Greene County

2020 Hazard Mitigation Plan

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INTERNATIONAL

Table of Contents

Table of Figures

Table of Tables

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SECTION 1. INTRODUCTION

The safety of the Greene 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. The Greene County Hazard Mitigation Plan (HMP) is an effort to mitigate the effects of hazards and return to normal operating status 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 Greene County.

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, Greene County, in partnership with an HMP consultant, is developing the 2020 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.

There have been 14 federal disaster declarations been documented in Greene County since 1953, due to: severe storms, snow, flooding, tornadoes, and a hurricane. These recorded natural hazard events provide a hazard footprint across the region which helps mitigation planners understand hazards that could occur in and around Greene 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, the County must be prepared to implement efficient and effective short- and long-term actions where needed. The purpose of the 2020 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.

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.

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, Greene 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.

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 Greene County's 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.
- **Section 4.** Hazard Risk Assessment identifies and prioritizes all hazards affecting the 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.

1. HISTORY OF GREENE COUNTY

Greene County is located in the southwestern part of the State of Ohio, just east of Montgomery County and the City of Dayton. Established May 1, 1803, these 266,350 acres were named for Nathaniel Greene, a hero of the American Revolution.

East and west transportation through Greene County is provided primarily by U.S. Route 35, which runs east/west through the middle of the county, Beavercreek, Xenia and Jamestown. Interstate 675 skirts around the western edge of the county, running north to south and connecting Interstates 75 and 70 through the population center of Greene County. In addition, U.S. Routes 42 and 68, and State Routes 72 and 235 offer primary north and south access across the county. Part of Interstate 71 passes through the southeast corner of the county. Interstate 71 connects Louisville, Kentucky to Cleveland, Ohio. Greene County also has active freight railroad lines in the northwest portion of the county. But, many of the existing railroad lines have been abandoned and converted to bike paths, for which the county has become renowned. The County, with a population of 168,937 is home to 4 cities with 3 additional cities being partly in the County, 6 villages, 12 townships.

Greene County was home to Colonel Charles Young (1864-1922), the third African American to graduate from West Point and the highest-ranking African American officer of the First World War. Other historical attractions include the Clifton Mill, Antioch University and the Greene County prairie where the Wright brothers began their early experiments in flight. The County is also home to the majority of land that is the Wright Patterson Air Force Base. In addition, Greene County's natural attractions include the Little Miami National Scenic River, Clifton Gorge and John Bryan State Park in Miami Township, and the Spring Valley Wildlife Area. Greene County is also home to unique cultural attractions including the National African American Museum and Cultural Center and the Blue Jacket Outdoor Drama.

The county is also unique in that it has two public universities and three private, non-for-profit universities, thus influencing the educational attainment level of its residents. The county also has twelve public school districts that deliver education in thirty-seven public schools and in eight private schools.

2. GEOGRAPHY, TOPOGRAPHY, AND CLIMATE

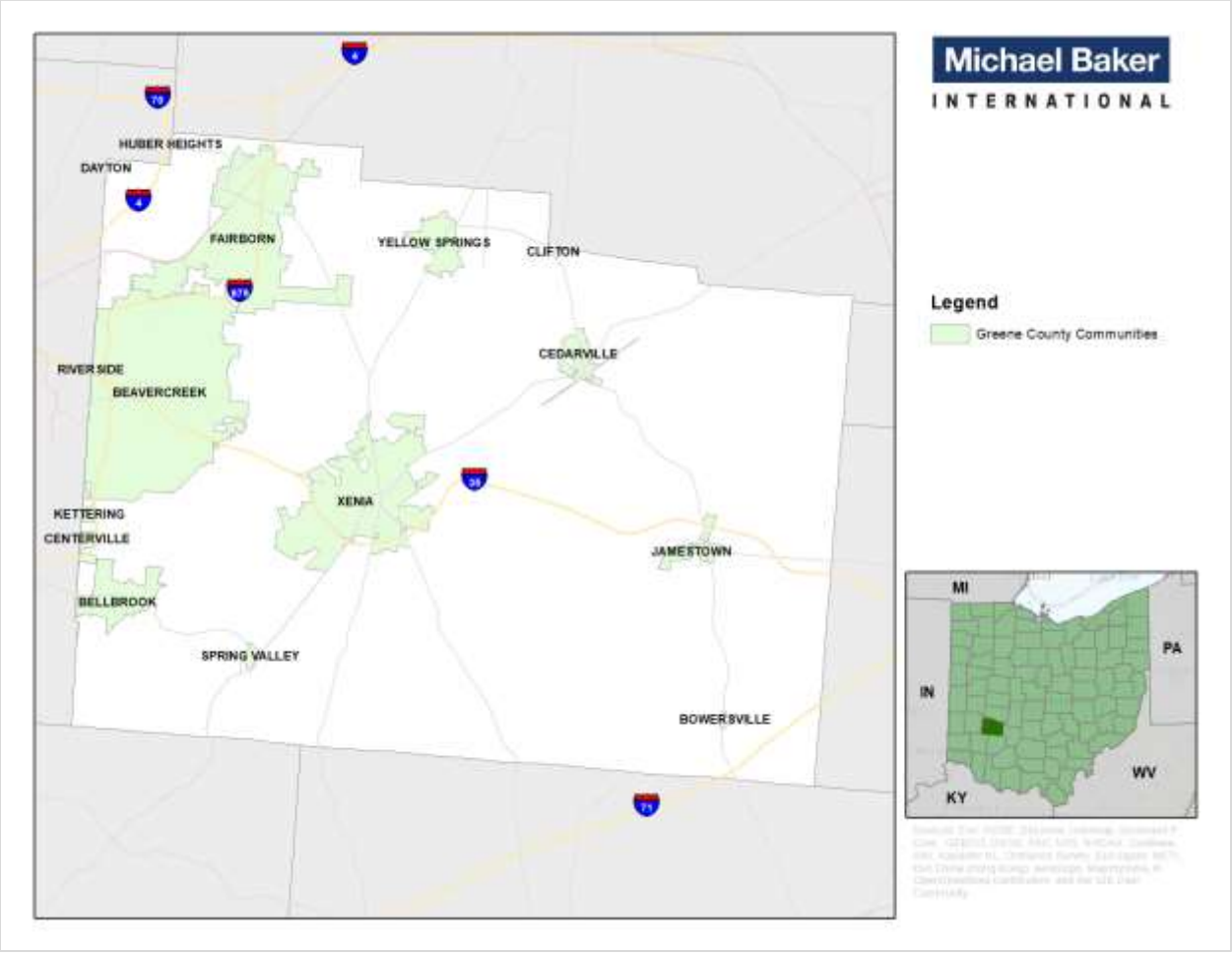
2.1 GEOGRAPHY

Greene County, located along the Little Miami River in southwestern Ohio, is primarily agricultural, especially the eastern half of the county. Greene County has a land area of 421 square miles. The general landscape of the county is a plain with an average elevation above sea level of about one thousand feet, with elevation ranges from 730 feet to 1135 feet. Land use within the county is arranged into six major categories and, as might be expected, the largest use of land (70%) is for cropland. Urban uses comprise 15% of the county. Like other suburban counties in Ohio, Greene County's population is distributed across multiple communities (both cities and townships), as opposed to having a large population centralized in one city.

Greene County is in four major watersheds. The major watershed is the Little Miami Watershed, and the other three watersheds are the Great Miami, the Lower Great Miami, and the Paint. Two major features characterize its topography, the valleys of the Little Miami River and Beaver Creek. The major bodies of water within the county are Caesar's Creek, which is located within the southeastern townships of the county, Mad River in the upper left corner of the County, and the Little Miami River. Shawnee Creek intersects with the Little Miami River in the western part of the County. Caeser's Creek winds throughout the southern area of the County to connect Shawnee Lake to Caeser Creek Lake that is located south of Greene County.

Greene County is bordered on the north by Clark County and in the south by Warren and Clinton Counties. Greene is also bordered on the east by Fayette and Madison Counties, and on the west by Montgomery County.

FIGURE 1 GREENE COUNTY, OHIO



2.2 TOPOGRAPHY

Greene County is an area of Ohio that has a great many hills as well as flat plains. Numerous small creeks and streams run through the many valleys and gorges, draining into larger rivers that they meet. Because of the flatter terrain in many places, Greene County's land cover is approximately 54.27% cultivated crop, leaving 14.10% as forested land. The number of hills leaves the County more susceptible to the effects of winter storms that can hinder transportation, geologic hazards such as landslides, and wildfires in the forested areas.

2.3 CLIMATE

Greene County's climate can be considered a temperate humid continental climate. This type of climate is characterized by moderate temperatures and precipitation and is typical of areas that are at a great distance from the oceans or other major bodies of water. And yet, the change to new seasons happens gradually. The majority of the precipitation and hazardous weather comes from tropical air masses in the Gulf of Mexico and the western Atlantic Ocean. While Greene County is adjacent to Montgomery County, Greene has experienced more weather-related hazards than its neighbor and this fact is most visible by studying the trends affecting the county seat, Xenia. Major

thunderstorms have resulted in the two most common hazards in the County, tornados and flooding. The largest tornado occurred in 1974 and damaged half of the City of Xenia.

Temperate continental characterizes the climate of the Great Miami Watershed. Extreme temperatures and precipitation can depict this type of climate, too. However, the adjustment to different seasons happens gradually. Due to its distance from the ocean, Greene County is hot in the summer and cold in the winter.

TABLE 2-1 GREENE COUNTY CLIMATE SUMMARY

Climate Measurements	Greene County	United States
Avg. Annual Rainfall (in.)	40.7	38.1
Avg. Annual Snowfall (in.)	18.3	27.8
Avg. Annual Precipitation Days	119.5	106.2
Avg. Annual Sunny Days	177	205
Avg. Annual July High	84.4°F	85.8°F
Avg. Annual Jan. Low	21.3°F	21.7°F
Comfort Index (higher=better)	7.2	7
UV Index	3.6	4.3
Avg. Elevation FT.	965	2,443

3. POPULATION, OCCUPANCY, AND DEMOGRAPHICS

Population and demographic information provide baseline data about Greene 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. The most recent demographic data available is from the 2019 American Community Survey Estimates 1-Year Data Profile, while population estimates are from 2019 Ohio Development website.

TABLE 2-2 COUNTY BASELINE DEMOGRAPHICS

Demographic Information	Total Count
Male	82,944
Female	85,993
Total Population	**168,937**
Race and ethnicity	**Residents**
White/Caucasian	141,262
Black or African American	10,687
Asian American	4,356
Hispanic	5,002
Two or More Races	6,329
American Indian/ Alaskan Native	479
Native Hawaiian / Pacific Islander	627
Other	195
Total	**168,937**
Previous Years' Populations	**Residents**
2018	167,446
2016	164,325
2010	161,573
2000	147,886
1990	136,731
1980	129,769
1970	125,057
1960	94,642
1950	58,892

Based on figures provided by the United States Census Bureau, the County has a residential population of 168,937. With a land total of 414.9 square miles, the population density is 407 people per square mile. The racial makeup of the County is approximately 83.6% White/Caucasian, 6.3% Black or African American, and 3.7% other races. Those of Hispanic descent make up approximately 3% of the population.

The following chart is a comprehensive list that details the actual population of the County in 2010, the population estimate for 2019, the estimated change in population between 2010 and 2019, the total number of housing units, the number of housing units occupied, and the area (in square miles) for the municipality.

TABLE 2-3 COUNTY DEMOGRAPHIC PROFILE

Municipality	Total Count
2010 Population	161,573
2019 Population Estimate	168,937
Population Change 2010 – 2019	4.56%

Total Housing Units, 2018	69,576
Occupied Housing Units, 2018	64,702
Vacant Housing Units, 2018	4,874

The following table breaks down the total population by cities and villages within Greene County. The data is from Ohio Development Services Agency's 2019 Population Estimates for Cities, Villages, and Townships.

TABLE 2-4 INCORPORATED POPULATION

Community	Population
City of Beavercreek	47,741
City of Bellbrook	7,344
City of Centerville*	2
City of Dayton*	0
City of Fairborn	33,876
City of Kettering*	461
City of Xenia	26,947
Bowersville	330
Cedarville	4,320
Clifton*	99
Jamestown	2,136
Spring Valley	499
Yellow Springs	3,744
Total Incorporated Population	127,499
Total Unincorporated Population	41,438

*denotes only part of the jurisdiction is located in Greene County

3.1 EFFECTS OF POPULATION CHANGE ON MITIGATION

The occupancy of housing has a direct correlation to mitigation planning and disaster management. Those homes that are maintained have a greater chance of not contributing to damage and debris during hazard events. Vacant homes are more like to sustain heavy damage during events such as thunderstorms, high winds, tornadoes, and winter storms.

If vacant homes deteriorate, they can be more easily damaged or destroyed during hazard events (specifically high winds, thunderstorms, and tornadoes), this can result in what were once homes becoming projectiles and wind-borne debris. Wind-borne debris can injure people, damage vehicles and other structures, as well as creating a post impact environment where debris management is intensified. As communities within the planning area experience a population increase, the amount of buildings, infrastructure, critical facilities, and people at risk increase as well. There is also a chance the amount of vacated homes could increase.

Because the population has been increasing for several decades, there are an increased number of people who are susceptible to hazards. Greene County has an increasingly aging population, which leaves those in the county *more* susceptible to hazard events, particularly where additional shelter is

required. Hazards such as extreme temperatures, tornadoes, severe winter storms, and severe summer storms can cause power outages that can cause the losses of heating and cooling, putting the elderly and the very young most at risk.

3.2 EMPLOYMENT

According to the United States Census Bureau Longitudinal Employer-Household Dynamics (LEHD), there are a total of 62,295 persons employed in the County workforce as of 2017. The North American Industry Classification Systems keeps track of jobs based on census blocks. Retail trade makes up 17.7% of the jobs in the County, followed by Professional, Scientific, and Technical Services at 15.2%. The next closest is Accommodation and Food Services at 14.0%.

It is expected that commercial development will continue to saturate more urban areas like the cities of Beavercreek, Dayton, Bellbrook, Xenia and the villages of Yellow Springs and Cedarville throughout the next 25 years. One reason is that the retail and service market is far from being saturated in the cities and in the villages. Another reason is that high transportation costs which are expected to continue to rise are keeping more travelers closer to home and in their search for goods and services.

TABLE 2-5 NAICS JOB INVENTORY

Industry	Count	Share
Agriculture, Forestry, Fishing and Hunting	141	0.2%
Mining, Quarrying, and Oil and Gas Extraction	89	0.1%
Utilities	158	0.3%
Construction	1,592	2.6%
Manufacturing	3,790	6.1%
Wholesale Trade	1,311	2.1%
Retail Trade	11,048	17.7%
Transportation and Warehousing	996	1.6%
Information	788	1.3%
Finance and Insurance	1,106	1.8%
Real Estate and Rental and Leasing	573	0.9%
Professional, Scientific, and Technical Services	9,465	15.2%
Management of Companies and Enterprises	1,287	2.1%
Administration & Support, Waste Management and Remediation	1,940	3.1%
Educational Services	8,565	13.7%
Health Care and Social Assistance	7,131	11.4%
Arts, Entertainment, and Recreation	613	1.0%
Accommodation and Food Services	8,741	14.0%
Other Services (excluding Public Administration)	1,375	2.2%
Public Administration	1,586	2.5%
TOTAL	**62,295**	**100%**

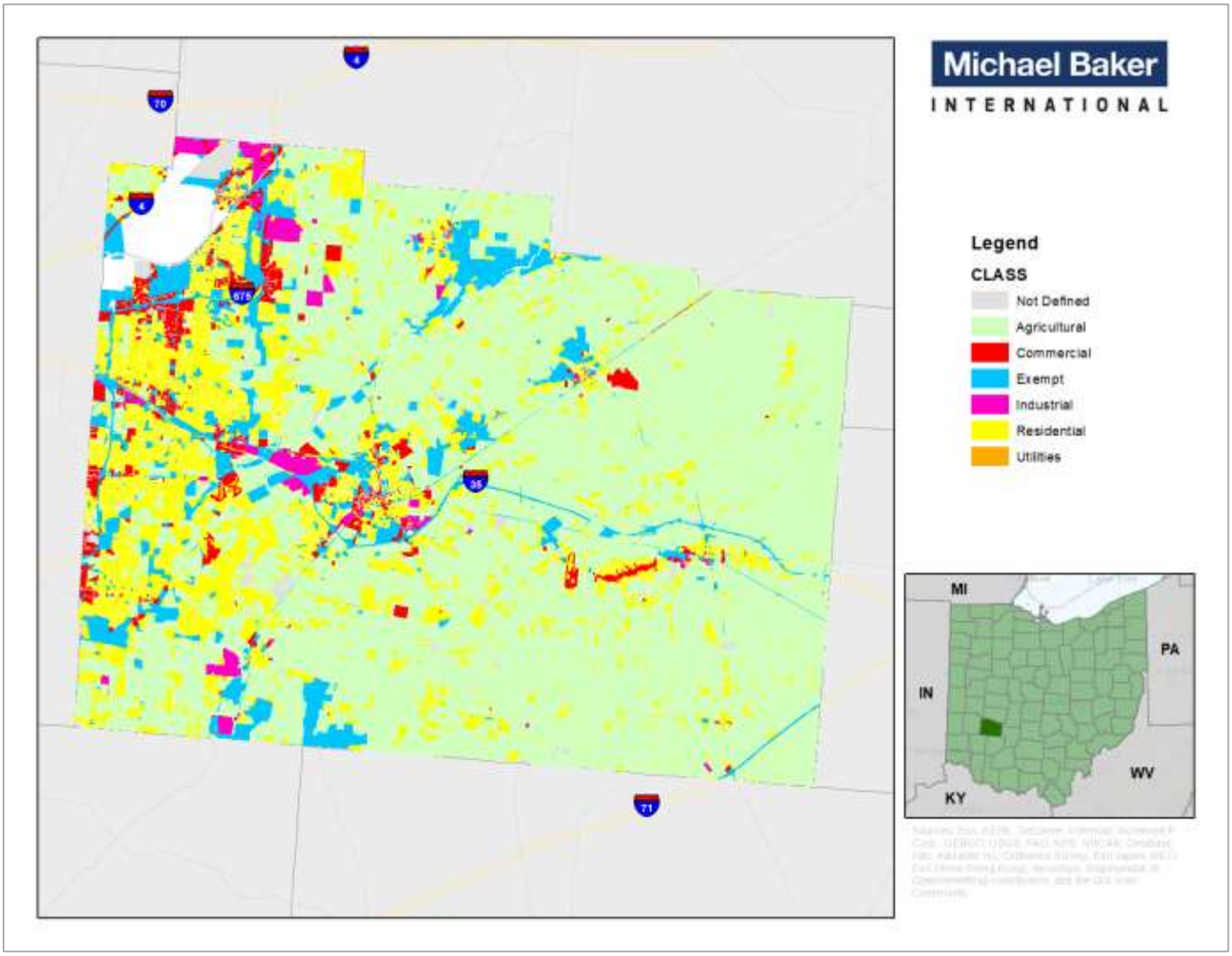
3.3 EFFECTS OF EMPLOYMENT ON MITIGATION PLANNING

Employment, similar to housing, can have an effect on mitigation planning and disaster events. This is because employment is tied directly to housing. Many small towns in rural areas are heavily reliant on a particular company or industry. When these disappear or take on a reduced role, the effects can be an economic downturn, resulting in blighted properties.

3.4 LAND USE AND FUTURE DEVELOPMENT AREAS

Cities of Fairborn, Xenia, Bellbrook, and Beavercreek have all been experiencing significant development in their commercial and residential districts. Cedarville Township has had growth due to Cedarville University continuing to grow and is expected to continue to see increased enrollment in the future. Very little new development or redevelopment has taken place in the smaller jurisdictions since the previous HMP. Overall, Greene County is seeing growth in the majority of its jurisdictions. Due to the rather rapid increase in population, the county's sanitary infrastructure has experienced strain. As development occurs, regulations have been set in place by the local governments to control growth around floodplains and take measures to lessen erosion. Members of the community completed a Risk Evaluation to determine how they perceived their change in vulnerability to each hazard in comparison to development trends and larger factors. These are available in Appendix D.

FIGURE 2 GREENE COUNTY LAND USE MAP



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SECTION 3. THE PLANNING PROCESS

This section describes each stage of the planning process used to develop the 2020 HMP. The planning process provides a framework for document development and follows the FEMA recommended steps. The 2020 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.

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 PLANNING PROCESS

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 2020 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, 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 MITIGATION PLANNING PROCESS

2. ORGANIZE RESOURCES

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

3. BUILDING THE PLANNING TEAM

The Planning Team, key to the backbone of the planning process, was critical for the development of the 2020 HMP. The planning team was built by Greene County, who invited private and non-profit agencies, as well as members of the consultant team. This group was known as the Hazard Mitigation Planning Committee (HMPC).

4. HAZARD MITIGATION PLANNING COMMITTEE

The 2020 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
- Decisions 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 2020 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, businesses, nonprofits, and other interested parties were invited and encouraged to participate in the development of the Plan. Emails were sent to inform and alert the local stakeholders of the plan update and planning process. Table 3-2 provides a list of the 2020 HMP Planning Committee members.

TABLE 3-2 2020 HMP PLANNING COMMITTEE

Name	Department	Title / Role	Meeting Attended
Matt Ingram	American Red Cross	Disaster Services	1
Steve Ross	Bath Township	Trustee	1
Amy Hiles	Beavercreek Township	Clerk	1
Alex Zaharieff	Beavercreek Township	Township Administrator, Public Safety Director	2
David VandenBos	Beavercreek Township	Beavercreek Township Fire Chief	2
Jim Neidhard	Bellbrook Fire Department	Fire Chief	2
Kyle Miller	Cedarville Township	Township Fire Chief	2
Mike Thonnerieux	City of Beavercreek	Director	Ind. (8/5)
Melissa Dodd	City of Bellbrook	City Manager	1
David Reichert	City of Fairborn	Fire Chief	1, 2, Ind. (8/11)
Chris Berger	City of Xenia	City Engineer/PS Director	1, 2
Thomas Breckel	Clinton County	Director	1
Alsu Shaydullina	GCSED	Administration Coordinator	1
Jason Tincu	Greene County	Director of Sanitary	1
Al Kuzma	Greene County	Chief Building Officer	1, 2
Stephanie Goff	Greene County	County Engineer	1, 2
Rosanne Anders	Greene County EMA	Directors	2
Kim Caudill	Greene County Public Health	Em. Response Coordinator	1
Barry Puskas	Miami Conservation District	Manager of Technical Services	1, 2
Phillip Clayton	Ohio EMA	SW Region Supervisor	1
Devon Shoemaker	RPCC	Director	1, 2
Brett Bonecutter	Spring Valley Township	Township Administrator	2
Jeff Leaming	Sugarcreek Township	Township Fire Chief	2
Rachel Cline	Village of Bowersville	Fiscal Officer	Ind. (8/27)
Burton Roberts	Village of Cedarville	Chief of Police	Ind. (8/20)
Joshua Bradley	Village of Jamestown	Mayor	Ind. (8/20)
Julie Robinson	Village of Spring Valley	Village Administrator	Ind. (6/3)

Name	Department	Title / Role	Meeting Attended
Brian Carlson	Village of Yellow Springs	Chief of Police	1
Scott Miller	Xenia Township	Trustee	1
Greg Beegle	Xenia Township/City of Xenia	Fire Chief	1, 2

4.1 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
July 16, 2019	Internal Kickoff (Steering Committee)	• Review of Mitigation Planning Standards • Schedule & Meetings • Participation • Relevant Data and Documentation • Questions and Next Steps
October 8, 2019	Hazard Assessment Meeting (Planning Committee Meeting #1)	• Planning Committee Introductions • Hazard Mitigation Planning Process • Hazard Identification & Risk Assessment (HIRA) Exercise • Develop Mitigation Goals & Objectives
May 18, 2020	Mitigation Strategy Meeting (Planning Committee Meeting #2)	• Review of Planning Process • Review of HIRA • Review Mitigation Techniques ○ Categories of Action • Introduce Greene County HMP Website • Develop Mitigation Actions • Develop Mitigation Actions Plan
June 3, 2020- August 7, 2020	Individual Meetings	• Communities participated on an as-needed basis

As the planning committee prepared to meet for the second time, the COVID-19 pandemic ensued. All forms of in-person gatherings were canceled, postponed, or moved to a virtual setting. Rather than postpone the Mitigation Strategy Meeting until social gatherings were deemed safe, Greene County opted for a virtual conference through Cisco WebEx. The WebEx meeting information was created, and the County dispersed the announcement to the committee members.

WebEx is an online conference center that has multiple capabilities for users. As meeting participants logged into the meeting, they had the option to utilize the video feature or remain on audio. Screen sharing was used to present the PowerPoint that was created for the meeting. Should participants have questions, they were able to speak directly during the conference, or they could utilize the chat function and send a message to an individual, group, or the entire audience. Rather

than have the committee email the remaining completed forms they had received at the Hazard Assessment Meeting; a website was created for each jurisdiction to submit the information online.

The following table identifies how the eligible jurisdictions and stakeholders participated in the planning process. The bold jurisdictions are the communities found, or partially found, in Greene County. The entities below them are townships who provided information, townships who completed the planning process, and stakeholders who completed the planning process. Communities who did were not available to participate in the two scheduled meetings opted to complete an individual meeting to complete the planning process requirements. Xenia, Fairborn, Beavercreek, Cedarville, Jamestown, Spring Valley, and Bowersville all completed individual meetings between June 3rd and August 27th.

TABLE 3-4 JURISDICTIONAL PARTICIPATION

Jurisdiction	Meeting Participants				2020 Status
	Meeting 1	*Meeting 2*	*Ind. Meeting*	*Any Meeting*	*COMPLETE*
Greene County	O	O	-	O	O
Beavercreek	X	X	8/5	O	O
Bellbrook	O	O	-	O	O
Centerville**	X	X	-	X	X
Dayton**	X	X	-	X	X
Fairborn	O	O	8/11	O	O
Kettering**	X	X	-	X	X
Xenia	O	O	8/6	O	O
Bowersville	X	X	8/27	O	O
Cedarville	X	X	8/20	O	O
Clifton*	X	X	-	X	X
Jamestown	X	X	8/20	O	O
Spring Valley	X	X	6/3	O	O
Yellow Springs	O	X	8/27	O	O
Bath Township	O	X	-	O	O
Beavercreek Township	O	O	-	O	O
Cedarville Township	X	O	-	O	O
New Jasper Township	X	X	-	X	-
Spring Valley Township	X	O	-	O	O
Sugarcreek Township	X	O	-	O	O
Xenia Township	O	O	-	O	O
Miami Conservancy District	X	O	-	O	O

*Clifton is in two counties, and the town participated and adopted Clark County's mitigation plan; therefore, there was no need for them to participate in Greene County's plan update.

** Centerville, Dayton, and Kettering are all located in multiple counties. While they were informed of the upcoming planning process for Greene County's HMPU, they chose to not participate.

4.2 PUBLIC OUTREACH STRATEGY

Public outreach is a major component of the 2020 HMP. Participation from the public, including the general citizenry, is necessary in order to gain a full picture of the potential issues and hazards that affect the County.

Outreach Media

The Outreach Strategy used several methods for communicating information about the planning process to the public. The Greene County Emergency Management Agency invited the public to participate through Facebook postings and events. An ad was also placed in the local newspaper to ensure the public was aware of the planning process that was to be held.

The public was also notified upon completion of the final draft in order to review the plan and submit comments and/or questions. Greene County shared the public notice as well as the plan draft on the County's website under recent news as well as having the jurisdictions share the plan draft through social media.

FIGURE 4 EXAMPLE OF PUBLIC NOTIFICATION

4.3 DRAFT PLAN COMMENTS RECEIVED

The plan was posted for public review on Greene County's website on October 7th. The comment period for the public was open for two weeks, closing on October 21. No comments, questions, or concerns were submitted by the public during the review period.

The City of Xenia made several minor corrections to its capability assessment as well as ensured both wastewater treatment plants were mapped for the Water Quality hazard profile. Other

comments from community officials were minor grammatical changes and requests for clarity regarding data, mapping, and jurisdictional participation. Miami Conservancy District also submitted several grammatical changes as well as small edits to the Dam Failure hazard profile, their capability assessment, and vulnerabilities to hazards.

4.4 REVIEW AND INCORPORATE EXISTING INFORMATION

The HMP Planning Committee reviewed and assessed existing plans, studies, and data available from local, state, and federal sources. Documents reviewed and incorporated as part of the HMP planning process are shown in Table 3-5.

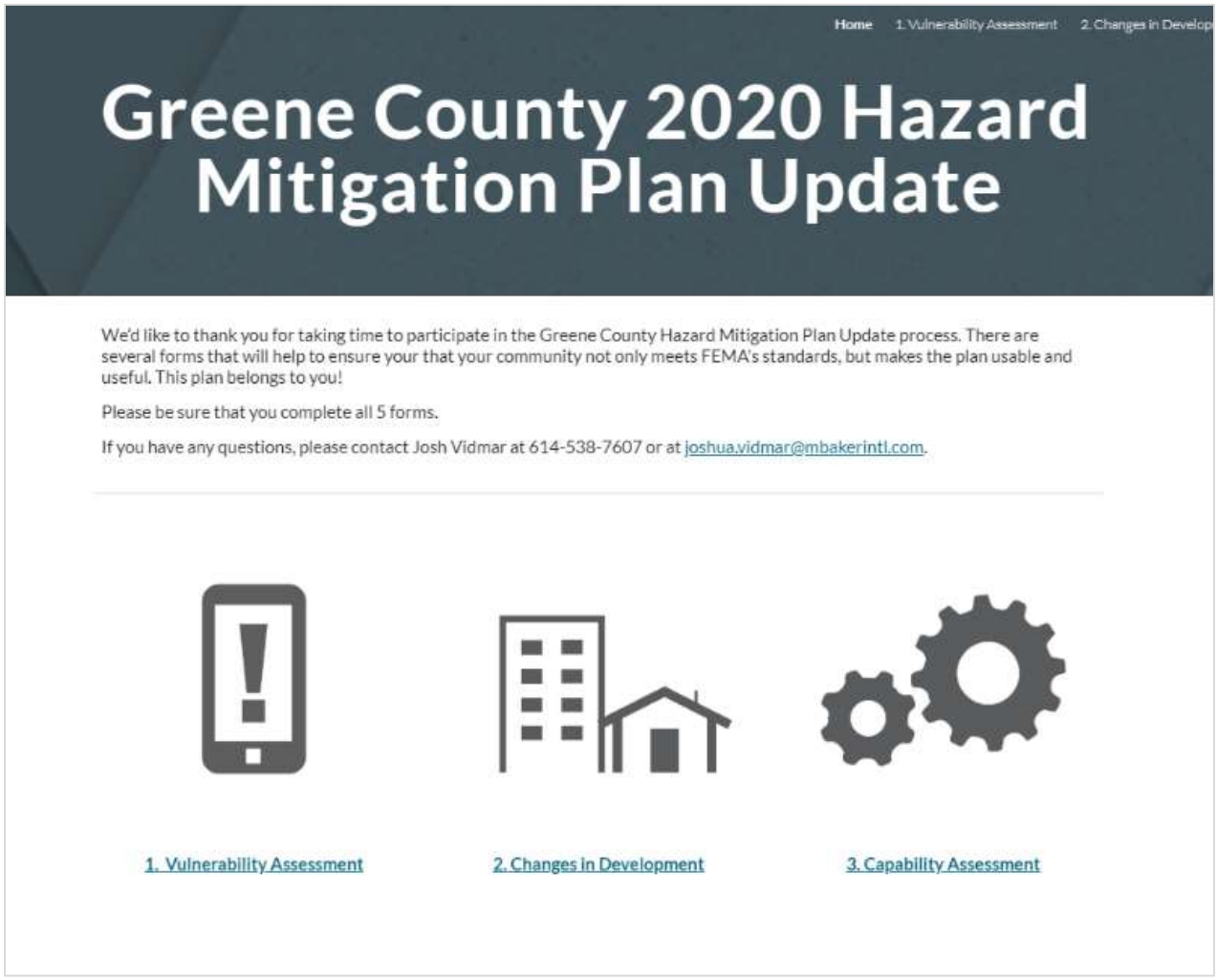
TABLE 3-5 EXISTING PLANS, STUDIES, REPORTS, AND TECHNICAL DATA

Existing Plans, Studies, Reports, and Other Technical Data/Information	Planning Process / Area of Document Inclusion
2015 Greene County Hazard Mitigation Plan	Used to assist with problem identification, mitigation goals, strategies and actions. Information from the previous plan was used for past data
Ohio Enhanced Mitigation Plan	This plan was consulted to assist with background information and hazard identification
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
Department of Homeland Security GIS Hub	Spatial Data for critical facilities
State of Ohio Mitigation Assistance Resource Guide	Referenced to identify potential funding sources and programs to assist with mitigation action implementation

4.5 GREENE COUNTY HAZARD MITIGATION PLAN UPDATE WEBSITE

A website was developed for local jurisdictions to provide the information needed to complete the Plan. Upon accessing the website, five forms were available for users to complete. Not only does it ensure participation that is required for jurisdictions to be able to adopt the HMPU, but the website adds to the diversity of methods used to encourage holistic involvement by each community. Vulnerability Assessment, Changes in Development, Capability Assessment, Previous Actions, and New Actions Form were provided on the website. Contact information was provided should the communities have questions, and examples and links were embedded in the introductions of each form for guidance.

FIGURE 5 GREENE COUNTY HMPU WEBSITE



4.6 ASSESS RISKS

In accordance with FEMA requirements, the 2020 HMP Planning Committee identified and prioritized the natural, technological, and man-made 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.

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 2020 HMPC developed and identified a list of hazards that could affect the County. Content for each hazard profile is provided in Section 4.

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

each hazard were determined. Detailed information on vulnerability assessment for each hazard is provided in Section 4.

4.7 DEVELOP MITIGATION PLAN

The 2020 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's 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.

Identify Goals

The HMPC developed goals and objectives for the 2020 HMP based on current information. The Goals and Objectives that were developed are presented in Section 5.

Develop Capability Assessment

A Capability 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 2020 HMP. The HMPC identified the technical, financial, and administrative capabilities to implement mitigation actions, as detailed in Section 5.

Identify Mitigation Actions

As part of the 2020 HMP planning process, the HMPC worked 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.

Draft HMP

Once the risk assessment and mitigation strategy were completed, information, data, and associated narratives were compiled into the 2020 HMP.

Plan Review and Revision

The plan was reviewed both internally by the County and by external stakeholders. All comments were incorporated into the final version of the plan.

Regional Approval

[This section will be completed after approval by FEMA Region V]

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SECTION 4. HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA)

Hazard Identification and Risk Assessment is the process of measuring the potential impact to life, property and the economy resulting from natural, technological, and man-made 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 all 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 planning process related to the above four steps are incorporated into the following discussions in this chapter.

This section identifies and prioritizes the identified natural, technological, and man-made hazards that threaten the County. The reasoning for omitting some hazards from further consideration is also provided in this discussion.

Section 4, Sub-sections 1 through 14: The Hazard Profiles describe each of the hazards that pose a threat to the County. Information includes the location, extent/magnitude/severity, previous occurrences, and the likelihood of future occurrences.

Each hazard profile includes a Vulnerability Assessment, which presents the County's exposure to natural, technological, and man-made hazards, identifying at-risk populations and assets, including critical facilities. Where the information was available, potential dollar loss estimates for facilities are provided to show a partial representation of the financial cost of a disaster.

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 all-hazards planning with respect to 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 information available, including GIS data and official government records. 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 HMPC compared the results of the hazard profile against their local and historical 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 HMPC. 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:

TABLE 4-1 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 Probability	**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**	
Geographic Location *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**	
RF Value = [(Probability x .30) + (Impact x .30) + (Geographic Location x .20) + (Warning Time x .10) + (Duration x .10)]				

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 4-2 provides the risk factor 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 4-2 GREENE COUNTY RISK FACTOR HAZARDS

Natural Hazards		Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Severe Thunderstorms	4	1.2	2	0.6	4	0.8	4	0.4	1	0.1	**3.1**
2	Extreme Temperatures	4	1.2	2	0.6	4	0.8	1	0.1	1	0.1	**2.8**
3	Invasive Species	4	1.2	1	0.3	4	0.8	4	0.4	1	0.1	**2.8**
4	Tornado	4	1.2	2	0.6	2	0.4	4	0.4	1	0.1	**2.7**
5	Drought	1	0.3	4	1.2	4	0.8	1	0.1	1	0.1	**2.5**
6	Floods	4	1.2	2	0.6	1	0.2	3	0.3	1	0.1	**2.4**
7	Dam Failure	1	0.3	4	1.2	2	0.4	4	0.4	1	0.1	**2.4**
8	Severe Winter Storms	3	0.9	1	0.3	4	0.8	1	0.1	1	0.1	**2.2**
9	Wildfire	2	0.6	2	0.6	1	0.2	4	0.4	1	0.1	**1.9**
10	Earthquake	2	0.6	1	0.3	1	0.2	4	0.4	1	0.1	**1.6**
Technological Hazards		**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	Sourcewater Contamination	2	0.6	3	0.9	4	0.8	4	0.4	4	0.4	**3.1**
2	Public Health Emergencies	3	0.9	3	0.9	4	0.8	1	0.1	2	0.2	**2.9**
3	Terrorism	3	0.9	3	0.9	2	0.4	4	0.4	1	0.1	**2.7**
4	Transportation Incidents/HazMat	2	0.6	2	0.6	2	0.4	4	0.4	1	0.1	**2.1**

Table 4-3 shows the hazards that are included in the State of Ohio's HMP, and those hazards covered in the previous version of the plan, implemented in 2015. For this plan update, several hazards have been separated from other hazards that were in the previous plan.

TABLE 4-3 HAZARDS INCLUDED IN THE 2020 PLAN UPDATE

Hazard Addressed	Ohio HMP	Greene 2015	Greene 2020	Notes
Severe Thunderstorms	O	O	O	Ohio HMP calls this hazard "Severe Summer Storms"; Greene 2015 plan identified "Hail" as a hazard, hail is now included under severe thunderstorms in 2020 update
Extreme Temperatures	X	O	O	Greene 2015 identified summer heat and drought as a hazard, the 2020 update includes extreme cold temperatures and separates drought to make it its own hazard
Invasive Species	O	X	O	

Hazard Addressed	Ohio HMP	Greene 2015	Greene 2020	Notes
Tornado	O	O	O	2015 plan included winds with tornadoes, the 2020 update identifies high winds under the Severe Thunderstorms hazard
Drought	O	O	O	Was combined with summer heat in Greene 2015 plan
Floods	O	O	O	
Severe Winter Storms	O	O	O	
Wildfire	O	X	O	
Earthquake	O	O	O	
Sourcewater Contamination	X	X	O	
Public Health Emergencies	X	X	O	
Terrorism	X	X	O	
Dam Failure	O	X	O	
Transportation Incidents/HazMat	O	X	O	
Landslide	O	X	X	Not a concern of the County
Seiche/Costal Flooding	O	X	X	There are no coasts in Greene County
Costal Erosion	O	X	X	There are no coasts in Greene County
Land Subsidence	O	X	X	Minimal activity in the County to create a hazard

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 Greene County and its population in the future. Information about Federal and State disaster declarations in the County was compiled from FEMA and Ohio databases, as shown in

Table 4-4. According to the OEMA, to date Greene County has been a part of 16 disaster declarations, 9 of which received public assistance dollars; 3 have received individual assistance.

