hazard, a particular tornado would only cause damages along its specific track. Since a tornado track cannot be predicted the total loss will depend upon aftermath estimates on what lies within that track

5.7.9 Multi-Jurisdictional Differences

Tornado paths can vary greatly in length and width. As such, it is virtually impossible to identify what jurisdictions are vulnerable and those that aren't. Tornadoes are a countywide hazard and can affect all areas of the county and its jurisdictions. Tracks have crossed not only municipal limits, but county lines, and even state lines. All jurisdictions are at equal risk to the dangers of a tornado.

5.7.10 Land Use & Development Trends

Improved and consistent building codes have been considered as a key measure to mitigate life and property losses associated with tornadoes and wind events. All of Warren County is equally at risk to tornado damage.

5.7.11 Tornadoes Hira Summary

It's difficult to separate the various wind components that cause damage throughout Warren County from other wind-related natural events that often occur to generate tornadoes. For example, hurricanes with

intense winds often spawn numerous tornadoes or generate severe thunderstorms producing strong, localized downdrafts. Due to this difficulty, tornadoes/windstorms in Warren County are difficult to predict and the entire village is subject to all categories of windstorms.

In addition to improved construction standards, retrofitting to enhance design standards of infrastructure can limit exposure. Examples include structural cladding, shuttering systems, and materials that are resistant to the penetration of wind-blown debris and projectiles.

5.8 *Drought*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Drought	2	0.6	3	0.9	3	0.6	**1**	**0.1**	**4**	**0.4**	**2.6**
MEDIUM RISK HAZARD (2.0 – 3.9)											

5.8.1 Hazard Identification

Drought is a normal, recurrent, feature of climate and originates from a deficiency of precipitation over an extended period, usually one or more seasons. Drought can result in a water shortage for some activity, group, or environmental sector. Drought is a complex natural hazard, which is reflected in the following four definitions commonly used to describe it:

- Agricultural – drought is defined principally in terms of naturally occurring soil moisture deficiencies relative to water demands of plant life, usually arid crops.
- Hydrological – drought is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- Meteorological – drought is defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
- Socio-economic – drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. It may also be called a water management drought.

Although climate is a primary contributor to hydrological drought, other factors such as changes in land use (e.g., deforestation), land degradation, and the construction of dams all affect the hydrological characteristics of a particular region. Since regions are interconnected by natural systems, the impact of meteorological drought may extend well beyond the borders of the precipitation-deficient area. Changes in land use upstream may alter hydrologic characteristics such as infiltration and runoff rates, resulting in more variable stream flow and a higher incidence of hydrologic drought downstream. Land use change is one way human actions alter the frequency of water shortage even when no change in the in precipitation has been observed has been observed (National Drought Mitigation Center 2014).

There is no commonly accepted approach for assessing risk associated with droughts given the varying types and indices. Drought risk is based on a combination of the frequency, severity, and spatial extent (the physical nature of drought) and the degree to which a population or activity is vulnerable to the effects of drought. The degree of Warren County's vulnerability to drought depends on the environmental and social characteristics of the region and is measured by its ability to anticipate, cope with, resist, and recover from drought.

Because drought is usually considered a regional hazard, it is not enhanced or analyzed by County-level mapping. All jurisdictions are assumed to have the same risk level within Warren County. Mapping of the current drought status is published by the National Integrated Drought Information System (NIDIS): U.S. Drought Portal which can be found online at: www.drought.gov

In 2012, extremely dry conditions pushed into the month of September. These same dry conditions had persisted for most of the month resulting in crop losses throughout Ohio. According to subsidy estimates

for 2012, Warren County received over $5,000,000 in 2012 related to soybean, corn, wheat and dairy program subsidies.

In the period from 1995-2012, Warren County has received almost $150,000,000 in subsidies for corn, soybean and wheat. Drought may not be directly responsible for all subsidies, however, it is a safe assumption that dry conditions have led to at least some of the losses.

The 2012-2013 North American droughts began in the spring of 2012, when the lack of snow in the continental United States resulted in very little melt water being absorbed into the soil. Drought conditions were experienced almost nationwide. Multiple Ohio counties were designated as being in a moderate drought condition by June. The Governor of Ohio sent a memorandum to the USDA State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought. The USDA reviewed this memorandum and determined that there were sufficient production losses in eighty-five counties to warrant a Secretarial disaster designation.

The following image shows the USDA Secretarial Disaster Designations for Crop Year (CY) 2012. As can be seen on the map, Warren County was included in this disaster designation.

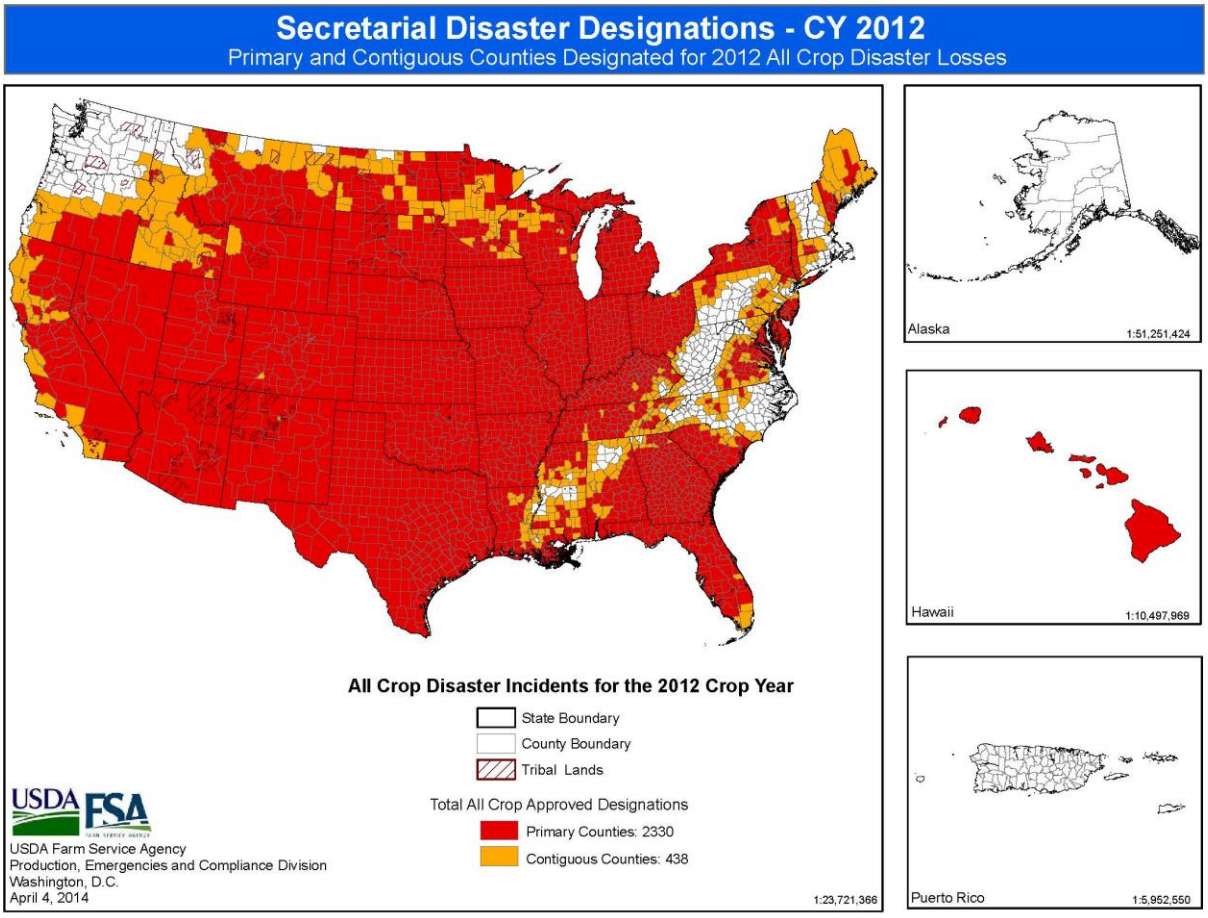


Figure 5-18 Crop Year 2012 USDA Disaster Declarations

5.8.1.1 Drought Impact Categories

- *Agriculture:*
  Impacts associated with agriculture, farming, and ranching. Examples of drought-induced agricultural impacts include: damage to crop quality; income loss for farmers due to reduced crop yields; reduced productivity of cropland (due to wind erosion, long-term loss of organic matter, etc.); insect infestation; plant disease; increased irrigation costs; costs of new or supplemental water resource development (wells, dams, pipelines); reduced productivity of rangeland; forced reduction of foundation stock; closure/limitation of public lands to grazing; high cost/unavailability of water for livestock; and range fires.

- *Water/Energy:*
  Impacts associated with surface or subsurface water supplies (i.e., reservoirs or aquifers), stream levels or stream flow, hydropower generation, or navigation. Examples of drought-induced water/energy impacts include: lower water levels in reservoirs, lakes, and ponds; reduced flow from springs; reduced stream flow; loss of wetlands; estuarine impacts (e.g., changes in salinity levels); increased groundwater depletion, land subsidence, reduced recharge; water quality effects (e.g., salt concentration, increased water temperature, pH, dissolved oxygen, turbidity); revenue shortfalls and/or windfall profits; cost of water transport or transfer; cost of new or supplemental water resource development; loss from impaired navigability of streams, rivers, and canals.

- *Environment:*
  Impacts associated with wildlife, fisheries, forests, and other fauna. Examples of drought-induced environment impacts include: loss of biodiversity of plants or wildlife; loss of trees from urban landscapes, shelterbelts, wooded conservation areas; reduction and degradation of fish and wildlife habitat; lack of feed and drinking water; greater mortality due to increased contact with agricultural producers, as animals seek food from farms and producers are less tolerant of the intrusion; disease; increased vulnerability to predation (from species concentrated near water); migration and concentration (loss of wildlife in some areas and too many wildlife in other areas); and increased stress to endangered species.

- *Fire:*
  Impacts associated with forest and range fires that occur during drought events. The relationship between fires and droughts is very complex. Not all fires are caused by droughts and serious fires can result when droughts are not taking place.

- *Social:*
  Impacts associated with the public, or the recreation/tourism sector. Examples of drought-induced social impacts include: health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations, reduced firefighting capability, etc.); loss of human life (e.g., from heat stress, suicides); public safety from forest and range fires; increased respiratory ailments; increased disease caused by wildlife concentrations; population migrations (rural to urban areas, migrants into the United States); loss of aesthetic values; reduction

or modification of recreational activities; losses to manufacturers and sellers of recreational equipment; losses related to curtailed activities (hunting and fishing, bird watching, boating, etc.).

- *Other:*
  Drought impacts that do not easily fit into any of the above categories.

5.8.2 Regulatory Environment

There are negligible formal regulations that pertain to drought events.

5.8.3 Hazard Events

Warren County has had only 2 occurrences of drought stage conditions (as recognized by NOAA). Neither of which caused any property damage or crop loss.

Table 5-33: Drought Events Since 1999

LOCATION	DATE	TYPE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
Warren Co.	7/1/1999	Drought	0	0	0.00K	0.00K
Warren Co.	8/1/1999	Drought	0	0	0.00K	0.00K
		TOTALS:	**0**	**0**	**$0**	**$0**

5.8.4 Historical Occurrences

July 1, 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.

August 1, 1999: 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.

While NOAA and its National Climactic Database do not list a drought in 2012, there were nationwide drought conditions observed that year. The 2012-2013 North American droughts began in the spring of 2012, when the lack of snow in the continental United States resulted in very little melt water being absorbed into the soil. Drought conditions were experienced almost nationwide. Multiple Ohio counties were designated as being in a moderate drought condition by June. The Governor of Ohio sent a memorandum to the USDA State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought. The USDA reviewed this memorandum and determined that there were sufficient production losses in eighty-five counties to warrant a Secretarial disaster designation.

5.8.5 Magnitude/Severity

The Palmer Drought Severity Index (PDSI) was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official

drought index. The Palmer Index is most effective in determining long term drought—a matter of several months—and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought.

Table 5-34 Palmer Drought Severity Index

DROUGHT SEVERITY	RETURN PERIOD (YEARS)	DESCRIPTION OF POSSIBLE IMPACTS	DROUGHT MONITORING INDICES		
			Standardized Precipitation Index (SPI)	NDMC* Drought Category	Palmer Drought Index
Minor Drought	3 to 4	Going into drought; short-term dryness slowing growth of crops or pastures; fire risk above average. Coming out of drought; some lingering water deficits; pastures or crops not fully recovered.	-0.5 to -0.7	D0	-1.0 to -1.9
Moderate Drought	5 to 9	Some damage to crops or pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-0.8 to -1.2	D1	-2.0 to -2.9
Severe Drought	10 to 17	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed	-1.3 to -1.5	D2	-3.0 to -3.9
Extreme Drought	18 to 43	Major crop and pasture losses; extreme fire danger; widespread water shortages or restrictions	-1.6 to -1.9	D3	-4.0 to -4.9
Exceptional Drought	44 +	Exceptional and widespread crop and pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells creating water emergencies	Less than -2	D4	-5.0 or less

Source: National Drought Mitigation Center

Drought severity depends on numerous factors, including duration, intensity, and geographic extent, as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. The magnitude of drought is usually measured in time and the severity of the hydrologic deficit.

Several resources are available to evaluate drought status and estimate future expected conditions. The National Integrated Drought Information System (NIDIS) Act of 2006 (Public Law 109-430) prescribes an interagency approach for drought monitoring, forecasting, and early warning. The NIDIS maintains the U.S. Drought Portal (www.drought.gov), a web-based access point to several drought related resources. Resources include the U.S. Drought Monitor (USDM) and the U.S. Seasonal Drought Outlook (USSDO).

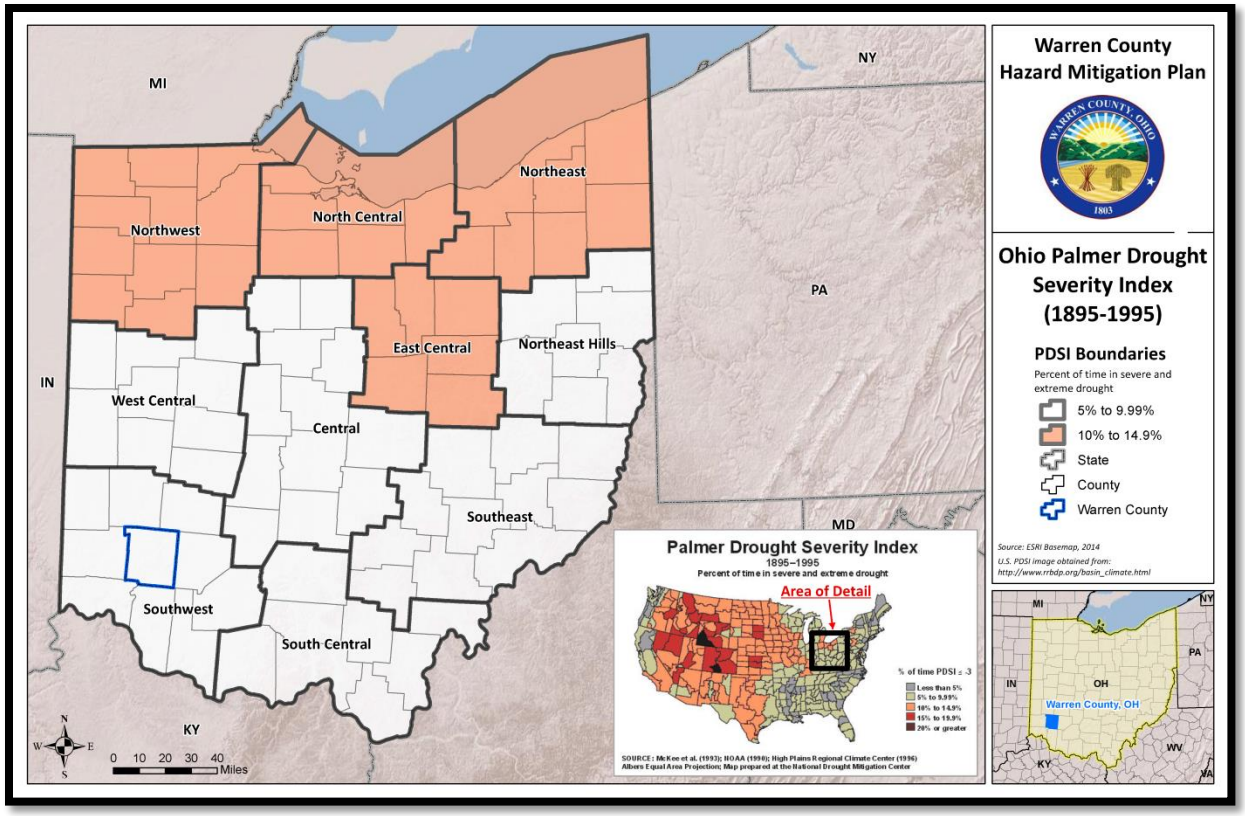


Figure 5-19 Drought Severity Map for the State of Ohio

5.8.6 Frequency/Probability of Future Occurrences

Drought conditions are likely to become more frequent and persistent over the 21st century due to climate change. Drought related to climate change will increase pressure on Ohio water resources such as Warren County. Decreasing snowmelt and spring stream flows coupled with increasing populations, anticipated hotter climate, and demand for water in southern portions of Ohio may lead to water shortages for residents.

Due to the nature of drought, it is extremely difficult to predict, but through identifying various indicators of drought, and tracking these indicators, it provides us with a crucial means of monitoring drought. Understanding the historical frequency, duration, and spatial extent of drought assists in determining the likelihood and potential severity of future droughts. The characteristics of past droughts provide benchmarks for projecting similar conditions into the future. The probability of Warren County and its municipalities experiencing a drought event can be difficult to quantify, but based on historical record of 3 recorded droughts since 1999, it can be stated that this type of event has occurred once every 5 years from 1995 through 2014.

[(Current Year) 2014] subtracted by [(Historical Year) 1999] = 15 Years on Record

[(Years on Record) 15] divided by [(Number of Historical Events) 3] = 5

Furthermore, the historic frequency calculates that there is a 20.0% chance of this type of event occurring each year.

The National Oceanic and Atmospheric Administration Paleoclimatology Program studies drought by analyzing records from tree rings, lake and dune sediments, archaeological remains, historical documents, and other environmental indicators to obtain a broader picture of the frequency of droughts in the United States. According to their research, "…paleoclimatic data suggest that droughts as severe as the 1950's drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in the 20th century have occurred in parts of North America as recently as 500 years ago." Based on this research, the 1950's drought situation could be expected approximately once every 50 years or a 20% chance every ten years. An extreme drought, worse than the 1930's "Dust Bowl," has an approximate probability of occurring once every 500 years or a 2% chance of occurring each decade. (NOAA, 2003) A 500-year drought with a magnitude similar to that of the 1930's that destroys the agricultural economy and leads to wildfires is an example of a high magnitude event.

Impacts to vegetation and wildlife can include death from dehydration and spread of invasive species or disease because of stressed conditions. However, drought is a natural part of the environment in Ohio and native species are likely to be adapted to surviving periodic drought conditions. It is unlikely that drought would jeopardize the existence of rare species or vegetative communities.

Environmental impacts are more likely at the interface of the human and natural world. The loss of crops or livestock due to drought can have far-reaching economic effects. Wind and water erosion can alter the visual landscape and dust can damage property. Water-based recreational resources are affected by drought conditions. Indirect impacts from drought arise from wildfire, which may have additional effects on the landscape and sensitive resources such as historic or archeological sites.

5.8.7 Inventory Assets and Potential Losses Due to Drought

Drought typically does not have a direct impact on critical facilities or structures. However, possible losses/impacts to critical facilities include the loss of critical function due to low water supplies. Severe droughts can negatively affect drinking water supplies. Should a public water system be affected, the losses could total into the millions of dollars if outside water is shipped in. Private springs/wells could also dry up. Possible losses to infrastructure include the loss of potable water.

But a drought evolves slowly over time and the population typically has ample time to prepare for its effects. Should a drought affect the water available for public water systems or individual wells, the availability of clean drinking water could be compromised. This situation would require emergency actions and could possibly overwhelm the local government and financial resources.

Droughts are not likely to impact structures or infrastructure. The prolonged absence of precipitation is more likely to have an impact on agricultural operations than on more urban settings. Warren County has a rural population that could be impacted by a prolonged drought. Drought conditions can significantly impact agricultural products and livestock, forcing farmers to pursue more costly methods to meet the needs of their respective farms.

5.8.8 Multi-Jurisdictional Differences

Drought is a countywide hazard and can affect all areas of the county and its jurisdictions. Due to the nature of drought, all jurisdictions within Warren County are expected to be impacted equally due to drought conditions.

5.8.9 Land Use & Development Trends

Society's vulnerability to drought is affected by (among other things) population growth and shifts, urbanization, demographic characteristics, technology, water use trends, government policy, social behavior, and environmental awareness. These factors are continually changing, and society's vulnerability to drought may rise or fall in response to these changes. For example, increasing and shifting populations put increasing pressure on water and other natural resources—more people need more water.

Future development's greatest impact on the drought hazard would possibly be to ground water resources. New water and sewer systems or significant well and septic sites could use up more of the water available, particularly during periods of drought. Public water systems are monitored, but individual wells and septic systems are not as strictly regulated. Therefore, future development could have an impact on the drought vulnerabilities.

5.8.10 Drought HIRA Summary

As stated prior, due to the nature of drought, it is extremely difficult to predict, but through identifying various indicators of drought, and tracking these indicators, it provides us with a crucial means of monitoring drought. Several mitigation measures will be reviewed and considered by Warren County for incorporation into future Plan updates.

- Assessment programs
- Water supply augmentation and development of new supplies
- Public awareness and education programs
- Technical assistance on water conservation
- Reduction and water conservation programs
- Emergency response programs
- Drought contingency plans

Some of these actions can have long-term impacts, such as contingency plan development, and the development of water conservation and public awareness programs. As Warren County gains more experience assessing and responding to drought, future actions will undoubtedly become more timely, effective, and less reactive.

5.9 *Flood Hazard Profile*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Flooding	3	0.9	2	0.6	1	0.2	2	0.2	2	0.2	**2.1**
MEDIUM RISK HAZARD (2.0 – 2.9)											

5.9.1 Hazard Identification

Warren County contains a number of rivers, streams, ditches that could potentially flood. Severe flooding would affect most Warren County waterways and, in turn, would impact properties that represent a variety of use.

A flood is a natural event for rivers and streams and occurs when a normally dry area is inundated with water. Excess water from snowmelt or rainfall accumulates and overflows onto the stream banks and adjacent floodplains. As illustrated in the figure below, floodplains are lowlands, adjacent to rivers, streams and creeks that are subject to recurring floods. Flash floods, usually resulting from heavy rains or rapid snowmelt, can flood areas not typically subject to flooding, including urban areas. Extreme cold temperatures can cause streams and rivers to freeze, causing ice jams and creating flood conditions.

The National Flood Insurance Program (NFIP), for which Flood Insurance Rate Maps (FIRM) are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the Special Flood Hazard Area (SFHA) and identify Base Flood Elevations. Figure 2-4 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA and Warren County.

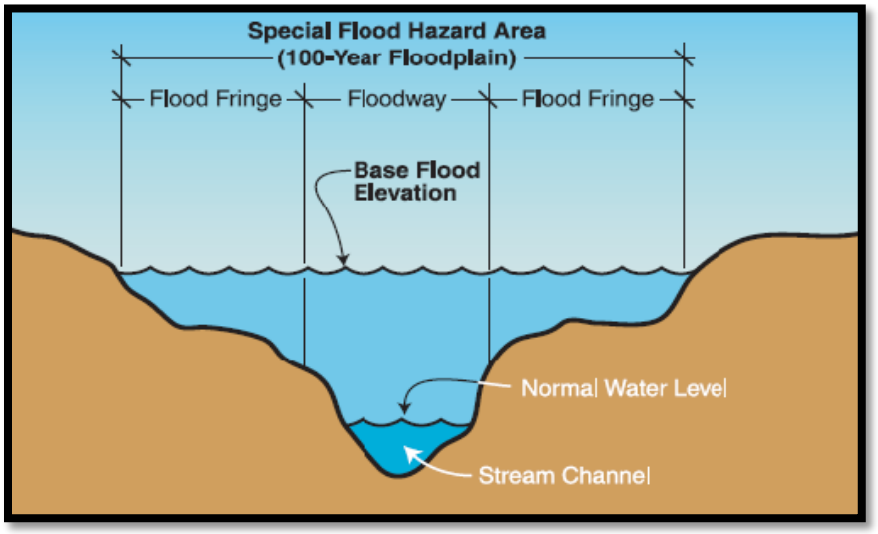


Figure 5-20 Diagram identifying Special Flood Hazard Area, 1% annual chance (100-Year) floodplain, floodway and flood fringe, FEMA.

