2018-2023

Muskingum County Hazard Mitigation Plan

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Section 1. Introduction

The safety of the Muskingum County community is a top priority, and planning for natural, technological, and man-made disasters is an important part of being proactive. Disasters can result in 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. Muskingum County Hazard Mitigation Plan (HMP) is an effort to mitigate the effects of 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 disasters cannot be prevented from occurring, the effects 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 Muskingum County.

1.1 *Background and Purpose*

Each year in the United States, 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, small communities and institutions throughout Ohio.

To reduce the community burden from the effects of all hazards, the Muskingum County Emergency Management Agency, in partnership with an HMP consultant, is developing the 2018 Hazard Mitigation Plan. This plan is being 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.

Twelve (12) federal disaster declarations have been documented in Muskingum County since 1956, due to: severe storms, high winds, blizzards, snow storms and flooding. These recorded natural hazard events provide a hazard footprint across the region which helps mitigation planners understand hazards that could occur in and around Muskingum County, and their associated risks to life and property. Understanding 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, Muskingum County must be prepared to implement efficient and effective short- and long-term actions where needed. The purpose of the 2018 HMP is to provide the County with a blueprint for hazard mitigation action planning. The plan identifies resources, information, and strategies for risk reduction, and acts as 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, through an all-hazards approach, creating 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 plans and strategies, but rather enhances the community's ability to communicate and mitigate natural, technological, and manmade 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 risk and cost of disaster response and recovery to the County and its residents, workers, and visitors by protecting critical facilities, reducing liability exposure, and minimizing overall impacts and disruptions from all hazards.

1.2 *Authority*

This plan 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, Muskingum 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 six 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 Muskingum County history, geography, topography, climate, population, economy, housing, and land use and development trends.

- **Section 3. The Planning Process** describes the 10-Step HMP Planning Process, as well as the meetings and outreach activities undertaken to engage stakeholders.

[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. Hazard Risk Assessment** identifies and prioritizes all hazards affecting Muskingum County, and assesses the vulnerability from the identified hazards.

- **Section 5. Mitigation Strategy** identifies mitigation goals and objectives and identifies and prioritizes new mitigation actions.

- **Section 6. 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, and land use and development trends.

2.1 *History of Muskingum County*[2]

Muskingum County was founded on March 1, 1804, one year after Ohio formally became a part of the United States. For a brief time, the County would house the state's capital, Zanesville, after taking it from Chillicothe. After two years, the torch was then passed back to Chillicothe in 1812, and then again to its final location in Columbus in 1816.

Arguably the most famous landmark in Muskingum County is located in Zanesville: The Y-Bridge. The current one, however, is not the first, nor the second, but indeed the fifth iteration of the bridge. The first bridge was constructed in 1814 during the construction of Zane's Trace. It lasted for roughly 4 years before becoming one with the river. The second bridge was rushed to construction, but was not strong enough to hold its own weight. During the final stage, when the wedges were removed, the span fell into the river. In 1832, a third version was constructed, which stood until 1900. Two years later, the fourth was completed, standing until 1979. Five years of careful planning led to the fifth Y-Bridge. This version, to the dismay of some locals, lacked the view that the previous version had of the Licking and Muskingum rivers converging. This is the bridge that still stands today.

2.2 *Geography, Topography, and Climate*

2.2.1 Geography

Muskingum County is located east of Central Ohio, and is bordered by Coshocton, Guernsey, Noble, Morgan, Perry, and Licking counties. According to the United States Census Bureau, Muskingum County has a total of 673 square miles, 665 of which are land, and 8 that are water. The Licking River is a tributary of the Muskingum River, with the two intersecting in the heart of Zanesville. There are numerous other minor streams and creeks throughout the County, as well.

The County government holds its seat in Zanesville, and is served by the Muskingum County Commissioners, of which there are three. Muskingum County is split into 11 municipalities: the City of Zanesville, and the villages of Adamsville, Dresden, Frazeysburg, Fultonham, Gratiot, New Concord, Norwich, Philo, Roseville, and South Zanesville.

The largest road in the County is Interstate 70, which is also a federal Hazardous Materials route. US Route 22 and US Route 40 also run through the County. The County does not have any major airports, though there are several small private airports

2.2.2 Topography

Muskingum County is dominated by hills and wooded terrain. This area of the state was not muted by the glaciation of northern Ohio. Extensive mixed mesophystic forests and mixed oak forests grew in this area. Today, however, the forests remain in the hills, while dairy, livestock, and farms, as well as residential development, are concentrated in the valleys. The area is also rich in natural resources, and has been mined extensively for coal. Gas well, mining, and reclaimed land are extensive locally and are associated with stream degradation. This mining has led to increases in hazards such as subsidence and landslides.

2.2.3 Climate

Muskingum County receives rainfall in line with national averages, and slightly less the average snowfall amount. The number of days with any measurable precipitation is approximately 79 days a year, and on average there are 173 sunny days per year in Muskingum County. The July average high temperature is around 84°F and the January average low temperature is 20°F. The Muskingum County comfort index, which is based on humidity during the hot months, is 51 out of 100, while the average comfort index for the U.S. is 54.

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. See Table 2-1 for a complete summary of average climate information.

Table 2-1 Muskingum County Climate Summary Table

Climate Measurements	Muskingum County, Ohio	United States
Avg. Rainfall (in.)	39.7	39.2
Avg. Snowfall (in.)	19.8	25.8
Avg. Precipitation Days	79.3	102
Avg. Sunny Days	173	205
Avg. July High	84	86.1
Avg. Jan. Low	20.3	54
Comfort Index (higher=better)	51	54
UV Index	5.5	4.3
Avg. Elevation FT.	890	1,443

Source: ***http://www.bestplaces.net/climate/county/ohio/muskingum***

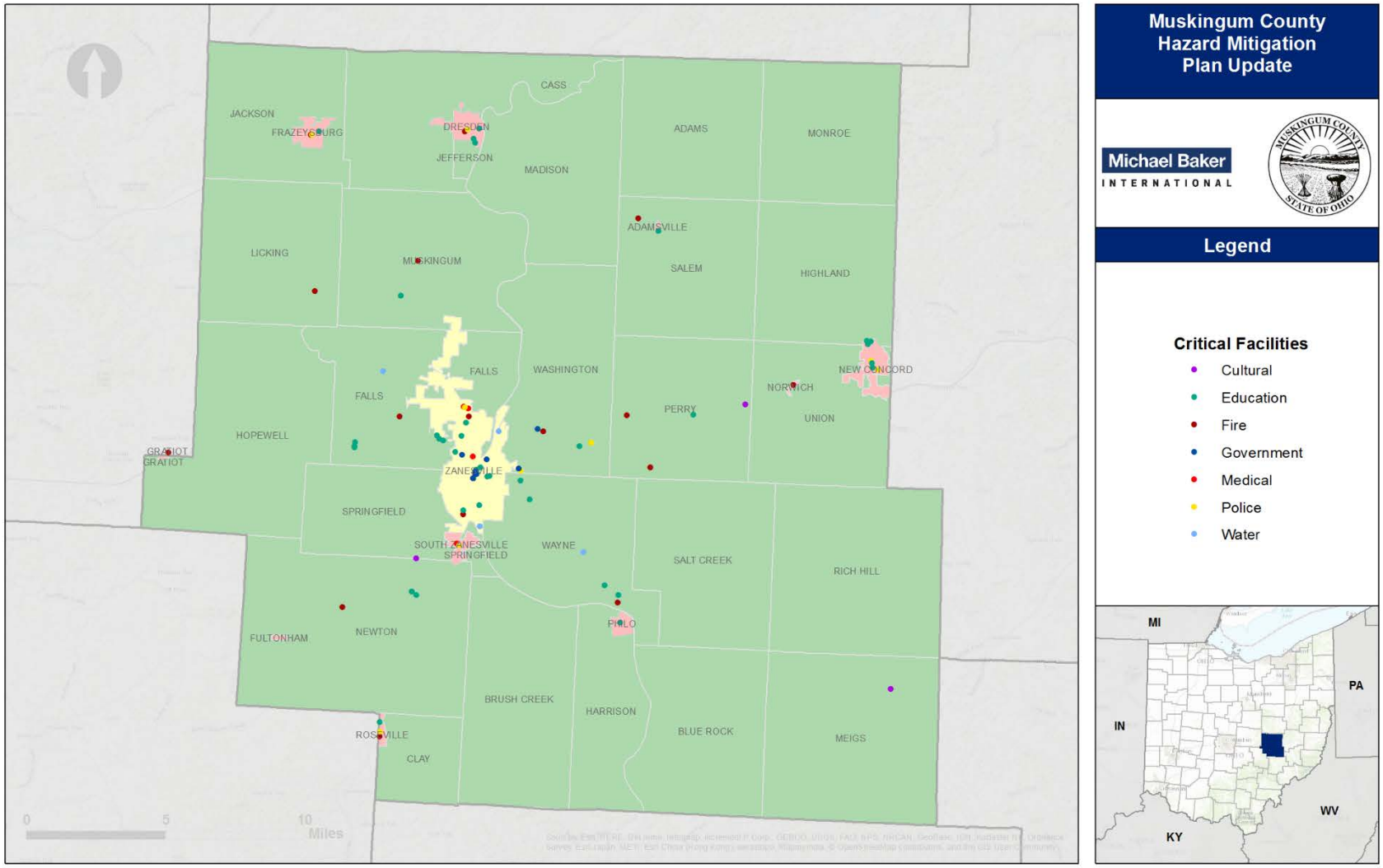

Figure 2-1 Muskingum County Basemap

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2.3 *Population, Occupancy, and Demographics*

Population and demographic information provides baseline data about Muskingum County. Maintaining and reviewing up-to-date data on demographics will allow the County to better assess magnitudes of hazards and develop more specific mitigation plans.

2.3.1 Population

2.3.1.1 County Population

Table 2-2 Muskingum County Baseline Demographics

Demographic	2015	Percent Total
Total Population	**86,016**	**-**
Male	41,796	49%
Female	44,220	51%
Race and ethnicity	**Residents**	**Percent Total**
White/Caucasian	79,640	91%
Black or African American	2,832	3%
Asian American	300	0%
Hispanic	783	0%
Two or More Races	2,720	3%
American Indian/ Alaskan Native	867	1%
Native Hawaiian / Pacific Islander	66	0%
Previous Years' Populations	**Residents**	**Percent Change**
2015*	86,016	- 0.1%
2010	86,074	+ 1.8%
2000	84,585	+ 3.1%
1990	82,068	- 1.5%
1980	83,340	+ 7.1%
1970	77,826	- 1.7%
1960	79,159	+ 6.2%
1950	74,535	-

Based on figures provided by the United States Census Bureau, Muskingum County has a residential population of 86,016. With a land total of 673 square miles, the population density is 130 people per square mile. The racial makeup of the County is approximately 91% White/Caucasian, 3% Black or African-American, less than 1% Hispanic, less than 1% Asian, and 3% who are two or more races. American Indian, Alaskan Natives, Native Hawaiians, and Pacific Islanders together equal about 1%.

The following chart is a comprehensive list that details the actual population of Muskingum County in 2010, the American Community Survey estimate for 2015, the estimated change in population between 2010 and 2015, the total number of housing units, the number of housing units occupied, and the area (in square miles) for each municipality.

Table 2-3: Profiles of Muskingum County Municipalities

Geography	2010 population	2015 population	Population Change	Total Housing	Occupied Housing	Sq. Miles
Muskingum County	85,951	86,016	0.1%	37,854	34,261	673
Adamsville	116	117	0.9%	65	43	0.05
Dresden	1,564	1,707	8.4%	751	700	1.14
Frazeysburg	1,620	1,620	0.0%	652	575	0.92
Fultonham	42	164	74.4%	65	61	0.16
Gratiot	287	381	24.7%	142	131	0.13
New Concord	2,459	2,670	7.9%	681	631	1.63
Norwich	108	96	-12.5%	47	39	0.1
Philo	871	866	-0.6%	304	291	0.42
Roseville	1,853	2,185	15.2%	886	768	0.71
South Zanesville	1,906	2,233	14.6%	850	850	0.83
Zanesville	25,567	25,470	-0.4%	12,555	11,010	12.14

2.4 *Employment*

According to the United States Census Bureau Longitudinal Employer-Household Dynamics (LEHD), there are a total of 31,447 persons employed in the Muskingum County workforce as of 2014. The County has a strong medical presence, with 6,400 people being employed in Health Care and Social Assistance programs, equating to 20.4% of overall employment.

Of those employed, the top five industry sectors by employment see approximately 20.4% of the workforce in Health Care and Social Assistance, 15.3% work in Retail Trade, 9.0% work in manufacturing, 8% work in Accommodation and Food Service, and 12.8% work in Educational Services. The largest employers are the Genesis Healthcare System with 2,800 employees, Zandex with 1,100 employees, Dollar General Distribution Center with 678 employees, Shlley and Sands with 500 employees, and Autozone Distribution Center with 470 employees.

The median income for Muskingum County residents is $40,524.

2.5 *Land Use and Future Development Areas*

Land uses within the county consist of the following: industrial/commercial areas, located north of the city to the north end of the City of Zanesville, including the North Pointe Business Park, north of City; the East Pointe Industrial Park, east of the City; the Air Park, near Zanesville Municipal Airport, off I-70 east; and other commercial and light industrial facilities located in and around Zanesville and the smaller villages in the county; residential areas, located in and around Zanesville and the smaller villages; park land and open space, including Dillon Dam State Park to the northwest of Zanesville, Tri-Valley Wildlife Area, east of Dresden and Powelson Wildlife Area, north of Dresden, Blur Rock State Forest, located southeast of Zanesville, The Wilds, east of Blue Rock and farmland, which covers the remainder of the county. Since the previous mitigation plan was adopted in 2005, there has not been a significant change to land uses that affect the County's risk to hazards.

As in the case of many rural areas, zoning is considered by many to be a violation of their right to live as they please. Many residents believe that zoning adds another layer of bureaucracy, that less government is better government, and that the use of one's private property should not be regulated by the agencies.

Because of the mindset, Muskingum County currently has no zoning for unincorporated areas, with the exception of Falls Township, Wayne Township and Perry Township.

The County does have an active Sub-Division Committee made up of representatives from the County Health Department, County Sewer Department, County Water Department, Engineer‘s Office, Commissioner‘s Office, Flood Plain Management Office, EPA, Soil and Water Conservation District Office, Township Trustees and others. The committee works with developers to ensure compliance with existing regulations, and must approve any new sub-division plans before construction can begin.

2.5.1 Development since 2005 Plan

The overall development of Muskingum County has been fairly minimal in the past decade since the last plan was adopted. Population growth has also been relatively minimal, increasing from 85,333 people to 86,016.

Development, while minimal, continues to take place throughout the County, but is largely centered in Zanesville. By 2010, the City had annexed 350 acres of land for the purpose of commercial development. In 2016, the City held a public meeting on what to do with an abandoned factory site for brownfield redevelopment.

The Hazard Mitigation Planning Committee filled out a risk evaluation that asked them to determine if their jurisdictions were more or less vulnerable to the selected hazards. Geologic Hazards ranked as the hazard with the most increased risk, due to the fact that there are numerous abandoned mines throughout the County, as well as steep slopes that are susceptible to landslides. Not all mines are mapped properly, which may result in new homes and businesses being built on top of them unknowingly. There was also a note that a slope had twice collapsed onto an unnamed road in recent years. Geologic hazards are covered in more detail in Section 4.10.

Flooding also was noted to have an increased significance due to development. There have been numerous buildings constructed within the 100-year Special Flood Hazard Area since the previous plan was adopted. This information is covered in more detail in Section 4.11.

The map on the following pages details land uses for the County as of 2016.

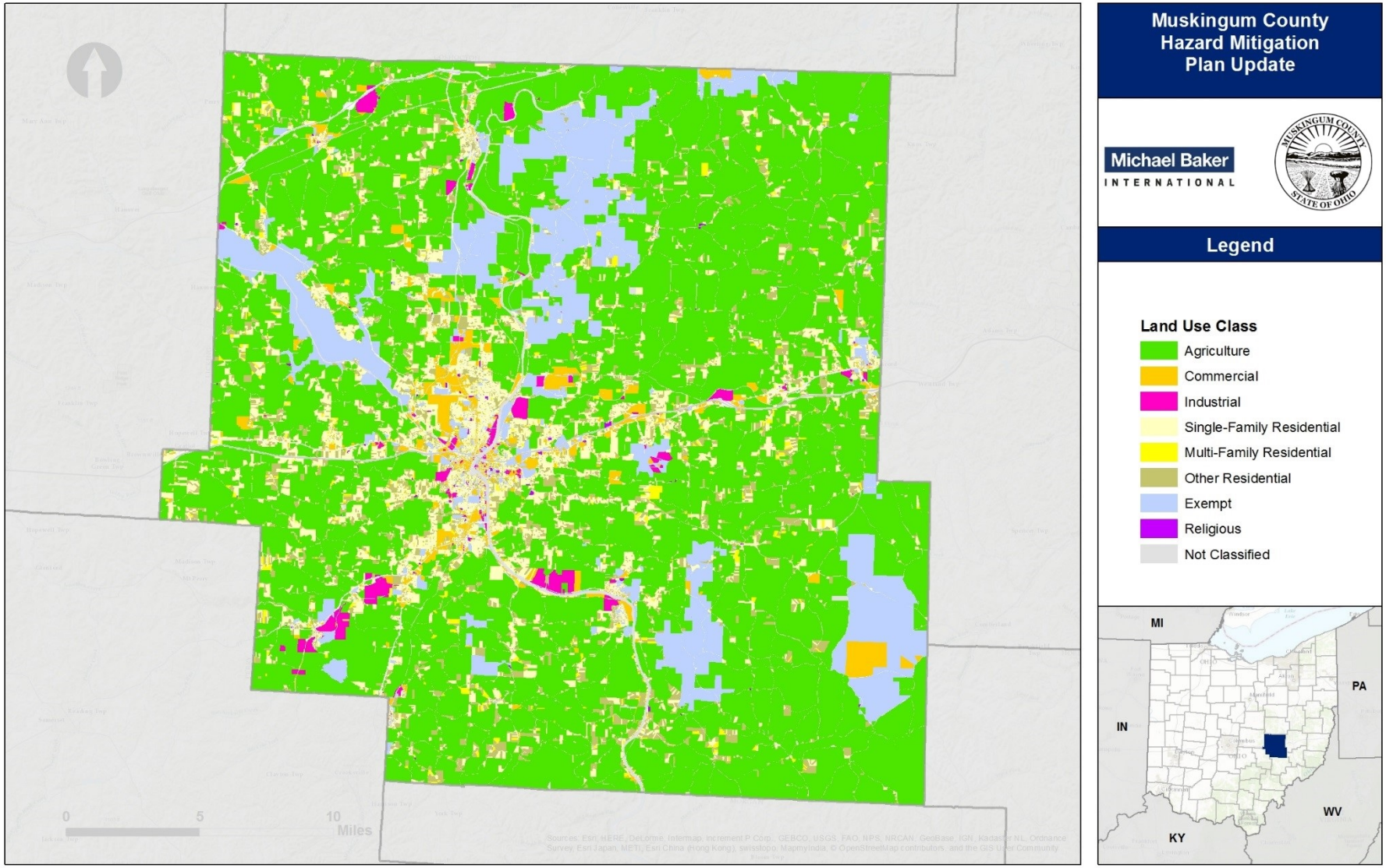


Figure 2-2 Muskingum Land Use

Section 3. The Planning Process

This section describes each stage of the planning process used to develop the 2018 HMP. The planning process provides a framework for document development and follows the FEMA recommended steps. The 2018 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.

3.1 *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 3-1 lists the specific CFR excerpts that identify the requirements for approval.

Table 3-1 DMA 2000 CFR Crosswalk

DMA 2000 (44 CFR 201.6)	HMP Plan Section
(1) Organize Resources	Section 3
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 4
201.6(c)(2)(i)	Assess the hazard
201.6(c)(2)(ii) and (iii)	Assess the problem
(3) Develop the Mitigation Plan	Section 5
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 6
201.6(c)(5)	Adopt the plan
201.6(c)(4)	Implement, evaluate, and revise

For the development of the 2018 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 3-1, 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.

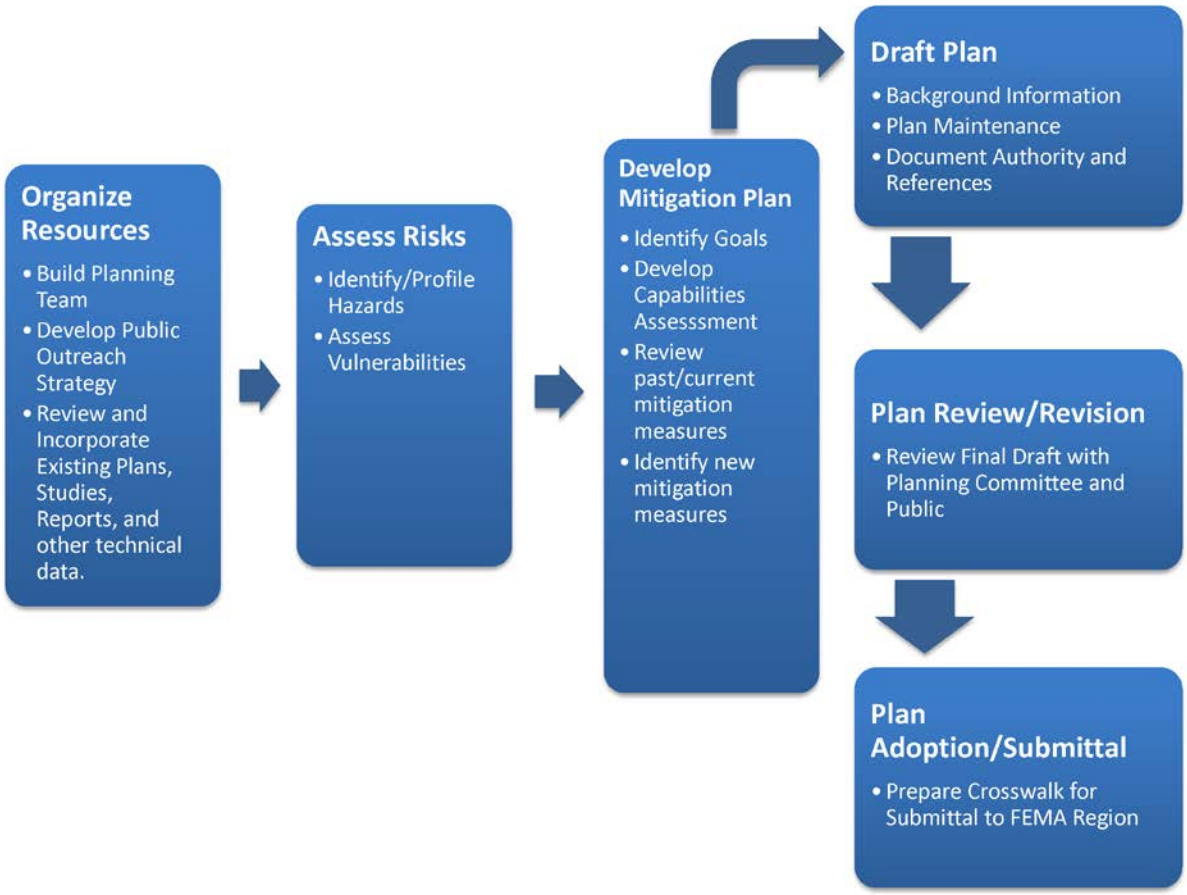
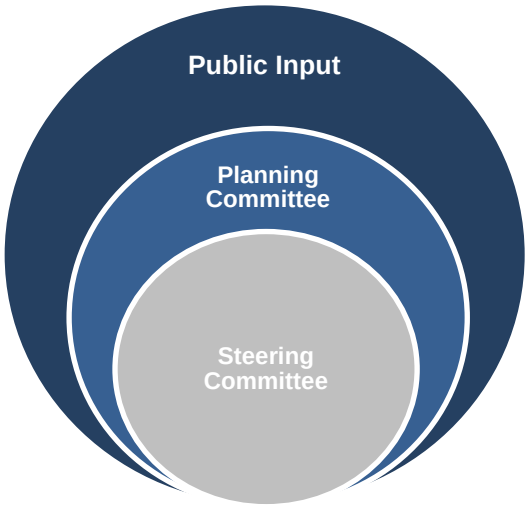


Figure 3-1 Mitigation Planning Process

3.2 *Organize Resources*

Organizing the resources consists of planning team development and document review tasks.



3.2.1 Building the Planning Team

The Planning Team, key to the back bone of the planning process, was critical for the development of the 2018 HMP. The Planning Team consisted of a Steering Committee, Department Representatives, and an HMP consultant used for plan development and facilitation.

3.2.1.1 Steering Committee

At the core of the 2018 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 County developed a professional services agreement with an HMP

consultant to provide direction for the development of the 2016 update. Members of the HMP Steering Committee were also a part of the HMP Planning Committee discussed below.

3.2.1.2 Planning Committee

The 2018 Hazard Mitigation Planning Committee (HMPC) consisted of key decision makers in specific County functions. 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 2018 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 neighboring communities, local universities, businesses, nonprofits, and other interested parties were invited and encouraged to participate in the development of the Plan. These stakeholders included the Muskingum County Engineer's Office, the National Weather Service, Genesis Hospital, and the Muskingum Watershed Conservancy District. 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. Table 3-2 provides a list of the 2018 HMP Planning Committee members.

Table 3-2 2018 HMP Planning Committee

Name	Title	Jurisidiction / Organization	Meetings Attended
Brent Gates	Fire Chief	New Concord	Open House
Chad Williams	Safety Officer	Genesis Hospital	Meeting 2
Charlotte Colley	Village Administrator	New Concord	Open House
Chris Kerby	Fiscal Officer	South Zanesville	Meeting 2, Open House
Dan Modder	Water Dept. Manager	Muskingum County	Meeting 1
Danny Wiseman	Adminstrator	South Zanesville	Meeting 2
Dave Carroll	Mayor	Roseville	Meeting 1, Meeting 2
David Matthew	Mayor	Dresden	Meeting 2, Open House
Fred Buck	Safety Director	Zanesville	Open House
Gerald Howard	Mayor	Frazeyburg	Meeting 1, Meeting 2
Jeff Jadwin	Department Manager	Muskingum County EMA	Meeting 1, Meeting 2, Open House
Jeff Slack	Village Administrator	Roseville	Meeting 1, Meeting 2
Jeff Thon	Mayor	Zanesville	Meeting 1
Kristina Bell	Emergency Preparation Coordinator	Zanesville-Muskingum County Health Department	Meeting 2
Lloyd Miller	Mayor	Philo	Ind. Meeting (10/2)
Melanie Kish	President	Gratiot	Open House

Name	Title	Jurisidiction / Organization	Meetings Attended
Melissa West	Mayor	Norwich	Ind. Meeting (10/2)
Michelle Horner	Design Engineer	Muskingum County Engineers Office	Meeting 1, Meeting 2
Mollie Crooks	Commissioner	Muskingum County	Meeting 2
Ray Mennego	Floodplain Manager	Muskingum County	Meeting 1
Rick Warren	Super	OEMA	Meeting 1, Open House
Shannon Weaver	Mayor	Adamsville	Meeting 1, Ind. Meeting (10/2)

3.2.1.3 Planning Committee Meetings

The HMPC met throughout the development of the updated HMP document. Table 3-3 provides a summary of the meetings conducted throughout the planning process, including meeting date, type, and topics discussed.

Table 3-3 Meeting Summary

Date	Meeting Type	Topics
1/19/2017	Internal Kickoff (Steering Committee)	• *Review of Mitigation Planning Standards* • *Schedule & Meetings* • *Participation* • *Relevant Data and Documentation* • *Questions and Next Steps*
2/28/2017	Planning Committee Meeting #1	• *Planning Committee Introductions* • *Hazard Mitigation Planning Process* • *Hazard Identification & Risk Assessment (HIRA) Exercise*
5/17/2017	Planning Committee Meeting #2	• *Review of Planning Process* • *Review of HIRA* • *Review Mitigation Techniques* o *Categories of Action* • *Develop Mitigation Goals & Objectives* • *Develop Mitigation Actions* • *Develop Mitigation Actions Plan*
9/14/2017	Open House #1	• *Review of planning process* • *Review mitigation goals, objectives, and actions* • *Review mitigation actions from previous plans* • *Prioritize new actions*

3.2.2 Public Outreach

Public outreach is a major and required component of the 2018 HMP. The Muskingum 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 websites and workshop process used during the HMP plan development.

The only community that did not participate in the planning process was the Village of Fultonham, due to extreme political circumstances that are highly likely to result in the dissolution of the village prior to the adoption of this plan. Below are the jurisdictions who did participate in the planning process:

- Muskingum County
- City of Zanesville
- Village of Adamsville
- Village of Dresden
- Village of Frazeysburg
- Village of Gratiot
- Village of New Concord
- Village of Norwich
- Village of Philo
- Village of Roseville
- Village of South Zanesville

The outline is a schedule for the planning events that took place over the course of the mitigation plan. This includes meetings, open houses, and individual stakeholder involvement meetings.

- **February 28, 2017**: First planning committee meeting. At this meeting, the overall planning process was discussed and hazards were chosen that would be addressed in the plan.

- **May 17th, 2017**: Second Planning Committee meeting. Mitigation goals and objectives for the plan were set, and mitigation actions were created for those communities that participated during this meetings. During this meeting, it was decided that Utility Failures would be added to the Hazard Identification and Risk Assessment section of the plan.

- **September 14th, 2017**: Open House #1. In order to facilitate a larger discussion for those jurisdictions that had not yet participated, members from the planning team spent a full day at the EMA hosting "office hours" for those who wanted to talk.

3.2.2.1 Publicizing the Plan

The planning team issued public notices inviting the public to the kickoff meeting as well as inviting comment on the draft plan through various websites, social media, and the local newspaper. Copies of these public notices can be found in Appendix C of this document.

3.2.2.1 Comments Received

The plan was put out for review from November 13th through November 20th, 2017. Both the planning team and the public had a chance to review the plan. No comments were received.

PUBLIC NOTICE

The Muskingum County Emergency Management Agency will be conducting a planning meeting to review and update Muskingum County's Hazard Mitigation Plan. The meeting will be held on 02/28/2017 from 10:00 AM to 12:00 PM at 2215 Adamsville Road, Zanesville, OH. Citizens are invited to attend and participate in the planning effort. Those who wish to attend, please register with the Muskingum County Emergency Management Agency at the contact number found below.
For more information, contact the Muskingum County Emergency Management Agency at 740-453-1655.
(Pub:ZTR,Feb26,'17#1946366)

PUBLIC NOTICE

The Muskingum County Emergency Management Agency is seeking public comment on the proposed draft of the 2018 Muskingum County Hazard Mitigation Plan. This plan addresses the various hazards that may impact the County. The plan will be available for public review until November 20th, 2017 online at EMA.MuskingumCounty.org, as well as the EMA office at 2215 Adamsville Road, Zanesville, Ohio 43701. Questions and comments can be directed to jjjadwin@muskingumcounty.org, or to 740-453-1655.
(Pub:ZTR,Nov12'17#2524895)

3.2.3 Review and Incorporate Existing Information

The HMPC 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 3-4.

Table 3-4 Existing Plans, Studies, Reports, and Other Technical Data/Information

Existing Plans, Studies, Reports, and Other Technical Data/Information	Planning Process / Area of Document Inclusion
2005 Natural Hazard Mitigation Plan	Used to assist with problem identification, mitigation goals, strategies and actions. Information from the previous plan was used for past data.
2013 Muskingum County Hazard Mitigation Plan (Not formally adopted)	Informed the general trajectory that the County was taking during its last update period.
Ohio Enhanced Mitigation Plan	This plan was consulted to assist with background information and hazard identification
FEMA Hazard Mitigation How-to Guides	2012 Hazard Mitigation Plan Development, Start to Finish
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
NOAA Record Storm Events	Death and Injuries Report for past storm and disaster events
Tornado History Project	Number of events and details of tornados in Muskingum County
History of Muskingum County (1882)	Included information about the history and pre-history of Muskingum County
Muskingum County Soil Survey	Used to develop the Geologic Hazards profile

3.2.4 Assess Risks

In accordance with FEMA requirements, the 2018 HMP Planning Committee identified and prioritized the natural and non-natural hazards affecting the 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 4.

3.2.4.1 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 2018 HMP Planning Committee developed and identified a list of hazards that could affect the County. Content for each hazard profile is provided in Section 4.

3.2.4.2 Assess Vulnerabilities

Hazard profiling exposes the unique characteristics of individual hazards and begins the process of determining which areas within the 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 4.

3.2.5 Develop Mitigation Plan

The 2018 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 the County ability to expand on and improve these existing tools. Developing the mitigation plan involved identifying goals, assessing existing capabilities, and identifying mitigation actions. This step of the HMP planning process is detailed in Section 5 and summarized below.

3.2.5.1 Identify Goals

The HMP Planning Committee developed goals and objectives for the 2018 HMP based on current information. The Goals and Objectives are presented in Section 5.

3.2.5.2 Develop Capabilities Assessment

A capabilities assessment is a comprehensive review of all the various mitigation capabilities and tools currently available to the County to implement the mitigation actions that are prescribed in the 2018 HMP. The HMP Planning Committee identified the technical, financial, and administrative capabilities to implement mitigation actions, as detailed in Section 5.

3.2.5.3 Identify Mitigation Actions

As part of the 2018 HMP planning process, the HMP Consultant Team and HMP Planning Committee worked together to identify and develop mitigation actions with implementation elements. Mitigation actions were prioritized and detailed implementation strategies were developed during Planning Committee Meeting #2, as well as after the meeting. 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 5.

3.2.5.4 Draft HMP

Once the risk assessment and mitigation strategy were completed, information, data, and associated narratives were compiled into the 2018 HMP.

3.2.5.5 Plan Review and Revision

During the week of November 13th, 2017, the plan was available for review at the Muskingum County EMA for public review. The public was invited to comment on the plan through an ad placed in the Zanesville Times Recorder. The planning team also reviewed the plan at this time. No comments were given from any party.

3.2.5.6 Plan Adoption and Submittal

The plan was adopted by Muskingum County and received final federal approval and is due to expire on April 30, 2023.

3.2.5.1 Plan Maintenance

Plan maintenance procedures, found in Section 6, include the measures the County 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 4. Hazard Identification & Risk Assessment (HIRA)

Hazard identification & risk assessment is the process of measuring the potential impact to life, property and economic impacts resulting from natural and non-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 5). 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 Muskingum County planning process related to the above four steps are incorporated into the following discussions in this chapter.

Section 4.1: Hazard Identification identifies and prioritizes the identified natural and non-natural hazards that threaten the County. The reasoning for omitting some hazards from further consideration is also provided in this discussion.

Section 4.5 through Section 4.16: Hazard Profiles describe each of the natural hazards that pose a threat to the County. Information includes the location, extent/magnitude/severity, previous occurrences, and the likelihood of future occurrences.

4.1 *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.

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. The quantitative analysis considered all the GIS 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 Muskingum 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 4-1 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 4-1 provides the risk factor table that details the hazards 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 4-1 Risk Factor Table

	Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	**Severe Winter Weather**	4	1.2	3	0.9	4	0.8	1	0.1	3	0.3	**3.3**
2	**Severe Thunderstorms**	4	1.2	3	0.9	4	0.8	2	0.2	1	0.1	**3.2**
3	**Tornado**	4	1.2	3	0.9	2	0.4	4	0.4	3	0.3	**3.2**
4	**Extreme Temperatures**	3	0.9	3	0.9	4	0.8	3	0.3	1	0.1	**3**
5	**Geologic Hazards**	4	1.2	2	0.6	3	0.6	4	0.4	1	0.1	**2.9**
6	**Flood**	4	1.2	2	0.6	2	0.4	1	0.1	4	0.4	**2.7**
7	**Wildfire**	4	1.2	1	0.3	2	0.4	4	0.4	1	0.1	**2.4**
8	**Drought**	2	0.6	1	0.3	4	0.8	1	0.1	4	0.4	**2.2**
	Technological Hazards	**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	**Dam/Levee Failure**	2	0.6	4	1.2	4	0.8	4	0.4	4	0.4	**3.4**
2	**Hazardous Materials**	4	1.2	3	0.9	3	0.6	4	0.4	3	0.3	**3.4**
3	**Utility Failure**	3	0.9	2	0.6	2	0.4	4	0.4	2	0.2	**2.5**

Table 4-2 below shows the hazards that are included in the State of Ohio's HMP, and those hazards covered in the 2005 and the unofficial 2013 plan. For this plan update, several hazards are combined. Coastal hazards were not included in this plan as Muskingum County is landlocked.

Table 4-2 Hazards included and excluded from the HMP

Hazard Addressed	Ohio HMP	Musk. 2005	Musk. 2013	Musk. 2018	Notes
Coastal Erosion	O	X	X	X	There are no coastal areas in Muskingum County
Dam/Levee Failure	O	O	O	O	
Drought	O	O	O	O	
Earthquake	O	O	O	O	Merged with Geologic Hazard
Extreme Temperatures	X	O	O	O	
Expansive Soil	X	O	O	O	Merged with Geologic Hazard
Flood	O	O	O	O	

Hailstorm	X	O	O	O	Merged with Severe Thunderstorms
Hazardous Materials Incidents	X	X	X	O	
Invasive Species	O	X	X	X	Invasive species are not a primary concern for Muskingum County
Land Subsidence	O	O	O	O	Merged with Geologic Hazard
Landslide	O	O	O	O	Merged with Geologic Hazard
Seiche/Coastal Flooding	O	X	X	X	There are no coastal areas in Muskingum County.
Severe Winter Storm	O	O	O	O	
Thunderstorm / Winds	O	O	O	O	Changed name to "Severe Thunderstorms"
Tornado	O	O	O	O	
Utility Failure	X	X	X	O	
Wildfire	O	O	O	O	

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 Muskingum County and its population in the future. Information about Federal and State disaster declarations in Muskingum County[3] was compiled from FEMA and Ohio databases, as shown in Table 4-3.

Though not a complete snapshot of hazard incidences in Muskingum County (since not all hazard events are federally or state declared), this table provides an account of disasters that have received public assistance from the government, dating back to 1965.Muskingum County has been a part of 12 disaster declarations, 5 of which received public assistance dollars. Assistance amounts were provided by the Ohio Emergency Management Agency.

Table 4-3 Federal and State Declared Disasters

Disaster Number	Title	Declaration Date	Public Assistance
DR-4077	Severe Storms And Straight-Line Winds	8/20/2012	$ 501,637.66
EM-3346	Severe Storms	6/30/2012	-
EM-3250	Hurricane Katrina Evacuation	9/13/2005	-
DR-1580	Severe Winter Storms, Flooding, And Mudslides	2/15/2005	$ 2,068,222.75
DR-1556	Severe Storms And Flooding	9/19/2004	$ 585,925.64
DR-1453	Severe Winter Storm And Record/Near Record Snow	3/14/2003	$ 101,660.00
DR-1227	Severe Storms, Flooding, And Tornadoes	6/30/1998	-
DR-870	Severe Storms, Tornadoes & Flooding	6/6/1990	$ 52,846.00
DR-630	Severe Storms & Flooding	8/23/1980	-
EM-3055	Blizzards & Snowstorms	1/26/1978	-
EM-3029	Snowstorms	2/2/1977	-
DR-266	Tornadoes, Severe Storms & Flooding	7/15/1969	-

Source: Ohio Emergency Management Agency and FEMA

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 identified a total of 11 hazards. There were 8 natural hazards which included severe winter weather, tornadoes, severe thunderstorms, geologic hazards, extreme temperatures, flooding,

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

drought, and wildfire. There were an additional 3 technological hazards, including Dam failure and Hazardous Materials Incidents, and utility failures.

4.2 *Hazard Event Data*

In developing the hazard profiles within this plan, a variety of information sources were researched. In order to develop a pattern of historical occurrences for identified hazards, sites like the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) and sites associated with the regional National Weather Service (NWS) locations. These sites break down information on a county-wide level, or by municipality.

4.3 *Event Narratives*

Within each hazard's section there are a series of narratives that provide greater detail into specific events that have either impacted the County. This section (Historical Occurrences or in some cases Hazard Events/Historical Occurrences) is not meant to be a comprehensive list of events that have occurred in Muskingum County. Rather, these incidents are included to provide context as to why this hazard was included in the plan.

4.4 *Hazard Profiles*

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 Muskingum 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.

4.5 *Critical Facilities*

The Planning Committee identified the types of structures that they consider to be "critical" to the day-to-day operation of the County. This includes fire and EMS stations, hospitals, law enforcement stations, cultural centers, water facilities, and schools. Muskingum County considers 88 facilities to be critical to day-to-day operations.