The financial data below is from the FEMA Disaster Declaration webpage. Totals provided on the webpage are for total funds delegated to all counties within the declared disaster rather than just for Greene County.

TABLE 4-4 DECLARED DISASTERS AFFECTING GREENE COUNTY (OEMA, FEMA)

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-4507	3/31/2020	COVID-19 Pandemic	$1,235,559.58	-
EM-3457	3/13/2020	COVID-19	-	-
Dr-4447	6/18/2019	Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides, and Mudslide	$3,702,466.32	$4,906,627.63
EM-3346	6/30/2012	Severe Storms	-	-
DR-1805	10/24/2008	Severe Wind Storm associated with Tropical Depression Ike	$38,841,921.56	-
EM-3286	4/24/2008	Snow	$7,122,145.99	-
EM-3250	9/13/2005	Hurricane Katrina Evacuation	$2,541,599.60	-
EM-3198	1/11/2005	Snow	$8,636,637.81	-
DR-1556	9/19/2004	Severe Storms and Flooding	$25,804,256.17	$23,662,227.18
DR-1453	3/13/2003	Severe Winter Storm	$31,856,038.61	$2,609,145.45
DR-1343	9/26/2000	Tornado and Severe Storms	$3,340,810.20	-
DR-831	6/10/1989	Severe Storms, Flooding	-	-
EM-3055	1/26/1978	Blizzards and Snowstorms	-	-
EM-3029	2/2/1977	Snowstorms	-	-
DR-421	4/4/1974	Tornadoes	-	-
DR-243	6/5/1968	Heavy Rains, Flooding	-	-

Based on the review of hazards identified in similar and relevant documents, previous incidents, historical knowledge of localized events, and hazard trends, the HMPC identified a total of 14 hazards. There were 10 natural hazards which included severe thunderstorms, extreme temperatures, invasive species, tornadoes, drought, floods, severe winter storms, wildfire, earthquakes, and dam failure. There were 4 technological or man-made hazards including terrorism, source water contamination, public health emergencies, and hazardous materials incidents.

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. Data is largely available at a countywide scale, but often have jurisdictional-level detail, as well.

EVENT NARRATIVES

Within each hazard's section there are a series of narratives that provide greater detail into specific events that have 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 Greene County. Rather, these incidents are included to provide context as to why this hazard was included in the plan.

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 Greene County. Hazard profiles are used to develop a vulnerability assessment, where hazard vulnerability to the community is quantified in terms of population and assets affected for each hazard deemed significant by the Planning Committee.

For those hazards that are technological or man-made, additional details within each profile's summary have been included that briefly discuss mitigation best practices, as these hazards are not included in standard mitigation handbooks.

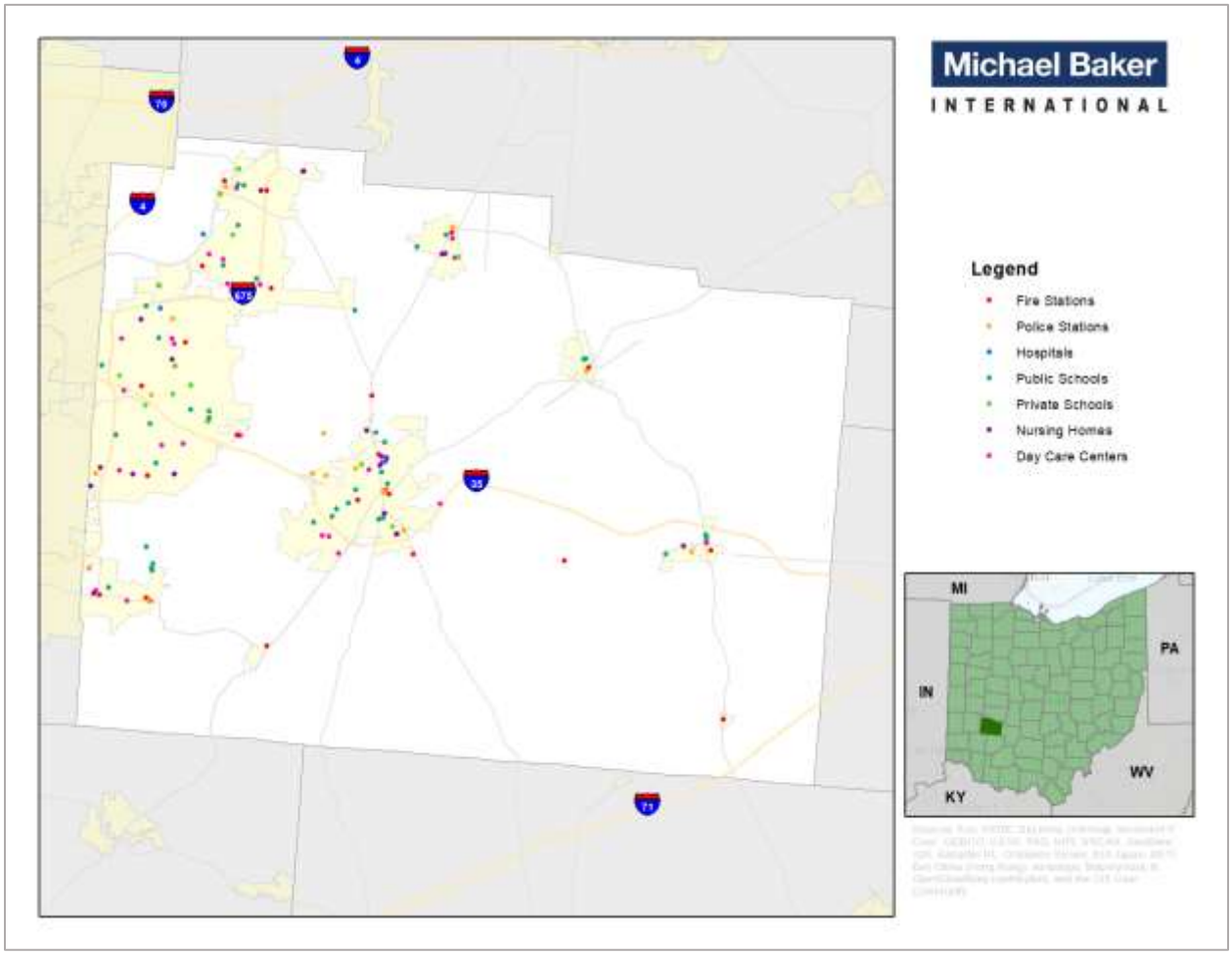
CRITICAL FACILITIES

The Planning Committee identified the types of structures that they consider to be "critical" to the day-to-day operations of the County. This includes day care facilities, educational centers, fire stations, government buildings, medical facilities, police stations, and utility structures. There is a total of 156 critical facilities in Greene County. There are also 69,576 homes in the County. Costs of structures were derived from parcel information from the Greene County Auditor's site. The total costs are an approximate value—few properties' values from each group were not listed or available. However, the quantitative data provides insight on how a hazard event could cause damage to the critical facilities in the County, even as an approximation. A map of County critical facilities can be found in Figure 6.

TABLE 4-5 COUNTY CRITICAL FACILITIES COST ESTIMATES

Category	Number	Total Cost	1% Loss	5% Loss
Public Safety	42	$52,615,890	$526,159	$2,630,795
Hospitals	3	$101,957,780	$1,019,578	$5,097,889
Nursing Homes	23	$69,646,860	$696,469	$3,482,343
Education	53	$478,674,720	$4,786,747	$23,933,736
Day Cares	35	$323,976,700	$3,239,767	$16,198,835
CRITICAL FACILITY TOTAL	**156**	**$1,026,871,950**	**$10,268,720**	**$51,343,598**

FIGURE 6 COUNTY CRITICAL FACILITIES



1. SEVERE THUNDERSTORMS

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Severe Thunderstorms	**4**	1.2	**2**	0.6	**4**	0.8	**4**	0.4	**1**	0.1	**3.1**
High Risk Hazard (3.0 – 4.0)											

1.1 SEVERE THUNDERSTORM CHARACTERISTICS

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. Even the remnants of tropical storms and hurricanes have been known to bring severe wind damage and flooding to the state.

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

- 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.

- Lightning, although not considered severe by the National Weather Service definition, can accompany heavy rain during thunderstorms. Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the

base of the cloud attract positive charges at the surface of the Earth. Invisible to the human eye, the negatively charged area of the cloud sends a charge called a stepped leader toward the ground. Once it gets close enough, a channel develops between the cloud and the ground. Lightning is the electrical transfer through this channel. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. The rapid expansion of the heated air causes thunder.

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

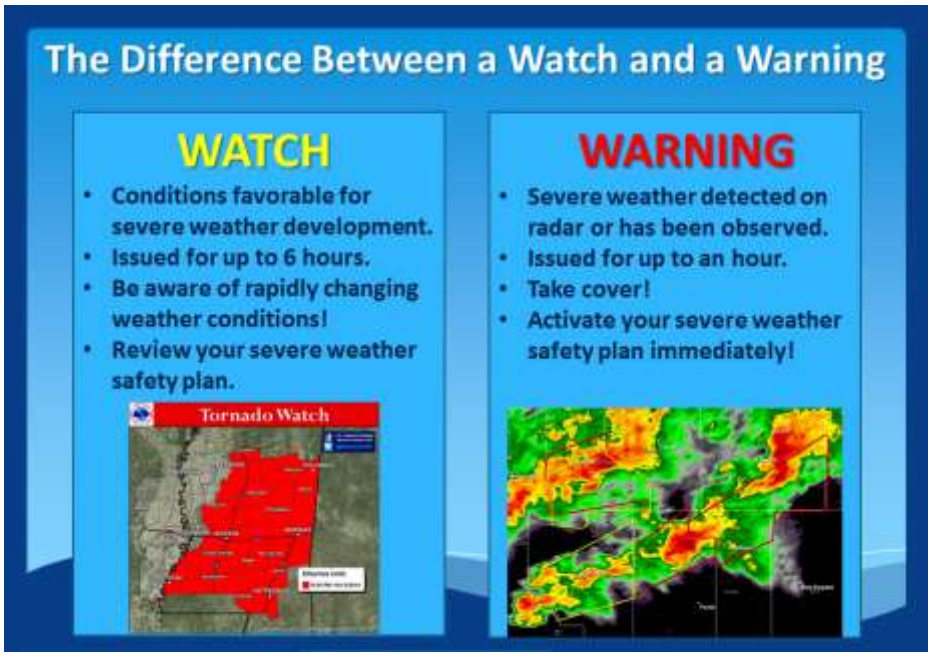
1.2 SEVERE THUNDERSTORM LOCATION

Severe thunderstorm events are generally county-wide or region-wide events that could affect the entirety of Greene County. All communities are affected during these occurrences. On occasion, only part of the County could experience the weather due to the original development location of the storm and the path it travels.

1.3 SEVERE THUNDERSTORM EXTENT

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

FIGURE 7 NWS 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 4-6 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.

Beaufort number	MPH	Description	Observation
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 4-7 HAIL SIZE COMPARISON CHART

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

1.4 HISTORICAL OCCURRENCES

General Trends

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 20 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).

TABLE 4-8 SUMMARY OF HISTORICAL SEVERE THUNDERSTORMS (2000-2020)

Row Labels	Count	Deaths	Injuries	Property Damage
Hail	101	0	0	$ 94,000
Heavy Rain	51	0	0	$ 0
Lightning	0	0	0	$ 0
Strong Wind	1	1	0	$ 60,000
Thunderstorm Wind	176	0	0	$ 727,500
Grand Total	**329**	**1**	**0**	**$ 881,500**

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 176 recorded severe wind events associated with thunderstorms since 2000 in Greene County.

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 101 recorded hail events associated with thunderstorms that have either directly or indirectly impacted the County and the immediately surrounding jurisdictions since 2000. A full list of events by date, and with additional detail, can be found at the end of this hazard profile.

Lightning Events

Except in cases where significant forest or range fires are ignited, lightning generally does not result in disasters. There have been no recorded instances of lightning-related incidents in Greene County.

Since 1953, 7 federally or state declared severe thunderstorm weather events have occurred in Greene County as shown in Table 4-9. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1953 to present), these events include: severe storms, straight-line winds, severe windstorms, and heavy rain.

TABLE 4-9 SEVERE STORM DISASTER DECLARATIONS

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-4447	6/18/2019	Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides, and Mudslide	$3,702,466.32	$4,906,627.63
EM-3346	6/30/2012	Severe Storms	-	-
DR-1805	10/24/2008	Severe Wind Storm associated with Tropical Depression Ike	$28,841,921.56	-
DR-1556	9/19/2004	Severe Storms and Flooding	$25,804,256.17	$23,662,227.18
DR-1343	9/26/2000	Tornado and Severe Storms	$3,340,810.20	-

DR-831	6/10/1989	Severe Storms, Flooding	-	-
DR-243	6/5/1968	Heavy Rains, Flooding	-	-

Event Narratives

- **August 9, 2000 – Thunderstorm Wind:** In the morning of August 9th, a large bow echo—a storm cell that forms like an archer's bow—produced high speed winds that left significant damage. Following the windstorm, multiple thunderstorms formed that brought high winds and hail along with some flooding. As a result of the weather events on the 9th, numerous trees and power lines were reported throughout the County. There were also trees reported down across roads in Xenia. There was no injuries, deaths, or crop damage as a result, but there was $25,000 property damage.

- **June 22, 2008 – Hail:** A low pressure trough in the Great Lakes region meshed with an airmass that was unstable and mid-level disturbances that created a cluster of thunderstorms. The chain of storms that moved through Greene County brought strong, damaging winds, and large hail around an inch in magnitude. It left $3,000 in property damage in Jamestown.

- **May 16, 2013 – Heavy Rain:** As multiple storms and rain moved through the County throughout the day, localized flooding began to occur in due to heavy rainfall in the same locations. The storms that traveled through the area were capable of producing non-threatening hail. Minor flooding occurred in southern Greene County along Highway 68.

- **April 3, 2018 – Thunderstorm Wind:** Yellow Springs saw severe thunderstorms as a result of a strong cold front in the afternoon of the 3rd. The Village reported thunderstorm winds at a magnitude of 70 knots. Later, the cell would go on to produce tornadoes. However, the area only saw high winds and high amounts of rain ranging from one to three inches. There was significant damage along Wilberforce-Clifton Road and State Route 72 near Clifton. Tree and roof damage totaled $25,000 for the event.

- **May 27, 2019 – Hail:** The same weather system that produced the deadly tornadoes that passed through the Miami Valley initially brought severe thunderstorms to the area. Developing in the evening hours along a warm front, hail was reported in Yellow Springs and Cedarville around 10:30 at night with a magnitude of 1.75 inches. Smaller hail was reported on the northwestern edge of the County. No reported damages to property or crops.

1.5 PROBABILITY OF FUTURE OCCURRENCES

The HMPC, based on their knowledge and experience, decided that Severe Thunderstorm events are "Highly Likely," meaning that they have a 100% chance of occurring each year.

Thunderstorm Probability

Reported thunderstorm winds over the past 20 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 329 thunderstorm events since 2000, it can reasonably be assumed that this type of event has occurred once every 0.06 years from 2000 through 2020.

(2020 CY) - (2000 HY) = 20 Years on Record

(20 Years) / (329 Events) = 0.06 Years Between Events

Thunderstorms have occurred on a regular basis every year. There is little reason to expect that this trend will change. Due to climate change, it is expected that thunderstorms will grow increasingly frequent and intensify in severity.

1.6 VULNERABILITY TO THUNDERSTORMS

TABLE 4-9 POTENTIAL IMPACTS FROM THUNDERSTORMS

Impact	Description
People	Loss of life or severe injuries can occur, especially to those outside. Lightning will strike outdoors. Hail can cause lacerations, concussions, and even death if large enough.
Infrastructure	Roofs and building siding severely damaged by high winds or hail. Power outages may result from lightning strikes or downed power lines.
Economy	Mostly localized disruptions. Large-scale storms such as hurricanes or derechos can temporarily affect businesses.
Natural Systems	Lightning can cause wildfires and urban fires. Wind can down trees.
Transportation	Fallen trees can hinder transportation. High winds and heavy rain can temporarily make driving conditions dangerous.

TABLE 4-10 JURISDICTIONAL VULNERABILITY TO THUNDERSTORMS

Jurisdiction	Vulnerability
Beavercreek	Trees down powerlines in central portion of the community with overhead lines.
Bellbrook	Have many mature trees in Bellbrook that cause power outages during thunderstorms.
Fairborn	Trees have a history of taking down powerlines in the community. Tree issues also have an impact for commuters in the city
Xenia	Older sections of community have overhead power lines which are susceptible to tree collapses and power failures. Also, routine lighting strikes on tower at Xenia Justice Center has resulted in a need for switching onto generator power.
Bowersville	N/a
Cedarville	Old trees often fall on power lines, on houses or the road.
Jamestown	Trees fall frequently with thunderstorms.
Spring Valley	Town hall is a three-story building that needs a roof, we also are having more trees needing removed, some because of ash bore.

Yellow Springs	We have 29 miles of overhead electrical wires that are vulnerable to sever weather conditions, particularly thunderstorms. At risk of old trees and overgrown trees to blow down power lines.
Cedarville Township	Strong storms bring down trees and power lines; power service is interrupted.
New Jasper Township	Old trees often blow down power lines.
Xenia Township	Several trees of various ages and conditions throughout the Township. During a thunderstorm, trees blow down into power lines and land on houses and other property. Trees can also cause road obstructions, delaying the response of Emergency Services and fire department apparatus.
Miami Conservancy District	None.

Inventory Assets Exposed

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% 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.

Potential Losses

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.

There is no way to predict an area that will be impacted by thunderstorm winds, hailstorms or lightning strikes. An individual thunderstorm is unlikely to damage large numbers of structures on its own. However, the side effects of a thunderstorm (hail, winds and lightning), have the ability to cause damage to structures and property throughout the County.

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 4-10 PROPERTIES VULNERABLE TO SEVERE THUNDERSTORMS

Class	Number	Total Cost	1% Damage	5% Damage
Residential	69,576	$6,666,215,630	$66,662,156.30	$333,310,781.50
Critical Facilities				
Public Safety	42	$52,615,890	$526,159	$2,630,795
Hospitals	3	$101,957,780	$1,019,578	$5,097,889
Nursing Homes	23	$69,646,860	$696,469	$3,482,343
Education	53	$478,674,720	$4,786,747	$23,933,736
Day Cares	35	$323,976,700	$3,239,767	$16,198,835
CRIT. FACILITY TOTAL	**156**	**$1,026,871,950**	**$10,268,720**	**$51,343,598**
Total Value				
Grand Total				

1.7 LAND USE & DEVELOPMENT TRENDS

All future structures built in the County will likely be exposed to severe thunderstorm damage. The County needs to adhere to building codes so that new development can be built to current standards.

Regulatory Environment

Greene County has adopted Ohio Building Codes for its commercial and residential building construction. The current building code requirements have regulations for wind speed in buildings. Risk Category 1 buildings must be able to withstand 105 mph winds. Risk Category 2 buildings must be able to withstand 115 mph winds, and Risk Category 3 & 4 buildings are required to be built withstanding 120 mph winds.

1.8 THUNDERSTORM SUMMARY

Greene 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.

2. EXTREME TEMPERATURES

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Extreme Temperatures	**4**	1.2	**2**	0.6	**4**	0.8	**1**	0.1	**1**	0.1	**2.8**
Medium Risk Hazard (2.0 – 2.9)											

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.

2.1 EXTREME TEMPERATURE CHARACTERISTICS

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-). 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.

Extreme Cold

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

2.2 LOCATION

Extreme Temperature events are region-wide events that affect the entirety of Greene County. All communities are affected during these occurrences.

2.3 EXTREME TEMPERATURE EXTENT

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 4-11 serve as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors.

Temperature advisories, watches, and warnings are issued by the National Weather Service relating the above impacts to the range of temperatures typically experienced in Ohio. Exact thresholds vary across the State, but in general Heat Advisories are issued when the heat index will be equal to or

greater than 100°F, but less than 105°F, Excessive Heat Warnings are issued when heat indices will attain or exceed 105°F, and Excessive Heat Watches are issued when there is a possibility that excessive heat warning criteria may be experienced within twelve to forty-eight hours.

TABLE 4-11 FOUR CATEGORIES OF HEAT STRESS

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 8 NWS SEVERE HEAT INDEX

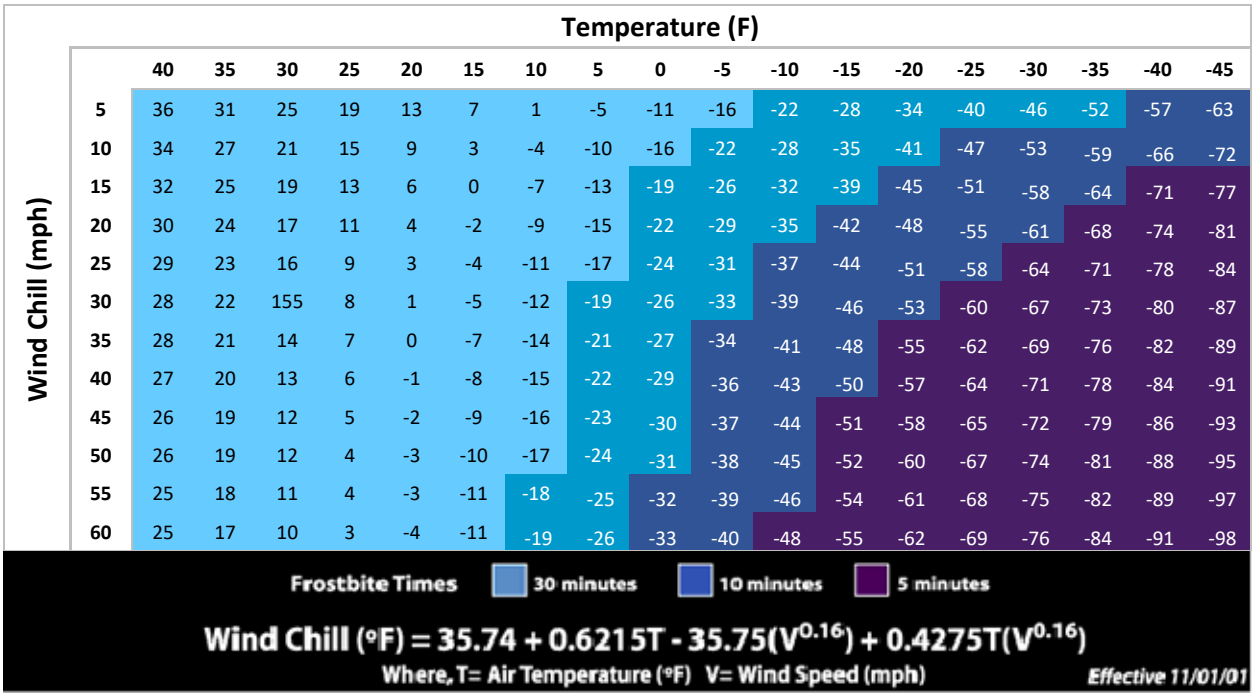
Relative Humidity \ Temperature	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	127			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	91	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

TABLE 4-12 EXTREME COLD TEMPERATURE AND ASSOCIATED THREAT

Excessive Cold Threat Level	Threat Level Descriptions
Non-Threatening	**"No Discernable Threat to Life and Property from Excessive Cold."** Cold season weather conditions are non-threatening.
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.

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.
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.
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.
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.

FIGURE 9 NWS WINDCHILL CHART



2.4 HISTORICAL OCCURRENCES

Extreme temperatures are hazards that affect areas as large as an entire state or region. As such, all Greene County, Ohio instances of these events were looked at as previous hazard events.

According to the NCDC, there have been two documented cases of Excessive Heat in Greene County. NCDC also reports two documented events of extreme cold/wind chill since 2000.

TABLE 4-11 SUMMARY OF HISTORICAL EXTREME TEMPERATURES (2000-2020)

Row Labels	Count	Deaths	Injuries	Property Damage
Excessive Heat	2	0	0	$ 0

Extreme Cold/Wind Chill	2	1	0	$ 0
Total	**4**	**1**	**0**	**$ 0**

- Cold – January 6-7, 2014: Brutal cold weather settled over the area on January 6th and 7th. This event was categorized as a polar vortex. This is a whirling and persistent large area of low pressure, found typically over both North and South poles. The northern polar vortex was pushing southward over western Wisconsin and eastern Minnesota on Monday, Jan. 6, 2014, and brought frigid temperatures to half of the continental United States. Extreme temperatures were reported for much of the US.
- Cold – January 30, 2019: In late January, bitter cold dipped down from the Arctic, plunging the Midwest into a deep freeze. Greene County saw temperatures as low as the negative single digits. The front brought with it high winds from thirty to forty-five miles per hour, which put the wind chill in a range of -20 to -40 degrees.

FIGURE 10 JANUARY 2014 POLAR VORTEX

- Heat – July 19-20, 2019: The entire southwest corner of Ohio experienced excessive heat starting on July 19th and extending through the 20th. Temperatures climbed into the 90s, and with the humidity added to the temperature, the heat index was well into the triple digits.

2.5 PROBABILITY OF FUTURE OCCURRENCES

The probability of Greene 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 degrees may also extend significantly.

The HMPC, based on their knowledge and experience, decided that Extreme Temperature events are "Highly Likely," meaning that they have a 100% chance of occurring each year.

Reported extreme temperature 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 experiencing extreme heat associated with damages or injury can be difficult to quantify, but based on historical record of 2 excessive heat events since 2000, it can reasonably be assumed that this type of event has occurred once every 10 years from 2000 through 2020. Greene County has experienced two extreme cold events since 2000, so it can reasonably be assumed that this type of event has occurred once every 10 years from 2000 to 2020. Or, there is a 10% chance of the County experiencing excessive heat or extreme cold a year based on historical data.

(2020 CY) - (2000 HY) = 20 Years on Record

(20 Years) / (2 Events) = 10 Years Between Events

2.6 IMPACTS FROM EXTREME TEMPERATURES

TABLE 4-12 POTENTIAL IMPACTS FROM EXTREME TEMPERATURES

Impact	Description
People	**Heat:** Heat stroke and dehydration **Cold:** Frostbite or hypothermia
Infrastructure	**Heat:** Power outages and brownouts. Water may become scarce. **Cold:** Burst pipes from freezing temperatures.
Economy	Extreme temperatures can discourage people from traveling and shopping, causing local economic slowdowns. Loss of crops may damage the agricultural sector.
Natural Systems	**Heat:** Vegetation can die and dry out, making areas susceptible to wildfires. **Cold:** Crops may be lost if cold occurs during growing season.
Transportation	**Heat:** Hot vehicles may break down, causing delays. **Cold:** Extreme cold temperatures can cause ice to form on roads. Cars may not start.

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 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.

2.7 COMMUNITY VULNERABILITY TO EXTREME TEMPERATURES

TABLE 4-13 JURISDICTIONAL VULNERABILITY TO EXTREME TEMPERATURES

Jurisdiction	Vulnerability
Beavercreek	Single family households without updated heating and air-conditioning.
Bellbrook	We have used cooling centers in the past. No real risk beyond what is expected.
Fairborn	As listed in the example, we do have an older population in the community. Extreme temperatures are usually an issue coupled with a power outage.
Xenia	If extreme temperatures arise, City Administration works with local churches to designate heating/cooling centers. Bridges of Hope Shelter on W. Second Street also provides these services for the homeless population.
Bowersville	The Senior Citizen building is used for cooling/heating center.
Cedarville	In the event of extreme temps, we would reach out to the schools and churches for cooling centers.
Jamestown	Jamestown would have some of the population vulnerable to extreme extended temperatures.
Spring Valley	The jurisdiction does not have any cooling shelters.
Yellow Springs	Not a concern. Majority of our population has access to heating and cooling.
Cedarville Township	Not too much of an issue. In previous occurrences, the jurisdiction has been able to provide heating/cooling to those in need with shelter. An area of concern is livestock and several apartment areas that do not have air conditioning.
New Jasper Township	No heating or cooling centers.
Xenia Township	Extreme temperatures cause hardship on our elderly population. We have very few community-based cooling centers.
Miami Conservancy District	None.

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.

There is no way to predict an area that will be impacted by extreme temperatures. As a result, all property located within the County must be viewed as susceptible to the effects of extreme temperatures. While temperature extremes are not usually thought of as damaging to structures, they can make structures unusable. The 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 2019 American Community Survey, there were approximately 9,866 children under the age of 5, which is equal to about 5.8% of the total population. There were an estimated 29,955 people above the age of 65, equating to about 17.7% of the population.

TABLE 4-14 POPULAGE AGE ESTIMATES, 2019

Total	Population	Percent
Under 5 years	9,866	5.8%
65 and up	29,955	17.7%

TABLE 4-15 DATE OF BUILDING CONSTRUCTION

Year Built	Percent	Number
Built 1939 or earlier	9.8%	6,815
Built 1940 to 1949	4.0%	2,760
Built 1950 to 1959	16.4%	11,379
Built 1960 to 1969	13.4%	9,299
Built 1970 to 1979	16.7%	11,624
Built 1980 to 1989	9.3%	6,461
Built 1990 to 1999	13.2%	9,159
Built 2000 to 2009	14.8%	10,285
Built 2010 to 2013	2.0%	1,398
Built 2014 or later	0.6%	396
Total:	100%	69,576

TABLE 4-16 POTENTIAL LOSSES FROM EXTREME TEMPERATURES

Class	Number	Total Cost	1% Damage	5% Damage
Residential	69,576	$6,666,215,630	$66,662,156.30	$333,310,781.50
Critical Facilities				
Public Safety	42	$52,615,890	$526,159	$2,630,795
Hospitals	3	$101,957,780	$1,019,578	$5,097,889
Nursing Homes	23	$69,646,860	$696,469	$3,482,343
Education	53	$478,674,720	$4,786,747	$23,933,736
Day Cares	35	$323,976,700	$3,239,767	$16,198,835
CRIT. FACILITY TOTAL	**156**	**$1,026,871,950**	**$10,268,720**	**$51,343,598**
Total Value				
Grand Total	**69,732**			

2.8 LAND USE & DEVELOPMENT TRENDS

Greene County as a whole, is subject to temperature extremes. These extremes affect entire regions, making them a countywide hazard. The effect temperature extremes will have on the County will vary due to population density, age of population, and the age of structures.

The elderly, just like small children, are more susceptible to temperature extremes. Additionally, buildings of significant age may be more susceptible to temperature extremes. Older homes are generally less insulated than newer construction. In addition, the use of modern windows and doors can improve a structure's ability to resist extreme temperatures. Older structures and infrastructure are likely to be more susceptible to both heat waves and freezes. It is important to identify building stock and special needs populations so that those who must respond to an emergency will be better prepared.

Regulatory Environment

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

2.9 TEMPERATURE EXTREME 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 and poses a potentially grave danger to the residents of Greene County.

3. INFESTATION

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Infestation	**4**	1.2	**1**	0.3	**4**	0.8	**4**	0.4	**1**	0.1	**2.8**
Medium Risk Hazard (2.0 – 2.9)											

3.1 HAZARD IDENTIFICATION

Infestation of an area can be described as a foreign species overtaking local species and their resources in a hostile manner. Infestation can also occur by a foreign species living in or on a host as a parasite. The introduction of a nonnative species into an ecosystem can cause harm to the economy, environment, and human health. The Ohio Department of Natural Resources categorizes invasive species into four categories: invasive terrestrial plants, invasive wildlife, invasive insects and diseases, and aquatic invasive species.

Invasive Terrestrial Plants

Currently in Ohio, it is estimated that one-fourth of the plant species are originally from other places in the world. However, not all of the nonnative plant species are invasive to the local habitats they reside in. Statistically, of the over seven hundred plant species that are not native to Ohio, less than one hundred are categorized as invasive. The plant species that are noted as invasive have the ability to cause extensive damage to the economy, natural resources of Ohio, and natural heritage of the state. These species crowd native plants, disrupt wildlife who rely on native plants for food, shelter, and reproductive habitat, and reduce biological diversity where they invade.

Invasive Wildlife

Feral swine in Ohio are the most destructive wildlife species. Also referred to as wild boar or hogs, the species has been damaging habitat that other wildlife require to survive. The species is a mixture of Eurasian wild boar and escaped domesticated swine. They arrived in the United States in 1539 and can be found in thirty-five states at the minimum. In Ohio, feral swine can grow between 125 to 200 pounds. Feral swine damage corn and soybean crops as a food source, but they also eat turnips, watermelon, squash, orchids, and timber. They are most destructive when they are in search of roots. Digging holes ranging from 2 inches to three feet deep damages roots and soil drastically. Water quality is threatened by feral swine due to their instinct to wallow in mud or wet areas. Bacteria that is transported downstream from the feral swine can contaminate water sources. They are also known carriers of thirty viral and bacterial diseases and thirty-seven parasites that can harm people, pets, livestock, and wildlife.

Invasive Insects and Diseases

The insects, fungus, and other organisms that are nonnative to Ohio are known to be destructive to plant, forest, and wildlife health. The Ohio Department of Natural Resources, ODNR, collaborates with state and federal agencies to identify, quarantine, and remove invasive insect species and diseases.

Aquatic Invasive Species

Waterway habitats in Ohio are being altered by invasive plants and animals. Zebra mussels, bighead carp, silver carp, and curlyleaf pondweed are invading streams, rivers, ponds, and lakes in the state. ODNR and its government partners are monitoring the impacts the invasive species has on the aquatic environment.

According to searches and reviews of online information provided by the Ohio Division of Forestry and the Ohio Department of Agriculture, Greene County is susceptible to several infestations: European Gypsy Moth; cicadas; the pine shoot beetle; Emerald Ash Borer; Asian long horned beetles; spider mites; and Japanese Honeysuckle. However, the majority of these invasive species are already present in the County. The threat of a new, large-scale infestation occurring is relatively low and poses only moderate associated risk to human life.

3.2 LOCATION

Due to the nature of the hazard, infestation generally occurs in wildlife. While the hazard can easily spread to developed parcels of land, non-welcomed terrestrial plant species are usually eradicated. Invasive insects and diseases can be found anywhere in the County due to their ability to travel and spread. Aquatic invasive species can be located in all bodies of water where they have been introduced.

The specific species identified may not be currently present in the county. However, it is important to identify possible infestations that could occur within the planning area. Should an infestation occur, steps to quarantine the area and eradicate the invasive species from the area should be taken.

FIGURE 11 GYPSY MOTH - CATERPILLAR PHASE

3.3 EXTENT

European Gypsy Moth is currently affecting the county. The invasive species is a European strain of gypsy moth, which is one of the most destructive defoliating insects to attack the trees and forests of the northeastern United States. Impacts of a gypsy moth infestation include economic losses through timber mortality, loss of recreational opportunities in severely defoliated areas, and nuisances from gypsy moth caterpillars. A State Gypsy Moth quarantine was established in 1987. The quarantine is an effort to minimize the movement of egg masses into non-infested areas of Ohio. Several counties surrounding Greene County are among those that have been quarantined due to gypsy moth infestation. The Division of Forestry mitigation efforts have been successful in containing the gypsy moth infestation. Greene County has yet to experience significant damages as a result of an infestation.

FIGURE 12 GYPSY MOTH - MOTH PHASE (PHOTO FROM WSDA)

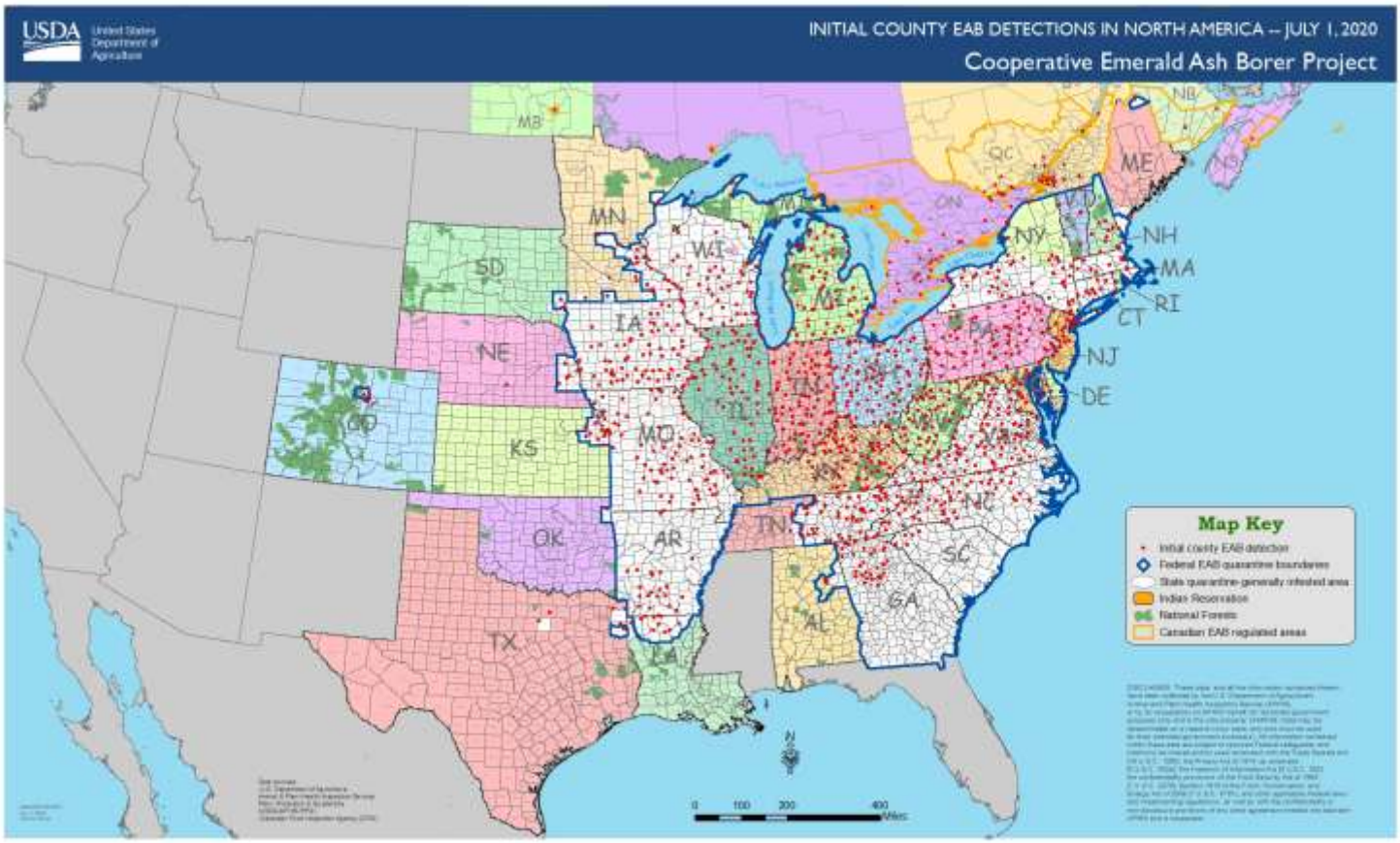
Cicada & Pine Shoot Beetle both have the capability to damage acres of foliage, they are particularly dangerous to the 37,440 acres of wooded land and 144,106 acres of agriculture land in Greene County. According to the Division of Forestry, the spring of 2004 saw an infestation of Brood X

Cicadas in the southern portion of Greene County. These cicadas were last seen in 1987. Adult cicadas damage deciduous trees (especially oak, apple, dogwood, and hickory) especially when the female cicada lays her eggs. Cicada infestation can be mitigated against by careful pruning, covering smaller trees with cheesecloth, or spraying insecticide. The pine shoot beetle infests many species of pine, but Scotch pine is the preferred host. The beetle causes serious damage to the new growth of healthy pine trees, the trunks of weak pine trees, and bark-covered logs and lumber. Cosmetic damage to pines growing on Christmas tree farms and nurseries may result in reduced product quality and substantial economic loss. According to the most recent available information, 49 Ohio Counties are considered infested.