Floods are considered hazards when people and property are affected. Nationwide, hundreds of floods occur each year, making it one of the most common hazards in all 50 states and U.S. territories. In Ohio, flooding occurs commonly and can occur during any season of the year from a variety of sources. Most injuries and deaths from flooding happen when people are swept away by flood currents and most property damage results from inundation by sediment-filled water. Fast-moving water can wash buildings off their foundations and sweep vehicles downstream. Pipelines, bridges, and other infrastructure can be damaged when high water combines with flood debris. Basement flooding can cause extensive damage. Flooding can cause extensive damage to crop lands and bring about the loss of livestock. Several factors determine the severity of floods, including rainfall intensity and duration, topography and ground cover.

Riverine flooding originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. Water from snowmelt, rainfall, freezing streams, ice flows, or a combination thereof, causes the river or stream to overflow its banks into adjacent floodplains. Winter flooding usually occurs when ice in the rivers creates dams or streams freeze from the bottom up during extreme cold spells. Spring flooding is usually the direct result of melting winter snow packs, heavy spring rains, or a combination of the two.

Flash floods can occur anywhere when a large volume of water flows or melts over a short time period, usually from slow moving thunderstorms or rapid snowmelt. Because of the localized nature of flash floods, clear definitions of hazard areas do not exist. These types of floods often occur rapidly with significant impacts. Rapidly moving water, only a few inches deep, can lift people off their feet, and only a depth of a foot or two, is needed to sweep cars away. Most flood deaths result from flash floods.

Urban flooding is the result of development and the ground's decreased ability to absorb excess water without adequate drainage systems in place. Typically, this type of flooding occurs when land uses change from fields or woodlands to roads and parking lots. Urbanization can increase runoff two to six times more than natural terrain. (National Oceanic and Atmospheric Administration, 1992) The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it.

Stream Bank Erosion is measured as the rate of the change in the position or horizontal displacement of a stream bank over a period of time. It is generally associated with riverine flooding and discharge, and may be exacerbated by human activities such as bank hardening and dredging.

Ice Jams are stationary accumulations of ice that restrict flow. Ice jams can cause considerable increases in upstream water levels, while at the same time, downstream water levels may drop. Types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, the effects downstream can be similar to that of a flash flood or dam failure. Ice jam flooding generally occurs in the late winter or spring.

Flood reduction, prevention, and mitigation are major challenges to Warren County residents and its floodplain managers. Many areas of Warren County are at risk to flooding, especially properties near creeks. Flood prone areas within Warren County can be organized by watershed, thus examining the impact of water as it travels downhill on its journey towards Little Miami River. Localized flooding associated with creek or stream overflow occurs in Warren County when rainfall runoff volumes exceed the design capacity of drainage facilities or a lack of flood control structures in place. Heavy seasonal rainfall, which typically occurs from late October through April, can result in stream overflows.

5.9.2 Regulatory Environment

Warren County continues to work to enforce the local floodplain management ordinance requirements set forth by the National Flood Insurance Program (NFIP).

Table 5-35 Warren County Community Status in the NFIP

CID	Community Name	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Reg-Emer Date	Sanctioned
390606	Carlisle, City of	07/25/1975	04/03/1984	12/17/2010	04/03/1984	
390556	Franklin, City of	11/16/1973	11/05/1980	12/17/2010	11/05/1980	
390557	Lebanon, City of	05/10/1974	03/15/1979	12/17/2010	03/15/1979	
390068	Loveland, City of	02/01/1974	09/01/1978	02/17/2010	09/01/1978	
390559	Mason, City of	06/14/1974	03/15/1979	12/17/2010	03/15/1979	
390040	Middletown, City of	06/21/1974	03/02/1979	12/17/2010	03/02/1979	
390042	Monroe, City of	05/17/1974	08/05/1991	12/17/2010	08/05/1991	
390561	Morrow, Village of	05/24/1974	08/01/1978	12/17/2010	08/01/1978	
390563	South Lebanon, Village of	05/24/1974	09/01/1978	12/17/2010	19/01/1978	
390564	Springboro, City of	04/12/1974	02/04/1981	12/17/2010	02/04/1981	
390757	Warren County*	01/06/1978	04/15/1981	12/17/2010	04/15/1981	
390565	Waynesville, Village of	11/09/1973	08/01/1980	12/17/2010	08/01/1980	
390719	Butlerville, Village of	02/14/1975	12/17/2010	12/17/2010		02/14/1976
390555	Corwin, Village of	02/08/1974	09/03/1980	12/17/2010		02/08/1975
390833	Harveysburg, Village of		12/17/2010	12/17/2010		12/17/2011
390934	Maineville, Village of		12/17/2010	12/17/2010		12/17/2011

5.9.2.1 Warren County Floodplain Regulations

These regulations authorize a County Floodplain Manager/Administrator and duties to be performed. Duties include, but are not limited to, routine monitoring of the floodplains, enforcing floodplain regulations, and providing community assistance, such as encouraging owners to maintain flood insurance.

5.9.2.2 Local Building Codes

Warren County has a number of building codes and development regulations in place to reduce flood risk for new construction, substantial improvements, or other man-made changes. The Warren County Building Department, as the floodplain administrator for the City, determines if new construction must meet certain flood zone construction criteria.

The Building Department has authority to perform Flood Zone Determinations per Flood Damage Prevention Resolution, Sections ***307.37*** and ***307.85***. Upon application for a development permit, the application and plans are reviewed to determine whether or not the site of the proposed structure is within any Special Flood Hazard Area (SFHA) designated by FEMA on regulatory Flood Insurance Rate Maps (FIRMs). More information on FEMA flood hazard areas is provided further on in this section.

New construction and substantial improvements of any structure shall have the lowest floor, including the basement, elevated at least one foot above the base flood elevation. Upon the completion of the structure, the elevation of the lowest floor including basement shall be certified by a registered professional engineer or surveyor, and verified by the community building inspector to be properly elevated. Such certification and verification shall be provided to the floodplain administrator. All new

construction and substantial improvement with fully enclosed areas below the lowest floor (excluding basements) that are usable solely for parking of vehicles, building access or storage, and which are subject to flooding, shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwater. Designs for meeting this requirement must exceed the following minimum criteria[30]:

a. Be certified by a registered professional engineer or architect; or
b. Have a minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves or other coverings or devices provided that they permit the automatic entry and exit of floodwater.

5.9.2.3 Floodplain Maps

Warren County underwent the map modernization process with FEMA and Ohio Dept. of Natural Resources from June 21, 2007 to June 17, 2010. These updated maps were adopted by the County and became effective on December 17, 2010.

5.9.2.3.1 RiskMAP Meetings

On April 16, 2014, RiskMAP meetings for the Little Miami Watershed were held in Kettering, Ohio. Representatives from Warren County and its jurisdictions included:

Table 5-36 RiskMap Attendees

Name	Title
Darren Owens	City Engineer – City of Lebanon
Kathy Dorman	Stormwater Engineer – City of Mason
Bill Barnett	Building Inspector – City of Mason
Lionel Lawhorn	Mayor – Village of South Lebanon
Jerry Spurling	Chief Building Official – Warren County

This meeting, as well as research into the existing mitigation plan helped inform information related to the Cities of Mason and Lebanon, the Village of South Lebanon and Warren County. Some of the documented items that resulted from this process include: a *List of Prioritized Mitigation Needs, Identified Actions and Challenges*; Desired Technical Support to assist with Initiating or Implementing Actions; and *Recommendations to FEMA for future Risk MAP efforts*.

Some of the Recommendations to FEMA for Future Risk MAP Efforts included:

Table 5-37 Little Miami River Watershed Recommendations to FEMA

Future Effort	Location
Floodplain Data: Provide the city with the necessary guidance to assist them in submitting the French Run culvert study for a LOMR	City of Lebanon
Produce the updated H&H (near Indianwood Drive including both Davis Run and Davis Tributary, and for Little Muddy Creek north of Bethany Road) along with depth and frequency grids to assist with risk communication and prioritizing mitigation projects	City of Mason

[30] Warren County Flood Prevention Regulations

Flood prone Properties: Identify the risk facing structures within the Special Flood Hazard Area at multiple flood frequencies. Utilize this analysis to assess the risk potential of the structures and incorporate the community's priorities to establish a prioritized list of mitigation actions. Provide additional information on possible funding sources for any mitigation projects.	Village of South Lebanon
Infrastructure Issues: Provide the county assistance in determining possible solutions to many of its infrastructure issues related undersized culverts. Assistance would include identification of issues associated with the roadway flooding, the development of possible solutions to the problems, and as the identification of funding sources for any projects. The county would also benefit from an outreach effort that includes information on how to more effectively implement mitigation into infrastructure projects since it is generally underfunded.	Warren County

5.9.2.3.2 National Flood Insurance Program (NFIP)

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. As a participating member of the NFIP, Warren County NFIP administrators are dedicated to protecting homes with 893 NFIP policies currently in force. FEMA has prepared a detailed Flood Insurance Study (FIS) for areas of Warren County; the study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood (100-year flood, base flood) and the 0.2-percent annual chance flood (500-year flood). Base flood elevations and the boundaries of the 0.1% and 0.2% Annual Chance flood zones are shown on FIRMs. More information on location and geographic extent are provided in Section 5.3.3.

Warren County entered the NFIP on April 15, 1981. As a participant in the NFIP, Warren County is dedicated to regulating development in the FEMA floodplain areas in accordance with NFIP criteria. Structures permitted or built in Warren County before the NFIP regulatory requirements were incorporated into the ordinances (before the effective date of the County's FIRM) and are called "pre-FIRM" structures.

There are 11 Repetitive Loss (RL) to private properties insured by the NFIP in Warren County. The total dollar amount of claims paid to date by the NFIP is $367,933.76. A RL *property* is a FEMA designation defined as an insured property that has made two or more claims of more than $1,000 in any rolling 10-year period since 1978. The term "rolling 10-year period" means that a claim of $1,000 can be made in 1991 and another claim for $2,500 in 2000; or one claim in 2001 and another in 2007, as long as both qualifying claims happen within ten years of each other. Claims must be at least ten days apart but within ten years of each other. RL properties may be classified as a Severe Repetitive Loss (SRL) property under certain conditions. A SRL property has had four or more claims of at least $5,000, or at least two claims that cumulatively exceed the building's reported value. A property that sustains repetitive flooding may or may not be on Warren County RL property list for a number of reasons:

- Not everyone is required to carry flood insurance. Structures carrying federally-backed mortgages that are in a SFHA are required to carry flood insurance in Warren County;
- Owners who have completed the terms of the mortgage or who purchased their property outright may not choose to carry flood insurance and instead bear the costs of recovery on their own;
- The owner of a flooded property that does carry flood insurance may choose not to file a claim;
- Even insured properties that are flooded regularly with filed claims may not meet the $1,000 minimum threshold to be recognized as an RL property; or

- The owner adopted mitigation measures that reduce the impact of flooding on the structure, removing it from the RL threat and the RL list (in accordance with FEMA's mitigation reporting requirements).

Extensive FEMA NFIP databases are used to track claims for every participating community. FEMA databases maintain all NFIP claims which allow for the examination of single-loss (SL) properties and RL properties.

NFIP Community Overview:

Table 5-38: Warren County In-Force Policies[31]

Community	Policies In-Force	Insurance In-Force	Premium In-Force
WARREN COUNTY*	436	$73,887,100	$334,253
SPRINGBORO, CITY OF	42	$12,349,000	$49,406
WAYNESVILLE, VILLAGE OF	4	$1,185,400	$3,994
Total	**482**	**$87,421,500**	**$387,653**

Table 5-39 Warren County Repetitive Loss Properties

LOCATION	TYPE	NUMBER OF LOSSES	BUILDING PAYMENTS	CONTENTS PAYMENTS	TOTAL PAYMENTS
Mason, City of	Non-Residential	2	$21,036.85	$933.80	$21,970.65
Morrow, Village of	Single Family	2	$2,720.00	$530.00	$3,250.00
South Lebanon, Village of	Single Family	3	$131,148.01	$29,008.19	$160,156.20
South Lebanon, Village of	Single Family	4	$22,323.05	$2,128.30	$24,451.35
South Lebanon, Village of	Single Family	2	$14,446.02	$0.00	$14,446.02
South Lebanon, Village of	Single Family	4	$61,035.80	$2,509.61	$63,545.41
South Lebanon, Village of	Single Family	2	$11,444.78	$10,051.35	$21,496.13
Springboro, City of	Non-Residential	2	$1,459.79	$11,119.26	$12,579.05
Warren County*	Single Family	3	$34,162.35	$1,159.66	$35,322.01
Warren County*	Single Family	2	$5,389.38	$0.00	$5,389.38
Warren County*	Single Family	2	$5,327.56	$0.00	$5,327.56

5.9.2.4 Miami Conservancy District

[32]The Conservancy Act is a broadly powered piece of legislation that allowed the creation of conservancy districts in the state of Ohio. In February 1914, the Ohio General Assembly passed the Conservancy Act of Ohio (Chapter 6101), which permitted the creation of regional agencies to provide flood protection for

[31] http://bsa.nfipstat.fema.gov/reports/1011.htm#OHT

[32] https://www.miamiconservancy.org/about/conservancy.asp

communities within the state. The Miami Conservancy District was formed in 1915, and is among the oldest conservancy districts in the state.

As political subdivisions of the state of Ohio, conservancy districts can form at the initiative of local landowners or communities to solve water management problems, usually flooding. In addition to flood protection, other approved purposes of conservancy districts include conserving and developing water supplies, treating wastewater and providing recreational opportunities.

5.9.3 Hazard Events

Table 5-40 Warren County Flood Events Since 1996

LOCATION	DATE	TYPE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
Warren County	4/29/1996	Flood	0	0	$3,000	$0
Warren County	4/29/1996	Flash Flood	0	0	$2,000	$0
Warren County	5/4/1996	Flash Flood	0	0	$10,000	$0
Warren County	5/11/1996	Flood	0	0	$0	$0
Deerfield TWP	5/11/1996	Flash Flood	0	0	$3,000	$0
Warren County	6/1/1997	Flood	0	0	$1,000,000	$0
Warren County	6/1/1997	Flash Flood	0	0	$10,000	$0
Mason	6/18/1997	Flash Flood	0	0	$5,000	$0
Mason	7/14/1997	Flash Flood	0	0	$100,000	$0
Loveland Park	7/22/1997	Flash Flood	0	0	$500,000	$0
Warren County	4/16/1998	Flash Flood	0	0	$2,000,000	$0
Warren County	4/16/1998	Flood	0	0	$0	$0
Warren County	1/3/2000	Flash Flood	0	0	$10,000	$0
Morrow	2/13/2000	Flash Flood	0	0	$5,000	$0
Warren County	2/18/2000	Flood	0	0	$0	$0
Mason	5/18/2001	Flash Flood	0	0	$5,000	$0
Mason	6/6/2001	Flash Flood	0	0	$3,000	$0
Warren County	6/6/2001	Flash Flood	0	0	$10,000	$0
Waynesville	6/12/2001	Flash Flood	0	0	$3,000	$0
Mason	7/17/2001	Flash Flood	0	0	$604,000	$0
Mason	8/11/2001	Flash Flood	0	1	$0	$0
Warren County	12/17/2001	Flood	0	0	$0	$0
Warren County	5/7/2002	Flood	0	0	$0	$0
Warren County	7/23/2002	Flood	0	0	$2,000	$0
Warren County	7/27/2002	Flood	0	0	$2,000	$0
Five Points	7/27/2002	Flash Flood	0	0	$8,000	$0
Warren County	9/27/2002	Flood	0	0	$0	$0
Warren County	9/27/2002	Flood	0	0	$0	$0
Warren County	11/10/2002	Flood	0	0	$0	$0
Warren County	5/10/2003	Flood	0	0	$0	$0
Lebanon	6/16/2003	Flash Flood	0	0	$20,000	$0
Warren County	6/17/2003	Flood	0	0	$30,000	$0
Warren County	7/10/2003	Flood	0	0	$0	$0
Warren County	7/10/2003	Flood	0	0	$0	$0
Warren County	7/15/2003	Flood	0	0	$0	$0
Warren County	8/15/2003	Flood	0	0	$0	$0
Warren County	9/2/2003	Flood	0	0	$0	$0
Warren County	9/2/2003	Flood	0	0	$0	$0
Warren County	1/4/2004	Flood	0	0	$0	$0
Warren County	1/4/2004	Flood	0	0	$0	$0
Warren County	1/4/2004	Flood	0	0	$0	$0

LOCATION	DATE	TYPE	DEATH	INJURY	PROPERTY DAMAGE	CROP DAMAGE
Warren County	5/19/2004	Flood	0	0	$0	$0
Warren County	1/5/2005	Flood	0	0	$10,000	$0
Warren County	1/5/2005	Flash Flood	0	0	$20,000	$0
Warren County	1/5/2005	Flood	0	0	$10,000	$0
Warren County	1/11/2005	Flood	0	0	$10,000	$0
Warren County	3/28/2005	Flood	0	0	$0	$0
Warren County	6/30/2005	Flood	0	0	$0	$0
Lebanon	3/12/2006	Flash Flood	0	0	$0	$0
Maineville	4/7/2006	Flash Flood	0	0	$0	$0
Mason	6/26/2007	Flood	0	0	$0	$0
Kings Mills	3/4/2008	Flood	0	0	$3,000	$0
Socialville	3/18/2008	Flood	0	0	$5,000	$0
South Lebanon	3/18/2008	Flash Flood	0	0	$30,000	$0
Warren County	5/15/2008	Flood	0	0	$2,000	$0
Mason	6/26/2009	Flash Flood	0	0	$20,000	$0
Morrow	8/4/2009	Flash Flood	0	0	$15,000	$0
Lebanon	5/21/2010	Flash Flood	0	0	$2,000	$0
Lebanon	5/21/2010	Flash Flood	0	0	$1,000	$0
Lebanon	5/21/2010	Flash Flood	0	0	$10,000	$0
Stubbs Mills	4/19/2011	Flood	0	0	$1,000	$0
Lebanon	12/5/2011	Flood	0	0	$1,000	$0
Socialville	1/17/2012	Flood	0	0	$1,000	$0
Crosswick	1/26/2012	Flood	0	0	$1,000	$0
Mason	7/6/2013	Flash Flood	0	0	$1,000	$0
Springboro	7/6/2013	Flash Flood	0	0	$1,000	$0
South Lebanon	7/6/2013	Flood	0	0	$10,000	$0
Union Village	7/6/2013	Flash Flood	0	0	$1,000	$0
Lebanon	12/22/2013	Flood	0	0	$0	$0
TOTALS:			**0**	**1**	**$4,490,000**	**$0**

5.9.4 Historical Occurrences

Warren County has been a part of 34 Federal Disaster Declarations that included flooding. Warren County has been able to avoid the bulk of the damages associated with flood events of this magnitude. However, the County has experienced localized riverine and urban flooding, impacting residents and their property.

March 1913: The citizens of the Miami Valley witnessed a natural disaster unparalleled in the region's history. Within a three-day period, eight to 11 inches of rain fell throughout the Great Miami River Watershed. This rainfall, coupled ground already saturated from the melting of snow and ice of a hard winter, produced more than 90-percent runoff, and caused the Great Miami River and its tributary streams to overflow. Every city along the river was inundated with floodwaters.

More than 360 people lost their lives. Property damage exceeded $100 million (that's more than $2 billion in today's economy). The amount of water that passed through the river channel in Dayton equaled the amount of water that flows over Niagara Falls in a four-day period.

July 22, 1997: Five inches of rain fell in only a few hours in a highly urbanized area. Water flooded roads and swept a few cars away. The local Holiday Inn had 30 rooms flooded. Property damage was estimated at $500,000 as a result of this event.

April 16, 1998: A warm front remained across southwestern Ohio through the overnight hours providing the focus for thunderstorms which produced 2-4 inches of rain in 6-8 hours. Persistent heavy rainfall

caused county creeks and streams to flood across roads. A section of State Route 350 was washed out by the high water. One hundred fifty people were evacuated from the banks of Turtle Creek while a total of 210 were evacuated across the county. Seventy homes received minor damage and 5 had major damage. This storm event generated $2 Million in damages.

July 17, 2001: One hundred homes sustained damage with two destroyed from high water. A resident lost six cars when water flooded his garage. Several roads across county sustained minor damage. Total estimate of public assistance is $603,916.

January 5, 2005: A stationary frontal boundary draped across the Ohio Valley was the focusing mechanism for an extended period of heavy rain across much of central and southern Ohio. Many locations received two to four inches of rain in a 24-hour period, which increased flooding problems as the ground was already saturated from recent snowmelt. Widespread flooding of roads and low lying areas occurred across the region, with numerous creeks and streams rising out of their banks.

March 18, 2008: Several waves of low pressure moved along a stationary front located across the Ohio Valley. The waves of low pressure brought an extended period of heavy rain, with three to six inches of rainfall across southwest and central Ohio. Voluntary evacuations due to high water in South Lebanon. One home was surrounded by water along Mason-Morrow-Millgrove Road just east of South Lebanon. Todds Fork came out of its bank in Morrow, forcing the closure of US Route 22/State Route 3 in town. Numerous other roads were flooded across the southern part of the county, particularly near Landen in Deerfield Township and in Harlan Township.

July 6, 2013: A large, slow moving area of rain with embedded heavier showers moved across the area from the late morning into the afternoon. The result was heavy rainfall with localized flooding and flash flooding. Basement flooding occurred due to heavy rainfall. Property damage was estimated at $10,000 as a result of this incident.

5.9.5 Magnitude/Severity

The Little Miami River is a tributary of the Ohio River. It is part of a watershed that drains 1,757 square miles in 11 southwestern Ohio counties. The river discharges on average 1,737 cubic feet per second (49.2 m3/s) into the Ohio River. An average of 1,280 cubic feet per second (36 m3/s) flow through the river proper; after heavy rains, the river flow may rise to 84,100 cubic feet per second (2,380 m3/s).

Tributaries of the Little Miami include Sugar Creek, the East Fork Little Miami, North Fork, Todd's Fork, Duck Creek, Caesar Creek, Massie Creek, and Turtle Creek. The river's main tributary, the East Fork of the Little Miami, was dammed in 1977 by the United States Army Corps of Engineers to create Harsha Lake, located in East Fork State Park. Similarly, in 1973, the Army Corps dammed Caesar Creek to create Caesar Creek Lake, located in Caesar Creek State Park.

The river's headwaters, considered part of the North Fork, are located about 5 miles (8.0 km) from South Charleston in Clark County, near Plattsburgh. The river empties into the Ohio River at California, a neighborhood of Cincinnati in Hamilton County. Between the headwaters and the mouth, there is a 705-foot (215 m) decrease in elevation.

The maximum flood of record occurred along the Little Miami River in March 1913. Along small tributaries, flood stages can rise from normal flow to extreme flood peaks, with accompanying high velocities, in a relatively short period. Along the Little Miami, floods rise to their crest over a longer period and remain out of banks for a more extended length of time.

Considering the available records of all known floods in the basin, it is probable that the ten (10) largest floods along the Blanchard occurred in 1913, 1959, 1940, 1937, 1945, 1963, 1964, 1968, 1937 and 1933. Historical Crests for the five largest floods of record for the Little Miami at Kings Mills are shown below.

Table 5-41 Highest Historical Crests on the Little Miami River

DATE OF CREST	FEET
03/26/1913	33.70
01/22/1959	31.80
04/20/1940	26.77
01/25/1937	26.77
03/06/1945	26.54

Information on historical floods along the Little Miami River and along the lower reaches of its major tributaries was obtained from stream gauging stations maintained by NOAA.

Table 5-42 Flood Stage Categories for the Little Miami at Kings Mill

FLOOD CATEGORIES	FEET
MAJOR FLOOD STAGE	31’
MODERATE FLOOD STAGE	24’
FLOOD STAGE	17’
ACTION STAGE	13’

5.9.6 Frequency/Probability of Future Occurrences

Reported flood events over the past 18 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County and its municipalities experiencing a flood event can be difficult to quantify, but based on historical record of 50 flood events since 1996, it can reasonably be assumed that this type of event has occurred once every .36 years from 1996 through 2014.