Row Labels	Count	Total Value
Cultural	3	$ 2,038,300
Education	39	$ 285,786,200
Fire	20	$ 7,911,930
Government	8	$ 15,485,800
Medical	4	$ 15,901,600
Police	10	$ 7,736,000
Water	4	$ 18,742,500
Grand Total	**88**	**$ 353,602,330**

Figure 4-2 below shows the critical facilities found throughout the County. They are symbolized by their overall category.

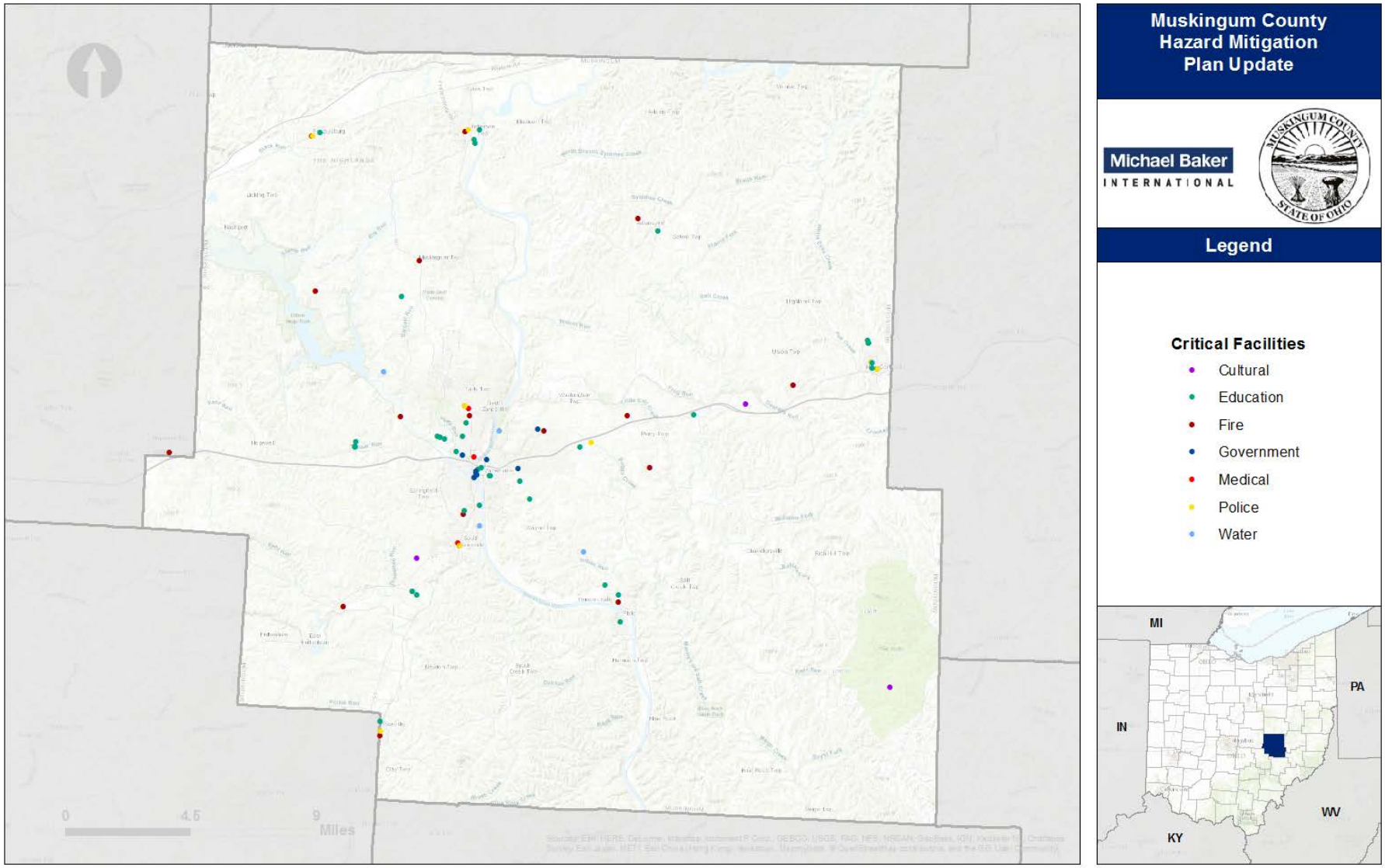

Figure 4-2 Muskingum County Critical Facilities

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4.6 *Severe Winter Storms*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Severe Winter Weather	4	1.2	3	0.9	4	0.8	1	0.1	3	0.3	**3.3**
High Risk Hazard (3.0 – 3.9)											

4.6.1 Hazard Identification

Muskingum 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. 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.

Heavy Snow Storms can immobilize a region and paralyze the County. 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.

Extreme Cold in extended periods, although infrequent, could occur throughout the winter months in Muskingum 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. 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.

4.6.2 Regulatory Environment

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

4.6.3 Hazard Events

Since 1996, there have been 20 winter weather events according to NOAA, most of which have caused either no damage or minor damage to property. According to NOAA, there have been no injuries and no deaths. The total amount of property damage done by winter storm events equates to a total of $11,000.

Table 4-4 Winter Weather Events in Muskingum County

Date	Type	Deaths	Injuries	Property Damage	Crop Damage
1/2/1996	Ice Storm	0	0	$ 0	$ 0
1/2/1999	Winter Storm	0	0	$ 0	$ 0
1/8/1999	Winter Storm	0	0	$ 0	$ 0
1/13/1999	Winter Storm	0	0	$ 5,000	$ 0

3/9/1999	Heavy Snow	0	0	$ 0	$ 0
12/13/2000	Winter Storm	0	0	$ 0	$ 0
1/20/2001	Heavy Snow	0	0	$ 0	$ 0
2/16/2003	Heavy Snow	0	0	$ 0	$ 0
1/22/2005	Ice Storm	0	0	$ 6,000	$ 0
2/13/2007	Ice Storm	0	0	$ 0	$ 0
3/7/2008	Winter Storm	0	0	$ 0	$ 0
1/27/2009	Winter Storm	0	0	$ 0	$ 0
12/13/2009	Winter Weather	0	0	$ 0	$ 0
2/5/2010	Heavy Snow	0	0	$ 0	$ 0
1/20/2012	Ice Storm	0	0	$ 0	$ 0
12/26/2012	Heavy Snow	0	0	$ 0	$ 0
1/15/2013	Winter Weather	0	0	$ 0	$ 0
11/12/2013	Winter Weather	0	0	$ 0	$ 0
2/4/2014	Winter Storm	0	0	$ 0	$ 0
12/1/2014	Winter Weather	0	0	$ 0	$ 0
Totals:		**0**	**0**	**$ 11,000**	**$ 0**

Since 1978, two federal and one state disaster declarations involving severe winter weather events have occurred in Muskingum County, as shown in Table 4-5. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1956 to present), these events include blizzards and snowstorms.

Table 4-5: Severe Winter Weather Federal Declarations

Disaster Number	Title	Declaration Date	Total Award
DR-1580	Severe Winter Storms, Flooding, And Mudslides	2/15/2005	$ 2,068,222.75
DR-1453	Severe Winter Storm And Record/Near Record Snow	3/14/2003	$ 101,660.00
EM-3055	Blizzards & Snowstorms	1/26/1978	
EM-3029	Snowstorms	2/2/1977	

4.6.4 Historical Occurrences

Blizzard, January 26th, 1978: The forecast initially called for nothing more than “rain tonight, possibly mixed with snow at time. Windy and cold Thursday with snow flurries.” What actually followed was one of the worst winter storms that the state has ever seen. Much of Ohio received several feet of snow, with some drifts reaching as high as 15 feet, resulting in wide-ranging transportation shutdowns and utility outages.

Winter Storm, February 2nd, 2014: A complex and fast moving storm system swept across eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett county Maryland from late evening of the 4th into late morning of the 5th. Snowfall from 4 to 10 inches fell along and north of a line from Zanesville in Ohio, to Wheeling in West Virginia, and from Pittsburgh to Latrobe in Pennsylvania. The snow then changed to sleet and freezing rain in the early morning hours of the 5th, with sleet accumulations of an inch or more, and freezing rain accretion from one quarter to one half inch. Outside of this region freezing rain was reported up to one half inch in parts of Greene county in Pennsylvania, and Monroe county in Ohio. Sleet accumulated more than 2 inches across the Fayette county ridges and in Garrett county Maryland, topped by about one quarter inch of freezing rain. Across northern West Virginia south of the Pennsylvania border, warmer air at the surface limited freezing rain amounts to around one tenth of an inch with a mix of sleet as well (NCDC, 2017)

4.6.5 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 4-3 Winter Storm Watch Definitions

Warning - Warnings 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 4-4 Winter Storm Warning Definitions

Advisory - Advisories 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 4-5 Winter Storm Advisory Definitions

4.6.6 Frequency/Probability of Future Occurrences

Reported winter events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County experiencing a winter storm event can be difficult to quantify, but based on historical record of 69 winter storm events since 1996, it can reasonably be assumed that this type of event has occurred more than three times every year from 1996 through 2017.

> *[(Current Year) 2017] subtracted by [(Historical Year) 1996] = 21 Years on Record*
>
> *[(Years on Record) 21] divided by [(Number of Historical Events) 20] = 1.05 years between events*

Furthermore, the historic frequency calculates that there is a 95% chance of this type of event occurring each year.

The HMPC agreed that, based on their knowledge, decided that severe winter storms are "Highly Likely," meaning there is a 100% annual chance of winter storms occurring.

4.6.7 Inventory Assets Exposed to Winter Storms

A timely forecast may not be able to mitigate 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. The County is also subject to outages resulting from damages to the electrical grid in other parts of the state.Winter storms affect the entirety of Muskingum County, as well as all communities and jurisdictions, and 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.

4.6.8 Potential Losses from Winter Storms

All County assets can be considered at risk from severe winter storms. This includes 100 percent of the County population and all buildings and infrastructure. 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, even if only certain systems are powered by that generator.

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.

In addition to the infrastructure of the County, the population needs to be taken into consideration. The County is home to an estimated 86,016 people. At particular risk are elderly individuals. The US Census Bureau estimates that there are approximately 16.3% of the

County's population is above the age of 65, leading to an estimated 14,021 people at risk of severe winter weather.

Table 4-6 Facilities vulnerable to severe winter storms

Vulnerability to Winter Storms			
Non-Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Residential	$ 2,756,732,090	$ 27,567,321	$ 137,836,605
Agriculture	$ 183,050,500	$ 1,830,505	$ 9,152,525
Total	**$ 2,939,782,590**	**$ 29,397,826**	**$ 146,989,130**
Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Cultural	$ 2,038,300	$ 20,383	$ 101,915
Education	$ 285,786,200	$ 2,857,862	$ 14,289,310
Fire	$ 7,911,930	$ 79,119	$ 395,597
Government	$ 15,485,800	$ 154,858	$ 774,290
Medical	$ 15,901,600	$ 159,016	$ 795,080
Police	$ 7,736,000	$ 77,360	$ 386,800
Water	$ 18,742,500	$ 187,425	$ 937,125
Total	**$ 353,602,330**	**$ 3,536,023**	**$ 17,680,117**

4.6.9 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. 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.

There has not been a significant amount of development that would affect the County's vulnerability to Severe Winter Storms since the previous plan.

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.

4.6.10 Winter Storm HIRA Summary

Muskingum 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.

4.7 *Severe Thunderstorms*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Severe Thunderstorms	4	1.2	3	0.9	4	0.8	2	0.2	1	0.1	**3.2**
High Risk Hazard (3.0 – 3.9)											

4.7.1 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 are electrical storms capable of producing high winds, heavy rains, lightning, and hail. These event 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. They often occur in large groups or fronts, and thus are often felt over an entire county. 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 is a sudden discharge of electricity released during thunderstorms. It can occur between storm clouds, but can also strike the ground. Although not considered severe by the National Weather Service definition, lightning 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. 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.

4.7.2 Regulatory Environment
There are negligible formal regulations that pertain to thunderstorm events.

4.7.3 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 60 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).

4.7.3.1 Hail Events
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.

There have been 78 recorded hail events associated with thunderstorms that have either directly or indirectly impacted the County and the immediately surrounding jurisdictions since 1955.

Table 4-7 Muskingum County Hail Events Since 1955

Date Range	# Of Events	Death	Injury	Property Damage	Crop Damage
1955 - 2017	78	0	0	$ 0	$ 0
	TOTALS:	**0**	**0**	**$ 0**	**$ 0**

Reported hail events over the past 62 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a hail event associated with damages or injury can be difficult to quantify, but based on historical record of 78 hail events since 1955, it can reasonably be assumed that this type of event has occurred once every 0.64 years from 1955 through 2017.

[(Current Year) 2017] subtracted by [(Historical Year) 1955] = 62 Years on Record

[(Years on Record) 62] divided by [(Number of Historical Events) 78] = 0.79 Years Between Events

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

4.7.3.2 Thunderstorm Wind Events
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 299 recorded severe storm events associated with thunderstorms since 1955.

Table 4-8 Thunderstorm Wind Events Since 1967

Date Range	# Of Events	Type	Death	Injury	Property Damage	Crop Damage
1955 - 2017	299	Thunderstorm Wind	1	1	$ 2,375,500	$ 0
		TOTALS:	**1**	**1**	$ 2,375,500	**$ 0**

Reported thunderstorm winds over the past 62 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing thunderstorm winds associated with damages or injury can be difficult to quantify, but based on historical record of 299 thunderstorm wind events since 1955, it can reasonably be assumed that this type of event has occurred once every 0.21 years from 1955 through 2017.

(Current Year) 2017] subtracted by [(Historical Year) 1955] = 62 Years on Record

[(Years on Record) 62] divided by [(Number of Historical Events) 299] = 0.21

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

4.7.3.3 Lightning Events

Except in cases where significant forest or range fires are ignited, lightning generally does not result in disasters. For the period of 1999 to 2017, NOAA reported 2 events for Muskingum County and its jurisdiction. As result of these, two deaths and six injuries were recorded. $100,000 in property damage was also recorded.

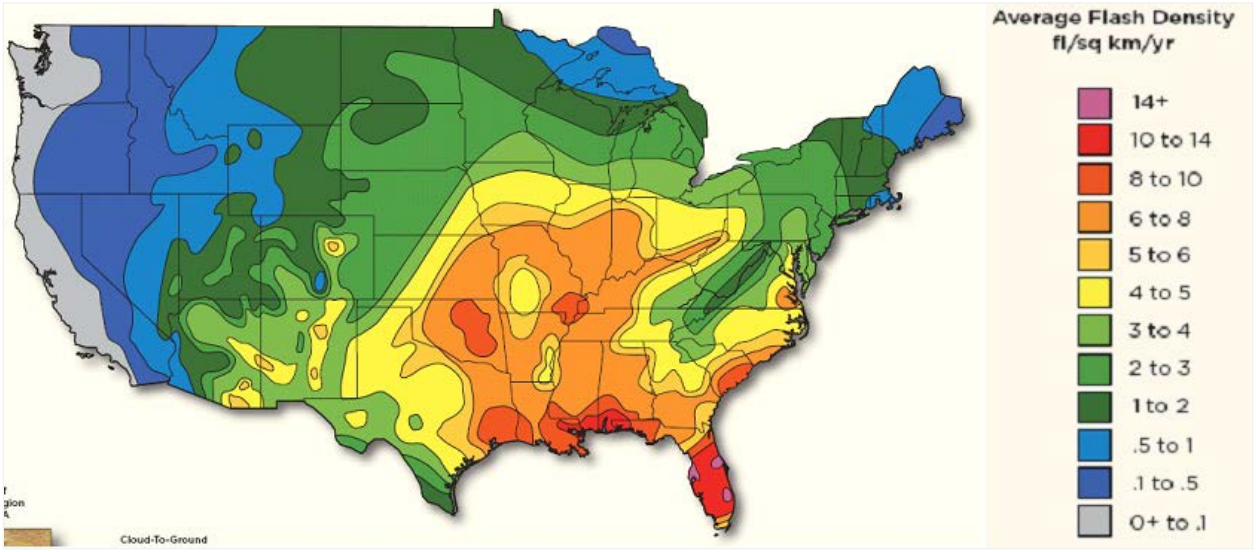


Figure 4-6 Flash Density associated with Lightning Strikes

Table 4-9 Lightning Strikes in Muskingum County Since 1999

Date Range	# Of Events	Death	Injury	Property Damages	Crop Damage
1999 - 2017	2	1	0	$100,000	**$ 0**
	TOTAL	**1**	**0**	**$100,000**	**$ 0**

Reported lightning strikes over the past 18 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a lightning strike associated with damages or injury can be difficult to quantify, but based on historical record of 5 lightning strikes since 1999 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 9 years from 1999 through 2017.

[(Current Year) 2017] subtracted by [(Historical Year) 1999] = 18 Years on Record

[(Years on Record) 18] divided by [(Number of Historical Events) 2] = 9 Years Between Events

Furthermore, the historic frequency calculates that there is an 11.11% chance of this type of event occurring each year.

4.7.4 Historical Occurrences

Since 1956, 7 federally or state declared severe thunderstorm weather events have occurred in Muskingum County as shown in Table 4-10. 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 4-10 Severe Weather Federal Declarations

Disaster Number	Title	Declaration Date	Total Award
DR-4077	Severe Storms and Straight-Line Winds	8/20/2012	$ 501,637.66
EM-3346	Severe Storms	6/30/2012	
DR-1556	Severe Storms and Flooding	9/19/2004	$ 585,925.64
DR-1227	Severe Storms, Flooding, And Tornadoes	6/30/1998	
DR-870	Severe Storms, Tornadoes & Flooding	6/06/1990	$ 52,846.00
DR-630	Severe Storms & Flooding	8/23/1980	
DR-266	Tornadoes, Severe Storms & Flooding	7/15/1969	

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 Muskingum County

August 14, 1999: Lightning struck a house during a thunderstorm, setting it on fire. The house was destroyed as a result. The damage was estimated at $100,000.

June 28, 2012: An anomalously strong ridge centered across the Southeast brought record heat to the Upper Ohio Valley with the area in a zonal flow on the northern edge of the ridge. A weak frontal boundary extended from northern Indiana into western Pennsylvania. Abundant moisture (1.75-2.00 PWAT), strong instability (SBCAPE 4000-5000 J/kg), moderate shear (40kts 0-6km), and a short wave just south of the boundary provided the ingredients for a long-tracked mesoscale convective system, classified by the Storm Prediction Center as a derecho, to track all the way from northern Indiana across eastern Ohio, southwestern Pennsylvania, northern WV, and western Maryland. As the MCS crossed the area, widespread wind damage was reported across areas primarily south and west of Pittsburgh. There were several reports of structural damage and damage led to a fatality when a barn collapsed in Muskingum County. Power outages were widespread with up to 130,000 outages reported immediately after the storms passage, most of which, were in Ohio. Muskingum and Guernsey counties sustained $712,000 and $500,000 in damages respectively. This also became of the costliest disasters to hit Ohio, right behind Hurricane Ike in 2008. One woman was killed and another man injured when the barn they were in collapsed due to the straight-line winds. They were checking on their animals when the barn collapsed. The man was able to escape. The woman was not.

July 3, 2012: An upper level disturbance moving southeast over the upper Ohio Valley produced scattered severe thunderstorms across eastern Ohio, western Pennsylvania, and northern West Virginia. A 60-year-old man was struck and killed by lightning while standing under a tree.

August 10, 2015: A weak cold front and an associated upper level shortwave produced scattered thunderstorms the afternoon and evening of the 10th. A weak and short-lived EF-0 tornado occurred in northern Butler County in Pennsylvania, with isolated downburst damage to trees in Muskingum County in Ohio. Emergency management reported numerous trees snapped and uprooted.

4.7.5 Magnitude/Severity

Thunderstorm watches and warnings are issued by the National Weather Service. There are no watches or warnings for lightning. Figure 4-7 explains the difference between watches and warnings, as used by the NWS.

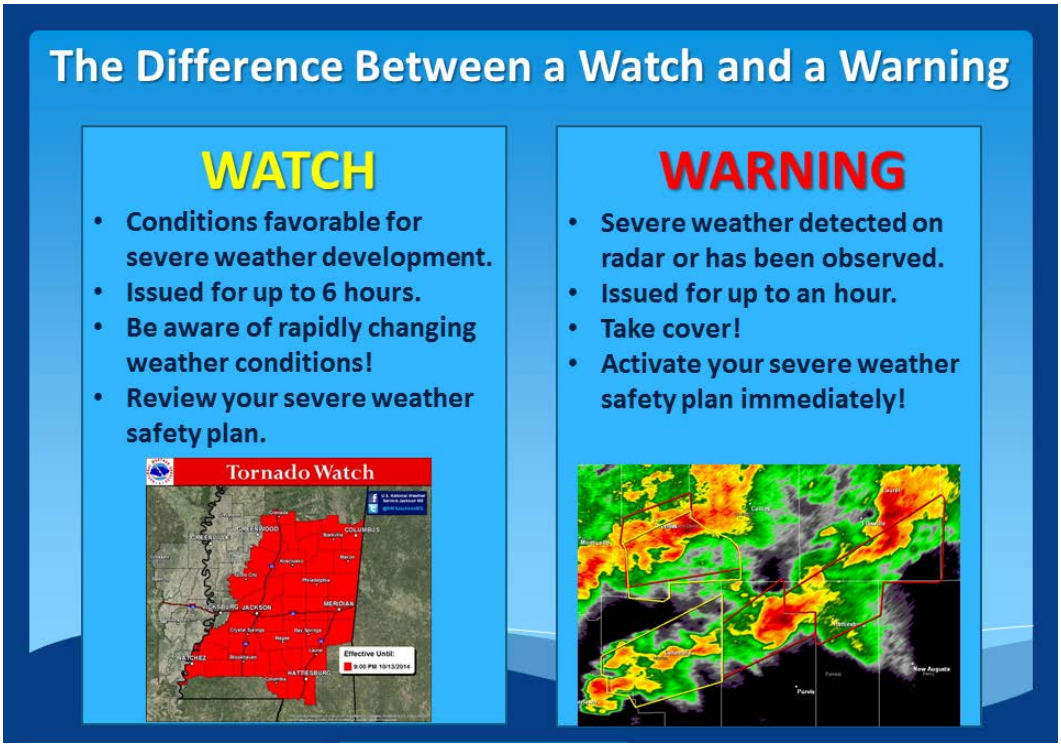


Figure 4-7 National Weather Service Watch vs Warning

The Beaufort scale is a scale for measuring wind speeds. It is based on observation rather than accurate measurement. It is the most widely used system to measure wind speed today. There are twelve levels, plus 0 for "no wind."

Table 4-11 Beaufort Scale

Beaufort number	MPH	Description	Observation
0	**<1**	Calm	Calm. Smoke rises vertically.
1	**1-3**	Light air	Wind motion visible in smoke
2	**3-7**	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	**8-12**	Gentle breeze	Leaves and smaller twigs in constant motion.
4	**13-17**	Moderate breeze	Dust and loose paper raised. Small branches begin to move.
5	**18-24**	Fresh breeze	Branches of a moderate size move. Small trees begin to sway.
6	**25-30**	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.
7	**31-38**	High wind, Moderate Gale, Near Gale	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	**39-46**	Fresh Gale	Twigs broken from trees. Cars veer on road.
9	**47-54**	Strong Gale	Larger branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	**55-63**	Whole Gale/Storm	Trees are broken off or uprooted, saplings bent and deformed, poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	**64-72**	Violent storm	Widespread vegetation damage. More damage to most roofing surfaces, asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	**≥73**	Hurricane-force	Considerable and widespread damage to vegetation, a few windows broken, structural damage to mobile homes and poorly constructed sheds and barns. Debris may be hurled about.

Hail sizes can differ greatly from one storm to another depending on the strength of the storm's updraft. Stronger updrafts can create larger hailstones, which in turn causes more damage. This makes reporting the size of hail important for public safety. The preferred hail measurement method is to use a ruler to measure the diameter of the hail stone along its longest axis. However, various coins and balls are often used when reporting hail size.

Table 4-12 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

4.7.6 Frequency/Probability of Future Occurrences

Table 4-13 Probability of Thunderstorm Events

Hazard	Number of Events in Historic Record	Number of Years in Historic Record	Historic Recurrence Interval (years)	Historic Frequency (% chance/year)
Hail	78	62	0.79	100%
Thunderstorm Wind	199	62	0.21	100%
Lightning	2	18	9	11.11%

The HMPC, based on their own knowledge and experience, decided that severe thunderstorms are “Highly Likely,” meaning there is a 100% annual chance of them occurring.

4.7.7 Inventory Assets Exposed to Thunderstorms

Damage to 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 County assets can be considered at risk from severe thunderstorms. This includes 100 percent of the County population and all buildings and infrastructure. 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.

4.7.8 Potential Losses from Thunderstorms

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 4-14 Damage Estimates for Thunderstorms

Category	Time on Record	# Events	Damages
Hail	1955-2017	78	$ 0
Thunderstorm Winds	1955-2017	299	$ 2,375,500
Lightning	1999-2017	2	$100,000

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), can cause damage to structures and property throughout the County. Nationally, insurance claims resulting from hailstorm damage increased 84% ($467,602 to $861,579) from 2010 to 2012 according to the National Insurance Claim 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.

Table 4-15 Properties vulnerable to Severe Thunderstorms

Vulnerability to Severe Thunderstorms			
Non-Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Residential	$ 2,756,732,090	$ 27,567,321	$ 137,836,605
Agriculture	$ 183,050,500	$ 1,830,505	$ 9,152,525
Total	**$ 2,939,782,590**	**$ 29,397,826**	**$ 146,989,130**
Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Cultural	$ 2,038,300	$ 20,383	$ 101,915
Education	$ 285,786,200	$ 2,857,862	$ 14,289,310
Fire	$ 7,911,930	$ 79,119	$ 395,597
Government	$ 15,485,800	$ 154,858	$ 774,290
Medical	$ 15,901,600	$ 159,016	$ 795,080
Police	$ 7,736,000	$ 77,360	$ 386,800
Water	$ 18,742,500	$ 187,425	$ 937,125
Total	**$ 353,602,330**	**$ 3,536,023**	**$ 17,680,117**

4.7.9 Land Use & Development Trends

All future structures built by the County will likely be exposed to severe thunderstorm damage. The County needs to adhere to building codes, and therefore, new development can be built to current standards. There has not been a significant amount of development that would affect the County's vulnerability to Severe Thunderstorms since the previous plan.

4.7.10 Thunderstorm HIRA Summary

Muskingum 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 thunderstorms profile is primarily concerned with past and future damages from high winds, lightning, and hail. Flooding is covered as a separate hazard, including flooding that occurs from a heavy precipitation event.

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, the County will remain proactive in its mitigation efforts to help build sustainability.

4.8 *Tornado*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Tornado	4	1.2	3	0.9	2	0.4	4	0.4	3	0.3	**3.2**
High Risk Hazard (3.0 – 3.9)											

4.8.1 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.

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. Nationwide, severe windstorms result in as many as 1,000 tornadoes annually.

Figure 4-8 Example of a Tornado

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 1,000 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries (NOAA, 2016).

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.

4.8.2 Regulatory Environment

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

4.8.3 Hazard Events

The 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 during the late spring through the summer as past County records indicate. Muskingum County has been a part of 3 federal Disaster Declaration involving tornadoes. All tornadic events in Muskingum County will be displayed in this section.

Table 4-16 Tornado Disaster Declarations

Disaster Number	Title	Declaration Date	Total Award
DR-1227	Severe Storms, Flooding, & Tornadoes	6/30/1998	
DR-870	Severe Storms, Tornadoes & Flooding	6/6/1990	$ 52,846.00
DR-266	Tornadoes, Severe Storms & Flooding	7/15/1969	

Table 4-17 Tornado Events in Muskingum County (1950-2017)

Location	Date	Time	Mag	Deaths	Injuries	Property Damage	Crop Damage
Muskingum Co.	6/26/1954	11:40	F1	0	0	$ 25,000	$ 0
Muskingum Co.	7/22/1958	12:50	F2	0	3	$ 0	$ 0
Muskingum Co.	7/22/1958	17:00	F1	0	1	$ 25,000	$ 0
Muskingum Co.	11/16/1965	19:40	F2	0	5	$ 250,000	$ 0
Muskingum Co.	6/25/1968	14:30	F2	0	5	$ 250,000	$ 0
Muskingum Co.	9/8/1970	17:00	F1	0	0	$ 250,000	$ 0
Muskingum Co.	8/14/1973	14:15	F2	0	0	$ 25,000	$ 0
Muskingum Co.	7/11/1976	19:15	F1	0	0	$ 0	$ 0
Muskingum Co.	4/13/1981	15:54	F1	0	0	$ 250,000	$ 0
Muskingum Co.	6/13/1981	14:30	F2	0	0	$ 2,500,000	$ 0
Muskingum Co.	6/13/1981	15:45	F1	0	0	$ 250,000	$ 0
Muskingum Co.	5/31/1985	17:50	F1	0	5	$ 2,500,000	$ 0
Muskingum Co.	3/10/1986	18:45	F2	1	3	$ 250,000	$ 0
Otsego	6/27/1998	17:45	F1	0	2	$ 250,000	$ 0
Zanesville	6/27/1998	18:30	F1	0	0	$ 20,000	$ 0
Trinway	8/11/2014	14:00	EF0	0	0	$ 1,000	$ 0
Totals:	**16 events**			**1**	**24**	**$ 6,846,000**	**$ 0**

4.8.4 Historical Occurrences

June 16, 1912: A number of unusually strong storms were occurring throughout central and southeastern Ohio. Reports of funnel clouds were being reported in Muskingum County around 6:30 in the morning. The storm moved right over Zanesville ten minutes later, just as Mass was beginning at St. Thomas Catholic Church on North 5th St. The congregation would later describe the event as a "great wind" that moved through the church. The tornado touched downed west of the church creating a damage path 300 to 500 feet wide. During the storm the spire of St. Thomas' crashed through the roof onto the heads of the large congregation. According to the churches website three people were killed and several others were injured. The destroyed steeple was never rebuilt. As it fell, it created a massive hole in the roof and damaging the pipe organ in the balcony. If the storm were to have occurred today, it would have cause upwards of $600,000 in damage. The destruction to life and property in Zanesville that day was much greater than any other part of the state.

June 27, 1998: At 5:45p, an F1 Tornado touched down along Big Run Lane in Adams Township. The tornado traveled southeast, crossing Ferncliff Road and moved across Edgemoor Road before dissipating. Damage along the path that was associated with the event included the destruction of one mobile home and modular home, severe damage to a two-story wood frame home and 2 injuries. Witnesses to the event said that as the tornado dissipated, debris including boards, tree limbs and siding fell from the sky. A short time late at 6:30pm a weak F1 tornado with winds estimated at 80 mph touched down near the WHIZ radio station located southeast of Zanesville in Wayne Township. The storm continued to move off to the southeast destroying a wood garage before it dissipated.

August 11, 2014: An EF-0 tornado briefly touched down near the town of Twinway. Maximum winds were estimated at 70 MPH, with a path width of 25 yards. Video and pictures showed the tornado skipped as it touched down for less than one quarter mile. A large tree branch was on top of a home with no apparent damage, and areas of corn were knocked down in a field.

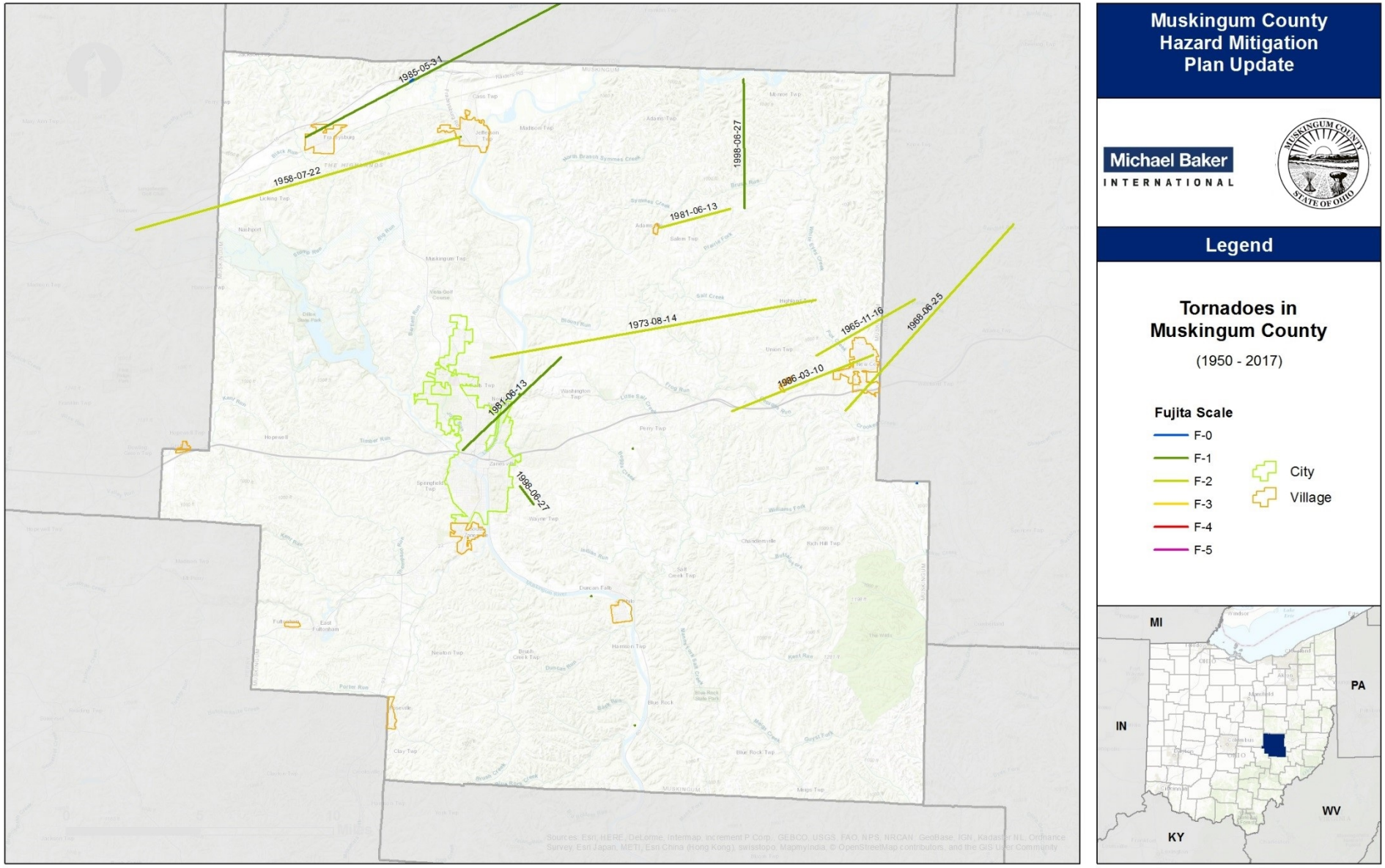


Figure 4-9 Muskingum County Tornado Tracks

4.8.5 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 4-18 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.

Figure 4-10 Example of a powerful EF-5 Tornado

Table 4-19 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 4-20 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 4-21 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 4-22 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 Muskingum County is equally at risk to tornado damage.

4.8.6 Frequency/Probability of Future Occurrences

Reported tornado events over the past 67 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a tornado event, although infrequent, can be difficult to quantify, but based on historical record of 16 tornado events since 1950, it can reasonably be assumed that this type of event has occurred once every 4.19 years from 1950 through 2017.

[(Current Year) 2017] subtracted by [(Historical Year) 1950] = 67 Years on Record

[(Years on Record) 67] divided by [(Number of Historical Events) 16] = 4.19 years between events

Furthermore, the historic frequency calculates that there is a 24% chance of this type of event occurring each year.

The HMPC decided, based on their knowledge, that tornadoes are “Highly Likely,” meaning they have a 100% annual chance of occurring.

4.8.7 Inventory Assets Exposed to Tornadoes

All assets located in Muskingum County can be considered at risk from tornadoes and wind events. This includes 86,016 people, or 100% of the County’s population and all critical facilities, structures, and infrastructure.

4.8.8 Potential Losses from Tornadoes

While all County assets are considered at risk from this hazard, a particular tornado would only cause damages along its specific track. A high-magnitude tornado sweeping through densely-populated portions of the County would have extensive injuries, deaths, and economic losses. There is no way to be sure how many people would be injured or killed due to the difference time of day and year can make, but property values can provide an estimate of economic losses.

Table 4-23 Properties Vulnerable to Tornadoes

Vulnerability to Tornadoes			
Non-Critical Facilities			
Category	Total Cost	1% Damage	5% Damage
Residential	$ 2,756,732,090	$ 27,567,321	$ 137,836,605
Agriculture	$ 183,050,500	$ 1,830,505	$ 9,152,525
Total	$ 2,939,782,590	$ 29,397,826	$ 146,989,130

Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Cultural	$ 2,038,300	$ 20,383	$ 101,915
Education	$ 285,786,200	$ 2,857,862	$ 14,289,310
Fire	$ 7,911,930	$ 79,119	$ 395,597
Government	$ 15,485,800	$ 154,858	$ 774,290
Medical	$ 15,901,600	$ 159,016	$ 795,080
Police	$ 7,736,000	$ 77,360	$ 386,800
Water	$ 18,742,500	$ 187,425	$ 937,125
Total	**$ 353,602,330**	**$ 3,536,023**	**$ 17,680,117**

4.8.9 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 Muskingum County property is equally at risk to tornado damage and there are no locations of high-risk exposure.

There has not been a large amount of development that would affect the County's vulnerability to Tornadoes since the previous plan.

4.8.10 Tornadoes HIRA Summary

It's difficult to separate the various wind components that cause damage 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 are difficult to predict and the entire County 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.

4.9 *Extreme Temperatures*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Extreme Temperatures	3	0.9	3	0.9	4	0.8	3	0.3	1	0.1	**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. 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.

4.9.1 Hazard Identification

4.9.1.1 Extreme Heat

Temperatures that remain at 10 degrees or more above the average high temperature for the area 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 4-25). 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.

4.9.1.2 Extreme Cold

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in Muskingum 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 60 years of age. More than 75 percent of injuries happen to males, and almost 20 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.

4.9.2 Regulatory Environment

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

4.9.3 Hazard Events

Extreme temperatures are city/county/zone-wide hazards. As such, all Muskingum County, Ohio instances of these events were looked at as previous hazard events.

The National Oceanic and Atmospheric Administration (NOAA) Climatic Data Center (NCDC) does not list any occurrences of either excessive heat. Since 2009, there have been six (6) extreme cold/wind chill events for Muskingum County, Ohio which have resulted in $200,000 in property damage. There have been no recorded deaths or injuries from extreme cold/wind chill events.

According to the NCDC, there have been no documented cases of Extreme Heat in Muskingum County.

Table 4-24 Extreme Temperature Events in Muskingum County

Date	Type	Deaths	Injuries	Property Damage	Crop Damage
1/16/2009	Extreme Cold/wind Chill	0	0	$ 0	$ 0
1/5/2014	Extreme Cold/wind Chill	0	0	$ 0	$ 0
1/27/2014	Extreme Cold/wind Chill	0	0	$ 0	$ 0
2/19/2015	Extreme Cold/wind Chill	0	0	$ 0	$ 0
2/24/2015	Extreme Cold/wind Chill	0	0	$ 0	$ 0
Totals:		**0**	**0**	**$ 0**	**$ 0**

4.9.4 Historical Occurrences

COLD – January 16-17, 2009: Arctic air moved over the Upper Ohio Valley with a large dome of High pressure. Morning lows across eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett county Maryland. The lowest low temperatures ranged from 10 below zero at Pittsburgh to 22 below zero at Accident, Maryland. Low temperatures were generally 10 to 15 degrees below zero elsewhere.

COLD – January 5-7, 2014: An arctic cold front crossed the Upper Ohio Valley on the 6th, bringing record low temperatures and extreme wind chills the morning of the 7th. It was the coldest January 7th on record in Pittsburgh with a low temperature of 9 below zero, and a high temperature of 4 above zero. Across eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett county Maryland, low temperatures ranged from 5 to 15 degrees below zero the morning of the 7th, with the lowest wind chill readings from 25 to 55 degrees below zero. A low temperature of 9 degrees below zero with a wind chill of 32 degrees below zero was recorded near New Concord the morning of the 7th.

COLD – January 27-29, 2014: A strong arctic cold front moved across eastern Ohio, northern West Virginia, western Pennsylvania, and Garrett county Maryland the morning of the 27th. Visibilities were reduced to near zero at times in snow showers along the front. As high pressure moved over the region the 28th and 29th, morning low temperatures ranged from 5 below zero to 25 below zero across the region. Light winds did not allow for extreme wind chills, with the exception being wind chills near 30 below zero across parts of Garrett and Tucker counties just after midnight on the 28th. Low temperatures at the Zanesville Municipal Airport were -19 on the 28th and -20 on the 29th.

COLD – February 19, 2015: Bitter cold Arctic high pressure brought temperatures well below zero the morning of the 20th, with many low temperature records broken. A record low of -16 was set at Zanesville.