Emerald Ash Borer, an ash tree-killing insect from Asia, was identified in Ohio in 2003. The department has been battling the pest through detection, regulation, and public outreach in an attempt to protect the state's more than 3.8 billion ash trees over the past decade. The pest has since spread from the initial detection in near Toledo to nearly all other parts of the state. Because the pest is established throughout most of Ohio, including Cincinnati, Cleveland, Columbus, Dayton and the Wayne National Forest, there are no longer quarantine regulations in place for emerald ash borer within the state. Despite the fact that the Ohio quarantine has been lifted, to prevent the spread of EAB and other pests, it is still recommended that Ohioans continue to exercise caution when moving firewood. EAB kills ash trees within three to five years of infestation. Adults are dark metallic green, 1/2 inch in length and 1/8 inch wide, and fly only from mid-May to September. Larvae spend the rest of the year developing beneath the bark.

FIGURE 13 ADULT EMERALD ASH BORER

FIGURE 14 IDENTIFIED EAB INFESTATIONS IN THE U.S



Asian Long-Horned Beetles, also known as ALB, was first found present in Ohio in June 2011. The beetle feeds on twelve host trees: Ash, Birch, Elm, Golden raintree, London planetree/sycamore, Maple, Horsechestnut/buckeye, Katsura, Mimosa, Mountain ash, Poplar, and Willow trees. The invasive bugs do not make their presence known in an area until three to four years after initial infestation. Host trees infested by ALB typically die within ten to fifteen years after the bug makes its home in the tree. Native to China and the Korean Peninsula, the Asian Long-Horned Beetle is from the wood-boring beetle family Cerambycidae. Adult ALB can grow between 1 inch to 1.5 inches long with long black and white antennae and black bodies with small with spots. Females chew into bark of host trees to lay eggs. Within two weeks of laying the eggs, white larva hatches and begins to bore into the tree to feed itself. Evidence of infestation by the ALB can be found at the trunk of trees with a sawdust-like material called frass. It takes a year for the larvae to grow into the adult stage.

Spider Mites are an invasive species that attacks agriculture and plants alike. The invasive species belongs to the arachnid family rather than the insect family. In Greene County, due to the high amount of crops that are produced, the pest harms soybean and corn fields. The lifespan of the spider mite is approximately 30 days, but the newborns can complete the growing stage within five days, making it difficult to eradicate infestation. Chlorophyll is the main source of food for spider

mites. Their eating habits leave small white spots or a spotted appearance on the leaves, later causing the infected leaves to turn brown and fall off the plant.

Japanese Honeysuckle is one of the more well-known invasive species in Ohio. The plant grows rapidly in forested and residential areas. Originally introduced to the United States in 1806 as a way to control erosion and promote wildlife cover, the species spread rapidly. Its destruction comes from its method of spreading and growing. As it grows, Japanese honeysuckle crowds out native species, steals nutrients, grows on other plants, and lessens the sunlight that is able to reach lower-growing plants. Eradication of the species involves removal by hand, or spraying chemicals to kill the plant.

3.4 HISTORICAL OCCURRENCES

TABLE 4-14 APPROXIMATE ARRIVAL OF INVASIVE SPECIES IN OHIO

Invasive Species	Approximate Arrival in the State	Approximate Location in the State
Feral Swine	1980	Southern border
European Gypsy Moth	1993	Northwest corner, central Ohio, southeast area
Cicada	Information not available – annual cicadas and periodical cicadas are both known to be destructive	Entire state
Pine Shoot Beetle	1992	Discovered near Cleveland, has traveled statewide
Emerald Ash Borer	2003	Entire state
Asian Long-Horned Beeetles	2011	Clermont County
Spider Mites	Information not available.	Entire state
Japanese Honeysuckle	Arrived in the country in the early 1800s, began to spread by 1900, traveling to the Midwest	Entire state

3.5 PROBABILITY OF FUTURE OCCURENCES

The probability of a large-scale infestation actually occurring in Greene County is relatively low, with only moderate associated risk to human life. The HMPC, based on their knowledge, determined that infestation is "Highly Likely," meaning there is a 100% probability of these events occurring each year.

The recurrence frequency interval for this type of event is difficult to calculate, as infestations are not a rapid onset and subsidence type of event. Infestation is a long-term invasion on an area and therefor assigning a statistical frequency of infestation would inaccurately assess the impact of such an event.

3.6 INVENTORY ASSETS EXPOSED TO INFESTATION

Infestation does not directly pose a threat to county facilities or human life at this time. This does not preclude the potential for a life-threatening infestation or structurally damaging one in the future.

3.7 POTENTIAL LOSSES

Infestation is most likely to occur in the acres of forested or farmland and will likely cause no damage to structural assets; however, it may cause significant economic loss. Infestation is

considered as a hazard in Greene County due to the high percentage of agricultural and forestland in the county.

TABLE 4-15 POTENTIAL IMPACTS FROM INFESTATION

Impact	Description
People	Infestation can reduce the well-being of human life by impairing livelihood options, food security, recreational opportunities, risk to health, and increased social challenges.
Infrastructure	There is not a threat to existing infrastructure; however, new infrastructure could require the removal of non-native plant species.
Economy	Possibly the most vulnerable to invasive species, as it can drive value and land value down. It can also hinder crop productivity and drive up the cost of the termination of invasive species.
Natural Systems	Reducing biodiversity, decreasing availability and quality of natural resources, increasing pollution from chemicals, and water shortages are all impacts.
Transportation	Loss of funds in order to combat infestation along roadways.

3.8 COMMUNITY VULNERABILITY TO INFESTATION

TABLE 4-16 JURISDICTIONAL VULNERABILITY TO INFESTATION

Jurisdiction	Vulnerability
Beavercreek	Several trees impacted by Emerald Ash Borers. Additionally, honeysuckle and others impact our native plants.
Bellbrook	Nothing recent.
Fairborn	The emerald ash bore has been an issue in the City of Fairborn. I am not aware of any other invasive species issues.
Xenia	Emerald Ash borers are prevalent in Xenia. No other invasive species to note.
Bowersville	N/A.
Cedarville	Several local trees have been killed by the emerald ash borers. Half of the trees in our park have been killed.
Jamestown	We have had trees killed by ash borers but do not know to what extent.
Spring Valley	We definitely have ash bore, but something seems to be killing other trees. We have maples, pine, and some others that are not looking so good.
Yellow Springs	We have a large presence of honeysuckle woody shrub.
Cedarville Township	Trees have had to be cut down due to Emerald Ash Bore.
New Jasper Township	N/A.
Xenia Township	Local trees have been killed by emerald ash borers.
Miami Conservancy District	None.

3.9 LAND USE & DEVELOPMENT TRENDS

Land use related to agricultural crops and forested areas may be impacted by infestation due to the nature of the hazard. With 54.27% of the land use as cultivated crops and 14.10% as forest, Greene County has a total of 68.37% land use that could be seriously damaged by invasive species.

Current facilities and any new developments are not at risk to infestation. However, this could change should a new infestation occur, or a current infestation grow out of control.

3.10 INFESTATION SUMMARY

Greene County is susceptible to several infestations that may impact agricultural and forested portions of the county. Economic losses pose the greatest threat to the county and as such mitigation efforts should be conducted to limit and eliminate infestations.

Mitigation efforts for all types of infestation should be closely coordinated with the Ohio Division of Forestry and the Ohio Department of Agriculture. Current practices by these organizations, including quarantining infested areas, have proven, as in the case of the gypsy moth, to be very successful. Some areas have also begun spraying crops or foliage to prevent further infestation. This has also proven to be very successful.

4. TORNADO

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

4.1 TORNADO CHARACTERISTICS

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.

FIGURE 15 EXAMPLE OF A TORNADO

They are more likely to occur during the spring and early summer months of March through June and are most likely to form in the late afternoon and early evening. Most tornadoes are a few dozen yards wide and touchdown briefly, but even small, short-lived tornadoes can inflict tremendous damage. Destruction ranges from minor to catastrophic depending on the intensity, size, and duration of the storm. Structures made of light materials such as mobile homes are most susceptible to damage. Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries.

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.

4.2 LOCATION

Tornado events are region-wide events that affect the entirety of Greene County. All communities are affected during these occurrences. Tornadoes can touch down in any location without any way to predict where they will occur. Generally, an entire county or region is under a tornado warning or watch.

4.3 TORNADO EXTENT

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 4-17

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 4-17 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 (SPC) has developed damage indicators to be used with the Enhanced Fujita Scale for different types of buildings but can be also be used to classify any high wind event. Some of the indicators for different building types are shown in tables below.

TABLE 4-18 SPC INSTITUTIONAL BUILDING DAMAGE INDICATORS

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 4-19 SPC EDUCATIONAL INSTITUTIONS (ELEMENTARY) DAMAGE INDICATORS

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 4-20 SPC METAL BUILDING SYSTEMS DAMAGE INDICATORS

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 4-21 SPC ELECTRIC TRANSMISSION LINES DAMAGE INDICATORS

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)

Source: Storm Prediction Center, 2009

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 Greene County is equally at risk to tornado damage.

4.4 HISTORICAL OCCURRENCES

General Trends

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 in March through October as past county records indicate. From 2000 to 2020, Greene County has experienced twelve tornado events.

TABLE 4-22 TORNADO EVENTS IN GREENE COUNTY (2000-2020)

Location	Date	Time	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Xenia	9/20/2000	18:18	F4	1	100	$ 15,000,000	$ -
Jamestown	5/8/2008	16:25	EF0	0	0	$ 1,000	$ -
Bryon	5/23/2011	18:55	EF1	0	0	$ 3,000	$ -
Xenia Port Xenia Arp	5/14/2014	16:44	EF3	0	0	$ 500,000	$ -
Country Acres	5/26/2015	16:16	EF1	0	2	$ 750,000	$ -
Xenia Greene Co Arpt	5/24/2017	19:26	EF0	0	0	$ 3,000	$ -
Bowersville	5/24/2017	19:30	EF0	0	0	$ -	$ -
Fairborn	5/24/2017	20:06	EF0	0	0	$ 2,000	$ -
Bryon	4/3/2018	15:45	EF1	0	0	$ 500,000	$ -
New Germany	5/27/2019	22:13	EF3	0	0	$ 50,000,000	$ -
Grape Grove	5/27/2019	22:48	EF1	0	0	$ 50,000	$ -
Jamestown	5/27/2019	23:23	EF0	0	0	$ 200,000	$ -

TABLE 4-23 HISTORY OF ALL TORNADO IMPACTS BY FUJITA MAGNITUDE

Row Labels	Count of Type	Sum of Dth	Sum of Inj	Sum of PropDam
EF0	5	0	0	$ 206,000
EF1	4	0	2	$ 1,303,000
EF3	2	0	0	$ 50,500,000
F0	1	0	0	$ 10,000
F1	4	0	0	$ 550,000
F2	4	0	19	$ 3,050,000
F3	1	0	6	$ 250
F4	1	1	100	$ 15,000,000
F5	1	36	1150	$ 250,000,000
Grand Total	**23**	**37**	**1277**	**$ 320,619,250**

Historical Occurrences

Greene County has been directly impacted by 23 tornadoes. The County has been part of 3 federal disaster declarations relating to tornadoes. Two resulted in public assistance, and one has resulted in Individual Assistance.

TABLE 4-24 DECLARED DISASTERS AFFECTING GREENE COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-4447	6/18/2019	Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides, and Mudslides	$3,702,466.32	$4,906,627.63
DR-1343	9/26/2000	Tornado and Severe Storms	$3,340,810.20	-
DR-421	4/41974	Tornadoes	-	-

The 1974 Tornado

Measured by any metric, the worst tornado that Greene County has ever experienced was the one on April 3rd, 1974 as part of a Super Outbreak. Striking at 4:40 in the afternoon, the tornado was the most powerful on the old Fujita Scale, an F5. It tore straight through Xenia, destroying much of the city, killing 36, and injuring 1,150 others. Total damages were estimated at $250 million.

FIGURE 16 THE 1974 XENIA TORNADO

The 1974 Super Outbreak began on April 1, when a springtime low pressure system developed. This system was soon met by a jet of low level moisture, creating a violent system that spanned from Georgia to Michigan. In total, seven F5 tornadoes were observed during the outbreak.

In Xenia, 32 people were killed immediately. Numerous buildings, homes, businesses, churches, and schools were destroyed, including Xenia High School. Home footage of the tornado taken by residents revealed multiple vortices within the tornado, making it even more destructive. Prior to the 1974 storm, the City had no tornado sirens. Afterward, ten sirens were installed throughout the area.

2000 Tornado

A violent tornado that moved at 65 mph hit the town of Xenia for the second time in 26 years damaging some of the same areas that were hit in 1974. Along the path of the tornado, around 250 homes were either damaged or destroyed, over 40 businesses were damaged or destroyed including the local Wal Mart, Kroger, and Tire Discounters, and 6 churches were damaged. A strip mall was nearly destroyed, cars were thrown from the Highway 35 bypass into ditches, 4 semi-trailers were thrown up to 400 yards, and most of the buildings were damaged or destroyed at the Greene county fairgrounds. In Sugarcreek Township, which is to the southwest of Xenia, an additional 14 houses and 3 barns were damaged and some crops were destroyed on a narrow path. Over 10,000 residents were without power for at least 1 day.

2019 Tornado

The tornado first touched down in Riverside in far eastern Montgomery County at 10:12 PM before quickly moving into western Greene County at 10:13 PM. The tornado continued to move east across western and central Greene County before lifting along U.S. 68, about 5 miles north of Xenia.

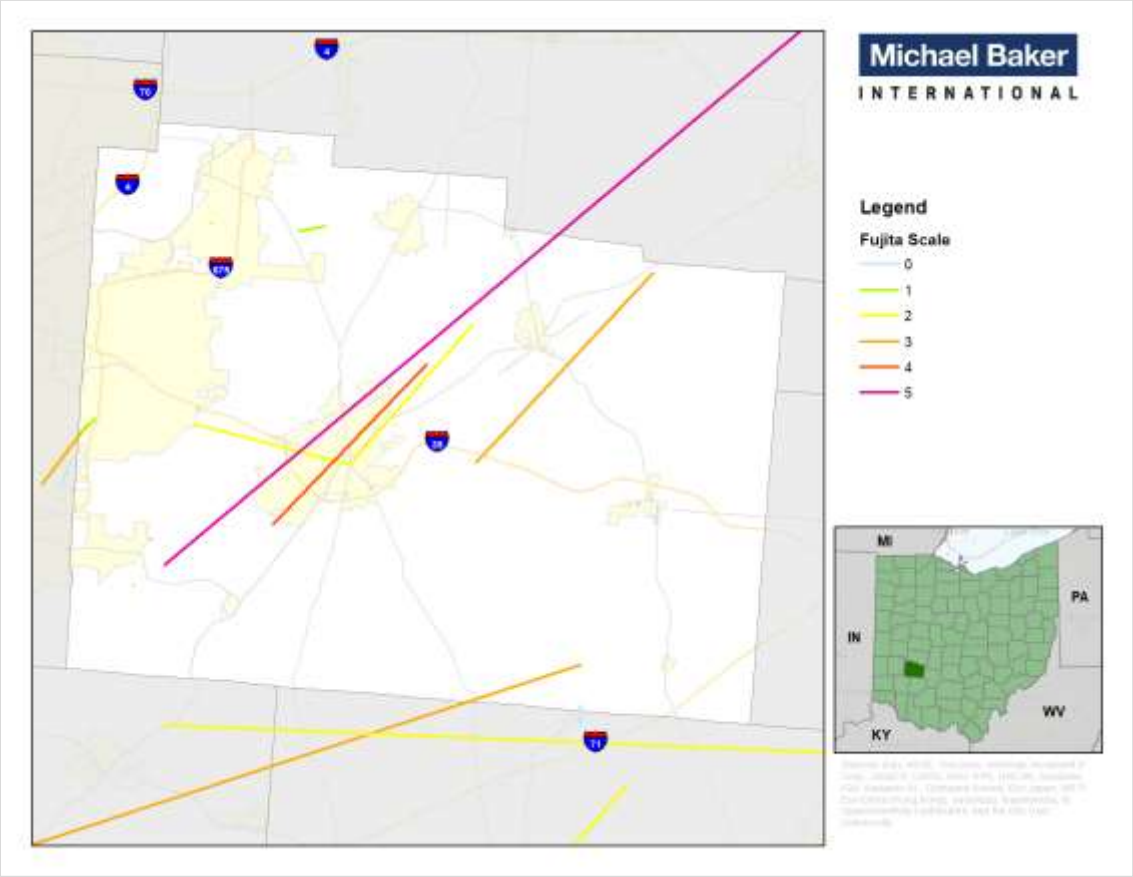
There were two locations along the track of this tornado in the Beavercreek area where damage was indicative of EF3 intensity. The first was in the vicinity of I-675 and Grange Hall Road. Several homes along Rushton Drive had entire roofs lifted, as well as the collapse of several exterior walls with only interior walls left standing. Additional homes along Gardenview and Wendover Drives experienced high-end EF2 damage with windows shattered, garage doors collapsed and entire roof structures removed.

Additional EF3 damage occurred in Beavercreek near Anna Laura Lane. In this area, some buildings of an apartment complex had large sections of roofs removed and exterior walls on upper levels collapsed, leaving just interior walls standing.

Most of the damage from near Grange Hall road eastward to businesses near North Fairfield Road was EF2 to EF1 type damage, where some concrete block businesses had partially collapsed walls and roof lift off.

Much of the tornado path occurred from roughly 0.5 miles north of Kemp Road to within 0.1 miles south of Kemp Road, within the limits of Beavercreek. As the tornado moved east-southeast into Beavercreek township, the damage became more consistent with EF0, to occasionally lower-end EF1, damage. This included damage along Fairground, Beaver Valley and Ludlow Roads. The tornado damage ended just to the east of U.S. 68 in Xenia Township, where roof and tree damage occurred just north of Clifton Road. This was also consistent with high-end EF0 to low-end EF1 damage.

FIGURE 17 GREENE COUNTY TORNADOES



4.5 PROBABILITY OF FUTURE OCCURRENCES

Reported tornado 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 experiencing a tornado event, although infrequent, can be difficult to quantify, but based on historical record of 12 tornado events since 2000, it can reasonably be assumed that this type of event has occurred once every .6 years from 2000 through 2020.

(2020 CY) - (2000 HY) = 20 Years on Record

(20 Years) / (12 Events) = 1.67 Years Between Events

The HMPC, based on their knowledge, determined that Tornadoes are "Highly Likely," meaning there is a 100% probability of these events occurring each year.

4.6 VULNERABILITY TO TORNADOES

TABLE 4-25 POTENTIAL IMPACTS FROM TORNADOES

Impact	Description

People	Severe injuries or death may occur, particularly to those outside or in their vehicles. Large enough tornadoes can kill those even in moderately sturdy structures.
Infrastructure	Damaged or completely destroyed. Weak tornadoes may only rip shingles off a roof, while the strongest can level buildings completely. Power lines can be ripped off their poles, creating power outages for large areas.
Economy	Small town will often be the most affected from significant events. Large tornadoes can hinder transportation, delaying or cutting off supplies to towns.
Natural Systems	Small trees completely uprooted, large trees could have significant branches missing. Crops destroyed or heavily damaged.
Transportation	Transportation can be severely disrupted by debris strewn across roadways.

TABLE 4-26 JURISDICTIONAL VULNERABILITY TO TORNADOES

Jurisdiction	Vulnerability
Beavercreek	Older housing stock that is not built to current codes. Most public buildings do not have tornado assembly spaces that can handle large numbers of people.
Bellbrook	We have many homes that were built in the 1950s and 1960s. Our downtown is extremely old which could make it more at risk. It is also in a valley which may help.
Fairborn	The City of Fairborn does have a history with Tornadoes. We have been fortunate that they have just grazed the city. The city has a number of old structures that would not fair well with a direct hit.
Xenia	Older sections of the City (East end, Laynewood Subdivision, Arrowhead Subdivision) are typically smaller, older homes which would be more susceptible to tornado damage.
Bowersville	Bowersville is unable to hear tornado sires from surrounding communities. Bowersville does not have a tornado siren in the community.
Cedarville	Many of our homes are not able to withstand a powerful tornado. Grace Baptist Church is a designated tornado shelter for the Village.
Jamestown	Most homes/businesses/schools will not withstand a powerful tornado.
Spring Valley	Most of our homes are older and would not withstand a powerful tornado abut.
Yellow Springs	The majority of our homes here were built around the early 1900's and are not built to withstand tornadoes. Many homes do not have basements to provide adequate shelter in the event of a tornado.
Cedarville Township	Several tornadoes have passed through in the past twenty years. Damage to residential and commercial trees, uprooted trees, barns destroyed. Two houses leveled. A direct hit on the south end of town would cause destruction to a housing development that has cheaper-built construction. North end of town has university buildings and dormitories with potential for large loss of life.
New Jasper Township	Homes are not able to withstand high winds and tornadoes.
Xenia Township	Many of our homes are not able to withstand a powerful tornado. We have several farms in our community that lack protection from high winds and storms. Tornadoes have occurred in the last two years in our community, causing hundreds of thousands of dollars in damage.

Miami Conservancy District	None.

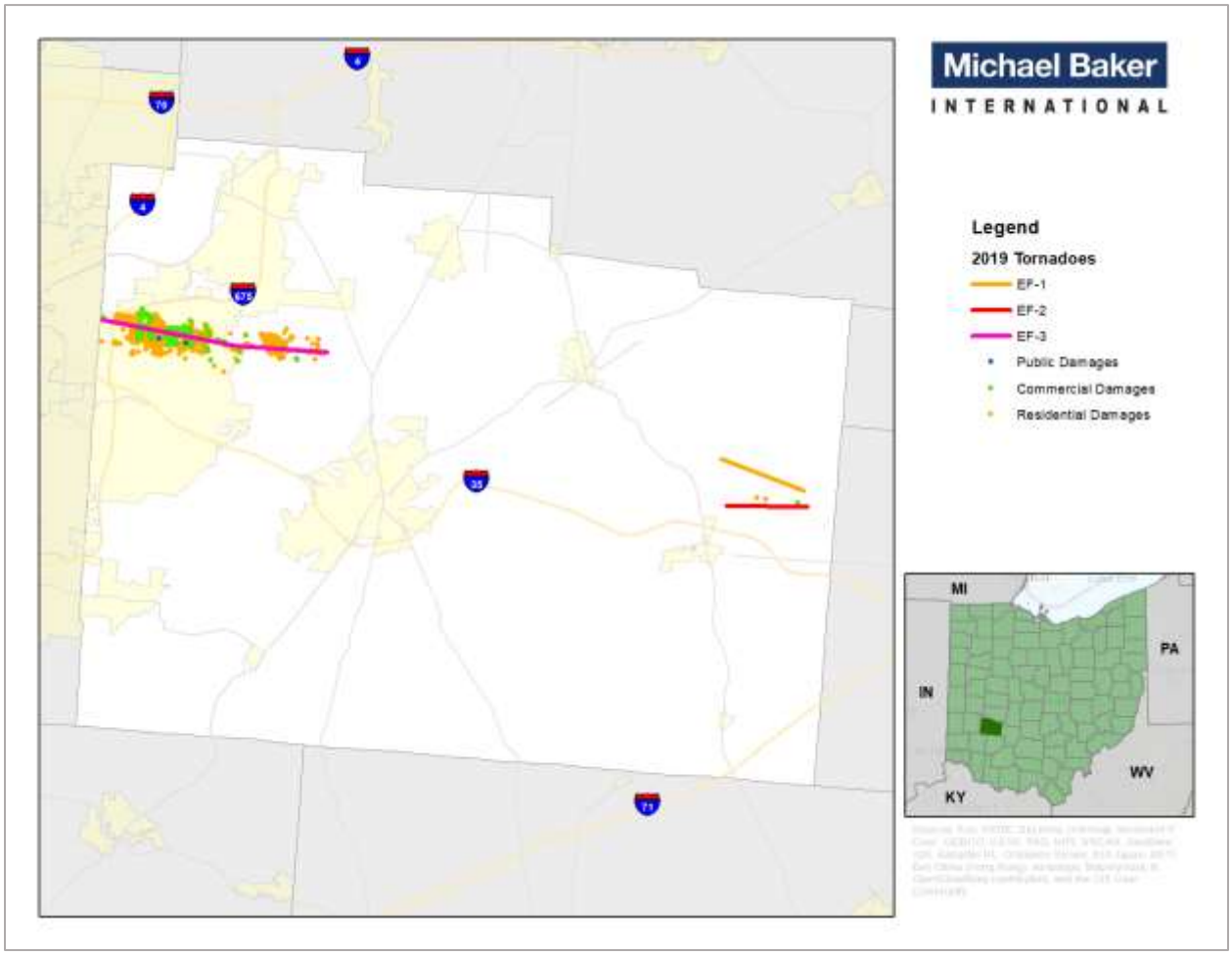
Inventory Assets Exposed to Tornadoes

All assets located in Greene County can be considered at risk from tornadoes and wind events. This includes 100% of the County's population and all critical facilities, structures, and infrastructure.

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 as shown below in Figure 18. 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.

FIGURE 18 2019 TORNADO PATHS IN GREENE COUNTY



4.7 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 Greene County property is equally at risk to tornado damage, and there are no locations of high-risk exposure.

Regulatory Environment

Greene County has adopted Ohio Building Codes for its commercial and residential building construction. The current building code requirements have regulations for wind speed in buildings. Risk Category 1 buildings must be able to withstand 105 mph winds. Risk Category 2 buildings must be able to withstand 115 mph winds, and Risk Category 3 & 4 buildings are required to be built withstanding 120 mph winds.

4.8 TORNADOES 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 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.

5. DROUGHT

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Drought	**1**	0.3	**4**	1.2	**4**	0.8	**1**	0.1	**1**	0.1	**2.5**
Medium Risk Hazard (2.0 – 2.9)											

5.1 DROUGHT CHARACTERISTICS

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:** Defined principally in terms of naturally occurring soil moisture deficiencies relative to water demands of plant life, usually arid crops.
- **Hydrological:** Related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- **Meteorological:** 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:** 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 precipitation has been observed.

Drought risk is assessed 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. Mapping of the current drought status is published by the National Integrated Drought Information System (NIDIS).

5.2 LOCATION

Drought events are region-wide events that affect the entirety of Greene County. All communities are affected during these occurrences.

5.3 DROUGHT EXTENT

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 4-27 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

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).

5.4 HISTORICAL OCCURENCES

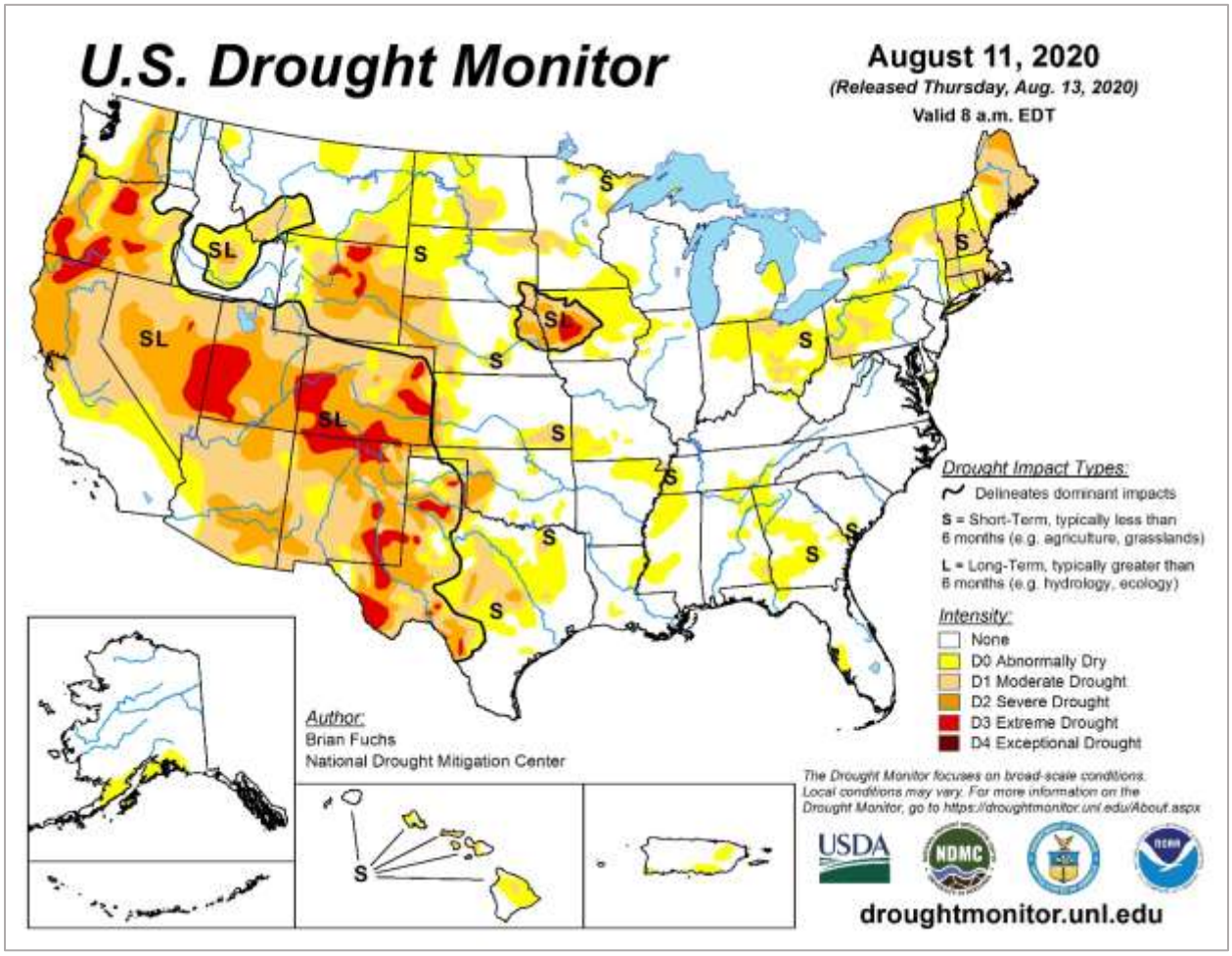
Greene County has experienced 3 notable drought events in recent decades. This information comes from local knowledge, the USDA, and the US Drought Monitor.

- **Drought of 1999:** The dry conditions that actually began in the spring and early summer continued through the months of July and August. Precipitation deficits for the period of May through August show the area to be anywhere between 2 and 8 inches below normal. Excessive heat also contributed to the dry conditions, creating substantial crop loss. Preliminary estimates predict a $600 million agricultural loss statewide from the drought. Dry conditions continued through September. With an estimated 50% total crop loss in many areas, most counties were declared Federal Disaster Areas by the USDA.

- **Drought of 2012:** The 2012-2013 North American droughts began in the spring of 2012, when the lack of snow in the continental United States resulted in very little melt water being absorbed into the soil. Drought conditions were experienced almost nationwide. Multiple Ohio counties were designated as being in a moderate drought condition by June. The Governor of Ohio sent a memorandum to the USDA State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought. The USDA reviewed this memorandum and determined that there were sufficient production losses in eighty-five counties to warrant a Secretarial disaster designation. The 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 85 counties to warrant a Secretarial disaster designation.

- **Drought of 2016:** The second drought occurred from July through August of 2016. During this time, there was little rain, and approximately 15% of the state was labeled as being in “severe drought” status. As a result of the drought in the early summer months, only 45% of corn, and 54% of soybeans rated good or better. The drought ended in August, which, after heavy rains, ended up being a wetter than normal month.

FIGURE 19 EXAMPLE US DROUGHT MONITOR MAP



5.5 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.

Greene County has experienced drought conditions in both 2012 and 2016. Within the observation period of 2000 to 2020, these are the only two notable vents.

(2020 CY) - (2000 HY) = 20 Years on Record

(20 Years) / (2 Events) = 10 Years Between Events

Furthermore, the historic frequency calculates that there is a 10% chance of this type of event occurring each year. The HMPC, based on their knowledge, determined that drought are "Unlikely," meaning there is a less than 1% probability of these events occurring each year.

The National Oceanic and Atmospheric Administration Paleoclimatology Program studies drought by analyzing records from tree rings, lake and dune sediments, archaeological remains, historical documents, and other environmental indicators to obtain a broader picture of the frequency of droughts in the United States. According to their research, "…paleoclimatic data suggest that droughts as severe as the 1950's drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future. The paleoclimatic record also indicates that droughts of a much greater duration than any in the 20th century have occurred in parts of North America as recently as 500 years ago." Based on this research, the 1950's drought situation could be expected approximately once every 50 years or a 20% chance every ten years. An extreme drought, worse than the 1930's "Dust Bowl," has an approximate probability of occurring once every 500 years or a .02% chance of occurring each decade. (NOAA, 2003) A 500-year drought with a magnitude similar to that of the 1930's that destroys the agricultural economy and leads to wildfires is an example of a high magnitude event.

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

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

5.6 DROUGHT IMPACT CATEGORIES

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

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

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

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

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

5.7 VULNERABILITY FROM DROUGHT

TABLE 4-28 JURISDICTIONAL VULNERABILITY TO DROUGHT

Jurisdiction	Vulnerability
Beavercreek	Not applicable.
Bellbrook	We have our own water system so our wells are extremely important to provide water to the community
Fairborn	Not much data available for droughts in the City.
Xenia	Nothing of significance with droughts.
Bowersville	N/a.

Cedarville	We have a reservoir, an old gravel pit, in the Village. The Village owns the water. Pumps are in place and maintained by the Village of Cedarville at this time. It is not a used source of water. Currently controlled by pumping into local creek when level gets high.
Jamestown	We supply our residents with water from 4 wells, relying on our underground aquifers.
Spring Valley	Not so much, extreme drought could affect our water quality.
Yellow Springs	Not much of a concern. Droughts are brief and infrequent here.
Cedarville Township	Farming community where crops are affected by the lack of rainfall, also have to consider livestock and watering them. Also an increase in fires.
New Jasper Township	Rely on the County water supply.
Xenia Township	Community is heavily reliant on income from agriculture. Drought conditions also increase the change of fire spread occurring in open fields and along busy highways.
Miami Conservancy District	None.

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.

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 throughout the County would be affected the most. No injuries, death, or property damage has been recorded as a result of drought in Greene County.

TABLE 4-29 POTENTIAL IMPACTS FROM DROUGHT

Impact	Description
People	Dehydration can occur during drought if water reserves run out.
Infrastructure	Lack of moisture in the ground can cause roadways to crack after long periods of time. Water reservoirs can dry up.

Economy	Rural areas that rely on crops will suffer the most damage economically. Farmers will lose large amounts of money during extended drought.
Natural Systems	Vegetation severely damaged. Rivers and streams can dry up.
Transportation	Cracks in roads can cause delays or detours.

5.8 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.

Regulatory Environment

There are negligible formal regulations that pertain to drought events.

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

6. FLOODING

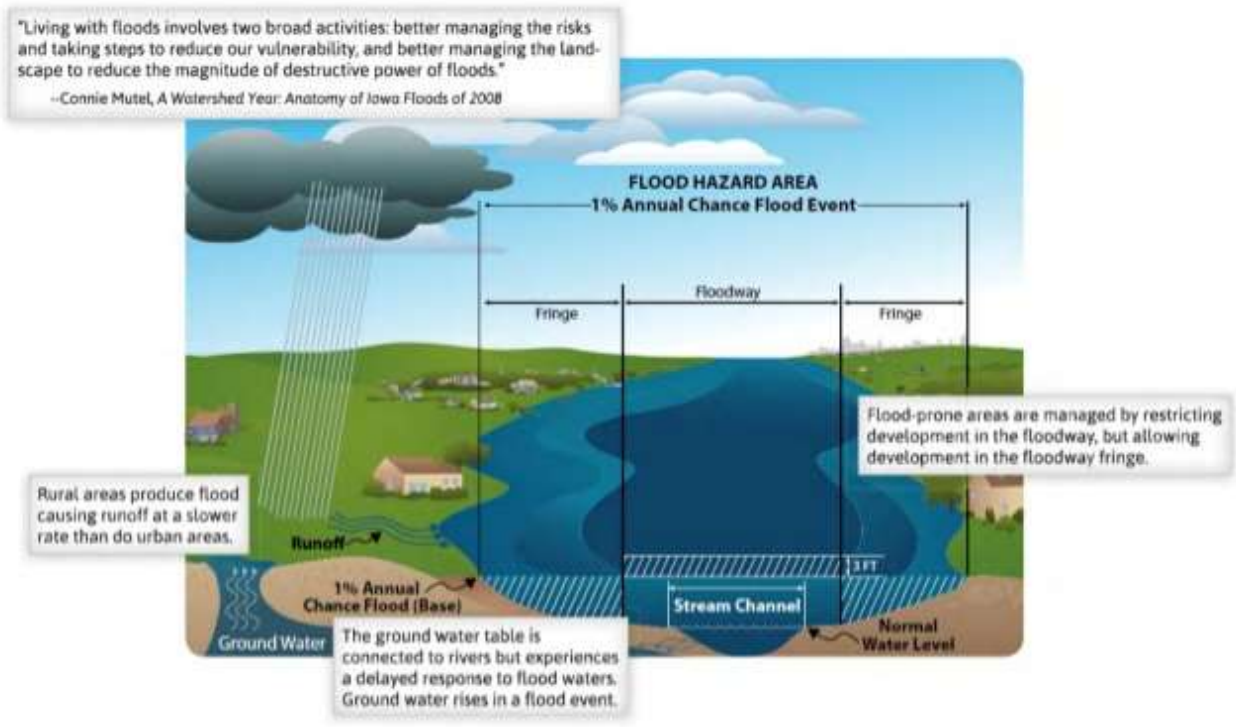
Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Flooding	**4**	1.2	**2**	0.6	**1**	0.2	**3**	0.3	**1**	0.1	**2.4**
Medium Risk Hazard (2.0 – 2.9)											

6.1 FLOODING CHARACTERISTICS

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. Floodplains are lowlands, adjacent to rivers, streams, and creeks that are subject to recurring floods. Flash floods, usually resulting from heavy rains or rapid snowmelt, can flood areas not typically subject to flooding, including urban areas. Extreme cold temperatures can cause streams and rivers to freeze, causing ice jams, and creating flood conditions.