[(Current Year) 2014] subtracted by [(Historical Year) 1996] = 18 Years on Record

[(Years on Record) 18] divided by [(Number of Historical Events) 50] = 0.36

Furthermore, the historic frequency calculates that there is a 100% chance of this type of event occurring each year.

5.9.7 Inventory Assets Exposed to Flooding

The method used in determining the types and numbers of potential assets exposed to flooding was conducted using a loss estimation model called HAZUS-MH. HAZUS-MH is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Buildings Sciences (NIBS). For this Plan, a 100-year flood scenario was modeled and the results are presented below.

5.9.7.1 HAZUS-MH 100-YEAR FLOOD SCENARIO

HAZUS estimates that approximately 1,102 buildings will be at least moderately damaged which is over 60% of the total number of buildings in the scenario. There are an estimated 465 buildings that will be completely destroyed. The tables below summarize the expected damage by general occupancy for the buildings and the expected building damage by building type in the study region.

Table 5-43 HAZUS-MH Flood Scenario Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	1	25.00	2	50.00	1	25.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	1	33.33	1	33.33	0	0.00	1	33.33	0	0.00
Religion	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	28	2.56	105	9.60	191	17.46	305	27.88	465	42.50
Total	**0**		**31**		**108**		**192**		**306**		**465**	

Table 5-44 HAZUS-MH Flood Scenario Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	68	100.00
Masonry	0	0.00	2	1.27	11	7.01	30	19.11	50	31.85	64	40.76
Steel	0	0.00	1	50.00	1	50.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	26	2.99	95	10.91	162	18.60	255	29.28	333	38.23

The scenario reports that 2 critical facilities in the study region will experience a moderate damage by a 100-year flood event. Critical facilities are essential to the health and welfare of the whole population and are especially important following hazard events. HAZUS indicates that there are approximately 44 critical facilities that are flood prone. Please note that HAZUS refers to these buildings as "essential." The definition of these facilities may differ between the County and what HAZUS refers to as essential.

Table 5-45 HAZUS Determined Critical Facilities in Warren County that are Flood Prone

CRITICAL FACILITIES	# OF FLOODPRONE STRUCTURES
FIRE	19
POLICE	0
HOSPITALS	12
SCHOOLS	61
TOTAL STRUCTURES	**92**

5.9.7.2 HAZUS-MH 100-Year Flood Scenario Debris Generation

HAZUS estimates the amount of debris that will be generated by the 100-year flood. The model breaks the debris into three general categories: a) Finishes (dry wall, insulation), b) Structural (wood, brick), and c) Foundations (concrete, slab, block, rebar). This distinction is made because of the different types of materials handling equipment required to handle the debris.

The model estimates that a total of 23,659 tons of debris will be generated due to the flood. Of the total amount, finishes comprises 51% of the total, structural comprises of 34% of the total, with the remainder being foundations. If the building tonnage is converted to an estimated number of truckloads, it will require 946 truckloads (@25 tons/truck) to remove the debris generated by the flood.

5.9.7.3 HAZUS-MH 100-Year Flood Scenario Displacement and Shelter Requirements

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 4,710 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area.

5.9.8 Multi-Jurisdictional Differences

Many of the jurisdictions in Warren County are situated along waterways. This may date back to the initial settlement of the area, and the need to be near water for a variety of reasons. As a result, there are multiple jurisdictions at risk to a 100-year, or 1% annual chance flood event. The Cities of Franklin, Lebanon and Mason have areas impacted by these flood waters. The areas around the Little Miami River, Great Miami River and Millers Creek all see increased risk from a 1% annual chance event. When examining the results from the Hazus-MH scenario for the County, the area around the City of Franklin is projected to suffer the highest levels of commercial losses. When looking at projected residential losses, the City of Franklin and the Village of South Lebanon are expected to experience the greatest impact. This is further reinforced when looking at the repetitive loss properties in Warren County. South Lebanon has 5 of the 11 total RL properties in the County.

5.9.9 Potential Losses from Flooding

All assets are considered at risk from flooding; however, losses may vary widely depending on the type and factors contributing to the flood. To examine the potential losses from a flood, Warren County modeled a 100-year flood using FEMA's loss estimation tool: HAZUS-MH.

5.9.9.1 HAZUS-MH 100-YEAR FLOOD SCENARIO

The total economic loss estimated for the flood is $400.24 million, which represents 6.31% of the total replacement value of the scenario buildings. The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with the inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were $399.06 million. 0% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 53.06% of the total loss. The table below provides a summary of the losses associated with the building damage.

Table 5-46 HAZUS-MH Building-Related Economic Loss Estimates (Flood Scenario)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	136.73	23.62	17.98	4.28	182.61
	Content	75.40	60.67	47.89	20.42	204.38
	Inventory	0.00	2.29	9.41	0.38	12.08
	Subtotal	**212.13**	**86.58**	**75.28**	**25.07**	**399.06**
Business Interruption						
	Income	0.01	0.23	0.01	0.03	0.28
	Relocation	0.15	0.05	0.01	0.01	0.22
	Rental Income	0.04	0.03	0.00	0.00	0.07
	Wage	0.04	0.27	0.01	0.30	0.61
	Subtotal	**0.24**	**0.57**	**0.02**	**0.34**	**1.17**
ALL	**Total**	**212.36**	**87.15**	**75.31**	**25.42**	**400.24**

The following chart summarizes the data produced by the level II, 100-year flood scenario performed on the County.

Table 5-47 Warren County HAZUS-MH Flood Scenario Summary Table

Structure Type	Number	Exposure for 100-year Scenario
Residential	6,498	$4,891,609,000
Non-residential	1,596	$1,202,141,000
Critical Facilities	325	$245,540,000

The drainage pattern for the Warren County general flows from north to south. There are three major streams that run through the county. Little Miami River and Millers Creek are a part of the Little Miami Watershed. Great Miami River is a part of the Lower Great Miami Watershed. The Little Miami River starts in the North East part of the county and flows south toward the south western part of the county where it discharges into Clermont County. See figure for location and extent of each drainage area.

The County's topography provides sufficient slope to quickly dispense storm water runoff downstream. From time to time small streams are at critical capacities during heavy rain events. These events create shallow depth and high velocity stream channel characteristics. Under such conditions, any characteristic that blocks flow has the potential to create a hydraulic jump that can significantly increase water surface elevations, increasing the risk to structures due to high water or diverted flows into uncontrolled routes. Carefully engineered drainage improvements can help minimize these risks.