HEAT – July 25, 2016: Temperatures were recorded to be as high as 97 degrees in Zanesville. Throughout the city, cooling stations were opened up to provide relief to residents. All four city pools were open throughout the day. Paramedics made routine stops to answer any heat-related questions that people might have had, including where cooling stations were located.

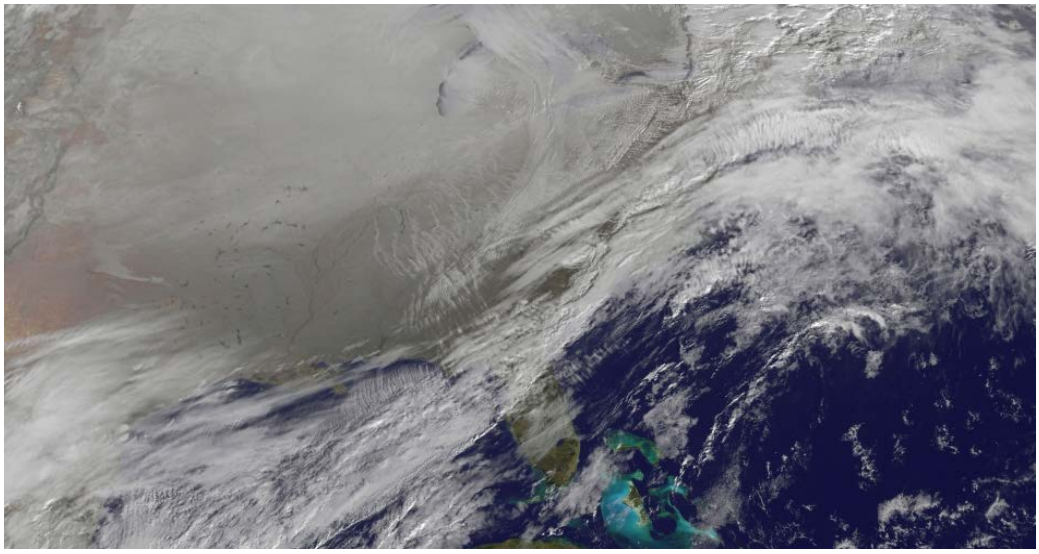


Figure 4-11 January 2014 Polar Vortex

4.9.5 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. 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 4-25 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 Warning*s 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).

Table 4-25 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

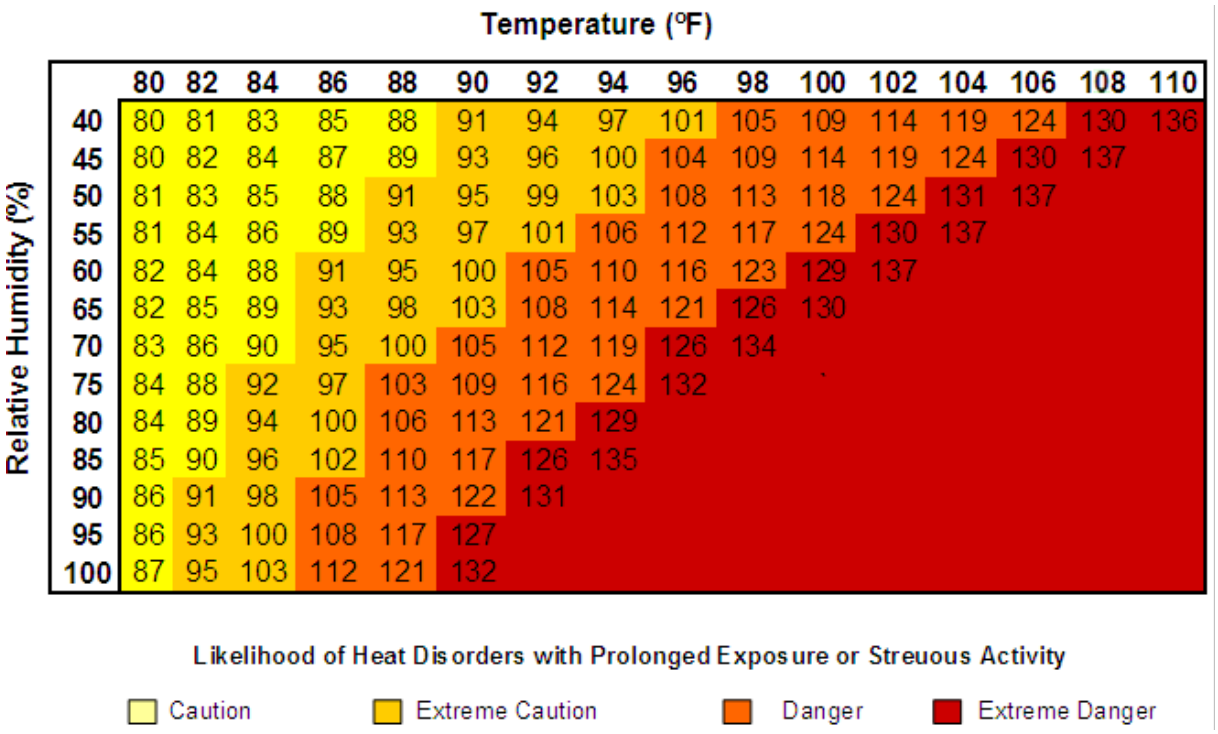


Figure 4-12 NOAA's National Weather Service Heat Index

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 4-13 Extreme Cold Temperature and Associated Threat Level

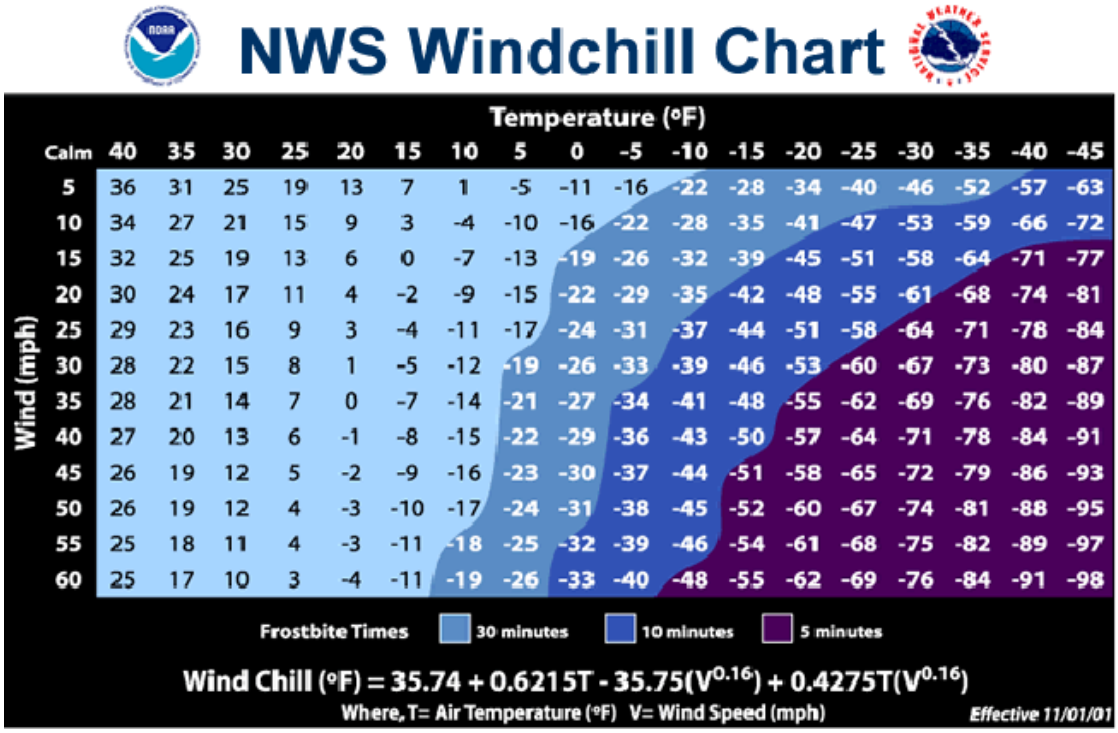


Figure 4-14 National Weather Service Wind Chill Chart

4.9.6 Frequency/Probability of Future Occurrences

The probability of Muskingum County experiencing an extreme temperature can be difficult to quantify. 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 may also extend significantly.

While there have been no NCDC-recorded extreme heat events, they have been recorded by local sources. There have been 5 extreme cold events listed since 2009. These reported events over the past 8 years provide a framework for determining the future occurrence in terms of frequency for such events.

> *[(Current Year) 2017] subtracted by [(Historical Year) 2009] = 8 Years on Record*
>
> *[(Years on Record) 8] divided by [(Number of Historical Events) 5] = 1.6 years between events*

Furthermore, the historic frequency calculates that there is a 62.5% chance of this type of event occurring each year.

Based on their knowledge, the HMPC considers Extreme Temperature events as “Likely,” meaning that they have between a 10% and 100% annual chance of occurring.

4.9.7 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.

4.9.8 Potential Losses from Temperature Extremes

It is evident that extreme temperatures are dangerous and can be potentially life-threatening. Therefore it is 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. Extreme cold can cause damage to structures; for example, burst pipes will damage buildings and will necessitate repairs. Extreme heat can cause health issues for older and younger residents of the County, and can overload electrical infrastructure.

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 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.

According to the 2015 American Community Survey, there were approximately 5,201 children under the age of 5, which is equal to about 6% of the total population. There were an estimated 14,021 people above the age of 65, equating to about 16.3% of the population.

Table 4-26 2014 Population Age Estimates

Total	Population	Percent
Under 5 years	5,201	6.0%
5 to 9 years	5,428	6.3%
10 to 14 years	5,595	6.5%
15 to 19 years	5,801	6.7%
20 to 24 years	5,897	6.9%
25 to 29 years	5,122	6.0%
30 to 34 years	5,021	5.8%
35 to 39 years	4,896	5.7%
40 to 44 years	5,190	6.0%
45 to 49 years	5,569	6.5%
50 to 54 years	6,060	7.0%
55 to 59 years	6,357	7.4%
60 to 64 years	5,502	6.4%
65 to 69 years	4,751	5.5%
70 to 74 years	3,481	4.0%
75 to 79 years	2,558	3.0%
80 to 84 years	1,857	2.2%
85 years and over	2,004	2.3%

Table 4-27 Date of Building Construction

Year Built	Number	Percentage
Built 2014 or later	9	0.2%
Built 2010 to 2013	228	1.3%
Built 2000 to 2009	4,312	10.4%
Built 1990 to 1999	4,168	12.3%
Built 1980 to 1989	3,748	11.1%
Built 1970 to 1979	5,373	13.2%
Built 1960 to 1969	3,941	8.8%
Built 1950 to 1959	3,754	10.0%
Built 1940 to 1949	2,450	6.8%
Built 1939 or earlier	9,871	26.0%

Table 4-28 Potential Losses from Extreme Temperatures

Vulnerability to Extreme Temperatures			
Non-Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Residential	$ 2,756,732,090	$ 27,567,321	$ 137,836,605
Agriculture	$ 183,050,500	$ 1,830,505	$ 9,152,525
Total	**$ 2,939,782,590**	**$ 29,397,826**	**$ 146,989,130**
Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Cultural	$ 2,038,300	$ 20,383	$ 101,915
Education	$ 285,786,200	$ 2,857,862	$ 14,289,310
Fire	$ 7,911,930	$ 79,119	$ 395,597
Government	$ 15,485,800	$ 154,858	$ 774,290
Medical	$ 15,901,600	$ 159,016	$ 795,080
Police	$ 7,736,000	$ 77,360	$ 386,800
Water	$ 18,742,500	$ 187,425	$ 937,125
Total	**$ 353,602,330**	**$ 3,536,023**	**$ 17,680,117**

4.9.9 Land Use & Development Trends

Muskingum County is subject to temperature extremes, which are a countywide hazard and effect all areas 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. 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.

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.

4.9.10 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.

4.10 *Geologic Hazards*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Geologic Hazards	4	1.2	2	0.6	3	0.6	4	0.4	1	0.1	**2.9**
Medium Risk Hazard (2.0 – 2.9)											

Geologic hazards pose a substantial danger to people, property and infrastructure. Geologic hazards exist in Muskingum County due to naturally occurring geologic events and geologic hazards accelerated by human development. Common geologic hazards present throughout Muskingum County include seismic shaking or "earthquakes," expansive soils, subsidence, and landslides.

4.10.1 Hazard Identification

4.10.1.1 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. Breaks in the Earth's 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.

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 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). Predicting the amount of damage would be difficult due to lack of historic activity in the area.

As noted by the Ohio Seismic Network, when the peak acceleration nears 0.1g, damage may be caused to poorly constructed buildings while acceleration nearing 0.2 would create loss of balance and greater damage to lesser quality structures. Muskingum County has peak acceleration much below that number, thus providing a buffer from most seismic activity. On a local basis, community members within Muskingum County 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 Muskingum County:

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

4.10.1.2 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. There are several types of waves that occur during earthquake events:

> **Primary waves** (p-waves) are compressional waves that are longitudinal in nature. These waves travel faster than the other types of waves and are thus the first to arrive at seismographic stations. These can help give warning – typically 60-90 seconds – before an event occurs. These waves can move through rock, water, and air.
>
> **Secondary waves** (s-waves) are shear waves that are transverse in nature. When they reach the surface, they may displace the ground perpendicularly to the direction of propagation. S-waves can only travel for solids, since water and air do not support shear stresses.
>
> **Surface waves** are of a lower frequency than body waves. These waves are what most people are familiar with during earthquakes, as they are responsible for the damage and destruction that takes place during seismic events.

"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.

4.10.1.3 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.

4.10.1.4 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.

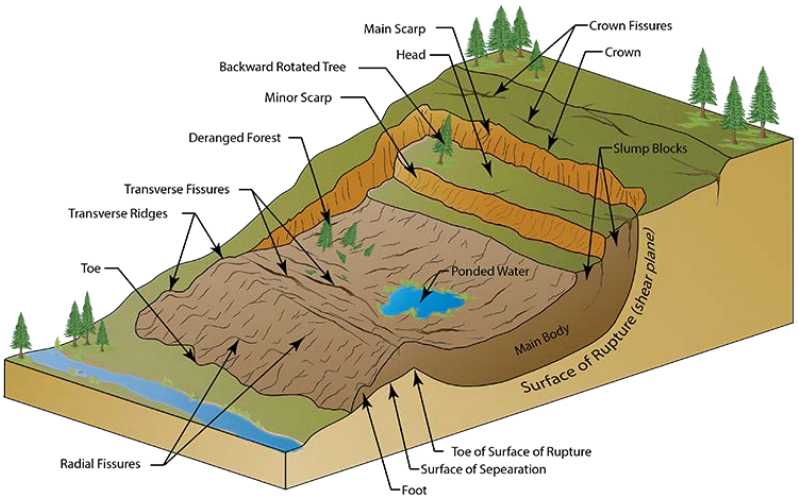


Figure 4-15 Diagram of a landslide

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.

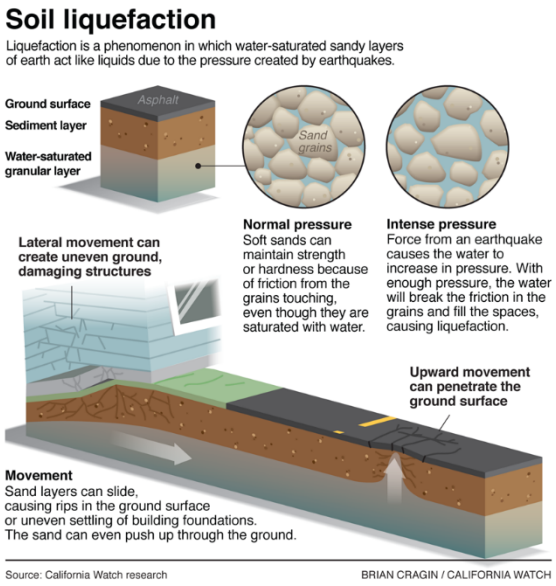


Figure 4-16 Diagram of soil liquefaction

4.10.1.5 Landslide

The term “landslide” describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures. In addition to the different types of landslides, the broader scope of ground failure includes subsidence, permafrost, and shrinking soils.

According to the Ohio Department of Natural Resources, landslides are not a random, totally unpredictable natural hazard event. The presence of one or more inherent geological conditions can serve as an alert to a possible landslide event. The most common conditions are listed below:

- **Steep slope:** Downward movement due to gravity
- **Jointed rock**: Fractures allow freezing and thawing to weaken rock
- **Fine-grained rock or sediment:** Moisture causes weakening and bonding of particles

- **Clay or shale subject to lubrication**: Moisture causes loss of bonding to underlying materials
- **Vibrations**: Blasting, heavy truck traffic or earthquakes
- **Over Steepened slope:** Construction, large amounts of fill or precipitation
- **Removal of vegetation:** Removal of tree roots or binding vegetation increased water saturation

Although an area may possess one or more of the above conditions, landslides require a "triggering mechanism." The most common triggers are listed below:

- **Intense rainfall**: Storms that produce intense rainfall for periods as short as several hours, or have more moderate intensity lasting for several days have triggered abundant landslides. The rapid infiltration of rainfall, causing soil saturation and a temporary rise in pore-water pressure is generally believed to be the mechanism by which most shallow landslides are generated during storms.
- **Rapid snowmelt**: Rapid melting of a snow-pack caused by sudden warming spells or by rain falling on snow can ass water to hillside soils. Rain-on –snow events commonly reduce the water content of the snow-pack and add sufficient water to soils to be significant in triggering landslides.
- **Water-level change**: The sudden lowering of the water level (rapid draw down) against a slope can trigger landslides in earth dams, along coastlines and on the banks of lakes, reservoirs, canals and rivers. Rapid draw down can occur when a river drops following a flood stage, the water level is a reservoir or canal is dropped suddenly, or the sea level drops following a storm.
- **Earthquake shaking**: Strong ground shaking during earthquakes has triggered landslides in many different topographical and geologic settings.

4.10.1.6 Expansive Soils

Expansive soil expands and contracts due to changes in the moisture content of the soil, causing structural problems through differential movement of the structure. Moisture content can play a large role in the stability of a structure: different soil moistures or soil types underneath a structure can lead to movement in the foundation. This can cause damage to buildings as the ground shifts below them. This may result in cracks in either walls or the foundation slab itself, uneven windows, and misaligned doors. Cracks or bowing of basement walls due to lateral pressure applied from the outside soil. Serious damage, or even failure, may result if not checked as a result of expansive soils.

4.10.1.7 Mine Subsidence

Mine subsidence poses a threat to people and property on the surface when the support structures that once supported the roof of the cavern begin to rot, collapse, or otherwise give way. When this happens, particularly with mines that were not properly mapped, homes and other structures begin to sink.

4.10.2 Regulatory Environment

4.10.2.1 Earthquakes

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. Because Ohio does not have strong earthquakes, there are negligible laws or guidelines pertaining to seismic stress on roads, bridges, or buildings.

4.10.2.2 Landslides
There are negligible codes relating to landslides in Muskingum County.

4.10.2.3 Expansive Soils
There are negligible codes relating to expansive soils in Muskingum County.

4.10.2.4 Mine Subsidence
According to ODNR, Muskingum County residents are required to purchase mine subsidence insurance. This is due to the numerous abandoned mines that are found throughout Eastern Ohio. Through this legislation, a total of 26 Ohio counties require their residents to purchase subsidence insurance, while 11 others have it as optional.

4.10.3 Hazard Events / Historical Occurrences

Earthquakes: Muskingum County has not been the site for any earthquake epicenters, according to the Ohio Geological Survey and the United States Geological Survey. Earthquakes do occur throughout the state, however, and it may be possible for events to be felt in the future. Figure 4-18 shows epicenters in the State of Ohio from 1970 – 2015. Earthquakes have occurred in surrounding communities, which were likely felt within the County at the time.

Landslides: In 1986, a landslide occurred in the westbound lanes of I-70 near New Concord. According to John Clark, Transportation Technician with the Ohio Department of Transportation, District 5 Office, water coming off the hill from the eastbound lane undermined the soil in the westbound lane and caused a major slip that closed those lanes to traffic for approximately 30 days. To correct the problem, ODOT constructed a cut-off ditch in the eastbound lanes, removed all the material from the eastbound lanes, and brought in all new materials.

Figure 4-17 Muskingum Avenue, Credit Google Maps

Another problem area has been the westbound off-ramp at New Concord. There have been 3 different instances when sliding has caused failure on this ramp. The latest occurrence was in 1992-93.

Muskingum Avenue, a road running through the center of Zanesville, experienced landslide issues in 2016, resulting in its closure until it was cleared of debris. The eastern two-thirds of the County are highly susceptible to landslides. This can be seen in Figure 4-20.

Expansive Soils: The Muskingum County Soil Survey identifies approximately 15 different soils that have a high shrink-swell potential. The research done for the hazard profile did not uncover any deaths, injuries or damage to structures in Muskingum County as a result of expansive soils. However, the soil types may contribute to road damage in certain areas of the county.

Mine Subsidence: In March 2014, a mobile home belonging to a family in White Cottage, a township in Muskingum County, was in danger of being swallowed by a sinkhole caused when an abandoned mine began to collapse. The family was denied entry to the home when a second sinkhole opened. ODNR spent approximately $40,000 by June filling in the sinkhole with gravel and other materials to stabilize the land by the home.

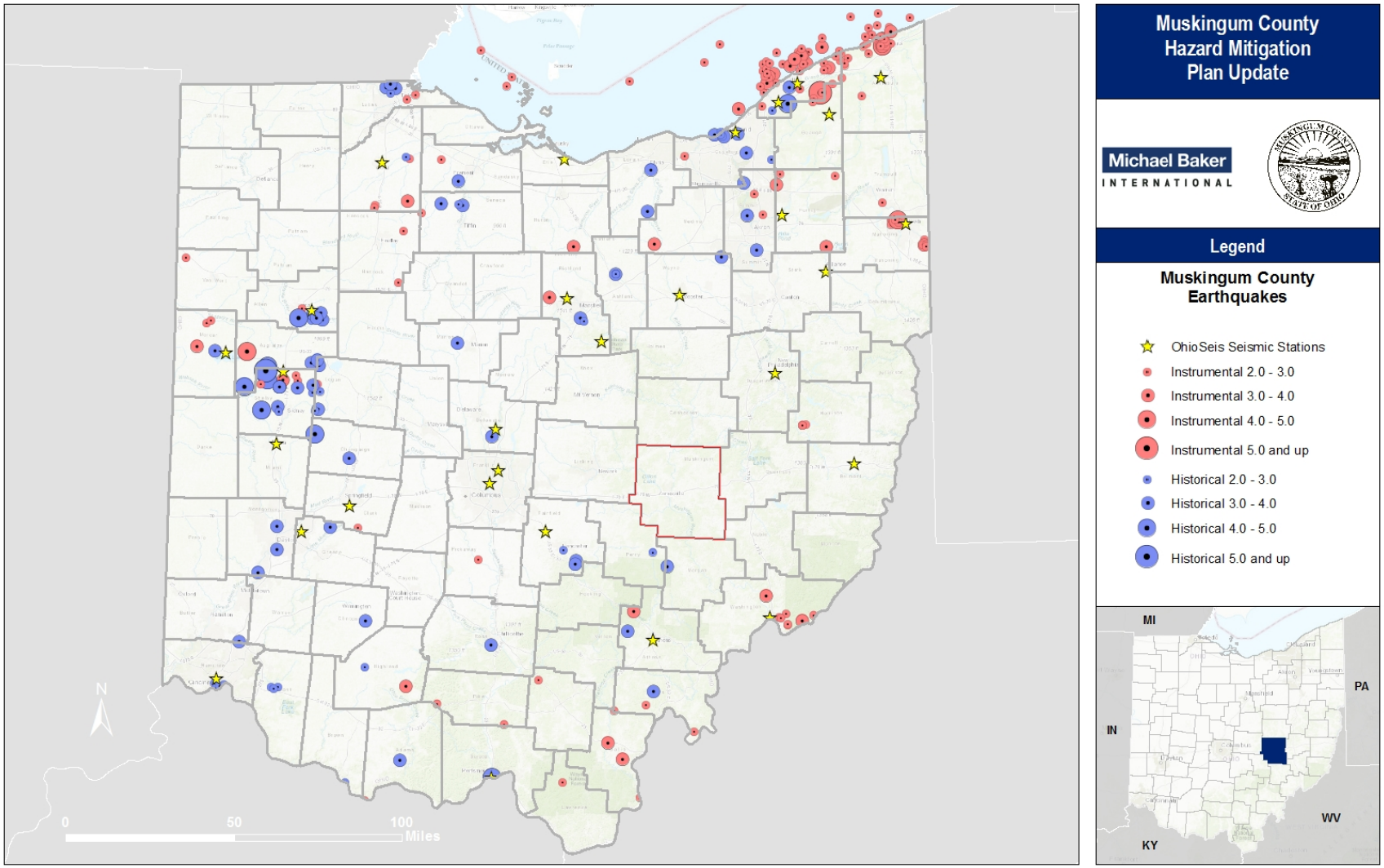


Figure 4-18 Ohio Historic Epicenters

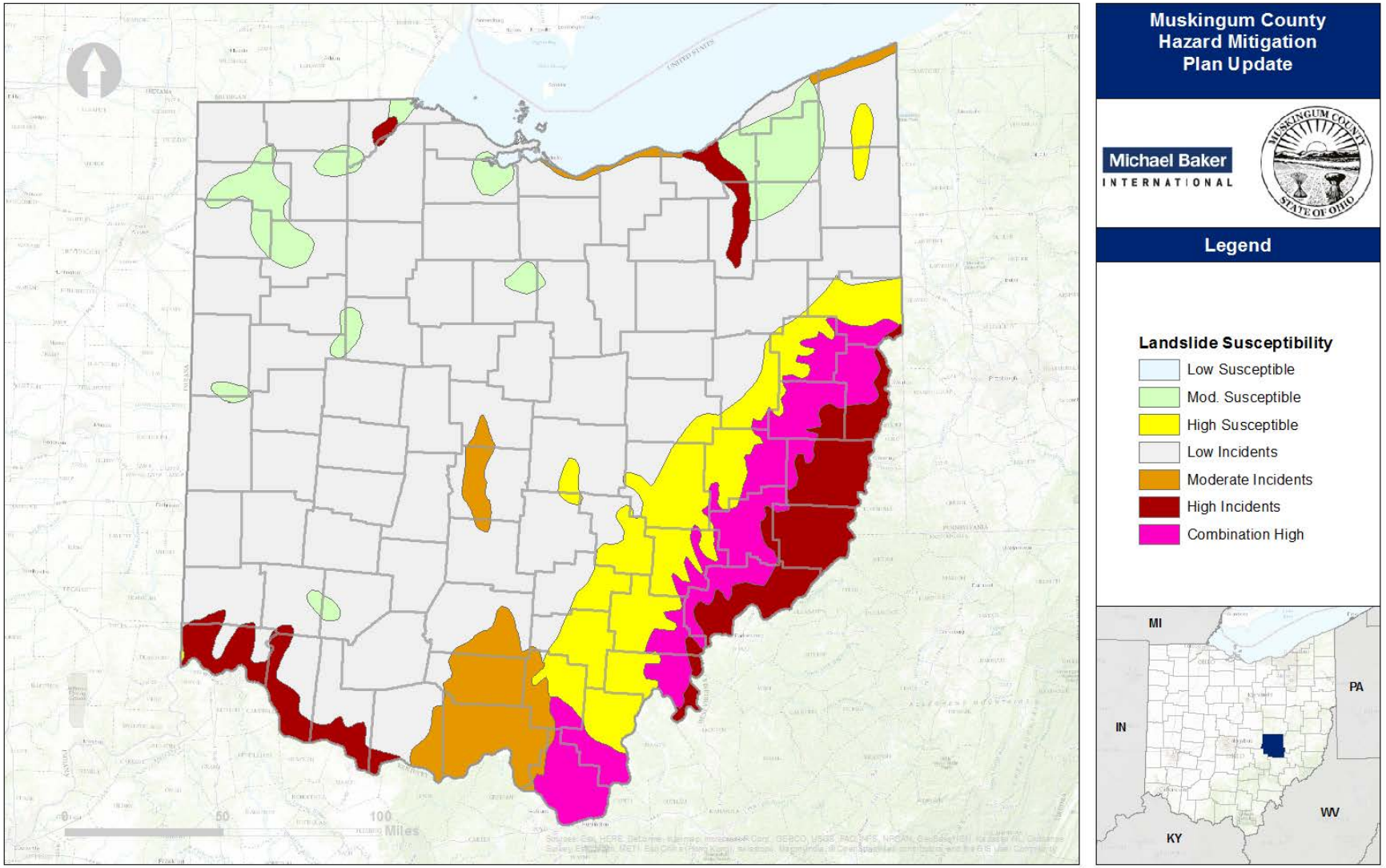


Figure 4-20 Landslide Incidence and Susceptibility

4.10.4 Magnitude/Severity

4.10.4.1 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 4-29, there are seven earthquake magnitude classes, ranging from great to micro. A great class of magnitude can cause tremendous damage to infrastructure in the County, compared to a micro class, which results in minor damage to infrastructure.

Table 4-29 Moment Magnitude Scale

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

The MMI Scale measures earthquake intensity as shown in Table 4-30, 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.

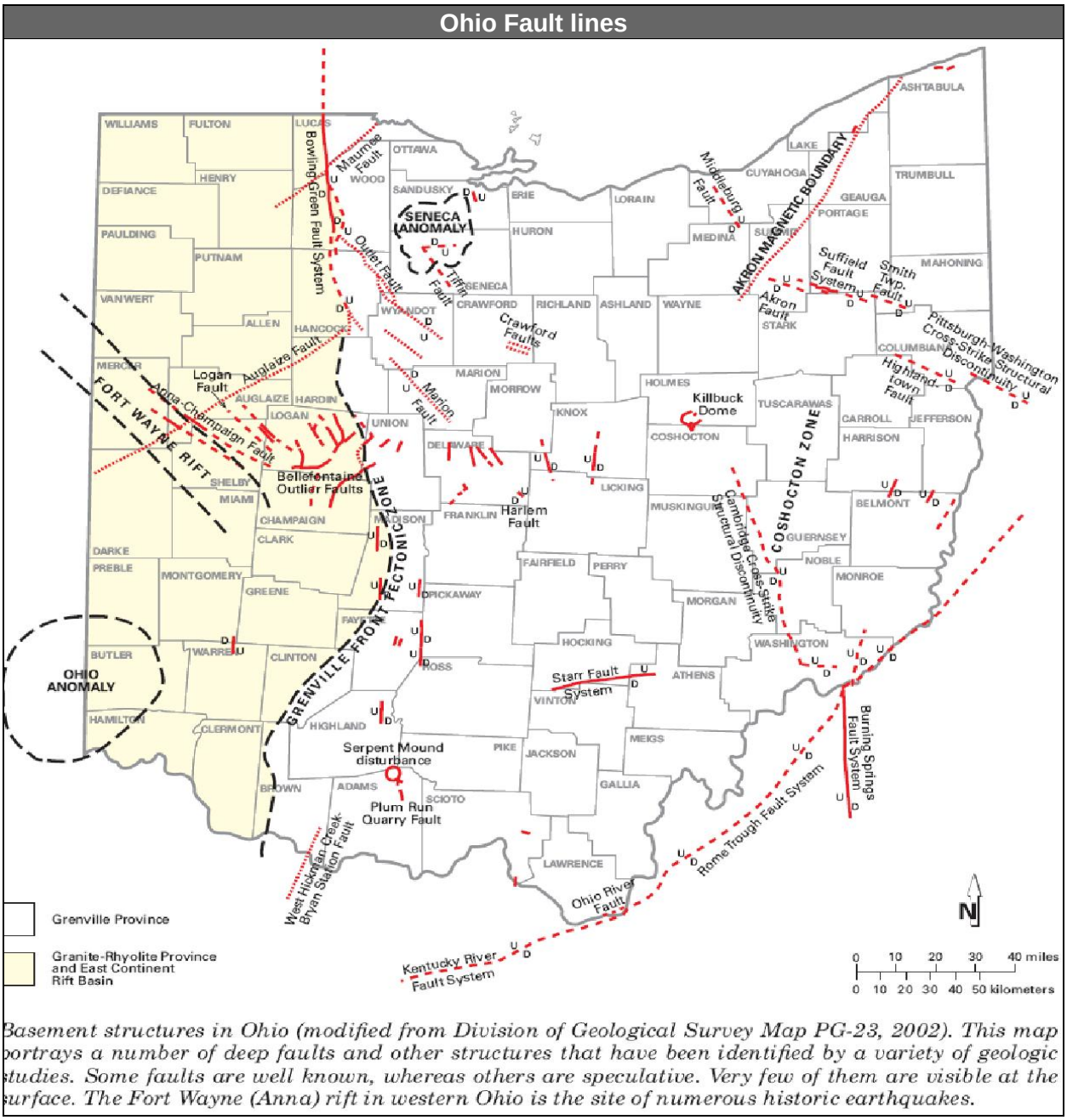
Table 4-30 Modified Mercalli Scale

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	**Instrumental**	Usually detected only on seismographs.	<4.2
II	**Feeble**	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	**Slight**	Felt quite noticeably indoors, especially on upper floors. Most people don't recognize it as an earthquake (i.e. a truck rumbling).	
IV	**Moderate**	Can be felt by people walking; dishes, windows, and doors are disturbed.	
V	**Slightly Strong**	Sleepers are awoken; unstable objects are overturned.	<4.8
VI	**Strong**	Trees sway; suspended objects swing; objects fall off shelves; damage is slight.	<5.4
VII	**Very Strong**	Damage is negligible in buildings of good design and construction, slight to moderate in well-built	<6.1

		ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken.	
VIII	Destructive	Damage is slight in specially designed structures; considerable in ordinary, substantial buildings. Moving cars become uncontrollable; masonry fractures, poorly constructed buildings damaged.	<6.9
IX	Ruinous	Some houses collapse, ground cracks, pipes break open; damage is considerable in specially designed structures; buildings are shifted off foundations.	
X	Disastrous	Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with foundations. Ground cracks profusely; liquefaction and landslides widespread.	<7.3
XI	Very Disastrous	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed.	<8.1
XII	Catastrophic	Total destruction; trees fall; lines of sight and level are distorted; ground rises and falls in waves; objects are thrown upward into the air.	>8.1

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



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 4-21 Fault Lines in the State of Ohio

4.10.5 Frequency/Probability of Future Occurrences

There is not sufficient historical precedent to determine the frequency at which geologic hazards occur within Muskingum County. There is also no centralized database of events that might allow for an approximation of how often these events occur.

Based on their knowledge of previous occurrences, including those that may not be recorded, the HMPC gave a possibility of “Highly Likely” or a 100% annual chance of geologic hazards occurring in Muskingum County each year. This includes, earthquakes, landslides, mine subsidence, and expansive soils.

4.10.6 Inventory Assets Exposed to Seismic/Earthquake Activity

The method used in determining the types and numbers of potential assets exposed to earthquake damage 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). This program was conducted at the census block level. For this Plan, a 5.5 magnitude earthquake was modeled and the results are presented below.

Although a 5.5 magnitude has never occurred within the planning area for this document, this is the accepted baseline for simulating potential losses due to seismic events. The software takes into account the depth of the epicenter, as well as its location. In addition, the program helps to determine the potential losses based on the prevailing soil types in the region.

4.10.6.1 HAZUS-MH HAZUS 5.50 Earthquake

HAZUS estimates that about 7,980 buildings will be at least moderately damaged. This is over 22.00 % of the total number of buildings in the region. There are an estimated 542 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.

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	127	0.63	42	0.49	44	0.80	21	1.09	5	0.98
Commercial	758	3.77	438	5.18	536	9.77	276	14.12	86	15.85
Education	38	0.19	18	0.21	21	0.39	10	0.51	3	0.58
Government	41	0.20	22	0.26	29	0.53	13	0.66	4	0.78
Industrial	245	1.22	114	1.34	144	2.63	80	4.11	24	4.36
Other Residential	2,188	10.88	1,192	14.10	1,346	24.54	602	30.81	136	25.13
Religion	120	0.60	53	0.63	49	0.90	25	1.29	8	1.43
Single Family	16,592	82.52	6,581	77.79	3,316	60.45	926	47.42	276	50.89
Total	**20,107**		**8,460**		**5,485**		**1,953**		**542**	

Figure 4-22: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	14,893	74.07	5623	66.47	2,136	38.93	274	14.05	22	4.01
Steel	343	1.71	152	1.80	282	5.15	197	10.07	62	11.49
Concrete	114	0.57	49	0.57	64	1.17	34	1.75	8	1.39
Precast	106	0.53	38	0.45	65	1.18	48	2.48	10	1.86
RM	47	0.24	14	0.17	26	0.48	19	0.97	3	0.50
URM	3,239	16.11	1781	21.05	1,783	32.50	848	43.39	322	59.34
MH	1,365	6.79	802	9.49	1,129	20.59	533	27.29	116	21.40
Total	**20,107**		**8,460**		**5,485**		**1,953**		**542**	

Figure 4-23: Expected Building Damage by Building Type (All Design Levels)

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 0.31 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 49.00% 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 12,520 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Before the earthquake, the region had 393 hospital beds available for use. On the day of the earthquake, the model estimates that only 66 hospital beds (17.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 29.00% of the beds will be back in service. By 30 days, 60.00% will be operational.

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	1	0	0
Schools	45	19	0	11
EOCs	1	1	0	0
PoliceStations	6	3	0	3
FireStations	15	4	0	5

Figure 4-24 Expected Damage to Essential Facilities

4.10.7 Potential Losses from Geologic Hazards

The risk of seismic hazards to residents of Muskingum County is based on the approximate location of earthquake faults within and outside the region. According to the USGS Fault Zone Maps, Muskingum County is near several minor faults, with the Middleburg Fault running through it on the western side. Several Fault Zones have been identified as the closest active and possibly hazardous fault to Muskingum County residents and property: Suffield Fault, Akron Fault, Smith Township Fault, and the Highland Fault.

As noted by the Ohio Seismic Network, when the peak acceleration nears 0.1g, damage may be caused to poorly constructed buildings while acceleration nearing 0.2 would create loss of balance and greater damage to lesser quality structures. Muskingum County only has a PGA of 0.01 – 0.02.

Muskingum County is at a very low vulnerability to seismic activity. The nearest major fault, the New Madrid Fault, 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 Muskingum County. The lack of major 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. 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.