The National Flood Insurance Program (NFIP), for which Flood Insurance Rate Maps (FIRM) are published, identifies the 1% annual chance flood. This 1% annual chance flood event is used to delineate the Special Flood Hazard Area (SFHA) and identify Base Flood Elevations. Figure 20 illustrates these terms. Greene County had its FIRM updated effective March 17, 2011.

FIGURE 20 DIAGRAM IDENTIFYING THE SPECIAL HAZARD FLOOD AREA



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 snowpacks, 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.

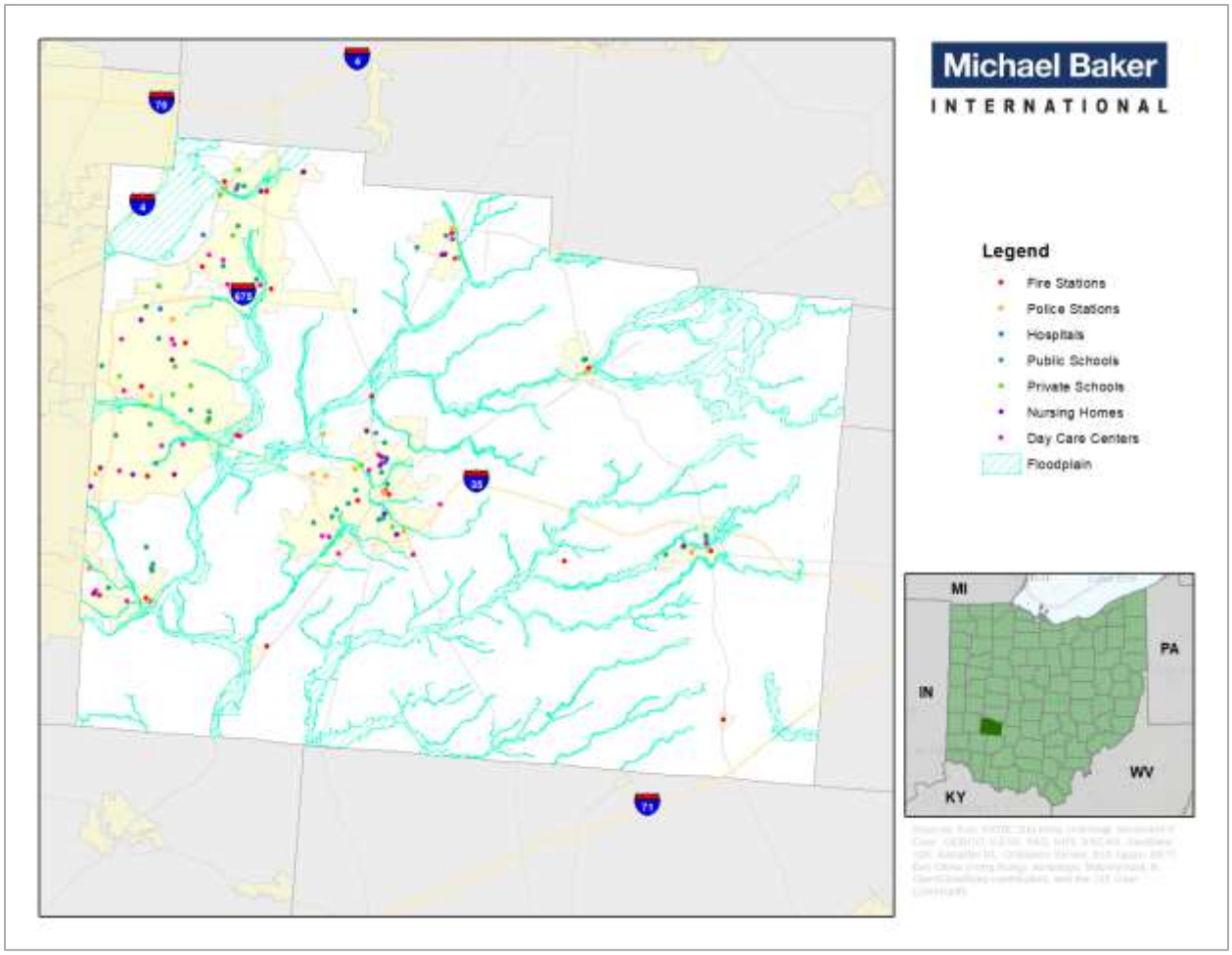
- Ice Jams are stationary accumulations of ice that restrict river flow. Ice jams can cause considerable increases in upstream water levels, while at the same time, downstream water levels may drop. Types of ice jams include freeze up jams, breakup jams, or combinations of both. When an ice jam releases, 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 Greene County residents and its floodplain manager. Many areas of the County are at risk to flooding, especially properties near creeks. Heavy seasonal rainfall, which typically occurs from late October through April, can result in stream overflows.

6.2 FLOODING LOCATION

Flooding in Greene County is most likely to occur in the floodplain shown in the figure below. However, smaller, localized flash flooding can occur anywhere in the County.

FIGURE 21 GREENE COUNTY FLOODPLAIN



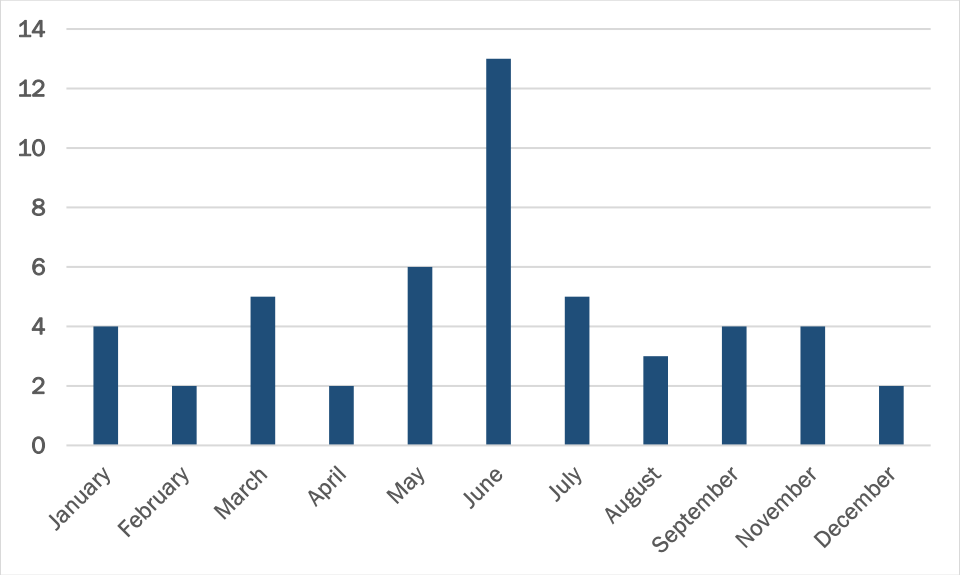
6.3 FLOODING EXTENT

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.

FIGURE 22 TOTAL FLOOD EVENTS BY MONTH



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. Greene County coordinates with the National Weather Service.

Greene County's Rivers Characteristics

Information on historical floods along Mad River and Little Miami River was obtained from stream gauging stations maintained by NOAA. Table 4-31 and Table 4-33 shows the flood stage categories as determined by the National Oceanic and Atmospheric Administration and the National Weather Service (NWS).

There is a USGS river gage located near where for the Mad River near Dayton and the Little Miami River near Spring Valley. These gages provide discharge information, historic crests, recent crests, flood categories, as well as river height, in feet. Historical Crests for the five largest floods of record for the two rivers are shown below in the respective tables. To date, the highest crest for Mad River reached 32.00 feet during the winter of 1959; Little Miami reached 19.20 in the same winter.

TABLE 4-30 HIGHEST HISTORICAL CRESTS ON THE MAD RIVER NEAR DAYTON

Crest Feet	Date of Crest
32.00	1/23/1959
28.20	2/26/1929
27.10	3/5/1963
24.00	1/21/1937
23.80	1/27/1952

TABLE 4-31 FLOOD STATE CATEGORIES FOR MAD RIVER

Flood Categories	Crest (ft)
Action Stage:	15
Flood Stage:	25
Moderate Flood Stage:	32
Major Flood Stage:	52

TABLE 4-32 HIGHEST HISTORICAL CRESTS ON THE LITTLE MIAMI RIVER NEAR SPRING VALLEY

Crest Feet	Date of Crest
19.20	1/21/1959
19.14	3/5/1963
16.80	2/6/1929
16.75	1/27/1952
16.47	2/14/1948

TABLE 4-33 FLOOD STATE CATEGORIES FOR LITTLE MIAMI RIVER

Flood Categories	Crest (ft)
Action Stage:	9
Flood Stage:	11
Moderate Flood Stage:	14
Major Flood Stage:	17

6.4 HISTORICAL OCCURRENCES

General Trends

According to the NCDC, since 2000, there have been 65 flood or flash flood events in Greene County. These events have caused a total of $201,000 in property damage but no reported financial crop damage.

TABLE 4-34 FLOOD EVENTS 2000-2020

Row Labels	County	Deaths	Injuries	Property Damage	Crop Damage
Flash Flood	19	0	0	$ 120,000	$ -
Flood	46	0	0	$ 81,000	$ -
Grand Total	**65**	**0**	**0**	**$ 201,000**	**$ -**

Greene County has been a part of 4 Federal Disaster Declarations that included flooding. Two resulted in public assistance, and two have resulted in Individual Assistance.

TABLE 4-35 DECLARED DISASTERS AFFECTING GREENE COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-4447	6/18/2019	Severe Storms, Straight-line Winds, Tornadoes, Flooding, Landslides, and Mudslides	$3,702,466.32	$4,906,627.63
DR-1556	9/19/2004	Severe Storms and Flooding	$25,804,256.17	$23,662,227.18
DR-831	6/10/1989	Severe Storms, Flooding	-	-
DR-243	6/5/1968	Heavy Rains, Flooding	-	-

Event Narratives

- June 16, 2003: Thunderstorms producing heavy rain moved across portions of the Miami Valley and southwest Ohio throughout the morning. Some locations saw two to four inches of rain, and combined with rainfall over the previous few days, flooding problems developed. Numerous roads were flooded and closed across the region. Up to fifty homes and one business sustained flood damage in the Dayton suburb of Riverside, and a few homes had flooded basements in western Greene County.
- January 11, 2005: A widespread area of showers and thunderstorms ahead of a warm front affected much of central and western Ohio. One to three inches of rain fell across the region, exacerbating existing flooding from previous rains and snowmelt. The heaviest rainfall occurred from west central Ohio southeast through the Columbus area. Numerous roads and low lying areas were flooded, and a number of creeks and streams rose out of their banks.
- March 19, 2008: Several waves of low pressure moved along a stationary front located across the Ohio Valley. The waves of low pressure brought an extended period of heavy rain, with three to six inches of rainfall across southwest and central Ohio. Several roads were flooded and closed across the county. A school sustained minor flooding in Jamestown.
- May 19, 2020: Mill Road near Xenia was closed due to flash flooding. The Sheriff's office opened the road a short time later.
- June 6, 2020: Slow moving showers and thunderstorms developed in the vicinity of a stalled frontal boundary which was draped across the region. Isolated rainfall amounts were between 3 and 4 inches. One basement in Xenia flooded as a result.

6.5 PROBABILITY OF FUTURE OCCURRENCES

Reported flood 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 flood event can be difficult to quantify but based on historical record of 65 flood or flash flood events since 2000, it can reasonably be assumed that there are .31 years between events.

(2020 CY) - (2000 HY) = 20 Years on Record

(20 Years) / (65 Events) = .31 Years Between Events

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

The HMPC, based on their knowledge, determined that flood events are "Highly Likely," meaning they have a 100% annual chance of occurring.

6.6 FLOODING IMPACTS

TABLE 4-36 POTENTIAL IMPACTS FROM FLOODING

Impact	Description
People	Severe floods can kill those caught in their way. Injuries may also result. Illnesses from water-borne viruses, bacteria, or parasites if contact is made with floodwaters.
Infrastructure	Buildings can be severely damaged or destroyed. Mold can occur after flooding.
Economy	Local economies can sustain the most damage. If enough disruption is caused by damage or transportation shortages, effects may be felt at a larger scale.
Natural Systems	Land may be waterlogged, destroying crops. Vegetation may be uprooted and displaced. Animals can lose habitats.
Transportation	Roadways may become impassable. Affected railways can halt movement of goods.

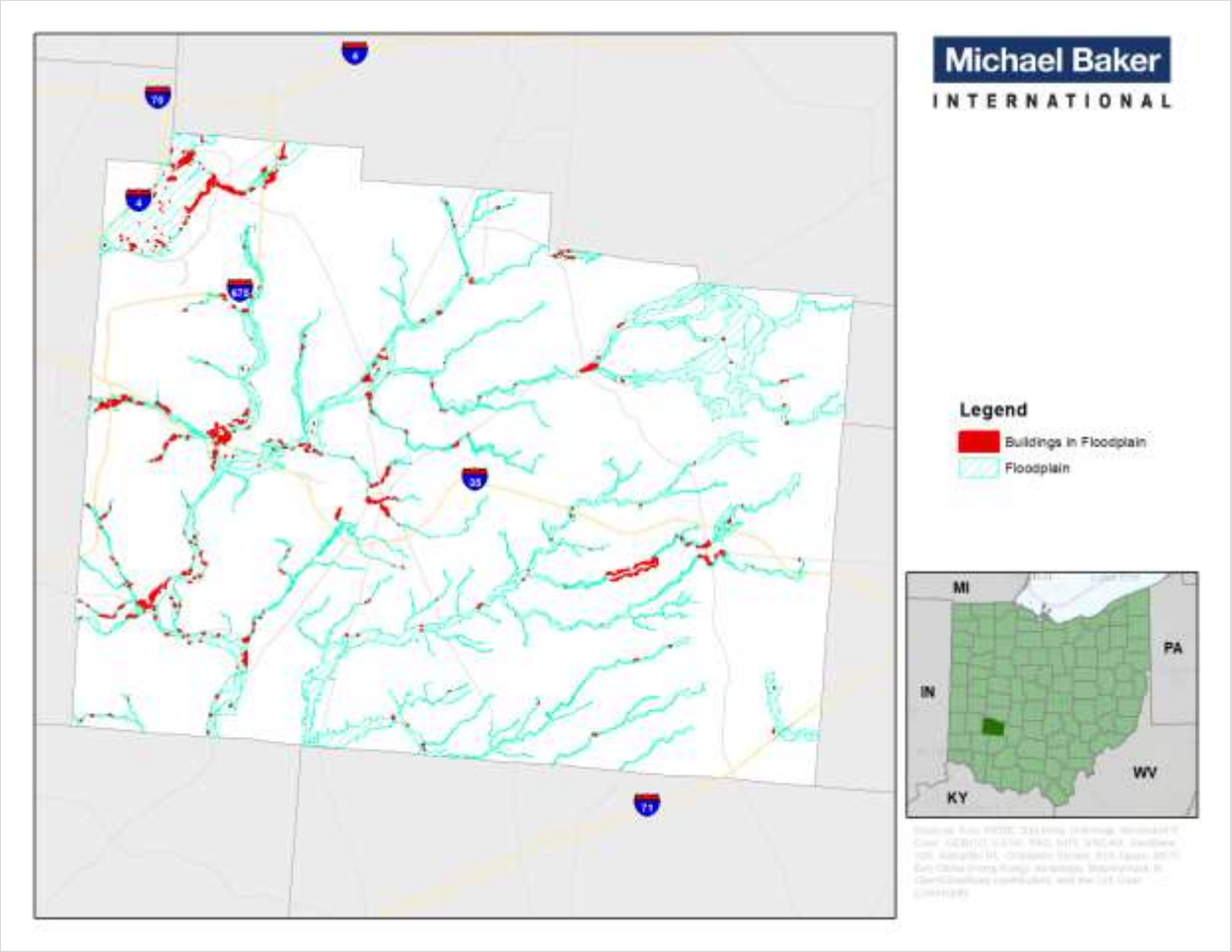
6.7 VULNERABILITY TO FLOODING

TABLE 4-37 JURISDICTIONAL VULNERABILITY TO FLOODING

Jurisdiction	Vulnerability
Beavercreek	City does not have a means for addressing storm water projects due to limited funding sources.
Bellbrook	We have a couple of areas throughout Bellbrook that are susceptible to heavy rains causing flooded areas. Flooding is and always has been an issue for us as much of our area is in the floodplain.
Fairborn	We are fortunate that we have limited areas that flood. Usually this is short lived.

Jurisdiction	Vulnerability
Xenia	City facilities are located outside the designated 100-year floodplain. Access to the City Water Treatment Plant on US 68 may be hindered by Massie Creek backwaters if a 100-Year event were to occur. There are also susceptible structures (detached garages) along E. Third Street as the Shawnee Creek Tributary Stream rises that can cause erosion of the banks.
Bowersville	No flooding issues.
Cedarville	State Rt 72 at the South end of town becomes water covered with heavy rain due to field runoff as well as at Wilmington Road at the Village limits.
Jamestown	The creek on N. Limestone sometimes floods during large rain. There is also a low spot near the railroad tracks on S. Limestone
Spring Valley	We have 25-30 houses in the floodplain. About 15 years ago, we received CDBG grant money from the county to put in a stormwater pump in the lower end of the town next to a levee. It pumps water through the levee into a ditch away from the Village. This helps to prevent flooding and with mosquitos, but there is only one pump and no generator. If the pump or electric goes out and the little Miami river is flooding, the lower end of town starts filling like a pond. Also if the field that it pumps into ever fills up and runs back over the levee, the pump wouldn't be able to keep up.
Yellow Springs	We have a lot of infiltration and inflow, where our sanitary sewer systems, including the wastewater treatment facility, takes on a significant amount of clean water that has to be unnecessarily treated. For example, during a common 2 inches rain event over 2 hours, caused our wastewater treatment facility to receive 6 million gallons of water.
Cedarville Township	Occasional flooding, mostly in rural areas where roads will be covered with water, making them impassable. Some older homes require assistance in pumping out basements.
New Jasper Township	Roads become closed due to damage to roadway, and basements flood.
Xenia Township	Flood damage causes erosion of roads in our community. We also have some areas that are not accessible when eater levels rise beyond a certain point. Our residents that rely on agriculture are negatively affected by flooding as a result of damaged crops and soil.
Miami Conservancy District	Flood prone areas as mapped by FEMA maps and other potential dam pool inundation areas can impact infrastructure, transportation, and other infrastructure.

FIGURE 23 BUILDINGS LOCATED IN FLOODPLAIN



Of all the critical facilities in the County, only one structure sits in the 100 Year Floodplain, Xenia Township Fire Station #1. There are 2,473 residential structures in the County's floodplain. The cost of all buildings in the floodplain totals to $75,388,600.

6.8 LAND USE & DEVELOPMENT TRENDS

Greene County is a mix of developed land, agriculture, and forestry. Much of the existing development, as well as trends, tend to place new development along the I-675 corridor, in the larger towns and cities, and near the Wright-Patterson Air Force Base. Localized flooding continues to remain a possibility throughout the County, especially in the many low-lying areas. 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.

6.9 REGULATORY ENVIRONMENT

There are numerous laws at the federal, state, and local levels throughout the country regarding floodplain management. Greene County continues to work to enforce the local floodplain

management ordinance requirements set forth by all flooding programs, including the National Flood Insurance Program.

Greene County Building and Floodplain Codes

These regulations authorize 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. Flood regulations are codified in the Special Purpose Flood Damage Reduction Resolution.

RiskMAP

Greene County has not been the recipient of any FEMA RiskMAP projects.

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, Greene County is dedicated to protecting homes, with 534 NFIP policies currently in force.

TABLE 4-38 GREENE COUNTY NFIP STATUS SUMMARY

Community	Initial FHBM	Initial FIRM	Current Effective Map Date	Reg-Emerg Date	Total Coverage	Policies in Force
Beavercreek	9/4/1981	8/2/1982	3/17/2011	8/2/1982	$39,589,400	149
Bellbrook	11/2/1974	6/1/1977	3/17/2011	8/2/1982	$13,787,500	87
Cedarville	1/10/1975	7/2/1980	3/17/2011	2/24/1981	$ 1,803,000	14
Centerville	5/17/1974	11/18/1981	3/17/2011	11/18/1981	-	-
Clifton	8/8/1975	7/2/1980	3/17/2011	7/8/1980	$210,000	1
Fairborn	3/15/1974	11/19/1980	3/17/2011	11/19/1980	$21,380,600	114
Greene Co.	7/7/1978	4/1/1981	3/17/2011	4/1/1981	$24,644,700	98
Huber Heights	-	12/11/1984	8/2/2011	12/11/1984	-	-
Jamestown	-	2/1/1984	3/17/2011	2/1/1984	$2,039,700	16
Kettering	5/31/1974	10/15/1980	3/17/2011	10/15/1980	$70,000	1
Spring Valley	11/16/1973	8/1/1980	3/17/2011	8/1/1980	$1,057,800	11
Xenia	12/23/1977	1/2/1981	3/17/2011	1/2/1981	$5,000,200	35
Yellow Springs	10/18/1974	9/4/1985	3/17/2011	9/4/1985	$2,422,000	8
Total	**-**	**-**	**-**	**-**	**$112,004,900**	**534**

Greene County entered the NFIP on July 7, 1978. As a participant in the NFIP, the County is dedicated to regulating development in the FEMA floodplain areas in accordance with NFIP criteria. Structures permitted or built in the 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.

A RL property is a FEMA designation defined as an insured property that has made two or more claims of more than $1,000 in any rolling 10-year period since 1978. The term "rolling 10-year

period" means that a claim of $1,000 can be made in 1991 and another claim for $2,500 in 2000; or one claim in 2001 and another in 2007, as long as both qualifying claims happen within ten years of each other. Claims must be at least ten days apart but within ten years of each other. RL properties may be classified as a Severe Repetitive Loss (SRL) property under certain conditions. A SRL property has had four or more claims of at least $5,000, or at least two claims that cumulatively exceed the building's reported value. A property that sustains repetitive flooding may or may not be on the County's RL property list for a number of reasons:

- Not everyone is required to carry flood insurance. Structures carrying federally backed mortgages that are in a SFHA are required to carry flood insurance in the 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).

The following table breaks down the repetitive losses in Greene County. The data provided by the State of Ohio is the most recent data available for use as it is from 2018.

TABLE 4-39 REPETITIVE LOSS PROPERTIES

Community	Type	Bldg. Payment	Cont. Payment	Losses	# of Properties
Beavercreek	Residential	$32,672.72	$1,338.57	4	2
	Non-Residential	-	-	0	0
Fairborn	Residential	$69,332.02	-	6	1
	Non-Residential	-	-	0	0
Greene County	Residential	$13,639.93	$4,054.85	5	2
	Non-Residential	-	-	0	0
Huber Heights	Residential	$7,361.34	$4,797.41	2	1
	Non-Residential	-	-	0	0
Kettering	Residential	$6,235.38	-	2	1
	Non-Residential	-	-	0	0
Xenia	Residential	-	-	0	0
	Non-Residential	$77,239.05	$88,852.52	6	2

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. There is one Severe Repetitive Loss property in the County.

TABLE 4-40 SEVERE REPETITIVE LOSS PROPERTIES

Community	Type	Bldg. Payment	Cont. Payment	Losses	# of Properties
Greene County	Residential	$13,384.64	$7,970.32	3	1

6.10 FLOODING SUMMARY

Severe flooding has the potential to inflict significant damage along the river and small creeks that run 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.

7. DAM FAILURE

Technological Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Dam Failure	**1**	0.3	**4**	1.2	**2**	0.4	**4**	0.4	**1**	0.1	**2.4**
Medium Risk Hazard (2.0-2.9)											

7.1 DAM FAILURE CHARACTERISTICS

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 levee, unlike a dam, 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. According to the National Levee Inventory, there are no levees in Greene County.

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

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

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

- **Prolonged periods of rainfall and flooding**, which cause most failures;
- **Inadequate spillway capacity**, resulting in excess overtopping flows;
- **Internal erosion** caused by embankment or foundation leakage or piping;
- **Improper maintenance**, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, and other operational 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.

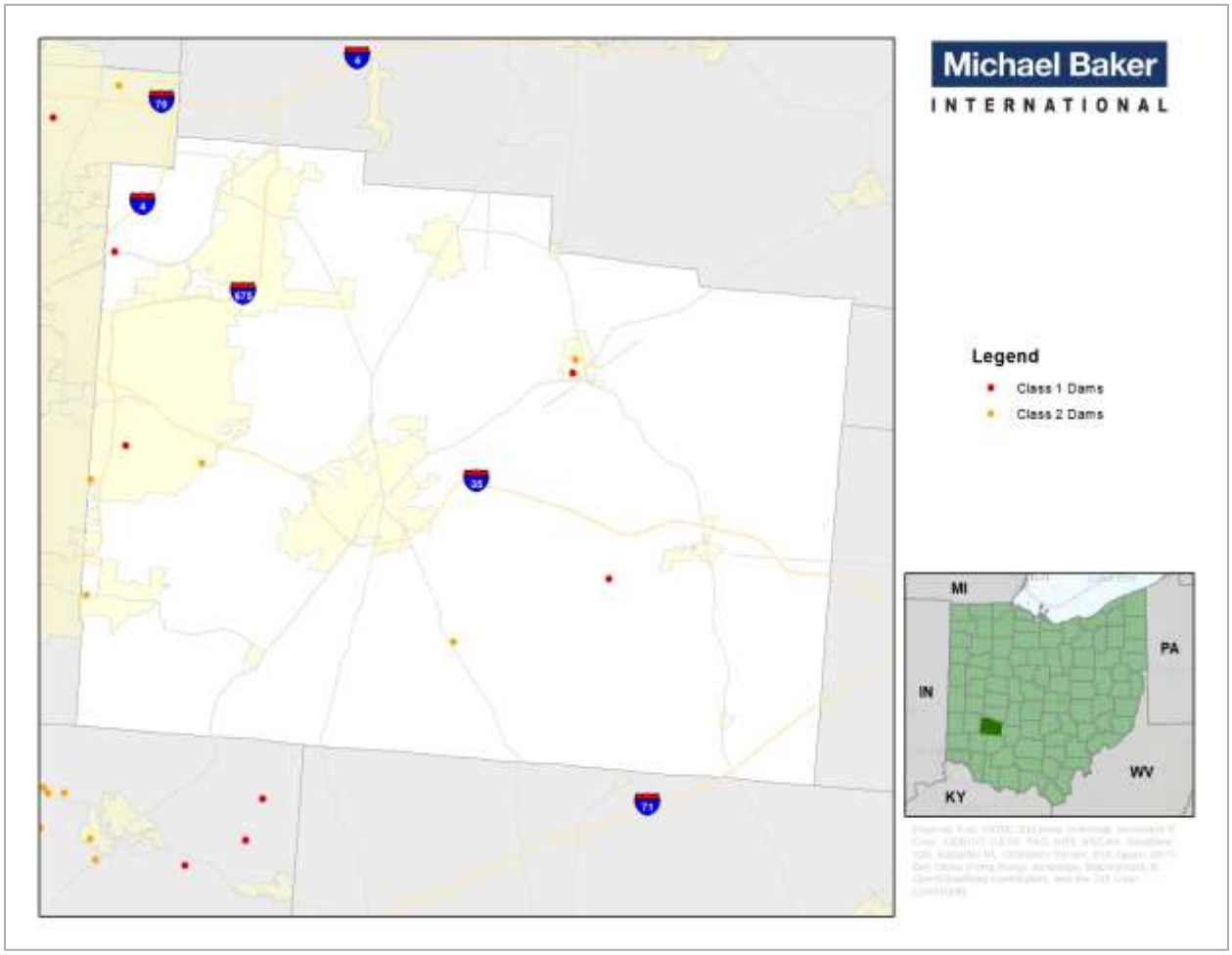
Dams are considered to be localized in the state and are most likely to affect inundation areas downstream and immediate areas around the dam. Discharge from a dam breach is usually several times the 1% chance flood, and, therefore, typical flood studies are of limited use in estimating the extent of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

7.2 LOCATION

FIGURE 24 DAMS IN GREENE COUNTY



7.3 DAM FAILURE EXTENT

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.

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

- Class I – Probable loss of life, serious hazard to health, structural damage to high value property (i.e., homes, industries, and major public utilities.).

- Class II – Floodwater damage to homes, businesses, and industrial structures (no loss of life envisioned); damage to state and interstate highways, railroads; only access to residential areas.
- Class III – Damage to low value non-residential structures, local roads, agricultural crops and livestock.
- Class IV – Losses restricted mainly to the dam

7.4 HISTORICAL OCCURRENCES

There have been no recorded dam failure events in Greene County.

7.5 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, based on their knowledge, determined that Dam Failure is "Unlikely," meaning there is a less than 1% probability of this event occurring each year.

7.6 VULNERABILITY TO DAM FAILURE

TABLE 4-41 JURISDICTIONAL VULNERABILITY TO DAM FAILURE

Jurisdiction	Vulnerability
Beavercreek	The northernmost edge of the Dominick Lofino Park Lake Dam faces a downhill slope, at the bottom of which are several homes and a gravel supply company. All of these would be severely damaged or destroyed during a dam failure event as there would be no time to prepare.
Bellbrook	No dams nearby that could pose a risk unless one far away ruptured catastrophically.
Dayton	The Huffman Dam is near numerous homes that could be potentially damaged or destroyed in the event of a catastrophic dam failure.
Fairborn	The city does not have any dams. We do have a dam close in Bath Twp. There are a number of properties that would receive significant flooding if there was a failure.
Xenia	No dams that hold back water exist in Xenia.
Bowersville	Not applicable
Cedarville	We have an old earthen water retention area, the Cedarville Upground Reservoir (Class I dam), that held water that was pumped in from the old gravel pit. Stopped using it when the Village contracted with the County for water services. Earthen reservoir is not used at this time but is inspected regularly by ODNR as it is considered a dam.

Jurisdiction	Vulnerability
	Any failure along its northern edges would be devastating, as there are numerous homes, as well as a solar farm directly adjacent. There would be no warning time, resulting in potential lives lost and millions in damages.
Jamestown	If the western edge of the Lake Shawnee Dam fails, numerous homes and fields will be damaged. There are several built within the floodplain beneath this dam.
Spring Valley	No dams.
Yellow Springs	Not a concern.
Cedarville Township	While the Cedarville Upground Reservoir is present, it is not likely to damage the larger township.
New Jasper Township	Shawnee Lake Dam is vulnerable.
Xenia Township	Not applicable.
Miami Conservancy District	Dam failure in the county can affect downstream areas within the county and further downstream. Some potential dam failures at an extreme event have a population at risk (PAR) of greater than 65,000.

TABLE 4-42 POTENTIAL IMPACTS FROM DAM FAILURE

Impact	Description
People	Loss of life and injury is most likely in Class I breaches. Fatalities could be expected in the dozens or hundreds depending on population density. Communities can become isolated due to impassable roads.
Infrastructure	Entire buildings can be washed away, or otherwise flooded irreparably. Power outages from disrupted underground utilities.
Economy	Significant or catastrophic dam failures can wipe out large portions of a single small town. Residents may move away permanently, and jobs may be lost.
Natural Systems	Flooding can destroy large tracts of land. Alteration of riverbeds can occur. Debris can become stuck in place.
Transportation	Bridges, highways, and roads can be destroyed completely. Significant detours will be necessary.

Potential Losses from Dam Failure

Dam 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.

TABLE 4-43 HIGH-HAZARD DAM INFORMATION FOR GREENE COUNTY

Dam Name	Hazard Class	EAP	Owner
Huffman Dam	I	Yes	Miami Conservancy District
Greene Town Center Dam	II	Yes	Greene Town Center LLC
Bayberry Cove Development Dam	II		Sugarcreek Township Board of Trustees
Dominick Lofino Park Lake Dam	I	Yes	City of Beavercreek
Tara Lake Dam	II		Private
Greene Co. Fish & Game Pond No. 1 Dam	III		Private
Fisher Lake Dam	II		Private
Mystic Lake Dam	III		Private
Cedarville College Lake Dam	II	Yes	Private
Cedarville Upground Reservoir	I		Village of Cedarville
Spring Lake Dam	III		Private
Lake Shawnee	I	Yes	Private

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

7.7 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. There are no development trends that are likely to affect the vulnerability of the County to dam failure.

Regulatory Environment

Ohio's Department of Natural Resources classifies dams by 2 conditions: height and storage. There are 4 classes of dams, which vary, based on the height of the actual dam, and the amount of water held behind the dam.

7.8 DAM FAILURE SUMMARY

As dams continue to age, maintenance becomes more critical. Significant efforts have been made in Greene County to rehabilitate the older dams located in the County. Since dam failures are often exacerbated by flooding, the probability of dam failures can be associated with projected flood frequencies. Overall, 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.

8. SEVERE WINTER STORMS

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Severe Winter Storms	**3**	0.9	**1**	0.3	**4**	0.8	**1**	0.1	**1**	0.1	**2.2**
Medium Risk Hazard (2.0 – 2.9)											

8.1 SEVERE WINTER STORM CHARACTERISTICS

Greene County has been impacted by varying degrees of winter weather over the last century; however; the occurrence of severe winter storms in the County is relatively infrequent, even during winter months. Severe winter storms 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 Snowstorms 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 the 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)

Winter storms 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 has an extensive history of winter storms. 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.

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.

8.2 LOCATION

Severe winter storm events are region-wide events that affect the entirety of Greene County. All communities are affected during these occurrences.

8.3 WINTER STORM EXTENT

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

- Outlook - Winter storms 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 storm 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.

TABLE 4-44 WINTER STORM WATCH DEFINITIONS

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.

- Advisory - Advisories are issued when a hazardous winter storm 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. Table 4-45 shows the different type of winter weather advisories and the conditions that it takes for them to be met.

TABLE 4-45 WINTER STORM ADVISORY DEFINITIONS

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.

- Warning - Warnings are issued when a hazardous winter storm 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. Table 4-46 discusses the various winter storm warnings that can occur and the conditions of each that are required for them to be posted.

TABLE 4-46 WINTER STORM WARNING DEFINITIONS

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.

Warning Type	Description
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.

8.4 HISTORICAL OCCURRENCES

General Trends

Since 2000, there have been 15 winter storm events that have been recorded by the NOAA. According to NOAA, there have been no injuries and no deaths. Several million dollars of public and individual assistance have been distributed to the County as the result of winter storm disaster declarations.

Since 1977, five federally or state declared severe winter storm events has occurred in Greene County. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1950 to present), these events include severe winter storms, blizzards and snowstorms.

TABLE 4-47 DECLARED DISASTERS AFFECTING GREENE COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
EM-3286	4/24/2008	Snow	$7,122,145.99	-
EM-3198	1/11/2005	Snow	$8,636,637.81	-
DR-1453	3/13/2003	Severe Winter Storm	$31,856,038.61	$2,609,145.45
EM-3055	1/26/1978	Blizzards and Snowstorms	-	-
EM-3029	2/2/1977	Snowstorms	-	-

Event Narratives

- February 4, 2014: A fast moving winter storm moved across the Ohio Valley on Tuesday evening, February 4th. Locations across northern Kentucky and southern Ohio started with heavy snow and transitioned to sleet and freezing rain. Significant ice accumulations caused tree damage and power outages to 5-10,000 people. Further north, snow mixed briefly with sleet, before changing to freezing rain as precipitation tapered off. The resulting 5 to 10 inches of snow and sleet accumulation in west-central and central Ohio. This storm brought widespread travel impacts with many schools and businesses being closed on Wednesday, February 5th. A spotter in Cedarville measured 6 inches of snow.

- February 21, 2008: Low pressure tracked to the Ohio Valley as cold air at the surface was already entrenched. This resulted in snow and significant ice accumulations over much of the region. A spotter in Fairborn measured 3 inches of snow and a quarter inch of ice. A spotter in Spring Valley had 2.8 inches of snow and a tenth of an inch of ice.

- **January 19, 2019**: An upper level trough of low pressure in the Mississippi Valley tracked northeast through the Ohio Valley. A strong surface low developed in eastern Kentucky. Mixed freezing rain and sleet early on the evening of the 19th quickly transitioned to a heavy snow overnight. This system was followed by bitter cold and sub-zero wind chills. The county garage in Xenia measured 5 inches of snow. While other reports across the county were generally between 3 and 4 inches, periods of freezing rain and sleet combined with this snow created significant hazards across the county.

8.5 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 82 winter storm events since 2000, it can reasonably be assumed that this type of event has occurred about four times every year from 2000 through 2020.

(2020 CY) - (2000 HY) = **20 Years on Record**

(**20 Years**) / (**15 Events**) = **1.33 Years Between Events**

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

The HMPC, based on their knowledge, determined that Severe Winter Storms are "Likely," meaning they have between a 10% and 100% chance of occurring each year.

8.6 VULNERABILITY FROM WINTER STORMS

TABLE 4-48 JURISDICTIONAL VULNERABILITY TO SEVERE WINTER STORMS

Jurisdiction	Vulnerability
Beavercreek	Older neighborhoods have heavy tree canopy impacting the service delivery of electric.
Bellbrook	Many mature trees that break off during heavy snow or ice.
Fairborn	Winter storms in the area usually become a problem coupled with power outages. These power outages are the usually the result of ice accumulation on the trees.
Xenia	Residents with disabilities and/or those that cannot drive automobiles become "stranded" in their homes. As previously stated, Xenia has many exposed, overhead power lines that are susceptible to the winter elements.
Bowersville	Older population has issues with getting around in winter storms.
Cedarville	Old trees are an issue with ice and wind.
Jamestown	Ice brings down trees/power lines. Heavy snow makes it difficult for the elderly to maneuver.
Spring Valley	We have had some issues with ice.
Yellow Springs	Heavy snows and ice storms are of a concern here, which has historically damaged power lines and citizens property due to falling trees and/or branches.

Jurisdiction	Vulnerability
Cedarville Township	Rural roads become snow covered quickly due to blowing and drifting, making them impassable at times. Access issues for fire and EMS. Ice storms bring down power lines and trees.
New Jasper Township	Older populations and downed power lines from ice storms.
Xenia Township	Storms have caused roads to be impassible for fire and EMS services. Our elderly population is cut off from resources. Heavy snow and ice cause trees to fall into power lines and block roadways.
Miami Conservancy District	None.