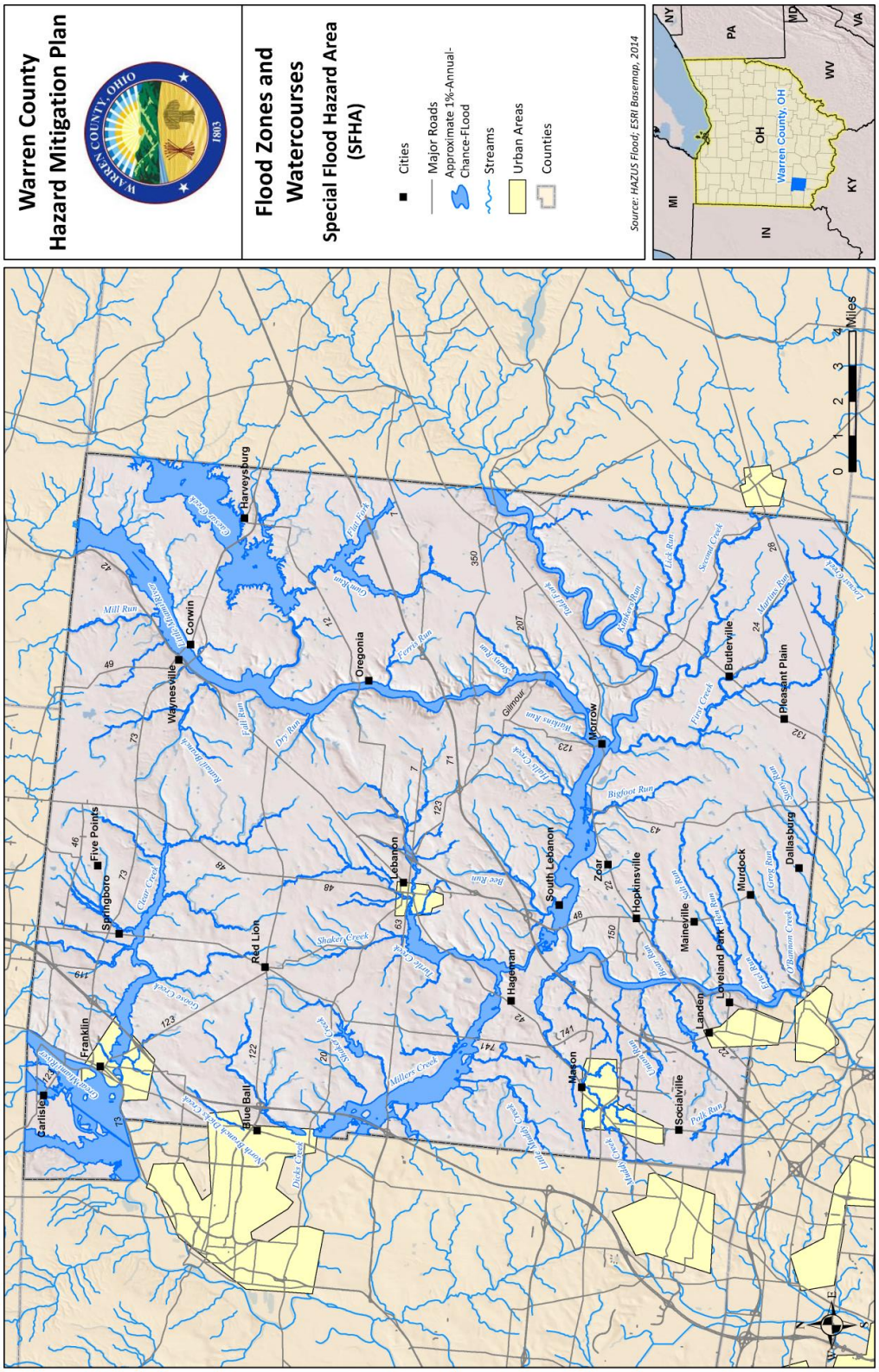


Figure 5-21 Flood Zones and Water Courses in Warren County

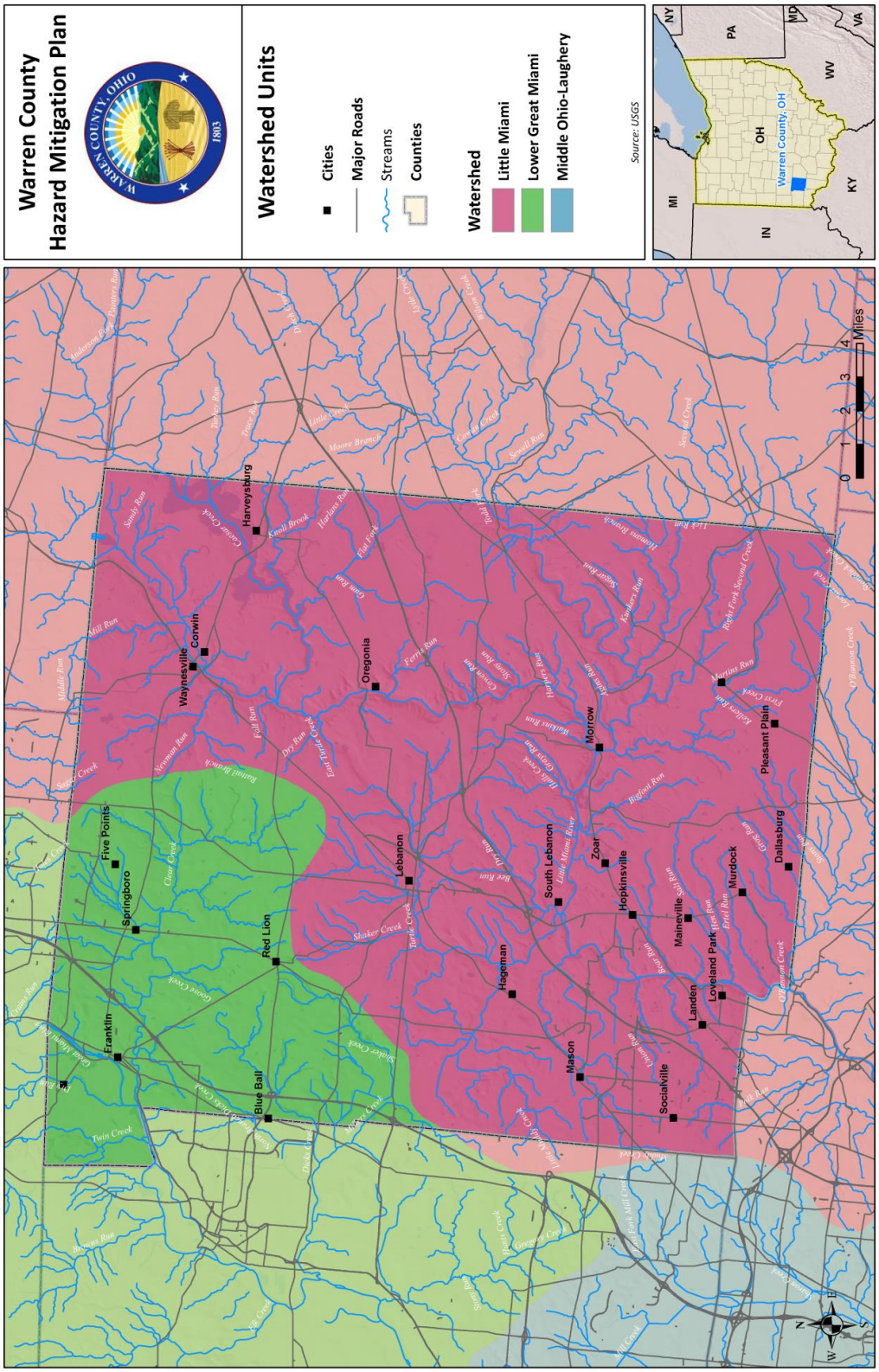


Figure 5-22 Warren County Watersheds

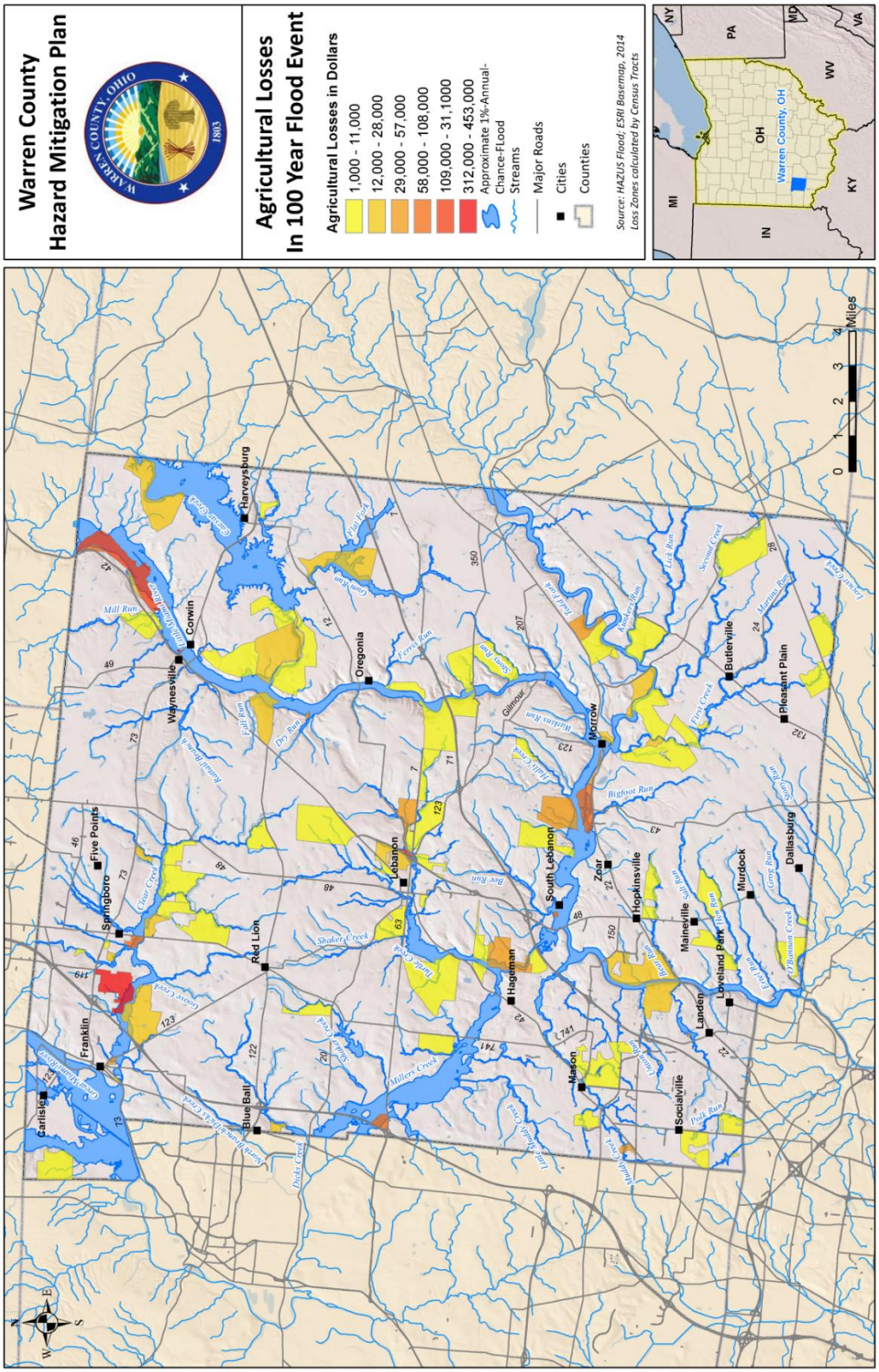


Figure 5-23 HAZUS-MH Agricultural Loss Estimation

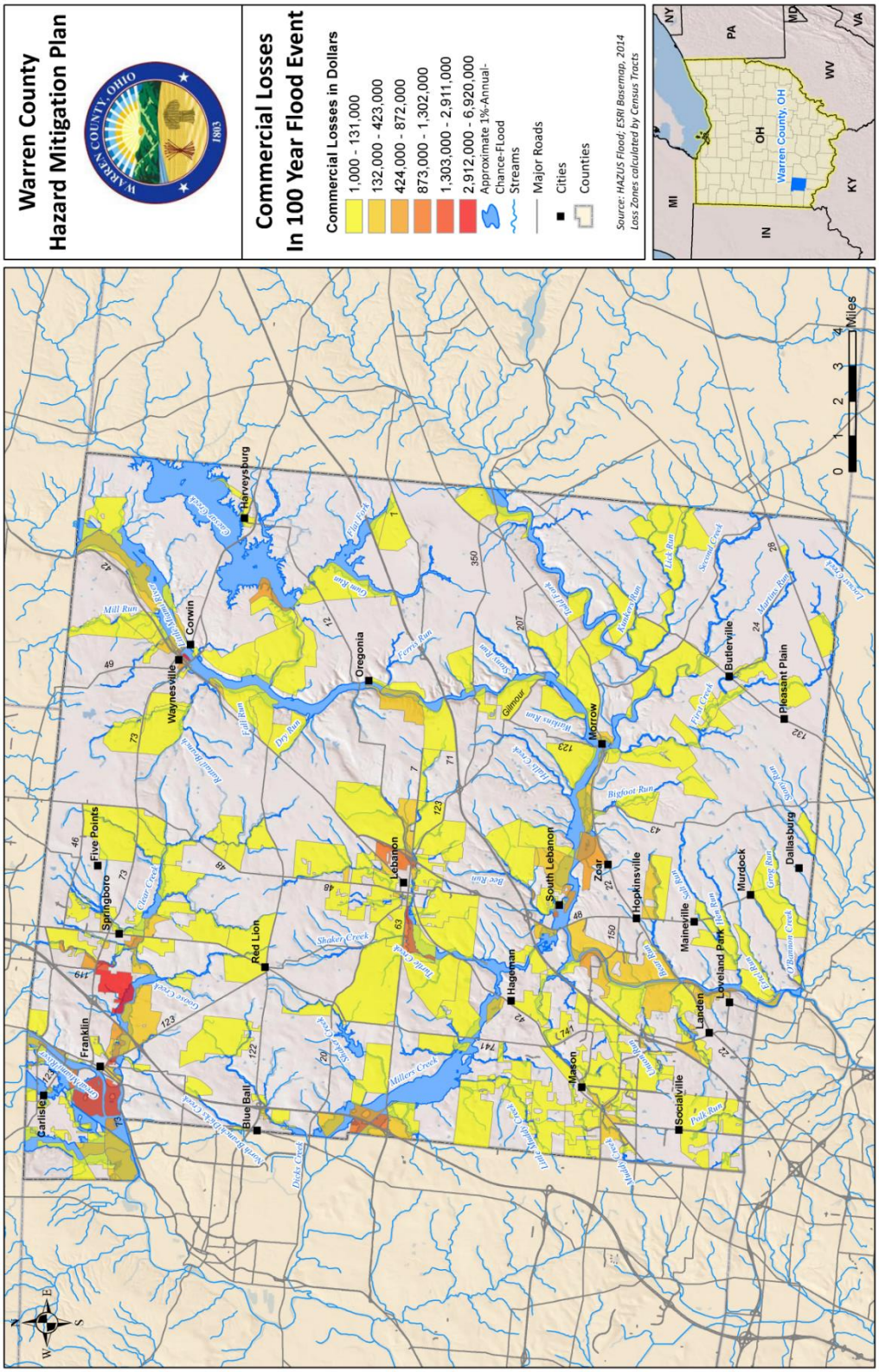


Figure 5-24 HAZUS-MH Commercial Loss Estimation

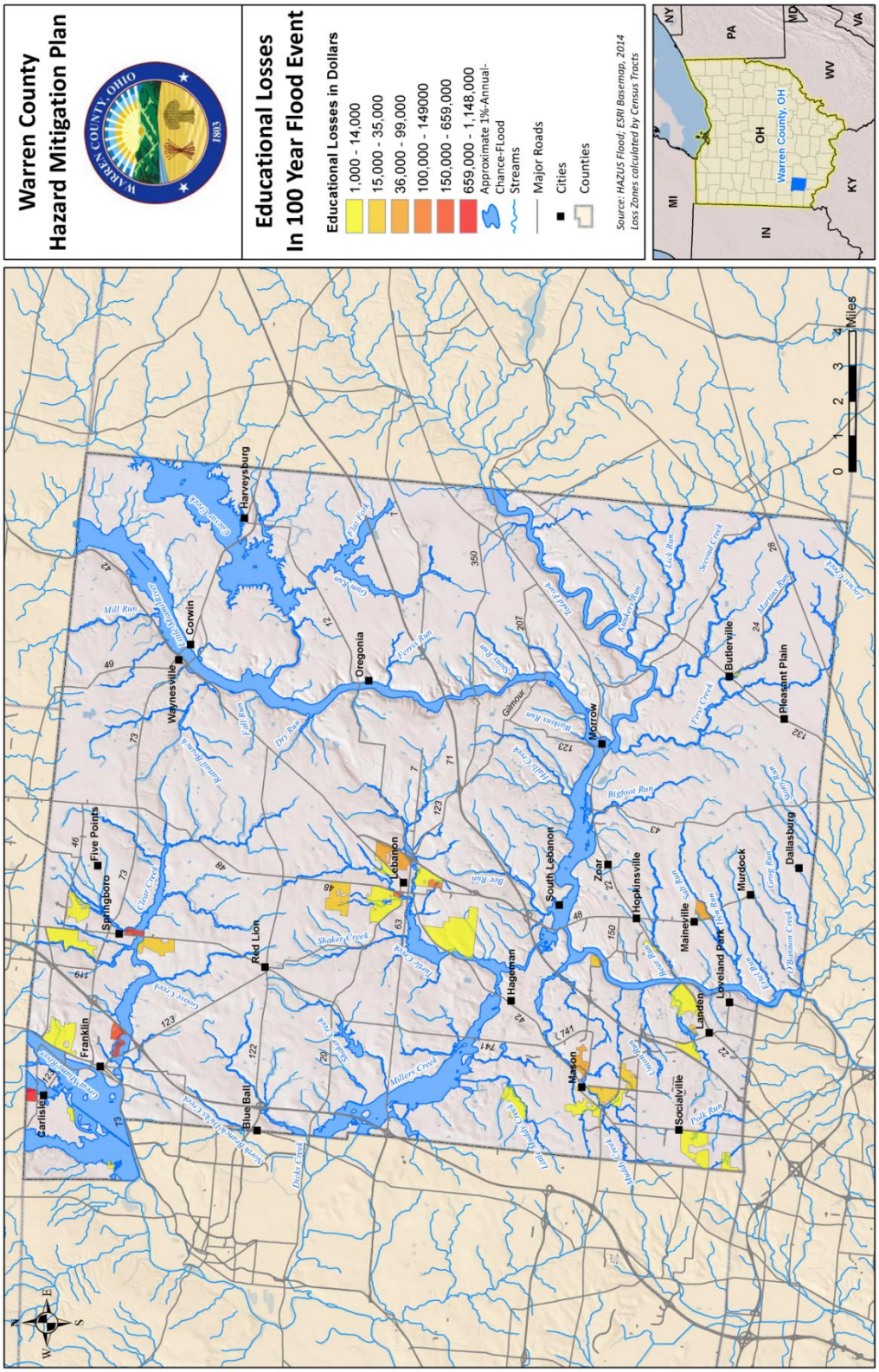


Figure 5-25 HAZUS-MH Educational Loss Estimation

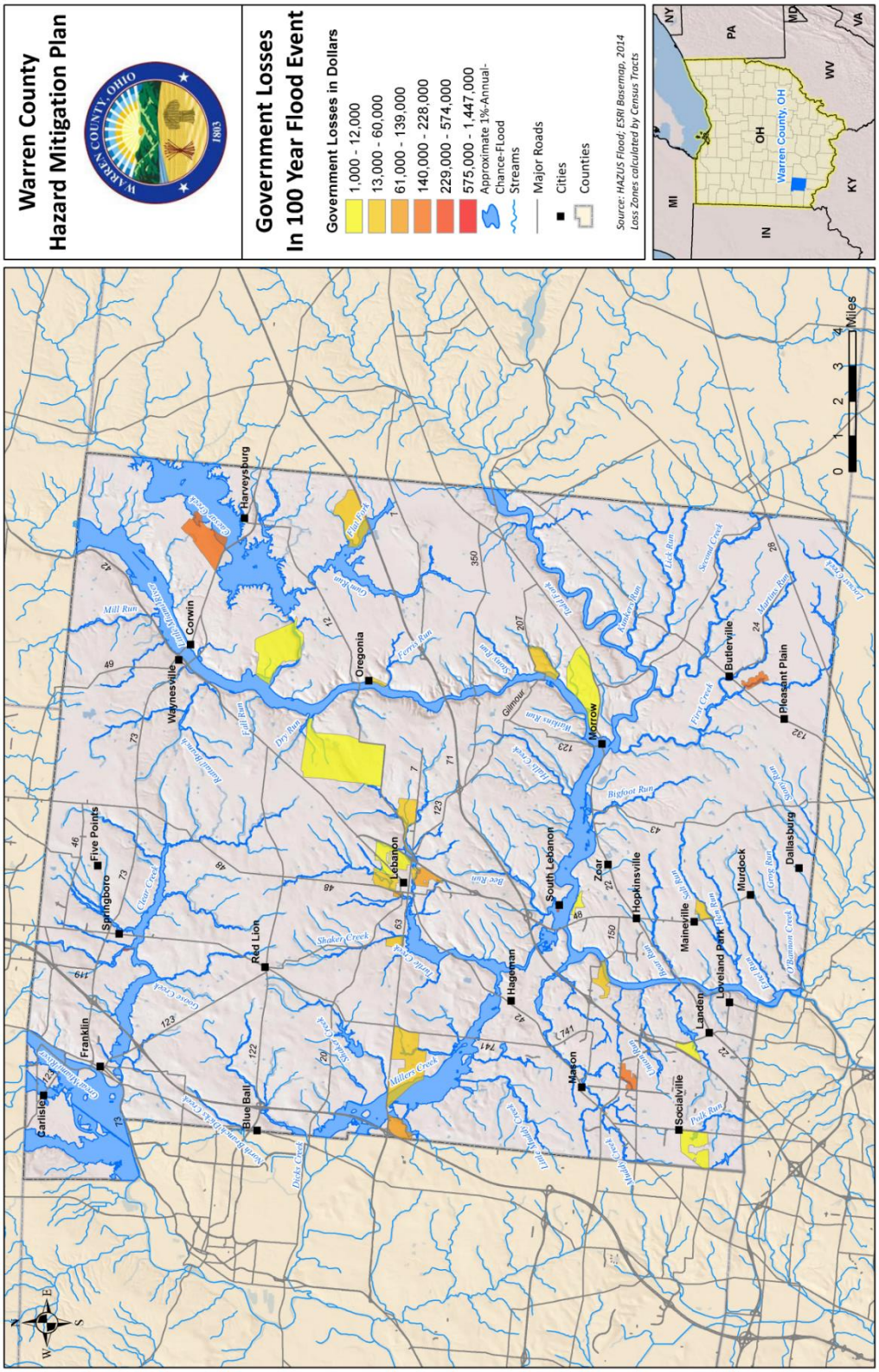


Figure 5-26 HAZUS-MH Governmental Loss Estimation

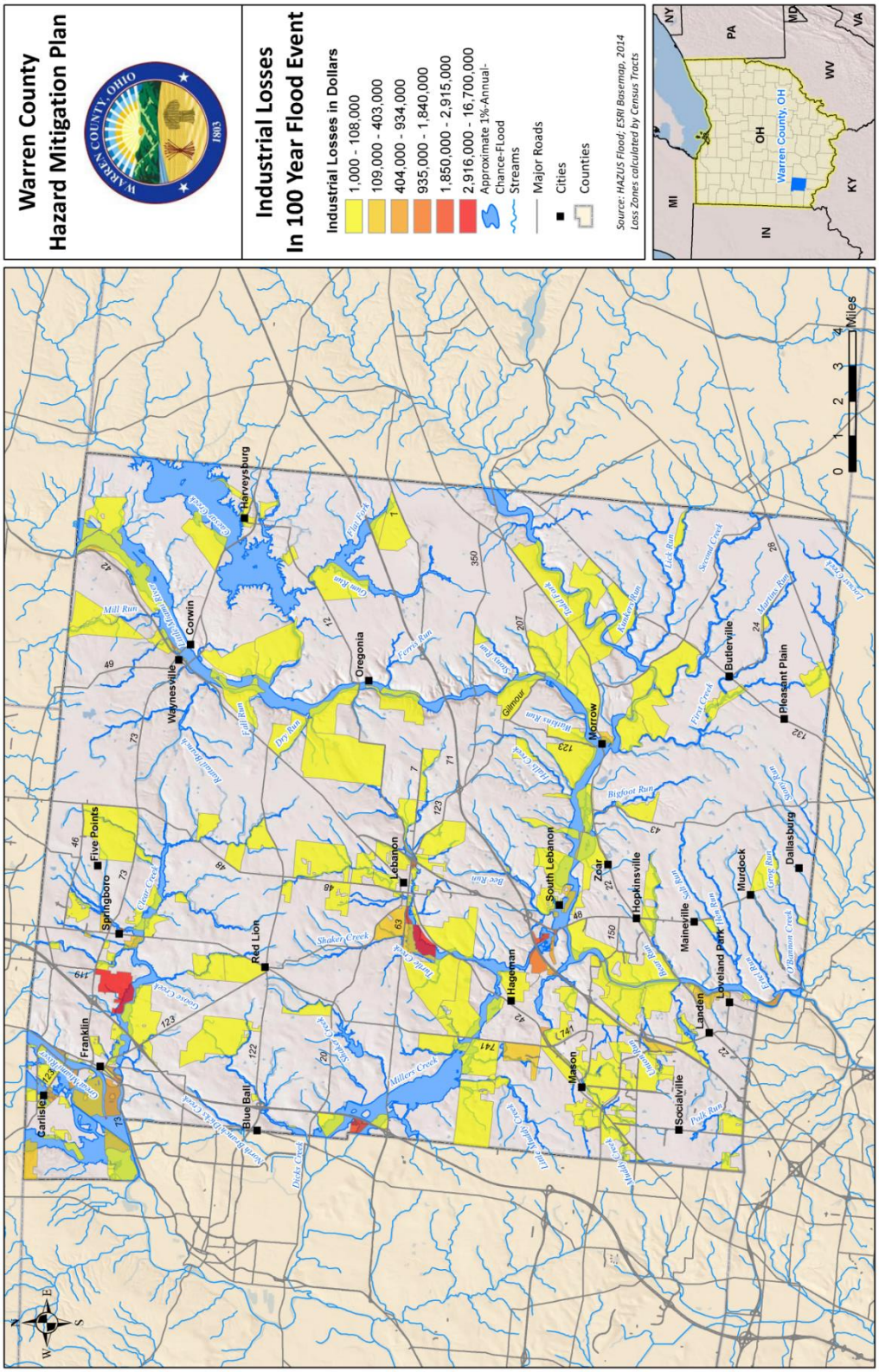


Figure 5-27 HAZUS-MH Industrial Loss Estimation

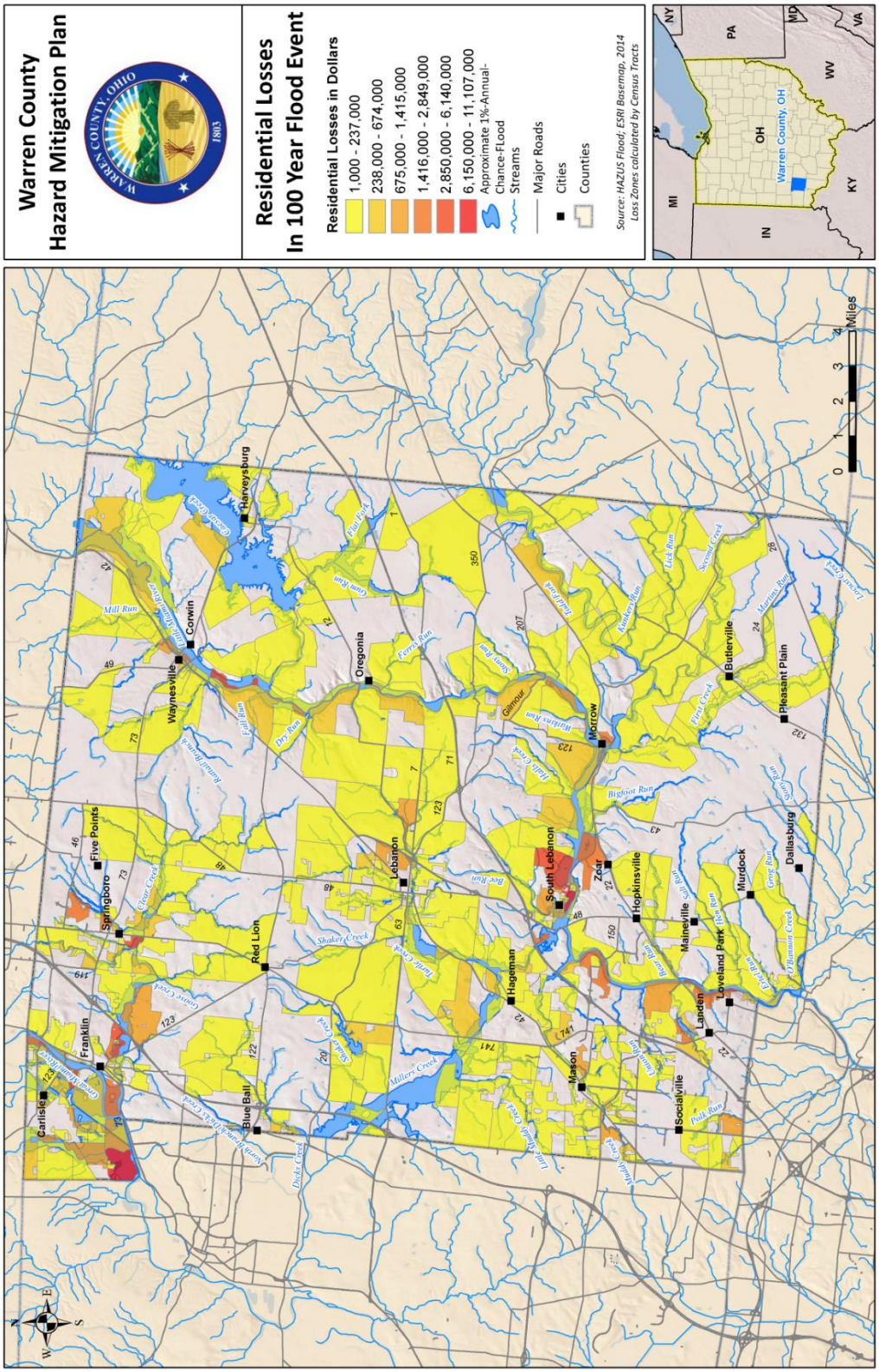


Figure 5-28 HAZUS-MH Residential Loss Estimation

5.9.10 Magnitude / Severity

Magnitude and severity of flooding generally results from prolonged heavy rainfall and are characterized by high intensity, short duration runoff events, due to the relatively short distance from the top of the mountains. Floods usually occur during the season of highest precipitations or during heavy rainfalls after long dry spells. Widespread storms over the region can occur anytime from September through April. Flooding is more severe when the ground is frozen and infiltration is minimal due to saturated ground conditions, or when rain-on-snow in the higher elevations adds snowmelt to rainfall runoff, resulting in intensified flood conditions.

Cloudburst storms, sometimes lasting as long as 3 hours, can occur over the region anytime from late spring to early fall. They also may occur as extremely severe sequences within general winter rainstorms or during unseasonable rains. The intensity of cloudburst storms is very high, and the storms can produce enough precipitation to result in significant runoff.

Backyard flooding as well as some street flooding can occur during severe storms. Reports of minor flooding to garages and outbuildings, landscape erosion, and flooded streets have occurred in Warren County. Trash and other debris can also be found obstructing culvert and pipe openings during even moderate flows in smaller channels, which can lead to clogging, obstruction, and eventual flooding of nearby properties.

5.9.10.1 Flood Warning and Notification

The magnitude and severity of flood damage can be reduced with longer periods of warning time and proper notification before flood waters arrive. Warning times of 12 hours or more have proven adequate for preparing communities for flooding and reducing flood damages. More than 12 hours advance warning of a flood can reduce a community's flood damage by approximately 40% in comparison with unprepared communities (Read Sturgess and Associates 2000). In addition, seasonal notification for flooding can enhance awareness for residents at risk, and when communicated effectively advance notification can reach target audiences on a large scale. Warren County coordinates with National Weather Service.

5.9.11 Land Use & Development Trends

Besides the localized flooding, there is also the great amount of property, both private and public that is at risk from flooding. As development grows within the County, there is added risk and probability for damage. It is essential that zoning and land use plans take into account not only the dollar amount of damage that buildings near waterways could incur, but also the added risk of flood debris and narrowing the floodplains by building close to the rivers.

5.9.12 Flooding HIRA Summary

Severe flooding has the potential to inflict significant damage in Warren County. Assessing flood damage requires residents throughout the Village to remain alert and notify local officials of potential flood prone areas near infrastructure such as roads, bridges, and buildings. While flooding remains a highly likely occurrence throughout the identified flood hazard areas of Warren County, smaller floods caused by heavy rains and inadequate drainage capacity will be more frequent, but not as costly as the large-scale floods which may occur at much less frequent intervals. While the potential for flood is always present, Warren County does have policies and regulations for development that should help lessen potential damage due to floods.

5.10 *Wildfire Hazard Profile*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Wildfire	2	0.6	2	0.6	1	0.2	4	0.4	2	0.2	**2.0**
MEDIUM RISK HAZARD (2.0 – 2.9)											

5.10.1 Hazard Identification

Wildfire events are unwanted wildland fires, including unauthorized human-caused fires, escaped debris burns, and other ignition sources that lead to fire over wildland areas. Throughout Ohio, communities are increasingly concerned about wildfire safety as increased development and subsequent fire control practices have affected the natural cycle of the ecosystem. Wildland fires affect grass, forest, and brush lands, as well as any structures located within them. Human access to wildland areas, such as urban development in forested areas, increases the risk of fire due to a greater chance for human carelessness.

Generally, there are three major factors that sustain wildfires and predict a given area's potential to burn. These factors are fuel, topography, and weather.

- Fuel – Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is generally classified by type and volume. Fuel sources are diverse and include everything from dead tree leaves, twigs, and branches, to dead standing trees, live trees, brush, and cured grasses. Manmade structures are also considered a fuel source, such as homes and other associated combustibles. The type of prevalent fuel directly influences the behavior of wildfire. Fuel is the only factor that is under human control.

- Topography – An area's terrain and slope affect its susceptibility to wildfire spread. Both fire intensity and rate of spread increase as slope increases due to the tendency of heat from a fire to rise via convection. The arrangement of vegetation throughout a hillside can also contribute to increased fire activity on slopes.

- Weather – Weather components such as temperature, relative humidity, wind, and lightning also affect the potential for wildfire. High temperatures and low relative humidity dry out fuels that feed wildfires, creating a situation where fuel will ignite more readily and burn more intensely. Thus, during periods of drought the threat of wildfire increases. Wind is the most treacherous weather factor. The greater the wind, the faster a fire can spread and the more intense it can be. Wind shifts, in addition to wind speed, can occur suddenly due to temperature changes or the interaction of wind with topographical features such as slopes or steep hillsides. As part of a weather system, lightning also ignites wildfires, often in terrain difficult to reach by firefighters.

Wildfires can be classified as either a wildland fire or a wildland-urban interface (WUI) fire. A wildland fire occurs in an area that is relatively undeveloped except for the possible existence of basic infrastructure such as roads and power lines. A WUI fire occurs in an area that is developed with structures and other human developments. In WUI fires, the fire is fueled by both naturally occurring vegetation and the urban structural elements themselves. According to the National Fire Plan issued by the U.S. Departments of Agriculture and Interior, the wildland-urban interface is defined "as the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels".

5.10.2 Regulatory Environment

The regulatory setting for fire protection and management in Warren County is comprised of a several jurisdictions. Wildfires and structure fires are managed separately with local involvement occurring at defined geographical boundaries.

5.10.2.1 State

The Ohio Department of Natural Resources (ODNR) has statutory responsibility for wildfire protection on private lands in Ohio. (ODNR) is the agency responsible for fire suppression and prevention on non-federal lands identified as the States responsibility. (ODNR) may also provide and manage emergency services through cooperative agreements with counties and fire districts.

5.10.2.2 County

Fire protection for fire emergencies within Warren County boundaries, including structures and vehicles, is the responsibility of the nearest municipal Fire Department. Cooperative agreements between the agencies establish a partnership to protect the whole of Warren County.

5.10.3 Hazard Events/Historical Occurrences

There has not been a documented (per Ohio Department of Natural Resources) wildfire event in Warren County. Although Ohio has had several wild fires throughout the state, the region near Warren County has not yet sustained any substantial damage attributed to fires for as long as records have been maintained.

Wildfire risk analysis from Ohio Department of Forestry (ODNR), helps illustrate the areas at risk from a wildfire event throughout the State. (ODNR)

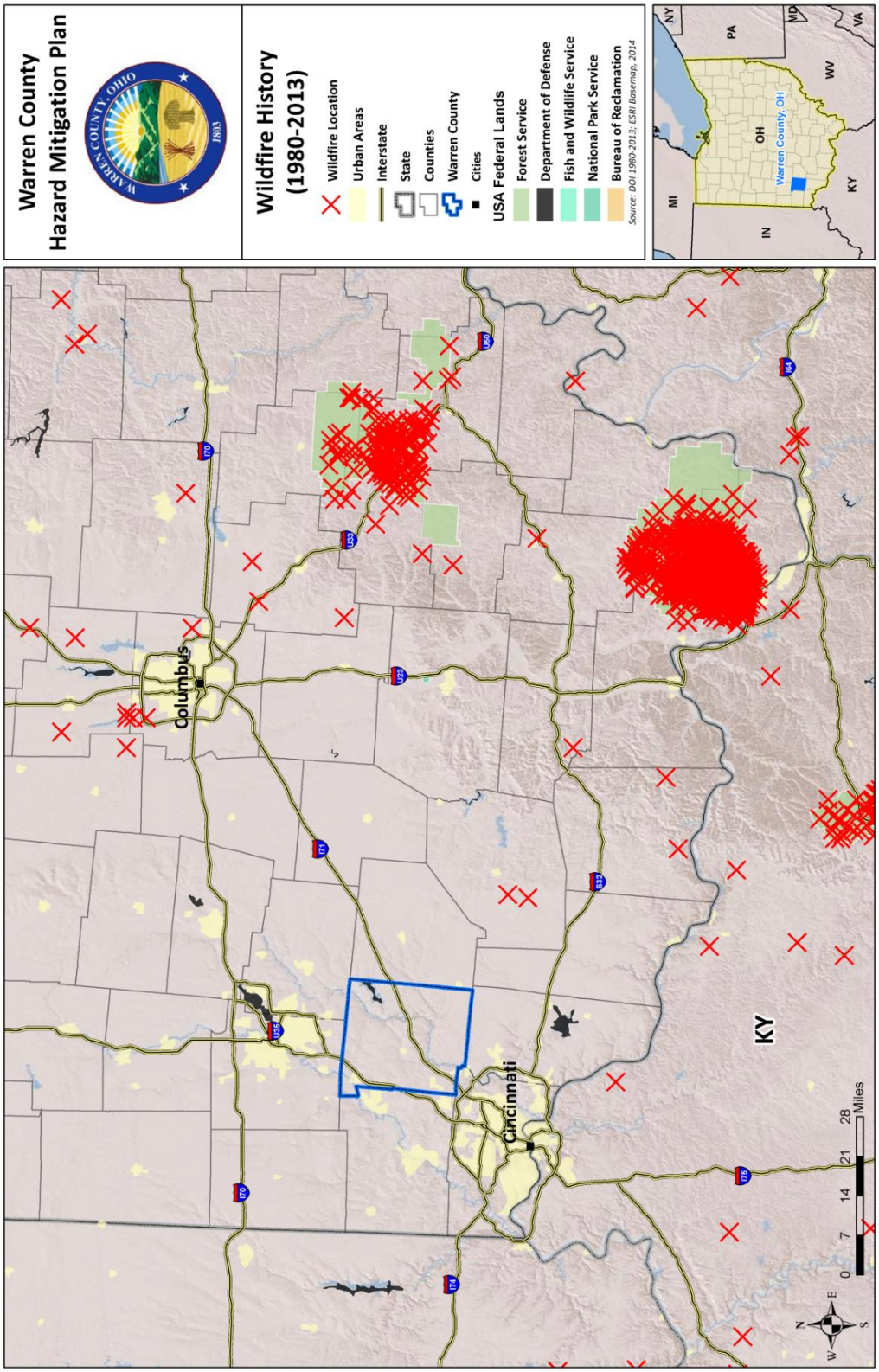


Figure 5-29 Wildfire History in Ohio (US Department of the Interior)Magnitude/Severity

The magnitude and severity of a wildfire event is measured by calculating the number of acres burned in a specific wildfire event and the severity of the burn classifications[33]. The below burn severity classifications have been adapted from USDA Natural Resources Conservation Service.

Low Fire Severity (Type III)

General statements:

- primarily occur on rangeland
- no sediment delivery
- natural recovery likely

Indicators:

- duff (decaying leaves and branches covering a forest floor) and debris are partly burned
- soil is a normal color
- hydrophobicity is low to absent
- standing trees may have some brown needles

Interpretations:

- root crowns and surface roots will re-sprout quickly
- infiltration and erosion potential are not significantly changed

Medium Fire Severity (Type II)

General statements:

- primarily occur on steep, lightly timbered slopes with grass
- some sediment delivery

Indicators:

- duff is consumed
- burned needles are still evident
- ash is generally dark colored
- hydrophobicity is low to medium on surface soil up to 1 inch deep
- soil is brown to reddish-brown and up to 2 inches of soil is darkened from burning (below ash)
- roots are alive below 1 inch
- shrub stumps and small fuels are charred but present
- standing trees are blackened but not charcoal

Interpretations:

- root crowns will usually re-sprout
- roots and rhizomes below 1 inch will re-sprout
- most perennial grasses will re-sprout
- vegetative recovery (non-tree), depending on conditions, could be one to five years
- soil erosion potential will increase due to the lack of ground cover and moderate hydrophobicity

High Fire Severity (Type I)

General statements:

- primarily occurs in unprotected drainages on steep, timbered, north or east slopes with dense forest canopy
- sediment delivery likely

[33] Natural Resources Conservation Service burn intensity classifications can be used to estimate soil heating by vegetative and physical conditions. Wildfire burn intensity is useful in preparing rehabilitation plans for properties and other post-fire activities.