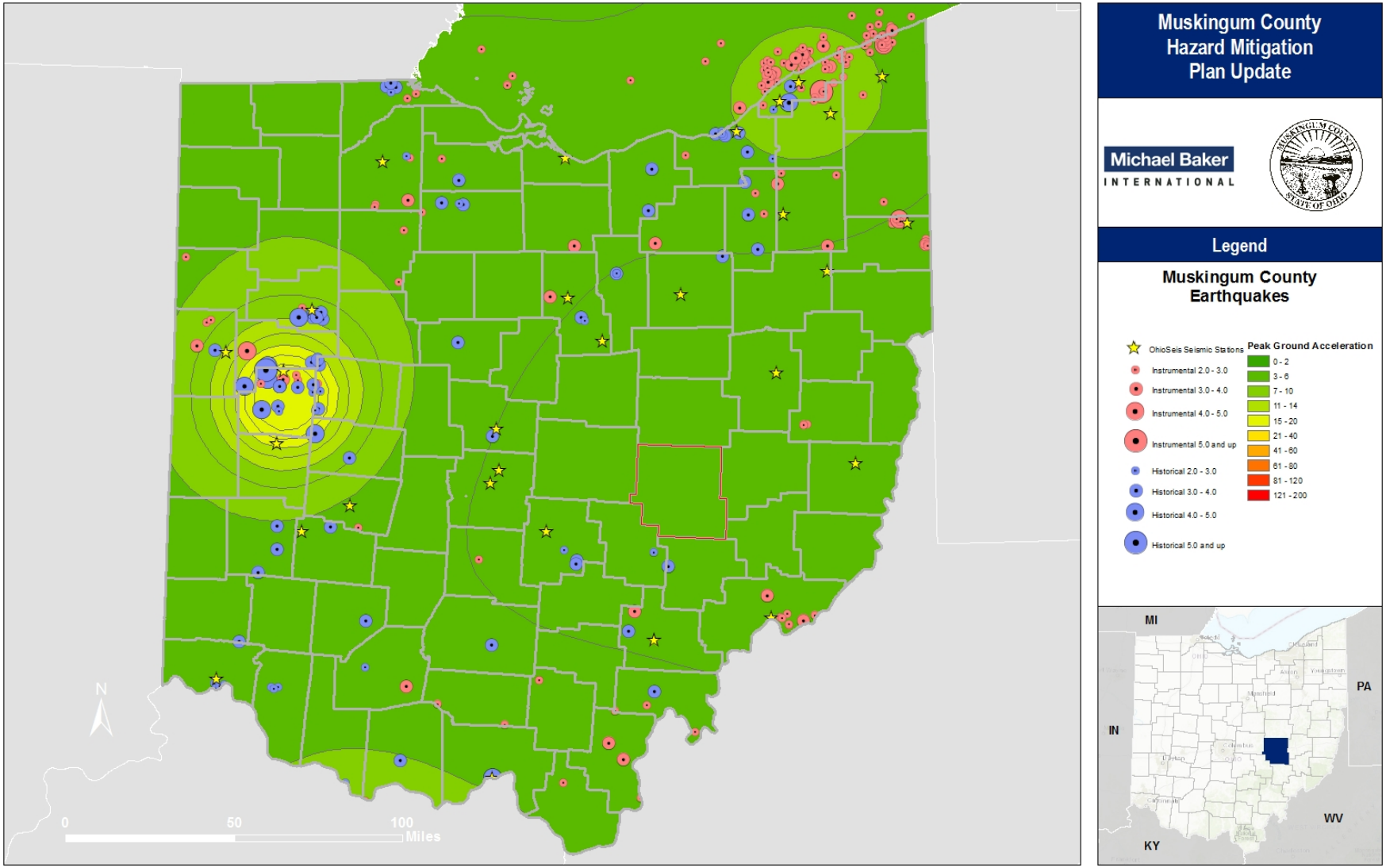


Figure 4-25 Muskingum County Peak Ground Acceleration

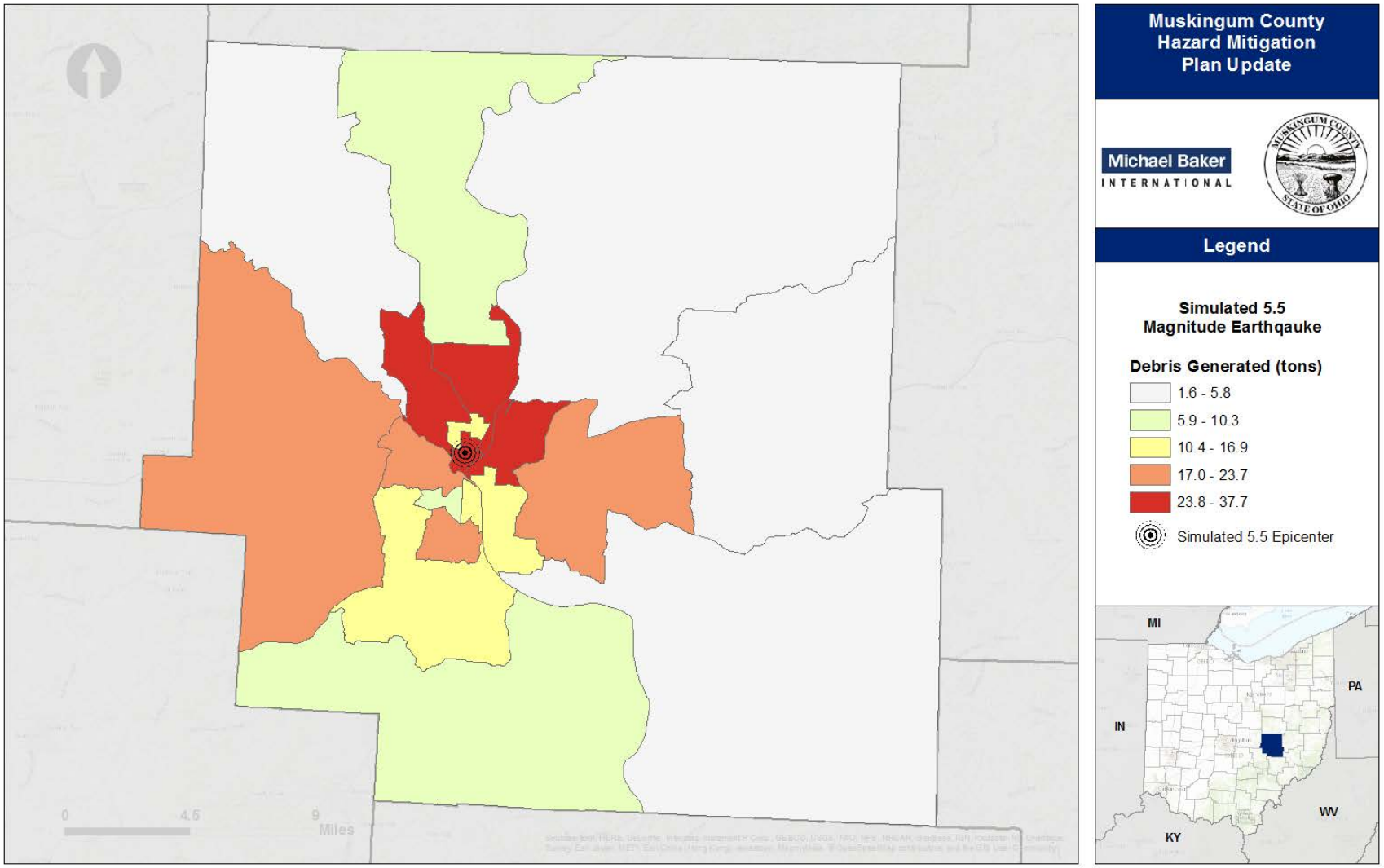


Figure 4-26 Debris Generated from a 5.5 Magnitude Event in Muskingum County

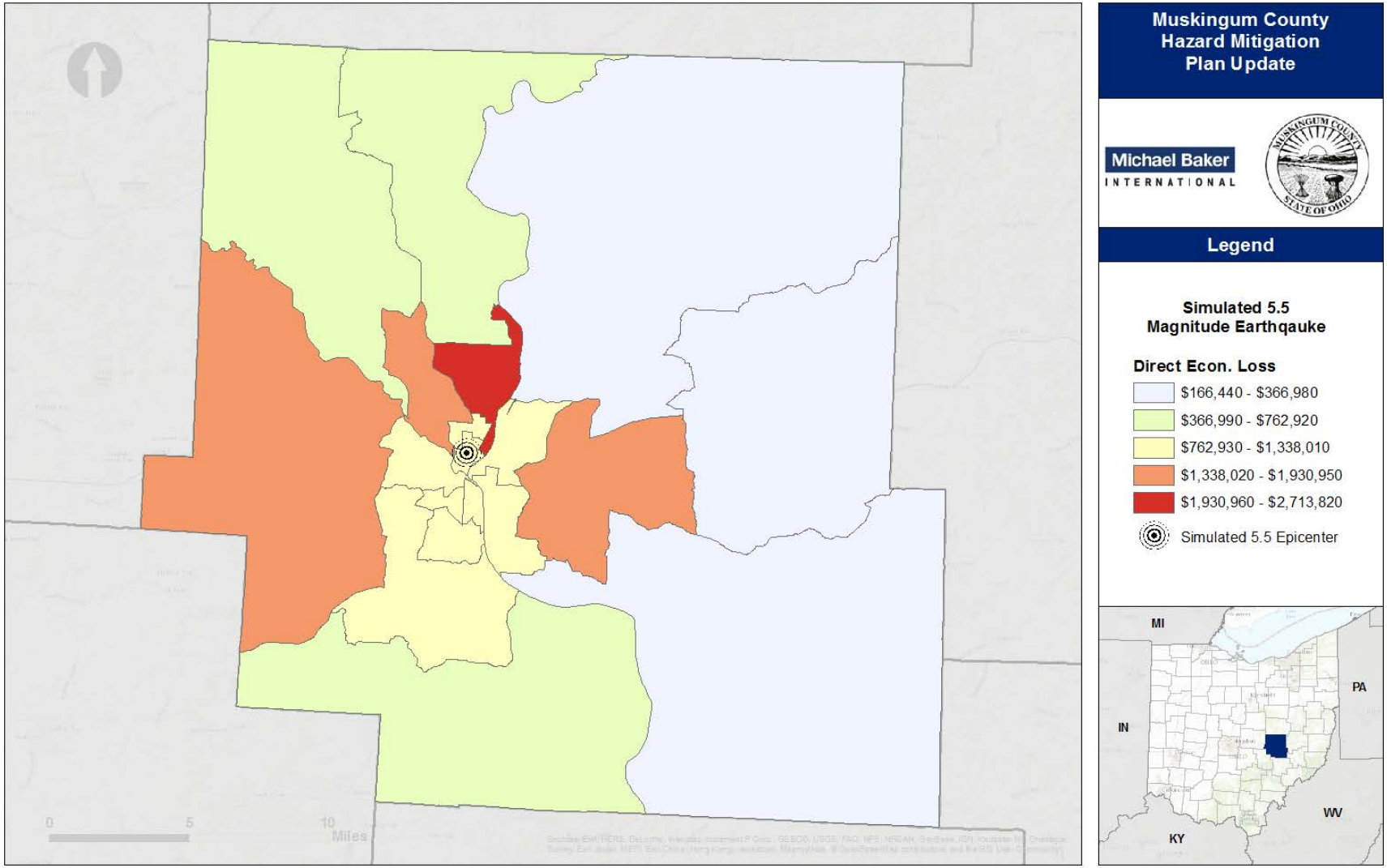


Figure 4-27 Projected Economic Losses from a 5.5 Magnitude Event in Muskingum County

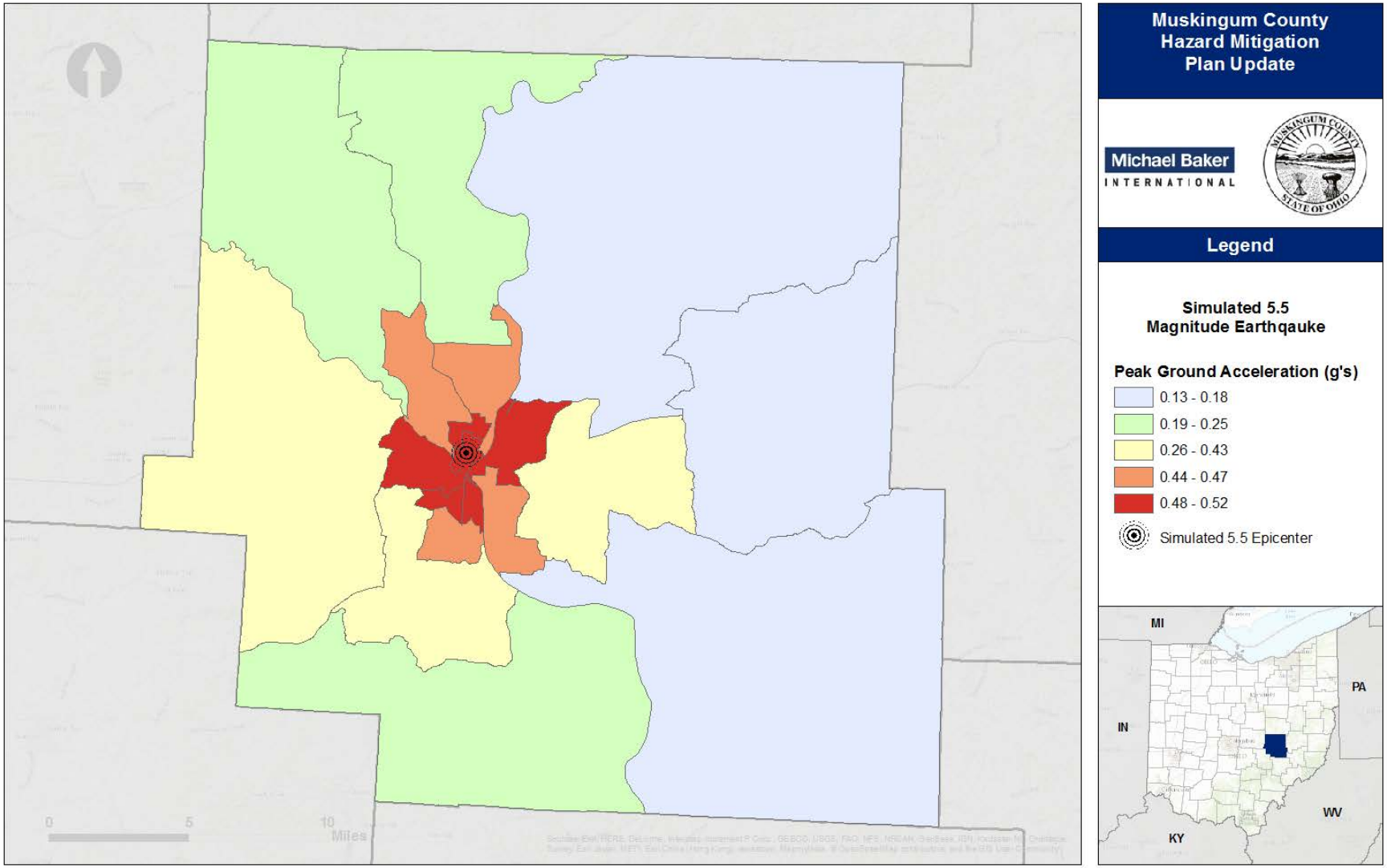


Figure 4-28 Peak Ground Acceleration Resulting from a Magnitude 5.5 Event in Muskingum County

4.10.8 Land Use & Development Trends

4.10.8.1 Earthquake
There are negligible new developments that could be affected by earthquakes.

4.10.8.2 Landslides
Landslides can occur where there are steep slopes. There are numerous homes, roads, and commercial centers built near slopes. However, very little new development has occurred since the previous plan. Redevelopment will likely occur as needed.

4.10.8.3 Expansive Soils
There are negligible new developments that could be affected by expansive soils.

4.10.8.4 Mine Subsidence
There are abandoned mines throughout the County. While geologists do their best to map them, many remain elusive and undetected. Homes and businesses are undoubtedly built upon old mines that have not been mapped, and have likely been constructed on some since the previous plan update.

4.10.9 Geologic Hazard HIRA Summary
The earth is dynamic, regardless of how solid it may feel. When it moves, either on a large scale as a result of an earthquake, or on the smaller scale of a subsided mine or a landslide. In these events, people and structures can be harmed. While Muskingum County is not likely to incur a major earthquake, should an unexpected one occur, the damage would be potentially catastrophic. More often, the County experiences issues relating to landslides and mine subsidence, as is demonstrated by the requirement for all homes in the County to be covered by mine subsidence insurance. These will continue to be issues for the foreseeable future.

4.11 *Flooding*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Flood	4	1.2	2	0.6	2	0.4	1	0.1	4	0.4	**2.7**
Medium Risk Hazard (2.0 – 2.9)											

4.11.1 Hazard Identification

Muskingum County contains rivers, streams, ditches that could potentially flood, most notably the Muskingum River. Severe flooding would affect most Muskingum 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. Extremely cold temperatures can cause streams and rivers to freeze, causing ice jams and in turn 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 4-29 illustrates these terms. The SFHA serves as the primary regulatory boundary used by FEMA and Muskingum County.

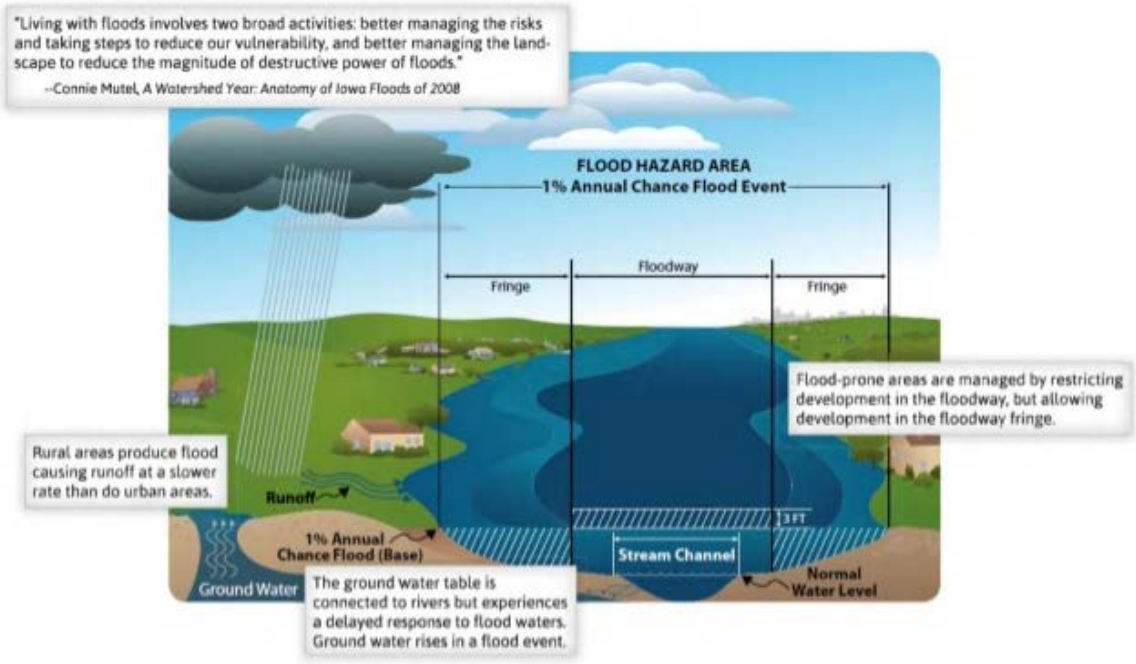


Figure 4-29 Diagram identifying Special Flood Hazard Area, 1% annual chance (100-Year) floodplain, floodway and flood fringe, AIA.

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 river 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 Muskingum County residents and its floodplain managers. Many areas of Muskingum County are at risk to flooding, especially properties near creeks. Flood prone areas within Muskingum County can be organized by watershed, thus examining the impact of water as it travels downhill on its journey towards the Ohio River. Localized flooding associated with creek or stream overflow occurs in Muskingum County when rainfall runoff volumes exceed the design capacity of drainage facilities or a lack of flood control structures in place.

4.11.2 Regulatory Environment

4.11.2.1 National Flood Insurance Program

Compliance and Enforcement: Muskingum County continues to work to enforce the local floodplain management ordinance requirements set forth by the NFIP. The County, and jurisdictions participating in the NFIP, have authorized a 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. These are ongoing duties that are an integral part of their communities remaining a part of the NFIP.

Participation in the NFIP: Muskingum County continues to work to enforce the local floodplain management ordinance requirements set forth by the NFIP. Adamsville, New Concord, and Norwich do not participate in the NFIP. Philo participates but currently has its status suspended.

Table 4-31 Muskingum County Community Status in the NFIP

CID	Community Name	FHBM Identified	FIRM Identified	Current Map Date	Reg-Emer Date
390705	Dresden	02/14/75	05/15/86	07/06/10	05/15/86
390426	Frazeysburg	08/30/74	07/06/10	07/06/10	02/09/05
390425	Muskingum County	03/28/75	06/03/88	07/06/10	06/03/88
390847	New Concord	09/08/78	07/06/10	07/06/10(M)	07/06/10
390860	South Zanesville	10/20/78	07/06/10	07/06/10(M)	07/06/10
390646	Rosesville	02/15/74	01/17/91	08/17/15	07/25/75
390427	Zanesville	05/03/74	09/16/88	07/06/10	09/16/88
390851	Philo	03/30/79	07/06/10	07/06/10	07/07/10(S)

Geography	2010 population	2015 population	Population Change	Total Housing	Occupied Housing	Sq. Miles
Muskingum County	85,951	86,016	0.1%	37,854	34,261	673
Adamsville x	116	117	0.9%	65	43	0.05
Dresden	1,564	1,707	8.4%	751	700	1.14
Frazeysburg	1,620	1,620	0.0%	652	575	0.92
Fultonham x	42	164	74.4%	65	61	0.16
Gratiot x	287	381	24.7%	142	131	0.13
New Concord x	2,459	2,670	7.9%	681	631	1.63
Norwich x	108	96	-12.5%	47	39	0.1
Philo	871	866	-0.6%	304	291	0.42
Roseville	1,853	2,185	15.2%	886	768	0.71
South Zanesville	1,906	2,233	14.6%	850	850	0.83
Zanesville	25,567	25,470	-0.4%	12,555	11,010	12.14

4.11.2.2 Muskingum 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.

The Muskingum County Floodplain Department is responsible for inspecting and issuing permits within the FEMA Special Flood Hazard Areas in the County. The building standards used are:

- 2011 Ohio Building Code
- 2011 Ohio Mechanical Code
- 2011 Ohio Plumbing Code
- 2011 Ohio Fire Code
- 2009 International Energy Conservation Code
- 2009 International Fuel Gas Code

The Floodplain Department has developed a list guidelines that regulate, and will continue to regulate development within the SFHA. This helps to ensure that they remain in compliance with the NFIP.

- Floodplain development activity includes but is not limited to:
    - Residential, non-residential, manufactured. All structural and non-structural development activity in a designated FEMA Flood Zone requires a permit.
- A Floodplain Permit Application must be completed and submitted to the Muskingum County Floodplain Department prior to any development activity.
- The permit fee for floodplain development activity is $100 for structural activity and $50 for non-structural activity. The fee is payable to:
    - Muskingum County Floodplain Department, located at 22 N. 5th Street, Zanesville, Ohio 43701.
- Development activity should not begin until all permits are issued.
- Structural development activity includes any walled or roofed building, manufactured home or gas or storage tank that is principally above ground in a designated FEMA Flood Zone. Structural development activity includes but is not limited to:
    - New homes, accessory buildings, material storage buildings, and gas or storage tanks, alterations and additions to homes, accessory buildings, and material storage buildings.
- Non-structural development activity is all other activity in a designated FEMA Flood Zone which includes but is not limited to:
    Excavation, driveways, agriculture levies, bridge replacement, maintenance, lake/ponds, landscaping, riprap (bank stabilization), land clearing.
- Other permits for floodplain activity that may be required are:
    - Health Department, Township Zoning, County Subdivision, Ohio EPA 401, Corps of Engineers Section 404, Corps of Engineers Section 10.
- Flood Insurance through the National Flood Insurance Program (NFIP) will be required if a mortgage is carried on the property.
- NFIP insurance premiums are based on risk determined by the exposure to potential flood damage.
- Risk for flood damage is reduced if the structure complies with the local floodplain regulations.
- Specific Floodplain Development information can be obtained from the Floodplain Office at 22 N. 5th Street, Zanesville, Ohio 43701.

4.11.2.3 Local Building Codes

Development within the floodplain is strictly governed by the Mid-East Building Department, based out of Zanesville. The Department also regulate construction within Perry, Morgan,

Guernsey, and Coshocton counties. It is a state-certified commercial building department that issues plan approvals and inspects all building activity regulated by the Ohio Building Code.

4.11.2.4 RiskMAP Meetings

In July of 2011, FEMA Region V initiated the Discovery process for the Licking River Watershed, which partly includes Muskingum County. The process involved coordination with watershed stakeholders, data collection and analysis, a meeting with stakeholders in the watershed, and development of recommendations for RiskMAP projects based on an analysis of data and information gathered throughout the process. The end result of this project was a full Discovery report. The Village of Dresden and the City of Zanesville are the only two jurisdictions within the Licking River Watershed in Muskingum County.

4.11.2.5 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, Muskingum County NFIP administrators are dedicated to protecting homes with 184 NFIP policies currently in force. FEMA has prepared a detailed Flood Insurance Study (FIS) for areas of Muskingum 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.

Muskingum County entered the NFIP on May 3, 1974. As a participant in the NFIP, Muskingum County is dedicated to regulating development in the FEMA floodplain areas in accordance with NFIP criteria. Structures permitted or built in Muskingum 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.

Repetitive Losses in Muskingum County

A repetitive loss (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 Muskingum County RL property list for a number of reasons:

There are 21 RL properties insured by the NFIP in Muskingum County. 19 are in unincorporated County land, while 2 are in the City of Zanesville. The total dollar amount of claims paid to date by the NFIP is $839,398.38. There are no Severe Repetitive Loss properties in Muskingum County.

Table 4-32 Repetitive Loss Properties

Community	Comm. #	Type	Bldg. Payment	Cont. Payment	Losses	# of Properties
Muskingum County	390425	Residential	$ 519,073.18	$ 107,648.05	44	18
		Non-Residential	$ 4,358.55	$ 8,303	2	1

Zanesville	390427	Residential	$ 151,582.78	$ 48,432.82	5	2

- 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 Muskingum 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.

Table 4-33 Muskingum County NFIP Policies

Community	Policies In- Force	Insurance In-Force Whole $	Written Premium In-Force
Dresden	4	$ 504,500	$ 2,585
Frazeysburg	5	$ 414,500	$ 3,332
Muskingum County	150	$ 22,772,000	$ 120,266
New Concord	1	$ 47,100	$ 493
Roseville	3	$ 665,000	$ 1,069
Zanesville	21	$ 42,384,400	$ 18,883
TOTAL	**184**	**$ 66,787,500**	**$ 146,628**

4.11.3 Hazard Events

According to the NCDC, since 1996, there have been 63 flood or flash flood events in Muskingum County. Though there have been no fatalities or injuries as a result, these events have caused $10,867,500 in property damage, and $14,000,000 in crop damage.

Table 4-34 Muskingum County Flood Events Since 1996

Location	Date	Type	Deaths	Injuries	Property Damage	Crop Damage
Zanesville	1/19/1996	Flash Flood	0	0	$ -	$ -
Zanesville	5/9/1996	Flash Flood	0	0	$ -	$ -
Zanesville	5/29/1996	Flash Flood	0	0	$ -	$ -
Muskingum (Zone)	6/8/1996	Flood	0	0	$ -	$ -
Zanesville	6/11/1996	Flash Flood	0	0	$ -	$ -
Zanesville	7/13/1996	Flash Flood	0	0	$ -	$ -
Zanesville	6/2/1997	Flash Flood	0	0	$ -	$ -
Countywide	1/7/1998	Flash Flood	0	0	$ -	$ -
Countywide	5/2/1998	Flash Flood	0	0	$ 5,000	$ -
Gaysport	6/15/1998	Flash Flood	0	0	$ -	$ -

Location	Date	Type	Deaths	Injuries	Property Damage	Crop Damage
Duncan Falls	6/15/1998	Flash Flood	0	0	$ -	$ -
Frayszeburg	6/27/1998	Flash Flood	0	0	$ -	$ -
Dresden	6/27/1998	Flash Flood	0	0	$ -	$ -
Countywide	6/27/1998	Flash Flood	0	0	$ 10,000,000	$ 14,000,000
Zanesville	2/14/2000	Flash Flood	0	0	$ -	$ -
Zanesville	8/9/2000	Flash Flood	0	0	$ -	$ -
Nashport	12/16/2000	Flash Flood	0	0	$ -	$ -
Southwest Portion	4/11/2001	Flash Flood	0	0	$ -	$ -
Duncan Falls	8/10/2001	Flash Flood	0	0	$ -	$ -
East Fultonham	8/12/2001	Flash Flood	0	0	$ 5,000	$ -
South Portion	8/12/2001	Flash Flood	0	0	$ 10,000	$ -
Zanesville	6/4/2002	Flash Flood	0	0	$ -	$ -
White Cottage	6/6/2002	Flash Flood	0	0	$ -	$ -
Zanesville	7/19/2002	Flash Flood	0	0	$ 50,000	$ -
Zanesville	6/16/2003	Flash Flood	0	0	$ -	$ -
Adamsville	6/16/2003	Flash Flood	0	0	$ -	$ -
Bloomfield	6/16/2003	Flash Flood	0	0	$ -	$ -
Philo	6/16/2003	Flash Flood	0	0	$ -	$ -
South Zanesville	7/6/2003	Flash Flood	0	0	$ -	$ -
White Cottage	7/31/2003	Flash Flood	0	0	$ -	$ -
Zanesville	8/6/2003	Flash Flood	0	0	$ -	$ -
Muskingum (Zone)	1/4/2004	Flood	0	0	$ 20,000	$ -
Muskingum (Zone)	2/6/2004	Flood	0	0	$ -	$ -
Chandlersville	5/18/2004	Flash Flood	0	0	$ -	$ -
Dresden	5/21/2004	Flash Flood	0	0	$ -	$ -
Zanesville	6/11/2004	Flash Flood	0	0	$ -	$ -
Muskingum (Zone)	9/8/2004	Flood	0	0	$ 25,000	$ -
Muskingum (Zone)	9/17/2004	Flood	0	0	$ 350,000	$ -
Muskingum (Zone)	1/5/2005	Flood	0	0	$ -	$ -
Muskingum (Zone)	1/11/2005	Flood	0	0	$ 75,000	$ -
Zanesville	6/22/2006	Flash Flood	0	0	$ -	$ -
New Concord	7/12/2006	Flash Flood	0	0	$ -	$ -
Zanesville	3/15/2007	Flood	0	0	$ -	$ -
Roseville	3/4/2008	Flood	0	0	$ 5,000	$ -
Duncan Falls	3/4/2008	Flood	0	0	$ 5,000	$ -
Adams Mills	3/19/2008	Flood	0	0	$ 5,000	$ -
Cannelville	3/19/2008	Flood	0	0	$ 10,000	$ -
Otsego	3/19/2008	Flood	0	0	$ 10,000	$ -
Spangler	6/26/2008	Flood	0	0	$ 30,000	$ -
Roseville	4/19/2011	Flood	0	0	$ 15,000	$ -
Zanesville	4/19/2011	Flood	0	0	$ 15,000	$ -
Trinway	6/5/2011	Flash Flood	0	0	$ 30,000	$ -
Adams Mills	6/5/2011	Flash Flood	0	0	$ 50,000	$ -
Zanesville Parr Arpt	6/5/2011	Flash Flood	0	0	$ 25,000	$ -
Ironspot	6/5/2011	Flash Flood	0	0	$ 50,000	$ -
North Zanesville	6/5/2011	Flood	0	0	$ 25,000	$ -
Adams Mills	1/27/2012	Flood	0	0	$ 10,000	$ -
Moxahala Park	1/27/2012	Flood	0	0	$ 25,000	$ -
Shannon	1/27/2012	Flood	0	0	$ 10,000	$ -
South Zanesville	8/23/2013	Flood	0	0	$ -	$ -
North Zanesville	6/20/2015	Flash Flood	0	0	$ 2,000	$ -
Adams Mills	6/20/2015	Flash Flood	0	0	$ 5,000	$ -
White Cottage	6/23/2016	Flash Flood	0	0	$ 500	$ -
Totals:			**0**	**0**	**$ 10,867,500**	**$ 14,000,000**

4.11.4 Historical Occurrences

Muskingum County has been a part of 6 Federal Disaster Declarations that included flooding.

Table 4-35 Flooding Disaster Declarations

Disaster Number	Title	Declaration Date	Public Assistance
DR-1580	Severe Winter Storms, Flooding, and Mudslides	2/15/2005	$ 2,068,222.75
DR-1556	Severe Storms And Flooding	9/19/2004	$ 585,925.64
DR-1227	Severe Storms, Flooding, And Tornadoes	6/30/1998	-
DR-870	Severe Storms, Tornadoes & Flooding	6/6/1990	$ 52,846.00
DR-630	Severe Storms & Flooding	8/23/1980	-
DR-266	Tornadoes, Severe Storms & Flooding	7/15/1969	-

The following historical narratives are descriptions of flooding as compiled by the NCDC and other resources.

Flash Flood, June 26, 1998:
Another in a series of thunderstorms passing over the county on the evening of the 27th produced widespread flash flooding. Several towns in the county, including Fraszeysburg, Dresden, Chandlersville and Gaysport reported extensive damage. Some portions of towns, especially Fraszeysburg and Chandlersville, were under water. Many roads across the county were closed due to the high water, with some remaining closed well into July. Numerous evacuations were required across the county. A preliminary estimate of crop damage alone from the flooding was $14 million dollars (NCDC, 2017).

Flooding, January 11 – 14, 2005:
SR 22 flooded south of Zanesville. SR 60, between Zanesville and Dresden, was still flooded early on the 14th. Water behind Wills Creek Dam rose to record levels on the 14th (NCDC, 2017).

Flooding, March 1, 2017:
Several areas in Muskingum County were affected by high water, and municipalities were taking precautions throughout the day. Roseville put up floodgates in the afternoon. Some flooding in Canneville occurred, though no resources were needed in that area. A mother and son were rescued in Roseville after their vehicle was swept off the road and into a ditch, trapping them inside (ZTR, 2017).

4.11.5 Magnitude/Severity

Magnitude and severity of flooding generally results from prolonged heavy rainfall and are characterized by high intensity, short duration events. 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.

Surface flooding, including some street flooding, can occur during severe storms. Reports of minor flooding to garages and outbuildings, landscape erosion, and flooded streets have

occurred in and around the 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.

4.11.5.1 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. Muskingum County coordinates with the National Weather Service.

4.11.5.2 Muskingum River Characteristics

The Muskingum River is the largest waterbody in Muskingum County. The River comes into the County in the north, and merges with the Licking River, a tributary, in Zanesville. In total, the Muskingum River Watershed drains 8,051 square miles before merging with the Ohio River on the West Virginia border.

There is a USGS river gage on the Muskingum River, at Zanesville. This gage provides discharge information, historic crests, recent crests, flood categories, as well as river height, in feet. This gage's data goes back to 1895. From January 2015, through December 2015, the highest recorded height is just over 19.51 feet, recorded on June 27, 2015. The discharge values have reached to just under 6,000 cfs on five occasions over that 11 month period.

Considering the available records of all known floods in at this gage, it is probable that the ten (10) largest floods along the Muskingum River occurred in 1891, 1893, 1905, 1907, 1908, 1913, 1920, 1935, and 1937. Historical Crests for the five largest floods of record for the Muskingum River at Zanesville are shown below.

Table 4-36 Highest Historical Crests on the Muskingum River

Crest Feet	Date of Crest
51.8	03/27/1913
37.6	01/25/1937
36.8	03/24/1898
33.6	08/09/1935
32.0	03/14/1907
30.1	05/21/1893
28.8	03/06/1908
27.3	02/17/1891
27.2	01/25/1905
26.8	04/22/1920

Information on historical floods along the Muskingum was obtained from stream gauging stations maintained by NOAA.

Table 4-37 Flood Stage Categories for the Muskingum River at Zanesville

Flood Categories	Feet
Action Stage:	16.7
Flood Stage:	25
Moderate Flood Stage:	27
Major Flood Stage:	29

4.11.6 Frequency/Probability of Future Occurrences

Reported flood 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 experiencing a flood event can be difficult to quantify, but based on historical record of 70 flood events since 1996, it can reasonably be assumed that this type of event has occurred once every 0.26 years from 1996 through 2017.

> *[(Current Year) 2017] subtracted by [(Historical Year) 1996] = 21 Years on Record*
>
> *[(Years on Record) 21] divided by [(Number of Historical Events) 63] = 0.33 years between events*

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

The HMPC agreed that flood events are “Highly Likely,” meaning that there is a 100% annual chance of occurrence.

4.11.7 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 FEMA and the NIBS. For this Plan, a 100-year flood scenario was modeled and the results are presented below.

4.11.7.1 Hazus-MH 100-Year Flood Scenario

Hazus estimates that about 1,019 buildings will be at least moderately damaged. This is over 76% of the total number of buildings in the scenario. There are an estimated 69 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.

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building 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 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 341.61 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 40.63% of the total loss.

The scenario reports that 4 critical facilities in the study region will experience moderate damage by a 100-year flood event, and one will suffer a loss of use. Critical facilities are essential to the health and welfare of the whole population and are especially important

following hazard events. 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.

4.11.7.2 Hazus-MH 100-Year Flood Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 14,797 tons of debris will be generated. Of the total amount, Finishes comprises 61% of the total, Structure comprises 20% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 592 truckloads (@25 tons/truck) to remove the debris generated by the flood.

4.11.7.3 Hazus-MH 100-Year Flood 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 2,313 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 4,225 people (out of a total population of 86,074) will seek temporary shelter in public shelters.

4.11.8 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, Muskingum County modeled a 100-year flood using FEMA’s loss estimation tool: HAZUS-MH.

Hazus estimates that there are 36,547 buildings in the region which have an aggregate total replacement value of 9.2 billion dollars (2014 dollars). The total economic loss estimated for the flood is 343.61 million dollars, which represents 11.77% of the total replacement value of the scenario buildings.