TABLE 4-49 POTENTIAL IMPACTS FROM SEVERE WINTER STORMS

Impact	Description
People	Winter storms can bring with them severely cold temperatures, which can cause frostbite. Slips and falls resulting from ice can cause injuries, particularly older populations. Community isolation with little power, water, or food.
Infrastructure	Power outages can result from heavy snow on power lines. Roof collapses may also occur. Burst pipes may also result, damaging homes and businesses.
Economy	As transportation becomes dangerous, local shops lose customers. Some are forced to close during storms.
Natural Systems	Rivers may freeze and cause flooding. Trees and other vegetation may be killed by ice or brought down from high winds.
Transportation	Roads can become either dangerously traversable, or completely impassable.

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 winter storm situation should the power go out, even if only certain systems are powered by that generator.

Winter 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 storms 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 167,779 people. At particular risk are elderly individuals. The US Census Bureau estimates that there are approximately 15.9% of the County's population is above the age of 65, leading to an estimated 26,000 people at risk of severe winter storms.

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. Greene 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 Greene 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.

8.7 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.

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.

Regulatory Environment

Greene County's current Building Codes require a roof to be able to hold, at minimum, twenty pounds per square foot to lessen the collapsing of roofs should a high amount of snow fall. Ground must be able to also hold twenty pounds per square foot as well.

8.8 WINTER STORM SUMMARY

Greene 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.

9. WILDFIRE

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Wildfire	**2**	0.6	**2**	0.6	**1**	0.2	**4**	0.4	**1**	0.1	**1.9**
Low Risk Hazard (1.0 – 1.9)											

9.1 WILDFIRE CHARACTERISTICS

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.

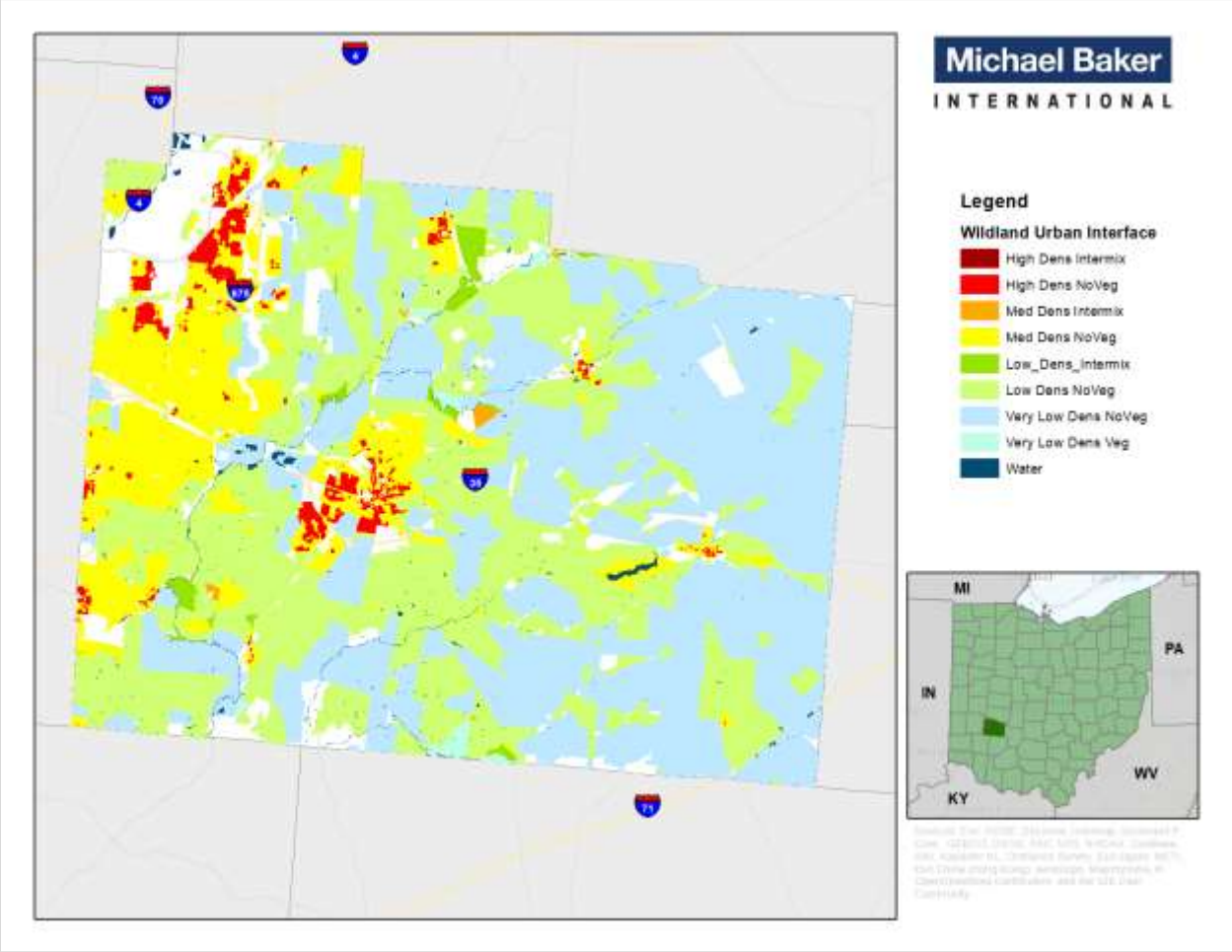
Wildfires can be classified as either a wildland fire or a wildland-urban interface (WUI) fire. A wildland fire occurs in an area that is relatively undeveloped except for the possible existence of basic

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".

9.2 LOCATION

The map below shows the areas of the County that are vulnerable to wildfires. Structures located in the Intermix zones are the most likely to be susceptible to this hazard.

FIGURE 25 WILDLAND URBAN INTERFACE



9.3 WILDFIRE EXTENT

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

9.4 REGULATORY ENVIRONMENT

Local

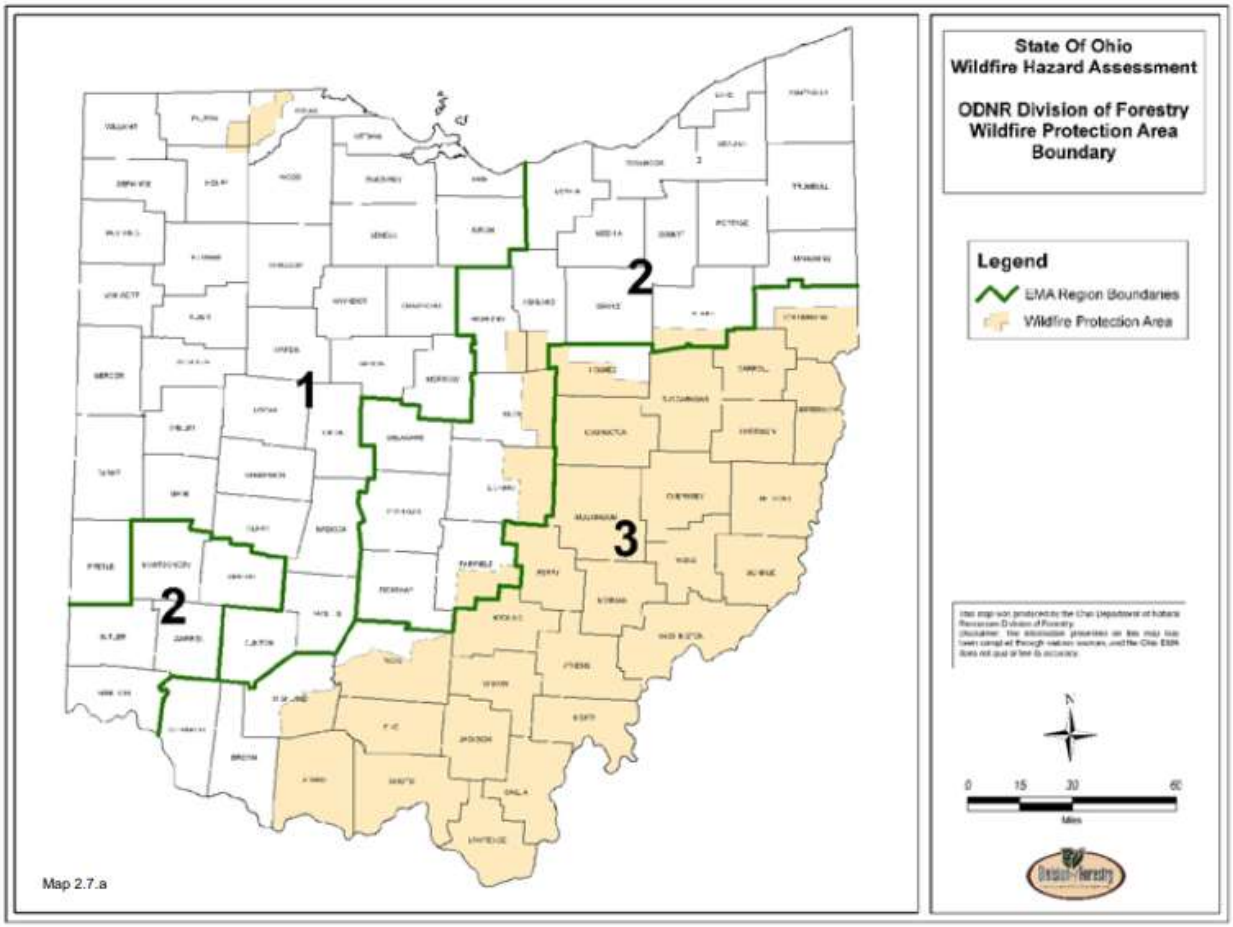
Fire protection is handled by the full time and volunteer staff at the Township Fire Departments, as well as numerous local fire departments. Stations are spread throughout the County to ensure a rapid response when needed.

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. Wildfires occur primarily within the southeastern section of the state, along with a section in the northwest. These areas are known as the wildfire protection area. Wildfires do not typically occur in areas outside of the boundaries due to terrain and vegetation.

Green County falls outside of these zones, as seen in the map below.

FIGURE 26 ODNR WILDFIRE PROTECTION AREA BOUNDARY (OHIO SHMP)



9.5 HISTORICAL OCCURRENCES

There is no recorded history of wildfires occurring within Greene County, according to the National Centers for Environmental Information database. However, local fires continue to happen on a regular basis.

9.6 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 "Possible" chance of wildfires occurring annually in Greene County, meaning that there is between a 1-10% chance.

9.7 VULNERABILITY FROM WILDFIRE

TABLE 4-50 JURISDICTIONAL VULNERABILITY TO WILDFIRE

Jurisdiction	Vulnerability
Beavercreek	Not applicable.
Bellbrook	We have a very large nature preserve that borders the southern portion of our city.
Fairborn	No real history with wildfires.

Jurisdiction	Vulnerability
Xenia	Not really a concern in Xenia.
Bowersville	N/A.
Cedarville	The Cedarville TWP. Fire Department is equipped with fire apparatus and holds a mutual aid agreement with area fire departments.
Jamestown	We are surrounded by farmland on all sides which leaves us vulnerable to wildfires, however our fire department is within a mile.
Spring Valley	There are some crops that abuts the Village that could cause problems south and a wooded area north; it would all depend on wind direction.
Yellow Springs	Not a concern.
Cedarville Township	Area has experienced wildfires especially in extreme dry temperatures. Of concern is autumn when the standing corn is dry, and it is windy. Can lead to a swiftly moving, hot fire.
New Jasper Township	During dry weather, fields are vulnerable to fire.
Xenia Township	Wildfires would cause severe losses to our agriculture-based economy and could threaten homes and lives.
Miami Conservancy District	None.

TABLE 4-51 POTENTIAL IMPACTS FROM WILDFIRE

Impact	Description
People	Burn injuries, death, and homelessness possible
Infrastructure	Large fires can severely damage buildings, burn down homes and businesses, and several power to areas. Those areas in the WUI are most at-risk.
Economy	Fires can completely shut down a local economy. If businesses are destroyed, it may take years to recover and rebuild. Jobs may be lost permanently.
Natural Systems	Large swaths of forest or wildland can be burned down, especially in cases of prolonged drought.
Transportation	Transportation of any sort is incredibly dangerous in areas with active fires, due to both heat and smoke. Long delays and detours are expected.

Potential Losses from 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.

9.8 LAND USE & DEVELOPMENT TRENDS

The wildland-urban interface (WUI) will continue to be an issue for the more rural fringes of the County. Developed 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 25 above.

9.9 WILDFIRE 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.

10. EARTHQUAKES

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Earthquake	**2**	0.6	**1**	0.3	**1**	0..2	**4**	0.4	**1**	0.1	**1.6**
Low Risk Hazard (1.0 – 1.9)											

10.1 EARTHQUAKE CHARACTERISTICS

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

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

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

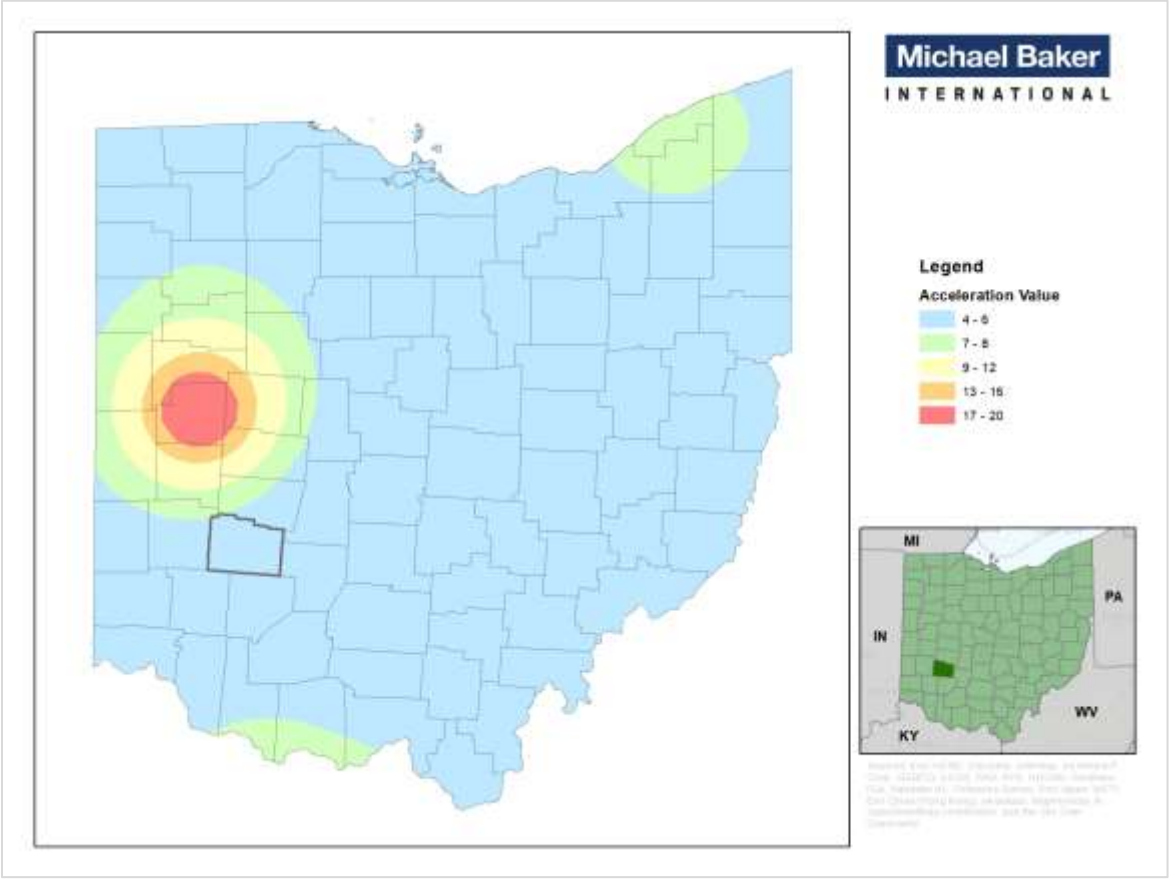
Ohio has recorded more than 300 earthquakes with a magnitude of 2.0 or greater since 1776. Of these earthquakes, 15 were reported to have caused noticeable to moderate damage statewide. Two (2) major centers of seismic activity in Ohio are 1) the Anna Seismogenic Area located in Shelby and Auglaize Counties, and 2) the northeast area of the state on the eastern side of Lake Erie, which is referred to as the Akron Magnetic Boundary. The Anna area has been home to more than 40 earthquakes since the late 1770's while northeastern Ohio has recorded over 100. None of these earthquakes were reported to cause major damage or loss of life. Most seismologists predict that the largest magnitude earthquake that might occur in the western Ohio zone could register between 6.5 and 7.0, while the northeastern zone could generate an earthquake with a magnitude between 6.0 and 6.5. Predicting the amount of damage would be difficult due to lack of historic activity in the area.

The lack of noticeable activity in the County can be partly attributed to the PGA. PGA is partly determined by what soils and bedrocks are present in the area. In regard to Greene County, the PGA is relatively low. As shown in the figure below, the County is in the border area of 4 to 6 PGA. According to the Ohio Department of Natural Resources Ohio Seismic Network, this is interpreted as the area having the possibility of 4%-6% percent of gravities acceleration listed as 1g.

According to 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. Greene County has peak acceleration much below that number, thus providing a buffer from most seismic activity. However, because of the proximity to a fault zone, and the age of some structures in the County, earthquakes are a higher 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 Greene County:

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

FIGURE 27 OHIO PGA



Earthquake Mechanics

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

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

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

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 weekdays, 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.

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 phenomena that can generate additional damage:

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

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

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

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

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

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

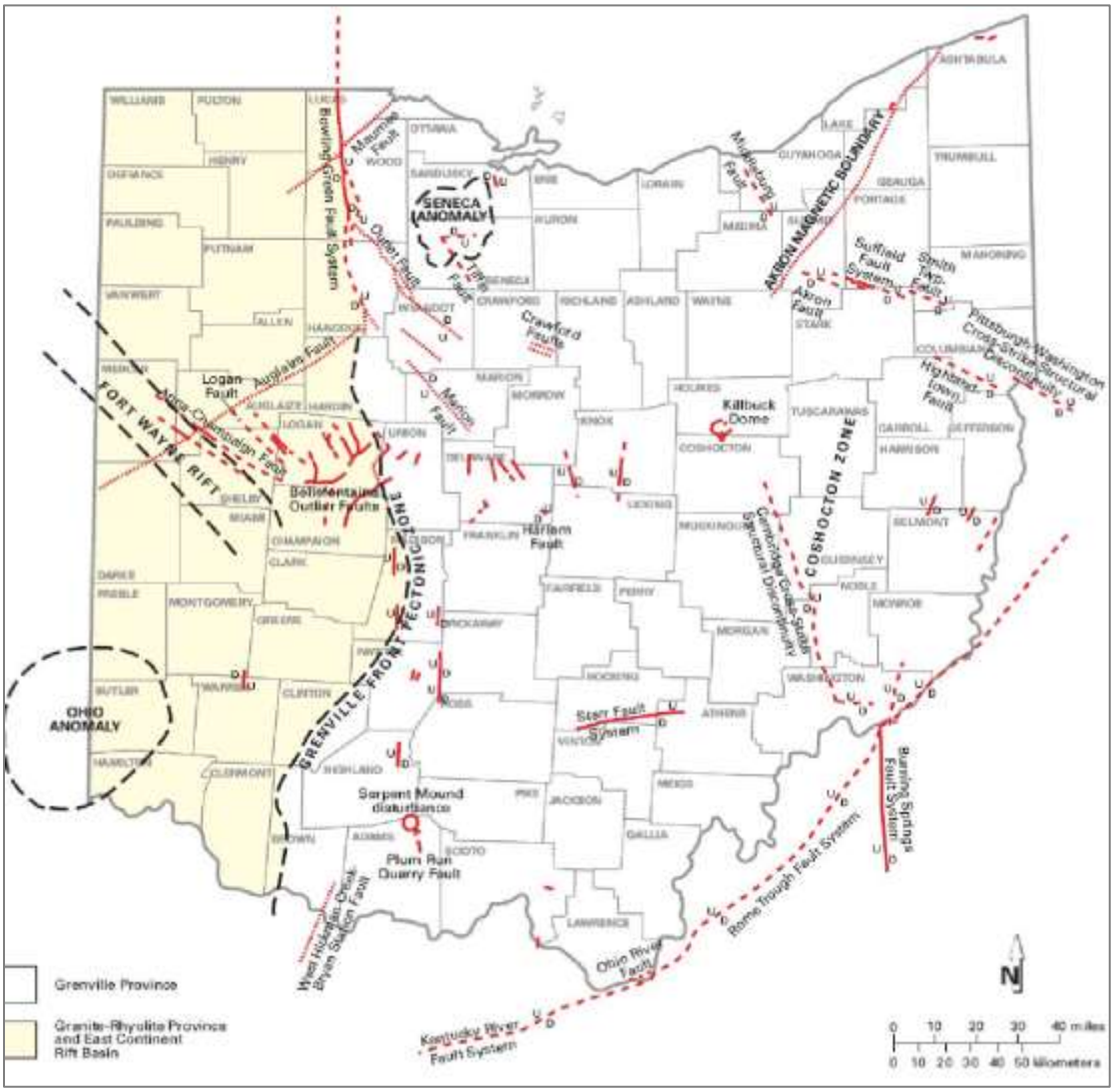
Liquefaction and Subsidence: Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils can lead to possibly widespread structural damage. The oscillation and failure of the soils may result in increased water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

flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

10.2 LOCATION

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.

FIGURE 28 FAULT LINES IN OHIO



10.3 GEOLOGIC HAZARD EXTENT

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 Mw 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 4-52, 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 4-52 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 4-53, 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 4-53 MODIFIED MERCALLI SCALE WITH ASSOCIATED IMPACTS

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.	

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
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 ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken.	<6.1
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

10.4 REGULATORY ENVIRONMENT

Ohio building codes generally do not focus on construction relative to earthquake loads. In such instances where earthquakes of seismic events are mentioned, it is usually in relation to truss design and anchoring of appliances in structures. Because Ohio does not have strong earthquakes, there are negligible laws or guidelines pertaining to seismic stress on roads, bridges, or buildings. However, Greene County's current building codes require a Seismic Design Category B.

10.5 HISTORICAL OCCURRENCES

Earthquake Events

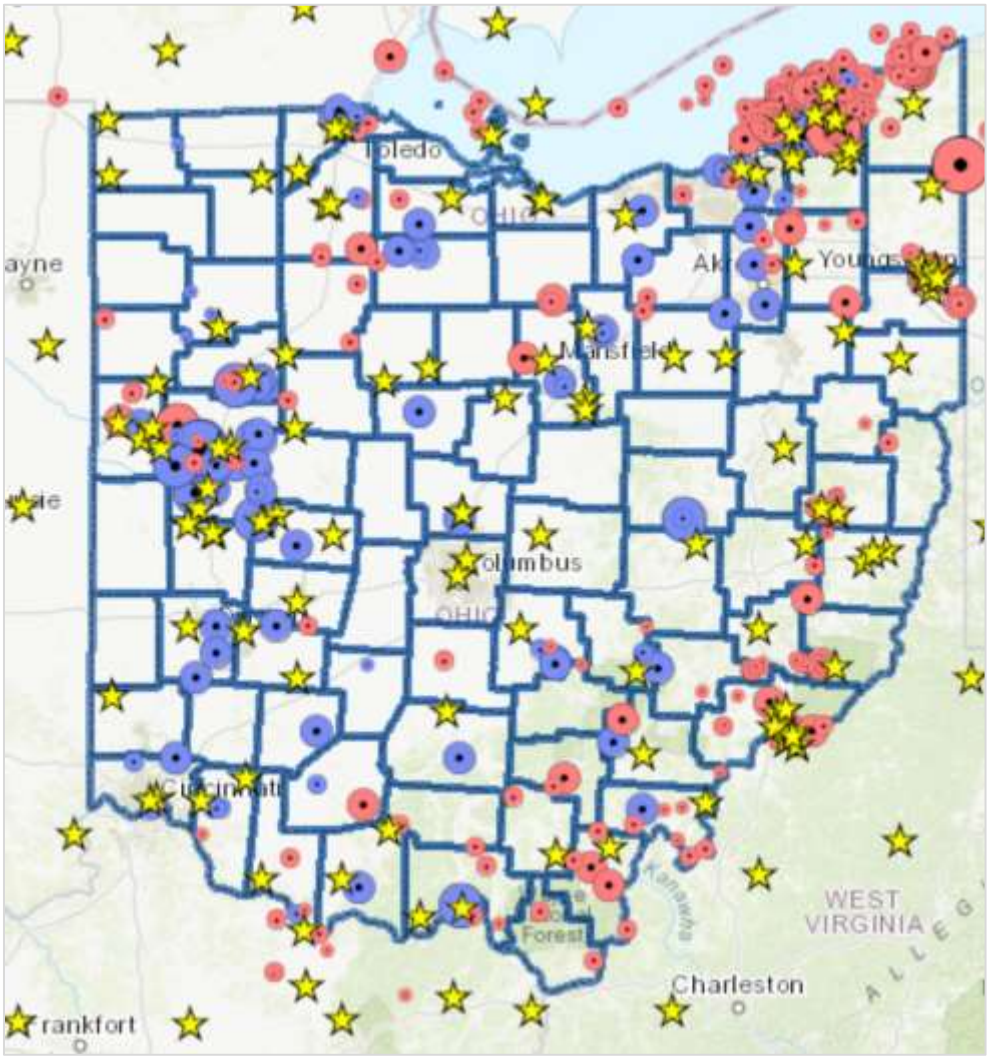
There has been one recorded earthquake in Greene County in 1925. It was recorded as a Modified Mercalli Intensity V with a Magnitude Type 3. In the adjacent counties of Clark, Montgomery, Clinton, and Fayette only minor quakes have been recorded by the Ohio Department of Natural Resources. No significant effects were recorded in Greene County. In the timeframe of 2000-2020, there have not been any recorded earthquake events in Greene County.

TABLE 4-54 RECORDED EARTHQUAKES IN GREENE AND SURROUNDING COUNTIES

Location	Magnitude	Year	Magnitude Type	MMF
Greene Co.	3.4	1925	3	V
Montgomery Co.	3.1	1950	3	IV
Montgomery Co.	3	1873	3	IV
Montgomery Co.	3.5	1834	2	IV
Clinton Co.	3.5	1854	3	IV
Fayette Co.	1.9	1985	1	NF
Clark Co.	2	1980	1	NF

Figure 28 shows epicenters in the State of Ohio from 1970 – 2020.

FIGURE 29 OHIO HISTORIC EARTHQUAKE EPICENTERS



Source: Ohio Department of Natural Resources Division of Geological Survey

10.6 PROBABILITY OF FUTURE OCCURRENCES

There has been an insufficient number of historical occurrences of earthquakes to effectively measure their frequency. Based on their local knowledge, the HMPC determined that earthquakes have a "Possible" chance of occurring, or between a 1-10% annual chance.

10.7 VULNERABILITY FROM GEOLOGIC HAZARDS

TABLE 4-55 JURISDICTIONAL VULNERABILITY TO EARTHQUAKES

Jurisdiction	Vulnerability
Beavercreek	Impact to existing housing stock and retail areas.
Bellbrook	We have new homes and a solid Zoning Department.
Fairborn	Although the city has experienced small earthquakes in the past, we have not received any structural issues. The city does have a number of old structures that could receive significant damage if we had a strong earthquake.
Xenia	No structural deficiencies known with public facilities and the infrequent nature of earthquakes to this part of the country is of little concern.
Bowersville	N/A.
Cedarville	Building inspections are conducted by NIC, National Building Inspectors are contracted. Many of the homes and buildings in the Village are very old.
Jamestown	Our buildings are not earthquake-proof.
Spring Valley	Our town hall was built in the 1800s, is three stories, and has the post office on one side. It would not do very well with an earthquake. It has steel support bars that go through the middle of the building that help hold it together, with businesses on both sides that could be affected or destroyed.
Yellow Springs	We have a significant number of aged buildings in our community, should we experience an earthquake, these structures are likely to have damage.
Cedarville Township	Not too much of a vulnerability, but potential does exist with college dormitory buildings with many students and older buildings in the town and on campus.
New Jasper Township	Fire station is old.
Xenia Township	Several homes in our community are old and would not stand up to an earthquake event.
Miami Conservancy District	Dams can have potential impacts or damages due to earthquakes.

Assets Exposed to Geologic Hazards

TABLE 4-56 POTENTIAL IMPACTS FROM EARTHQUAKES

Impact	Description
People	Injuries may occur from falling objects during an earthquake. Landslides can result in death or injury if unexpected.

Impact	Description
Infrastructure	Homes and businesses can suffer cracks to their structure. If they are close to a landslide, they could be potentially destroyed. Underground infrastructure may be split open during an earthquake.
Economy	Localized damaged only.
Natural Systems	Landslides can move large sections of land, killing trees and rerouting rivers.
Transportation	Entire roads can be cracked, uplifted, or otherwise made to be impassable until repaired. Detours would be needed in the meantime.

Greene County is at a very low vulnerability to seismic activity. The nearest major fault, the New Madrid Fault, is hundreds of miles away. 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 were to occur with the County near the epicenter, there is no way to comprehend the amount of damage that could be sustained.

10.8 LAND USE & DEVELOPMENT TRENDS

As discussed, some earthquakes are only detectable by seismograph. Earthquakes that can be felt may result in continuum of damages, from minor to severe. The more minor incidents may have no damage, or very light damage, such as items falling off of shelves, or bricks coming loose from buildings. Major earthquakes, should they strike, could result in fallen trees, ground rises and falls, and buildings being destroyed.

Infrastructure, including office buildings, government buildings, and homes, in Greene County are not built to withstand the effect of a major earthquake. Continued enforcement of the unified construction code should mitigate this vulnerability.

10.9 GEOLOGIC HAZARDS SUMMARY

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

Man-Made Hazards

11. WATER QUALITY

Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Water Quality	**2**	0.6	**3**	0.9	**4**	0.8	**4**	0.4	**4**	0.4	**3.1**
High Risk Hazard (3.0 – 4.0)											

11.1 WATER QUALITY CHARACTERISTICS

Maintaining a high level of quality for drinking water in communities is an essential part of life. In rural areas where resources can be limited, ensuring that reservoirs are clean and safe becomes an ever more vital part of the maintenance process.

Perfluorooctanesulfonic acid (PFOS)

PFOS is a hazard that has only recently been identified. This acid is a common ingredient used in common materials that are used in households and industrial settings. PFOS is the key ingredient in the fabric protector Scotchgard; it is found in fire-fighting foams; it is commonly used in the semiconductor industry and is used in photolithographic chemicals; and is used in a hydraulic fluid used in commercial aviation.

PFOS has been found to break down extremely slowly and can remain in the human body for extended periods of time. This chemical has been shown to affect the immune system in those who ingest the chemical.

Algae

Harmful algal blooms are overgrowths of algae in water. Some produce toxins that are dangerous to freshwater or marine environments. These blooms can affect local fisheries and reservoirs, which can be damaging to the health of local populations, as well as local economies. There are several factors that contribute to the trigger and sustainability of an algal bloom.

- Nutrients: The eutrophication (nutrient enrichment) of waters is a major contributor to algal blooms. Much of this enrichment comes from nitrogen and phosphorus found in agricultural and household fertilizers. When these drain into bodies of water, they have the potential to greatly promote the spread of algae.
- Temperature: Algae develops and thrives best in warm waters, typically in the spring and summer months. Temperatures above 77°F are ideal for the growth of harmful algae. When water becomes warmer, harmful algae varieties have a competitive advantage over others that have lower temperature thresholds.
- Light: Algae grows best when exposed intermittently to light. Highly adaptable algae varieties, such as blue-green algae, can exist and thrive in many different kinds of lighted environments, giving them an advantage over other organisms.

- Stable Conditions: Water that is stagnant or has a low flow is very conducive to growing algae. Droughts, humans and livestock, and the regulation of river flows all contribute to decreased flows of water.
- Turbidity: Floating organic or sedimentary materials decrease the amount of light that penetrates through water. Low turbidity means that there is more light, which is conducive to algae growth.

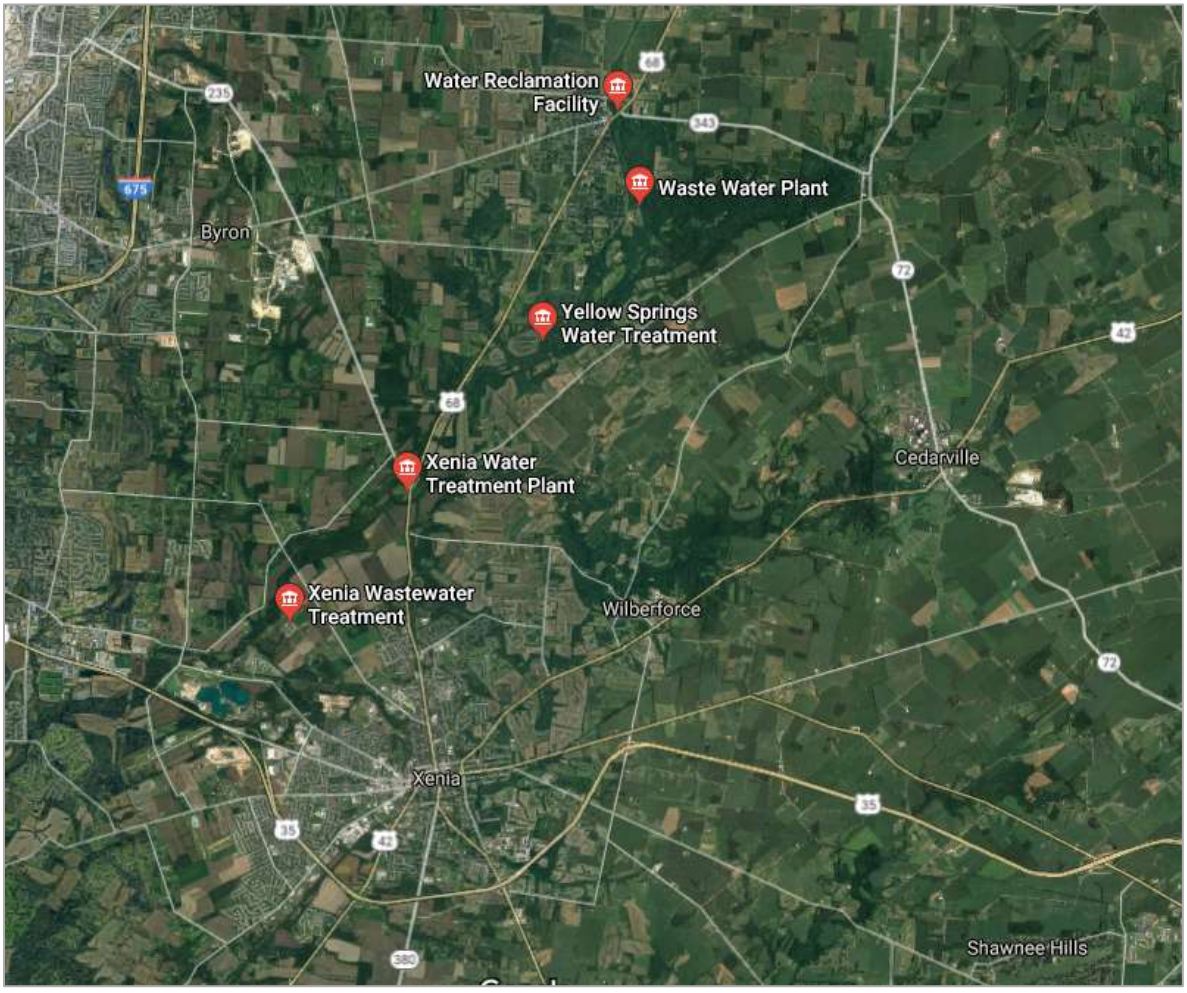
11.2 REGULATORY ENVIRONMENT

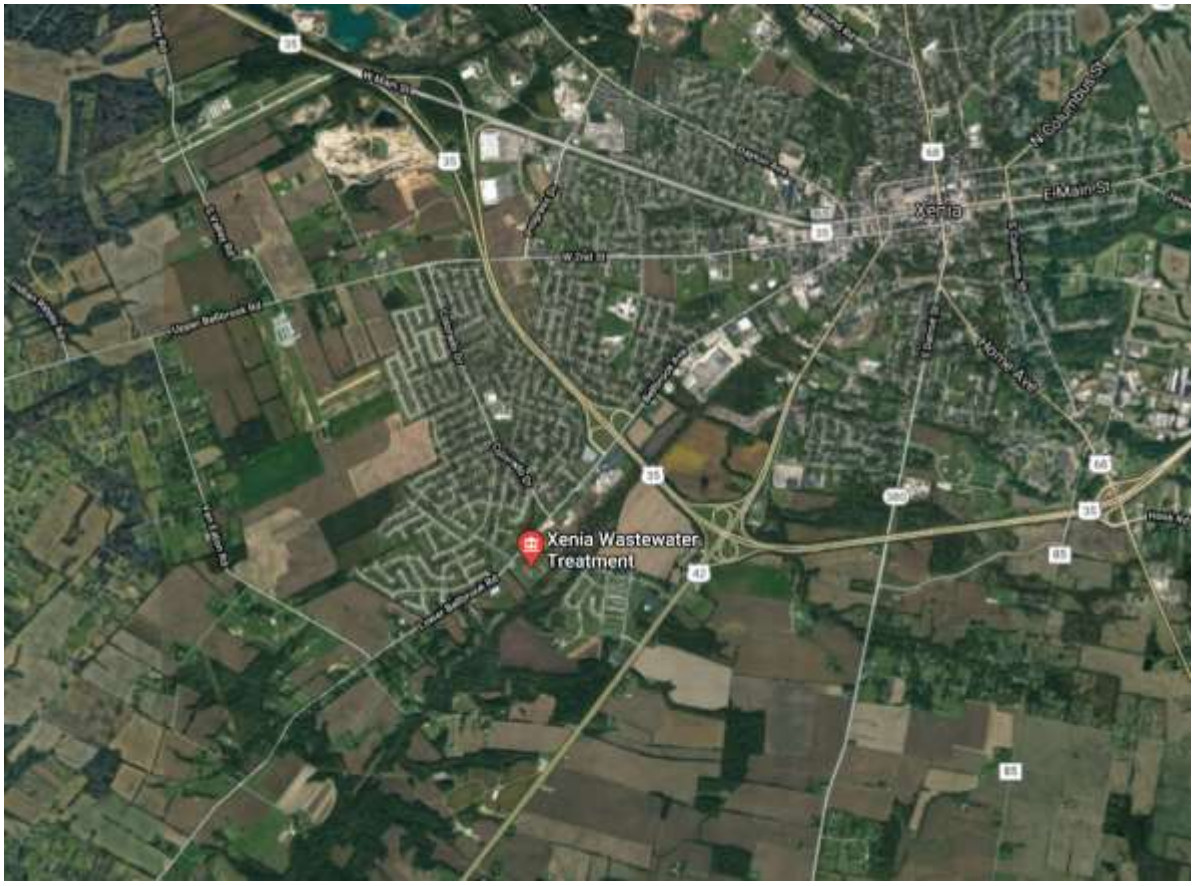
The Ohio Environmental Protection Agency provides guidelines and regulations regarding water quality. Regulations regarding farm runoff, including nitrate and phosphates, are governed by the Ohio Department of Agriculture. The County itself does not have any regulations on farming runoff that might contribute to algal blooms.