- natural recovery limited

Indicators:

- duff consumed
- uniformly gray or white ash (in severe cases ash is thin and white or light)
- no shrub stumps or small fuels remain
- hydrophobicity medium to high – up to 2 inches deep
- 2 to 4 inches of soil is darkened (soil color often reddish orange)
- roots burned 2 to 4 inches
- soil physically affected (crusting, crystallization, agglomeration)
- standing trees charcoal up to 1 inch deep

Interpretations:

- soil productivity is significantly reduced
- some roots and rhizomes will re-sprout but only those deep in soil
- vegetative recovery (non-tree), depending on conditions, could be five to 10 years
- soil erosion potential can be significantly increased

5.10.4 Frequency/Probability of Future Occurrences

There is no historical precedence to determine frequency though the probability of wildfires will increase as climate change impacts increase in the region.

5.10.5 Inventory Assets Exposed to/Potential Losses to Wildfire

Fires can extensively impact the economy of an affected area, especially the logging, recreation, and tourism industries, upon which many counties depend. Major direct costs associated with forest fires or wildfires include the salvage and removal of downed timber and debris and the restoration of the burned area. If burned-out woodlands and grasslands are not replanted quickly to prevent widespread soil erosion, then landslides, mudflows, and floods could result, compounding the damage.

5.10.6 Multi-Jurisdictional Differences

Wildfires can occur at any time of day and during any month of the year, and the season length and peak months may vary appreciably from year to year.

5.10.7 Land Use & Development Trends

The Wildland Urban Interface will continue to be an issue for the more rural areas of the County. Urban areas of the County will have little issue with wildfire. Drought conditions can increase the likelihood of fire events in rural areas.

5.10.8 Wildfire HIRA Summary

Wildfires and brush fires can force school closings, disrupt telephone services by burning fiber optic cables, damage railroads and other infrastructure, and adversely affected tourism, outdoor recreation, and hunting. The likelihood of one of those fires attaining significant size and intensity is unpredictable and highly dependent on environmental conditions and firefighting response. Weather conditions, particularly drought events, increase the likelihood of wildfires occurring. It is important to note that 98% of wildfires are human-caused. Nonetheless, the critical inference to draw from this statistic is the fact that the occurrence of future wildfire events will strongly depend on patterns of human activity. Events are more likely to occur in wildfire-prone areas experiencing new or additional development.

5.11 *Dam Failure*

NATURAL HAZARDS	PROBABILITY		IMPACT		SPATIAL EXTENT		WARNING TIME		DURATION		RF RATING
Dam Failure	1	0.3	4	1.2	4	0.8	4	0.4	4	0.4	**3.1**
High RISK HAZARD (3.0 – 4.0)											

5.11.1 Hazard Identification

A dam is defined as a barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Dams typically are constructed of earth, rock, concrete, or mine tailings. A dam failure is the collapse, breach, or other failure, often resulting in down-stream flooding.

A dam impounds water in the upstream area, referred to as the reservoir. The amount of water impounded is measured in acre-feet. An acre-foot is the volume of water that covers an acre of land to a depth of one foot. As a function of upstream topography, even a very small dam may impound or detain many acre-feet of water. Two factors influence the potential severity of a full or partial dam failure: the amount of water impounded, and the density, type, and value of development and infrastructure located downstream.

Dam failures typically occur when spillway capacity is inadequate and excess flow overtops the dam, or when internal erosion (piping) through the dam or foundation occurs. Complete failure occurs if internal erosion or overtopping results in a complete structural breach, releasing a high-velocity wall of debris-laden water that rushes downstream.

Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding, which cause most failures;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Negligent operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway;
- Landslides into reservoirs, which cause surges that result in overtopping;
- High winds, which can cause significant wave action and result in substantial erosion; and
- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments, which can weaken entire structures.

Dams are considered to be localized in the state and are most likely to affect inundation areas downstream and immediate areas around the dam or levee. Discharge from a dam breach is usually several times the 1% chance flood, and, therefore, typical flood studies are of limited use in estimating the extent of flooding.

Determining the impact of flooding is difficult to accomplish, especially 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 scenarios. Many dam safety agencies have used “population at risk”, a more quantifiable measurement of the impact to human life, rather than “loss of life”. Population at risk 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. The impacts of a dam failure are contingent on many factors and, therefore, cannot be concisely described.

Dam safety laws are embodied in the Dam Safety and Encroachments Act ("DSE Act") -enacted July 1, 1979 and last amended in 1985. Rules pertaining to dam safety are found in Title 25-Rules and Regulations; Part I-Department of Environmental Resources; Subpart C-Protection of Natural Resources; Article II-Water Resources; Chapter 105-Dam Safety and Waterway Management ("the Rules")-adopted Sept. 16, 1980. (www.damsafety.org)

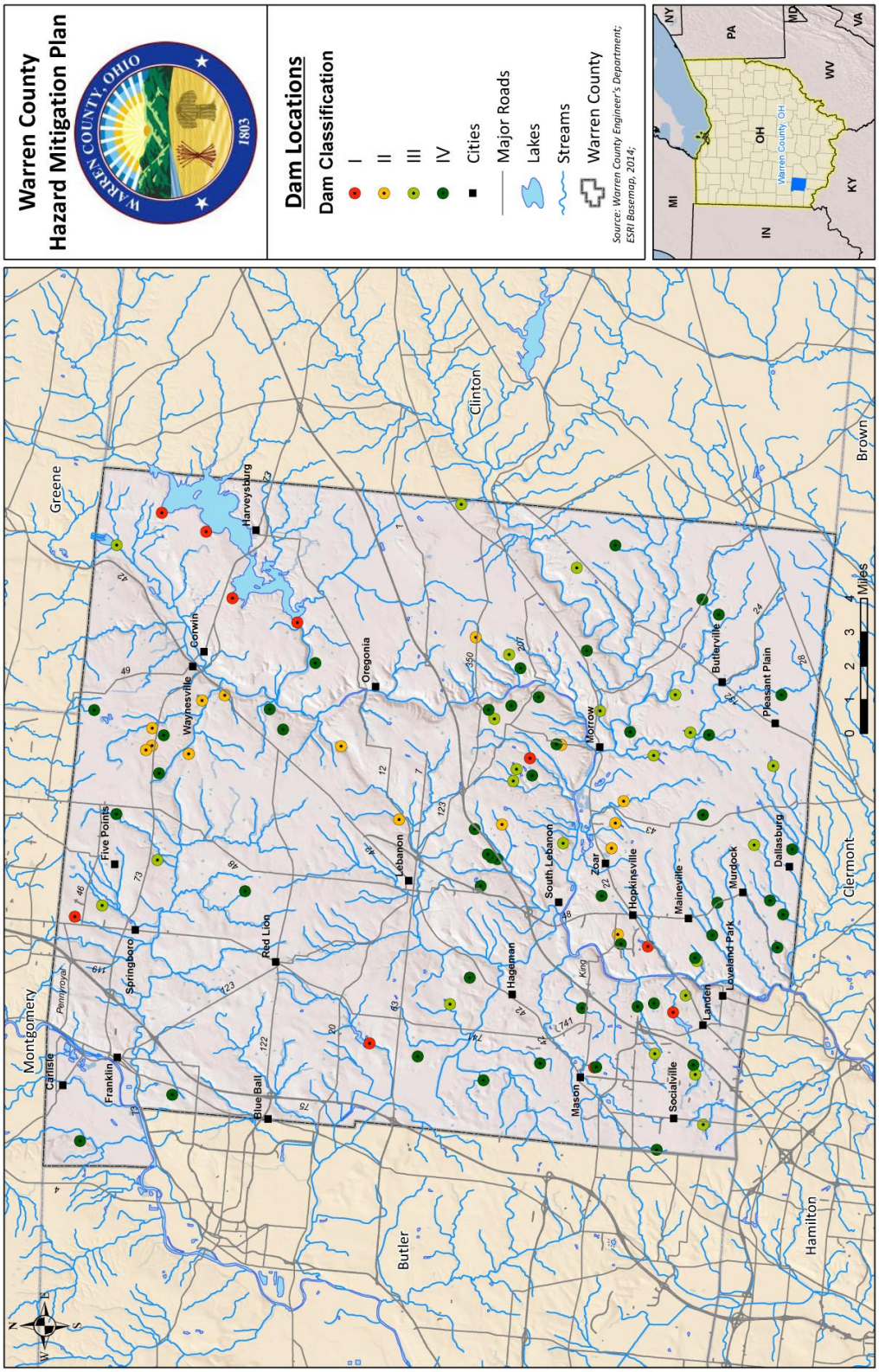


Figure 5-30 Dam Locations in Warren County

5.11.2 Regulatory Environment

Ohio's Department of Natural Resources, classifies dams by two (2) conditions, height and storage. There are four (4) classes of dams, which vary, based on the height of the actual dam, and the amount of water held behind the dam. In Warren County, there is nine (9) Class I dams, and fifteen (15) class II dams.

Many dams throughout Ohio were created 50 years ago or more. These dams present the possibility that at some point in time they may fail. If this is the case, there will be damage to the surrounding area. According to the Ohio Department of Natural Resources, the damage predicted by a dam failure coincides with the class of the dam. The potential downstream hazard is broken into four classes.

- *Class I - Probable loss of life, serious hazard to health, structural damage to high value property (i.e., homes, industries, and major public utilities.).*
- *Class II – Floodwater damage to homes, businesses, and industrial structures (no loss of life envisioned); damage to state and interstate highways, railroads; only access to residential areas.*
- *Class III- Damage to low value non-residential structures, local roads, agricultural crops and livestock.*
- *Class IV- Losses restricted mainly to the dam*

Information on the Class I dam is listed in the table below. Developing loss estimates resulting from dam failures will continue to be a long-term identified project.

Table 5-48: Location and Info on Class I Dams in Warren County

NAME	OWNER	NEAREST COMMUNITY	STREAM	TYPE
REMICK LAKE DAM	Settlers Walk HOA, MCS Land Dev. LLC	CLEAR CREEK	TRIBUTARY TO CLEAR CREEK	EARTHFILL
CAESAR CREEK LAKE DIKE `F'	COE, Louisville District	MASSIE	CAESAR CREEK - OFFSTREAM	EARTHFILL
PINE HILL LAKE DAM	City of Mason	DEERFIELD	TRIBUTARY TO MUDDY CREEK	EARTHFILL
LANDEN FARM LAKE DAM	Landen Farm Comm. Services Assn. Inc.	DEERFIELD	SIMPSON CREEK	EARTHFILL
CAESAR CREEK LAKE DIKE `B'	COE, Louisville District	MASSIE	CAESAR CREEK - OFFSTREAM	EARTHFILL
SUNRISE LAKE DAM	Sunrise Lake Club	HAMILTON	TRIBUTARY TO BEAR RUN	EARTHFILL
SHAKER RUN DAM	The Shaker Run Golf Group, LLC	TURTLE CREEK	SHAKER CREEK	EARTHFILL
LILLEY LAKE DAM	Stephen R. Lilley	SALEM	TRIBUTARY TO HALLS CREEK	EARTHFILL
CAESAR CREEK LAKE DAM	COE, Louisville District	MASSIE	CAESAR CREEK	EARTHFILL
CAESAR CREEK LAKE DIKE `A'	COE, Louisville District	WAYNE	CAESAR CREEK - OFFSTREAM	EARTHFILL

For reasons previously mentioned in this section and uncontrollable by humans, it is possible a dam can fail at any time, given the right circumstances. However the probability of future occurrence is for

regulated dams can be reduced due to proactive preventative action in compliance with the Ohio Department of Natural Resources – Dam Safety Program. Ohio's Dam Safety Program provides for the regulation and safety of high hazard dams and reservoirs throughout the state in order to protect the health, safety, and welfare of its citizens and their property.

5.11.3 Hazard Events/Historical Occurrences

Table 5-49 Dam Incidents in Warren County

NID No.	STRUCTURE NAME	INCIDENT DATE	INCIDENT	DAM FAILURE
OH00547	Lilley Lake Dam	02/08/2001	Inadequate Spillway Capacity	No

5.11.4 Inventory Assets Exposed To Dam Failure

Dam or levee failures can have a greater environmental impact than that associated with a flood event. Large amounts of sediment from erosion can alter the landscape changing the ecosystem. Hazardous materials can be carried away from flooded out properties and distributed throughout the floodplain. Industrial and agricultural chemicals and wastes, solid wastes, raw sewage, and common household chemicals comprise the majority of hazardous materials spread by flood waters along the flood zone, polluting the environment and contaminating private property and the community's water supply. The soil loss from erosion and scouring would be significantly greater because of a large amount of fast moving water affecting a small localized area, which would likely change the ecosystem.

5.11.5 Potential Losses

For reasons previously mentioned in this section and uncontrollable by humans, it is highly possible a dam can fail at any time, given the right circumstances. However the probability of future occurrence for regulated dams is reduced through compliance with the Ohio's Department of Natural Resources, Dam Safety Program.

The Emergency Action Plan (EAP) for the Pine Hill Lake and Shaker Run Dams are approved. The EAP details possible scenarios for a dam break.

Oregonia, the Village of Morrow and South Lebanon are located in proximity to Class I Dams (As classified by the Ohio Department of Natural Resources). Potential losses from dam failure in these areas are difficult to quantify. However, by using the populations, number of homes, and their median value, some vulnerability can be attributed to a dam failing. The following table presents this data for the previously identified villages.

Table 5-50 Dam Failure Vulnerability in Oregonia, the Village of Morrow and South Lebanon

LOCATION	POPULATION	# HOMES	AVERAGE VALUE	POTENTIAL PROPERTY LOSSES
Oregonia	2,377	757	$167,400	$126,721,800
Village of Morrow	1,229	487	$130,721	$63,661,127
South Lebanon	4,216	1,068	$121,894	$130,182,792
TOTALS	**7,822**	**2,312**	**$140,005**	**$320,565,719**

5.11.6 Land Use & Development Trends

Public awareness measures such as notices on final plats and public education on dam safety are proactive mitigation measures that should be implemented by local communities. Also, Emergency Action Plans that identify potential dam failure inundation areas, notification procedures, and thresholds are also prepared for response to potential dam related disaster events.

5.11.7 Dam Failure HIRA Summary

As dams continue to age, the likelihood for failure increases as undesirable woody vegetation on the embankment, deteriorated concrete, inoperable gates, and corroded outlet pipes become problems. Since dam failures are often exacerbated by flooding, the probability of dam failures can be associated with projected flood frequencies. Without these activities and oversight from the Ohio Department of Natural Resources, vulnerability increases significantly. The probability of a dam failure throughout the state should remain low with continued maintenance of dams. Additionally, warning plans in place for designated high hazard dams will continue to decrease the danger for those residents in potential risk areas.

5.11.8 Multi-Jurisdictional Differences

Warren County has ten Class I dams. Of these ten dams, four of them are situated along Caesar Creek Lake. The other six are spread out across the County. Four of these dams are privately held, and two of those do not have approved Emergency Action Plans (as of 8/12/14). In total, Warren County is home to 162 dams, including those that are: exempt, unclassified or abandoned. Many of the 162 dams are situated along tributaries to creeks, and were created for recreational purposes.

Table 5-51 Dams by USGS Quad

USGS Quad	Number of Dams (Class I Dams)
Clarksville	2
Franklin	5
Lebanon	28 (1)
Mason	19 (2)
Monroe	7 (1)
Oregonia	20 (1)
Pleasant Plain	19
South Lebanon	42 (1)
Springboro	15 (1)
Waynesville	8 (3)

Section 6. Mitigation Strategy

The intent of the Mitigation Strategy is to provide Warren County and its municipalities with the goals that will serve as the guiding principles for future mitigation policy and project administration, along with a list of proposed actions deemed necessary to meet those goals and reduce the impact of natural hazards. It is designed to be comprehensive and strategic in nature.

The development of the strategy included a thorough review of natural hazards and identified policies and projects intended to not only reduce the future impacts of hazards, but also to help Warren County achieve compatible economic, environmental and social goals. The development of this section is also intended to be strategic, in that all policies and projects are linked to establish priorities assigned to specific departments or individuals responsible for their implementation and assigned target completion deadlines. Funding sources are identified that can be used to assist in project implementation.

- *Mitigation goals* are general guidelines that explain what the County wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results.

- *Mitigation objectives* describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date.

- *Mitigation Actions* provide more detailed descriptions of specific work tasks to help the County and its municipalities achieve prescribed goals and objectives.

Based on participation from the Warren County Mitigation Planning Committee, the mitigation strategy was developed. Objectives were clarified to better document roles and responsibilities. Actions have been added to address particular hazards facing the County and the consensus achieved in how to address those actions.

The last step in updating the Mitigation Strategy is the creation Mitigation Action Plans (MAPs). The MAPs represent the key outcome of the mitigation planning process. MAPs include a prioritized list of proposed hazard mitigation actions (policies and projects) for the County, including accompanying information such as those agencies or individuals assigned responsibility for their implementation, potential funding sources, estimated target date for completion, and a current status. The MAPs provide those individuals or agencies responsible for implementing mitigation actions with a clear roadmap that also serves as an important tool for monitoring progress over time. The collection of actions listed in each jurisdictions MAP also serves as an easily understood synopsis of activities for local decision makers.

Prioritizing mitigation actions for each jurisdiction was completed using FEMA's STAPLEE methodology.

The STAPLEE approach allows for a careful review of the feasibility of mitigation actions by using seven criteria. The criteria are described below:

- *S - Social*
- *T - Technical*
- *A - Administrative*

- *P - Political*
- *L - Legal*
- *E - Economic*
- *E - Environmental*

FEMA mitigation planning requirements indicate that any prioritization system used shall include a special emphasis on the extent to which benefits are maximized according to a cost-benefit review of the proposed projects. To do this in an efficient manner that is consistent with FEMA's guidance on using cost-benefit review in mitigation planning, the STAPLEE method was adapted to include a higher weighting for two elements of the economic feasibility factor – Benefits of Action and Costs of Action. This method incorporates concepts similar to those described in Method C of FEMA 386-5: Using Benefit Cost Review in Mitigation Planning (FEMA, 2007).

For the individual action plans, a STAPLEE score was calculated based on the number of favorable considerations that can be found on the STAPLEE document. Up to 23 considerations can be used to prioritize each action using this evaluation methodology.

In order to ensure that a broad range of mitigation actions were considered, the Warren County Mitigation Planning Committee analyzed a comprehensive range of specific mitigation actions for each hazard after it had completed the risk assessment. This helped to ensure that there was sufficient span and creativity in the mitigation actions considered.

There are four categories of mitigation actions which Warren County considered in developing its mitigation action plan. Those categories include:

- **Local Plans and Regulations**: These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.

- **Structure and Infrastructure Projects:** These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards. Many of these types of actions are projects eligible for funding through the FEMA Hazard Mitigation Assistance program.

- **Natural Systems Protection:** These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.

- **Education and Awareness Program**: These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady1 or Firewise2 Communities. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards

and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.

6.1 *Planning Process for Setting Hazard Mitigation Goals and Objectives*

The mitigation strategy represents the key outcomes of the 2015 Warren County HMP planning process. The hazard mitigation planning process conducted by the Planning Committee is a typical problem-solving methodology:

- Estimate the impacts the problem could cause;
- Describe the problem;
- Assess what safeguards and resources exist that could potentially lessen those impacts;
- Develop Goals and Objectives with current capabilities to address problem
- Using this information, determine what, if anything, can be done, and select those actions that are appropriate for the community

6.2 *Capabilities Assessment*

The mitigation strategy includes an assessment of Warren County planning and regulatory, administrative/technical, fiscal, and political capabilities to augment known issues and weaknesses from identified natural hazards.

Table 6-1: Planning and Regulatory Mitigation Capabilities Summary

Tool/Program	Jurisdictions with this resource, or in process of developing this resource
Hazard Mitigation Plan	Village of Blanchester, Village of Butlerville, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Pleasant Plain, Village of South Lebanon, Warren County
Emergency Operations Plan	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
Disaster Recovery Plan	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, Warren County
Evacuation Plan	Village of Carlisle, City of Lebanon, City of Mason, City of Loveland, City of Middletown, City of Monroe, Village of South Lebanon, City of Springboro
Continuity of Operations Plan	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, Warren County
NFIP	Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
NFIP-CRS	
Floodplain Regulations	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
Floodplain Management Plan	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Monroe, City of Springboro, Warren County
Zoning Regulations	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, Village of Corwin, City of Franklin, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County, Village of Waynesville
Subdivision Regulations	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County, Village of Waynesville
Comprehensive Land Use Plan (or General, Master or Growth Mgmt. Plan)	Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County, Village of Waynesville
Open Space Management Plan (or Parks/Rec or Greenways Plan)	Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, Village of Maineville, City of Monroe, City of Springboro, Warren County
Stormwater Management Plan / Ordinance	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of South Lebanon, Warren County, Village of Waynesville
Natural Resource Protection Plan	City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, City of Monroe, Warren County

Tool/Program	Jurisdictions with this resource, or in process of developing this resource
Capital Improvement Plan	Village of Blanchester, City of Lebanon, City of Mason, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County, Village of Waynesville
Economic Development Plan	City of Lebanon, City of Mason, City of Franklin, City of Loveland, Village of Morrow, City of Springboro, Warren County, Village of Waynesville
Historic Preservation Plan	City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, City of Springboro, Warren County, Village of Waynesville
Farmland Preservation	City of Monroe, Warren County
Building Code	Village of Carlisle, City of Lebanon, City of Mason, Village of Corwin, City of Franklin, Village of Harveysburg, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County, Village of Waynesville
Fire Code	Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, City of Springboro

6.2.1 Administrative and Technical Capabilities

Table 6-2 provides a summary of administrative and technical capabilities organized by staff type and department. It is important to understand current administrative and technical capabilities before developing a myriad of mitigation activities.

Table 6-2: Administrative and Technical Mitigation Capabilities

Staff/Personnel Resources	Department / Agency
Planners (with land use / land development knowledge)	City of Lebanon, City of Mason, Village of Harveysburg, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
Planners or engineers (with natural and/or human caused hazards knowledge)	City of Lebanon, City of Mason, City of Loveland, Village of Maineville, City of Monroe, Village of Morrow, City of Springboro, Warren County
Engineers or professionals trained in building and/or infrastructure construction practices (includes building inspectors)	Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
Emergency manager	Village of Blanchester, City of Lebanon, City of Franklin, Village of Maineville, City of Middletown, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County, Village of Waynesville
Floodplain manager	Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
Land surveyors	Village of Carlisle, City of Middletown, Village of Morrow, Warren County

Staff/Personnel Resources	Department / Agency
Scientists or staff familiar with the hazards of the community	City of Mason, City of Loveland, City of Middletown, City of Springboro, Warren County
Personnel skilled in Geographic Information Systems (GIS) and/or FEMA's HAZUS program	Village of Carlisle, City of Lebanon, City of Loveland, City of Middletown, City of Monroe, City of Springboro, Warren County
Grant writers or fiscal staff to handle large/complex grants	Village of Carlisle, City of Lebanon, City of Mason, City of Loveland, Village of Maineville, City of Middletown, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County, Village of Waynesville

6.2.2 Fiscal Capabilities

This section identifies the financial tools or resources that Warren County could potentially use to help fund mitigation activities. Fiscal capabilities include community-specific as well as state and federal resources.