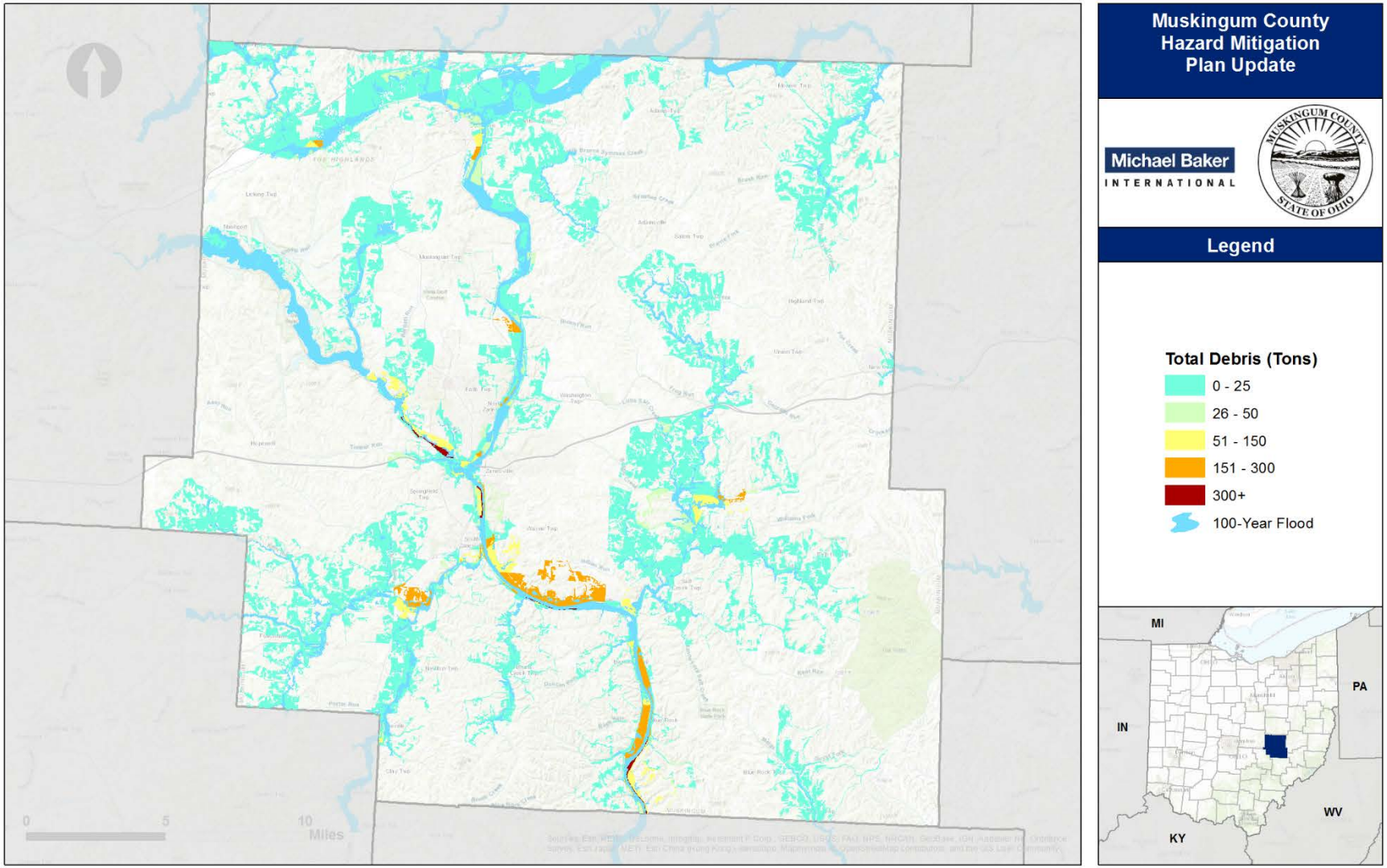


Figure 4-30 100-Year SFHA Debris Generation

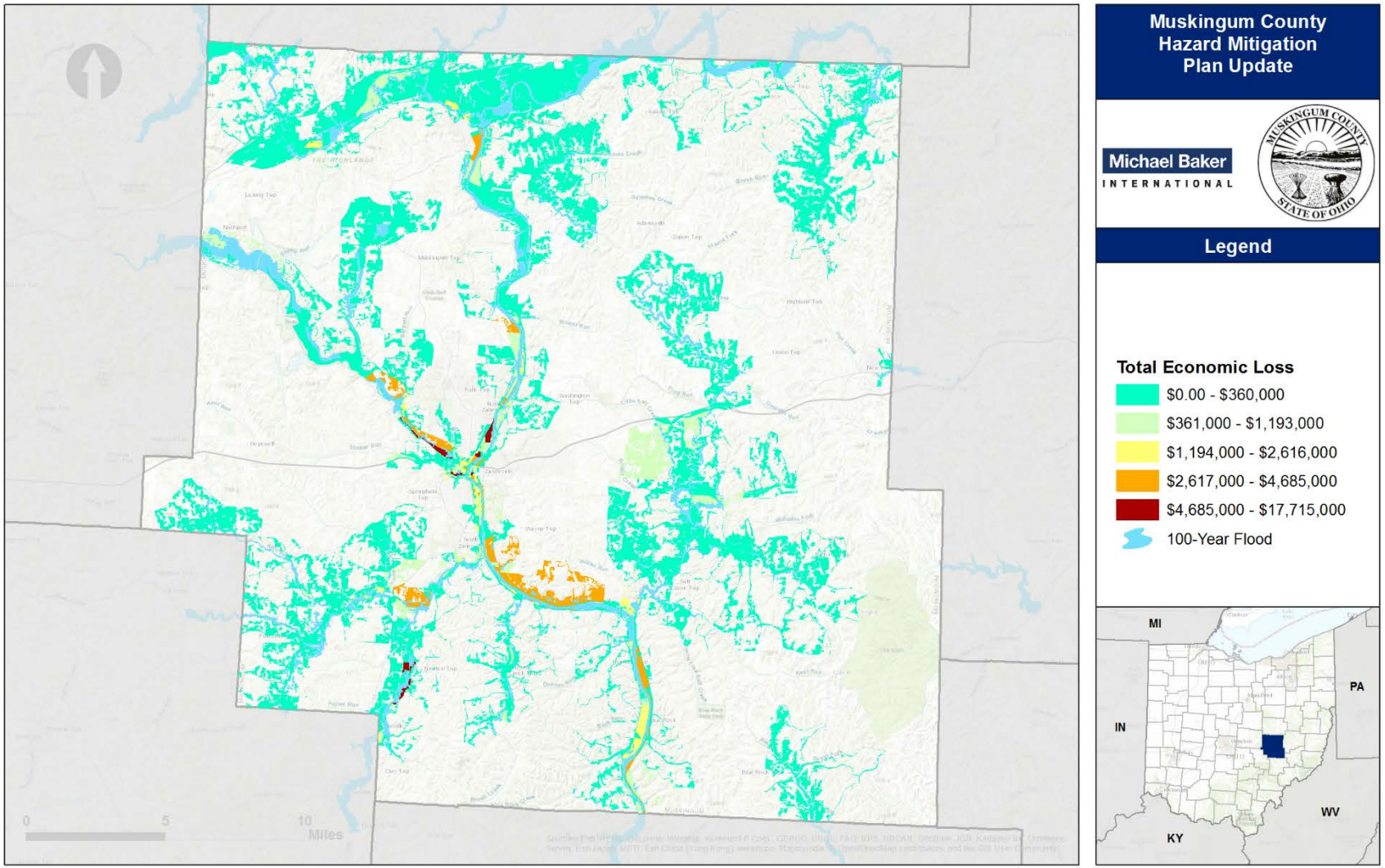


Figure 4-31 100-Year SFHA Total Economic Losses

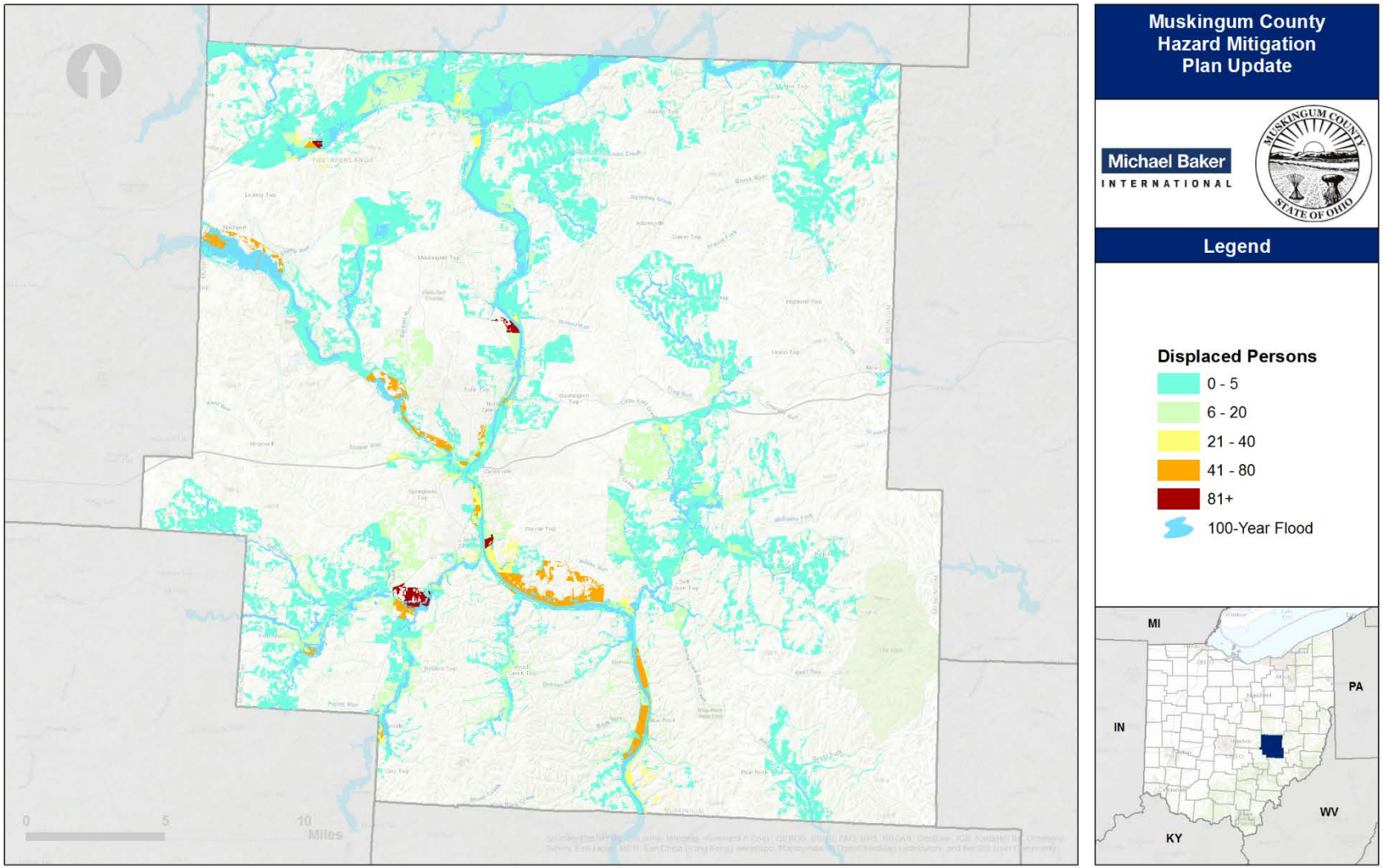


Figure 4-32 100-Year SFHA Shelter Needs

Table 4-38 Expected damage to critical facilities

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	15	2	0	3
Hospitals	1	0	0	0
Police Stations	6	1	1	2
Schools	45	1	0	3

Table 4-39 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	3	10.34	25	86.21	1	3.45	0	0.00	0	0.00	0	0.00
Education	2	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	8	88.89	1	11.11	0	0.00	0	0.00	0	0.00
Religion	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	247	20.10	569	46.30	227	18.47	90	7.32	27	2.20	69	5.61
Total	**252**		**604**		**229**		**90**		**27**		**69**	

Table 4-40 Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	6,669,921	72.1%
Commercial	1,490,776	16.1%
Industrial	556,302	6.0%
Agricultural	47,228	0.5%
Religion	206,754	2.2%
Government	108,992	1.2%
Education	175,742	1.9%
Total	**9,255,715**	**100.0%**

All jurisdictions in the County are susceptible to flooding. Zanesville, as the largest of the communities, and is at the confluence of two rivers, stands to take the most damage from a flood. The estimated loss would be approximately $17,715,000. The Village of South Zanesville estimates that a total of $188,000 worth of land would be lost, and $613,300 in structural damage would be caused as a result of a flood.

4.11.9 Land Use & Development Trends

Muskingum County is largely developed, with the majority of the land being covered by single family housing units. Besides the localized flooding, there is also the great amount of property, both private and public that is at risk from flooding. It is essential that 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.

The tables below show how cost of property developed in the 100-year floodplain since 2005, as well as the number of structures built. The majority of buildings are single-family homes, of which there are 90. This information was based on data provided by the County auditor.

Table 4-41 Development in Floodplain since 2005

	2006	2007	2008	2009	2010	2011
Commercial	-	-	-	-	$ 1,405,500	-
Exempt	-	-	-	-	-	-
Multi-Family Residential	$ 749,100	$ 239,400	-	$ 177,800	-	-
Other Residential	$ 158,400	$ 20,700	$ 29,400	$ 159,700	$ 111,800	$ 33,500
Single-Family Residential	$ 1,995,000	$ 1,293,800	$ 1,029,920	$ 803,200	$ 974,500	$ 33,700
Grand Total	**$ 2,902,500**	**$ 1,553,900**	**$ 1,059,320**	**$ 1,140,700**	**$ 2,491,800**	**$ 67,200**

	2012	2013	2014	2015	Grand Total
Commercial	-	-	-	-	$ 1,405,500
Exempt	-	$ 2,399,300	-	-	$ 2,399,300
Multi-Family Residential	$ 95,000	-	$ 239,100	-	$ 1,500,400
Other Residential	-	$ 176,700	-	$ 62,200	$ 752,400
Single-Family Residential	$ 977,300	$ 3,809,700	$ 777,900	$ 1,028,900	$ 12,723,920
Grand Total	**$ 1,072,300**	**$ 6,385,700**	**$ 1,017,000**	**$ 1,091,100**	**$ 18,781,520**

Table 4-42 Number of structures built in floodplain since 2005

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Grand Total
Commercial	-	-	-	-	1	-	-	-	-	-	1
Exempt	-	-	-	-	-	-	-	1	-	-	1
Multi-Family Residential	8	3	-	2	-	-	1	-	3	-	17
Other Residential	2	1	1	2	1	1	-	2	-	1	11
Single-Family Residential	12	5	5	6	5	1	5	37	6	8	90
Grand Total	**22**	**9**	**6**	**10**	**7**	**2**	**6**	**40**	**9**	**9**	**120**

4.11.10 Flooding HIRA Summary

Severe flooding has the potential to inflict significant damage along the rivers and streams throughout the County. Assessing flood damage requires residents throughout the County 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 for the 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, the County does have policies and regulations for development that should help lessen potential damage due to floods.

4.12 *Drought*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Drought	2	0.6	1	0.3	4	0.8	1	0.1	4	0.4	**2.2**
Medium Risk Hazard (2.0 – 2.9)											

4.12.1 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.

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 the 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 Muskingum 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 Drought.gov.

According to the NCDC, the only recorded drought for Muskingum County, Ohio was in the summer of 1999, from August through September. However, 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.

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. 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 85 counties to warrant a Secretarial disaster designation.

The following image shows the USDA Secretarial Disaster Designations for Crop Year (CY) 2012.

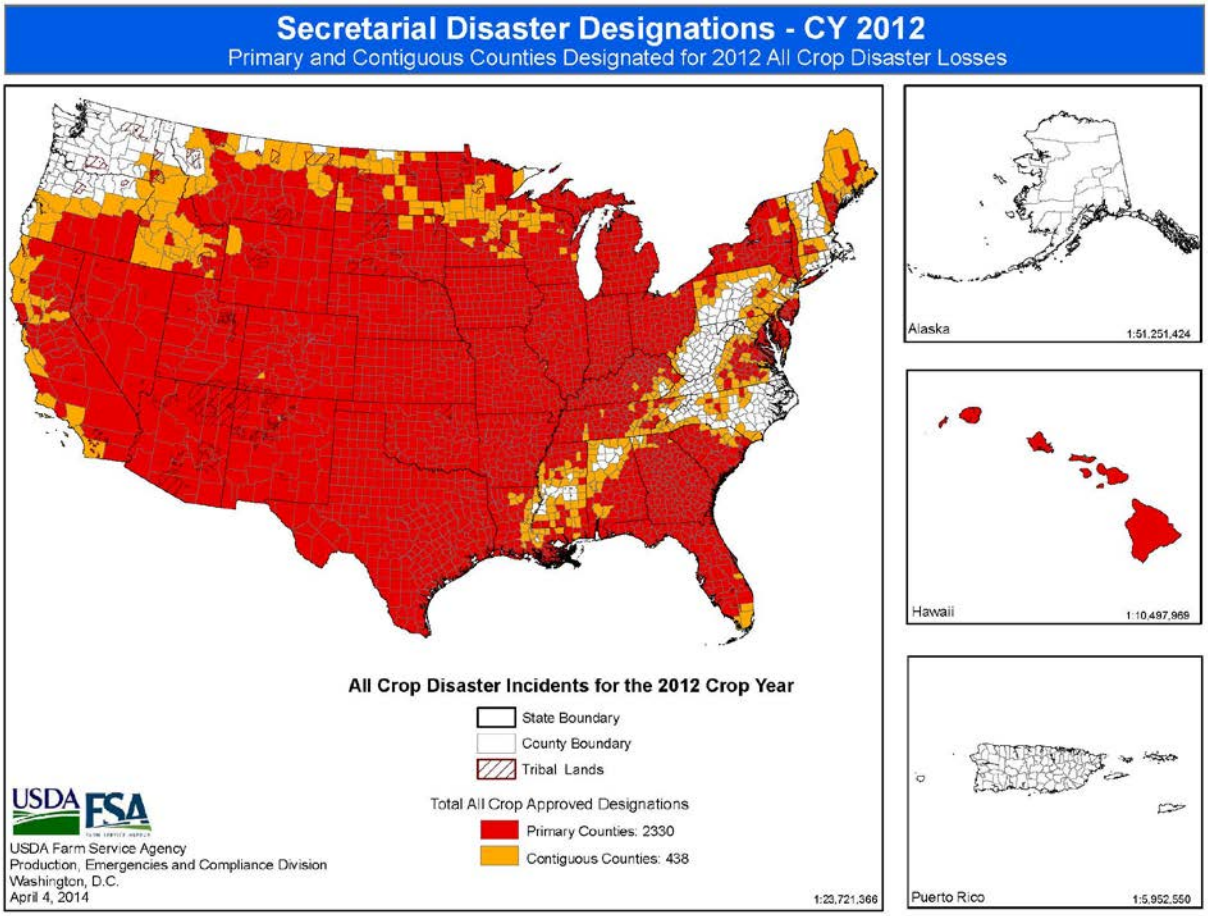


Figure 4-33 Crop Year 2012 USDA Disaster Declarations

4.12.1.1 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; droughts may often, but not always, exacerbate fire risk. However, 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.

4.12.2 Regulatory Environment

There are negligible formal regulations that pertain to drought events.

4.12.3 Hazard Events

Muskingum County has had only two occurrences of drought stage conditions (as recognized by NOAA) since 1996, both of which were consecutive months between August and September of 1999. No injuries, death, or property damage has been recorded as a result of drought.

Table 4-43 Drought Events Since 1996

Location	Date	Type	Death	Injury	Property Damage	Crop Damage
Muskingum County	8/1/1999	Drought	0	0	$ 0	$ 0
Muskingum County	9/1/1999	Drought	0	0	$ 0	$ 0
Totals:			**0**	**0**	**$ 0**	**$ 0**

4.12.4 Historical Occurrences

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.

4.12.5 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 4-44 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).

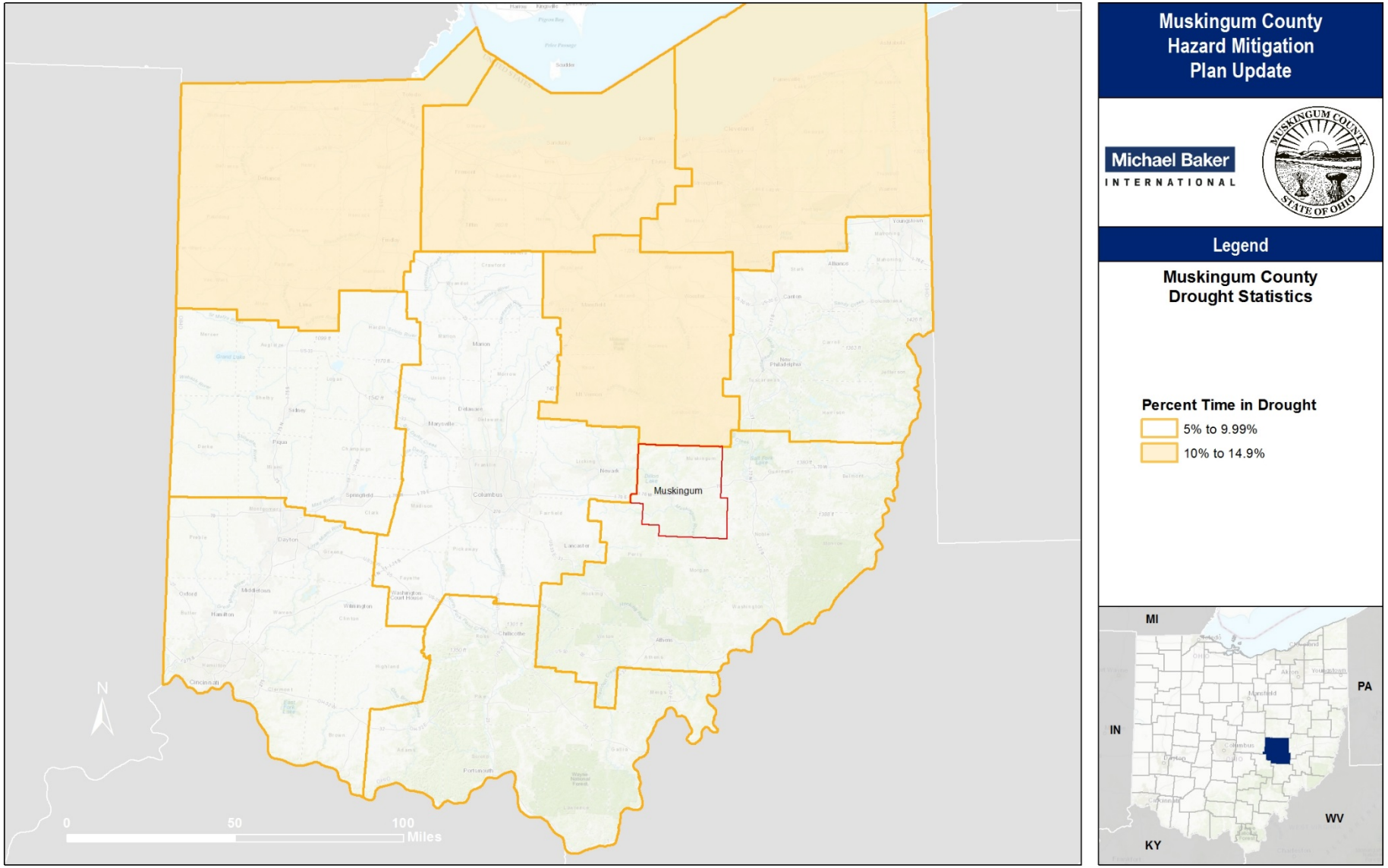


Figure 4-34 Percent time spent in drought (1895-1995)

4.12.6 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. 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 the County 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 4 years from 1999 through 2017.

> *[(Current Year) 2017] subtracted by [(Historical Year) 1996] = 21 Years on Record*
>
> *[(Years on Record) 21] divided by [(Number of Historical Events) 3] = 7 years between events*

Furthermore, the historic frequency calculates that there is a 14.3% chance of this type of event occurring each year.

The HMPC decided, based on their knowledge, that droughts are "Possible," meaning that there is between a 1% and 10% chance of these occurring each year. This is slightly below the calculate historic frequency.

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.

4.12.7 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.

Droughts slowly evolve 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. While the County's infrastructure may not be susceptible to the effects of a drought, the agricultural program's various project areas may be impacted.

4.12.8 Potential Losses from Drought

Due to the nature of drought, all property in the County is expected to be impacted equally due to drought conditions. Agricultural land will take the brunt of the losses incurred by Drought. Potential losses were measured using the County's assessed value of agricultural land, and summing up its total assessed value. A 1% and 5% total loss were shown to represent two different drought severities.

Table 4-45 Property vulnerable to Drought

Vulnerability to Drought			
Non-Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Agriculture	$ 183,050,500	$ 1,830,505	$ 9,152,525
Total	**$ 183,050,500**	**$ 1,830,505**	**$ 9,152,525**
Critical Facilities			
Category	**Total Cost**	**1% Damage**	**5% Damage**
Water	$ 18,742,500	$ 187,425	$ 937,125
Total	**$ 18,742,500**	**$ 187,425**	**$ 937,125**

4.12.9 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.

4.12.10 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 the 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 the County gains more experience assessing and responding to drought, future actions will undoubtedly become more timely, effective, and less reactive.

4.13 *Wildfire*

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Wildfire	4	1.2	1	0.3	2	0.4	4	0.4	1	0.1	**2.4**
Medium Risk Hazard (2.0 – 2.9)											

4.13.1 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:** 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**: 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".

4.13.2 Regulatory Environment

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

4.13.2.1 State

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.

4.13.2.2 County

Fire protection for fire emergencies within the Muskingum 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 Muskingum County.

4.13.3 Hazard Events / Historical Occurrences

There have been no recorded incidents of wildfire in Muskingum County.

4.13.4 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. Based on their knowledge, the HMPC determined that there is a “Highly Likely” chance of wildfires occurring in Muskingum County, or 100%.

4.13.5 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 classification. The below burn severity classifications have been adapted from USDA NRCS.

- ***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
    - 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

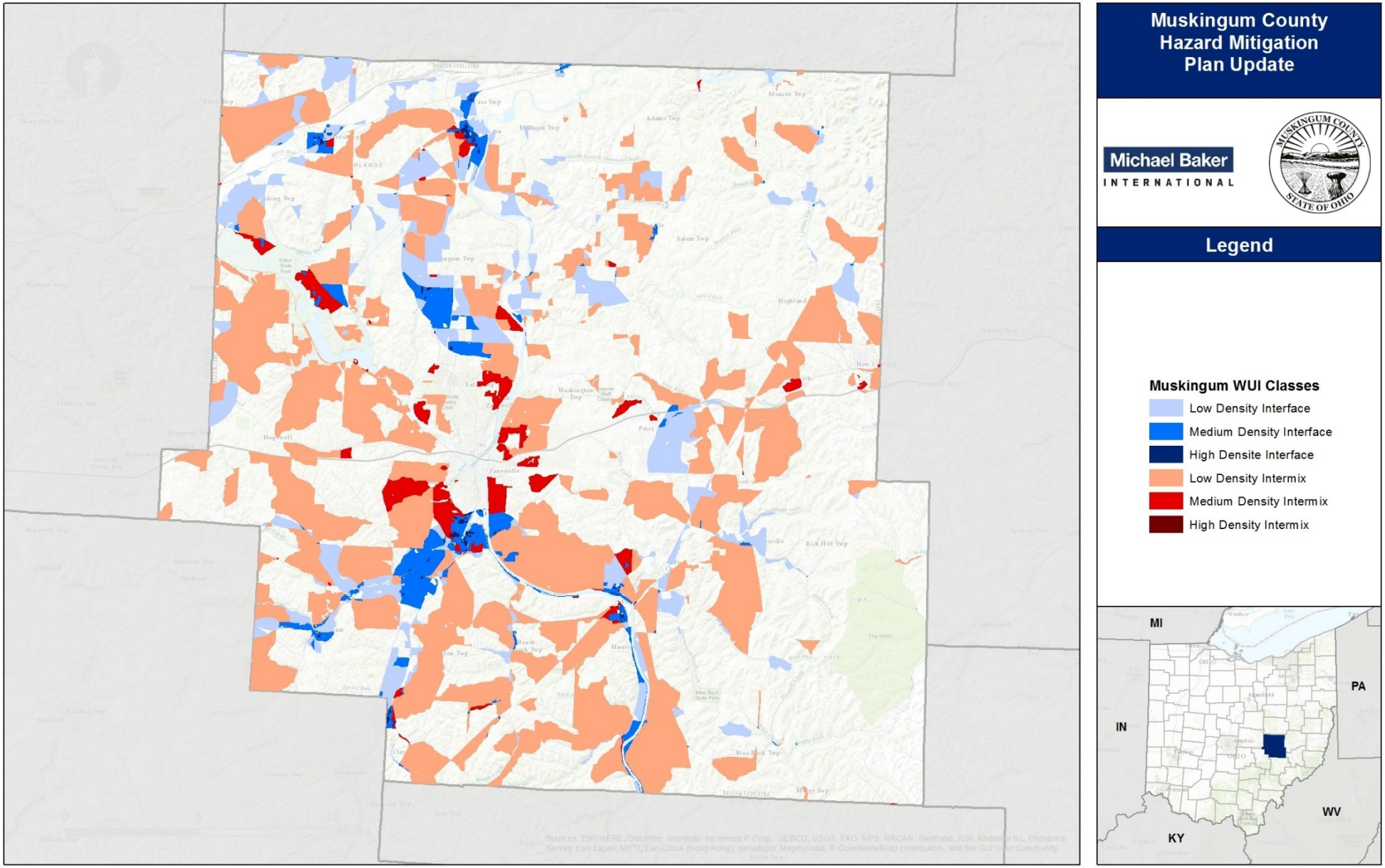


Figure 4-35 Wildland Urban Interface and Intermix in Muskingum County

4.13.6 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.

4.13.7 Land Use & Development Trends

The wildland-urban interface (WUI) 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. The WUI can be seen in

Figure 4-35 above.

4.13.8 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.

4.14 *Dam/Levee Failure*

Technological Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Dam/Levee Failure	2	0.6	4	1.2	4	0.8	4	0.4	4	0.4	**3.4**
High Risk Hazard (3.0 – 3.9)											

4.14.1 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.

A levee is an elongated ridge constructed of fill or wall which regulates water levels. These are usually earthen hills built along a river's floodplain to prevent flooding in nearby population areas. Typically, these run parallel to a river.

Figure 4-37 Example Class-I Dam

Figure 4-36 Example of a Levee

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

- Prolong 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 component;

- 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.

4.14.2 Regulatory Environment

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 ODNR 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.

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. According to the ODNR Division of Water Resources. In Muskingum County, there are 5 Class I dams, and 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.

Dams and levees have inundation maps that are very strictly controlled by the Army Corps of Engineers, who do not release this information publically.

4.14.3 Hazard Events/Historical Occurrences
There have been no historical failures of dams or levees in Muskingum County.

4.14.4 Magnitude/Severity
The severity of a dam failure depends mostly on what class the dam is, where it is located, and what caused it to fail. The inundation zone as defined by each Emergency Action Plan (EAP) shows what areas will be the most heavily impacted during a dam failure event. During these events, hazardous materials such as agricultural chemicals and wastes, solid wastes, raw sewage, common household chemicals, and loose mud and concrete can worsen rescue and cleanup operation. Much of the damage done during a dam failure will be downstream and within the immediate 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

4.14.5 Frequency/Probability of Occurrences
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.

The HMPC decided that Dam/Levee Failures were "Possible," meaning that they have between a 1% and 10% annual chance of occurring.

4.14.6 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.

Below in Figure 4-38 and Figure 4-40, are the locations of dams and levees found throughout Muskingum County. These are covered in greater detail in Table 4-46 and Table 4-47. There is no comprehensive database of levees in the State of Ohio. The State of Ohio Hazard Mitigation Plan, however, lists one levee in Muskingum County that protects the Village of Roseville.

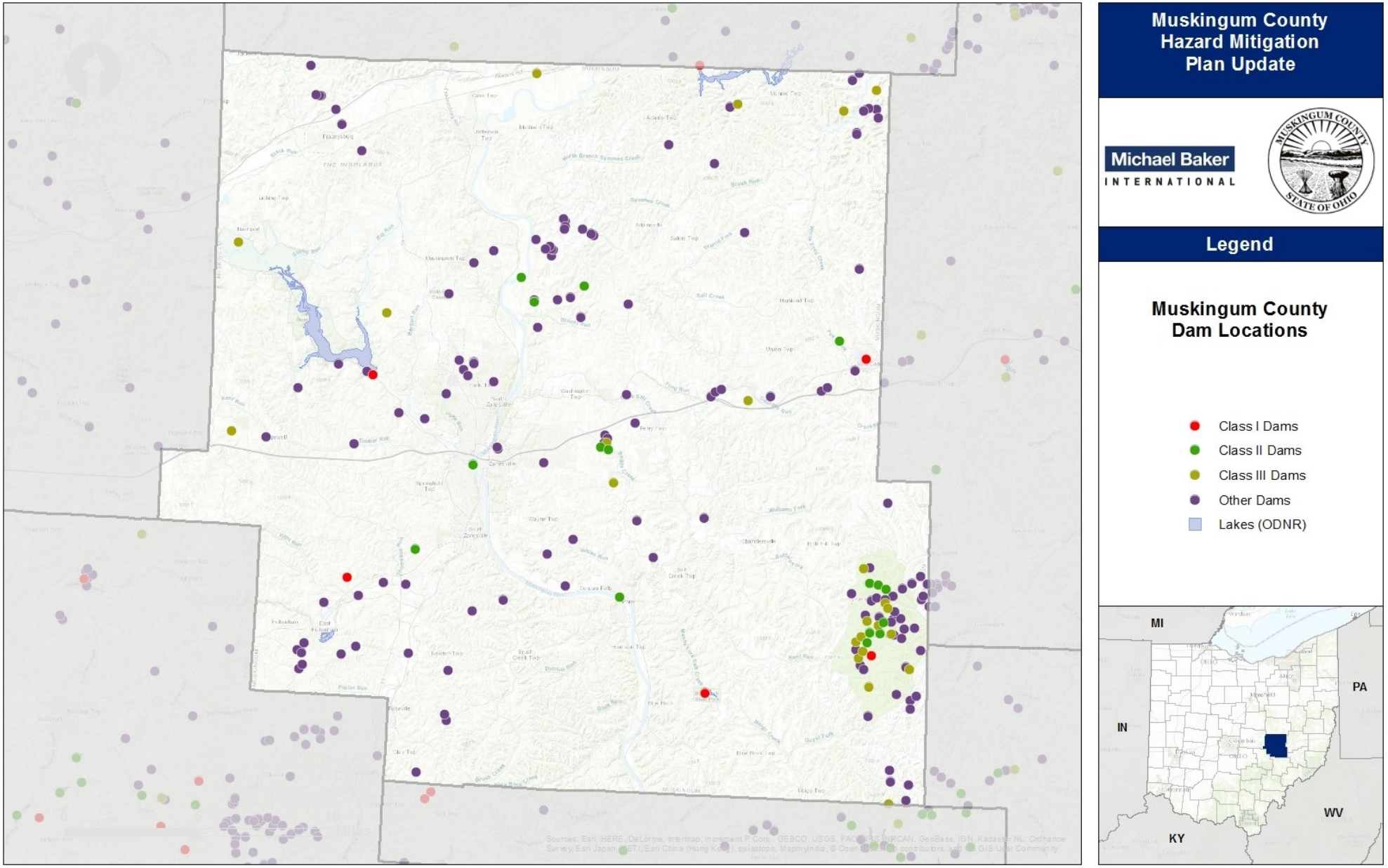


Figure 4-38 Muskingum County Dams

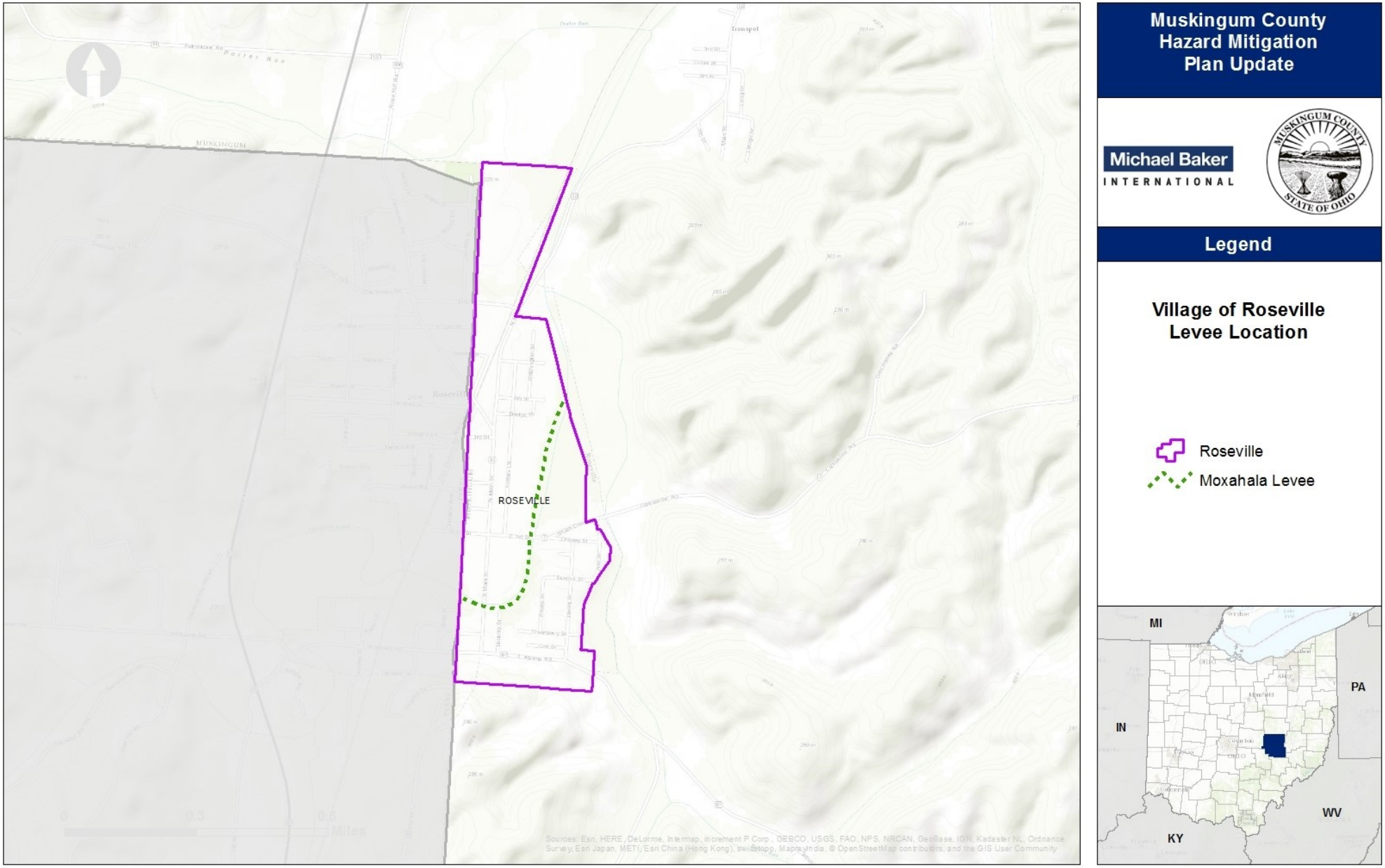


Figure 4-39 Location of Moxahala Levee

Table 4-46 Table 4 45 Class 1 Dams in Muskingum County

Name	Owner	Owner Type	Type	Structure	Length	Height	Pool Area (Acres)	Top of Dam Storage (Acre Ft.)
Muskingum College Lake Dam	Muskingum College	Private	Dam and Spillway	Earthfill	300	27.7	3	36
International Animal Preserve Pond Dam #10	ICPWA	Commercial	Dam and Spillway	Earthfill	910	75.6	33.5	1,490
Blue Rock Lake Dam	ODNR	Public, State	Dam and Spillway	Earthfill	385	31	14.2	361
Deer Lake Dam	Private	Private	Dam and Spillway	Earthfill	450	30	9	138
Dillon Lake Dam	Corps of Engineers	Public	Dam and Spillway	Earthfill	1,400	113	1,560	Null

Table 4-47 Class 2 Dams in Muskingum County

Name	Owner	Owner Type	Type	Structure	Length	Height	Area	Top of Dam Storage (Acre Ft.)
Muskingum River Lock And Dam No. 11	ODNR	Public	Dam and Spillway	Timber Crib / Concrete	340	15.3	352	1461
Lake Legendary Dam	Private	Private	Dam and Spillway	Earthfill	430	44.6	6.5	137.1
Zanesville State Nursery Lake Dam	ODNR	Public	Dam and Spillway	Earthfill	300	31.5	12.6	375
Muskingum River Lock And Dam No. 10	ODNR	Public	Dam and Spillway	Steel Sheet	514	11.6	470	3,410
New Concord Village Reservoir Dam	Village of New Concord	Public	Dam and Spillway	Earthfill	452	41.4	13.8	216
Luburgh Lake Dam No. 11	Private	Private	Dam and Spillway	Earthfill	620	48.1	7.4	153
Lakeview Dam	Private	Private	Dam and Spillway	Earthfill	550	15	8	60
Muskingum River Lock And Dam No. 9	ODNR	Public	Dam and Spillway	Timber Crib / Concrete	730	18.1	533	3,120
International Animal Preserve Pond Dam	ICPWA	Commercial	Dam and Spillway	Earthfill	575	51.1	Null	93.7
International Animal Preserve Pond Dam #65	ICPWA	Commercial	Dam and Spillway	Earthfill	450	42.6	3.5	67
International Animal Preserve Pond Dam #35	ICPWA	Commercial	Dam and Spillway	Earthfill	400	38.1	3.4	63.5
International Animal Preserve Pond Dam #2	ICPWA	Commercial	Dam and Spillway	Earthfill	800	50.4	13.7	295
International Animal Preserve Pond Dam #36	ICPWA	Commercial	Dam and Spillway	Earthfill	600	42.2	5.6	95.9
International Animal Preserve Pond Dam #8	ICPWA	Commercial	Dam and Spillway	Earthfill	450	40.8	20.9	445
International Animal Preserve Pond Dam #9	ICPWA	Commercial	Dam and Spillway	Earthfill	400	40.3	13.4	375

4.14.7 Potential Losses

For reasons previously mentioned in this section, it is 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. To better estimate the possible effects of a Dam/Levee failure, two scenarios were modeled, one for a dam, and one for a levee. These are described in the following subsections.

4.14.7.1 Dam Failure

Dillon Lake Dam, located northwest of the City of Zanesville, is the largest of the dams in the County, with a pool area of 1,560 acres. This gives it the largest potential for widespread destruction downstream. To ascertain what a potential dam breach scenario would look like for the County, the 100-year floodplain south of dam was used. The cost estimates can be found in Table 4-48 below for if 1% or 5% of the structures were damaged as a result.

4.14.7.2 Levee Failure

The Moxahala Levee runs through the center of Roseville, though the majority of buildings are on the west side of the levee and stream. Should the levee catastrophically fail, the entirety of Roseville would be affected.

Table 4-48 Potential Losses from Dam Failure

Dam/Levee	Community Affected	Total Monetary Value at Risk	1% Loss	5% Loss
Dillon Lake Dam	Muskingum County	$ 385,561,600	$ 3,855,616	$ 19,278,080
Moxahala Levee	Roseville	$ 13,781,200	$ 137,812	$ 689,060

4.14.8 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.

4.14.9 Dam/Levee Failure HIRA Summary

As dams and levees 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.

4.15 *Hazardous Materials Incident*

Technological Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Hazardous Materials	4	1.2	3	0.9	3	0.6	4	0.4	3	0.3	**3.4**
High Risk Hazard (3.0 – 3.9)											

4.15.1 Hazard Identification

4.15.1.1 Traditional Hazardous Materials

A hazardous material release is the contamination of the environment (i.e. air, water, soil) by any material that because of its quantity, concentration, physical characteristics, or chemical characteristics threatens human, animal, or plant health, the environment, or property. Hazardous material spills are usually accidental events that arise from human activities such as the manufacture, transportation, storage, and use of hazardous materials. The consequences of such spills are usually unintended. An accidental or intentional release of hazardous materials could produce a health hazard to those in the area, downwind, and/or downstream with immediate, prolonged, and/or delayed effects. The spread of the material may additionally be defined by weather conditions and topography of the area. A hazardous material release can come from a fixed facility, transportation, or an intentional release such terrorism.

A hazardous material release may also occur due to a transportation accident. The most likely locations for a transportation-related hazardous material release are along the roads and highways running throughout the County. Gas, propane, and other hazardous materials are delivered throughout the area year round. The need for gas, propane, fertilizers, and other toxic materials in daily life creates a larger risk for a hazardous materials release.

A hazardous materials release in the County may not only contaminate dirt or surface material but potentially contaminate flowing water in ditches, rivers, or small streams. Other potential concerns for spills/leaks are icy road conditions during winter months, sabotage, and terrorism.

The Muskingum County EMA Hazmat Team is responsible for hazardous materials clean-up. When a release occurs, the Hazmat team is dispatched depending on the location of the spill.

Fixed facilities housing hazardous substances at the County include swimming pools, gas stations, and supply stores containing substances such as fuel, farm chemicals, propane, fuel oil, paint, and small amounts of chlorine.

4.15.1.2 Hospital Radioactive Isotopes

Hospitals are increasingly using radioactive isotopes for diagnostic and therapeutic applications. The bulk of the hospital radioactive waste is commonly generated in the department of Nuclear Medicine. Generally, most of the radioactive waste is liquid. Some lesser amounts of the waste are solid and gaseous. The solid waste containing traces of radioactivity can be in the form of syringes, needles, cotton swabs, vials, contaminated gloves and absorbent materials.