11.3 LOCATION

Water contamination can occur in all bodies of water, including lakes, ponds, streams, rivers, reservoirs, runoff, wells, and any other collection of water in the County. The following figures are locations of the Greene County's jurisdictional water treatment plants, reservoirs, and water reclamation facilities.

FIGURE 30 LOCATIONS OF WATER FACILITIES




Xenia Wastewater Treatment
Xenia


Cedarville University
Columbus St
Cedarville
Cedarville Ice Pond Reservoir
Cedarville Reservoir

11.4 HISTORICAL OCCURRENCES

There have been no substantial Water Quality incidents that have affected the County's drinking water supply.

PFOS

The State of Ohio is currently performing a review of drinking water systems. It is not yet known whether PFOS has been located within Greene County, but it is likely given its pervasiveness.

11.5 WATER QUALITY EXTENT

Some algae are capable of producing extremely dangerous toxins in the right settings. These can lead to severe illness, or even deaths. The Ohio Department of Health has a guide for the different levels of algae exposure.

TABLE 4-57 WATER QUALITY ADVISORIES

Type of Advisory
Do Not Drink Advisory for: • Bottle-fed infants and children younger than school age • Pregnant women • Nursing mothers • Individuals with pre-existing liver conditions • Individuals receiving dialysis treatment *As a precautionary measure, the elderly and people with compromised immune systems may want to consider using an alternate water source, as well during this type of advisory.*
Do Not Drink Advisory for: • All people of all ages • Pets • Livestock

The potential magnitude of PFOS is not yet known due to the recent discovery of the hazard. The above Water Quality Advisories are the best guides for different levels of PFOS exposure.

11.6 FREQUENCY/PROBABILITY OF FUTURE EVENTS

There have not been a sufficient number of events to be able to determine how often algal blooms or Perfluorooctanesulfonic acid occur. It is assumed that PFOS incursion is an ongoing process, though there is no known study on if there are peak spikes. The Hazard Mitigation Planning Committee determined, based on their own knowledge that these events are "Possible," meaning that there is between a 1% and 10% annual-chance of these events occurring.

11.7 POTENTIAL IMPACTS

There are many potential impacts from contaminated water that can result from drinking, inhaling, or having skin contact with the contaminated source.

Health Problems Exposure in People & Pets

- Drinking/Swallowing HABs-Contaminated Water
- Skin Contact with HABs-Contaminated Water
- Inhaling HABs-Contaminated Water

Drinking/Swallowing Contaminated Water

- Severe diarrhea and vomiting
- Liver toxicity (abnormal liver function, abdominal pain)
- Kidney toxicity
- Neurotoxicity (weakness, salivation, tingly fingers, numbness, dizziness)
- Difficulty breathing
- Death

Skin Contact with Contaminated Water

- Rashes
- Hives
- Skin blisters (especially on the lips and under swimsuits)

Inhaling Contaminated Water

- Runny eyes and nose
- Sore throat
- Asthma-like symptoms
- Allergic reactions

11.8 VULNERABILITY TO WATER QUALITY INCIDENTS

TABLE 4-58 JURISDICTIONAL VULNERABILITY TO WATER QUALITY INCIDENTS

Jurisdiction	Vulnerability
Beavercreek	Water fields are inside our community and should be protected appropriately.
Bellbrook	Our water department is equipped to handle this issue; however, this would run a huge risk to our wells and water we supply through our system.
Fairborn	Our water department has done a great deal to protect the city's water system.
Xenia	The effects of PFOS to the drinking water supply are currently unknown. Testing will be conducted by Ohio EPA in Fall 2020.
Bowersville	N/A.
Cedarville	We are on County water and have the ability to tap into Cedarville University's water system if needed.
Jamestown	We have EPA mandated radius or no farming chemicals or livestock within 300' of our water source wells, but there is always a chance of some kind of rare contamination.
Spring Valley	We have two ground water wells, that are in the flood plain. We have a filter for iron and manganese but would depend on what chemical, or fuel spill. ODOT will not lower the speed limit at US-42 and Paintersville Road. If a truck carrying chemicals would wreck there, it could travel down the ditch, into the storm drain, and go right across our well.
Yellow Springs	We have a Wellhead protection program in place to protect our source water, and we are currently in the process of installing monitoring wells to track contaminants before they reach our capture zones.
Cedarville Township	Municipal water is pumped from well fields around Xenia, using the Little Miami buried aquifer. University supplies their own water with their own well field. Other residents have

	their own well water. Potential from contamination from field runoff or some type of disaster.
New Jasper Township	Rely on Greene County Water.
Xenia Township	Many of our residents rely on well systems for their home water resources. Our source water comes from several wells in our community. We would have to control access to these
Miami Conservancy District	Promote water monitoring to identify potential impacts of water quality concerns.

All residents of Greene County are at risk if there is a water contamination that affects drinking water. If concentrations are high enough, a Do Not Drink Advisory would be issues for all those in the County. Those under the age of 5, and those over the age of 65, should be given fresh drinking bottled drinking water. These age groups make up 39,821 people out of the 168,937 residing in Greene County, or approximately 23.6% of the County's population. Table 4-59 shows the data of vulnerable populations in the County. Common locations visited by these age groups include, but are not limited to, schools, day care facilities, and nursing homes.

TABLE 4-59 POPULATION VULNERABLE TO ALGAL BLOOMS

Total	Population
Under 5 years	**9,866**
65 to 69 years	**29,955**

Land Use & Potential Development

Greene County is a fairly high agricultural community, with approximately half of the land being dedicated to farming. This has remained consistent over the past several decades and is likely to continue for the foreseeable future. Development or redevelopment is not likely to significantly impact the frequency or intensity of algal blooms and water quality events.

11.9 WATER QUALITY SUMMARY

PFOS is a chemical threat has only recently been identified as a hazard. Water treatment facilities do not currently screen out this chemical, resulting in its continued presence in drinking water sources. It has so far proven to be potentially harmful and is undergoing further research.

As development and redevelopment occur, it is important the County ensures that drinking water quality is sufficient for all of its residents.

12. PUBLIC HEALTH EMERGENCY

Technological Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Public Health Emergency	**3**	0.9	**3**	0.9	**4**	0.8	**1**	0.1	**2**	0..2	**2.9**
Medium Risk Hazard (3.0 – 4.0)											

12.1 HAZARD IDENTIFICATION

Pandemic

Pandemic is defined as a disease affecting or attacking the population of an extensive region which may include several countries and/or continents. It is further described as extensively epidemic. Generally, pandemic events cause sudden, pervasive illness in all age groups on a global scale, though some age groups may be more at risk. As such, pandemic events cover a wide geographic area and can affect large populations, depending on the disease. The exact size and extent of the infected population is dependent upon how easily the illness is spread, the mode of transmission, and the amount of contact between infected and non-infected persons. Three recent pandemics that have affected Greene County are West Nile Virus, Influenza, and COVID-19.

West Nile Virus is a vector-borne disease that can cause headache, high fever, neck stiffness, disorientation, tremors, convulsions, muscle weakness, paralysis, and, in its most serious form, death. The virus spreads via mosquito bite and is aided by warm temperatures and wet climates conducive to mosquito breeding.

Influenza, also known as "the flu," is a contagious disease that is caused by the influenza virus and typically presents with fever, headache, sore throat, cough, and muscle aches. Influenza is considered to have pandemic potential if it is novel, meaning that people have no immunity to it, virulent, it causes deaths in normally healthy individuals, and it is easily transmittable from person-to-person. Influenza spreads via the air in crowded populations in enclosed spaces, and it may persist on surfaces and in the air. Individuals are communicable for 3-5 days after clinical onset. Pandemic influenza planning began in response to the H5N1 (avian) flu outbreak in Asia, Africa, Europe, the Pacific, and the Near East in the late 1990s and early 2000s. In 2009, the US experienced a pandemic of H1N1. The County implemented its Pandemic Response Plan and Medical Countermeasures Plan to provide vaccinations to at risk populations once vaccine was available. Continuing to prepare and plan for future pandemics needs to continue. As stated in the Ohio Department of Health Pandemic Influenza Preparedness and Response Plan, "The impact of an influenza pandemic on the health care system could be devastating. The CDC estimates in the United States a moderate pandemic could result in 90 million people becoming ill; 45 million outpatient visits; 865,000 hospitalizations; and 209,000 deaths." This underscores the importance of planning for this hazard (Ohio Department of Health, 2006).

COVID-19, also known as Coronavirus, is a respiratory disease that spreads from person to person contact. This specific coronavirus, COVID-19, comes from a large group of viruses that infect people and different species of animals. Only a few strains of animal coronaviruses can infect people, but SARS-CoV-2, the virus behind the pandemic, is one of the three that can infect and spread between people. The virus has its origin from bats. The first cases of the pandemic originated in Wuhan, China. Symptoms of the virus can appear as early as two days or as late as fourteen days after exposure. Fever, cough, and shortness of breath are associated with the virus, and they can range from mild to severe to death. The severity of the illness can also increase in patients who older in age, have chronic medical conditions such as heart disease, diabetes, or lung disease, and those who have compromised immune systems.

Epidemic

Epidemic is defined as something affecting many persons at the same time and spreading from person to person in a locality where the disease is not permanently prevalent. The amount of a particular disease that is usually present in a community is referred to as the baseline or endemic level of the disease. This level is not necessarily the desired level, which may in fact be zero, but rather is the observed level. In the absence of intervention and assuming that the level is not high enough to deplete the pool of susceptible persons, the disease may continue to occur at this level indefinitely. Thus, the baseline level is often regarded as the expected level of the disease.

While some diseases are so rare in a given population that a single case warrants an epidemiologic investigation (e.g., rabies, plague, polio), other diseases occur more commonly so that only deviations from the norm warrant investigation. Sporadic refers to a disease that occurs infrequently and irregularly. Endemic refers to the constant presence and/or usual prevalence of a disease or infectious agent in a population within a geographic area. Hyperendemic refers to persistent, high levels of disease occurrence.

Occasionally, the amount of disease in a community rises above the expected level. Epidemic refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area. Outbreak carries the same definition of epidemic but is often used for a more limited geographic area. Cluster refers to an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known. Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

Epidemics occur when an agent and susceptible hosts are present in adequate numbers, and the agent can be effectively conveyed from a source to the susceptible hosts. More specifically, an epidemic may result from:

- A recent increase in amount or virulence of the agent,
- The recent introduction of the agent into a setting where it has not been before,
- An enhanced mode of transmission so that more susceptible persons are exposed,

- A change in the susceptibility of the host response to the agent, and/or
- Factors that increase host exposure or involve introduction through new portals of entry

12.2 LOCATION

As this hazard is initially affects humans, the location of the hazard is the entire County. Due to community spread, each jurisdiction within Greene County is susceptible to a public health emergency.

12.3 HAZARD EVENTS/HISTORICAL OCCURRENCES

Greene County has been a part of 2 Federal Disaster Declarations that included public health emergencies. One has resulted in Public Assistance.

TABLE 4-60 DECLARED DISASTERS AFFECTING GREENE COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-4507	3/31/2020	COVID-19 Pandemic	$1,235,559.58	-
EM-3457	3/13/2020	COVID-19	-	-

2009: The 2009 H1N1 influenza (flu) pandemic occurred against a backdrop of pandemic response planning at all levels of government including years of developing, refining and regularly exercising response plans at the international, federal, state, local, and community levels. At the time, experts believed that avian influenza A (H5N1) viruses posed the greatest pandemic threat. H5N1 viruses were endemic in poultry in parts of the world and were infecting people sporadically, often with deadly results. Given that reality, pandemic preparedness efforts were largely based on a scenario of severe human illness caused by an H5N1 virus. Despite differences in planning scenarios and the actual 2009 H1N1 pandemic, many of the systems established through pandemic planning were used and useful for the 2009 H1N1 pandemic response.

H1N1 was first detected in the United States in April 2009. This virus was a unique combination of influenza virus genes never previously identified in either animals or people. The virus genes were a combination of genes most closely related to North American swine-lineage H1N1 and Eurasian lineage swine-origin H1N1 influenza viruses. Because of this, initial reports referred to the virus as a swine origin influenza virus. However, investigations of initial human cases did not identify exposures to pigs and quickly it became apparent that this new virus was circulating among humans and not among U.S. pig herds.

Infection with this new influenza A virus (then referred to as 'swine origin influenza A virus') was first detected in a 10-year-old patient in California on April 15, 2009, who was tested for influenza as part of a clinical study. Laboratory testing at Centers for Disease Control (CDC) confirmed that this virus was new to humans. Two days later, CDC laboratory testing confirmed a second infection with this virus in another patient, an 8-year-old living in California about 130 miles away from the first patient who was tested as part of an influenza surveillance project. There was no known connection between the two patients. Laboratory analysis at CDC determined that the viruses obtained from

these two patients were very similar to each other, and different from any other influenza viruses previously seen either in humans or animals.

2014/2015: The 2014 Ebola epidemic is the largest in history, affecting multiple countries in West Africa. There were a small number of cases reported in Nigeria and Mali and a single case reported in Senegal; however, these cases were contained, with no further spread in these countries. Two imported cases, including one death, and two locally acquired cases in healthcare workers were reported in the United States. CDC and its partners are taking precautions to prevent additional Ebola cases in the United States. CDC is working with other U.S. government agencies, the World Health Organization (WHO), and other domestic and international partners and has activated its Emergency Operations Center to help coordinate technical assistance and control activities with partners. CDC has also deployed teams of public health experts to West Africa and will continue to send experts to the affected countries. At the time, the general public and media feared that the epidemic would spread to Ohio after a nurse from Texas traveled to the Akron, Ohio area in advance of a wedding.

2020: On March 11, 2020, the outbreak of COVID-19 was characterized as a pandemic by the World Health Organization. Originating from the Hubei Province in China, the virus reached the United States on January 22, 2020. Since then, there have been over 8.3 million confirmed cases in all fifty states. Community spread remains to be the biggest culprit of infection. In order to slow the spread in Ohio, Governor Mike DeWine placed a Stay at Home order on March 23 at 11:59 P.M. for two weeks. A new order was put into place on April 6 as a continuation of the Stay at Home order which was later extended until May 29th. As of October 22, 2020, Ohio has recorded 188,005 cases, 17,523 hospitalizations, and 5,149 deaths with daily numbers spiking. Greene County itself has had 2,248 confirmed cases, 173 people have been hospitalized, and 41 people have passed away due to the virus. The shortage of testing available for the state, and nation, have made it difficult to test all those who are reporting symptoms. Tests are reserved for those who are showing the most severe symptoms, so the numbers reported may not reflect the totality of the infected.

12.4 MAGNITUDE/SEVERITY

The magnitude of a health-related emergency will range significantly depending on the aggressiveness of the virus in question and the ease of transmission. Pandemic influenza is more easily transmitted from person-to-person and is more easily transmitted than West Nile, but advances in medical technologies have greatly reduced the number of deaths caused by influenza over time. In terms of lives lost, the impact various pandemic influenza outbreaks have had globally over the last century has declined. The 1918 Spanish flu pandemic remains the worst-case pandemic event on record.

In contrast, the severity of illness from the 2009 H1N1 influenza flu virus has varied, with the gravest cases occurring mainly among those considered at high risk. High risk populations considered more vulnerable include children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with H1N1 in 2009 have recovered without needing

medical treatment. According to the CDC, about 70% of those who have been hospitalized with the 2009 H1N1 flu virus in the United States have belonged to a high-risk group (CDC, 2009).

COVID-19 has brought an unprecedented time upon Greene County, Ohio, the United States of America, and the entire globe. The extent of the virus has changed the way of life for Ohioans. In Ohio alone, as of three months after the declaration of the pandemic, 1.5 million people filed for unemployment in the state. In the United States, 36 million people have filed for unemployment benefits during the pandemic. The current hospitalization rate for confirmed cases of the virus is 17.9%, with 26.9% of cases requiring ICU admission. The community spread aspect of COVID-19 not only sparked a shutdown of the entire State's economy except for essential businesses for approximately a month and a half, but it has also set forth guidelines for Ohioans to follow as businesses begin to open back up. Wearing masks heavily encouraged while having a six-foot distance between consumers when possible is required. Increased surveillance employee and consumer health is also a best-practice guideline. Due to COVID-19, Greene County has paused travel and new hires while continuing to evaluate the decline of the economy before attempting to return to business as usual. However, Greene County had spent a substantial amount of years safeguarding their budget. The extent of the pandemic has not been exposed completely yet, as the virus is far from being eradicated from Ohio, and specifically, Greene County.

The magnitude of a health-related emergency may be exacerbated by the fact that outbreaks across the United States could limit the ability to transfer assistance from one jurisdiction to another. Additionally, effective preventative and therapeutic measures, including vaccines and other medications, will likely be in short supply or will not be available. There are no true environmental impacts in pandemic disease outbreaks, but there may be significant economic and social costs beyond the possibility of deaths. Widespread illness may increase the likelihood of shortages of personnel to perform essential community services. In addition, high rates of illness and worker absenteeism occur within the business community, and these contribute to social and economic disruption. Social and economic disruptions could be temporary but may be amplified in today's closely interrelated and interdependent systems of trade and commerce. Social disruption may be greatest when rates of absenteeism impair essential services, such as power, transportation, and communications.

12.5 FREQUENCY/PROBABILITY OF FUTURE OCCURRENCE

The precise timing of a health-related emergency is uncertain. Pandemic occurrences are most likely when the Influenza Type A virus makes a dramatic change, or antigenic shift, that results in a new or "novel" virus to which the population has no immunity. Epidemic occurrences are more likely when there are ecological changes, the pathogen mutates, or the pathogen is introduced into an unprepared host population.

However, the HMPC, based on their knowledge, determined that Public Health Emergencies are "Likely," meaning there is between a 10-100% probability of these events occurring each year.

12.6 INVENTORY ASSETS EXPOSED TO HEALTH-RELATED EMERGENCIES

TABLE 4-61 JURISDICTIONAL VULNERABILITY TO PUBLIC HEALTH EMERGENCIES

Jurisdiction	Vulnerability
Beavercreek	One hospital inside our community that serves as a regional facility.
Bellbrook	Not applicable.
Fairborn	We are currently experiencing a public emergency due to the pandemic. This pandemic has had a large impact on the city with the number of positive patients we have.
Xenia	With the recent news of Greene Memorial Hospital no longer having an ICU, patients would have to be seen on an emergency basis at facilities in Beavercreek and/or Dayton.
Bowersville	Nearest medical center is in Jamestown, OH.
Cedarville	We do not have a hospital in town. We use area hospitals: Xenia, Jamestown Beavercreek, Springfield, and Dayton
Jamestown	We are fortunate to have an emergency center and doctor's office in Jamestown. Also have Silvercreek Twp EMS within the village to transport.
Spring Valley	Township handles the fire department and transfers patients to the nearest hospitals.
Yellow Springs	We have a large senior population here which are particularly vulnerable to infectious illnesses, such as COVID-19.
Cedarville Township	Have been able to maintain needed resources so far during the COVID-19 Pandemic.
New Jasper Township	No ICU beds at Greene Memorial Hospital.
Xenia Township	Our elderly population and local school is negatively affected by public health threats. We have seen the reality of the the effects during the current Pandemic.
Miami Conservancy District	None.

All County assets can be considered at risk to health-related emergencies, including 100% of the its residents. Certain population groups are at higher risk of pandemic flu infection. This population group includes people 65 years and older, children younger than 5 years old, pregnant women, and people of any age with certain chronic medical conditions. Such conditions include but are not limited to diabetes, heart disease, asthma and kidney disease (CDC, 2015). Schools, colleges, convalescent centers, and other institutions serving those younger than 5 years old and older than 65 years old, are locations conducive to faster transmission of pandemic influenza since populations identified as being at high risk are concentrated at these facilities or because of a large number of people living in close quarters. The hospital system would be the most likely point of introduction for an epidemic or pandemic to enter the County's area.

TABLE 4-62 POPULAGE AGE ESTIMATES, 2019

Total	Population	Percent
Under 5 years	9,866	5.8%
65 and up	29,955	17.7%

12.7 POTENTIAL LOSSES FROM HEALTH-RELATED EMERGENCIES

Health related emergencies are unlikely to directly impact buildings and infrastructure. However, losses can be measured in lost productivity from employees unable to perform their job duties and students not able to attend classes.

12.8 LAND USE AND DEVELOPMENT TRENDS

Greene County has experienced and will continue to experience new development as their population increases. Denser areas are more susceptible to the spread of diseases as people tend to live closer to one another. Because of this, incorporated areas including Beavercreek, Bellbrook, Centerville, Dayton, Fairborn, Kettering, Xenia, Cedarville, and Yellow Springs which have populations over 3,000, are the most vulnerable to a rapidly spreading disease.

12.9 REGULATORY ENVIRONMENT

There are a variety of regulations which drive the health industry, and as a result, the treatment of pandemics and epidemics. The Ohio Revised Code, Chapter 3701-59 specifically deals with hospitals. Soin Medical Center, Greene Memorial Hospital, and 88th Medical Group, Wright Patterson Air Force Base Medical Center were accredited by The Joint Commission in 2018 with its Gold Seal of Approval for demonstrating compliance with their national standard for health care quality. The Joint Commission is an independent, not-for-profit organization. The Joint Commission accredits and certifies nearly 21,000 health care organizations and programs in the United States. Joint Commission accreditation and certification is recognized nationwide as a symbol of quality that reflects an organization's commitment to meeting certain performance standards.

12.10 HEALTH RELATED EMERGENCIES SUMMARY

Pandemic and infectious disease events cover a wide geographical area and can affect large populations. The exact size and extent of an infected population is dependent upon how easily the illness is spread, the mode of transmission and the amount of contact between infected and uninfected individuals. The transmission rates of pandemic illnesses are often higher in denser areas where there are large concentrations of people. The transmission rate of infectious disease will depend on the mode of transmission of a given illness.

13. TERRORISM

Technological Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Terrorism	**3**	0.9	**3**	0.9	**2**	0.4	**4**	0.4	**1**	0.1	**2.7**
Medium Risk Hazard (2.0 – 2.9)											

13.1 HAZARD IDENTIFICATION

The term "terrorism" refers to intentional, criminal, malicious acts, but the functional definition of terrorism can be interpreted in many ways. Officially, terrorism is defined in the Code of Federal Regulations as "…the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 CFR §0.85). Terrorists use threats to create fear, to try to convince citizens of the powerlessness of their government, and/or to get publicity for their cause.

Terrorist attacks can take many forms, including agriterrorism, arson/incendiary attack, armed attack, assassination, biological agent, chemical agent, cyberterrorism, conventional bomb, hijackings, intentional hazardous material release, kidnapping, nuclear bomb and radiological agent (FEMA April 2009). Explosives have been the traditional method of conducting terrorism, but intelligence suggests that the possibility of biological or chemical terrorism is increasing. The severity of terrorist incidents depends upon the method of attack, the proximity of the attack to people, animals, or other assets and the duration of exposure to the incident or attack device. For example, chemical agents are poisonous gases, liquids or solids that have toxic effects on people, animals, or plants. Many chemical agents can cause serious injuries or death. In this case, severity of injuries depends on the type and amount of the chemical agent used and the duration of exposure.

Biological agents are organisms or toxins that have illness-producing effects on people, livestock and crops. Some biological agents cannot be easily detected and may take time to develop. Therefore, it can be difficult to know that a biological attack has occurred until victims display symptoms. In other cases, the effects are immediate. Those affected by a biological agent require the immediate attention of professional medical personnel. Some agents are contagious which may result in the need for victims to be quarantined.

Terrorism using **explosive** and incendiary devices includes bombs and any other technique that creates an explosive, destructive effect. Bombs can take many forms from a car bomb to a mail bomb. They can be remotely detonated using a variety of devices or directly detonated in the case of a suicide bomb.

Radiological terrorism involves the use of radiological dispersal devices or nuclear facilities to attack the population. Exposure to radiation can cause radiation sickness, long-term illness, and even death. Terrorism experts fear the use of explosive and radiological devices in the form of a "dirty

bomb" to attack the population. A "dirty bomb" is a low-tech, easily assembled and transported device made up of simple explosives combined with a suitable radioactive agent.

In recent years, **cyber terrorism** has become a larger threat than in years past. Cyber terrorism can be defined as activities intended to damage or disrupt vital computer systems. These acts can range from taking control of a host website to using networked resources to directly cause destruction and harm. Protection of databases and infrastructure appear to be the main goals at this point in time. Cyber terrorists can be difficult to identify because the internet provides a meeting place for individuals from various parts of the world. Individuals or groups planning a cyber-attack are not organized in a traditional manner, as they are able to effectively communicate over long distances without delay. They have been known to overtake websites and alter the content that is presented to the public. The largest threat to institutions from cyber terrorism comes from any processes that are networked and controlled via computer. Any vulnerability that could allow access to sensitive data or processes should be addressed, and any possible measures taken to harden those resources to attack.

In recent years, as **drones** have become more available to the public and prevalent in society; they pose a growing risk. These small, remote controlled objects are becoming a tool for criminals and terrorists. Of specific worry to law enforcement is that these small aircraft are difficult to detect and stop. Recently, drones have been used to smuggle drugs and contraband. Another concern is that these drones could be modified to mount attacks with explosives or chemical weapons. Most small drones remain limited by short battery life and small payload capacity. The most popular consumer drones can carry just a few pounds. But some of the features that have made the devices increasingly attractive for businesses and photographers—that they are small, easy to fly and can capture high-definition images—also make them a potentially powerful tool for criminals and terrorists.

NOAA Alerts

When notified by a government official, the NWS has the ability to send alert messages through the Emergency Alert System and over NOAA Weather Radio. Examples include the following:

Local Area Emergency Message: This message defines an event that by itself does not pose a significant threat to public safety and/or property, but the event could escalate, contribute to other more serious events, or disrupt critical public safety services. Instructions, other than public protective actions, may be provided by authorized officials. Examples of when this message may be used include: utility disruptions, road closures, or a potential terrorist threat where the public is asked to remain alert.

- Civil Emergency Message: This message outlines a significant threat or threats to public safety and/or property that is imminent or in progress. The hazard is usually less specific or severe than those requiring a Civil Danger Warning.

- Law Enforcement Warning: This warning is issued for a bomb explosion, riot, or other criminal event. An authorized law enforcement agency may block roads, waterways, or facilities, evacuate or deny access to affected areas, and arrest violators or suspicious persons.
- Radiological Hazard Warning: This warning warns of the loss, discovery, or release of a radiological hazard such as the theft of a radiological isotope used for medical, seismic, or other purposes, discovery of radioactive materials, or a transportation accident involving nuclear weapons, nuclear fuel, or radioactive wastes. Authorized officials may recommend protective actions be taken if a radioactive hazard is discovered.
- Civil Danger Warning: This warning is issued when an event presents a danger to a significant civilian population. The message usually warns of a specific hazard and outlines specific protective actions such as evacuation or shelter in place.
- Shelter In Place Warning: This warning is issued when the public is recommended to shelter in place (go inside, close doors and windows, turn off air conditioning or heating systems, and turn on the radio or TV for more information). Examples include hazardous material releases or radioactive fallout.

13.2 REGULATORY ENVIRONMENT

Terrorism, by definition, is an act that is against the law. The regulatory environment tied to terrorism falls under law enforcement jurisdiction. Terrorism is investigated by the Federal Bureau of Investigations.

13.3 HAZARD EVENTS/HISTORICAL OCCURRENCES

While there have been no large-scale terrorist attacks on Greene County, incidents throughout the country have occurred in locations analogous to those found in the Greene County communities. There have been several small-scale incidents reported in the County, including numerous threats of violence. Nationally, terrorism continues to be an issue of significant importance.

May 2003: A series of over 24 sniper attacks concentrated along the Cap-City Beltway I-270 in the Columbus Metropolitan Area caused widespread fear across Ohio and leaving one dead.

May 1, 2012: Five self-described anarchists were arrested in an alleged plot to blow up a bridge in Cuyahoga Valley National Park in Brecksville, Ohio. The group was being monitored as part of an FBI undercover operation and had considered other plots previously. One of the suspects expressed a desire to cause financial damage to companies while avoiding casualties.

July 20, 2012: In Aurora, Colorado, during the midnight screening of The Dark Knight Rises, a gunman dressed in tactical clothing, set off tear gas grenades and shot into the audience with multiple firearms. Twelve people were killed, and seventy others were injured.

December 2, 2015: In San Bernardino, CA a planned shooting occurred at the Inland Regional Center which resulted in 16 deaths and 23 casualties. A shootout occurred between the suspects, ultimately leading to their deaths.

June 12, 2016: A 29-year old man armed with an automatic assault rifle, walked into a gay nightclub in Orlando, Florida, killing 49 people and injuring 53 more. The man swore allegiance to the leader of the Islamic State of Iraq and the Levant. It has been marked as the deadliest terror attack since the 9/11 attacks in 2001 in the United States.

August 4, 2019: A gunman entered a bar in the Oregon Historic District in Dayton, Ohio. At around 1 AM, he opened fire on the bar, killing 10 and injuring 27 others. The gunman was shot dead by responding police. The incident was then investigated by the FBI as Domestic Terrorism.

13.4 LOCATION

Due to the nature of the hazard, it is impossible to predict where a terrorist attack will take place. Generally, terrorist tend to target areas with large populations, gatherings, or infrastructure that will cause as much destruction as possible. Possible targets for such events include, but are no means limited to, Wright State University, Central State University, Clark State Community College, Antioch College, Wilberforce University, Cedarville University, public and private elementary, middle, and high schools, The Greene, The Mall at Fairfield Commons, events at the Nutter Center, the Yellow Springs Street Fair, Hamvention, government-owned buildings of state or federal agencies, and the Wright Patterson Air Force Base.

13.5 MAGNITUDE/SEVERITY

Events classified as terrorism have been shown to impact as few as one person to tens of thousands. One of the inherent risks of terrorism is the unpredictability. Available data for heightened at-risk locations is displayed in Table 4-64.

TABLE 4-63 GREENE COUNTY POPULATION GATHERINGS

Location	Size
Wright State University	Over 13,000 students
Central State University	3,000 students
Clark State Community College	Over 6,000 students
Antioch College	Over 100 students
Wilberforce University	500 students
Cedarville University	Over 4,000 students
Hamvention	Over 28,000 attendees
Yellow Springs Street Fair	Up to 25,000 attendees, twice a year
Wright Patterson Air Force Base	Approximately 30,000 people
Nutter Center	Capacity of 10,400 people

Terrorism events impact not only those who are directly killed or injured, but also those around them through psychological trauma afterward. Terrorists are not always easily identified, and events can be unpredictable.

Terrorism attacks can occur extremely quickly, with some events lasting just a few minutes from beginning to end.

13.6 FREQUENCY/PROBABILITY OF FUTURE OCCURRENCES

There is not enough historical precedence to determine frequency or future probability of terrorism or threatened terroristic events. However, the HMPC, based on their knowledge, determined that terrorism events are "Likely," meaning there is between a 10-100% probability of these events occurring each year.

13.7 INVENTORY ASSETS EXPOSED TO/POTENTIAL LOSSES TO TERRORISM

Since the probability of terrorism occurring cannot be quantified in the same way as that of many natural hazards, it is not possible to assess vulnerability in terms of likelihood of occurrence. Instead, vulnerability is assessed in terms of specific assets. By identifying potentially at-risk terrorist targets, planning efforts can be put in place to reduce the risk of attack. FEMA's Integrating Manmade Hazards into Mitigation Planning (2003) encourages site-specific assessments that should be based on the relative importance of a particular site to the surrounding community or population, threats that are known to exist and vulnerabilities including:

- Inherent vulnerability:
    - Visibility – How aware is the public of the existence of the facility?
    - Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
    - Accessibility – How accessible is the place to the public?
    - Asset mobility – is the asset's location fixed or mobile?
    - Presence of hazardous materials – Are flammable, explosive, biological, chemical and/or radiological materials present on site? If so, are they well secured?
    - Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
    - Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?
- Tactical vulnerability:

  Site Perimeter
    - Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
    - Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?

  Building Envelope

- Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological and radiological contaminants?

Facility Interior

- Architectural and Interior Space Planning – Does security screening cover all public and private areas?
- Mechanical Engineering – Are utilities and Heating, Ventilating and Air Conditioning (HVAC) systems protected and/or backed up with redundant systems?
- Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lighting sufficient?
- Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
- Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

TABLE 4-64 JURISDICTIONAL VULNERABILITY TO TERRORISM

Jurisdiction	Vulnerability
Beavercreek	The city is immediately adjacent to the Wright Patterson Air Force Base. This base has a major focus on research and development increasing the concern for cyber terrorism for the entire community.
Bellbrook	We recently changed to a new software protection plan. No real risk beyond normal expectations. We have heavily invested in our IT system after we were hit with ransomware.
Fairborn	Our police department and IT department have done a great job in trying to deter computer terrorism as well as violent terrorism. We do have a threat of terrorism to the community due to some of the large scale events the city hosts.
Xenia	The City's IT Department has installed safeguards to prevent ransomware and/or hackers, but nothing is ever 100% full proof. The IT Department is constantly monitoring the security of the City's network.
Bowersville	Our municipal IT infrastructure lack the safeguards to block ransomware or hackers.
Cedarville	We have firewalls in place for the police department.
Jamestown	Jamestown, like all other communities, it subject to be hacked.
Spring Valley	I think we have minimal exposure on our IT, but we have no police and rely on the Greene County Sheriff.
Yellow Springs	We have local and online backups to safeguard, and we have done several trainings and tests of our staff to ensure there is organizational awareness to avoid cyber threats.
Cedarville Township	Cedarville University is a conservative Baptist Christian school.
New Jasper Township	New Jasper Township infrastructure is safeguarded.

Xenia Township	We have two universities and an elementary school in our jurisdiction that would be a target of opportunity. We also have a fairgrounds and several churches in our community that are possible targets as well.
Miami Conservancy District	Cyber security measures are in place and may need periodic updates to protect IT infrastructure for operations. Structural terrorism to a dam is a possibility.

Due to its unpredictable nature, all County assets, including all structures and all population, can be considered at risk for terrorism. Public facilities such as government buildings, sports venues, and dams can be considered as higher-potential potential targets for terrorism since these are highly important and can cause severe disruption if their operations are interrupted due to terrorist threats or activity.

13.8 LAND USE & DEVELOPMENT TRENDS

Land use and development are not directly tied to the prevention or discouragement of terrorism. However, structures can be designed with safety devices meant to protect the populations inside. Precautionary devices such as two-way fire alarm panels, security cameras, and alarm boxes are currently in use throughout the country.

13.9 TERRORISM SUMMARY

One of the primary attributes of terrorism is its unexpected nature. This makes planning for potential attacks virtually impossible. The key to terrorism mitigation lies in the planning phase and understanding the potential vulnerability of a specific area.

14. HAZARDOUS MATERIALS INCIDENT

Technological Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
HazMat Incident	**2**	0.6	**2**	0.6	**2**	0.4	**4**	0.4	**1**	0.1	**2.1**
Medium Risk Hazard (2.0 – 2.9)											

14.1 HAZARD MATERIAL CHARACTERISTICS

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 as 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 railroads that run through 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. Ground water may also be contaminated, depending on the size of the incident. Other potential concerns for spills/leaks are icy road conditions during winter months, sabotage, and terrorism.

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.

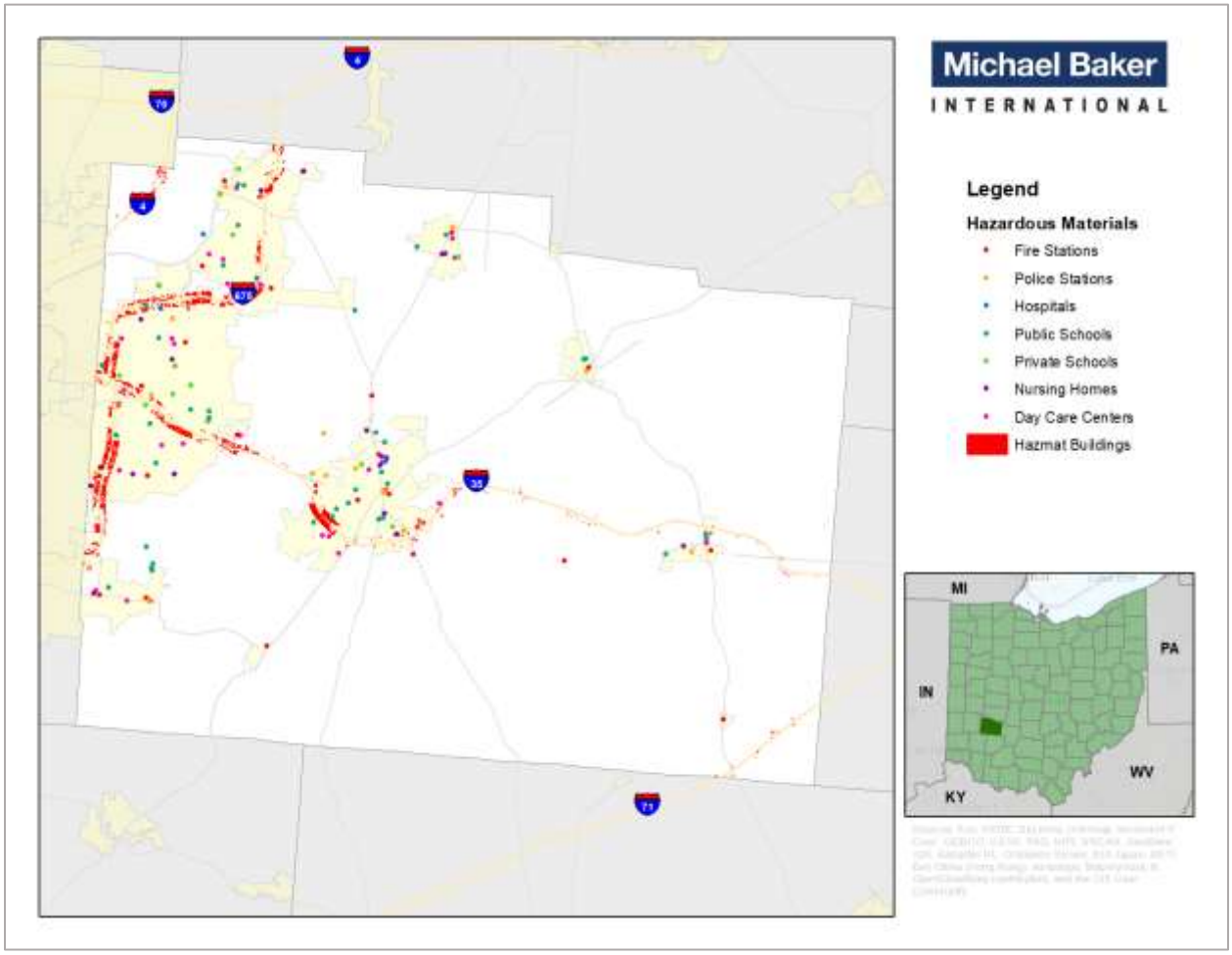
Hospital Radioactive Isotopes

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.