Table 6-3: Fiscal Capabilities Table

Financial Resources	Department / Agency
Capital improvement programming	Village of Blanchester, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County
Community Development Block Grants (CDBG)	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, Village of Harveysburg, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, City of Springboro, Warren County
Special purpose taxes	Village of Blanchester, City of Lebanon, City of Mason, City of Franklin, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County
Gas / electric utility fees	Village of Blanchester, Village of Carlisle, City of Lebanon, Village of Morrow, Warren County
Water / sewer fees	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County
Stormwater utility fees	Village of Blanchester, City of Lebanon, City of Mason, City of Franklin, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County
Development impact fees	City of Lebanon, City of Mason, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County
General obligation, revenue, and/or special tax bonds	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, City of Springboro, Warren County

Financial Resources	Department / Agency
Partnering arrangements or intergovernmental agreements	City of Lebanon, City of Mason, City of Franklin, City of Loveland, City of Middletown, City of Monroe, Village of Morrow, Village of South Lebanon, City of Springboro, Warren County

6.2.3 Education and Outreach

This section identifies the education and outreach tools or resources that Warren County could potentially use. These capabilities include community-specific as well as state and federal resources.

Table 6-4 Education and Outreach Table

Financial Resources	Department / Agency
Firewise Communities Certification	
StormReady Certification	Warren County
Natural disaster or safety related school programs	Village of Carlisle, City of Lebanon, City of Franklin, City of Loveland, City of Monroe, Warren County
Ongoing public education or information program (e.g. responsible water use, fire safety, household preparedness, environmental education)	Village of Blanchester, Village of Carlisle, City of Lebanon, City of Mason, City of Franklin, City of Loveland, Village of Maineville, City of Middletown, City of Monroe, City of Springboro, Warren County
Public-private partnership initiatives addressing disaster- related issues	City of Loveland, City of Monroe, Warren County
Local citizen groups or non- profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	City of Mason, City of Franklin, City of Loveland, City of Monroe

6.3 *Community Values, Historic and Special Considerations*

Historic resources include landmark buildings, historic structures and sites, commercial and residential districts, historic rural resources, archaeological and cultural sites, and the historic environment in which they exist. Historic Resources serve as visual reminders of a community's past, providing a link to its cultural heritage and a better understanding of the people and events that shaped the patterns of its development. Preservation of these important resources makes it possible for them to continue to play an integral, vital role in the community. Currently the County has forty-five properties listed on the National Register of Historic Places and eight historic districts; Armco Park Mound I (Turtlecreek Township), Armco Park Mound II (Turtlecreek Township), Bone Mound II (Wayne Township), Bone Stone Graves (Wayne Township), Charles Butler House (Franklin), Goldsmith Coffeen House (Lebanon), Corwin Council House and Jail (Corwin), Corwin House (Lebanon), Corwin-Bolin House (Lebanon), Jonathan Crane Farm (Clearcreek Township), Crossed Keys Tavern (Turtlecreek Township), Daniel L. Deardoff House (Franklin Township), Henry Decker Farmstead (Clearcreek Township), East End Historic District (Lebanon), John Ferney House (Lebanon), Floraville Historic District (Lebanon), Fort Ancient (Washington Township), Glendower (Lebanon), Golden Lamb (Lebanon), Elizabeth Harvey Free Negro School (Harveysburg), Hatton Farm (Harveysburg), Hill-Kinder Mound (Franklin), Hunt-Forman Farm (Turtlecreek Township), Kern Effigy (Turtlecreek Township), Ahimaaz King House (Deerfield Township), Landen Mounds I and II (Deerfield Township), Lebanon Academy (Lebanon), Lebanon Cemetery Entrance Arch (Lebanon), Lebanon Cemetery Superintendent's House (Lebanon), Lebanon Commerical District (Lebanon), Mackinaw Historic District (Franklin, Maplewood Sanitorium (Lebanon), Moses McKay House (Wayne Township), Miami monthly Meeting Historic District (Waynesville), Moar Mound and Village (Hamilton Township), Morhman-Jack-Evans House (Lebanon), North Broadway Historic District (Lebanon), Old Log Post Office (Franklin), Peters Cartridge Company (Hamilton Township), Edmund Robinson House (Clearcreek Township), John Satterwaite House (Waynesville), Smith-Davis House (Lebanon), Springboro Historic District (Springboro), Stanton Farm (Springboro), Benjamin A. Stokes House (Clearcreek Township), Stubbs Earthworks (Hamilton Township), Taylor Mound and Village Site (Wayne Township), Trevey Mound (Morrow), Waynesville Engine House and Lockup (Waynesville), Waynesville Greek Revival Houses (Waynesville), Waynesville Main Street Historic District (Waynesville), West Baptist Church (Lebanon), and the Dr. Aaron Wright House (Springboro).

Depending on the number of historic resources within a community, it can be unrealistic to assume that all of the necessary mitigation activities can be done at once to protect these resources. The work must be done in a manner that retains the character-defining features of a historic property, and can be costly. Therefore, it makes sense to set priorities in terms of which resources and mitigation projects should be the point of focus. Warren County recognizes that the preservation and maintenance of archaeological sites and historic structures contribute to the cultural heritage of the county and are in the long-term best interest of the county.

6.4 *Mitigation Goals, Objectives and Actions*

Goals and objectives discussed in this section help describe what actions should occur, using increasingly narrow descriptors. Long-term goals are developed which can be accomplished by objectives. To achieve the stated objectives "mitigation actions" provide specific measurable descriptors on how to accomplish the objective. The goals, objectives, and actions form the basis for the development of a Mitigation Action Strategy and specific mitigation projects to be considered for implementation.

The process consists of 1) setting goals and objectives, 2) considering mitigation alternatives, 3) identifying strategies or "actions", and 4) developing a prioritized action plan resulting in a mitigation strategy.

6.4.1 Goals and Objectives

The Planning Committee discussed goals and objectives for this plan update at distinct points in the planning process. In November 2014 (Planning Committee Meeting #3), the Planning Committee discussed the results of the risk assessment and the identified issues/weaknesses to be addressed by Mitigation Actions. During that time the HMP Planning Committee opted to develop an entirely new set of goals and objectives due to the 2007 plan not containing any. More details of this particular meeting are provided in Appendix B. The following goals and objectives have been developed as part the planning effort:

- ***GOAL 1:*** **Minimize the impact to the citizens of Warren County due to temperature extremes.**
  - ✓ *Objective 1.1: Identify sheltering capabilities within Warren County and surrounding areas and improve where possible*
  - ✓ *Objective 1.2: Develop and execute a public education and outreach program about the dangers of temperature extremes*

- ***GOAL 2:*** **Minimize the impact of winter storms on the lives, property and infrastructure of Warren County and its jurisdictions.**
  - ✓ *Objective 2.1 Improve response and communications capabilities of Warren County in dealing with winter storms.*
  - ✓ *Objective 2.2: Improve the sheltering capability of Warren County and its jurisdictions.*
  - ✓ *Objective 2.3: Develop and execute a public education and outreach program for winter storms and possible mitigation efforts*

- ***GOAL 3:*** **Residents that have a better understanding of earthquakes and the response to them in Warren County and its jurisdictions.**
  - ✓ *Objective 3.1: Develop and execute a public education and outreach program centered around earthquakes and possible mitigation efforts*

- ***GOAL 4:*** **Minimize the impact of summer storms on the lives, property and infrastructure of Warren County and its jurisdictions.**
  - ✓ *Objective 4.1: Improve response and communications capabilities of Warren County in dealing with Summer Storms*
  - ✓ *Objective 4.2: Develop and execute a public education and outreach program about summer storms and possible mitigation efforts*

- ***GOAL 5:*** **Reduce the risk of injury and fatalities while minimizing long term impacts from tornadoes in Warren County and its jurisdictions**
  - ✓ *Objective 51: Ensure effectiveness of early warning system(s) in Warren County*
  - ✓ *Objective 5.2: Purchase equipment to enhance County response to tornadic events*
  - ✓ *Objective 5.3: Identify sheltering capabilities within Warren County and surrounding areas and improve where possible*
  - ✓ *Objective 5.4: Develop and execute a public education and outreach program about tornadoes and straight line winds*

- ***GOAL 6:*** **Residents that have a better understanding of droughts and the response to them in Warren County and its jurisdictions.**
  - ✓ *Objective 6.1: Develop and execute a public education and outreach program centered around addressing drought and possible actions to combat its results*

- ***GOAL 7:*** **Prevent and reduce the impact of flood events on the lives, property, infrastructure and environment of Warren County and its jurisdictions.**
  - ✓ *Objective 7.1: Examine and improve zoning regulations throughout the County as they relate to flooding.*
  - ✓ *Objective 7.2: Pre-plan for flood events in the County*
  - ✓ *Objective 7.3: Develop and execute a public education and outreach program centered around flood hazards in Warren County, to include NFIP information, SFHA information and CRS*

- ***GOAL 8:*** **Minimize and reduce the risk to life, property, infrastructure and the environment due to wildfire in Warren County and its jurisdictions.**
  - ✓ *Objective 8.1: Enhance response capability of Warren County to wildfire events*
  - ✓ *Objective 8.2: Develop methods to evaluate and respond to the environmental impacts of wildfires in Warren County*
  - ✓ *Objective 8.3: Develop and execute a public education and outreach program about wildfire risk in Warren County*

- ***GOAL 9:*** **An efficient and effective system of dams in Warren County and its jurisdictions**
  - ✓ *Objective 9.1: Enhance the relationship between ODNR and dam owners in Warren Co.*
  - ✓ *Objective 9.2: Develop and execute a public education and outreach program about dam safety in Warren County*

6.4.2 Mitigation Action Development

To begin the process of identifying mitigation actions, the HMP Planning Committee reviewed existing mitigation actions from the 2007 LHMP. Based upon new priorities and risk assessment results, mitigation actions were edited and removed. Most importantly, the newly developed mitigation actions acknowledge updated risk assessment information outlined in Section 5.

6.4.2.1 Mitigation Costs

Cost effectiveness of each measure was a primary consideration when developing mitigation actions. Because mitigation is an investment to reduce future damages, it is important to select measures for which the reduced damages over the life of the measure are likely to be greater than the project cost. For

structural projects, the level of cost effectiveness is primarily based on the likelihood of damages occurring in the future, the severity of the damages when they occur, and the level of effectiveness of the selected measure.

While detailed analysis was not conducted during the mitigation action development process, these factors were of primary concern when selecting measures. For measures that do not result in a quantifiable reduction of damages, such as public education and outreach, the relationship of the probable future benefits and the cost of each measure was considered when developing the mitigation actions. Costs are made available in individual Implementation Plans described in Section 7.

6.4.3 2007 Mitigation Action Review

During the third planning meeting, the mitigation actions from the 2007 plan were reviewed and determined to be; deferred into the new plan, changed to reflect an update in priorities, completed, or deleted. These actions can be found in Table 6-5. Actions marked as "Completed" were finished between the drafting of the 2007 plan, and the 2015 update. Deletion of an action generally refers to that action no longer being relevant to the community. The 2007 actions were very County-centric. Virtually no actions were developed for the individual jurisdictions within Warren County.

Table 6-5 Goals, Objectives, & Actions 2015 Update

ACTIONS	DEFER	ONGOING	COMPLETED	DELETE	REASON
Action 1: Evaluate existing capability of Warren County and its jurisdictions to respond to a winter storm, specifically as it relates to fuel, resources, facilities and materials	X				
Seek funding for additional salt storage facilities and loading equipment throughout the County.		X			Ongoing action, but rolled into Action 1
Evaluate the need for on-site back-up fuel storage due to historic shortages for first responders during significant winter storm events.		X			Ongoing Action, but rolled into Action 1
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather.			X		Action was completed
Develop a public education program for informing residents of the hazards associated with severe winter weather, such as medical conditions and driving conditions, as well as what to do and where to go after an event occurs.		X			Re-written
Action 2: Review, revise and evaluate the existing SOP regarding use and activation of warning sirens in Warren County	X				
Develop a regional comprehensive plan for the use of outdoor warning sirens		X			Ongoing Action, but rolled into Action 2
Seek funding for early warning systems, such as sirens and			X		Action Completed

ACTIONS	DEFER	ONGOING	COMPLETED	DELETE	REASON
reverse 9-1-1, to warn residents of approaching severe weather					
Seek funding for additional equipment and manpower necessary for clean-up and removal of debris				X	Removed by planning committee, no longer a priority.
Action 3: Evaluate the need for structural projects meant to protect the people, property and infrastructure of Warren County from flood waters	X				
Implement structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, wetlands protection and restoration).		X			Ongoing Action, but rolled into Action 3
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather.			X		Action Completed
Action 4: Encourage communities to join the National Flood Insurance Program, which would allow residents to purchase flood insurance.	X				
Develop a regional comprehensive plan for the use of outdoor warning sirens		X			This action is ongoing, and covered under Action 2

ACTIONS	DEFER	ONGOING	COMPLETED	DELETE	REASON
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather			X		Action Completed
Action 5: Develop a mutual aid agreement/planning mechanism to provide water in drought events that may impact local aquifers, to include the Old Mason Water Treatment Facility.	X				
Develop designs and plans for water delivery systems that include a consideration of drought events		X			Ongoing Action, but rolled into Action 5
Action 6: Determine feasibility of providing potable water to the agricultural community in the event of a drought	X				
Provide an alternate potable water source in the event that existing water supplies are disrupted or wells run dry, especially for the agricultural community		X			Ongoing Action, but rolled into Action 6
Implement structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, wetlands protection and restoration)				X	This action is no longer relevant to the community's mitigation priorities.
Encourage communities to join the National Flood Insurance				X	Action no longer relevant

ACTIONS	DEFER	ONGOING	COMPLETED	DELETE	REASON
Program, which would allow residents to purchase flood insurance					
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents			X		Action Completed
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents			X		Action Completed

6.5 *Temperature Extremes Mitigation Strategy*

6.5.1 Community Mitigation Goals

***GOAL 1**: Minimize the impact to the citizens of Warren County due to temperature extremes.*

6.5.2 Identification and analysis of range of mitigation options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Temperature Extremes Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.5.3 Existing policies, regulations, ordinances, and land use

Existing weather policies may be considered as guidance to assist with the management of the work environment and the comfort of staff during varying climate conditions. The National Weather Service (NWS) provides alerts when heat indices approach hazardous levels. Upon issuing an extreme heat advisory, the NWS does the following:

- Includes heat index values
- Issues special weather statements including who is most at-risk, safety rules for reducing risk, and the extent of the hazard and heat index values
- Assist state/local health officials in preparing civil emergency messages for the severe heat wave

When conditions warrant, the NWS issues wind chill products such as wind chill watches, wind chill advisories, and wind chill warnings.

6.5.4 New buildings and infrastructure

Extreme temperatures, both cold and hot, have a significant effect on human health and/or infrastructure. As development continues within Warren County, builders should recognize that concrete, asphalt, and metal absorb the sun's heat during the day before radiating it out into the environment at night. These materials trap solar radiation faster than wooded parks and suburban lawns and fields and hence cool more slowly, radiating furnace-like heat. The more urban areas of the county such as the Cities of Mason and Lebanon, can somewhat block the path of cooling winds. Generally wind speeds greater than 15 mph can substantially dissipate heat and reduce the heat island effect.

6.5.5 Existing buildings and infrastructure

A large portion of Warren County's utility infrastructure is susceptible to cracks and breaks from extreme temperatures. During the winter periods, frozen pipes are a routine occurrence. This can create service interruptions in water, drainage, and gas supply. To limit these effects, utility providers monitor conditions, perform routine maintenance, and address problems as they arise. Although buildings throughout Warren County and its municipalities are not generally susceptible to temperature extremes, some provisions can be placed in building codes that aim to reduce the effects of extreme heat or cold.

6.5.6 Mitigation Action Plan

- ✓ ***Goal 5****: Minimize the impact to the citizens of Warren County due to temperature extremes.*
  - ✓ ***Objective 5.1****: Identify sheltering capabilities within Warren County and surrounding areas and improve where possible*

Goal 1; Objective 1.1; Action 1.1.1	
Coordinate with local response agencies, to include the Red Cross, to identify possible sheltering locations within the County	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 1; Objective 1.1; Action 1.1.2	
Purchase generators to continue to supply power to heating/cooling shelters in the event of temperature extremes	
Responsible Department	Village of Carlisle Mayor

Anticipated Cost	Up to $20,000 per generator
Existing & Potential Funding Sources	Municipal Funds and HMA Grants
Jurisdiction	Village of Carlisle
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

- ✓ ***Objective 1.2:*** *Develop and execute a public education and outreach program about the dangers of temperature extremes*

Goal 1; Objective1.2; Action 1.2.1	
Develop an informational brochure to distribute to local residents	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	$5,000
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

6.5.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-6 Updated Actions for Temperature Extremes

ACTION	STATUS	NOTES
Coordinate with local response agencies, to include the Red Cross, to identify possible sheltering locations within the County	New	
Purchase generators to continue to power heating/cooling shelters in the event of temperature extremes	New	
Develop an informational brochure about temperature extremes to distribute to local residents	New	

6.6 *Winter Storm Mitigation Strategy*

6.6.1 Community Mitigation Goals

***Goal 2**: Minimize the impact of winter storms on the lives, property and infrastructure of Warren County and its jurisdictions.*

6.6.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Severe Winter Storms Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.6.3 Existing Policies, Regulations, Ordinances, and Land Use

Standard building codes have the opportunity to provide Warren County with reasonable guidance for development throughout unincorporated and incorporated areas. However, contractors and builders should be aware of winter hazards such as extreme cold, high winds, and snow loads that can result from winter weather.

6.6.4 New Buildings and Infrastructure

As development grows in the County, it will be a priority to improve the roads, utilities, and storm water management systems in the area. Any structures and infrastructure built should be considered vulnerable to severe winter weather. New structures and infrastructure built in the County should take into account snow loads when being constructed.

6.6.5 Existing Buildings and Infrastructure

The entire inventory in the County is vulnerable to winter storms. Winter storms in Warren County cause widespread impacts with the greatest threats to public safety on major roads and highways. Power outages caused by snow, ice, and wind accompanied by cold temperatures create needs for additional sheltering. It is the priority of Warren County to continue operation of existing buildings and infrastructure, especially critical facilities and services like emergency services and hospitals in times of severe winter weather and winter storms.

6.6.6 MITIGATION ACTION PLAN

- ✓ ***Goal 2**: Minimize the impact of winter storms on the lives, property and infrastructure of Warren County and its jurisdictions.*
  - ✓ ***OBJECTIVE 2.1**: Improve response and communications capabilities of Warren County in dealing with winter storms.*

Goal 2; Objective 2.1; Action 2.1.1	
Evaluate existing capability of Warren County and its jurisdictions to respond to a winter storm, specifically as it relates to fuel, resources, facilities and materials	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (est. $3,000)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020

STAPLEE Priority	17/23
Status (Deferred or New)	Deferred

Goal 2; Objective 2.1; Action 2.1.2	
Review needs and purchase (if necessary) equipment for snow removal.	
Responsible Department	Jurisdictional Safety Directors/Mayors/Engineers (where applicable)
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	County and Municipal Funds
Jurisdiction	Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 2; Objective 2.1; Action 2.1.3	
Develop a resource manual that can be used to inventory emergency resources that can be deployed to aid in the event of a severe winter storm	
Responsible Department	City of Mason Safety Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Mason
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 2; Objective 2.1; Action 2.1.4	
Purchase additional generators so that more critical facilities can operate if/when the power is disrupted as a result of winter storms	
Responsible Department	City of Lebanon City Manager
Anticipated Cost	Up to $20,000 per generator
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Lebanon
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

✓ ***OBJECTIVE 2.2:*** *Improve the sheltering capability of Warren County and its jurisdictions.*

Goal 2; Objective 2.2; Action 2.2.1	
Coordinate with local response agencies, to include the Red Cross, to identify possible sheltering locations within the County	
Responsible Department	Warren County Department of Emergency Services Director

Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 2; Objective 2.2; Action 2.2.2	
Coordinate with the Red Cross to identify possible shelter sites that would be able to address hazards specifically linked to winter storms	
Responsible Department	City of Franklin City Manager
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Franklin
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 2.3:*** *Develop and execute a public education and outreach program for winter storms and possible mitigation efforts*

Goal 2; Objective 2.3; Action 2.3.1	
Develop a comprehensive public education and outreach program, to include social media, dealing with the hazards of winter storms	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	$5,000
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

6.6.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-7 Updated Actions for Winter Storms

ACTION	STATUS	NOTES
Evaluate existing capability of Warren County and its jurisdictions to respond to a winter storm, specifically as it relates to fuel, resources, facilities and materials	Deferred	Deferred from the 2007 plan to the 2015 plan.
Review needs and purchase (if necessary) equipment for snow removal.	New	

Develop a resource manual that can be used to inventory emergency resources that can be deployed to aid in the event of a severe winter storm	New	
Purchase additional generators so that more critical facilities can operate when/if the power is disrupted as a result of winter storms		
Coordinate with local response agencies, to include the Red Cross, to identify possible sheltering locations within the County	New	
Coordinate with the Red Cross to identify possible shelter sites that would be able to address hazards specifically linked to winter storms	New	
Develop a comprehensive public education and outreach program, to include social media, dealing with the hazards of winter storms	Changed	Re-written from language in the 2007 plan.
Evaluate the need for on-site back-up fuel storage due to historic shortages for first responders during significant winter storm events.	Deleted	This action was rolled into action 2.1.1
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather.	Deleted	This action has been completed and therefore removed from the update.

6.7 *Earthquake Mitigation Strategy*

6.7.1 Community Mitigation Goals

GOAL 3: *Residents that have a better understanding of earthquakes and the response to them in Warren County and its jurisdictions.*

6.7.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Earthquake Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.7.3 Existing Policies, Regulations, Ordinances, and Land Use

Standard building codes have the opportunity to provide Warren County with reasonable guidance for development throughout unincorporated and incorporated areas. However, contractors and builders

should be aware of applicable codes and regulations designed to reduce losses sustained by new and existing construction due to seismic hazards.

6.7.4 New Buildings and Infrastructure

The light weight of wood frame buildings results in less force from inertia. Less force means less damage. Wood's natural flexibility also is an advantage when seismic forces are brought to bear and the nailed joints in wood frame buildings dissipate energy and motion.

But wood's inherent earthquake resistance must be accompanied by design and construction techniques that take advantage of those characteristics. Structural wood panels nailed to wall framing add rigid bracing, help resist lateral loads and help tie framing members together. Bolted connections at the sill plate/foundation joint help keep the structure in one spot. Securely connected wall, floor and roof framing also help tie a structure together and make it a single, solid structural unit. Proper connections will do more to hold a house together during an earthquake than any other single seismic design element.

As development grows in the County, it will be important for citizens to consult with local building codes as modern building codes generally require seismic design elements for new construction.

6.7.5 Existing Buildings and Infrastructure

The entire inventory in the County is vulnerable to earthquake. An earthquake occurring in Warren County could cause widespread impacts with the greatest threat to public safety on major roads and highways. Power outages caused down power lines could impact critical facilities such as fire protection, law enforcement, and hospitals. It is the priority of Warren County to continue operation of existing buildings and infrastructure, especially critical facilities and infrastructure after an earthquake has occurred.

6.7.6 Mitigation Action Plan

- ✓ ***GOAL 3:*** *Residents that have a better understanding of earthquakes and the response to them in Warren County and its jurisdictions.*

  - ✓ **OBJECTIVE 3.1**: *Develop and execute a public education and outreach program centered around earthquakes and possible mitigation efforts*

Goal 3; Objective 3.1; Action 3.1.1	
Develop a public education program concerning the hazards associated with earthquakes, including where to go and what to do after an event	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (est. $3,000)

Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	10/01/2014 – 10/01/2019
STAPLEE Priority	18/23
Status (Deferred or New)	Deferred

Goal 3; Objective 3.1; Action 3.1.2	
Promote equipment fastening within municipal facilities	
Responsible Department	City of Springboro Mayor
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Springboro
Timeframe	10/01/2014 – 10/01/2019
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 3; Objective 3.1; Action 3.1.3	
Review Building codes and evaluate low cost earthquake resistant features	
Responsible Department	Village of Maineville Mayor
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Maineville
Timeframe	10/01/2014 – 10/01/2019
STAPLEE Priority	14/23
Status (Deferred or New)	New

Goal 3; Objective 3.1; Action 3.1.4	
Utilize state-developed program explaining the potential for earthquakes, as well as the potential damages from those earthquakes. The brochure includes information pertaining to measures to take to safe-proof homes and other structures from the potential effects of earthquakes	
Responsible Department	Village of Morrow Mayor
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Morrow
Timeframe	10/01/2014 – 10/01/2019
STAPLEE Priority	16/23
Status (Deferred or New)	New

6.7.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

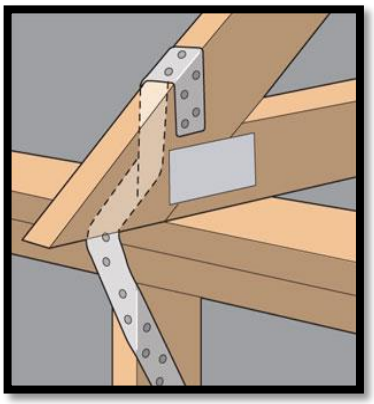
Table 6-8 Updated Actions for Earthquakes

ACTION	STATUS	NOTES

Develop a public education program concerning the hazards associated with earthquakes, including where to go and what to do after an event	Deferred	Deferred from the 2007 plan to the 2015 plan update.
Promote equipment fastening in municipal facilities	New	
Review building codes and evaluate low cost earthquake resistant features	New	
Utilize state-developed program explaining the potential for earthquakes, as well as the potential damages from those earthquakes. The brochure includes information pertaining to measures to take to safe-proof homes and other structures from the potential effects of earthquakes	New	
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents	Deleted	This action has been completed and therefore removed from the update.