4.15.1.3 Pipeline Failure

There are numerous pipelines transporting natural gas throughout the County. These pipelines carry liquefied natural gas. Should one of these break, it would disrupt customers from receiving gas to their homes or businesses, and would result in a large spill that a hazardous materials team would be required to clean up.

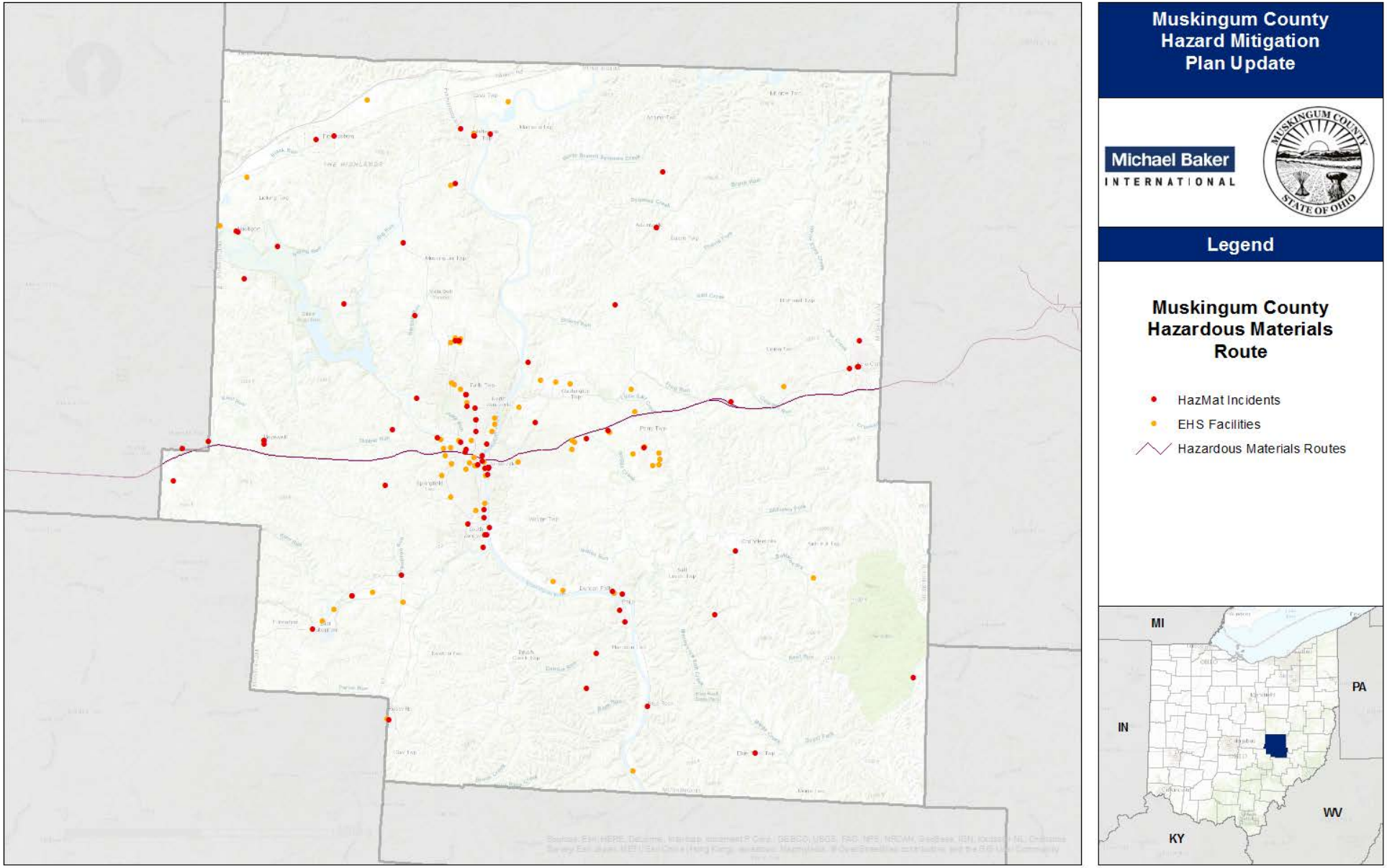


Figure 4-40 Hazardous Materials Spills in Muskingum County

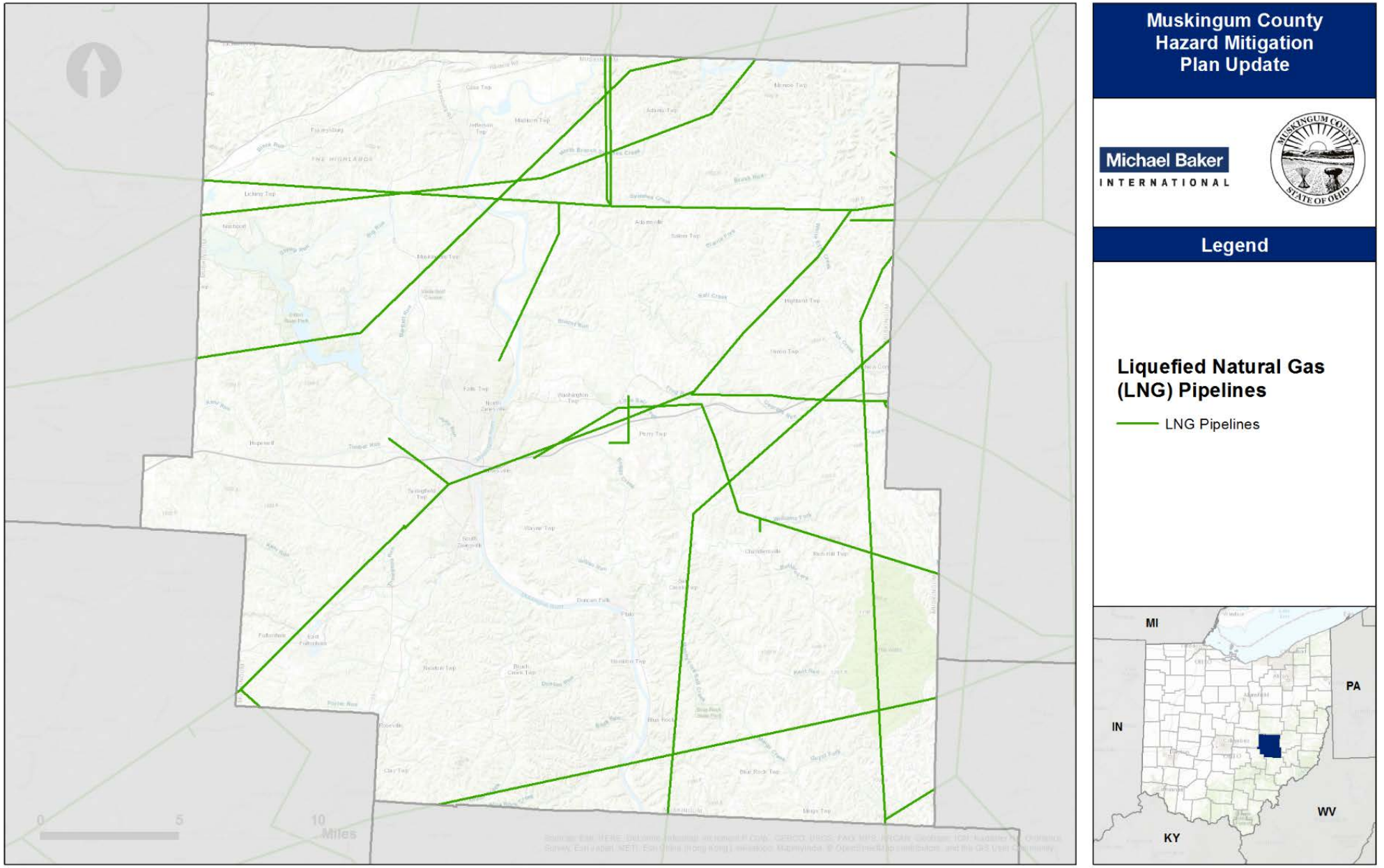


Figure 4-41 Natural Gas Pipelines in Muskingum County

4.15.2 Regulatory Environment

The US EPA's Toxic Release Inventory (TRI) program, tracks hazardous materials release and disposal data for US counties and states. Disposals in Muskingum County nitric acid, certain glycol ethers, methyl methacrylate, hydrogen fluoride, and trimethethylbenzene. Much of this is due to the production of steel within the County. The TRI data does not provide data regarding the effect on the public of releases or disposals of hazardous materials.

Natural gas pipeline safety rules are developed by the US Department of Transportation, Pipeline and Hazardous Materials Safety Administration. The Public Utilities Commission of Ohio has additional regulations regarding natural gas pipelines.

4.15.3 Hazard Events/Historical Occurrences

Between 2011 and 2017, there were 139 hazard materials spill incidents in Muskingum County. Many of these were related to semi-truck accidents along Interstate 70. HazMat spills occur frequenty, and cleanup teams are called even during car crashes where gasoline spills.

Table 4-49 HazMat Incidents in Muskingum County

Type of Spill	Spiller	Location of Spill	City	Year
Crude Oil	Tank Battery	Maysville Pike west of Limestone Valley Road	White Cottage	2011
Mercury	Thermometer	Newark Road and Adams Lane Zanesville	Zanesville	2011
McGyver Bomb in Mail Box	Vandalism	2155 Adamsville Road (EMA Office)	Zanesville	2011
Odor	Sewer Treatment Facility	West Pike & County Line Road	Gratiot	2011
Diesel Fuel	Semi Crash	5640 Adamsville Road	Zanesville	2011
Crude Oil in Natural Gas Line	Equipment Malfunction	750 Airport Road (Factory)	Zanesville	2011
Gasoline Release	Equipment Failure	Maple & Taylor (Gas Station)	Zanesville	2011
Transformer Fluid	Transformer Fire	Philo Jr High	Philo	2011
Gasoline Release	drilled thru supply line	Maple & Taylor (Gas Station)	Zanesville	2011
Diesel Fuel	Semi Crash	I-70 & 166 Mile Marker	Norwich	2011
Crude Oil	Tank Battery	Barr Rd & Mercer Rd	Otsego	2011
Unknown	Semi Crash	I-70 @ 163 WB Rest Area	Zanesville	2011
Gasoline Release	Abandon Storage Tank	Ninth St & Marietta St	Zanesville	2011
Ammonia Release	Equipment Failure	Northpointe & Fairview	Zanesville	2011
Diesel Fuel	Semi Crash	Maysville Pike @ County Line	Fultonham	2011
Waste Oil	Driver Error	SR 719 & Moxahala	Zanesville	2011
Unknown Hydrocarbon	unknown	State Route 93 & US 22	Zanesville	2011
Gasoline Spill	Crash	Maysville Pike & Broadview Circle	Zanesville	2011
Diesel Fuel	Semi Crash & Fire	I-70 at 142 Mile Marker	Gratiot	2011
Diesel Fuel & Motor Fluids	Semi Fire	I-70 & 146 Mile Marker	Gratiot	2011
Waste Oil	Abandon Tank	State Route 83 & US 40	New Concord	2012
Motor Oil	Equipment Failure	4196 East Pike	Zanesville	2012
Diesel Fuel	Truck Crash	State Route 146 @ Clay Littick Drive	Nashport	2012
Diesel Fuel	Semi Crash	I-70 @ 145 Mile Marker	Gratiot	2012
Gasoline	Driver Error	Maple Ave & Military Road	Zanesville	2012
Diesel Fuel	Semi Crash	300 Block Wayne Ave	Zanesville	2012
Motor Oil	Lack of Knowledge	2290 Old River Road	Zanesville	2012
Liquid Asphalt	Driver Error	State Route 60 @ Dietz Lane	Zanesville	2012
Gasoline	Car Crash/OSHP Pursuit	US 40 @ Rix Mills Road	New Concord	2012
Paint	Unsecure Load	Maple Ave & Harding Road	Zanesville	2012
Diesel Fuel	Fatal Semi Crash	I 70 @ 153 Exit	Zanesville	2012
Carbon Tetrachloride	Vandalism	1136 Adair Ave	Zanesville	2012
Diesel Fuel	Equipment Malfunction	I-70 from 157 to 169 Mile Markers	Zanesville	2012
Abandon Barrels	Criminal	I-70 @ 169 Mile Marker	New Concord	2012
Paint	Trailer Rollover	Zane Street @ Melinda Street	Zanesville	2012

Type of Spill	Spiller	Location of Spill	City	Year
Meth	Mobile Lab	West Pike @ Ridge Road	Hopewell	2012
Garbage	Train Derailment	Rock Cut Road	Dresden	2012
Diesel Fuel	Semi Crash	I-70 @ 167 Mile Marker	New Concord	2012
Diesel Fuel	Semi Crash	7th Street & Main Street	Zanesville	2013
Gasoline	Abandon Tanks	Main Street & 1st Street	Roseville	2013
Diesel Fuel	Semi Crash & Fire	I-70 @ 161 Mile Marker	Zanesville	2013
Unknown Powder	US Mail Shipment	Zanesville Safety Center 4th & South Streets	Zanesville	2013
? Meth Lab	Abandon Materials	Zane Landing Park	Zanesville	2013
Diesel Fuel	Truck Crash	Northpointe & Fairview Road	Zanesville	2013
Paint	Vandalism	Front Street & Old River Road	Philo	2013
Diesel Fuel	Semi Crash	I-70 @ 142 Mile Marker	Gratiot	2013
Coal	Train Derailment	Armco Ball Parks near Veterans Memorial Bridge	Zanesville	2013
Diesel Fuel	Semi & ODOT Truck Crash	I-70 @ 153 Mile Marker	Zanesville	2013
Liquid Asphalt	Operator Error	Northpointe & Kearns	Zanesville	2013
Gasoline	Abandon Tank	East Pike & Jackson Road	Zanesville	2013
Crude Oil	Tank Battery	8055 Sugar Grove Rd	Chandlersville	2013
Gasoline	Tank Failure	2nd Street & Mound Street	Frazeysburg	2013
Waste Oil	Abandon Tank	Maple Ave & Dresden Road	Zanesville	2013
Transformer Oil	Transformer Fire	So. State Street & Quincy Road	Zanesville	2013
Crude Oil	Pump Jack Failure	State Route 60 near Sugargrove Road	Duncan Falls	2013
Diesel Fuel	Poperator Error	Maple Ave & Military Road	Zanesville	2013
Gasoline	Car Crash	Dillon Falls & Kingsview	Zanesville	2013
Diesel Fuel/Crude Oil	Semi Crash	I-70 @ 163 Mile Marker	Zanesville	2013
Gasoline	Car Crash	Ritchey Road & Northpointe	Zanesville	2013
Diesel Fuel	Semi Crash	I-70 @ 146 Mile Marker	Gratiot	2013
Diesel Fuel/Hydraulic Fluid	Fatal Semi/Car Crash X 2	Northpointe & Powelson	Nashport	2014
Diesel Fuel	Semi Crash	I-70 @ 153 Mile Marker	Zanesville	2014
Anhydrous Ammonia	Worker Error	Northpointe & Fairview Road	Zanesville	2014
Crude Oil	Tank Battery	Obannon Road & Newark Road	Nashport	2014
Natural Gas Leak	Compressor Station Malfunction	Ruraldale Rd & Paisley Rd	Blue Rock	2014
Diesel Fuel	Semi Crash	I-70 @ 166 Mile Marker	Norwich	2014
Crude Oil	Tank Failure	1100 Block Mt. Perry Road	Mt Perry	2014
Natural Gas Leak	Farmer Error	11705 Ruraldale Rd	Blue Rock	2014
Crude Oil	Equipment Failure	International Rd & Cumberland Rd	Cumberland	2014
Diesel Fuel	Semi Crash	I-70 @166	Norwich	2014
Diesel Fuel	Semi Fire	I-70 @ 155	Zanesville	2014
Diesel Fuel	Road Debris Punctured Tank	I-70 @ 167 Mile Marker	Norwich	2014
Diesel Fuel	Equipment Failure	2400 Boatdock Rd	Zanesville	2014
Diesel Fuel	Semi Crash	I-70 @ 166 Mile Marker	Norwich	2014
Drilling Waste	Unsecure Load	I-70 @ 143 Exit	Gratiot	2014
Manufacturing Waste	Truck Crash	I-70 @ Mt Perry Rd	Gratiot	2014
Drilling Waste	Unsecure Load	I-70 @ 143 Exit - Mt Perry Rd - US 40	Gratiot	2014
Diesel Fuel	Operator Error	4900 Eastpointe	Zanesville	2014
Transformer Oil	Accident	John Glenn High School Rd	New Concord	2014
Natural Gas Leak	Contractor Hit Line	Bethesda Hospital	Zanesville	2014
Diesel Fuel	Semi Crash	State Route 83 @ Granny's Knob	Otsego	2014
Diesel Fuel & Other Liquids	Multi Vehicle Crash	I-70 @ 154 Mile Marker	Zanesville	2014
Diesel Fuel	Semi Crash	State Route 60 @ Bridge St	Duncan Falls	2014
Hydraulic Fluid	Line Failure	Pleasant Valley Road	Nashport	2014
Gasoline Motor Fluids	Fatal Car Crash X 2	State Route 22 @ Old Town Rd	White Cottage	2015
Hydraulic Fluid	Line Failure	320 Musser Dr	Hopewell	2015

Type of Spill	Spiller	Location of Spill	City	Year
Molasses	Semi Crash	I-70 @ 146 Mile Marker	Gratiot	2015
Diesel Fuel	Semi Crash	I-70 @ 152 Mile Marker	Zanesville	2015
Motor Oil	Old Equipment	Powelson Dr & Dresden Rd	Dresden	2015
Volatile Organics	Drilling Site	I-70 @ 157 Exit	Zanesville	2015
Diesel Fuel	Semi Crash	I-70 @ 146 Mile Marker	Gratiot	2015
Diesel Fuel & Crude Oil	Drilling Rig Crash	US 40 @ County Line Rd	Hopewell	2015
Diesel Fuel & Solvent	Semi Crash	I-70 @ 157 Mile Marker	Zanesville	2015
Diesel Fuel & Motor Fluids	Semi Crash & Fire - Fatal	State Route 146 @ Vickers Hill Rd	Nashport	2015
Paint & Solvent Barrels	Flooding	Various Locations along US 40	Zanesville	2015
Diesel Fuel	Semi Crash	State Route 83 & State Route 209	Bloomfield	2015
Farm Chemicals & Diesel Fuel	Truck Crash	Dresden Adamsville Road @ Edgemoor Rd	Adamsville	2015
Hydraulic Fluid	Line Failure	600 Sand Ridge Rd	Hopewell	2015
Diesel Fuel	Semi Crash	State Route 60 @ Third St	Dresden	2015
Acetone/Methyl Ethyl Ketone	Leaking Tanker	I-70 @ 157 Exit	Zanesville	2015
Diesel Fuel	Semi Crash	I-70 @ 154 Mile Marker	Zanesville	2015
Motor Oil	Human Error	Muskingum River @ AEP Plant	Dresden	2015
Paint	Human Error	State Route 208 @ North River Road East	Dresden	2015
Diesel Fuel	Semi Crash	State Route 60 @ Dave Longaberger	Dresden	2015
Diesel Fuel	Debris Punctured Tank	I-70 @ 169 Exit	New Concord	2015
Diesel Fuel	Truck Crash	State Route 16 @ State Route 60	Dresden	2015
Processed Sewage	Unsecure Load	Ninth & Main Streets	Zanesville	2015
Diesel Fuel	Debris Punctured Tank	I-70 @ 157 Exit	Zanesville	2015
Diesel Fuel & Motor Fluids	Semi Crash & Fire - Fatal	I-70 @ 153 Mile Marker	Zanesville	2015
Gasoline	Driver Error	Maple Ave @ Military Rd	Zanesville	2016
Honing Oil	Unsecure Load	Avon & Economy Linen	Zanesville	2016
Gasoline	Car Crash	3665 Conn Rd	Nashport	2016
Transformer Oil	Transformer Fire	2345 Licking Rd	Zanesville	2016
Diesel Fuel & Coal	Semi Crash	State Route 83 & Edgemoor Rd	Adamsville	2016
Unknown	Unknown	1700 State St	Zanesville	2016
Transformer Oil	Transformer Fire	Duncan Run Rd	Philo	2016
Brine	Unknown	Raiders Rd @ East 3rd St	Frazeysburg	2016
Motor Oil	Blown Bus Engine	I-70 @ 158 Mile Marker	Zanesville	2016
Gasoline	Pickup Crash	990 Pinkerton Lane	Zanesville	2016
Natural Gas Leak	Equipment Failure	North Linden @ Yacht Club	Zanesville	2016
Motor Oil	Semi Crash	I-70 @ 145 Mile Marker	Gratiot	2016
Transformer Oil	Crash	Clay St & Maysville Pike	South Zanesville	2016
Gasoline	Equipment Failure	1400 Moxahala Ave	Zanesville	2016
Diesel Fuel	Semi Crash	I-70 @ 163 Mile Marker	Zanesville	2016
Diesel Fuel	Semi Crash	I-70 @ 164 Mile Marker	Zanesville	2016
Diesel Fuel	Semi Crash	I-70@ 164 Mile Marker	Zanesville	2016
Crude Oil	Equipment Malfunction	1352 Butterbean Ridge Rd	Philo	2016
Crude Oil	Men Down in Tank	8475 East Pike	Norwich	2016
Crude Oil	Equipment Failure	9130 Matchett Rd	Adamsville	2016
Cement	Truck Crash	I-70 @ 164 Exit	Zanesville	2016
Diesel Fuel	Semi Crash	I-70 @ 155 Mile Marker	Zanesville	2016
Gasoline & Motor Fluids	Car Crash	Old River Rd & State Route 555	Zanesville	2016
Diesel Fuel	Semi Crash	I-70 @ 155 Mile Marker	Zanesville	2016
Diesel Fuel	Semi Crash	I-70 @ 168 Mile Marker	New Concord	2016
Diesel Fuel/Motor Oil/Antifreeze	Truck Crash	2200 Block Millers Lane	Zanesville	2016

Type of Spill	Spiller	Location of Spill	City	Year
Hydrauli Fluid/Motor Oils	Truck Crash	I-70 @ 145 Mile Marker	Gratiot	2016
Gas Odor	Scrap Pipe	West End & Downtown of Zanesville	Zanesville	2017
Hydraulic Fluid	Operator Error	1675 Fairview Rd	Zanesville	2017
Natural Gas Leak	Equipment Failure	4220 McDonald Rd	Chandlersville	2017

4.15.4 Magnitude/Severity

With a hazardous material release, whether accidental or intentional, there are several potentially exacerbating or mitigating circumstances that will affect its severity or impact. Mitigating conditions are precautionary measures taken in advance to reduce the impact of a release on the surrounding environment. Primary and secondary containment or shielding by sheltering-in-place protects people and property from the harmful effects of a hazardous material release. Exacerbating conditions, or characteristics that can enhance or magnify the effects of a hazardous material release, include:

- **Weather conditions:** affects how the hazard occurs and develops
- **Micro-meteorological effects of buildings and terrain:** alters dispersion of hazardous materials
- **Non-compliance with applicable codes (e.g. building or fire codes) and maintenance failures (e.g. fire protection and containment features):** can substantially increase the damage to the facility itself and to surrounding buildings.

Whether or not a hazardous materials site is contained in the SFHA is also a concern, as there could be larger-scale water contamination during a flood event should the flood compromise the production or storage of hazardous chemicals. Such a situation could swiftly move toxic chemicals throughout a water supply and across great distances.

The severity of a given incident is dependent not only on the circumstances described above, but also with the type of material released and the distance and related response time for emergency response teams. The areas within closest proximity to the releases are generally at greatest risk, yet depending on the agent, a release can travel great distances or remain present in the environment for a long period of time (e.g., centuries to millennia for radioactive materials), resulting in extensive impacts on people and the environment.

4.15.5 Frequency/Possibility of Future Occurrences

Between 2011 and 2017, there were 139 hazardous materials release incidents in Muskingum County.

[(Current Year) 2017] subtracted by [(Historical Year) 2011] = 6 Years on Record

[(Years on Record) 6] divided by [(Number of Historical Events) 139] = 0.04 Years Between Events

The historic frequency calculates that there is a 100% chance of this type of event occurring each year. The HMPC agreed that these events are “Highly Likely,” having a 100% annual chance.

4.15.6 Inventory Assets Exposed To Hazardous Materials/Radiological Release

All County assets can be considered at risk from hazardous materials releases. This includes 100 percent of the County population and all buildings and infrastructure. The presence of the

interstates, state routes, as well as railroad tracks which pass throughout the County, make all of Muskingum County vulnerable to the effects of a possible incident.

4.15.7 Potential Losses

A hazardous materials release has the possibility of having a significant impact on the County.

Most hazardous material releases do not usually have an effect on infrastructure, particularly underground infrastructure. Some critical facilities use hazardous materials to operate such as chlorine for water treatment and PCB's for electric transformers. Similarly, the contamination of the water supply may be treated like a hazardous material release. Propane, oil, and natural gas, necessary fuels for heating, can also be hazardous if released during their delivery due to their explosive potential. Transportation may be limited if a key roadway or railway is blocked by an incident.

- Possible losses to critical facilities include:
    - Critical functional losses
    - Contamination
    - Structural and contents losses, if an explosion is present

- Possible losses to structures include:
    - Inaccessibility
    - Contamination
    - Structural and contents losses, if an explosion is present

- Possible economic losses include:
    - Business closures and associated business disruption losses

- Possible ecologic losses include:
    - Loss of wildlife
    - Habitat damage
    - Reduced air and water quality

- Possible social losses include:
    - Canceled activities
    - Emotional impacts of significant population losses and illnesses

4.15.8 Land Use & Development Trends

The population impacts are often greater than the structural impacts during a hazardous material a release. Depending on the material, the health impacts to humans can be long and short term. Generally, an incident will affect only a subset of the total population at risk. In a hazardous materials release, those in the immediate isolation area would have little to no warning, whereas, the population further away in the dispersion path may have some time to evacuate, depending on the weather conditions, material released, and public notification.

There are often no land use regulations that restrict building around industrial facilities or along transportation routes. As the population increases, development will also continue to increase in these areas thereby exposing a greater number of individuals to the risk of a hazardous materials release. Increase development will lead to increased vulnerability and increased potential losses.

4.15.9 Hazardous Materials HIRA Summary

Hazardous materials incidents can pose a series of threats to human safety and welfare, as well as the environment. Incidents occur regularly, but are not often of a size to cause a significant countywide threat. However, it seems likely that incidents will continue and the potential for a significant release is present. Incidents often occur in conjunction with, or as a result of, natural hazards impacting facilities that house hazardous materials. Depending upon the materials released, as well as atmospheric conditions, an incident has the potential to cause significant disruption to the County.

4.16 *Utility Failure*

Non-Natural Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Utility Failure	**3**	0.9	**2**	0.6	**2**	0.4	**4**	0.4	**2**	0.2	**2.5**
MEDIUM RISK HAZARD (2.0 – 2.9)											

4.16.1 Hazard Identification

Utility failure includes any impairment of the functioning of telecommunication, gas, electric, water, or waste networks. These interruptions or outages occur because of geomagnetic storms, fuel or resources shortage, electromagnetic pulses, information technology failures, transmission facility or linear utility accident, and major energy, power, or utility failure. Sabotage, criminal activity, and terrorism/cyberterrorism are other causes of utility disruptions. The focus of utility interruptions as a hazard lies in fuel, energy, or utility failure; this hazard is often secondary to other natural hazard events, particularly transportation accidents, lightning strikes, extreme heat or cold events, and coastal and winter storms.

Utility failures in Muskingum County focus primarily on power failures which are often a secondary impact of another hazard event. For example, severe thunderstorms or winter storms could bring down power lines and cause widespread disruptions in electricity service. Strong heat waves may result in rolling blackouts where power may not be available for an extended period of time. Local outages may be caused by traffic accidents or wind damage. Utility interruptions and power failures can take place throughout the County.

Muskingum County utilities are predominantly served by the Ohio Power Company, Columbia Gas of Ohio, and the Muskingum County Water Department.

4.16.2 Regulatory Environment

All Muskingum County utilities are required to comply with all regulations and requirements as defined by the Public Utility Commission of Ohio.

4.16.3 Hazard Events / Historical Occurrences

Minor, short-term utility failures occur often in any given area of the County, while major, long-term events may take place once every few years. Utility interruptions are difficult to predict, but they are likely to have a relatively short duration of 24 hours or less. Since utility interruptions are sometimes by-products of severe weather events, citizens should prepare for them before and during severe storms.

Windstorms and winter storms have caused power outages to building throughout Muskingum County. Extreme cold can increase regional demand gas demand to the limit of the gas distribution systems' capacity. Extreme heat can increase regional demand to the limit of the electrical distribution system's capacity. Minor utility interruptions occur regularly throughout the County, caused by these and other circumstances. There is no complete list of utility failure events available for Muskingum County.

4.16.4 Magnitude/Severity

Most severe power failures or outages are regional events, though there are innumerable smaller, localized outages. A loss of electricity can have numerous impacts including, but not limited to food spoilage, loss of heat or air conditioning, basement flooding (i.e. sump pump failure), lack of indoor lighting, loss of water supply (i.e. well pump failure) and lack of phone or internet service. These issues are often more of a nuisance than a hazard, but can cause damage or harm depending on the population affected and the severity of the outage.

In a possible worst-case scenario in Muskingum County, a winter storm event could cause widespread power outages, leaving citizens without heat in the midst of subzero temperatures for several days. The power outage would also put elderly populations or others at risk of health problems due to the lack of heat and the inability to call for assistance or leave their homes. Power lines may also be difficult to repair because of the magnitude of the storm.

4.16.5 Frequency/Probability of Future Occurrences

Minor utility failure events (i.e. short outage) events may occur several times a year for any given area in the County, while major (i.e. widespread, long outage) events take place once every few years. Failures are likely occurrences during severe weather and therefore, should be expected during those events. The probability of future utility outages impacting the County can be considered *likely* according to the Risk Factor Methodology.

The HMPC decided, based on their knowledge, that there is a "Likely" chance of a utility failure occurring, or a 10% - 100% chance per year. This is partly because power failures are often tied to severe storm events. However, there is not enough historical precedence to predict when a large-scale incident may occur.

4.16.6 Inventory Assets Exposed to Utility Failure

All County assets can be considered at risk to utility failure. This includes 100 percent of the County population and critical facilities. Utility disruptions can encompass individual parts of the County, or can affect the whole planning area.

4.16.7 Potential Losses from Utility Failure

Utility failure in and of itself would be unlikely to cause any sort of physical losses. However, losses from utility failure can be measured in lost productivity (due to IT issues) and loss of use in structures (due to loss of water/electric/heat). Emergency medical facilities, including retirement homes and senior centers are particularly vulnerable to power outages or the loss of gas. While back-up power generators are often used at these facilities, loss of electricity may result in hot or cold temperatures for which elderly populations are particularly vulnerable. Conservation and improved technology have resulted in more efficient use of energy sources. The increasing use of alternative fuel supplies, such as kerosene heaters, wood burning stoves, coal burners, etc., has also decreased our vulnerability to future shortages. However, severe weather extremes, accidents, labor strikes, terrorism, or nationwide shortages could cause significant energy shortage problems. There is no accurate way to predict potential utility failure.

4.16.8 Land Use & Development Trends

Utility services are produced and delivered to customers by an extensive countywide utility infrastructure system. Electricity infrastructure is mostly aboveground in the form of transmission and distribution lines, with some underground in urban areas, while gas, water, and waste are almost exclusively underground. There is a high demand for utilities because of the densely populated nature of the County. Demand is likely to remain high as the County has a substantial residential population.

4.16.9 Utility Failure HIRA Summary

The probability of a catastrophic utility failure is low, but there is the potential for mild to moderate interruptions. Because much of the County is rural in nature, many of those who live out in the more isolated areas are more vulnerable to potentially large utility failure events. These areas take more time to address large outages because they are spread out, as opposed to urbanized areas that are clustered together. The largest impacts will be felt economically through lost time and productivity. Utility Failure can affect the entirety of Muskingum County.

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Section 5. Mitigation Strategy

The intent of the Mitigation Strategy is to provide Muskingum 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 the 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 Muskingum 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.

In order to ensure that a broad range of mitigation actions were considered, the 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 the 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 students, faculty and staff about hazards and potential ways to mitigate them. These actions may also include participation in national programs, such as StormReady or Firewise 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 County officials, stakeholders, and the public is more likely to lead to direct actions.

5.1 *Previous Mitigation Action Prioritization Methodology*

The 2005 plan, as well as the 2013 version, prioritized their actions by each jurisdiction. Each jurisdiction had its own set of goals, and underneath that a set of objectives. Under each objective were actions with specific tasks. There were up to 3 goals for each jurisdiction. For each action, there was no indication on how each was ranked and why goals were ordered as they were.

5.2 *2018 Plan Update Mitigation Action Prioritization Methodology*

Prioritizing mitigation actions for this plan update was completed using FEMA's STAPLEE methodology for each jurisdiction's actions. The prioritization process has changed from the previous plan in order to incorporate this adaptable method that allows for a more comprehensive examination of the mitigation actions.

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. Typically, scores rank between 17 and 21. Infrastructure projects tend to incur a lower score due to their high price and lengthy completion times, while actions such as plans, regulations, and educational programs rank higher due to their ease of deployment. The table below shows an example of the STAPLEE tool.

STAPLEE ACTION EVALUATION TABLE:

Alternative Actions	STAPLEE Criteria Considerations + Favorable - Less favorable N Not Applicable																								
	S (Social)		T (Technical)			A (Administrative)			P (Political)			L (Legal)			E (Economic)				E (Environmental)				
	Community Acceptance	Effect on Segment of Population	Technically Feasible	Long-Term Solution	Secondary Impacts	Staffing	Funding Allocation	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land/ Water	Effect on Endangered Species	Effect on HAZMAT/ Waste Sites	Consistent with Community Environmental Goals	Consistent with Federal Laws

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

The mitigation strategy represents the key outcomes of the 2018 Muskingum 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

5.4 *Muskingum County Capability Assessment*

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

Tool/Program	Jurisdictions with this resource, or in process of developing this resource
Hazard Mitigation Plan	Muskingum County, Adamsville, Dresden, Frazeysburg, Gratiot, New Concord, Norwich, Philo, Roseville, South Zanesville, Zanesville
Emergency Operations Plan	Muskingum County, Adamsville, New Concord, Norwich, Philo, Zanesville
Disaster Recovery Plan	Muskingum County, Adamsville, New Concord, Norwich, Philo, Zanesville
Evacuation Plan	New Concord, Zanesville
Continuity of Operations Plan	Muskingum County, Gratiot, New Concord
NFIP	Muskingum County, Adamsville, Dresden, Frazeysburg, New Concord, Philo, Roseville, South Zanesville, Zanesville
NFIP-CRS	None
Floodplain Regulations	Muskingum County, Adamsville, Dresden, Frazeysburg, New Concord, Philo, Roseville, South Zanesville, Zanesville
Floodplain Management Plan	Muskingum County, New Concord, Roseville, Zanesville
Zoning Regulations	Frazeysburg, Zanesville
Subdivision Regulations	Muskingum County, New Concord, Zanesville
Comprehensive Land Use Plan (or General, Master or Growth Mgmt. Plan)	Muskingum County, Adamsville, New Concord, Norwich, Philo, Zanesville
Open Space Management Plan (or Parks/Rec or Greenways Plan)	Zanesville
Stormwater Management Plan / Ordinance	New Concord, Zanesville
Natural Resource Protection Plan	None
Capital Improvement Plan	Muskingum County, South Zanesville, Zanesville

Economic Development Plan	Philo
Historic Preservation Plan	Muskingum County, New Concord, Zanesville
Farmland Preservation	Muskingum County
Building Code	Muskingum County, New Concord, Zanesville
Fire Code	Muskingum County, New Concord, Zanesville

5.4.1 Administrative and Technical Capabilities

Table 5-1 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 5-1: Administrative and Technical Mitigation Capabilities

Staff/Personnel Resources	Department / Agency
Planners (with land use / land development knowledge)	Muskingum County, Adamsville, Norwich, Philo, South Zanesville, Zanesville
Planners or engineers (with natural and/or human caused hazards knowledge)	Muskingum County, Adamsville, Norwich, Philo, South Zanesville, Zanesville
Engineers or professionals trained in building and/or infrastructure construction practices (includes building inspectors)	Muskingum County, Adamsville, Norwich, Philo, Zanesville
Emergency manager	Muskingum County, Adamsville, Norwich, Philo, Roseville, Zanesville
Floodplain manager	Muskingum County, Adamsville, Dresden, Norwich, Philo, Roseville, Zanesville
Land surveyors	Muskingum County, Norwich, Philo
Scientists or staff familiar with the hazards of the community	Muskingum County, Zanesville

Personnel skilled in Geographic Information Systems (GIS) and/or FEMA's HAZUS program	Muskingum County, Adamsville, New Concord, Norwich, Philo, Zanesville
Grant writers or fiscal staff to handle large/complex grants	Muskingum County, Adamsville, New Concord, Norwich, Philo, Roseville, South Zanesville, Zanesville

5.4.2 Fiscal Capabilities

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

Table 5-2: Fiscal Capabilities Table

Financial Resources	Department / Agency
Capital improvement programming	Muskingum County, New Concord, Philo, South Zanesville, Zanesville
Community Development Block Grants (CDBG)	Muskingum County, Adamsville, Norwich, Philo, Roseville, South Zanesville, Zanesville
Special purpose taxes	New Concord, South Zanesville, Zanesville
Gas / electric utility fees	Zanesville
Water / sewer fees	Muskingum County, Adamsville, Frazeysburg, New Concord, Norwich, Philo, Roseville, South Zanesville, Zanesville
Stormwater utility fees	Dresden, Frazeysburg, Zanesville
Development impact fees	None
General obligation, revenue, and/or special tax bonds	New Concord, Roseville, South Zanesville, Zanesville
Partnering arrangements or intergovernmental agreements	Muskingum County, New Concord, South Zanesville, Zanesville

5.4.3 Degree of Capability

Financial Resources	Degree of Capability		
	Limited	Moderate	High
Planning and Regulatory	Adamsville, Dresden, Frazeysburg, Norwich, Roseville, Gratiot, Philo	Muskingum County, New Concord, Zanesville	South Zanesville
Administrative and Technical	Adamsville, Frazeysburg, Gratiot, Norwich, Philo, Roseville	Muskingum County, Dresden, New Concord, Zanesville	South Zanesville
Financial	Adamsville, Dresden, Frazeysburg, Gratiot, Norwich, Philo, Roseville	Muskingum County, New Concord, Zanesville	South Zanesville
Community Political Capabilities	Adamsville, Dresden, Frazeysburg, Gratiot, Norwich, Philo	New Concord, Roseville, South Zanesville, Zanesville	Muskingum County
Education and Outreach	Adamsville, Dresden, Frazeysburg, Gratiot, Norwich, Philo, Zanesville	Muskingum Count, New Concord, Roseville, South Zanesville	None

5.5 *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.

5.5.1 Goals and Objectives

The Planning Committee discussed goals and objectives for this plan at distinct points in the planning process. On May 17th, 2017 (Planning Committee Meeting #2), the Planning Committee discussed the results of the risk assessment and the identified issues/weaknesses to be addressed by the Mitigation Goals and Objectives. 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. Reduce the effects of Severe Winter Storms on the people, property, and infrastructure of Muskingum County

Objective 1.1: Use policies and education to lower the impact of Severe Winter Storms

Goal 2. Reduce the effect of Severe Thunderstorms on Muskingum County

Objective 2.1: Increase public awareness for all Village residents for all hazard events

Objective 2.2: Limit and reduce damage caused by downed trees

Goal 3. Minimize the loss of life and damage to infrastructure caused by Tornadoes in Muskingum County

Objective 3.1: Increase the coverage area for tornado sirens

Objective 3.2: Renovate existing structures to act as shelter for residents

Objective 3.3: Enhance citizen's knowledge about what to do during a tornado

Goal 4. Mitigate loss of life and property due to Extreme Temperatures in Muskingum County

Objective 4.1: Educate citizens about extreme temperatures and the appropriate precautions to take

Goal 5. Enhance Muskingum County to be able to better handle the effects of Geologic Hazards

Objective 5.1: Prepare citizens so they know what precautions to take in the event of a geologic hazard event.

Objective 5.2: Provide infrastructure changes to reduce the losses from geologic hazards

Goal 6. Protect the people, property, and infrastructure of Muskingum County from Flooding

Objective 6.1: Identify and eliminate areas subject to persistent debris problems

Objective 6.2: Implement stormwater improvements to protect resident during a hazard event

Objective 6.3: Through policies and education, reduce the impact of flood events on the public.