14.2 LOCATION

While the initial incident may occur on a roadway, railroad, or in a facility that houses hazardous materials, the hazard could expand to the entire County. Contamination of hazardous materials can spread through the air, soil, and water of surrounding resources thus carrying the toxin throughout the area. Interstate 675 intersects the west side of Greene County while Interstate 71 cuts through the southeast corner. A few other major roadways are State Route 35, 68, and 42. The County also has a railroad that runs northeast to southwest through Fairborn.

FIGURE 31 HAZARDOUS MATERIALS BUILDING LOCATIONS IN GREENE COUNTY



14.3 HAZARD MATERIAL EXTENT

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.

14.4 REGULATORY ENVIRONMENT

The US EPA's Toxic Release Inventory (TRI) program, tracks hazardous materials release and disposal data for communities throughout the nation. Disposals in Greene County include Hydrochloric Acid, Ammonia, Acetaldehyde, and Formaldehyde. These disposals are largely due to the Fairborn Cement Company as they release 2,090,527 pounds of the 3,020,385 total pounds released out of Greene County. The TRI data does not provide data regarding the effect on the public of releases or disposals of hazardous materials.

TABLE 4-65 TRI GREENE COUNTY FACILITIES SUMMARY

Facility	Releases (lbs)	RSEI Score	Waste Managed (lbs)	Pollution Prevention Activities
Fairborn Cement Co.	3,020,385	1,926,479	5,482,742	0
Miami Products & Chemical Co.	120	386	120	5
Plastic Trim International	590	0	14,756	0
Twist Inc.	87,503	24,893	140,751	0
Unison Industries LLC Plant 1	3,747	749,653	767,570	4
Unison Industries LLC Plant 2	449	68,901	307,819	4
Unison Industries LLC Plants 3 & 4	2,905	480,094	993,802	4
Wright Patterson Air Force Base	834,237	3,075	870,368	2
Yoder Die Casting Inc.	307	97	175,002	0
Grand Total	**3,020,385**	**1,926,479**	**5,482,742**	**19**

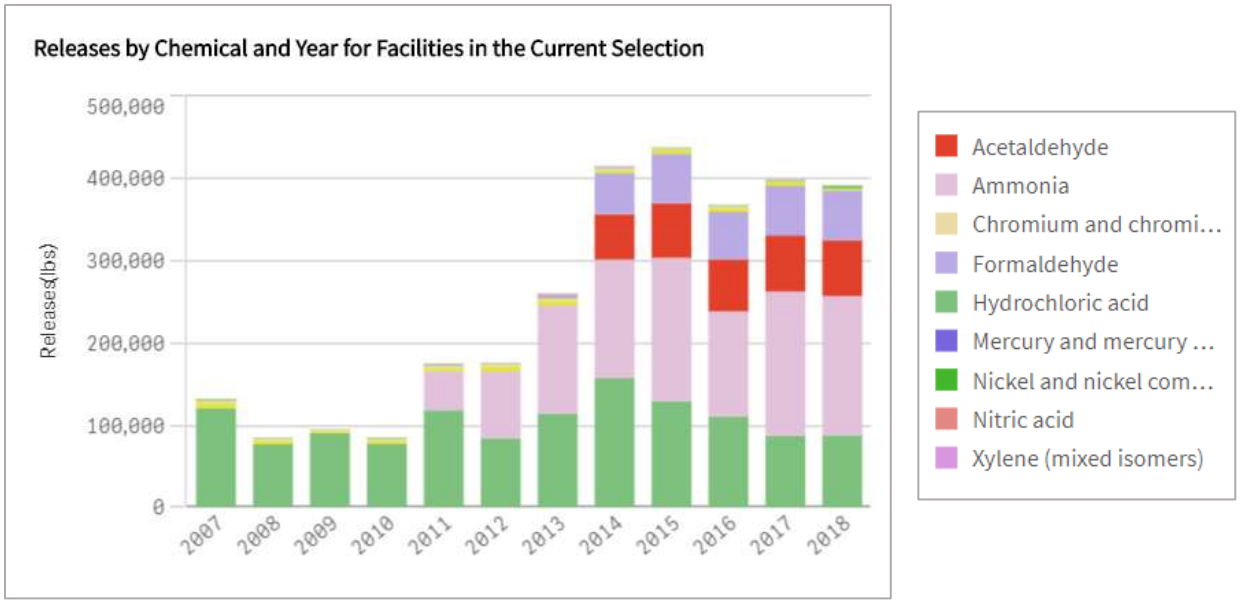
14.5 HISTORICAL OCCURRENCES

There has only been one recent occurrence of emergency crews being deployed to handle a possible hazardous materials incident in Greene County. On January 10, 2020, emergency personnel responded to Wright-Patterson Air Force Base in the afternoon at Building 16 in Area B. After evacuation and inspection, the building was deemed safe. One person did receive medical attention, but it was noted that there had not been any exposure to hazardous materials.

General Trends

Over the past eleven years, Greene County has seen a dramatic rise in chemicals being released. The addition of approximately 300,000 pounds of chemicals have occurred over the snapshot of time. While Hydrochloric Acid has been a common release for the County, Ammonia, Acetaldehyde, and Formaldehyde have become more prevalent in the past five years. However, these releases of chemicals are reported to the EPA from the facilities in Greene County and do not account for hazardous materials spills or accidents.

FIGURE 32 GREENE COUNTY CHEMICAL RELEASES



14.6 POSSIBILITY OF FUTURE OCCURRENCES

The HMPC, based on their knowledge of previous events, assigned HazMat incidents as being "Possible," or having a 1% - 10% chance of happening annually. Reported hazardous material 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 hazardous materials event can be difficult to quantify but based on historical record of 1 hazardous materials incident events since 2000, it can reasonably be assumed that there are 20 years between events.

(2020 CY) - (2000 HY) = 20 Years on Record

(20 Years) / (1 Event) = 20 Years Between Events

Furthermore, the historic frequency calculates that there is a 5% chance of this type of event occurring each year.

14.7 VULNERABILITY TO HAZARDOUS MATERIAL INCIDENTS

TABLE 4-66 JURISDICTIONAL VULNERABILITY TO HAZARDOUS MATERIAL INCIDENTS

Jurisdiction	Vulnerability
Beavercreek	The community has two major highways bisecting the community: I-675 and State Route 35.
Bellbrook	With being along a state route, there is increased truck traffic which could create issues if there were a spill, especially with the route running between our well field properties.
Fairborn	The city has a very busy rail system that runs through the center of town as well as a very active interstate highway. The rail system transports dangers materials daily. On issue with the rail system could be catastrophic to the city. We also have a number of vehicles that transport dangerous material on our highways.
Xenia	Not a concern in Xenia.
Bowersville	I-71 is about a half a mile away.
Cedarville	State Route 72 and 42 run through the Village of Cedarville. Homes are along these state roads.
Jamestown	Jamestown has two state routes running through making it a hazard for spills from trucks/tankers/farm equipment; even the 35 bypass has taken most of the traffic around Jamestown
Spring Valley	We don't know what travels on US 42 and/or ST RT 725. Either one could have an effect on our water system. ODOT won't lower the speed limit at a dangerous intersection, on US-42.
Yellow Springs	We have a US State Route (68) that runs through the center of town and would be the only source of hazmat contamination. It is infrequent that hazardous materials are transported on this road.
Cedarville Township	Many trucks use State Route 72 as a shortcut between I-70 and U.S. Rt 35 or I-71.
New Jasper Township	US-35 bypass has semis hauling toxic materials regularly.
Xenia Township	We have several highways that are used for intrastate and interstate travel. Many shipments of hazardous material pass through our community daily.
Miami Conservancy District	None.

TABLE 4-67 POTENTIAL IMPACTS FROM HAZARDOUS MATERIALS INCIDENTS

Impact	Description
People	In some hazmat incidents, toxic chemicals can force residents to evacuate. Too much exposure can result in health complications.
Infrastructure	Significant events can damage structures
Economy	Hazmat incidents are unlikely to cause long-lasting economic damage.
Natural Systems	Nearby vegetation may die as the result of hazmat spills. Materials that spills into waterways can adversely impact wildlife and other areas downstream.
Transportation	Major highways are the most likely to incur major incidents. If one does occur, major delays and reroutes are possible.

Assets Exposed to Hazardous Material Incidents

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 surrounding farmland, as well as railroad tracks and various highways which pass through the County, make all of Greene County vulnerable to the effects of a possible incident.

TABLE 4-68 CRITICAL FACILITIES IN GREENE COUNTY

Category	Number	Total Cost	1% Loss	5% Loss
Public Safety	42	$52,615,890	$526,159	$2,630,795
Hospitals	3	$101,957,780	$1,019,578	$5,097,889
Nursing Homes	23	$69,646,860	$696,469	$3,482,343
Education	53	$478,674,720	$4,786,747	$23,933,736
Day Cares	35	$323,976,700	$3,239,767	$16,198,835
CRITICAL FACILITY TOTAL	**156**	**$1,026,871,950**	**$10,268,720**	**$51,343,598**

Potential Losses from Hazardous Material Incidents

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

14.8 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 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 and increasing the overall vulnerability of Greene County.

14.9 HAZARDOUS MATERIALS 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.

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SECTION 5. MITIGATION STRATEGY

The intent of the Mitigation Strategy is to provide Greene 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, technological, and man-made hazards. It is designed to be comprehensive and strategic in nature.

The development of the strategy included a thorough review of natural, technological, and man-made 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.

1. GOALS

The following are the goals for this mitigation plan:

- **GOAL 1: Increase public awareness**
- **GOAL 2: Protect life and property**
- **GOAL 3: Create and/or strengthen partnerships**
- **GOAL 4: Create a safer environment through construction or installation projects of natural hazard safety systems**
- **GOAL 5: Reduce losses that result from the failure of High Hazard Potential Dams**

Based on participation from Greene County Mitigation Planning Committee, the mitigation strategy was developed. 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 of 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:

1. **Local Plans and Regulations:** These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.
2. **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.
3. **Natural Systems Protection:** These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.
4. **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.

2. 2020 PLAN UPDATE MITIGATION ACTION PRIORITIZATION METHODOLOGY

Prioritizing mitigation actions for the 2020 plan update, were completed by each jurisdiction as they developed new actions and assessed actions from the previous plan. 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 criteria are described below:

- Funding availability
- Workload
- Cost
- High impact
- Urgency in completion
- Widespread mitigation
- Feasibility
- General acceptance
- Secondary impacts resulting from the project
- Project complexity

The jurisdictions used the criteria to prioritize the new and deferred mitigation actions for the 2020 plan. The scale of 1-10 was used, with 1 being the lowest priority and 10 being the highest priority.

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 prioritizing method was adapted to include a higher weighting for elements of the economic feasibility factor. This method incorporates concepts similar to those described in Method C of FEMA 386-5: Using Benefit Cost Review in Mitigation Planning (FEMA, 2007).

3. PLANNING PROCESS FOR SETTING HAZARD MITIGATION GOALS AND OBJECTIVES

The mitigation strategy represents the key outcomes of the 2020 Greene 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

4. GREENE COUNTY CAPABILITY ASSESSMENT

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

4.1 ABILITY TO EXPAND ON EXISTING CAPABILITIES

The planning process used surveys to determine the existing capabilities for the County and its political subdivisions. These capabilities can be expanded upon with the proper influx of funds or personnel. Should additional state or federal funding become available to specifically augment existing capabilities, then the jurisdictions represented in this plan would be able to improve their capabilities. Additionally, as personnel turn over, they may be replaced with individuals with skillsets not captured in these surveys. The County will continue to develop their capabilities over time and expand upon them where they are able.

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.

TABLE 5-1 PLANNING AND REGULATORY CAPABILITIES

Tool/Program	Greene County	City of Beavercreek	City of Bellbrook	City of Fairborn	City of Xenia	Village of Bowersville	Village of Cedarville	Village of Jamestown	Village of Spring Valley	Village of Yellow Springs
Hazard Mitigation Plan	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD
Emergency Operations Plan	X	X		X	X					X
Disaster Recovery Plan				X						
Evacuation Plan										
Continuity of Operations Plan				X	X					
NFIP	X	X	X	X	X		X	X	X	X
NFIP-CRS										
Floodplain Regulations		X			X					
Floodplain Management Plan		X			X					
Zoning Regulations		X		X	X				X	X
Subdivision Regulations		X		X	X					X
Other										

UD = Under Development

TABLE 5-2 PLANNING AND REGULATORY CAPABILITIES, TOWNSHIPS AND STAKEHOLDERS OF GREENE COUNTY

Tool/Program	Cedarville Township	New Jasper Township	Xenia Township	Miami Conservancy District
Hazard Mitigation Plan	UD	UD	UD	UD
Emergency Operations Plan	X	X	X	X
Disaster Recovery Plan	X	X		X
Evacuation Plan		X	X	X
Continuity of Operations Plan	X	X	X	X
NFIP				
NFIP-CRS				
Floodplain Regulations	X	X		
Floodplain Management Plan	X	X		X
Zoning Regulations	X	X	X	
Subdivision Regulations	X	X		
Other				

UD = Under Development

TABLE 5-3 PLANNING AND REGULATORY CAPABILITIES, CONTINUED

Tool/Program	Greene County	City of Beavercreek	City of Bellbrook	City of Fairborn	City of Xenia	Village of Bowersville	Village of Cedarville	Village of Jamestown	Village of Spring Valley	Village of Yellow Springs
Comprehensive Plan		X		X	X					X
Open Space Management Plan		X		X						X
Stormwater Management Plan		X		X	X					X
Natural Resource Protection Plan										
Capital Improvement Plan	X	X		X	X					X
Economic Development Plan		X		X	X					X
Historic Preservation Plan										X
Farmland Preservation	X									
Building Code		X		X	X					X
Fire Code		X		X	X					X
Firewise										
Storm Ready										X
Other	X*									

X = Solid Waste Management Plan*

TABLE 5-4 PLANNING AND REGULATORY CAPABILITIES, TOWNSHIPS AND STAKEHOLDERS OF GREENE COUNTY, CONTINUED

Tool/Program	Cedarville Township	New Jasper Township	Xenia Township	Miami Conservancy District
Comprehensive Plan	X		X	
Open Space Management Plan				
Stormwater Management Plan		X	X	
Natural Resource Protection Plan	X			X
Capital Improvement Plan	X		X	X
Economic Development Plan			X	
Historic Preservation Plan	X			
Farmland Preservation	X	X	X	
Building Code	X	X	X	
Fire Code	X	X	X	
Firewise		X		
Storm Ready		X	X	
Other				

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.

TABLE 5-5 ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Tool/Program	Greene County	City of Beavercreek	City of Bellbrook	City of Fairborn	City of Xenia	Village of Bowersville	Village of Cedarville	Village of Jamestown	Village of Spring Valley	Village of Yellow Springs
Planners (with land use / development knowledge)				X	X					X
Planners or engineers		X		X	X					
Engineers	X	X		X	X					
Emergency Manager	X	X		X						X
Floodplain Manager									X	
Land Surveyor										
Scientists										
GIS Personnel		X		X	X					X
Grant Writers					X					X
Other										

TABLE 5-6 ADMINISTRATIVE AND TECHNICAL CAPABILITIES, TOWNSHIPS AND STAKEHOLDERS OF GREENE COUNTY

Tool/Program	Cedarville Township	New Jasper Township	Xenia Township	Miami Conservancy District
Planners (with land use / development knowledge)				
Planners or engineers				
Engineers				X
Emergency Manager	X	X	X	
Floodplain Manager				
Land Surveyor				X
Scientists				X
GIS Personnel				X
Grant Writers		X		X
Other				

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.

TABLE 5-7 FISCAL CAPABILITY

Tool/Program	Greene County	City of Beavercreek	City of Bellbrook	City of Fairborn	City of Xenia	Village of Bowersville	Village of Cedarville	Village of Jamestown	Village of Spring Valley	Village of Yellow Springs
Capital Improvement Planning	X	X		X	X					X
Community Development Block Grant				X	X				X	
Special Purpose Taxes										X
Gas / Electric utility fees				X						X
Water / Sewer fees	X			X	X					
Stormwater utility fees				X	X					X
Development impact fees		X		X	X					
General obligation, revenue, or special tax bonds	X			X	X					X
Partnering / intergovernmental arrangements				X	X					X
Other	X*									

X = Generation Fees (Solid Waste)*

TABLE 5-8 FISCAL CAPABILITY, TOWNSHIPS AND STAKEHOLDERS OF GREENE COUNTY

Tool/Program	Cedarville Township	New Jasper Township	Xenia Township	Miami Conservancy District
Capital Improvement Planning		X		X
Community Development Block Grant	X	X		
Special Purpose Taxes		X		X
Gas / Electric utility fees		X		
Water / Sewer fees				
Stormwater utility fees				
Development impact fees		X		
General obligation, revenue, or special tax bonds				X
Partnering / intergovernmental arrangements	X		X	X
Other				

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.

5.1 GOALS AND OBJECTIVES

The Planning Committee discussed goals and objectives for this plan at distinct points in the planning process. On May 18th, 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.

5.2 2015 MITIGATION ACTION REVIEW

During the third planning meeting, the mitigation actions from the 2015 HMP were reviewed and determined to be; deferred into the new plan, changed to reflect an update in priorities, completed, or deleted. These actions can be found in Table 5-9. Actions marked as "Completed" were finished between the drafting of the 2015 HMP, and the 2020 HMP. Deletion of an action generally refers to that action no longer being relevant to the community.

TABLE 5-9 PREVIOUS MITIGATION ACTION STATUS

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Develop and distribute information about risks associated with the identified natural disasters affecting the County.	Greene County EMA	Ongoing
Develop and distribute an informational brochure on the types of homeowners hazard insurance, i.e. flood, fire, earthquake, etc.	Greene County EMA	Ongoing
Launch educational campaigns through public/government cable channels and newsletters, websites, street festivals, libraries, school functions, etc.	Greene County EMA	Ongoing
Develop and distribute information/education on weather-related-preparedness tools and resources, i.e. sources to purchase such material, etc.	Greene County EMA	Ongoing
Develop and launch awareness/educational campaigns to increase knowledge of weather alert methods (alert radios, e-mail, cell phones, etc.	Greene County EMA	Ongoing
Educate the public on the importance of properly trimming and maintaining the trees on their property (may be included in materials about natural hazard risk)	Greene County EMA	Ongoing
Educate the public, businesses and residents, of the importance of creating hazard contingency plans (May be included in materials about natural hazard risk)	Greene County EMA	Ongoing
Develop and complete a baseline survey to gather citizens' perceptions of the risks associated with natural disasters and the tools and services available to the public to reduce risk	Greene County EMA	Ongoing
Develop and complete a periodic post-educational campaign surveys to gather citizens' perceptions of the risks associated with natural disasters and the tools and services available to the public to reduce risk (Method to measure the effectiveness of educational campaigns)	Greene County EMA, All Local Jurisdictions	Defer – Village of Spring Valley, Jamestown, Bowersville City of Fairborn, Xenia, Beavercreek Ongoing – City of Bellbrook, Greene County Remove from plan, no longer a priority – Village of Yellow Springs

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Encourage the use of wind and impact resistant building components designed to withstand tornado strength winds.	Greene County EMA	Ongoing
Appeal to the State to enhance or create wind/impact resistant Ohio Basic Building Code(s)	Greene County EMA	Ongoing
Require compliance and enforcement of existing building codes	Greene County EMA	Ongoing
Encourage mitigation measures for existing development in areas vulnerable to natural hazards	Greene County EMA	Ongoing
Encourage jurisdictions to prevent or prohibit new development in areas vulnerable to natural hazards	Greene County EMA	Ongoing
Encourage watershed and wetland planning, as well as natural resource management in conjunction with land-use planning for natural hazard mitigation	Greene County EMA	Ongoing
Encourage regular and periodic pier inspections for bridges	Greene County EMA	Ongoing
Update dam maintenance programs and services	Greene County EMA	Ongoing
Develop a set of planned alternative routes and gate frequently flooded areas and inform the citizens	Greene County EMA	Ongoing
Encourage the use of vinyl siding to reduce dent damage due to hail incidents	Greene County EMA	Ongoing
Request legislation requiring tornado safe rooms in new mobile home communities and new residential communities without basements	Greene County EMA	Ongoing
Encourage code enforcement and engineering practitioners to enroll in seminars/classes offered by accredited building training centers that showcase the latest materials and techniques in natural hazard resistant construction.	Greene County EMA	Ongoing

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Encourage utility companies to hire tree trimming contractors who are capable of a more citizen friendly trimming service	Greene County EMA, Hazard Mitigation Planning Team	Ongoing
Two maps should be generated as established in the Miami Valley Emergency Operations Plan, 1993, Annex L, *Damage Assessment*, PG L-5. One map should graphically display Public damage where the worst damage is located and where minimal damage is located. The second should address the same for Private damages.	Greene County EMA	Ongoing
Establish clearly identified places of refuge within public facilities and spaces, neighborhoods, and businesses	Greene County EMA	Ongoing
Establish and encourage the use of weather warning radios in all public spaces	Greene County EMA	Ongoing
Test the effectiveness of tornado sirens	Greene County EMA	Ongoing
Establish and encourage the use of weather warning radios in all business and residences	Greene County EMA	Ongoing
Provide water and shade at all public outdoor events during extreme heat	Greene County EMA	Ongoing
Establish program(s) providing air conditioning to at-risk populations	Greene County EMA	Ongoing
Partner with organizations whose mission is to restore or preserve beneficial natural systems (wetlands, watersheds, etc.)	Greene County EMA	Ongoing

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Encourage the cooperation of neighbors to include, but not limited to: Contingency plans for the evacuation and care of neighboring families and pets and communication among the neighbors in the event of a natural hazard.; Contingency plans for checking-in on the shut-in and frail elderly neighbors	Greene County EMA, All Local Government, Hazard Mitigation Planning Team, Neighborhood Watch Groups	Defer – Village of Spring Valley, Yellow Springs, Bowersville, Jamestown, City of Fairborn, Xenia, Beavercreek, Ongoing – City of Bellbrook, Greene County
Seek $2.1 million in funding to install a county-wide tornado warning system complete with battery backup in communities with inadequate coverage, or no tornado siren systems	Greene County EMA, All Local Government	Defer – Village of Spring Valley, Bowersville, Jamestown, City of Fairborn, Xenia, Beavercreek Ongoing – City of Bellbrook, Greene County Remove from plan, no longer a priority – Village of Yellow Springs
In the event a county-wide warning siren system cannot be achieved, the following jurisdictions have requested funding to replace existing equipment or install new equipment: Jamestown/Silvercreek Township, New Jasper Township, Bowersville/Jefferson Township	Village of Jamestown, Silvercreek Township, New Jasper Township, Village of Bowersville, Jefferson Township	Defer- Jamestown Ongoing – New Jasper Township
Construct tornado safe rooms in public areas and neighborhoods without basements	Greene County EMA	Ongoing
Identify at-risk structures in Special Flood Hazard Area	Bath Township, City of Beavercreek, Beavercreek Township, City of Bellbrook, Ceaserscreek Township, Village of Cedarville, Cedarville Township, Village of Clifton, City of Fairborn, Village of Jamestown, Jefferson Township, Miami Township, New Jasper Township, Ross Township, Silvercreek Township, Village of Spring Valley, Spring Valley Township, Sugarcreek Township, City of Xenia, Xenia Township, Village of Yellow Springs	Completed – Xenia Township Ongoing – Cedarville Township, New Jasper Township, City of Bellbrook, Xenia Remove from plan, no longer a priority – Village of Spring Valley Defer – Village of Yellow Springs, Jamestown, Bowersville City of Fairborn, Beavercreek
Seek funding for the acquisition, elevation, or retrofit of structures with repetitive loss flood insurance claims through voluntary (owner) mitigation actions	Sugarcreek Township, City of Fairborn, City of Beavercreek, City of Xenia	Defer – City of Fairborn, Xenia, Beavercreek
Prioritize removal and/or relocation of at-risk structures or construction of improved or new storm drainage systems or levees to protect at-risk structures	Local Jurisdictions	Defer – Village of Spring Valley, Bowersville, City of Fairborn, Xenia, Beavercreek Ongoing – Village of Yellow Springs, Jamestown, City of Bellbrook
Seek funding for removal and/or relocation of at-risk structures or construction of improved or new storm drainage systems or levees to protect at-risk structures	Local Jurisdictions	Ongoing – Village of Yellow Springs, City of Bellbrook Defer – City of Fairborn, Xenia, Beavercreek, Village of Jamestown, Bowersville

5-17

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Remove and/or relocate at-risk structures or construction of improved or new storm drainage systems or levees to protect at-risk structures	Local Jurisdictions	Defer – Village of Spring Valley, Jamestown, Bowersville, City of Fairborn, Xenia, Beavercreek Ongoing – Village of Yellow Springs, City of Bellbrook
Seek funding for new storm drainage systems or levees to protect at-risk structures	Village of Jamestown, Village of Yellow Springs	Defer – Village of Yellow Springs, Jamestown
Construct or repair storm drainage systems and/or levees	City of Bellbrook, Greene County EMA	Ongoing – City of Bellbrook, Greene County
High impact window coverings for jail	Greene County Sheriff	Defer
Generator upgrade for jail	Greene County Sheriff	Defer
Tornado safe rooms for Kitridge Road, Spangler Road and Spring Valley and State Route 725 Trailer Parks	Greene County Sheriff	Defer
Upgrade windows to high impact windows on schools	Greene County EMA, Local Jurisdictions	Defer – City of Fairborn, Xenia, Beavercreek, Village of Jamestown, Bowersville Ongoing – City of Bellbrook, Greene County Remove from plan, no longer a priority – Village of Spring Valley, Yellow Springs
Establish a Flood Diversion program for roads in Greene County using the Hyper Reach mass notification system	Greene County EMA, Local Jurisdictions	Defer – Village of Spring Valley, Bowersville, City of Fairborn, Xenia Ongoing – Village of Yellow Springs, Jamestown, City of Bellbrook, Beavercreek, Greene County
Pleasant View Drainage, Phase I Construction – Redbank Parallel Trunk Sewer	City of Fairborn	Defer
Pleasant View Drainage, Phase II Design – Dellwood Drive Sewer	City of Fairborn	Defer
Pleasant View Drainage, Phase II Construction – Dellwood Drive Sewer	City of Fairborn	Defer

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Pleasant View Drainage, Phase III Design – Florence Avenue Sewer	City of Fairborn	Defer
Pleasant View Drainage, Phase III Construction – Florence Avenue Sewer	City of Fairborn	Defer
Pleasant View Drainage, Phase IV Design & Construction – Pat Lane & NE Sewer	City of Fairborn	Defer
Chapel Drive at Sycamore Drainage Materials	City of Fairborn	Defer
Upper Orville Street Storm Improvements Design & Construction	City of Fairborn	Defer
Hebble Creek Culvert Replacement, Central Ave	City of Fairborn	Defer
Hebble Creek Culvert Replacement, Elm and Dayton Drive	City of Fairborn	Defer
Adams St/Mitman Park Drainage Design	City of Fairborn	Defer
Adams St/Mitman Park Drainage Construction	City of Fairborn	Defer
Enclose Redbank Ditch between Kauffman and Maple Avenue	City of Fairborn	Defer
Hidden Hills detection basin modifications	City of Fairborn	Defer

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Lincoln Drive storm sewer improvements construction	City of Fairborn	Defer
Ironwood Drive storm sewer design & construction	City of Fairborn	Defer
Langview/Royal Oaks storm sewer design & construction	City of Fairborn	Defer
Redstone Drive storm sewer design & construction	City of Fairborn	Defer
Highview Drive storm sewer design and construction	City of Fairborn	Defer
Stormwater master plan	City of Fairborn	Defer
Dayton-Yellow Springs drainage improvement – Commerce Center area	City of Fairborn	Defer
Colonel Glenn drainage improvements	City of Fairborn	Defer
Redbank Ditch retaining wall replacement	City of Fairborn	Defer
Hebble Creek engineering study	City of Fairborn	Defer
Hebble Creek creek reprofiling	City of Fairborn	Defer

Action	Jurisdiction	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Kauffman Avenue drainage improvements	City of Fairborn	Defer
Drainage area easement procurements	City of Fairborn	Defer
Beaver control measures	City of Fairborn	Defer
Wrightview Park plat storm sewer	City of Fairborn	Defer
Fairfield Park drainage improvements	City of Fairborn	Defer
Fairfield Park pervious pavement of parking lots	City of Fairborn	Defer
Circle Drive storm drainage improvements	City of Fairborn	Defer
Mark Lane ditch renovation	City of Fairborn	Defer
E. Third Street retaining wall repair and replacement (E. Collier St. to 300 ft. downstream of S. Whiteman St.)	City of Xenia	Defer
Sycamore Street property acquisitions (3 structures and 5 parcels of land that are prone to flooding)	City of Xenia	Defer
Massie Creek US 68 N property acquisition; Kaufman/Washington Mill/Patterson	Greene County	Ongoing

5-21

5.3 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.

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 2020 plan are found below:

Severe Thunderstorms					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Purchase a generator	Village of Spring Valley, Mayor-Council	4-5 years	$85,000	Grants or other funding	8
Supply equipment to manage storm debris	Greene County Sanitary Engineer	2-3 years	$1,100,000	FEMA BRIC grant	9
Furnish and install an emergency generator with automatic transfer switch at the Environmental Services facility. The facility is the receiving facility for storm debris and 24/7 operation could be needed	Greene County Sanitary Engineer	2-3 years	$250,000	FEMA BRIC grant	8
Supply two portable generators with emergency connections to be used at sanitary lift stations and potable water pump stations during power outages	Greene County Sanitary Engineer	2-3 years	$60,000	FEMA BRIC grant	7
Furnish and install a 40KW Emergency Standby Generator with Automatic Transfer Switch at the Valley Well Field for wells 11 and 12. This generator is needed to maintain continuous service to the potable water system	Greene County Sanitary Engineer	2-3 years	$55,000	FEMA BRIC grant	6

Furnish and install a 25KW Emergency Standby Generator with Automatic Transfer Switch at Indian Ripple Water Tower. This generator is needed to maintain communications	Greene County Sanitary Engineer	2-3 years	$55,000	FEMA BRIC grant	6
Furnish and install a 25KW Emergency Standby Generator with Automatic Transfer Switch at Gerspacher Water Tower. This generator is needed to maintain communications.	Greene County Sanitary Engineer	2-3 years	$55,000	FEMA BRIC grant	6
Install underground power lines	Yellow Springs Village Manager, Public Works Director, and Chief of Police	4-5 years	$20,000,000	Local taxes, grants, FEMA BRIC/HMGP	8
Develop and distribute information/education on weather-related-preparedness tools and resources, i.e. sources to purchase such material, etc.	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7
Develop and launch awareness/educational campaigns to increase knowledge of weather alert methods (alert radios, e-mail, cell phones, etc.)	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7
Educate the public on the importance of properly trimming and maintaining the trees on their property (may be included in materials about natural hazard risk)	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7
Encourage the use of vinyl siding to reduce dent damage due to hail incidents	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7
Encourage utility companies to hire tree trimming contractors who are capable of a more citizen friendly trimming service	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	5

Extreme Temperatures					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Establish clearly identified places of refuge within public facilities and spaces, neighborhoods, and businesses	Greene County EMA	0-1 years	$2,000	County Funds	8
Provide water and shade at all public outdoor events during extreme heat	Greene County EMA	5 years	$2,500 per year	County Funds, Local Grants	9
Establish program(s) providing air conditioning to at-risk populations	Greene County EMA	5 years	$10,000	County Funds, Local Grants, State Assistance	8

Infestation					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Partner with organizations whose mission is to restore or preserve beneficial natural systems (wetlands, watersheds, etc.)	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7

Tornado					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Supply of an emergency response trailer including chainsaws, traffic safety signage, and proper PPE	Greene County Sanitary Engineer	2-3 years	$75,000	FEMA BRIC grant	6
Supply of a portable 6-inch bypass pump that will be used to bypass pump the sanitary sewer in the event of a catastrophic failure of the system. The proximity of local streams, creeks, and rivers make this equipment a higher priority to prevent pollution of the environment.	Greene County Sanitary Engineer	2-3 years	$150,000	FEMA BRIC grant	7
Install a tornado warning system on the north end of town near the university campus	Cedarville Township Trustees	2-3 years	$40,000	Community Block Development Grant, FEMA BRIC/HMGP or any other type of grant available	5
Install a tornado siren in the center of town on the corner of Maysville St. and Hussey Rd.	Mayor Gary Ellison, Bowersville	2-3 years	$5,000	FEMA BRIC program	3
Village administrative building that can double as shelter from tornadoes for community members and a command center for disasters and other emergencies that occur in the Village or the eastern half of Greene County.	Cedarville Mayor	2-3 years	$250,000	FEMA BRIC/HMGP	9
Encourage the use of wind and impact resistant building components designed to withstand tornado strength winds.	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	9
Appeal to the State to enhance or create wind/impact resistant Ohio Basic Building Code(s)	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	9
Request legislation requiring tornado safe rooms in new mobile home communities and new residential communities without basements	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	9
Test the effectiveness of tornado sirens	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	9

Seek $2.1 million in funding to install a county-wide tornado warning system complete with battery backup in communities with inadequate coverage, or no tornado siren systems	Greene County, Spring Valley, Fairborn, Xenia, Beavercreek, Bellbrook, Jamestown, Bowersville	4-5 years	$2,100,000	FEMA BRIC/HMGP	9
Construct tornado safe rooms in public areas and neighborhoods without basements	Greene County EMA	4-5 years	$100,000 per construction	FEMA BRIC/HMGP	8
In the event a county-wide warning siren system cannot be achieved, the following jurisdictions have requested funding to replace existing equipment or install new equipment: Jamestown	Village of Jamestown	2-3 years	$50,000	FEMA BRIC	8
Tornado safe rooms for Kitridge Road, Spangler Road and Spring Valley and State Route 725 Trailer Parks	Greene County EMA	4-5 years	$100,000 per construction	FEMA BRIC/HMGP	8

Drought					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Develop and distribute information about risks associated with drought.	Greene County EMA	5 years	Staff Time and Resources	County Funds	8

Flooding					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Rehabilitate/reconstruct E. Third Street Retaining Wall to avoid further erosion and prevent structure(s) from vulnerability to flooding	City of Xenia, City Engineer	4-5 years	$2.0-2.5 million	Local funds, Ohio Public Works Grant	5
Purchase a second pump for the stormwater system	Village of Spring Valley, Mayor-Council	4-5 years	$85,000	Grant or other funding	8
Update stormwater systems and reline sewer system	Yellow Springs Village Manager, Public Works Director, and Chief of Police	4-5 years	$5,750,000	Local taxes, grants, FEMA BRIC/HMGP	8
Widen the culvert from SR 72 to West Xenia Ave. It is insufficient, needs to be 36 inches.	Cedarville Village Administrator	0-1 years	$100,000	FEMA BRIC, HMGP	10

Develop and distribute an informational brochure on the types of homeowner's hazard insurance, i.e. flood, fire, earthquake, etc.	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	8
Encourage watershed and wetland planning, as well as natural resource management in conjunction with land-use planning for natural hazard mitigation	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7
Encourage regular and periodic pier inspections for bridges	Greene County EMA	2-3 years	Staff Time and Resources	County Funds	9
Develop a set of planned alternative routes and gate frequently flooded areas and inform the citizens	Greene County EMA	0-1 years	$5,000	County Funds	8
Identify at-risk structures in Special Flood Hazard Area	Cedarville Township, Bellbrook, Xenia, Yellow Springs, Fairborn, Beavercreek, Jamestown, Bowersville	4-5 years	Staff Time and Resources	County and Local Funds	7
Seek funding for the acquisition, elevation, or retrofit of structures with repetitive loss flood insurance claims through voluntary (owner) mitigation actions	Fairborn, Xenia, Beavercreek	4-5 years	$100,000 per project	County and Local Funds, FEMA BRIC/HMGP/FMA	8
Establish a Flood Diversion program for roads in Greene County using the Hyper Reach mass notification system	Greene County EMA, Spring Valley, Fairborn, Xenia, Yellow Springs, Bellbrook, Beavercreek, Jamestown, Bowersville	2-3 years	$15,000	County and Local Funds, FEMA BRIC/FMA	6
Pleasant View Drainage, Phase I Construction – Redbank Parallel Trunk Sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Pleasant View Drainage, Phase II Design – Dellwood Drive Sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Pleasant View Drainage, Phase II Construction – Dellwood Drive Sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Pleasant View Drainage, Phase III Design – Florence Avenue Sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7

Pleasant View Drainage, Phase III Construction – Florence Avenue Sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Pleasant View Drainage, Phase IV Design & Construction – Pat Lane & NE Sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Chapel Drive at Sycamore Drainage Materials	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Upper Orville Street Storm Improvements Design & Construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Hebble Creek Culvert Replacement, Central Ave	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Hebble Creek Culvert Replacement, Elm and Dayton Drive	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Adams St/Mitman Park Drainage Design	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Adams St/Mitman Park Drainage Construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Enclose Redbank Ditch between Kauffman and Maple Avenue	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Hidden Hills detection basin modifications	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Lincoln Drive storm sewer improvements construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Ironwood Drive storm sewer design & construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7

Langview/Royal Oaks storm sewer design & construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Redstone Drive storm sewer design & construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Highview Drive storm sewer design and construction	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Stormwater master plan	City of Fairborn	4-5 years	$15,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Dayton-Yellow Springs drainage improvement – Commerce Center area	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Colonel Glenn drainage improvements	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Redbank Ditch retaining wall replacement	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Hebble Creek engineering study	City of Fairborn	4-5 years	$15,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Hebble Creek creek reprofiling	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Kauffman Avenue drainage improvements	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Drainage area easement procurements	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Beaver control measures	City of Fairborn	4-5 years	Staff Time and Resources	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7

Wrightview Park plat storm sewer	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Fairfield Park drainage improvements	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Fairfield Park pervious pavement of parking lots	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Circle Drive storm drainage improvements	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Mark Lane ditch renovation	City of Fairborn	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Sycamore Street property acquisitions (3 structures and 5 parcels of land that are prone to flooding)	City of Xenia	4-5 years	$500,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7
Massie Creek US 68 N property acquisition; Kaufman/Washington Mill/Patterson	Greene County EMA	4-5 years	$100,000	FEMA BRIC/HMGP/FMA Program, Local Funds for Match	7

Dam Failure					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Develop a dam failure evacuation plan for Huffman Dam	Miami Conservancy District and Greene County EMA	2-3 years	$150,000	FEMA BRIC, HHDP, grant programs, local match, other	9
Structural stability analysis of Huffman Dam to assess any risks and develop a rehabilitation strategy, if necessary	Miami Conservancy District	0-1 years	$550,000	FEMA BRIC, HHDP, and local match	10
Concrete, structural repairs, and other improvements at Huffman Dam	Miami Conservancy District	4-5 years	$12,000,000	FEMA BRIC, HHDP, local match, other	9

Push in the old water retention reservoir that is no longer in use. It is a breeding area for rodents and mosquitoes and a drowning risk for area youth.	Cedarville Village Administrator	0-1 years	$100,000	FEMA BRIC, HHDP	9
Update dam maintenance programs and services	Greene County EMA	0-1 years	$10,000	Local Funds, HHDP	10
Seek funding for, prioritize and remove and/or relocate at-risk structures or construction of improved or new storm drainage systems or levees to protect at-risk structures	Spring Valley, Fairborn, Xenia, Beavercreek Yellow Springs, Bellbrook, Jamestown, Bowersville	4-5 years	$100,000 per jurisdiction	Local Funds, FEMA BRIC	7
Seek funding for new storm drainage systems or levees to protect at-risk structures	Jamestown, Yellow Springs	4-5 years	Staff Time and Resources	Local Funds	7
Construct or repair storm drainage systems and/or levees	City of Bellbrook, Greene County EMA	4-5 years	$50,000	Local Funds, FEMA BRIC	7

Severe Winter Storms					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Establish and encourage the use of weather warning radios in all public spaces, businesses, and residences	Greene County EMA	0-1 years	$5,000	County Funds, FEMA BRIC, local grants	8
Generator upgrade for jail	Greene County EMA	4-5 years	$25,000	County Jail Funds, FEMA BRIC	7

Wildfire					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Develop and distribute information about risks associated with wildfires	Greene County EMA	5 years	Staff Time and Resources	County Funds	8

Earthquakes					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Require compliance and enforcement of existing building codes	Greene County EMA	4-5 years	Staff Time and Resources	County funds	10

Water Quality					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Monitoring wells for the source water contamination	Yellow Springs Village Manager, Public Works Director, and Chief of Police	4-5 years	$100,000	Local taxes, grants, FEMA BRIC/HMGP	8
Launch educational campaigns through public/government cable channels and newsletters, websites, street festivals, libraries, school functions, etc.	Greene County EMA	4-5 years	Staff Time and Resources	County funds	8

Public Health Emergency					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Develop a program providing assistance for the disparate population	Yellow Springs Village Manager, Public Works Director, and Chief of Police	4-5 years	$50,000	Local taxes, grants, FEMA BRIC/HMGP	8

Terrorism					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Purchase and install a security camera system	Yellow Springs Village Manager, Public Works Director, and Chief of Police	4-5 years	$100,000	Local Taxes, Grants, and Funds	8
High impact window coverings for jail	Greene County EMA	4-5 years	$250,000	Local Taxes, Grants, and Funds	5
Upgrade windows to high impact windows on schools	Greene County EMA, Fairborn, Xenia, Beavercreek, Bellbrook, Jamestown, Bowersville	2-3 years	$250,000 per school	Local Taxes, Grants, and Funds	7

Hazardous Materials Incident					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Educate the public, businesses and residents, of the importance of creating hazard contingency plans (May be included in materials about natural hazard risk)	Greene County EMA	4-5 years	Staff Time and Resources	County Funds	7

All Hazards					
Action	**Lead Agency/ Department**	**Implementation Schedule**	**Estimated Cost**	**Funding Source**	**Priority Score**
Develop and distribute information about risks associated with the identified natural disasters affecting the County.	Greene County EMA	5 years	Staff Time and Resources	County Funds	7
Develop and complete a baseline survey to gather citizens' perceptions of the risks associated with natural disasters and the tools and services available to the public to reduce risk	Greene County EMA	5 years	Staff Time and Resources	County Funds	7
Develop and complete a periodic post-educational campaign surveys to gather citizens' perceptions of the risks associated with natural disasters and the tools and services available to the public to reduce risk (Method to measure the effectiveness of educational campaigns)	Greene County, Spring Valley, Fairborn, Xenia, Beavercreek, Bellbrook, Jamestown, Bowersville	5 years	$5,000	County and Local Funds	7
Encourage mitigation measures for existing development in areas vulnerable to natural hazards	Greene County EMA	5 years	Staff Time and Resources	County Funds	7
Encourage jurisdictions to prevent or prohibit new development in areas vulnerable to natural hazards	Greene County EMA	5 years	Staff Time and Resources	County Funds	7
Encourage code enforcement and engineering practitioners to enroll in seminars/classes offered by accredited building training centers that showcase the latest materials and techniques in natural hazard resistant construction.	Greene County EMA	5 years	$5,000	County Funds	5
Two maps should be generated as established in the Miami Valley Emergency Operations Plan, 1993, Annex L, Damage Assessment, PG L-5. One map should graphically display Public damage where the worst damage is located and where minimal damage is located. The second should address the same for Private damages.	Greene County EMA	4-5 years	$2,000	County Funds	7

Encourage the cooperation of neighbors to include, but not limited to: Contingency plans for the evacuation and care of neighboring families and pets and communication among the neighbors in the event of a natural hazard.; Contingency plans for checking-in on the shut-in and frail elderly neighbors	Greene County EMA, Local Jurisdictions	4-5 years	$5,000	County Funds	6

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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 Greene County. This section describes the incorporation of the HMP into existing planning mechanisms, and how the planning committee will continue to engage the public.