6.8 *Summer Storm Mitigation Strategy*

6.8.1 Community Mitigation Goals



***GOAL 1**: Minimize the impact of summer storms on the lives, property and infrastructure of Warren County and its jurisdictions.*

6.8.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Severe Summer Storms Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.8.3 Existing Policies, Regulations, Ordinances, and Land Use

Mitigation of building damage has been most successful where strict building codes for high-wind influence areas and designated special flood hazard areas have been adopted and enforced by local governments and builders have complied. Municipal construction and zoning ordinances are applicable within their respective jurisdictions.

6.8.4 New Buildings and Infrastructure

Mitigation opportunities for severe winds are similar to mitigation measures for other wind hazards (such as severe thunderstorms and lightning). Attention to the type of structure used in tornado-prone areas may yield benefits, particularly by avoiding highly susceptible manufactured or mobile homes. The greatest protection is afforded by quality construction and reinforcement of walls, floors, and ceilings. Proper anchoring of walls to foundations and roofs to walls is essential for a building to withstand certain

wind speeds. Code adoption by local jurisdictions, compliance by builders, and local government inspection of new homes could reduce the risk of destruction in high wind-prone areas.

6.8.5 Existing Buildings and Infrastructure

Existing manufactured or mobile homes are most exposed to damage from severe thunderstorms. Even if anchored, mobile homes do not withstand high wind speeds as well as some permanent, site-built structures. Existing structures can be retrofitted to withstand higher winds and safe rooms may be constructed in existing buildings or as standalone facilities. Safe room construction includes very specific design and engineering standards set forth by FEMA for structures to withstand tornado force winds. Retrofitting existing structures to meet safe room criteria involves making improvements to walls, roofs, window, doors, among other structural elements of the building.

6.8.6 Mitigation Action Plan

- ✓ ***GOAL 4****: Minimize the impact of summer storms on the lives, property and infrastructure of Warren County and its jurisdictions.*
  - ✓ ***OBJECTIVE 4.1****: Improve response and communications capabilities of Warren County in dealing with Summer Storms*

Goal 4; Objective 4.1; Action 4.1.1	
Use of the Emergency Alert System (EAS) on commercial radio, television, and cable systems to send out emergency information targeted to specific areas	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (est. $2,000)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 4; Objective 4.1; Action 4.1.2	
Review, revise and evaluate the existing SOP regarding use and activation of warning sirens in Warren County	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (est. $2,000)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	Deferred

Goal 4; Objective 4.1; Action 4.1.3	
Install uninterruptable power supplies on critical electronic equipment in municipal facilities	
Responsible Department	City of Springboro Mayor
Anticipated Cost	Staff Time and Resources (est. $2,000)

Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Springboro
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	15/23
Status (Deferred or New)	New

Goal 4; Objective 4.1; Action 4.1.4	
Install surge protectors on sensitive electronic equipment in municipal facilities	
Responsible Department	Village of South Lebanon Mayor
Anticipated Cost	Staff Time and Resources (est. $2,000)
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of South Lebanon
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	15/23
Status (Deferred or New)	New

Goal 4; Objective 4.1; Action 4.1.5	
Purchase additional generators so that more critical facilities can operate when/if the power is disrupted as a result of summer storms	
Responsible Department	City of Lebanon City Manager
Anticipated Cost	Up to $20,000 per generator
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Lebanon
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	15/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 4.2****: Develop and execute a public education and outreach program about summer storms and possible mitigation efforts*

Goal 4; Objective 4.2; Action 4.2.1	
Produce and distribute family emergency preparedness information pertaining to steps the general public can take to safeguard against the dangers of a severe thunderstorm	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	$2,000
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	Deferred

Goal 4; Objective 4.2; Action 4.2.2	
Encourage the use of NOAA weather radios and local alert monitors that continuously broadcast National Weather Service (NWS) forecasts and provide warnings for natural, technological, and man-made hazards and notify them of impending weather	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (est. $2,000)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 4; Objective 4.2; Action 4.2.3	
Promote the use of special roofing shingles designed to interlock and resist uplift forces for both new construction and retrofits	
Responsible Department	City of Monroe Building and Zoning Official
Anticipated Cost	Staff Time and Resources (est. $2,000)
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Monroe
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	15/23
Status (Deferred or New)	New

6.8.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-9 Updated Actions for Summer Storms

ACTION	STATUS	NOTES
Review, revise and evaluate the existing SOP regarding use and activation of warning sirens in Warren County	Deferred	
Install uninterruptable power supplies on critical electronic equipment in municipal facilities	New	
Use of the Emergency Alert System (EAS) on commercial radio, television, and cable systems to send out emergency information targeted to specific areas	New	
Install surge protectors on sensitive electronic equipment in municipal facilities	New	
Purchase additional generators so that more critical facilities can operate when/if the power is disrupted as a result of summer storms	New	
Produce and distribute family emergency preparedness information pertaining to steps the	New	

general public can take to safeguard against the dangers of a severe thunderstorm		
Encourage the use of NOAA weather radios and local alert monitors that continuously broadcast National Weather Service (NWS) forecasts and provide warnings for natural, technological, and man-made hazards and notify them of impending weather	New	
Promote the use of special roofing shingles designed to interlock and resist uplift forces for both new construction and retrofits	New	
Develop a regional comprehensive plan for the use of outdoor warning sirens	Changed	Re-written as Action 4.1.2
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather		This action has been completed and therefore removed from the update.
Seek funding for additional equipment and manpower necessary for clean-up and removal of debris		Removed by planning committee. No longer a priority in the County or its jurisdictions.

6.9 *Tornado Mitigation Strategy*

6.9.1 Community Mitigation Goals

***GOAL 5**: Reduce the risk of injury and fatalities while minimizing long term impacts from tornadoes in Warren County and its jurisdictions*

6.9.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Planning Committee considered a range of mitigation options for the Tornado Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.9.3 Existing Policies, Regulations, Ordinances, and Land Use

Mitigation of building damage has been most successful where strict building codes for high-wind influence areas and designated special flood hazard areas have been adopted and enforced by local governments and builders have complied. Municipal construction and zoning ordinances are applicable within the jurisdiction.

6.9.4 New Buildings and Infrastructure

Mitigation opportunities for tornadoes are similar to mitigation measures for general high wind hazards. Attention to the type of structure used in, for example hurricane-prone areas may yield benefits, particularly by avoiding highly susceptible manufactured or mobile homes.

The greatest protection is afforded by quality construction and reinforcement of walls, floors, and ceilings. Proper anchoring of walls to foundations and roofs to walls is essential for a building to withstand certain wind speeds. Code adoption by local jurisdictions, compliance by builders, and local government inspection of new homes could reduce the risk of destruction in tornado prone areas.

Construction of safe rooms has also shown great success in protecting life and reducing injuries during severe storm events. These are typically areas within an existing structure that are reinforced to serve as temporary shelters during the duration of an event. Walls and other structural components are heavily reinforced with concrete and rebar to provide an area designed to withstand high wind speeds and protect occupants from windborne debris. Safe rooms can be constructed not only in critical facilities such as police stations and hospitals but also in residential and commercial buildings. They can be built into any new structure during the construction phase which often proves to be the most cost beneficial time to do such an activity. Warren County, along with its municipalities will consider incorporating safe room areas into all new construction projects as well as retrofitting existing facilities to include safe room areas. All projects should be designed to meet FEMA 320 standards or beyond.

6.9.5 Existing Buildings and Infrastructure

High wind and tornadoes affect the entire planning area, including all above ground structures and utilities. Due to the erratic movement of tornadoes, destruction is often random. Buildings constructed prior to adoption of buildings codes remain more susceptible to damage. Some retrofit projects, for example, specially designed shutters and windows for public schools and retrofitted safe rooms are expected to reduce future damage and reduce loss of life and injury. Modification of existing buildings to incorporate wind-resistant measures may come about slowly as buildings are substantially improved. Post-disaster mitigation efforts include retrofits and the construction of safe rooms.

6.9.6 Mitigation Action Plan

- ✓ ***GOAL 5****: Reduce the risk of injury and fatalities while minimizing long term impacts from tornadoes in Warren County and its jurisdictions*
  - ✓ ***OBJECTIVE 5.1****: Ensure effectiveness of early warning system(s) in Warren County*

Goal 5; Objective 5.1; Action 5.1.1	
Conduct regular testing and inspection of early warning system in the County to ensure continued effectiveness	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 5; Objective 5.1; Action 5.1.2	
Continue to expand and strengthen the outdoor warning siren coverage in Warren County and its jurisdictions	
Responsible Department	Village of Harveysburg Mayor
Anticipated Cost	Up to $5,000 per siren
Existing & Potential Funding Sources	Municipal Funds and HMA Grants

Jurisdiction	Village of Harveysburg
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

✓ ***OBJECTIVE 5.2****: Purchase equipment to enhance County response to tornadic events*

Goal 5; Objective 5.2; Action 5.2.1	
Audit existing warning siren system, and augment as needed	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	$35,000 per siren
Existing & Potential Funding Sources	General Funds, Hazard Mitigation Grants (HMA / HMGP / PDM), EMPG Special Projects, Capital Improvement Grants
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

✓ ***OBJECTIVE 5.3****: Identify sheltering capabilities within Warren County and surrounding areas and improve where possible*

Goal 5; Objective 5.3; Action 5.3.1	
Assess the number, location, strength and ability of shelters to house residents and withstand high wind speeds. Identifying shelters near mobile home parks, shopping malls, and other vulnerable public areas should be a priority. Identifying or establishing underground shelters should also be given consideration	
Responsible Department	Warren County Department of Emergency Services Director, Local Red Cross Director
Anticipated Cost	Staff Time and Resources (est. $7,500)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 5; Objective 5.3; Action 5.3.2
Undertake safe room installation projects, where applicable, to protect citizens from the effects of tornadoes and straight line winds

Responsible Department	Warren County Department of Emergency Services Director, Local Jurisdictions
Anticipated Cost	$100,000 - $500,000 per safe room
Existing & Potential Funding Sources	General Funds, Hazard Mitigation Grants (HMA / HMGP / PDM), Capital Improvement Grants
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 5; Objective 5.3; Action 5.3.3	
Seek funding to build tornado/high wind shelters in areas surrounded by vulnerable populations	
Responsible Department	Village of Pleasant Plain Mayor
Anticipated Cost	$100,000 - $500,000 per safe room
Existing & Potential Funding Sources	General Funds, Hazard Mitigation Grants (HMA / HMGP / PDM), Capital Improvement Grants
Jurisdiction	Village of Pleasant Plain
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	15/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 5.4****: Develop and execute a public education and outreach program about tornadoes and straight line winds*

Goal 5; Objective 5.4; Action 5.4.1	
Reduce damages resulting from straight line winds/tornadoes by providing warning to citizens to store loose/unsecured items on property in advance of the storm	
Responsible Department	Jurisdictional Safety Directors/Mayors
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Village/City General Funds
Jurisdiction(s)	Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	12/23
Status (Deferred or New)	New

Goal 5; Objective 5.4; Action 5.4.2
Encourage residents to secure yard items, or stored items including oil, gasoline, and propane tanks that may be swept away by high winds

Responsible Department	Jurisdictional Safety Directors/Mayors
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Village/City General Funds
Jurisdiction	Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

Goal 5; Objective 5.4; Action 5.4.2	
Develop a public education program for informing residents of the hazards associated with tornadoes, as well as what to do and where to go after an event occurs	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 5; Objective 5.4; Action 5.4.2	
Reduce the risk of mobile home damage by promoting the use of tie-downs with ground anchors for the appropriate soil types	
Responsible Department	Village of Morrow Zoning Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Morrow
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	15/23
Status (Deferred or New)	New

6.9.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-9 Updated Actions for Tornadoes

ACTION	STATUS	NOTES
Conduct regular testing and inspection of early warning system in the County to ensure continued effectiveness	New	
Continue to expand and strengthen the outdoor warning siren coverage in Warren County and its jurisdictions	New	

Audit existing warning siren system, and augment as needed	New	
Assess the number, location, strength and ability of shelters to house residents and withstand high wind speeds. Identifying shelters near mobile home parks, shopping malls, and other vulnerable public areas should be a priority. Identifying or establishing underground shelters should also be given consideration	New	
Undertake safe room installation projects, where applicable, to protect citizens from the effects of tornadoes and straight line winds	New	
Seek funding to build tornado/high wind shelters in areas surrounded by vulnerable populations	New	
Reduce damages resulting from straight line winds/tornadoes by providing warning to citizens to store loose/unsecured items on property in advance of the storm	New	
Encourage residents to secure yard items, or stored items including oil, gasoline, and propane tanks that may be swept away by high winds	New	
Develop a public education program for informing residents of the hazards associated with tornadoes, as well as what to do and where to go after an event occurs	New	
Reduce the risk of mobile home damage by promoting the use of tie-downs with ground anchors for the appropriate soil types	New	
Develop a regional comprehensive plan for the use of outdoor warning sirens	Deleted	This action is covered under action 4.1.2
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather	Deleted	This action has been completed

6.10 *Drought Mitigation Strategy*

6.10.1 Community Mitigation Goals

Goal 6: *Residents that have a better understanding of droughts and the response to them in Warren County and its jurisdictions.*

6.10.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Drought Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.10.3 Existing Policies, Regulations, Ordinances, and Land Use

As Warren County continues to grow, it will consider practical guidelines for determining the impacts of drought such as measuring the economic value of water in alternative uses and objective methods for quantifying non-market impacts of drought on those uses. Warren County will follow guidance found within the State of Ohio Emergency Operations Plan: *Drought Incident Annex* which consists of pre-drought mitigation strategies and drought operation and response strategies.

6.10.4 New Buildings and Infrastructure

New water and sewer systems or significant well and septic sites could use up more of the water available, particularly during periods of drought. Public water systems are monitored, but individual wells and septic systems are not as strictly regulated. Therefore, future development could have an impact on the drought vulnerabilities to new buildings and infrastructure.

6.10.5 Existing Buildings and Infrastructure

Although drought conditions rarely affect existing buildings, infrastructure, and critical infrastructure, the economic livelihood could be negatively impacted due to crop loss, timberland damage, water shortages, and wildfires as a result of drought. Possible losses/impacts to critical facilities include the loss of critical function due to low water supplies.

6.10.6 Mitigation Action Plan

- ✓ ***Goal 6:*** *Residents that have a better understanding of droughts and the response to them in Warren County and its jurisdictions.*
  - ✓ ***OBJECTIVE 6.1:*** *Develop and execute a public education and outreach program centered around addressing drought and possible actions to combat its results*

Goal 6; Objective 6.1; Action 6.1.1
Develop a mutual aid agreement/planning mechanism to provide water in drought events that may impact local aquifers, to include the Old Mason Water Treatment Facility.

Responsible Department	Warren County Department of Emergency Services Director, City of Mason Mayor
Anticipated Cost	Staff Time and Resources (Est. $2,000)
Existing & Potential Funding Sources	General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

Goal 6; Objective 6.1; Action 6.1.2	
Develop a public education program concerning the hazards associated with droughts, including medical conditions and water restrictions during drought conditions	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (Est. $2,000)
Existing & Potential Funding Sources	General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 6; Objective 6.1; Action 6.1.3	
Determine feasibility of providing potable water to the agricultural community in the event of a drought	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (Est. $2,000)
Existing & Potential Funding Sources	General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	14/23
Status (Deferred or New)	New

Goal 6; Objective 6.1; Action 6.1.4	
Promote the use of water saving techniques (such as low-flow showerheads and toilets)	
Responsible Department	City of Loveland Utility Department
Anticipated Cost	Staff Time and Resources (Est. $2,000)
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Loveland
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	13/23
Status (Deferred or New)	New

Goal 6; Objective 6.1; Action 6.1.4	
Examine ordinances that can be written to prioritize or control water use during emergency drought conditions	
Responsible Department	City of Middletown Public Works Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Middletown

Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	14/23
Status (Deferred or New)	New

6.10.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-10 Updated Actions for Drought

ACTION	STATUS	NOTES
Develop a mutual aid agreement/planning mechanism to provide water in drought events that may impact local aquifers, to include the Old Mason Water Treatment Facility.	New	
Develop a public education program concerning the hazards associated with droughts, including medical conditions and water restrictions during drought conditions	New	
Determine feasibility of providing potable water to the agricultural community in the event of a drought	New	
Promote the use of water saving techniques (such as low-flow showerheads and toilets)	New	
Examine ordinances that can be written to prioritize or control water use during emergency drought conditions	New	
Develop designs and plans for water delivery systems that include a consideration of drought events	Changed	This action was re-written into Action 6.1.1
Provide an alternate potable water source in the event that existing water supplies are disrupted or wells run dry, especially for the agricultural community	Changed	This action was re-written into Action 6.1.3

6.11 *Flood Mitigation Strategy*

6.11.1 Community Mitigation Goals

***GOAL 7**: Prevent and reduce the impact of flood events on the lives, property, infrastructure and environment of Warren County and its jurisdictions.*

6.11.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Flood Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

With sufficient warning of a flood, a community and its residents can take protective measures such as moving personal property, cars, and people out of harm's way. New radar technologies, improved river forecast models, computer visualization, automated data transmission, and improved data collection techniques hold significant promise for improving the timeliness and accuracy of flood forecasts and warnings.

A comprehensive education and outreach program is critical to the success of early warning systems so that the general public, operators of critical facilities, and emergency response personnel will know what actions to take when warning is disseminated.

6.11.3 Existing Policies, Regulations, Ordinances, and Land Use

Floodplain management ordinances are intended to addresses methods and practices to minimize flood damage to new and substantial home improvement projects as well as address zoning and subdivision ordinances and state regulations. With that said, Warren County joined the National Flood Insurance Program (NFIP) on December 5, 1990 and continues to participate and support floodplain management. Floodplain management is required under the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

In the majority of the County, riverine floodplains tend to be narrow and slow moving. During heavy precipitation events, flash flooding is a constant concern for residents and local officials. The upland soils are generally well drained. The bottomlands along floodplains may be usable to some extent for non-intensive uses such as agriculture, recreation, etc.

6.11.4 New Buildings and Infrastructure

The greatest protection is afforded by quality construction and compliance with local ordinances which exceed NFIP requirements. Code adoption by local jurisdictions, compliance by builders, and local government inspection of new homes can reduce the risk of flooding. Warren County will continue to support monitoring, analysis, modeling, and the development of decision-support systems and geographic information applications for floodplain activities.

6.11.5 Existing Buildings and Infrastructure

In addition to land-use planning, zoning, and codes applicable to new development, flood mitigation measures include structural and non-structural measures to address susceptibility of existing structures. Flood mitigation measures such as acquisition, relocation, elevation-in-place, wet/dry flood proofing, and

enhanced storm drainage systems all have the potential to effectively reduce the impact of flood in Warren County.

6.11.6 Mitigation Action Plan

- ✓ ***GOAL 7**: Prevent and reduce the impact of flood events on the lives, property, infrastructure and environment of Warren County and its jurisdictions.*
  - ✓ ***OBJECTIVE 7.1**: Examine and improve zoning regulations throughout the County as they relate to flooding.*

Goal 7; Objective 7.1; Action 7.1.1	
Development of building codes which restrict building structures within the floodplain.	
Responsible Department	Jurisdictional Building Commissions/Planning Commissions
Anticipated Cost	Staff Time and Resources (Est. $5,000)
Existing & Potential Funding Sources	General Funds, Hazard Mitigation Grants (HMA / HMGP / PDM), Capital Improvement Grants, CBDG
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, City of Franklin, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.1; Action 7.1.2	
Development of building codes which restrict building structures in areas with wandering streams.	
Responsible Department	Jurisdictional Building Commissions/Planning Commissions
Anticipated Cost	Staff Time and Resources (Est. $5,000)
Existing & Potential Funding Sources	General Funds, Hazard Mitigation Grants (HMA / HMGP / PDM), Capital Improvement Grants, CBDG
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, City of Franklin, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.1; Action 7.1.3	
Update Warren County Flood Damage Prevention Regulations that would allow the County to better regulate construction within the 100-year floodplain.	
Responsible Department	Jurisdictional Building Commissions/Planning Commissions
Anticipated Cost	Staff Time and Resources (Est. $5,000)
Existing & Potential Funding Sources	General Funds, Hazard Mitigation Grants (HMA / HMGP / PDM), Capital Improvement Grants, CBDG

Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, City of Franklin, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	Deferred

Goal 7; Objective 7.1; Action 7.1.4	
Continually assess the areas that are affected during flood events to best determine proper land use in those areas	
Responsible Department	Warren County Department of Emergency Services Director, Participating Jurisdictions
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Hazard Mitigation Grant Program, General Funds
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	21/23
Status (Deferred or New)	New

Goal 7; Objective 7.1; Action 7.1.5	
Ensure NFIP requirements are being met concerning repairs, renovations, and remodeling of structures located in the regulatory floodplain	
Responsible Department	Village of Carlisle Zoning Officer
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Carlisle
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	19/23
Status (Deferred or New)	New

Goal 7; Objective 7.1; Action 7.1.6	
Update existing flood damage prevention ordinances (As they relate to 44 CFR 60.3)	
Responsible Department	City of Franklin Zoning Official
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Franklin
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

✓ ***OBJECTIVE 7.2****: Pre-plan for flood events in the County*

Goal 7; Objective 7.2; Action 7.2.1	
Evaluate the feasibility of buying flood-prone properties through Warren County and its jurisdictions in order to prevent future losses from flood events.	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Dependent on Scope
Existing & Potential Funding Sources	Hazard Mitigation Grants (HMA, PDM, FMA), EMPG Special Projects, Capital Improvement Grants, General Funds (For local match)
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, City of Franklin, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.2	
Acquisition / Demolition of the Village of South Lebanon Administration building and the Warren County Sheriff's Office South Lebanon Outpost	
Responsible Department	Warren County Department of Emergency Services Director, Village of South Lebanon Council
Anticipated Cost	$100,000
Existing & Potential Funding Sources	Hazard Mitigation Grant Program
Jurisdiction	Warren County, Village of South Lebanon
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	21/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.3	
Identify need for and install stormwater systems to address flood concerns.	
Responsible Department	Warren County Department of Emergency Services Director, Participating Jurisdictions' Engineers/Road Supervisors
Anticipated Cost	$100,000
Existing & Potential Funding Sources	Hazard Mitigation Grant Program, General Funds
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	21/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.4	
Identify need for and install culverts to protect vulnerable roadways.	
Responsible Department	Warren County Department of Emergency Services Director, Participating Jurisdictions' Engineers/Road Supervisors
Anticipated Cost	Depends on scope, (Est. at $75,000 per culvert)
Existing & Potential Funding Sources	Hazard Mitigation Grant Program, General Funds
Jurisdiction	Warren County, Village of Butlerville, Village of Carlisle, Village of Corwin, City of Franklin, Village of Harveysburg, City of Lebanon, City of Loveland, Village of Maineville, City of Mason, City of Monroe, Village of Morrow, Village of Pleasant Plain, Village of South Lebanon, Village of Springboro, Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	21/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.5	
Evaluate the need for structural projects meant to protect the people, property and infrastructure of Warren County from flood waters	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Depends on scope
Existing & Potential Funding Sources	Hazard Mitigation Grant Program (PDM, HMA, HMGP), General Funds
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.6	
Conduct Stream Restoration and Floodplain enhancement via Re-establish/remove fill to enhance floodplain, natural channel design.	
Responsible Department	Miami Conservancy District
Anticipated Cost	Depends on scope
Existing & Potential Funding Sources	Hazard Mitigation Grant Program (PDM, HMA, HMGP), Conservancy Funding
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.7	
Conduct Buyout program/Acquisition - Relocation of the Franklin Carlisle Great Miami River Overflow	
Responsible Department	Miami Conservancy District
Anticipated Cost	Depends on scope
Existing & Potential Funding Sources	Hazard Mitigation Grant Program (PDM, HMA, HMGP), Conservancy Funding

Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.8	
Conduct Buyout/Demolition of Carlisle properties susceptible to flood losses	
Responsible Department	Miami Conservancy District
Anticipated Cost	Depends on scope
Existing & Potential Funding Sources	Hazard Mitigation Grant Program (PDM, HMA, HMGP), Conservancy Funding
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.9	
Conduct Demolition/Removal projects for two Mason City owned buildings that were flooded in the 2001 event.	
Responsible Department	Mayor, City of Mason
Anticipated Cost	$450,000
Existing & Potential Funding Sources	Hazard Mitigation Grant Program (PDM, HMA, HMGP), General Fund for local match
Jurisdiction	City of Mason
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.10	
Place depth markers on frequently flooded roads to advise travelers of flooding depths	
Responsible Department	Village of Morrow Public Works Director
Anticipated Cost	$10,000
Existing & Potential Funding Sources	Hazard Mitigation Grant Program (PDM, HMA, HMGP), Municipal Fund for local match
Jurisdiction	Village of Morrow
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.11	
Identify structure inventory for properties at-risk to flood (especially properties located in the special flood hazard area/1% annual chance area)	
Responsible Department	Village of Carlisle Zoning Officer
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Carlisle
Timeframe	06/20/2015 – 06/20/2020

STAPLEE Priority	15/23
Status (Deferred or New)	New

Goal 7; Objective 7.2; Action 7.2.12	
Determine the need for upgrades/enhancements to the storm sewers in the City of Lebanon	
Responsible Department	City of Lebanon Engineer
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Lebanon
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 7.3****: Develop and execute a public education and outreach program centered around flood hazards in Warren County, to include NFIP information, SFHA information and CRS*

Goal 7; Objective 7.3; Action 7.3.1	
Encourage communities to join the National Flood Insurance Program, which would allow residents to purchase flood insurance.	
Responsible Department	Warren County Department of Emergency Services Director, Warren County Floodplain Administrator
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	County Funds
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	Deferred

6.11.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-11 Updated Actions for Flooding

ACTION	STATUS	NOTES
Development of building codes which restrict building structures within the floodplain.	New	
Development of building codes which restrict building structures in areas with wandering streams.	New	
Update Warren County Flood Damage Prevention Regulations that would allow the County to better regulate construction within the 100-year floodplain.	Deferred	
Continually assess the areas that are affected during flood events to best determine proper land use in those areas	New	

Ensure NFIP requirements are being met concerning repairs, renovations, and remodeling of structures located in the regulatory floodplain	New	
Update existing flood damage prevention ordinances (As they relate to 44 CFR 60.3)	New	
Evaluate the feasibility of buying flood-prone properties through Warren County and its jurisdictions in order to prevent future losses from flood events.	New	
Acquisition / Demolition of the Village of South Lebanon Administration building and the Warren County Sheriff's Office South Lebanon Outpost	New	
Identify need for and install stormwater systems to address flood concerns.	New	
Identify need for and install culverts to protect vulnerable roadways.	New	
Evaluate the need for structural projects meant to protect the people, property and infrastructure of Warren County from flood waters	Deferred	Changed from a 2007 action that read: *Implement structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, wetlands protection and restoration).*
Conduct Stream Restoration and Floodplain enhancement via Re-establish/remove fill to enhance floodplain, natural channel design.	New	
Conduct Buyout program/Acquisition - Relocation of the Franklin Carlisle Great Miami River Overflow	New	
Conduct Buyout/Demolition of Carlisle properties susceptible to flood losses	New	
Place depth markers on frequently flooded roads to advise travelers of flooding depths	New	
Identify structure inventory for properties at-risk to flood (especially properties located in the special flood hazard area/1% annual chance area)	New	
Determine the need for upgrades/enhancements to the storm sewers in the City of Lebanon	New	
Conduct Demolition/Removal projects for two Mason City owned buildings that were flooded in the 2001 event.	New	
Encourage communities to join the National Flood Insurance Program, which would allow residents to purchase flood insurance.	Deferred	

Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents of approaching severe weather.	Deleted	This action has been completed

6.12 *Wildfire Mitigation Strategy*

6.12.1 Community Mitigation Goals

***GOAL 7**: Minimize and reduce the risk to life, property, infrastructure and the environment due to wildfire in Warren County and its jurisdictions.*

6.12.2 Identification and Analysis of Range Of Mitigation Options

The Warren County Mitigation Planning Committee considered a range of mitigation options for the Wildfire Mitigation Strategy. See the four categories of mitigation measures that Warren County considered in the introduction of this section.

6.12.3 Existing Policies, Regulations, Ordinances, and Land Use

Warren County is experiencing population growth and because of this, there has been a substantial change in land use as well as the wildland urban interface over the years bringing a diverse range of challenges. Therefore, Warren County adheres to a comprehensive list of policies and regulations including the National Fire Protection Association Codes. It is also a priority for Warren County to address the primary concern regarding protection of existing and future development in the wildland urban interface areas within the county.

6.12.4 New Buildings and Infrastructure

As residential developments expand into wild land areas, people and property are increasingly at risk from wildfire. A cleared safety zone of at least 30 feet (100 feet in pine forests) should be maintained between structures and combustible vegetation, and fire-resistant ground cover, shrubs, and trees should be used for landscaping (for example, hardwood trees are less flammable than pines, evergreens, eucalyptus or firs). Only fire-resistant or non-combustible materials should be used on roofs and exterior surfaces. Roofs and gutters should be regularly cleaned and chimneys should be equipped with spark arrestors. Vents, louvers, and other openings should be covered with wire mesh to prevent embers and flaming debris from entering. Overhangs, eaves, porches, and balconies can trap heat and burning embers and should also be avoided or minimized and protected with wire mesh. Windows allow radiated heat to pass through and ignite combustible materials inside, but dual- or triple-pane thermal glass, fire-resistant shutters or drapes, and noncombustible awnings can help reduce this risk.

The term fireproof does not necessarily mean that an item cannot ever burn: It relates to measured performance under specific conditions of testing and evaluation. Fireproofing does not allow treated items to be entirely unaffected by any fire, as conventional materials are not immune to the effects of fire at a sufficient intensity and/or duration.

As stated above, safety zones can be created around structures by reducing or eliminating brush, trees, and vegetation around a home or facility. FEMA recommends using a 30-foot safety zone; including keeping grass below 2 feet tall and clearing all fallen leaves and branches promptly.

Firebreaks are areas of inflammable materials that create a fuel break and reduce the ability for fires to spread and roads and pathways can be planned and designed to serve as breaks. The use of Geographic Information System-based wildfire hazard assessment tools for use by Warren County should be considered for future planning and mitigation efforts.

Increased public education on fire safety is critical in Warren County due to its rapidly growing population, especially when many of the areas being developed are larger lots scattered throughout wildland fuels.

6.12.5 Existing Buildings and Infrastructure

Wildfire mitigation in the urban/wildland interface has primarily been the responsibility of property owners who choose to build and live in vulnerable zones. In practice, successful wildfire strategies can be quite involved. The most important aspect of successful suppression is disruption of the continuity of fuels, achieved by creating breaks or defensible areas. For interface fires, where homes and other structures fill the space, fuel reduction is best accomplished before the fires begin.

6.12.6 Mitigation Action Plan

- ✓ ***GOAL 8****: Minimize and reduce the risk to life, property, infrastructure and the environment due to wildfire in Warren County and its jurisdictions.*
  - ✓ ***OBJECTIVE 8.1****: Enhance response capability of Warren County to wildfire events*

Goal 8; Objective 8.1; Action 8.1.1	
Seek State and Federal Grants for the purpose of purchasing and training on better firefighting equipment	
Responsible Department	Warren County Department of Emergency Services Director, Local Fire Jurisdictions' Chiefs
Anticipated Cost	Staff Time and Resources (Est. $5,000) to prepare grants
Existing & Potential Funding Sources	General Funds/Budgets
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

Goal 8; Objective 8.1; Action 8.1.2	
Acquire more fire tankers (2000 – 3000 Gallon) for local fire departments	
Responsible Department	Warren County Department of Emergency Services Director, Local Fire Jurisdictions' Chiefs
Anticipated Cost	Staff Time and Resources (Est. $5,000) to prepare grants
Existing & Potential Funding Sources	General Funds/Budgets
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 8.2****: Develop methods to evaluate and respond to the environmental impacts of wildfires in Warren County*

Goal 8; Objective 8.2; Action 8.2.1	
Provide additional wildfire mitigation training to fire department personnel	
Responsible Department	Local Fire Jurisdictions' Chiefs
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	General Funds
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 8.3****: Develop and execute a public education and outreach program about wildfire risk in Warren County*

Goal 8; Objective 8.3; Action 8.3.1	
Support and promote Ohio Department of Natural Resources Burn Ordinances	
Responsible Department	Warren County Department of Emergency Services Director, Local Fire Departments' Chiefs
Anticipated Cost	Staff Time and Resources (Est. $5,000)
Existing & Potential Funding Sources	General Funds/Budgets
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	16/23
Status (Deferred or New)	New

Goal 8; Objective 8.3; Action 8.3.2	
Promote fuel reduction in areas prone to wildfires	
Responsible Department	Village of Corwin Mayor
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Corwin
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	14/23
Status (Deferred or New)	New

6.12.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-12 Updated Actions for Wildfire

ACTION	STATUS	NOTES

Seek State and Federal Grants for the purpose of purchasing and training on better firefighting equipment	New	
Acquire more fire tankers (2000 – 3000 Gallon) for local fire departments	New	
Provide additional wildfire mitigation training to fire department personnel	New	
Support and promote Ohio Department of Natural Resources Burn Ordinances	New	
Promote fuel reduction in areas prone to wildfires	New	

6.13 *Dam Failure Mitigation Strategy*

6.13.1 Community Mitigation Goals

***GOAL 9**: An efficient and effective system of dams in Warren County and its jurisdictions*

6.13.2 Identification and Analysis of Range Of Mitigation Options

The primary rationale for mitigating dams and levees is the potential loss of life and economic loss due to dam and/or levee failure. Dam and levee failures result from the failure of manmade water impoundment structures, which often results in catastrophic down grade flooding. Dam-safety and dam construction, although improving, remains imperfect and the necessity for hazard mitigation remains.

Mitigation of hazards associated with dam failure differs depending on whether the hazard is associated with a new or existing dam. New dams can be designed to meet stringent safety criteria, including passage of extreme flood discharges and resistivity to earthquakes. Land downstream of new dams can be zoned or other-wise regulated to limit new construction and exposure.

6.13.3 Existing Policies, Regulations, Ordinances, and Land Use

Floodplain management ordinances are intended to addresses methods and practices to minimize flood damage to new and substantial home improvement projects as well as address zoning and subdivision ordinances and state regulations. With that said, Warren County joined the National Flood Insurance Program (NFIP) on January 3, 1975 and continues to participate and support floodplain management. Floodplain management is required under the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The floodplain regulations will help protect the village from any potential impact resulting from a breach in the dams in the area.

6.13.4 New Buildings and Infrastructure

As new buildings and infrastructure are developed and constructed in inundation areas resulting in population growth and rural-to-urban migration, the potential for greater losses and impact rises. This development pattern will continue for the foreseeable future unless proper mitigation measures are taken. Public awareness measures such as notices on final plats and public education on dam safety are proactive mitigation measures that should be implemented by local communities.

This situation may create more potential debris flow during major flood events or dam failures and could damage or destroy downstream dams. Any additional development downstream of a dam and within the inundation area could elevate the dam hazard ranking and the level of risk.

6.13.5 Existing Buildings and Infrastructure

Inundation maps are required for each dam with an Emergency Action Plan (EAP). An inundation map illustrates which properties may be affected by floodwaters and show the extent of flooding expected spatially within a geographic area. These maps will not be included in this Plan for security reasons, but remain on file with the owners of the dam associated with the EAP.

6.13.6 Mitigation Action Plan

- ✓ ***GOAL 9****: An efficient and effective system of dams in Warren County and its jurisdictions*
  - ✓ ***OBJECTIVE 9.1****: Enhance the relationship between ODNR and dam owners in Warren Co.*

Goal 9; Objective 9.1; Action 9.1.1	
Coordinate with the Ohio Department of Natural Resources, Division of Water, in accordance with ORC Section 1512.062, to periodically reclassify any dam within the County as a result of a change in circumstances not in existence at the time of the initial classification to ensure adequate safety according to the potential for downstream damage	
Responsible Department	ODNR, Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (Est. $2,000)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	19/23
Status (Deferred or New)	New

Goal 9; Objective 9.1; Action 9.1.2	
Coordinate with dam owners to ensure that their inundation mapping and response plans are being kept up to date	
Responsible Department	City of Mason Engineering and Building Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	City of Mason
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

Goal 9; Objective 9.1; Action 9.1.3	
Develop land use strategies to promote the safe use of land downstream from dams	
Responsible Department	Village of Waynesville Planning and Zoning Director
Anticipated Cost	Staff Time and Resources

Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

Goal 9; Objective 9.1; Action 9.1.4	
During any and all new dam construction, encourage the completion of a critical flood engineering analysis by a professional engineer licensed in the State of Ohio	
Responsible Department	Village of Waynesville Planning and Zoning Director
Anticipated Cost	Staff Time and Resources
Existing & Potential Funding Sources	Municipal Funds
Jurisdiction	Village of Waynesville
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	18/23
Status (Deferred or New)	New

- ✓ ***OBJECTIVE 9.2****: Develop and execute a public education and outreach program about dam safety in Warren County*

Goal 9; Objective 9.2; Action 9.2.1	
Develop a public education program concerning the hazards associated with dams	
Responsible Department	Warren County Department of Emergency Services Director
Anticipated Cost	Staff Time and Resources (Est. $2,000)
Existing & Potential Funding Sources	County General Fund
Jurisdiction	Warren County
Timeframe	06/20/2015 – 06/20/2020
STAPLEE Priority	17/23
Status (Deferred or New)	New

6.13.7 Completed, Deferred, Deleted or New Action Steps From the 2007 Plan

Table 6-13 Updated Actions for Dam Failure

ACTION	STATUS	NOTES
Coordinate with the Ohio Department of Natural Resources, Division of Water, in accordance with ORC Section 1512.062, to periodically reclassify any dam within the County as a result of a change in circumstances not in existence at the time of the initial classification to ensure adequate safety according to the potential for downstream damage	New	
Coordinate with dam owners to ensure that their inundation mapping and response plans are being kept up to date	New	

Develop land use strategies to promote the safe use of land downstream from dams	New	
During any and all new dam construction, encourage the completion of a critical flood engineering analysis by a professional engineer licensed in the State of Ohio	New	
Develop a public education program concerning the hazards associated with dams	New	
Encourage communities to join the National Flood Insurance Program, which would allow residents to purchase flood insurance	Deleted	Removed for relevance. This action related more to flooding than dam failure.
Seek funding for early warning systems, such as sirens and reverse 9-1-1, to warn residents.	Deleted	This action has been completed
Implement structural projects to channel water away from people and property (dikes, levees, floodwalls) or to increase drainage or absorption capacities (spillways, water detention and retention basins, relief drains, drain widening/dredging or rerouting, debris detention basins, logjam and debris removal, extra culverts, bridge modification, dike setbacks, flood gates and pumps, wetlands protection and restoration)	Deleted	Planning committee opted to remove this action from the plan update

Section 7. Plan Implementation and Maintenance

As a living document it is important that this plan becomes a tool in Warren County resources to ensure reductions in possible damage from a natural hazard event. This section discusses plan adoption, implementation, monitoring, evaluating, and updating the HMP. Plan implementation and maintenance procedures will ensure that the HMP remains relevant and continues to address the changing environment in Warren County. This section describes the incorporation of the HMP into existing planning mechanisms, and how the staff will continue to engage the public.

7.1 *Plan Adoption*

To comply with DMA 2000, Warren County and its jurisdictions have officially adopted the 2015 Warren County HMP. The adoption of the 2015 HMP recognizes the commitment to reducing the impacts of natural hazards within Warren County limits. A copy of the adoption resolutions are included in Appendix A.

7.2 *Implementation*

Over time, Implementation Strategies will become more detailed and the mitigation planners will work to provide more detail for priority mitigation actions. In conjunction with progress report processes outlined in Section 7.4.2, implementation strategy worksheets provided in Appendix C, will be extremely useful as a plan of record tool for updates. Each implementation strategy worksheet provides individual steps and resources need to complete each mitigation action. The following provides several options to consider when developing implementation strategies in the future:

- **Use processes that already exist;** initial strategy is to take advantage of tools and procedures identified in the capability assessment in Section 6. By using planning mechanisms already in use and familiar to departments and organizations, it will give the planning implementation phase a strong initial boost, especially if a mitigation strategy calls for expanding existing programs, or creating new programs or processes at a later date. Section 6 provides more information on existing planning mechanisms.
- **Updated work plans, policies, or procedures**; hazard mitigation concepts and activities can help integrate the HMP into daily operations. These changes can include how major development projects and subdivision reviews are addressed in hazard prone areas or ensure that hazard mitigation concerns are considered in the approval of major capital improvement projects.
- **Job descriptions;** working with department or agency heads to revise job descriptions of government staff to include mitigation-related duties could further institutionalize hazard mitigation. This change would not necessarily result in great financial expenditures or programmatic changes.

7.3 *Evaluation, Monitoring and Updating*

Monitoring, evaluating, and updating this plan is critical to maintaining its value and success in Warren County's hazard mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also

provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis.

The Warren County Mitigation Planning Committee established for this 2015 Plan is designated to lead plan maintenance processes of monitoring, evaluation and updating with support and representation from all participating municipalities. The Mitigation Planning Committee will coordinate maintenance efforts, but the input needed for effective periodic evaluations will come from community representatives, local emergency management coordinators and planners, the general public, and other important stakeholders. In addition, the committee will serve in an advisory capacity to Warren County citizens and elected officials.

The Mitigation Planning Committee will oversee the progress made on the implementation of action items identified and modify actions, as needed, to reflect changing conditions. The Warren County Mitigation Planning Committee will meet annually to evaluate the plan and discuss specific coordination efforts that may be needed with participating jurisdictions and other stakeholders. The annual evaluation may include the participation of individual municipal monitors, or at least will include reports prepared by them.

The annual evaluation of the 2015 Hazard Mitigation Plan will not only include an investigation of whether mitigation actions were completed, but also an assessment of how effective those actions were in mitigating losses. A review of the qualitative and quantitative benefits (or avoided losses) of mitigation activities will support this assessment. Results of the evaluation will then be compared to the goals and objectives established in the plan and decisions will be made regarding whether actions should be discontinued, or modified in any way in light of new developments in the community. Progress will be documented by the Mitigation Planning Committee for use in the next Hazard Mitigation Plan update. Finally, the Mitigation Planning Committee will monitor and incorporate elements of this Plan into other planning mechanisms. The annual reviews will be led by Michael Bunner, Director of the Warren County EMA.

This Plan will be updated by the FEMA approved five year anniversary date, as required by the Disaster Mitigation Act of 2000, or following a disaster event. Future plan updates will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. During the five-year review process, the following questions will be considered as criteria for assessing the effectiveness of The Warren County Hazard Mitigation Plan.

- Has the nature or magnitude of hazards affecting the County changed?
- Are there new hazards that have the potential to impact the County?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional local resources be committed to address identified hazards?

Issues that arise during monitoring and evaluation which require changes to the local hazard, risk and vulnerability summary, mitigation strategy, and other components of the plan will be incorporated during future updates.

Update process for plan prior to 5-year update. Any interested party wishing for an update of this Plan sooner than the 5-year update will submit such a request to The Warren County EMA for consideration through Michael Bunner, Director of the Warren County EMA and the Mitigation Planning Committee. The request shall be accompanied by a detailed rationale. The EMA will evaluate all such requests and determine whether the update request should be acted upon. If the decision is in the affirmative, an assignment will be made for an individual to author the update. The draft updated section along with a detailed rationale will be submitted to The Warren County Mitigation Planning Committee. The committee will circulate the draft updated section of the plan for comment and after an appropriate period of time, the committee shall make a decision to update the plan at least partially based on the feedback received from the other jurisdiction. Municipal adoptions will then occur.

7.4 *Plan Update and Maintenance*

This section describes the schedule and process for monitoring, evaluating, and updating the 2015 HMP.

7.4.1 Schedule

Monitoring the progress of the mitigation actions will be on-going throughout the five-year period between the adoption of the HMP and the next update effort. The HMP Planning Committee will meet on an annual basis to monitor the status of the implementation of mitigation actions and develop updates as necessary.

The HMP will be updated every five years, as required by DMA 2000. The update process will begin at least one year prior to the expiration of the HMP. However, should a significant disaster occur within Warren County, the HMP Planning Committee will reconvene within 30 days of the disaster to review and update the HMP as appropriate.

7.4.2 Process

The HMP Planning Committee will coordinate with responsible agencies/organizations identified for each mitigation action. These responsible agencies/organizations will monitor and evaluate the progress made on the implementation of mitigation actions and report to the HMP Planning Committee on an annual basis. Working with the HMP Planning Committee, these responsible agencies/organizations will be asked to assess the effectiveness of the mitigation actions and modify the mitigation actions as appropriate. A HMP Mitigation Action Progress Report worksheet, provided in Appendix D, developed as part of this HMP to assist mitigation project managers in reporting on the status and assessing the effectiveness of the mitigation actions.

Information culled from the mitigation leads or "champions" will be used to monitor mitigation actions and annual evaluation of the HMP. The following questions will be considered as criteria for evaluating the effectiveness of the HMP:

- Has the nature or magnitude of hazards affecting the community changed?
- Are there new hazards that have the potential to impact the community?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the HMP?
- Should additional local resources be committed to address identified hazards?

An Annual HMP Review Questionnaire worksheet, provided in Appendix D, has been developed as part of this HMP to provide guidance to the HMP Planning Committee on what should be included in the evaluation. Future updates to the HMP will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. Issues that arise during monitoring and evaluating the HMP, which require changes to the risk assessment, mitigation strategy and other components of the HMP, will be incorporated into the next update of the HMP. The questions identified above would remain valid during the preparation of the update.

7.5 *Incorporation into Existing Planning Mechanisms*

An important implementation mechanism is to incorporate the recommendation and underlying principles of the HMP into community planning and development such as capital improvement budgeting, building and zoning codes, general plans and regional plans. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of the jurisdiction attempting to implement risk reducing actions. The integration of a variety of departments on the HMP Planning Committee provides an opportunity for constant and pervasive efforts to network, identify, and highlight mitigation activities and opportunities at all levels of government. This collaborative effort is also important to monitor funding opportunities which can be leveraged to implement the mitigation actions. HMP mitigation planners will actively incorporate information into:

- **Building / Development Codes and Zoning Ordinances:** The HMP will provide information to enable Warren County to make decisions on appropriate building/development codes and ordinances. Appropriate building codes and ordinances can increase resilience against natural disasters.
- **Warren County Comprehensive Plan:** The HMP will provide information that can be incorporated into the Land Use Element during the next general plan update. Specific risk and vulnerability information from the Warren County HMP will assist to identify areas where development may be at risk to potential hazards.
- **Warren County Emergency Operations Plan (EOP):** The HMP highlights hazards that the County and its jurisdictions are vulnerable to. This information would be valuable to include in future updates to the EOP.

The county's process to integrate the data, information, and hazard mitigation goals and actions in other planning mechanisms is accomplished through select members on the Mitigation Planning Committee. These members from Mitigation Planning Committee include, but are not limited to:

- County Commissioners
- Office of Public Safety
- Floodplain Administrators (County and jurisdictions)
- County Engineer's Office
- County Geographic Information System Staff

These Committee Members take information to their respective organizations that are charged with the development, maintenance, and on occasion, enforcement of rules, regulations, codes, ordinances, policies, plans, procedures and other administrative instruments. Information from the mitigation planning effort is presented to the leadership of these organizations, who then authorize the information to be added, to revise or update current administrative instruments. This allows for oversight, commitment of time, energy, and resources to change actions into projects.

Although the jurisdictions do not have as many representatives to serve on the Committee, their representatives follow the same processes as those at County level.