Goal 7. Develop additional capabilities to be able resist Drought in Muskingum County

Objective 7.1: Undertake a public education campaign to prevent unnecessary use of water during a drought event.

Objective 7.2: Ensure that there is drinkable water for residents in times of drought

Goal 8. Lessen the effects of Wildfire in Muskingum County

Objective 8.1: Through public education, enhance the County's knowledge about what they can do to prevent wildfires

Goal 9. Minimize the losses of life and property due to Dam/Levee Failure in Muskingum County

Objective 9.1: Educate the public about their risk from nearby dams and levees

Goal 10. Reduce potential damage and loss of life caused by Hazardous Materials Incidents in Muskingum County

Objective 10.1: Promote, review, and update existing plans and strategies, writing new ones as needed

Objective 10.2: Upgrade hazardous materials facilities to modern standards

Goal 11. Ensure that Muskingum County is prepared for Utility Failure incidents

Objective 11.1: Install backup power systems in essential facilities

Objective 11.2: Educate the public on what provisions are needed in the event of Utility Failures

Objective 11.3: Develop policies to prevent losses from utility failure

5.5.2 2005 and 2013 Mitigation Action Review

During the third planning meeting, the mitigation actions from the 2005 and 2013 HMPs were reviewed and determined to be; deferred into the new plan, changed to reflect an update in priorities, completed, or deleted. Actions marked as “Completed” were finished between the drafting of the 2005, the 2013, and the 2018 HMP. Deletion of an action generally refers to that action no longer being relevant to the community. Those actions that only appear in one of the plans, and not the other, are marked with a superscript indicating which year’s plan in which they appeared.

5.5.2.1 Muskingum County - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Develop educational campaign targeting area subject to repetitive flood damage		X			Transferred responsibility to the Floodplain Committee
Partner with local schools to provide a hazard awareness program for youth grades 4-6.				X	
Develop a "standard operating procedure" for all affected agencies for use during a natural hazard event.			X		
Improve early warning system				X	
Become a FEMA "Cooperating Technical Partner".		X			No longer a priority
Promote Muskingum County Natural Hazard Mitigation Plan.				X	
Reviews, revise or create strategies and regulations regarding natural hazard planning.				X	
Review and revise vulnerability analysis for low ranking hazards.				X	
Develop project to address documented. repetitive loss areas for flooding			X		
Complete the vulnerability assessment for all hazards [2005]	X				
Develop a long-term strategy to reduce or eliminate the existing debris problem in public waterways within the County				X	

5.5.2.2 City of Zanesville - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Separate combined sewers to minimize health risk due to surcharging and/or flooding				X	
Create program to identify and remove trees with the potential to cause damage during a hazard event.			X		
Develop evacuation routes for effected areas in the event of a dam failure			X		
Enact legislation establishing water conservation measures for City residents			X		
Design a contingency plan to deal with damage to or loss of City water and wastewater utilities			X		
Map and post 100 year flood boundaries within the City			X		
Identify, post and map infrastructure and critical facilities within the City [2013]	X				
Identify all abandoned mines in Zanesville [2013]		X			There are existing maps of abandoned mines

5.5.2.3 Village of Adamsville - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Identify all citizens in the Village who would require special consideration during a hazard event.				X	Person in charge of project passed away
Obtain more structured agreements from resources and improve ability to react in an emergency [2005]				X	

5.5.2.4 Village of Dresden - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?
Install an early warning system in the north and south areas of the Village [2013]			X		
Provide educational materials along with public meeting[2013]			X		
Hold meetings with police and Village Administrator (regarding Installation of power generator system at Dresden Municipal Building to provide power source for Law Enforcement/Safe Haven area)[2013]			X		
Village Council Building Committee to gather information and costs (about renovating existing Dresden Municipal Building to provide shelter during hazard events)[2013]			X		
Seek Funding and permission from Railroad (to upgrade storm drainage system to remove 40 homes from flood plain)[2013]			X		
Gather information regarding costs (to upgrade sewage plant to complete village plan to discharge storm water drainage from sanity sewer discharge)[2013]	X				

5.5.2.6 Village of Frazeysburg - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Encourage Village Council to participate in the National Flood Insurance Program		X			Dresden already participates in the NFIP
Educate the citizens about new Zoning Ordinance and any future codes or regulations			X		
Set up snow emergency route for use in the event of a severe winter storm			X		
Institute program to identify all at risk trees on Village owned property				X	
Secure an emergency generator and other emergency supplies[2013]	X				

5.5.2.7 Village of Fultonham - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Identify all citizens in the Village who would require special consideration during a hazard event		X			The Village was dissolved and incorporated into the County

5.5.2.8 Village of New Concord - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Identify and remove trees with the potential to cause damage during a hazard event				X	
Develop long-term strategy to reduce or eliminate the existing debris problem in culverts and public waterways within the Village				X	
Eliminate storm water infiltration into sanitary sewers to minimize health risk due to surcharging and/or flooding				X	
Identify, post and map infrastructure and critical facilities within the flood plain			X		
Acquire backup power, generators adequate to operate Village water and sewer systems and Village Hall [2013]			X		
Evaluate and upgrade (if necessary) Village tornado siren			X		
The Village will contract with Muskingum County to administrate Village Flood Plain Regulations in 2013 [2013]	X				
Write Standard Operating Procedures (SOP) for hazards that require evacuation			X		
Educate the public about the tornado warning system and how to react and protect themselves [2005]				X	
Install signs that delineate the 100-year flood plain areas of the Village [2005]			X		

5.5.2.9 Village of Norwich - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Provide information on disaster preparedness to residents of the Village				X	
Institute program to identify at risk trees within the Village			X		Limited village funds

5.5.2.10 Village of Philo - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Choose a committee to explore grant possibilities to purchase a generator for fire station [2013]	X				

5.5.2.11 Village of Roseville - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?
Increase Village warning siren to two (2) or more			X		

5.5.2.12 Village of South Zanesville - Mitigation Action Progress Report Form

ACTION	STATUS				STATUS UPDATE NOTES
	Completed	Canceled	Deferred	Ongoing	**What was accomplished for this action during this reporting period? What obstacles, problems, or delays were encountered? If not completed, is the action still relevant? Should the action and/or the anticipated completion date be revised? Do you have any other comments?**
Install signs along public streets marking boundaries of 100 year flood plain	X				
Write a Standard Operating Procedure (SOP) to be used during a natural hazard event that would require evacuation			X		
Develop a public educational program on how to react and protect oneself during a tornado				X	
Evaluate, upgrade and purchase if necessary additional early warning sirens	X				

5.5.3 2018 Mitigation Action Development

To begin the process of identifying mitigation actions, the HMP Planning Committee reviewed the identified hazards, as well as the mitigation goals and objectives. Based upon priorities and risk assessment results, mitigation actions were developed. Most importantly, the newly developed mitigation actions acknowledge updated risk assessment information outlined in Section 4.

5.5.3.1 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.

New mitigation actions for the 2018 plan are found below. A blue asterisks (*) denotes an action that strengthens a community's participation in the NFIP.

5.5.3.2 Severe Winter Storm Mitigation Strategy

Severe Winter Storm Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 1. Reduce the effects of Severe Winter Storms on the people, property, and infrastructure of Muskingum County					
Objective 1.1: Use policies and education to lower the impact of Severe Winter Storms					
Set up snow emergency route for use in the event of a severe winter storm	Village of Frazeysburg Mayor	2018-2023	Staff time	Existing Budget	22
Develop a standard operating procedure for all affected agencies for use during a hazard event	Muskingum County EMA	2018-2023	Staff time	Existing Budget	21
Promote the Muskingum County Hazard Mitigation Plan to the public	Muskingum County EMA	2018-2023	$1,000	Existing Budget	21
Install an emergency generation at the Fire Department	Village of Adamsville Village Council and Fire Department	2017-2022	$50,000	FEMA Grants	19

5.5.3.3 Severe Thunderstorm Mitigation Strategy

Severe Thunderstorms Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 2. Reduce the effect of Severe Thunderstorms on Muskingum County					
Objective 2.1: Increase public awareness for all Village residents for all hazard events					
Create a public education campaign warning citizens to stay out of parks when lightning is present	Muskingum County EMA	2018-2023	$1,000	Existing Budget	22
Objective 2.2: Limit and reduce damage caused by downed trees					
Institute a program to identify all at-risk trees on Village-owned property	Frazeysburg Mayor	2018-2023	$10,000	Existing Budget, FEMA Grants	20
Create program to identify and remove trees with the potential to cause damage during a hazard event	City of Zanesville Public Service Director	2018-2023	$50,000	Existing Budget, FEMA Grants	21
Identify and remove trees with potential to cause damage during a hazard event	New Concord Mayor	2018-2023	$10,000	Existing Budget, FEMA Grants	20
Institute program to identify at risk trees within the Village	Village of Norwich Mayor	2018-2023	$10,000	Existing Budget, FEMA Grants	20
Remove trees from near critical facilities	Village of Norwich Council	2018-2023	$10,000	Existing Budget, FEMA Grants	22

5.5.3.4 Tornado Mitigation Strategy

Tornado Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 3. Minimize the loss of life and damage to infrastructure caused by Tornadoes in Muskingum County					
Objective 3.1: Increase the coverage area for tornado sirens					
Install additional warning sirens to cover a greater area	Roseville Mayor	2018-2023	$50,000	Grants, Existing Budget	18
Install an early warning system in the north and south areas of the Village	Dresden Mayor	2018-2023	$70,000	Grants, Existing Budget	17
Install an additional siren to cover a greater area	New Concord Mayor	2018-2023	$35,000	FEMA Grants Dollars	19
Upgrade tornado sirens in the County that are 30 years or older in order to address coverage gaps.	Muskingum County EMA	2018-2023	$25,000	PDM, HMGP, County Budget	21
Evaluate and upgrade existing Village tornado siren	New Concord Mayor	2018-2023	$35,000	FEMA Grants Dollars	19
Upgrade existing tornado siren	Adamsville Village Council	2018-2023	$25,000	PDM, HMGP, County Budget	20
Upgrade tornado siren at fire house	Philo Village Council	2018-2023	$25,000	PDM, HMGP, County Budget	20
Upgrade tornado siren at water tower	Philo Village Council	2018-2023	$25,000	PDM, HMGP, County Budget	20
Install an emergency generator for the tornado siren	Village of Norwich Council	2018-2023	$10,000	PDM, HMGP, County Budget	21
Objective 3.2: Renovate existing structures to act as shelter for residents					
Retrofit existing municipal building to serve as a safety zone in the event of a tornado	S. Zanesville Village Administrator	2018-2023	$100,000	Grants, Existing Budget	16
Gather information and costs to renovate existing Dresden Municipal Building to provide shelter during hazard events	Dresden Village Council Building Committee	2018-2023	$250,500	State and Federal Grants	17
Design and build a tornado shelter for the village	Gratiot Village Administrator	2018-2023	$500,000	FEMA grants, CDBG, Village budget for match, USDA	18
Install tornado saferooms in existing community facilities and residential areas	Muskingum County, Adamsville, Dresden, Frazeysburg, New Concord, Philo, Roseville, South Zanesville, and Zanesville Administrators	2018-2023	$8-10 million	FEMA grants, Existing Budget	15
Objective 3.3: Enhance citizen's knowledge about what to do during a tornado					

Publish a flier and provide it to citizens at a publically held meeting to address tornado safety	Dresden Mayor	2018-2023	$600	Grants, Existing Budget	22
Develop a public education program on how to react and protect oneself during a tornado	S. Zanesville Village Administrator, New Concord Mayor	2018-2023	$1,000	Grants, Existing Budget	21

5.5.3.5 Extreme Temperature Mitigation Strategy

Extreme Temperature Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 4. Mitigate loss of life and property due to Extreme Temperatures in Muskingum County					
Objective 4.1: Educate citizens about extreme temperatures and the appropriate precautions to take					
Send out a flier to County residents to inform them that County buildings may be used as a heating or cooling center during times of extreme temperature	Muskingum County EMA	2018-2023	$1,000	Existing Budget	22

5.5.3.6 Geologic Hazards Mitigation Strategy

Geologic Hazard Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 5. Enhance Muskingum County to be able to better handle the effects of Geologic Hazards					
Objective 5.1: Prepare citizens so they know what precautions to take in the event of a geologic hazard event.					
Hold assemblies and class visits with schools throughout the County about what actions to take during an earthquake	Muskingum County EMA	2018-2023	Staff time and budget	Existing Budget	23
Objective 5.2: Provide infrastructure changes to reduce the losses from geologic hazards					
Install plant materials to reduce landslides and erosion along steep slopes alongside highway roads in the county	Muskingum County Public Works	2018-2020	$20,000	Existing Budgets, FEMA Grants	20

5.5.3.7 Flooding Mitigation Strategy

Flooding Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 6. Protect the people, property, and infrastructure of Muskingum County from Flooding					
Objective 6.1: Identify and eliminate areas subject to persistent debris problems					
Collect data on floods, including maps, storing it in a database *	ZMCHD Emergency Preparedness Coordinator	2019-2020	$10,000	ZMCHD Existing Budget, Grants	17
Map and post 100-year flood boundaries within the City *	Zanesville Public Service Director, New Concord Mayor	2018-2020	$20,000	Grants, Existing Budget	21
Develop a long-term debris-elimination plan for public waterways within the County	Muskingum County EMA Director, New Concord Mayor	2018-2023	$2,000	Grants, Existing Budget	22
Objective 6.2: Implement stormwater improvements to protect resident during a hazard event					
Replace damaged storm sewer on Chestnut St. in Dresden *	Village of Dresden Mayor	2018-2021	$500,000	Grants, Existing Budget	23
Replace existing storm sewer lines to allow for better storm drainage *	Frazeysburg Board of Public Affairs	2018-2020	$200,000	DWPA, EPA	17
Perform a comprehensive refit of culverts, bridges, and roadways to allow for a better stormwater drainage system *	Muskingum County Engineer's Office	2018-2023	$20,000,000	ODOT, EMA, FHWA	17
Objective 6.3: Through policies and education, reduce the impact of flood events on the public					
Seek funding and permission from Railroad to upgrade storm drainage system, and to remove 40 homes from flood plain	Dresden Mayor	2018-2023	$400,000	FEMA Grants	17
Create a public education pamphlet sharing information on about new Zoning Ordinance and any future codes or regulations	Frazeysburg Mayor	2018-2023	$600	Existing Budget, FEMA Grants	22
Write a Standard Operating Procedure to be used during a natural hazard event that would require evacuation*	S. Zanesville Village Administrator	2018-2023	Staff Time	Existing time and budget	21
Partner with local schools to provide a hazard awareness program for youth grades 4-6	Muskingum County EMA Director	2018-2023	$500	Existing Budget, FEMA Grants	22
Develop partnerships to enhance stormwater regulations countywide.*	Muskingum County, Adamsville, Dresden, Frazeysburg, New Concord, Philo, Roseville, South Zanesville, and	2018-2023	Staff Time	Existing time and budget	22

	Zanesville Administrators				
Map areas that flood that are outside of the SFHA. *	Muskingum County, Adamsville, Dresden, Frazeysburg, New Concord, Philo, Roseville, South Zanesville, and Zanesville Administrators	2018-2023	Staff Time	Existing time and budget	22
Acquire structures within floodprone area.*	Muskingum County, Adamsville, Dresden, Frazeysburg, New Concord, Philo, Roseville, South Zanesville, and Zanesville Administrators	2018-2023	$500,000	FMA Grants, Existing Budget to Match	22

5.5.3.8 Drought Mitigation Strategy

Drought Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 7. Develop additional capabilities to be able resist Drought in Muskingum County					
Objective 7.1: Undertake a public education campaign to prevent unnecessary use of water during a drought event.					
Provide information on the County's website regarding drought-time water conservation for residents	Muskingum County EMA	2018-2023	Staff time and Resources	Existing Budget	23
Objective 7.2: Ensure that there is drinkable water for residents in times of drought					
Enact legislation establishing water conservation measure for City residents	City of Zanesville Public Service Director	2018-2020	Staff time and resources	Existing budget	21

5.5.3.9 Wildfire Mitigation Strategy

Wildfire Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 8. Lessen the effects of Wildfire in Muskingum County					
Objective 8.1: Through public education, enhance the County's knowledge about what they can do to prevent wildfires					
Provide information on disaster preparedness to residents of the Village	Village of Norwich Mayor	2018-2023	Staff time and resources	Existing budget	21

5.5.3.10 Dam/Levee Failure Mitigation Strategy

Dam/Levee Failure Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 9: Minimize the losses of life and property due to Dam/Levee Failure in Muskingum County					
Objective 9.1: Minimize public health/safety risk in the event of a dam failure					
Develop evacuation routes for effected areas in the event of a dam failure	Muskingum County EMA	2018-2023	Staff time and resources	Existing budget	20

5.5.3.11 Hazardous Materials Incidents Mitigation Strategy

Hazardous Materials Incident Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 10. Reduce potential damage and loss of life caused by Hazardous Materials Incidents in Muskingum County					
Objective 10.1: Promote, review, and update existing plans and strategies, writing new ones as needed					
Update HazMat emergency protocols	Muskingum County EMA	2018-2023	Staff time and budget	Existing budget	21
Objective 10.2: Upgrade hazardous materials facilities to modern standards					
Upgrade equipment and capacity of waste water treatment plant in the village	Village of Dresden Mayor	2021-2023	$5 million	OPWC, Rural Development Grants	15
Separate combined sewers to minimize health risk due to surcharging and/or flooding	City of Zanesville Public service Director, New Concord Mayor	2018-2023	$20 million	Existing budget	16

5.5.3.12 Utility Failure Mitigation Strategy

Utility Failure Mitigation Actions					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Goal 11. Ensure that Muskingum County is prepared for Utility Failure incidents					
Objective 11.1: Install backup power systems in essential facilities					
Install backup generators along with new water wells	Village of Dresden Board of Public Affairs	2018-2020	$400,000	OWPA, USDA-Rural Development Grants	16
Install generators at well field and water plant	S. Zanesville Village Administrator	2018-2020	$100,000	Grants, Existing Budget	16
Add backup generator to Genesis Hospital	Genesis Hospital Safety Counsel	2018-2022	$750,000	FEMA, State Grants	22
Distribute emergency generators Licking Township Fire Department, Falls Station 303, and Zanesville Station #3.	Muskingum County Fire Department	2018-2023	$150,000	Grants, Existing budget	18
Provide generators for water pump stations throughout the County	Muskingum County Water Department	2018-2023	$150,000	Grants, Existing budget	17
Acquire backup generators to operate Village water and sewer system, and Village Hall	New Concord Mayor	2018-2023	$100,000	Grants, Existing Budget	17
Objective 11.2: Educate the public on what provisions are needed in the event of Utility Failures					
Hold meetings with police and Village Administrator regarding the installation of power generators system at Dresden Municipal Building to provide power source for Law enforcement/Safe Haven area	Dresden Board of Public Affairs	2018-2023	$45,000	Grants, Existing Budgets	19
Objective 11.3: Develop policies to prevent losses from utility failure					
Design a contingency plan to deal with damage to or loss of City water and wastewater utilities	City of Zanesville Public Service Director	2018-2023	Staff time and resources	Existing budget	21

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Section 6. Plan Implementation and Maintenance

As a living document it is important that this plan becomes a tool in County resources to ensure reductions in possible damage from a 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 Muskingum County. This section describes the incorporation of the HMP into existing planning mechanisms, and how the planning committee will continue to engage the public.

6.1 *Evaluation, Monitoring and Updating*

Monitoring, evaluating, and updating this plan is critical to maintaining its value and success in regards to identified 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 Muskingum County Hazard Mitigation Planning Committee established for this 2018 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 countywide representatives and other important stakeholders.

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 Mitigation Planning Committee will meet annually to evaluate the plan and discuss specific coordination efforts that may be needed.

Input from the public and these stakeholders will be sought by publishing public notices in the Zanesville Times Recorder, as well as through the Muskingum EMA's social media accounts. Notices will also be published in the EMA office. During the review process, the committee will serve in an advisory capacity to Muskingum County citizens and elected officials.

The annual evaluation of the 2018 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.

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 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 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 HMP Committee for consideration. The request shall be accompanied by a detailed rationale. The request will be evaluated and a determination will be made as to 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 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.

6.2 *Plan Update and Maintenance*

This section describes the schedule and process for monitoring, evaluating, and updating the 2018 HMP.

6.2.1 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, the HMP Planning Committee will reconvene within 30 days of the disaster to review and update the HMP as appropriate.

6.2.2 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.

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.

6.3 *Incorporation into Existing Planning Mechanisms*

An important implementation mechanism is to incorporate the recommendation and underlying principles of the HMP into planning and development such as capital improvement budgeting, general plans and comprehensive plans. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of the entity 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. This collaborative effort is also important to monitor funding opportunities which can be leveraged to implement the mitigation actions.

Integration has been somewhat limited due to the rural nature of the County; many residents feel that the reach of government should be minimal. The following are plans, policies, and tools where mitigation has been integrated since the adoption of the previous plan:

- **Muskingum County Building Department Website:** The County's website has a dedicate page that discusses flooding. Part of this is an education component showing what can be done to mitigate the loss of structures.

- **Zanesville Comprehensive Plan:** This plan was designed as a guide for future development. It has several goals in place with corresponding policies. Policy 8.8 states that the City shall "utilize redevelopment to eliminate or minimize land use conflicts that pose a significant hazard to human health and safety." This plan was adopted in 2016.

Community planners and leaders will actively incorporate information into:

- **Local Master Plans and Polices:** The HMP provides information and actions that can be incorporated into comprehensive plans, should they be pursued or updated by the cities and villages of the County. Specific risk and vulnerability information from the HMP will assist to identify areas where development may be at risk to potential hazards.

- **Capital Improvement Plans:** As communities in the counties grow or redevelop, they should be conscientious of their vulnerabilities to hazards, incorporating mitigation strategies into landscape designs and reconstruction projects.

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Appendix A. Adoption Letter

2018 Muskingum County Hazard Mitigation Plan
Municipal Adoption Resolution

Resolution No. _____
Village of Adamsville, Muskingum County, Ohio

WHEREAS, *the Village of Adamsville*, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, *the Village of Adamsville* acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of *the Village of Adamsville*, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for *the Village of Adamsville:*

- The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of *the Village of Adamsville* and
- The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this 5 day of April, 2018

ATTEST:

Village of Adamsville

By _____

By _____

By _____

Public Service Committee
Andrew Roberts, Chair

RESOLUTION NO. 18 - 39
INTRODUCED BY COUNCIL

A RESOLUTION IN THE MATTER OF ADOPTION OF THE 2018 MUSKINGUM COUNTY HAZARD MITIGATION PLAN.

WHEREAS, the City of Zanesville, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety; and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities; and

WHEREAS, the City of Zanesville acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds; and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with the other county departments, and officials and citizens of the City of Zanesville; and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan; and

WHEREAS, the Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments.

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Zanesville, State of Ohio, that:

SECTION ONE: The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the City of Zanesville.

SECTION TWO: The respective agencies identified in the implementation strategy for the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

SECTION THREE: This Resolution shall take effect and be in force from and after the earliest period allowed by law.

PASSED: March 12, 2018

ATTEST: Susan Culbertson
Susan Culbertson,
Clerk of Council

Daniel M. Vincent,
President of Council

APPROVED: March 13, 2018 **THIS LEGISLATION APPROVED AS TO FORM**

Jeff Tilton, Mayor

Law Director's Office

RESOLUTION NO. 2018-29

A RESOLUTION ADOPTING THE 2018 MUSKINGUM COUNTY HAZARD MITIGATION PLAN

WHEREAS, the Village of Dresden, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety; and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities; and

WHEREAS, the Village of Dresden acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds; and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of the Village of Dresden; and

WHEREAS, A public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan; and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments.

NOW, THEREFORE, BE IT RESOLVED THAT:

SECTION ONE: The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the Village of Dresden.

BE IT FURTHER RESOLVED THAT

SECTION TWO: The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

BE IT FURTHER RESOLVED THAT

SECTION THREE: It is found and determined that all formal actions of this Council concerning and relating to the adoption of this Resolution were taken in an open meeting of this Council, and that all deliberations of this Council and any of its committees that resulted in such formal actions were in meeting open to the public in compliance with law.

SECTION FOUR: This Resolution is hereby declared an emergency measure for the reason that the same is necessary for the protection of the public health, welfare and safety of the residents of said Village, the Council of the Village of Dresden, having voted by a two-thirds or greater vote of all members of the Council to dispense with a full and distinct reading of this Resolution on three different days; and having been so passed, this Resolution shall become effective immediately upon the signature of the Mayor and shall take effect at the earliest time allowable by law.

RESOLUTION NO. 2018-29 (cont.)

A RESOLUTION ADOPTING THE 2018 MUSKINGUM COUNTY HAZARD MITIGATION PLAN

PASSED IN COUNCIL this 19th day of March, 2018.

ATTEST:

NATALIE STILLION GRABLE,
Village Fiscal Officer

DAVID A. MATHEW, Mayor

TED L. CROZIER, SR., President
Pro-Tem of Council

APPROVED AS TO FORM ONLY:

STEVEN R. BALDWIN, Village Solicitor

RECORD OF RESOLUTIONS

Resolution No. _____ Passed _____ 20__

RESOLUTION NO# 05-18

A RESOLUTION OF THE VILLAGE OF FRAZEYSBURG ADOPTING THE 2018 MUSKINGUM COUNTY HAZARD MITIGATION PLAN; AND DECLARING IT AN EMERGENCY

WHEREAS, *the Village of Frazeysburg*, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, *the Village of Frazeysburg* acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of *the Village of Frazeysburg,* and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments,

BE IT RESOLVED, BY THE COUNCIL OF THE VILLAGE OF FRAZEYSBURG, MUSKINGUM COUNTY, OHIO, THE MAJORITY OF ALL MEMBERS DULY ELECTED THERETO, CONCURRING THAT:

SECTION ONE: The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the Village of Frazeysburg and.

SECTION TWO: The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

SECTION THREE: This resolution is hereby declared to be an emergency measure necessary to the public peace, health, safety and general welfare of the Village, and shall take effect immediately upon its passage. The reason for the emergency is the necessity for the Village to collect any revenue possible for the economic health of Frazeysburg.

PASSED IN AN OPEN SESSION OF COUNCIL THIS 9TH DAY OF APRIL, 2018.

Gerald R. Howard, Mayor

RECORD OF RESOLUTIONS

Resolution No. _____ Passed _____ 20____

Attest:

Jessica Everson
Jessica A. Everson, Fiscal Officer

APPROVED AS TO FORM ONLY:

Gerald J. Tiberio, Jr., Village Solicitor

2018 Muskingum County Hazard Mitigation Plan
Municipal Adoption Resolution

Resolution No. 3
Village of Gratiot, Muskingum County, Ohio

WHEREAS, *the Village of Gratiot*, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, *the Village of Gratiot* acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of *the Village of Gratiot,* and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for *the Village of Gratiot:*

- The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of *the Village of Gratiot* and
- The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this 4TH day of April, 2018

ATTEST:
Sandra L Baird Clerk Trans.

Village of Gratiot
By Connie L Boyd
By Paul Tyo
By Melanie Harvey

RES 18-0268

The following action was taken by the Board of Muskingum County Commissioners at its meeting today, March 12, 2018:

A RESOLUTION TO ADOPT 2018 MUSKINGUM COUNTY HAZARD MITIGATION PLAN – MUSKINGUM COUNTY EMA

It was moved by Commissioner Crooks, seconded by Commissioner Cameron, that this Board of County Commissioners, Muskingum County, Ohio adopts the following resolution:

WHEREAS, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, Muskingum County acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of Muskingum County, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED, that this Board of County Commissioners of Muskingum County, Ohio does hereby adopt the 2018 Muskingum County Hazard Mitigation Plan as the official Hazard Mitigation Plan of Muskingum County and the respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

Roll call: Porter, aye; Cameron, aye; Crooks, aye. Motion carried.

sr

cc: Jeff Jadwin, EMA Director

Copied on: 03.13.18

Copied by: Sar

CERTIFICATE

I, Susan Reese, Clerk to the Board of County Commissioners, Muskingum County, Ohio do hereby certify that the attached is a true and exact copy of Resolution 18-0268 in Journal Number 94 under the date of 03.12.2018 at the regular meeting of the Board of Muskingum County Commissioners. IN WITNESS WHEREOF, I have hereunto affixed by Signature and the Seal of Muskingum County, Ohio on this 12 day of 2018.

Susan Reese

Clerk of the Board

Muskingum County Commissioners

X

IN THE COUNCIL OF THE VILLAGE OF NEW CONCORD, OHIO

RESOLUTION NO. 04-18-6

A RESOLUTION ADOPTING THE 2018 MUSKINGUM COUNTY HAZARD MITIGATION PLAN AS THE OFFICIAL HAZARD MITIGATION PLAN OF THE VILLAGE OF NEW CONCORD AND DECLARING AN EMERGENCY.

WHEREAS, the Village of New Concord, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety; and,

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities; and,

WHEREAS, the Village of New Concord acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program Funds; and,

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of the Village of New Concord; and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan; and,

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments;

NOW, THEREFORE, be it resolved by the Council of the Village of New Concord, State of Ohio:

Section 1. The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of the Village of New Concord.

Section 2. The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

PASSED: April 9, 2018

Robert Dickson, President of Council

APPROVED: April 9, 2018

Brett Essex, Mayor

ATTEST: Lynn Marlatt, Fiscal Officer

I hereby certify that the above legislation was posted per Ordinance No. L-1-84-1.

Lynn Marlatt, Fiscal Officer

2018 Muskingum County Hazard Mitigation Plan
Municipal Adoption Resolution

Resolution No. 2018-16
Village of Roseville, Muskingum County, Ohio

WHEREAS, *the Village of Roseville*, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, *the Village of Roseville* acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of *the Village of Roseville*, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for *the Village of Roseville:*

- The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of *the Village of Roseville* and
- The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

ADOPTED, this 20 day of March, 2018

ATTEST: Heidi Mikes

Village of Roseville

By Dave Carroll

By _____

By _____

RECORD OF RESOLUTIONS

Dayton Legal Blank, Inc., Form No. 30048

Resolution No. 1036 Passed April 2nd 2018

2018 Muskingum County Hazard Mitigation Plan
Municipal Adoption Resolution

Resolution No. 1036
Village of South Zanesville, Muskingum County, Ohio

WHEREAS, *the Village of South Zanesville*, Muskingum County, Ohio is most vulnerable to natural and human-made hazards which may result in loss of life and property, economic hardship, and threats to public health and safety, and

WHEREAS, Section 322 of the Disaster Mitigation Act of 2000 (DMA 2000) requires state and local governments to develop and submit for approval to the President a mitigation plan that outlines processes for identifying their respective natural hazards, risks, and vulnerabilities, and

WHEREAS, *the Village of South Zanesville* acknowledges the requirements of Section 322 of DMA 2000 to have an approved Hazard Mitigation Plan as a prerequisite to receiving post-disaster Hazard Mitigation Grant Program funds, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan has been developed by the Muskingum County Emergency Management Agency in cooperation with other county departments, and officials and citizens of *the Village of South Zanesville*, and

WHEREAS, a public involvement process consistent with the requirements of DMA 2000 was conducted to develop the 2018 Muskingum County Hazard Mitigation Plan, and

WHEREAS, the 2018 Muskingum County Hazard Mitigation Plan recommends mitigation activities that will reduce losses to life and property affected by both natural hazards that face the County and its municipal governments,

NOW THEREFORE BE IT RESOLVED by the governing body for *the Village of South Zanesville:*

- The 2018 Muskingum County Hazard Mitigation Plan is hereby adopted as the official Hazard Mitigation Plan of *the Village of South Zanesville* and
- The respective officials and agencies identified in the implementation strategy of the 2018 Muskingum County Hazard Mitigation Plan are hereby directed to implement the recommended activities assigned to them.

Passed this 2nd day of April, 2018

Approved this 2nd day of April, 2018

Barbara Lloyd
President of Village Council

Jim Perdue
Mayor

Chris Kerby
Fiscal Officer/Clerk

Let it be noted:
A motion to suspend the three reading rule and pass this resolution as an emergency measure was made, seconded and passed with 6 affirmative votes. Refer to April 2nd, 2018 minutes.

By

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Appendix B. Meeting Agendas and Attendance

Muskingum County Hazard Mitigation Plan Update

Kickoff Meeting

February 28, 2017

10:00 AM – 12:00 PM

Place: Muskingum County Emergency Management Agency
2215 Adamsville Rd.
Zanesville, OH 43701

ATTACHED: LIST OF ATTENDANCE

MEETING FACILITATORS:

Jeff Jadwin, Deputy Director, Muskingum County Emergency Management Agency

Jason Farrell, Planner, Michael Baker International

Josh Vidmar, Planner, Michael Baker International

1. Welcome and Introductions
2. Project Overview
3. Planning Process
4. Participation
5. Hazard Review
    - Exercise: Risk Factor Evaluation
    - Exercise: Hazard Evaluation
6. Capability Assessment
    - Exercise: Capability Assessment Survey
7. Planning Timeline
8. Next Steps and Action Items

MUSKINGUM COUNTY HMPU 2017 KICKOFF MEETING OVERVIEW

Jeff Jadwin, Deputy Director, Muskingum County Emergency Management Agency, welcomed everyone and thanked them for attending the Kickoff Meeting for the Muskingum County Hazard Mitigation Plan Update. He then introduced Jason Farrell, Michael Baker International.

Upon Mr. Jadwin completing introductions and providing a brief overview of the purpose of the meeting, Jason Farrell spoke about the mitigation planning process, during which he gave a comprehensive overview of the definition of hazard mitigation and the mitigation planning process. In addition, he covered what is expected of the participants, both currently in attendance and those who will serve on the Muskingum County Hazard Mitigation Planning Committee in future meetings.

Mr. Farrell then provided those in attendance with a project timeline and an explanation of how Baker will complete the plan based on the proposed project schedule (looking at an approximate six month project schedule). Jason explained that it is a goal that the updated plan be delivered to Ohio for state review and then to FEMA for review in sufficient time for review and adoption.

Mr. Farrell explained the multiple purposes of the kickoff meeting: To kickoff the update of the plan, to reconvene the Muskingum County Mitigation Planning Committee (MPC) since the last plan update, and to encourage community involvement. Additionally, those in attendance will be asked to provide feedback and participate in the 5-year mitigation plan review; examining goals, objectives, and actions to determine if they should be kept in the updated plan, removed, or revised.

Jason then began discussion on the current plan.

JURISDICTIONAL CAPABILITY ASSESSMENT EXERCISE

The next step in the planning process was to explain the information that would be collected regarding each jurisdiction's capability assessment. The capability assessment was designed to show a municipality's capabilities in 4 areas: Planning and Regulatory, Administrative and Technical, Financial, and Education and Outreach.

Each jurisdiction in Muskingum County had a separate set of documents printed off and made available at this meeting. For those that did not attend, a physical copy and electronic copy were made available to the Muskingum County Emergency Management Agency for follow-up.

An example of a capability assessment is attached to these minutes.

RISK ASSESSMENT REVIEW EXERCISE

The next step in the kickoff meeting was reviewing the profiled hazards in the 2005 and 2010 plans, and addressing whether those hazards would be included in the update. Once the existing hazards were covered, the floor was opened to discuss inclusion of other hazards. The

HAZARD PRIORITY WORKSHEET

discussion led to questions as to whether man-made hazards like terrorism and hazardous materials should be included in the update. It was ultimately decided that hazardous materials and dam failure should be included in the plan as technological hazards.

Once the hazards were identified for the plan update, the planning committee ranked the hazards based on their probability, impact, spatial extent, warning time and duration. Attached to these minutes are the ranking methods assigned to these hazards.

The resulting risk factor priority table is shown below:

	Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Severe Winter Weather	4	1.2	3	0.9	4	0.8	1	0.1	3	0.3	**3.3**
2	Severe Summer Storms (Hail / Thunderstorms / High Winds / Lightning)	4	1.2	3	0.9	4	0.8	2	0.2	1	0.1	**3.2**
3	Tornado	4	1.2	3	0.9	2	0.4	4	0.4	3	0.3	**3.2**
4	Extreme Temperatures	3	0.9	3	0.9	4	0.8	3	0.3	1	0.1	**3**
5	Geologic Hazards (Earthquakes / Expansive Soils / Subsidence / Landslide)	4	1.2	2	0.6	3	0.6	4	0.4	1	0.1	**2.9**
6	Flood	4	1.2	2	0.6	2	0.4	1	0.1	4	0.4	**2.7**
7	Wildfire	4	1.2	1	0.3	2	0.4	4	0.4	1	0.1	**2.4**
8	Drought	2	0.6	1	0.3	4	0.8	1	0.1	4	0.4	**2.2**
	Technological Hazards	**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	Dam Failure	2	0.6	4	1.2	4	0.8	4	0.4	4	0.4	**3.4**
2	Hazardous Materials	4	1.2	3	0.9	3	0.6	4	0.4	3	0.3	**3.4**

RISK EVALUATION REVIEW EXERCISE

After the hazards were decided upon, a final exercise was completed by the group. The exercise was called the Risk Evaluation, in which the members of the committee determine, based on their own general knowledge, if the hazards selected pose more of a threat, less of a threat, or if there were no changes. It was explained to them that these were purely qualitative responses and that each would likely have different answers. The forms were completed and turned back in at the end of the meeting. They are enclosed in these minutes.

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? **NC=No Change, I=Increase, D=Decrease** ***(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)***	***Additional Comments***
Drought		
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)		
Extreme Temperatures		
Flood		
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)		
Severe Winter Weather		
Tornado		
Wildfire		
Dam Failure		

CLOSING AND NEXT STEPS

Once the risk factor exercise was completed, Mr. Vidmar went over the next steps of the project. This included a short discussion about the types of goals and objectives that would be discussed at the next meeting, as well a short talk about what mitigation actions are. After reviewing the planning schedule, those in attendance were asked if there were any further questions before adjourning. No questions were asked and the meeting was adjourned.

RF APPROACH

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. These criteria were used to evaluate hazards and identify the highest risk hazard.

The RF approach produces numerical values that allow identified hazards to be ranked against one another (the higher the RF value, the greater the hazard risk). 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 MPC. Based upon any unique

RF Value = [(Probability x .30) + (Impact x .30) +

(Spatial Extent x .20) + (Warning Time x .10) + (Duration x .10)]

concerns for the planning area, the MPC 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:

[Risk Factor Criteria]

Risk Assessment Category	Level	Degree of Risk Criteria	Index	Weight Value
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 ON 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 TWO WEEKS.	**3**	

Risk Assessment Category	Level	Degree of Risk Criteria	Index	Weight Value
	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 10% OF AREA AFFECTED	**1**	**20%**
	SMALL	BETWEEN 10% & 25% OF AREA AFFECTED	**2**	
	MODERATE	BETWEEN 25% & 50% OF AREA AFFECTED	**3**	
	LARGE	MORE THAN 50% 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 ***This category may be defined as "boots on the ground," or the time period of response to a hazard, or event.***	**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**	

According to the default weighting scheme applied, the highest possible RF value is 4.0.

Due to the inherent errors possible in any disaster risk assessment, the results of the risk assessment should only be used for planning purposes and in developing projects to mitigate potential losses. A strong analysis includes both quantitative and qualitative methodologies. For instance, geographic information systems (GIS)-based analysis and local knowledge are both important inputs to identifying vulnerabilities. As part of this hazard vulnerability analysis, the following steps should be considered:

- ✓ Inventory and summarize vulnerable assets
- ✓ Characterize repetitive flood loss properties
- ✓ Estimate loss
- ✓ Develop risk factor for each profiled hazard
- ✓ Describe asset vulnerability to future development

	Natural Hazards	Probability	Impact	Spatial Extent	Warning Time	Duration	RF Factor
1							
2							
3							
4							
5							
6							
7							
8							
	Technological Hazards	**Probability**	**Impact**	**Spatial Extent**	**Warning Time**	**Duration**	**RF Factor**
1							
2							
3							
4							
5							

The conclusions drawn from the qualitative and quantitative assessments, combined with final determinations from the MPC, were fitted into three categories for a final summary of hazard risk based on *High*, *Moderate*, or *Low* risk designations. It should be noted that although some hazards are classified as posing Low risk, their occurrence of varying or unprecedented magnitudes is still possible and will continue to be reevaluated during future updates of this plan.

Conclusions on Hazard Risk	
HIGH RISK (3.0 – 4.0)	
MODERATE RISK (2.0 – 2.9)	
LOW RISK (0.1 – 1.9)	

Jurisdiction: _____ ***Name/Title:*** _____

1. Planning and Regulatory Capability: Please indicate whether the following planning or regulatory tools and programs are currently in place or under development for your jurisdiction by placing an "X" in the appropriate box, followed by the date of adoption/update. Then, for each particular item in place, identify the department or agency responsible for its implementation and indicate its estimated or anticipated effect on hazard loss reduction (Supports, Neutral or Hinders) with the appropriate symbol and also indicate if there has been a change in the ability of the tool/program to result in loss reduction. Finally, please provide additional comments or explanations in the space provided.