1. PLAN ADOPTION

This section will be completed following the adoption of the plan by the County.

2. 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.

Greene County HMPC established for this 2020 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 County-wide representatives and other important stakeholders.

The HMPC will oversee the progress made on the implementation of action items identified and modify actions, as needed, to reflect changing conditions. The HMPC will meet annually to evaluate the plan and discuss specific coordination efforts that may be needed.

The annual evaluation of the 2020 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 HMP.

- 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 HMPC 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.

3. PLAN UPDATE AND MAINTENANCE

This section describes the schedule and process for monitoring, evaluating, and updating the 2020 HMP.

3.1 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 HMPC 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 HMPC will reconvene within 30 days of the disaster to review and update the HMP as appropriate.

3.2 PROCESS

The HMPC 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 HMPC on an annual basis. Working with the HMPC, 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.

Public Involvement

At all stages of the plan maintenance process, the general public of the County will be invited to participate. Prior to the HMP's annual review and after major disaster events when the HMP is revisited, the public will be invited through the County's website, local newspapers, and through fliers in the County's public facilities as well as local community buildings to participate in plan maintenance.

Any comments received will be logged and then addressed within the main document of the plan. A new version of the plan will be created and saved per each round of major edits.

3.3 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 HMPC 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.

Past Integration

County Building Codes: The County's building codes, 2017 Ohio Building Code, significantly cover construction and buildings within the floodplain.

City of Bellbrook Comprehensive Plan: Prepared in 2019, the City developed a plan to address Downtown Revitalization and Historic Preservation, Community Identity, Transportation Plan, Land Use, Healthy Communities, and Economic Development. Specifically in the Land Use section, Bellbrook actively identified the wish to remain a suburban city and to preserve the natural areas

within and around the City. Proper floodplain management methods as well as other land use ideas were integrated into the development of the plan.

Future Integration

- **Capital Improvement Plans:** Plans that involve the upgrade of existing infrastructure provide an excellent opportunity for the County to build in hazard mitigation. This may include roadways, stream embankments, riverfront upgrades, or public walkways, but is not limited to these.

- **Local Master Plans and Polices**: The HMP will provide information that can be incorporated into local master plans during the next plan update. Specific risk and vulnerability information from the HMP will assist to identify areas where development may be at risk to potential hazards.

- **Historic Building Inventory**: The HMP includes information on historic buildings that can help to guide decisions on what actions to take with historic buildings.

- **Emergency Operations Plan**: The County uses an Emergency Operations Plan that gives emergency personnel guidelines and procedures on how to best respond to dangerous events. Hazards as described in this plan, including those that are new to the 2020 iteration, will be included in the next version of the EOP.

- **Thoroughfare Plan Update**: Greene County is currently updating this plan. The HMP provides important data, vulnerability assessments, hazard profiles – hazardous materials, flooding, and terrorism – and mitigation efforts that will be integrated into plan update. These elements will link traditional planning to hazard mitigation planning as well as utilizing the mitigation strategy to the fullest.

- **Village of Yellow Springs Comprehensive Land Use Plan Update**: The Village of Yellow Springs is currently updating their Land Use Plan. Specific risk and vulnerability information from the HMP will assist to identify areas where development may be at risk to potential hazards. The Village will also consult the mitigation strategy to address floodplain concerns and any other applicable goals or actions.

- **Farmland Preservation Plan**: The County uses a Farmland Preservation Plan to protect the agricultural land in the County. In the next version of the Farmland Preservation Plan, the HMP will be integrated by including the hazards and mitigation strategy identified in this plan, including the hazards and actions that are new to the 2020 update.

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APPENDIX A. ADOPTION RESOLUTION

To be completed upon adoption of this plan

APPENDIX B. MEETING MINUTES & AGENDAS

Greene County Hazard Mitigation Plan Update

Kickoff Meeting

October 8, 2019
10:00 AM – 12:00 PM
5:00 PM – 7:00 PM

Place: Greene Memorial Hospital Menapace Center Auditorium
1141 N. Monroe Dr., Xenia, Ohio

ATTACHED: LIST OF ATTENDANCE

MEETING FACILITATORS:

Rosanne Anders, Director, Greene 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

Director Anders opened the meeting by thanking everyone for coming and briefly introducing the overall project. She then turned the floor over to Jason Farrell of Michael Baker International.

Jason explained the core concept of mitigation and why it is needed, and that the mitigation plan is required to receive certain funds through FEMA. In addition, he covered what is expected of the participants, both currently in attendance and those who will serve on the Greene County Hazard Mitigation Planning Committee in future meetings.

Jason 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 eight-month project schedule). He 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.

Identification of New Hazards

The first task for the group was to identify the hazards that are to be profiled in the new edition of the plan. This involved looking at those hazards currently identified in the 2015 plan and determining if they were to be carried over to the new plan. They were then prioritized using the Risk Factor worksheet:

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	
	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	

During the morning meeting, several hazards were removed from the plan in favor of condensing them into other related hazards. For instance, Hail was combined into the Severe Thunderstorm hazard, and

Tornadoes were separated out from High Winds. Winds were then also moved to the Thunderstorm profile as they have a different mechanism than tornadoes. Extreme Heat and Drought were also separated, as they have little to do with one another, meaning that Extreme Heat could then be added with Extreme Cold for the Extreme Temperatures category.

In addition to the existing hazards, several were added in, including some that are technological (ie. Man-made) hazards. This is notable because the previous plan only included natural hazards. The first new hazard is the Invasive Species category since the Emerald Ash Borer has been a significant issue in recent years, to the point that their decimation of trees has lead to increased flooding in some areas. Sourcewater contamination is also a concern due to an unknown quantity of PFOS, a recently-discovered contaminate. Terrorism was also added due to the increase in mass-casualty events. Dam Failure and Transportation Incidents were also added to the list of technological hazards identified in the morning meeting. During the morning meeting, there was a question on whether or not Earthquakes should be profiled as one or two separate hazards as catastrophic earthquakes present a very different risk than smaller ones. In the end, it was determined that they should remain the same hazard as they are the same mechanism, but have different magnitudes.

Later in the evening, Wildfire and Public Health Emergencies were included due to the participant's experiences.

The resulting table of hazards and their relative Risk Factor score can be found below:

	Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Severe Thunderstorms	4	1.2	2	0.6	4	0.8	4	0.4	1	0.1	**3.1**
2	Extreme Temperatures	4	1.2	2	0.6	4	0.8	1	0.1	1	0.1	**2.8**
3	Invasive Species	4	1.2	1	0.3	4	0.8	4	0.4	1	0.1	**2.8**
4	Tornado	4	1.2	2	0.6	2	0.4	4	0.4	1	0.1	**2.7**
5	Drought	1	0.3	4	1.2	4	0.8	1	0.1	1	0.1	**2.5**
6	Floods	4	1.2	2	0.6	1	0.2	3	0.3	1	0.1	**2.4**
8	Severe Winter Storms	3	0.9	1	0.3	4	0.8	1	0.1	1	0.1	**2.2**
9	Wildfire	2	0.6	2	0.6	1	0.2	4	0.4	1	0.1	**1.9**
10	Earthquake	2	0.6	1	0.3	1	0.2	4	0.4	1	0.1	**1.6**
	Technological Hazards	**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	Sourcewater Contamination	2	0.6	3	0.9	4	0.8	4	0.4	4	0.4	**3.1**
2	Public Health Emergencies	3	0.9	3	0.9	4	0.8	1	0.1	2	0.2	**2.9**
3	Terrorism	3	0.9	3	0.9	2	0.4	4	0.4	1	0.1	**2.7**
4	Dam Failure	1	0.3	4	1.2	2	0.4	4	0.4	1	0.1	**2.4**
5	Transportation Incidents/HazMat	2	0.6	2	0.6	2	0.4	4	0.4	1	0.1	**2.1**

Evaluating Risk

After the hazards were decided upon, another 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.

1. Risk Evaluation Worksheet

Name: _____ **Title:** _____

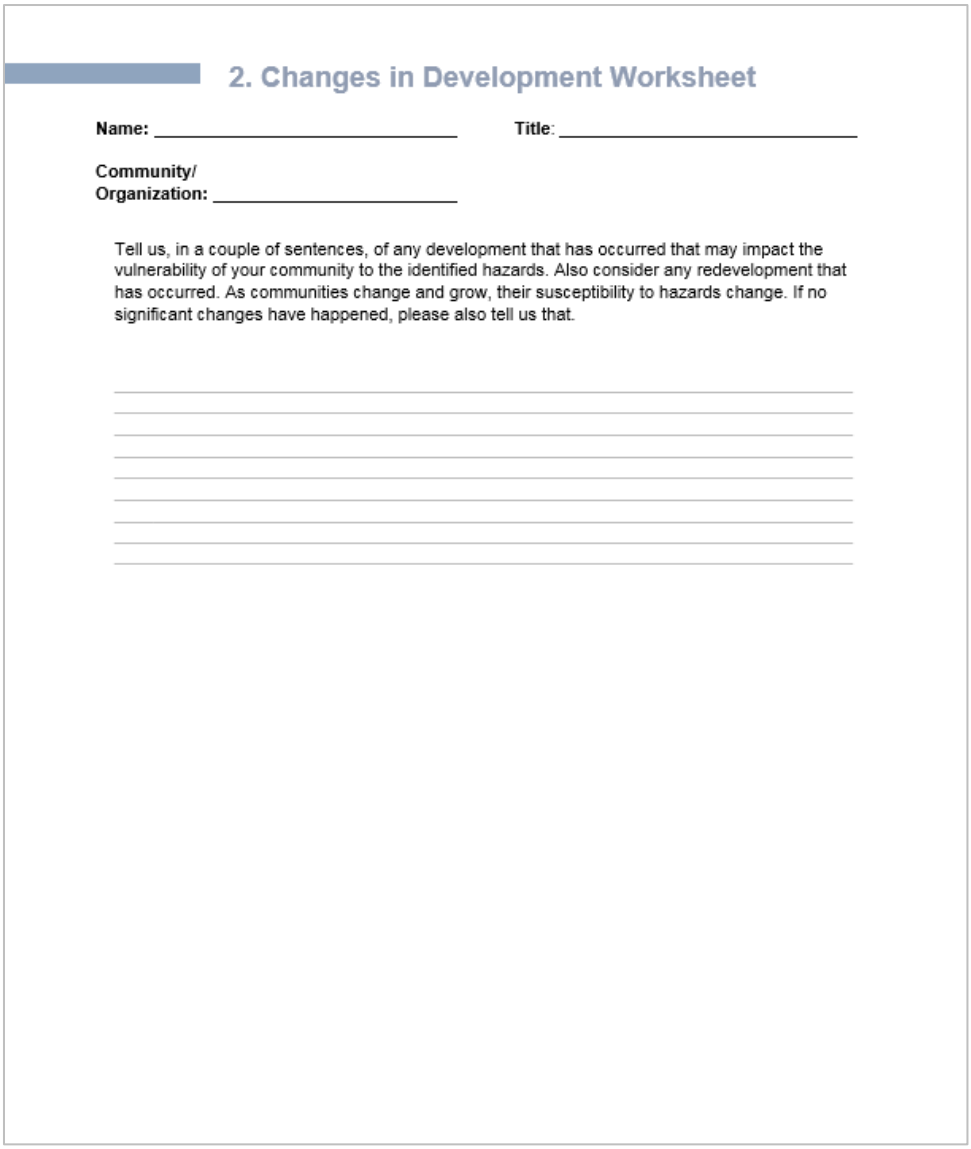
Community/ Organization: _____

	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*
Earthquake		
Floods		
Hail		
Severe Winter Storms		
Summer Heat and Drought		
Tornado & Winds		
Other Hazards - Hurricane		

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

Changes in Development

Upon completion of the Risk Evaluation, one more form was handed out, the Community Development Worksheet. This form asks representatives to explain what development has happened in recent years that would cause greater or lessen the vulnerability of their communities.



2. Changes in Development Worksheet

Name: _____ Title: _____

Community/
Organization: _____

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Closing and Next Steps

Once the Community Development exercise was completed, the final step was to go over the remainder 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 meetings were adjourned.

Greene County Hazard Mitigation Plan Update
Kick-off Meeting
October 8, 2019 10:00 AM

Name	Title	Jurisdiction/ Organization	Phone	E-Mail
Matt Ingram	Disaster Services	American Red Cross	937-567-2020	matt.f.ingram@yahoo.com
Phillip Clayton	SW Region Supervisor	Ohio EMA	614-296-1553	[illegible]
David Reichard	Fairborn Fire Chief	Fairborn	937 754-3080	[illegible]
Chris Berger	City Engineer/PS Director	City of Xenia	937-376-7264	cberger@ci.xenia.oh.us
Amy Hiles	Beavercreek township Clerk	Beavercreek township	937-426-7727	ahiles@beavercreektownship.org
Steve Ross	Trustee	Bath Twp	937-554-9907	steveross45324@gmail.com
Greg Beegle	Xenia Chief/Fire Lt	Xenia Twp/Xenia City	604-9895	gbeegle@xeniatownship.org gbeegle@ci.xenia.oh.us
[illegible]	[illegible]	Miami Conservancy Dist	937-223-1271	[illegible]
Jason Tinley	Director of Safety	[illegible]	937-562-7414	[illegible]
Devin Shoemaker	Director	RPCC	937-562-7480	dshoemaker@co.greene.oh.us
Scott Miller	Trustee	Xenia Twp	937 271 1657	smiller@xeniatownship.org
Alison Shaydullina	Admin. Coordinator	GCCED	937 562 7416	[illegible]
Thomas Brecker	Director	Clinton Co.	937 382 6673	[illegible]

Name	Title	Jurisdiction/ Organization	Phone	E-Mail
Melissa Dodd	city manager	Bellbrook	937-848-4666	mdodd@cityofbellbrook.org
Al Kuzma	CBO Greene Cty	Greene County	937-562-7427	akuzma@co.greene.oh.us
Brian Carlson	Chief of Police	Yellow Springs	937-408-8418	chief@yso.com
Stephanie Goff	County Engineer	Greene County	937-562-7500	[illegible]

Greene County Hazard Mitigation Plan Update
Kick-off Meeting
October 8, 2019 5:00 PM

Name	Title	Jurisdiction/ Organization	Phone	E-Mail
Kim Caudill	Emergency Preparedness Coordinator	Greene County / Public Health	937-374-9627	KCaudill@gcph.org

Greene County Hazard Mitigation Plan Update

Mitigation Strategy Meeting

May 18, 2020 - 10:00 AM

Place: Virtual Conference through Cisco WebEx

ATTACHED: LIST OF ATTENDANCE

Rosanne Anders, Director, Greene County Emergency Management Agency

Jason Farrell, Planner, Michael Baker International

Josh Vidmar, Planner, Michael Baker International

Claire Fetters, Planner, Michael Baker International

1. Welcome and Introductions
2. Risk Assessment Meeting Review
3. Review and Update Goals and Objectives (2015 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

GREENE COUNTY HMPU 2020 MITIGATION STRATEGY MEETING OVERVIEW

Josh Vidmar, the Planner from Michael Baker International who directed the meeting, welcomed everyone and thanked them for attending the Mitigation Strategy Meeting for the Greene County Hazard Mitigation Plan Update. A short round of introductions then took place, including Rosanne Anders of the Greene County EMA and Jason Farrell and Claire Fetters of Michael Baker International. Due to the nature of the meeting, roll call of the cities, villages, townships, and interested parties on the conference was taken.

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

Mr. Farrell 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. Vidmar made a call from the committee if they wanted to see any other hazards profiled than what was already covered.

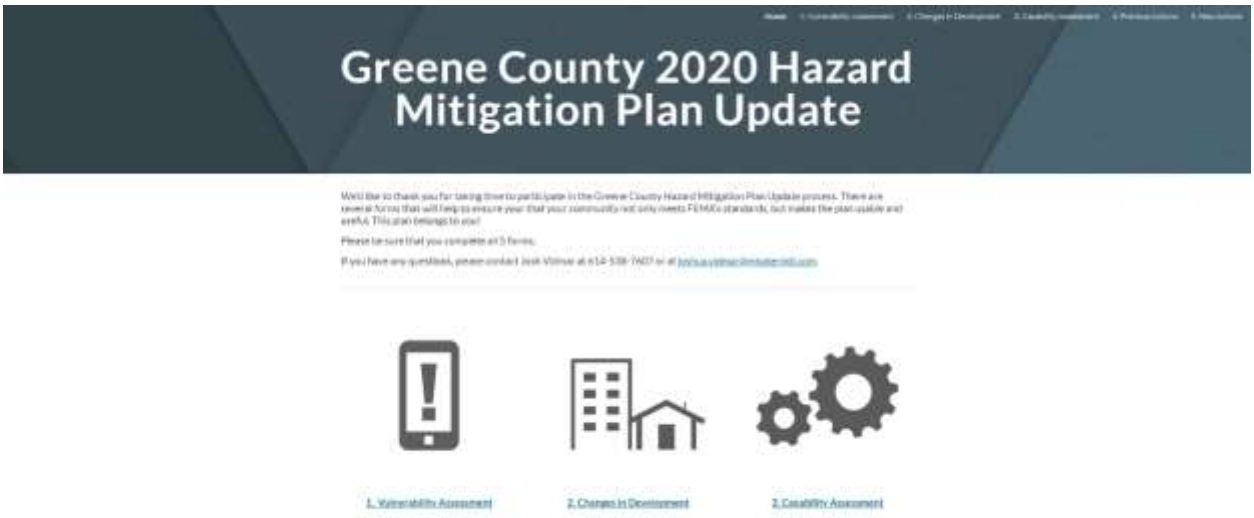
Natural Hazards		Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Severe Thunderstorms	4	1.2	2	0.6	4	0.8	4	0.4	1	0.1	**3.1**
2	Extreme Temperatures	4	1.2	2	0.6	4	0.8	1	0.1	1	0.1	**2.8**
3	Invasive Species	4	1.2	1	0.3	4	0.8	4	0.4	1	0.1	**2.8**
4	Tornado	4	1.2	2	0.6	2	0.4	4	0.4	1	0.1	**2.7**
5	Drought	1	0.3	4	1.2	4	0.8	1	0.1	1	0.1	**2.5**
6	Floods	4	1.2	2	0.6	1	0.2	3	0.3	1	0.1	**2.4**
7	Dam Failure	1	0.3	4	1.2	2	0.4	4	0.4	1	0.1	**2.4**
8	Severe Winter Storms	3	0.9	1	0.3	4	0.8	1	0.1	1	0.1	**2.2**
9	Wildfire	2	0.6	2	0.6	1	0.2	4	0.4	1	0.1	**1.9**
10	Earthquake	2	0.6	1	0.3	1	0.2	4	0.4	1	0.1	**1.6**
Technological Hazards		**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	Sourcewater Contamination	2	0.6	3	0.9	4	0.8	4	0.4	4	0.4	**3.1**
2	Public Health Emergencies	3	0.9	3	0.9	4	0.8	1	0.1	2	0.2	**2.9**
3	Terrorism	3	0.9	3	0.9	2	0.4	4	0.4	1	0.1	**2.7**
4	Transportation Incidents/HazMat	2	0.6	2	0.6	2	0.4	4	0.4	1	0.1	**2.1**

UPDATE MITIGATION GOALS

The next step of the meeting involved reviewing the mitigation goals from the previous version of the plan. During this review, the goals were presented to the Planning Committee. The four goals from the previous plan were deemed sufficient by the participants of the meeting.

GREENE COUNTY HAZARD MITIGATION PLAN UPDATE WEBSITE

In order to ensure participation of all jurisdictions that are seeking to adopt the HMP, Michael Baker International developed an online platform for representatives to submit the information required by FEMA and needed to complete the plan. Mr. Vidmar accessed the website during the meeting to explain the necessity of its usage, the different forms that are required to be completed, and how to complete the various forms.



UPDATE MITIGATION ACTIONS

Each member of the committee was given the link to the website 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. Vidmar 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.

CLOSING AND NEXT STEPS

The formal closing of the meeting came before the forms were completed so that committee members could remain in the conference as they finished their exercises should they have questions. After the majority of the committee had left, Mr. Vidmar 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:

Goal	Defer	Change	Delete	Reason
GOAL 1: Increase public awareness	X			
GOAL 2: Protect life and property	X			
GOAL 3: Create and/or strengthen partnerships	X			
GOAL 4: Create a safer environment through construction or installation projects of natural hazard safety systems	X			

Greene County Hazard Mitigation Plan Update

Mitigation Strategy Meeting

May 18, 2020 - 10:00 AM

County	Present	Name	Title
Greene County	x	Rosanne Anders	Greene County EMA Director
	x	Stephanie Goff	Greene County Engineer
Cities	**Present**	**Name**	**Title**
Beavercreek			
Bellbrook	x	Jim Neidhard	Bellbrook FD Chief
Centerville			
Dayton			
Fairborn	x	David Reichert	Fairborn FD Chief
Kettering			
Xenia	x	Chris Berger	City Engineer/Public Service Director
Villages	**Present**	**Name**	**Title**
Bowersville			
Cedarville			
Clifton			
Jamestown			
Spring Valley			
Yellow Springs			
Townships	**Present**	**Name**	**Title**
Bath			
Beavercreek	x	Alex Zaharieff	Township Administrator, Public Safety Director
	x	David VandenBos	Beavercreek Township Fire Chief
Caesarscreek			
Cedarville	x	Kyle Miller	Fire Chief
Jefferson			
Miami			
New Jasper			
Ross			
Silvercreek			
Spring Valley	x	Brett Bonecutter	Township Administrator
Sugarcreek	x	Jeff Leaming	Sugarcreek Township Fire Chief
Xenia	x	Greg Beegle	Xenia Township Fire Chief, City of Xenia FD Lieutenant
Anyone else?	**Present**	**Name**	**Title**
Greene County Regional Planning	x	Devon Shoemaker	Executive Director
Miami Conservency District	x	Barry Puskas	Chief of Technical and Engineering Services
Greene County Building Regulations	x	Al Kuzma	Chief Building Official

APPENDIX C. RISK EVALUATIONS

1. Risk Evaluation Worksheet

Name: Scott Miller Title: Trustee

Community/ Organization: Xenia Twp.

	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
Earthquake	No Change	
Floods	"	
Hail	"	
Severe Winter Storms	"	
Summer Heat and Drought	"	
Tornado & Winds	"	
Other Hazards - Hurricane	"	
Invasive	Ash Bore - Yes	Downed Trees
Source Water	Potential	
Dam	No Change.	
Transp. / Hazmat.	" "	
Terrorism	Increased	Cyber

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

1. Risk Evaluation Worksheet

Name: Alsu Shaydullina Title: Admin Support Coordinator

Community/ Organization: GCSED

	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
Earthquake	D	
Floods	NC	
Hail	NC	
Severe Winter Storms	NC	
Summer Heat and Drought	NC	
Tornado & Winds	NC	
Other Hazards - Hurricane	NC	
Invasive Species	NC	
Source water contan	I	
Dam Failure	NC	
Transportation Inc	NC	

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

1. Risk Evaluation Worksheet

Name: J. Devon Shoemaker Title: Director

Community/
Organization: ~~City of Dayton~~ RPCC

	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*
Earthquake	NC	
Floods	I	
Hail	I	
Severe Winter Storms	D	
Summer Heat and Drought	NC	
Tornado & Winds	I	
Other Hazards - Hurricane	N/C	
Invasive Species	I	Ash Borer
Extreme Temp	N/C	
Severe Summer Storms	I	
Drought	NC	
Source Water Cont	I	
Dam Failure	NC	
Trans / Hazmat	I	
Terrorism	I	

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

1. Risk Evaluation Worksheet

Name: City of Bellbrook Title: City Managers

Community/ Organization: City of Bellbrook

	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*
Earthquake	NC	
Floods	NC	our community suffers regular flooding
~~**Hail**~~	—	—
Severe Winter Storms	NC	
~~**Summer Heat and Drought**~~	—	—
Tornado ~~**& Winds**~~	NC	
~~**Other Hazards - Hurricane**~~	—	—
Extreme Temp	I	
Drought	NC	
Summer Storms	NC	
Invasive Species	NC	Not a huge issue in our community

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

1. Risk Evaluation Worksheet

Name: Brian Carlson Title: Chief of Police

Community/
Organization: Village of Yellow Springs

	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
Earthquake	NC	
Floods	NC	
Hail	NC	
Severe Winter Storms	NC	
Summer Heat and Drought	~~NC~~ I	INCREASE IN SUMMER HEAT
Tornado & Winds	NC	
Other Hazards - Hurricane	I	REGIONAL HURRICANE

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

1. Risk Evaluation Worksheet

Name: JASON TUNK Title: DIRECTOR

Community/ Organization: GCSED

	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
Earthquake	NC	
Floods	I	
~~Hail~~	X	
Severe Winter Storms	NC	
Summer ~~Heat and Drought~~ STORMS	I	
Tornado & Winds	I	
~~Other Hazards - Hurricane~~		
DROUGHT	I	
EARTHQUAKE	NC	
SINKHOLE/WATER	NC	
DAM	I	
TRANS/HAZMAT	NC	
TERRORISM	I	

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

1. Risk Evaluation Worksheet

Name: Al Kuzma Title: Director/CBO

Community/ Organization: Greene County Bldg Reg

	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
Earthquake	No Change	
Floods	Increase	More Extreme Events
Hail	No Change	
Severe Winter Storms	No Change	
Summer Heat and Drought	No Change	
Tornado ~~& Winds~~	Increase	More Extreme event
Other Hazards - Hurricane	Decrease	
Summer ~~Wind &~~ Hail Storms	No Change	
Invasive Species	Increase	recent occurrence
Sourcewater	Increase	Possibility
Dam Failure	No Change	
Transport Hazmat	No Change	
Terrorism	No Change	

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

1. Risk Evaluation Worksheet

Name: Stephanie Goff Title: County Engineer

Community/ Organization: County Engineer

	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
Earthquake	NC	
Floods	I (development, more intensity rain)	more isolated microbursts causing tree issues
~~Hail~~		
Severe Winter Storms	I	more isolated microbursts more intensity, more freq
~~Summer Heat and Drought~~ Summer Storms, Hail, Wind	I	"
~~Tornado & Winds~~	I	more frequently
~~Other Hazards - Hurricane~~		
INV Species	I	Emerald ash borer causing road closures flash flooding
Extreme Heat	I	more freq / longer
Drought	NC	
Source Water Contam	I	water contam Base/Fire protection
Dam Failure	NC	
Haz Mat	NC	
Terrorism	NC	

Increase for more detail

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

1. Risk Evaluation Worksheet

Name: STEVE ROSS Title: TRUSTEE

Community/ Organization: BATH TWP.

	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
Earthquake	NC	
Floods	NC	
~~Hail~~	—	
Severe Winter Storms	NC	
~~Summer Heat and Drought~~	—	
Tornado ~~& Winds~~	NC	
~~Other Hazards - Hurricane~~	—	
INVASIVE SPECIES	I	
EXTREME TEMPS	NC	
SEVERE SUMMER STORMS (WIND HAIL)	NC	
DROUGHT	NC	
SOURCE WATER CONT.	I	
DAM FAILURE	NC	
TRANS ISSUES / HAZMAT	NC	
TERRORISM	I	

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

1. Risk Evaluation Worksheet

Name: Matt Ingram Title: Disaster Services Rep.

Community/ Organization: Red Cross

	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*
Earthquake	NC	
Floods	I	
Hail	NC	
Severe Winter Storms	NC	
Summer Heat ~~and Drought~~	I	
Tornado & Winds	I	
~~Other Hazards - Hurricane~~		
Invasive Species	I	
Drought	NC	
Source Water Contam	I	
Dam Failure	NC	
Transp./Hazmat	NC	
Terrorism	I	

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

1. Risk Evaluation Worksheet

Name: Kim Caudill Title: Emergency Response Coordinator

Community/ Organization: Greene County Public Health

	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
Earthquake	NC	
Floods	I	
Hail	I	
Severe Winter Storms	D	
Summer Heat and Drought	I	
Tornado & Winds	I	
Other Hazards - Hurricane	NC	
Summer Storms	NC	
Dams	NC	
Invasive	I	
Haz MAT	NC	
Source Water	I	
Terrorism	I	
Public Health Em	I	

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

1. Risk Evaluation Worksheet

Name: DAVID FLETCHER Title: FIRE CHIEF

Community/
Organization: City of Fairborn

	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*
Earthquake	NC	
Floods	NC	
Hail	NC	
Severe Winter Storms	NC	
Summer Heat and Drought	NC	
Tornado & Winds	I	
Other Hazards - Hurricane	NC	

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

1. Risk Evaluation Worksheet

Name: Chris Berger Title: PS Director/City Engineer

Community/
Organization: City of Xenia

	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
Earthquake	NC	
Floods	NC	
Hail / Severe Summer Winds	NC	
Severe Winter Storms	NC	
~~Extreme~~ Summer Heat ~~and Drought~~	NC	
Tornado ~~& Winds~~	NC	
~~Other Hazards - Hurricane~~		
Drought	NC	
Invasive Species	NC	
Sourcewater Contamination	NC	
Dam Failure	NC	
Transportation Inc./Haz Mat	NC	
Terrorism	NC	

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

APPENDIX D. CHANGES IN DEVELOPMENT

2. Changes in Development Worksheet

Name: Alisa Shaydullina **Title:** Admin Support Coordinator

Community/ Organization: GCSED

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

No significant changes have happened.
(Sorry, I am relatively new to the role)

2. Changes in Development Worksheet

Name: JASON TINCH **Title:** DIRECTOR

Community/ Organization: GCSED

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

- STORMWATER MANAGMENT PLANS
- SOURCEWATER PROTECTION PROGRAMS
- COMMUNITY OUTREACH
- STAFF TRAINING
- EMA COLLABORATIONS

2. Changes in Development Worksheet

Name: Al Kuzma **Title:** Director/CBO

Community/ Organization: Greene Co Bldg Reg

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Increase in Development allows more + Quicker runoff
In regards to road ways parking lots etc
Therefore more Flooding
Also suggest Compensatory storage Requirements
for Flood plain Development

2. Changes in Development Worksheet

Name: Stephanie Goff **Title:** County Engineer

Community/ Organization: County Engineer

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

more increase (heavy commercial) development occuring on west side of county's more flooding occuring

all downhill → Beaver Creek Twp, Riverside City Fairborn, Bellbrook & Xenia

trees coming down in rivers causing more flooding

see me for more details

2. Changes in Development Worksheet

Name: Chris Berger **Title:** PS Director/City Engineer

Community/ Organization: City of Xenia

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Since 2015 any new development projects whether commercial or residential require stormwater management best practices (ie. detention basin). There has been low-impact erosion control measures taken on local streams (rip rap / revetment).

2. Changes in Development Worksheet

Name: STEVE TROSS **Title:** TRUSTEE

Community/ Organization: BATH TWP.

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

1. BIODIGESTER IN BATH TOWNSHIP ... COULD HAVE AN EFFECT ON SOURCEWATER CONTAMINATION. THEY ALSO HAVE A PROPOSAL TO ADD 32 MILLION GALLONS OF 2 LAGOONS FOR ADDITIONAL ORGANIC MATTER STORAGE.

2. Changes in Development Worksheet

Name: Matt Ingram **Title:** Disaster Services Rep.

Community/ Organization: Red Cross

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Red Cross National Campaign to install 10yr smoke alarms in fire prone area homes.
Has saved over 500 lives in last 4 yrs.
This is a long term mitigation plan to save lives.

2. Changes in Development Worksheet

Name: Kim Caudill **Title:** Emergency Response Coordinator

Community/ Organization: Greene County Public Health

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Increase in number of employees at WPAFB - now over 30,000. more vehicles. Increase in housing developments taking land from animals

2. Changes in Development Worksheet

Name: DAVID REICHERT **Title:** FIRE CHIEF

Community/ Organization: City of Fairborn

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

- MORE RESIDENTIAL HOMES BUILT IN THE CITY
- MORE COMMERCIAL DEVELOPMENT IN THE CITY

2. Changes in Development Worksheet

Name: Jeff Miller **Title:** Trustee

Community/ Organization: Xenia Twp.

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Population growth, new home growth; Ash Bore,

2. Changes in Development Worksheet

Name: J. Devon Sheelmatter **Title:** Director

Community/ Organization: ~~City of Dayton~~ RPCC

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

Greene County continues to grow. Suburban development continues to migrate eastward. Downtown redevelopment is occurring in our communities such as Xenia, Bellbrook, Fairborn. Development in floodplains is restricted by Flood Damage Resolution ... however runoff from new development can cause increased volume and higher chance for localized flooding.

2. Changes in Development Worksheet

Name: Melissa Dodd **Title:** City Manager

Community/ Organization: City of Bellbrook

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

We are pretty much built out. Development has created water issues but no real change in the last 5 years as development is minimal due to being at capacity for the most part.

2. Changes in Development Worksheet

Name: Brian Carlson **Title:** Chief of Police

Community/ Organization: Village of Yellow Springs

Tell us, in a couple of sentences, of any development that has occurred that may impact the vulnerability of your community to the identified hazards. Also consider any redevelopment that has occurred. As communities change and grow, their susceptibility to hazards change. If no significant changes have happened, please also tell us that.

NO SIGNIFICANT CHANGES

APPENDIX E. PLAN REVIEW TOOL