Tool/Program	***Status***			***Dept. / Agency Respon-sible***	***Effect on Loss Reduction: + Support O Neutral -- Hinder***	***Change Since Last Plan: + Positive -- Negative***	***Comments:***
	In Place	***Date Adopted or Updated***	***Under Develop-ment***				
EXAMPLE: Hazard Mitigation Plan	*X*	*1/1/2006*		*Hazard County EMA*	+	+	*Interim update in 2008 revised mitigation strategy; completed one action.*
Hazard Mitigation Plan							
Emergency Operations Plan							
Disaster Recovery Plan							
Evacuation Plan							
Continuity of Operations Plan							
NFIP							
NFIP-CRS							
Floodplain Regulations							
Floodplain Management Plan							
Zoning Regulations							
Subdivision Regulations							

Tool/Program	Status			Dept. / Agency Respon-sible	Effect on Loss Reduction: + Support O Neutral -- Hinder	Change Since Last Plan: + Positive -- Negative	Comments:
	In Place	Date Adopted or Updated	Under Develop-ment				
Comprehensive Land Use Plan (or General, Master or Growth Mgmt. Plan)							
Open Space Management Plan (or Parks/Rec or Greenways Plan)							
Stormwater Management Plan / Ordinance							
Natural Resource Protection Plan							
Capital Improvement Plan							
Economic Development Plan							
Historic Preservation Plan							
Farmland Preservation							
Building Code							
Fire Code							
Firewise							
Storm Ready							
Other							

2. Administrative and Technical Capability: Please indicate whether your jurisdiction maintains the following staff members within its current personnel resources by placing an "X" in the appropriate box. Then, if YES, please identify the department or agency they work under and provide any other comments you may have in the space provided or with attachments.

Staff/Personnel Resources	***Yes***	***No***	***Department / Agency***	***Comments***
Planners (with land use / land development knowledge)				
Planners or engineers (with natural and/or human caused hazards knowledge)				
Engineers or professionals trained in building and/or infrastructure construction practices (includes building inspectors)				
Emergency manager				
Floodplain manager				
Land surveyors				
Scientists or staff familiar with the hazards of the community				
Personnel skilled in Geographic Information Systems (GIS) and/or FEMA's HAZUS program				
Grant writers or fiscal staff to handle large/complex grants				
Other				

3. Fiscal Capability: Please indicate whether your jurisdiction has access to or is eligible to use the following local financial resources ***for hazard mitigation purposes*** (including as match funds for State of Federal mitigation grant funds). Then, identify the primary department or agency responsible for its administration or allocation and provide any other comments you may have in the space provided or with attachments.

Financial Resources	*Yes*	*No*	*Department / Agency*	*Comments*
Capital improvement programming				
Community Development Block Grants (CDBG)				
Special purpose taxes				
Gas / electric utility fees				
Water / sewer fees				
Stormwater utility fees				
Development impact fees				
General obligation, revenue, and/or special tax bonds				
Partnering arrangements or intergovernmental agreements				
Other				

4. Community Political Capability: Political capability in this instance is being measured by the degree to which local political leadership (including appointed boards) is willing to enact policies and programs that reduce hazard vulnerabilities in your community, even if met with some opposition. Examples may include guiding development away from identified hazard areas, restricting public investments or capital improvements within hazard areas, or enforcing local development standards that go beyond minimum State or Federal requirements (e.g., building codes, floodplain management, etc.). Rate the jurisdiction's political capability to enact policies and

programs that reduce hazard vulnerabilities on a scale from 0 to 5. Generally, a higher the score corresponds to a higher degree of community political capability.

5-Very Willing ***3-Moderately Willing*** ***0-Unwilling to Adopt Policies/Programs*** ***Score: _____***

5. Self-Assessment of Capability: Please provide an approximate measure of your jurisdiction's capability to effectively implement hazard mitigation strategies to reduce hazard vulnerabilities. Using the following table, please place an "**X**" in the box Jeffing the most appropriate degree of capability (Limited, Moderate or High) based upon best available information and the responses provided in Sections 1-4 of this survey.

Area	***Degree of Capability***		
	Limited	***Moderate***	***High***
Planning and Regulatory Capability			
Administrative and Technical Capability			
Fiscal Capability			
Community Political Capability			
Community Resiliency Capability			

Evaluation of Identified Hazards and Risk

Name: Sharron Weaver **Title:** Mayor

Jurisdiction: Adamsville

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? **NC=No Change, I=Increase, D=Decrease** *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	NC	
Extreme Temperatures	I	
Flood	NC	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	I	
Severe Winter Weather	NC	
Tornado	I	
Wildfire	NC	
Dam Failure	NC	
Haz Mat	I	

Please email completed forms to Jason.farrell@mbakerintl.com

Evaluation of Identified Hazards and Risk

Name: Gerald Howard **Title:** MAYOR

Jurisdiction: Frazeysburg

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? NC=No Change, I=Increase, D=Decrease *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	NC	
Extreme Temperatures	NC	
Flood	NC	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	NC	
Severe Winter Weather	NC	
Tornado	NC	
Wildfire	NC	
Dam Failure	NC	
HAZ MAT	NC	

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Evaluation of Identified Hazards and Risk

Name: JEFF JADWIN **Title:** DEPUTY DIRECTOR

Jurisdiction: EMA

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? **NC=No Change, I=Increase, D=Decrease** *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	I	
Extreme Temperatures	NC	
Flood	I	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	NC	
Severe Winter Weather	NC	
Tornado	NC	
Wildfire	NC	
Dam Failure	I	
HAZMAT	I	

Please email completed forms to Jason.farrell@mbakerintl.com

Evaluation of Identified Hazards and Risk

Name: Michelle Horner **Title:** Design Engineer

Jurisdiction: Muskingum County Engineer's Office

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? NC=No Change, I=Increase, D=Decrease *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	I	
Extreme Temperatures	NC	
Flood	NC	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	I	
Severe Winter Weather	NC	
Tornado	NC	
Wildfire	NC	
Dam Failure	NC	
Hazardous Materials	NC	

Please email completed forms to Jason.farrell@mbakerintl.com

Evaluation of Identified Hazards and Risk

Name: Don Maddox **Title:** Water Dept Manager

Jurisdiction: Muskingum County

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? NC=No Change, I=Increase, D=Decrease *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	NC	
Extreme Temperatures	NC	
Flood	NC	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	NC	
Severe Winter Weather	NC	
Tornado	NC	
Wildfire	NC	
Dam Failure	NC	
Haz Mat	I	additional traffic

Please email completed forms to Jason.farrell@mbakerintl.com

Evaluation of Identified Hazards and Risk

Name: Jeff Slack **Title:** Village Administrator

Jurisdiction: Roseville

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? NC=No Change, I=Increase, D=Decrease *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	NC	
Extreme Temperatures	I	
Flood	I	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	I	
Severe Winter Weather	NC	
Tornado	NC	
Wildfire	I	
Dam Failure	NC	

Please email completed forms to Jason.farrell@mbakerintl.com

Evaluation of Identified Hazards and Risk

Name: DAVE CARROLL **Title:** MAYOR

Jurisdiction: ROSEVILLE

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? NC=No Change, I=Increase, D=Decrease *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	NC	
Extreme Temperatures	I	EXTREMELY HOT FOR 2016
Flood	NC	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	NC	
Severe Winter Weather	D	NOT NEAR AS SEVERE FOR 2016-17
Tornado	NC	
Wildfire	NC	
Dam Failure	NC	

Please email completed forms to Jason.farrell@mbakerintl.com

Evaluation of Identified Hazards and Risk

Name: Jeff Tilton **Title:** MAYOR

Jurisdiction: C.O.2

	How has the frequency of occurrence, magnitude of impact, and/or geographic extent changed in your community? NC=No Change, I=Increase, D=Decrease *(Please provide an explanation for any hazards marked I or D in the "Additional Comments" column)*	*Additional Comments*
Drought	NC	
Geologic Hazards (Earthquakes, Expansive Soils, Subsidence, Landslides)	I	one hillside has slipped twice onto a road
Extreme Temperatures	NC	
Flood	NC	
Severe Summer Storms (Hail, thunderstorms, high winds, lightning)	NC	
Severe Winter Weather	NC	
Tornado	NC	
Wildfire	NC	
Dam Failure	NC	

Please email completed forms to Jason.farrell@mbakerintl.com

Muskingum County Hazard Mitigation Plan Update
Kick-off Meeting
February 28, 2017

Name	Title	Jurisdiction/ Organization	Telephone	E-Mail Address
DAVE CARROLL	MAYOR	ROSEVILLE	740-697-7323	Mayor43777@SBCGLOBAL.NET
Gerald Howard	MAYOR	Frazeysburg	740 828 2901	Frazeysburg Mayor@gmail.com
Jeff Slack	Village Administrator	Roseville	740-701-0055	rad43777@sbcglobal.net
Jeff Hall	COZ MAYOR	Zanesville	740 455 0601	MAYORE COZ.ORG
Rick Warren	Viper	OEMA	614/296-7314	warren@dhs.gov
Dan Madden	Water Dept Manager	Muskingum County	740-588-4389	dmadden@muskingumcounty.org
Ray Mennega	Floodplain Mgr	Muskingum Co	740-455-7905	rmennega@muskingumcounty.org
Michelle Horner	Design Engineer	MCEO	740-454-0155	horner.mceo@rrohio.com
Shannon Weaver	Mayor	Adamsville	740-617-7142	shannonweaver368@gmail.com
JEFF JADWIN	DEP. DIRECTOR	EMA	740 453-1655	jjadwin@muskingumcounty.org

Muskingum County

Hazard Mitigation Plan Update

Meeting Agenda

May 17, 2017

10:00 AM

Place: Muskingum County Emergency Management Agency
2215 Adamsville Rd.
Zanesville, OH 43701

ATTACHED: List of Attendance

Jeff Jadwin, Deputy Director, Muskingum County Emergency Management Agency

Jason Farrell, Planner, Michael Baker International

Josh Vidmar, Planner, Michael Baker International

1. Welcome and Introductions
2. Risk Assessment Meeting Review
3. Review and Update Goals and Objectives (2011 Plan)
4. Develop New Goals and Objectives
5. Next Steps and Action Items

Questions? Comments?

Mitigation Planner: Jason Farrell, CFM

Jason.farrell@mbakerintl.com

614-538-7610

MUSKINGUM COUNTY HMPU MEETING II OVERVIEW

MUSKINGUM COUNTY HMPU 2017 KICKOFF MEETING OVERVIEW

Jeff Jadwin, Deputy Director, Muskingum County Emergency Management Agency, welcomed everyone and thanked them for attending the Kickoff Meeting for the Muskingum County Hazard Mitigation Plan Update. A short round of introductions then took place, including Jason Farrell and Josh Vidmar of Michael Baker International.

After introductions, Mr. Vidmar provided a brief overview of the purpose of the meeting and then spoke about the mitigation planning process.

RISK ASSESSMENT REVIEW

As a method of review, Mr. Vidmar began by reviewing some of the information presented in the kickoff meeting, as well as some of the information that had been gathered through the Hazard Identification and Risk Assessment process, and progress that had thus far been made on the plan. This presentation primarily consisted of presenting the maps that had been created based on the data. There was some discussion about where the data came from, and how it was used.

Once the existing hazards had been reviewed, Mr. Farrell made a call from the committee if they wanted to see any other hazards profiled than what was already covered. It was requested that Baker also review pipeline failure, as well as utility failure. Pipeline failure, due to its nature as a hazardous materials event, was integrated into the existing HazMat profile. The new hazard ranking is below.

	Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Severe Winter Weather	4	1.2	3	0.9	4	0.8	1	0.1	3	0.3	**3.3**
2	Severe Thunderstorms	4	1.2	3	0.9	4	0.8	2	0.2	1	0.1	**3.2**
3	Tornado	4	1.2	3	0.9	2	0.4	4	0.4	3	0.3	**3.2**
4	Extreme Temperatures	3	0.9	3	0.9	4	0.8	3	0.3	1	0.1	**3**
5	Geologic Hazards	4	1.2	2	0.6	3	0.6	4	0.4	1	0.1	**2.9**
6	Flood	4	1.2	2	0.6	2	0.4	1	0.1	4	0.4	**2.7**
7	Wildfire	4	1.2	1	0.3	2	0.4	4	0.4	1	0.1	**2.4**
8	Drought	2	0.6	1	0.3	4	0.8	1	0.1	4	0.4	**2.2**
	Technological Hazards	**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	Dam Failure	2	0.6	4	1.2	4	0.8	4	0.4	4	0.4	**3.4**
2	Hazardous Materials	4	1.2	3	0.9	3	0.6	4	0.4	3	0.3	**3.4**
3	Utility Failure	3	0.9	2	0.6	2	0.4	4	0.4	2	0.2	**2.5**

UPDATE MITIGATION GOALS AND OBJECTIVES

The next step of the meeting involved reviewing the mitigation goals and objectives from the previous versions of the plan, both the official 2005 version that was accepted by FEMA, and the 2013 edition that did not meet requirements. During this review, it was decided that instead

of each jurisdiction having their own goals and objectives, they would be rolled up to the countywide level, and would be rewritten to cover each hazard.

UPDATE MITIGATION ACTIONS

Each member of the committee was given a sheet that had their jurisdiction's mitigation actions from the previous plan. They were asked to review this information and, based on their best knowledge, determine if those actions had been completed, had not been completed and should be deferred into the new plan, were part of ongoing processes, or were no longer relevant and should be removed.

Mr. Farrell then went over the next step, which was to create new mitigation actions based on the current needs of the County and its communities. He then explained the different types of actions that FEMA recommends, those being natural systems protections, public education and outreach, structure and infrastructure projects, and local plans and regulations. The committee members then filled out actions, with Mr. Vidmar and Mr. Farrell addressing questions.

CLOSING AND NEXT STEPS

The formal closing of the meeting came before the mitigation actions were updated so that committee members could leave as they finished their exercises. After the majority of the committee had left, Mr. Jadwin took a few moments to discuss further information requests with the consultants.

GOALS AND OBJECTIVES TABLE

The following table represents the changes made to the existing goals, and the objectives that were written for the plan update:

Jurisdiction	Goal	Objective	Defer	Change	Delete	Reason
Muskingum County	1. Eliminate loss of life and reduce property damage due to natural hazards through education and early warning.	1-1. Effort will be made to provide information about natural hazards and risk reduction to 100% of affected citizens		X		Public education and outreach program
		1-2. Improve the coordination and information sharing between all affected populations, jurisdictions and agencies.		X		Education and outreach to public/private entities when needed
	2. Encourage growth and development planning that considers natural hazards and promotes disaster resistant future development.	2-1. To promote, review and update existing plans and strategies.			X	
	3. Reduce possibility of damage and loss due to repetitive occurrences of identified natural hazards.	3-1. Analyze repetitive loss areas within the County		X		More accurately map potential flood loss areas
		3-2. Identify and eliminate areas subject to persistent debris problems	X			
City of Zanesville	1. Reduce damage and protect health and safety of City populations during a hazard event.	1-1. Address structures, infrastructure and natural features determined to pose safety risk during a hazard event		X		Planning objective – dam failure – cutting city in half
		1-2. Minimize public health/safety risk in the event of a dam failure	X			
	2. Make efficient use of public infrastructure during a hazard event	2-1. Prevent unnecessary use of water during a drought event		X		Public education - drought
	3. Improve available hazard mitigation resources	3-1. Update flood plain maps for the City of Zanesville	X			Maintenance
		3-2. Update infrastructure and critical facilities maps for the City of Zanesville	X			
		3-3. Update infrastructure and critical facilities maps for the City of Zanesville	X			
Village of Adamsville		1-1. Increase public awareness for all Village residents for all hazard events		X		Public education outreach

Jurisdiction	Goal	Objective	Defer	Change	Delete	Reason
	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning	1-2. Improve the ability of the Village to respond in disaster circumstances [2005]		X		Generator grant application – structure and infrastructure
Village of Dresden	1. Eliminate loss of life and reduce property damage due to natural hazard through education and early warning [2013]	1-1. Implement a suitable early warning systems in all of the village areas and educate residents in on how to avoid loss of lives during a hazard event		X		Structure and infrastructure projects – tornado sirens -
		1-2. Installation of power generator system at Dresden Municipal Building to provide power source for Law Enforcement/Safe Haven area		X		Structure and infrastructure project – generator -
		1-3. renovates existing Dresden Municipal Building to provide Safe Haven for residents during a hazard event		X		Structure and infrastructure- tornado – shelter projects
		1-4. Upgrade storm drainage system to remove 40 homes from flood plain		X		Structure and infrastructure - flooding – culverts/railroad tracks/elevation changes
		1-5. Upgrade sewage plant to complete village plan to discharge storm water drainage from Sanitary sewer discharge			X	Finished
Village of Frazeysburg	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning and advanced preparations	1-1. Promote, review and update existing plans and strategies, and write new ones as needed, to protect the lives and property of the citizens	X			Plans and regulation objective – evac plans -
		1-2. Address structures, infrastructure and natural features determined to pose public safety risk during a hazard event	X			Repeat
		1-3. Equip the Volunteer Fire Department to assure command, control and communications in the event of a natural disaster			X	Completed

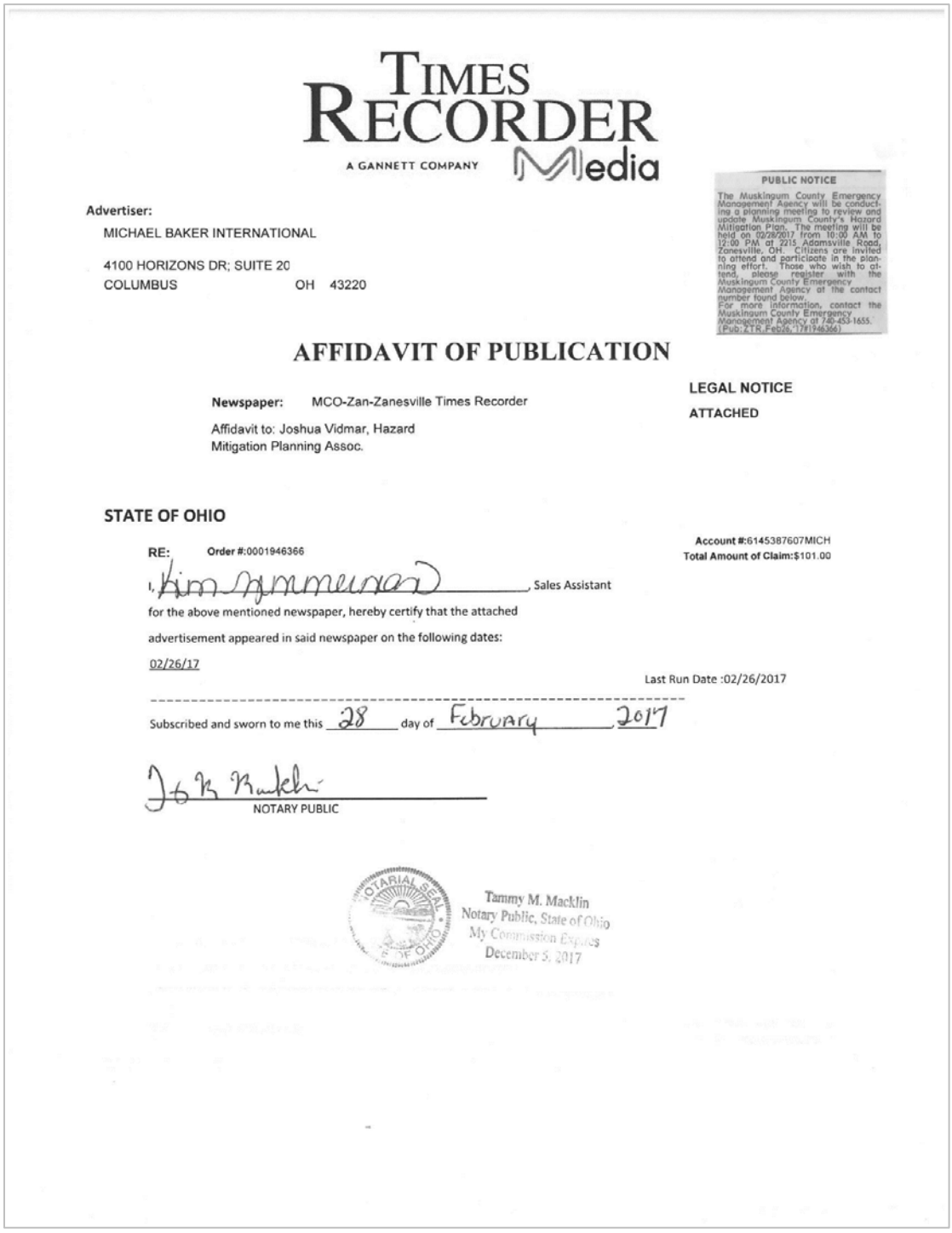
Jurisdiction	Goal	Objective	Defer	Change	Delete	Reason
Village of Fultonham	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning.	1-1. Increase public awareness for all Village residents for all hazard events		X		Repeat
Village of New Concord	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning.	1-1. Address structures, infrastructures and natural features that pose a public safety risk during a hazard event		X		Repeat
		1-2.* Eliminate loss of life and reduce injuries during a tornado *2005		X		Infrastructure project - tornadoes
		1-2. Educate and prepare the citizens about natural hazards and appropriate safety precautions		X		PE&O
		1-3. Ensure that all Village residents are familiar with the 100 year flood plain		X		PE&O
		1-4. Provide safe and timely evacuation when necessary		X		PE&O, planning – evac plans
Village of Norwich	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning.	1-1. Increase public awareness of emergency preparedness for all hazards for all residents		X		PE&O
		1-2. Limit and reduce damage caused by downed trees		X		Repeat
Village of Philo	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning. 2013	1-1. To upgrade existing tornado sirens	X			Structure and infrastructure project
		1-2. Purchase a Generator for Fire Station	X			S&I
Village of Roseville	1. To eliminate loss of life and reduce property damage due to natural hazard through education and early warning.	1-1. Update and improve Village early warning systems	X			S&I -

Jurisdiction	Goal	Objective	Defer	Change	Delete	Reason
Village of South Zanesville	1. To reduce property damage in flood plain area during flooding events	1-1. Educate all residents within South Zanesville as to the location of the designated 100 year flood plain areas	X			PE*O
	2. To eliminate loss of life and reduce property damage due to natural hazard through cooperation. Education and early warning	2-1. Improve coordination and information sharing between all effected populations, jurisdictions and agencies		X		Repeat
		2-2. Educate citizens about tornado warning systems		X		PE&O
		2-3. Update and improve Village early warning system			X	Complete

Muskingum County Hazard Mitigation Plan Update
Goals & Objectives Meeting
May 17, 2017

Name	Title	Jurisdiction/ Organization	Telephone	E-Mail Address
Chris Kerby	Fiscal Officer	Village of South Zanesville	(740) 454-2112	eckerby@yahoo.com
Danny Wiseman	Administrator	" of " "	(740) 454-0492	SouthZanesvillevillage@yahoo.com
DAVE CARROLL	MAYOR	VILLAGE OF ROSEVILLE	740-697-7315	MAYOR43777@SBCGLOBAL.NET
Jeff Slack	Administrator	Roseville	740-697-7323	rpd43777@sbcglobal.net
Michelle Horner	Design Engineer	Muskingum County Engineer's Office	740-454-0155	horner.mcoe@rrohio.com
JEFF JADWIN	DEPUTY DIRECTOR	MUSKINGUM COUNTY	740-453-1655	jjjadwin@muskingumcounty.org
Chad Williams	SAFETY	GENESIS HOSPITAL	740 454 5710	cwilliams@genesishcs.org
Kristina Bell	Emg Prep Coordinator	ZMCHD	7404549741	kristinab@zmchd.org
Gerald Howery	MAYOR	FREEZEYBURG	740 828-2201	freezeyburgmayor@gmail.com
David Matthew	DRESDEN Mayor	DRESDEN	740-754-3151	dresdenmayor@columbus.rr.com
MOLLIE CROOKS	COMMISSIONER	MUSKINGUM COUNTY	740-819-1954	MSCROOKS@MUSKINGUMCOUNTY.ORG

Appendix C. Draft Plan Public Notices



TIMES RECORDER
A GANNETT COMPANY Media

PUBLIC NOTICE

The Muskingum County Emergency Management Agency will be conducting a planning meeting to review and update Muskingum County's Hazard Mitigation Plan. The meeting will be held on 02/28/2017 from 10:00 AM to 12:00 PM at 2215 Adamsville Road, Zanesville, OH. Citizens are invited to attend and participate in the planning effort. Those who wish to attend, please register with the Muskingum County Emergency Management Agency at the contact number found below.
For more information, contact the Muskingum County Emergency Management Agency at 740-453-1655.
(Pub: ZTR,Feb26,'17#1946366)

Advertiser:
MICHAEL BAKER INTERNATIONAL

4100 HORIZONS DR; SUITE 20
COLUMBUS OH 43220

AFFIDAVIT OF PUBLICATION

LEGAL NOTICE
ATTACHED

Newspaper: MCO-Zan-Zanesville Times Recorder

Affidavit to: Joshua Vidmar, Hazard Mitigation Planning Assoc.

STATE OF OHIO

RE: Order #:0001946366

Account #:6145387607MICH
Total Amount of Claim:$101.00

I, Kim Hammond, Sales Assistant

for the above mentioned newspaper, hereby certify that the attached advertisement appeared in said newspaper on the following dates:

02/26/17

Last Run Date :02/26/2017

Subscribed and sworn to me this 28 day of February 2017

Tammy M. Macklin
NOTARY PUBLIC

NOTARIAL SEAL STATE OF OHIO

Tammy M. Macklin
Notary Public, State of Ohio
My Commission Expires
December 5, 2017

Vidmar, Joshua

From: Jeff Jadwin <jjjadwin@muskingumcounty.org>
Sent: Thursday, April 27, 2017 11:38 AM
To: 2017 Mitigation Planning Group
Cc: Luan K. Nguyen; Dan (Winningham) Endrizzi
Subject: Mitigation Plan Update Meeting

Good afternoon to All!

Please plan to attend a Mitigation Planning Meeting to be held May 17th, 2017 at the Muskingum County EMA Office at 2215 Adamsville Road from 10:00 am till 12 noon.

This meeting will be used to collect the paperwork that was issued to each City, or Village and the County so that we can compile the information that will affect each jurisdiction and their departments and agencies. Along with this we will collect information from all other agencies that operate within Muskingum County. The collected information will help in updating our Mitigation Plan.

If you cannot attend please send a representative. Your jurisdiction or agency/departments input is critical for this plan update and is required by FEMA.

Representatives from Michael Baker International will be on hand to facilitate the meeting and collect the neccessary information and forms.

Look forward to seeing everyone on May 17th. If you have any questions please feel free to contact me.

Have a great day!

Jeff

Jeff Jadwin
Deputy Director
Muskingum County EMA
Vice Chairman
Muskingum County LEPC
2215 Adamsville Road
Zanesville, Ohio 43701
740-453-1655 Office
740-252-1318 Cell
740-588-4304 Fax
jjjadwin@muskingumcounty.org
--

TIMES RECORDER Media

A GANNETT COMPANY

PUBLIC NOTICE

The Muskingum County Emergency Management Agency is seeking public comment on the proposed draft of the 2018 Muskingum County Hazard Mitigation Plan. This plan addresses the various hazards that may impact the County. The plan will be available for public review until November 20th, 2017 online at EMA.MuskingumCounty.org, as well as the EMA office at 2215 Adamsville Road, Zanesville, Ohio 43701. Questions and comments can be directed to jjjadwin@muskingumcounty.org, or to 740-453-1655.
(Pub:ZTR,Nov12'17#2524895)

Advertiser:

MICHAEL BAKER INTERNATIONAL

4100 HORIZONS DR; SUITE 20
COLUMBUS OH 43220

AFFIDAVIT OF PUBLICATION

Newspaper: MCO-Zan-Zanesville Times Recorder

LEGAL NOTICE
ATTACHED

STATE OF WISCONSIN

RE: **Order #:**0002524895

Account #:6145387607MICH
Total Amount of Claim:$81.30

I, _____, Sales Assistant

for the above mentioned newspaper, hereby certify that the attached

advertisement appeared in said newspaper on the following dates:

11/12/17

Last Run Date :11/12/2017

Subscribed and sworn to me this 22 day of Nov, 2017

Vicky Felty 9-1921
NOTARY PUBLIC

VICKY FELTY NOTARY PUBLIC STATE OF WISCONSIN

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Appendix D. Meeting Invitees

Muskingum County Meeting Invitee List					
MUNICIPALITIES	**Primary Representative**	**Kickoff Meeting 2/28/2017**	**Goals and Objectives Meeting 5/17/2017**	**Open House 9/14/2017**	**Individual Meeting**
Muskingum County	Jeff Jadwin	✓	✓	✓	✓
Adamsville	Shannon Weaver	✓			✓
Dresden	David Matthew		✓	✓	
Frazeysburg	Gerald Howard	✓	✓		
Fultonham		X	X	X	X
Gratiot	Melanie Kish			✓	
New Concord	Charlotte Colley			✓	
Norwich	Melissa West				✓ (10/2)
Philo	Lloyd Miller				✓ (10/2)
Roseville	Dave Carroll	✓	✓		
South Zanesville	Chris Kerby		✓	✓	
Zanesville	Jeff Thon	✓		✓	
ADJACENT COUNTIES	**Primary Representative**	**Kickoff Meeting 2/28/2017**	**Goals and Objectives Meeting 5/17/2017**	**Open House 9/14/2017**	**Individual Meeting**
Coshocton County					
Guernsey County					
Licking County					
Morgan County					
Noble County					
Perry County					
MISC. AGENCIES	**Primary Representative**	**Kickoff Meeting 2/28/2017**	**Goals and Objectives Meeting 5/17/2017**	**Open House 9/14/2017**	**Individual Meeting**
Muskingum County Engineers Office	Michelle Horner	✓	✓		
Muskingum Water Conservancy District					
Ohio Emergency Management Agency	Rick Warren	✓			
Zanesville-Muskingum County Health Department	Kristina Bell		✓		
HIGHER EDUCATION	**Primary Representative**	**Kickoff Meeting 2/28/2017**	**Goals and Objectives Meeting 5/17/2017**	**Open House 9/14/2017**	**Individual Meeting**
Muskingum College					
Zane State College					

PRIVATE SECTOR	Primary Representative	Kickoff Meeting 2/28/2017	Goals and Objectives Meeting 5/17/2017	Open House 9/14/2017	Individual Meeting
Autozone					
Genesis Healthcare System	Chad Williams		✓		
Zandex					

Appendix E. Plan Update Sheet

Year in HMP Cycle (circle one): 1 2 3 4

Purpose of Meeting (circle one): Annual Review / Post-Hazard Meeting

Date of Meeting: _____

This form is to provide an evaluation of County's Hazard Mitigation Plan. Documenting the implementation of the plan, and evaluating its overall effectiveness, is crucial to providing information during the next plan update. This will help those involved with the update process to determine what has been most useful after the 5-year lifecycle of the mitigation plan. Filling out this form on an annual basis will ensure that the County is actively considering hazard mitigation.

Were any mitigation actions implemented as a result of this plan?

Have other County plans been updated to include mitigation goals and priorities from this plan?

Has there been any development or redevelopment that could potentially increase or decrease the community's risk to hazards?

Is there anything else that should be noted as being particularly effective or ineffective from the mitigation plan?

Form filled out by:

Name _____

Title _____

Date _____

Appendix F. Plan Review Tool

LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

<table>
<tr><td>Jurisdiction: Muskingum County, Ohio</td><td colspan="2">Title of Plan: Muskingum County 2018 Hazard Mitigation Plan</td><td>Date of Plan: January 2018</td></tr>
<tr><td colspan="2">Local Point of Contact:

Jeff Jadwin</td><td colspan="2" rowspan="3">Address:

2215 Adamsville Rd.

Zanesville, Oh 43701

jjjadwin@muskingumcounty.org</td></tr>
<tr><td colspan="2">Title:

Director</td></tr>
<tr><td colspan="2">Agency:

Muskingum County EMA</td></tr>
<tr><td colspan="2">Phone Number:

740 453-1655</td><td colspan="2"></td></tr>
</table>

State Reviewer:	Title:	Date:
Luan Nguyen	**State Hazard Mitigation Planner**	**1/4/2017**

FEMA Reviewer:	Title:	Date:
Steve Greene	HM Community Planner	2/27/2018
Date Received in FEMA Region ***(insert #)***	1/10/2018	
Plan Not Approved		
Plan Approvable Pending Adoption	XX	
Plan Approved		

SECTION 1:

REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Sec. 3, pp. 1-7; App. B; App. C; App. D	✓	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	Sec. 3, pp. 1-7; App. B; App. C; App. D	✓	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	Sec. 3, pp. 1-7; App. B; App. C; App. D	✓	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Sec. 3, pp. 6-7; Reference throughout the plan	✓	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan	Met	Not Met
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Sec. 6, pp. 1-3	✓	
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Sec. 6, pp. 1-3	✓	
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Sec. 4, pp. 1-111	✓	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Sec. 4, pp. 1-111	✓	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Sec. 4, pp. 1-111	✓	
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Sec. 4.11, pp. 63-66	✓	
ELEMENT B: REQUIRED REVISIONS Misc. • Page 4-4; 4.10.3: "Error! Reference source not found." • Page 4-40; 4.10.3: "Error! Reference source not found." • Page 4-1 to 4-5, page numbering repeats after 4-5.			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Sec. 5.4, pp. 4-7	✓	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Sec. 4.7, pp. 63-66; Sec. 5, pp. 27-29	✓	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Sec. 5, pp. 7-9	✓	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan	Met	Not Met
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Sec. 5, pp. 21-31	✓	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Sec. 5, pp. 3-31	✓	
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Sec. 6, pp. 1-3	✓	
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Sec. 2, p. 6; Sec. 4, pp. 1-111	✓	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Sec. 5.5, pp. 9-20	✓	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Sec. 4, pp. 3-4; Sec. 5.5, pp. 9-20	✓	
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	App. A		
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))			
ELEMENT E: REQUIRED REVISIONS			

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan	Met	Not Met
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
F1.			
F2.			
ELEMENT F: REQUIRED REVISIONS			

SECTION 2:

PLAN ASSESSMENT

Plan Strengths and Opportunities for Improvement

- Neighboring Jurisdictions: The plan highlights the neighboring jurisdictions that surround the planning area but there is no discussion on if these jurisdictions were invited to participate in the planning process. For the next plan update the plan needs to discuss if they were invited to participate in the planning process and how they were invited to participate in the process.
- The plan does an excellent job in conveying the capabilities each jurisdiction possesses to advance mitigation.
- NFIP Participation: Page 5-4 indicates that Adamsville and Philo participates in the NFIP but according to the NFIP's Community Status Book Adamsville and Philo do not participate in the NFIP.
- Vulnerabilities/Impacts: The plan uses HAZUS to develop a scenario for a flooding event for the entire planning area. In reviewing this scenario, the discussion focuses on the overall planning area with very little discussion on each jurisdictions' vulnerabilities/impacts for this hazard. The plan must provide a summary for each jurisdiction's vulnerabilities/impacts to the identified hazards. For the next plan update, the plan needs to provide discussion on each jurisdiction's vulnerabilities/impacts for this hazard.

Resources for Implementing Your Approved Plan

The plan includes a list of mitigation actions that appear realistic and feasible. The county should pursue funding for the projects under the different mitigation grant programs. These grant programs include the following:

HMGP

The Hazard Mitigation Grant Program (HMGP) is authorized by Section 404 of the Robert T. Stafford Disaster Relief and Emergency Act, as amended. The key purpose of HMGP is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP is available, when authorized under the Presidential major disaster declaration, in areas of the State requested by the Governor.

PDM

The Pre-Disaster Mitigation (PDM) program is authorized by Section 203 of the Stafford Act, 42 USC 5133. The PDM program is designed to assist States and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future major disaster declarations.

FMA

The Flood Mitigation Assistance (FMA) program is authorized by Section 1366 of the National Flood Insurance Act (NFIA) of 1968, as amended with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).

SHARPP

The State Hazard Analysis Resource and Planning Portal (SHARPP) has additional resources listed in the Grants section under Other Mitigation Grants. Go to http://ohiosharpp.ema.state.oh.us/OhioSHARPP/Grants.aspx#otherMitigationGrants for more information.

SECTION 3:

MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1	Muskingum County	County										
2	Adamsville	Village										
3	Dresden	Village										
4	Frazeysburg	Village										
6	Gratoit	Village										
7	New Concord	Village										
8	Norwich	Village										

MULTI-JURISDICTION SUMMARY SHEET													
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
9	Philo	Village										
10	Roseville	Village										
11	South Zanesville	Village										
12	Zanesville	City										
13												

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

How does the Plan go above and beyond minimum requirements to document the planning process with respect to:

- *Involvement of stakeholders (elected officials/decision makers, plan implementers, business owners, academic institutions, utility companies, water/sanitation districts, etc.);*
- *Involvement of Planning, Emergency Management, Public Works Departments or other planning agencies (i.e., regional planning councils);*
- *Diverse methods of participation (meetings, surveys, online, etc.); and*
- *Reflective of an open and inclusive public involvement process.*

Element B: Hazard Identification and Risk Assessment

In addition to the requirements listed in the Regulation Checklist, 44 CFR 201.6 Local Mitigation Plans identifies additional elements that should be included as part of a plan's risk assessment. The plan should describe vulnerability in terms of:

1) *A general description of land uses and future development trends within the community so that mitigation options can be considered in future land use decisions;*
2) *The types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; and*
3) *A description of potential dollar losses to vulnerable structures, and a description of the methodology used to prepare the estimate.*

How does the Plan go above and beyond minimum requirements to document the Hazard Identification and Risk Assessment with respect to:

- *Use of best available data (flood maps, HAZUS, flood studies) to describe significant hazards;*
- *Communication of risk on people, property, and infrastructure to the public (through tables, charts, maps, photos, etc.);*
- *Incorporation of techniques and methodologies to estimate dollar losses to vulnerable structures;*
- *Incorporation of Risk MAP products (i.e., depth grids, Flood Risk Report, Changes Since Last FIRM, Areas of Mitigation Interest, etc.); and*
- *Identification of any data gaps that can be filled as new data became available.*

Element C: Mitigation Strategy

How does the Plan go above and beyond minimum requirements to document the Mitigation Strategy with respect to:

- *Key problems identified in, and linkages to, the vulnerability assessment;*
- *Serving as a blueprint for reducing potential losses identified in the Hazard Identification and Risk Assessment;*
- *Plan content flow from the risk assessment (problem identification) to goal setting to mitigation action development;*
- *An understanding of mitigation principles (diversity of actions that include structural projects, preventative measures, outreach activities, property protection measures, post-disaster actions, etc);*
- *Specific mitigation actions for each participating jurisdictions that reflects their unique risks and capabilities;*
- *Integration of mitigation actions with existing local authorities, policies, programs, and resources; and*
- *Discussion of existing programs (including the NFIP), plans, and policies that could be used to implement mitigation, as well as document past projects.*

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

How does the Plan go above and beyond minimum requirements to document the 5-year Evaluation and Implementation measures with respect to:

- *Status of previously recommended mitigation actions;*
- *Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;*
- *Documentation of annual reviews and committee involvement;*
- *Identification of a lead person to take ownership of, and champion the Plan;*
- *Reducing risks from natural hazards and serving as a guide for decisions makers as they commit resources to reducing the effects of natural hazards;*
- *An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);*
- *Discussion of how changing conditions and opportunities could impact community resilience in the long term; and*
- *Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.*

B. Resources for Implementing Your Approved Plan

Ideas may be offered on moving the mitigation plan forward and continuing the relationship with key mitigation stakeholders such as the following:

- *What FEMA assistance (funding) programs are available (for example, Hazard Mitigation Assistance (HMA)) to the jurisdiction(s) to assist with implementing the mitigation actions?*
- *What other Federal programs (National Flood Insurance Program (NFIP), Community Rating System (CRS), Risk MAP, etc.) may provide assistance for mitigation activities?*
- *What publications, technical guidance or other resources are available to the jurisdiction(s) relevant to the identified mitigation actions?*
- *Are there upcoming trainings/workshops (Benefit-Cost Analysis (BCA), HMA, etc.) to assist the jurisdictions(s)?*
- *What mitigation actions can be funded by other Federal agencies (for example, U.S. Forest Service, National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA) Smart Growth, Housing and Urban Development (HUD) Sustainable Communities, etc.) and/or state and local agencies?*

SECTION 3:

MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1												
2												
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10												
11												

MULTI-JURISDICTION SUMMARY SHEET												
#	Jurisdiction Name	Jurisdiction Type (city/borough/ township/ village, etc.)	Plan POC	Mailing Address	Email	Phone	Requirements Met (Y/N)					
							A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Requirements
12												
13												
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