ROSS COUNTY
HAZARD MITIGATION PLAN
OCTOBER 2025

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1| Introduction

1.1 Overview

With the 2020 Ross County Hazard Mitigation Plan set to expire in March of 2025, Ross County and its constituents are aiming to adopt a new, updated hazard mitigation plan. As outlined in the Disaster Mitigation Act of 2000 (DMA2K), any local jurisdiction seeking funding from the Federal Emergency Management Agency (FEMA) must maintain an up-to-date disaster mitigation plan. This Plan meets the criteria set forth by FEMA in the DMA2K and provides the County and its participating jurisdictions with a comprehensive guide for future mitigation efforts to combat the hazards that affect their communities.

Natural, geological, and human-caused hazards pose a variety of risks to the lives, businesses, and properties within Ross County. As such, a Core Planning Committee within Ross County has been established with the goal of developing and implementing the 2025 Ross County Hazard Mitigation Plan. Through cooperative efforts between local, county, state, and federal government agencies, this Plan is designed to minimize the adverse effects of hazardous events on the lives and properties of residents of Ross County.

This 2025 Ross County Hazard Mitigation Plan is a multi-jurisdictional plan which considers the impacts of hazards on incorporated cities and villages and unincorporated townships. Ross County's jurisdictions and townships are listed below in **Tables 1.1.1 and 1.1.2**. These areas are also displayed in **Figure 1.1.3** on the following page. The Plan is designed for a five-year implementation period and describes the methods and procedures utilized in its development, provides the results of community involvement activities such as survey collection, identifies the mitigation activities determined to be most important to the County, and establishes a timeline for the implementation of the actions.

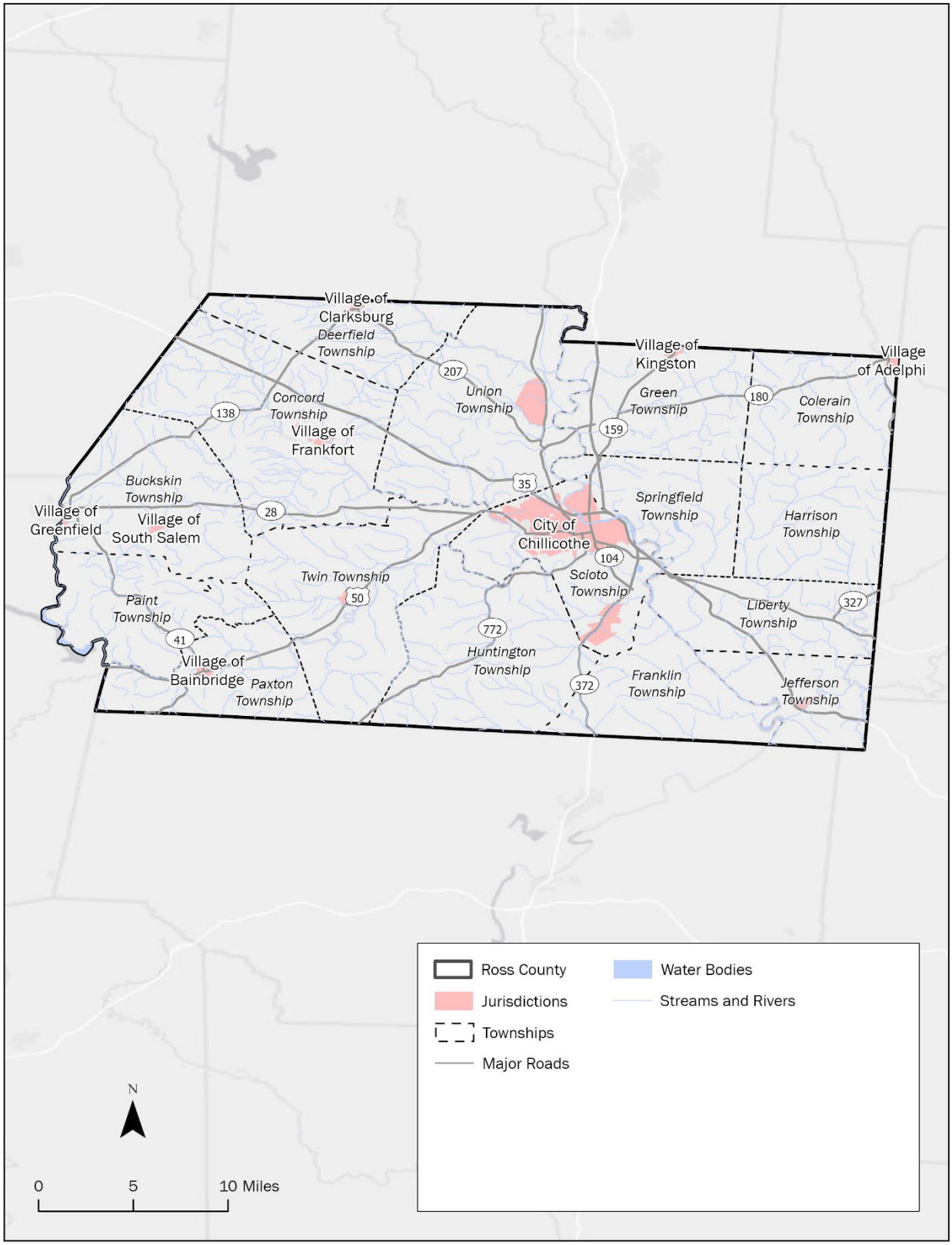
Table 1.1.1: Ross County Jurisdictions

Jurisdictions	
City of Chillicothe	Village of Frankfort
Village of Adelphi	Village of Kingston
Village of Bainbridge	Village of South Salem
Village of Clarksburg	

Table 1.1.2: Ross County Townships

Townships	
Buckskin Township	Jefferson Township
Colerain Township	Liberty Township
Concord Township	Paint Township
Deerfield Township	Paxton Township
Franklin Township	Scioto Township
Green Township	Springfield Township
Harrison Township	Twin Township
Huntington Township	Union Township

Figure 1.1.3: Ross County Jurisdictions Map



This Plan is comprised of six chapters, which detail the methods, analysis, and discussion surrounding the various hazards that threaten Ross County and its jurisdictions. These chapters are as follows:

- This **Introduction** (Chapter 1) provides a discussion about the general purpose and goals that Ross County wishes to achieve throughout the development and implementation of this Plan. This section also includes a summary of the Plan's contents.
- Chapter 2, **History and Demographics**, includes a description of Ross County and each participating jurisdiction, including their history, population, and other general information.
- Chapter 3, **Planning Process**, details the process for the development of this Plan. This section includes details about the process used to develop this Plan, including a description of who participated, how the community was involved, which hazards were included in the Plan and why, as well as how the Plan was developed through public meetings, reviews, and evaluations. This section also details the review and incorporation of existing plans, studies, reports, and technical information.
- Chapter 4 contains the **Hazard Identification and Risk Assessment (HIRA)**. This section provides detailed descriptions and a corresponding analysis for each hazard that could potentially affect Ross County. The nature, location, extent, historical impact, vulnerability, and likelihood of occurrence for each hazard are provided for each hazard. These analyses include the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; an estimate of the potential dollar losses to vulnerable structures; and a general description of land uses and development trends within the community.
- Chapter 5, **Hazard Mitigation**, outlines the goals, strategies, and actions for the County. The proposed actions are presented in tables, categorized by the associated hazard and community, and then ranked from highest to lowest priority based on feedback received from County officials and participating jurisdictions and stakeholders. Excluded hazards are also documented in this section, along with the rationale for exclusion from the Plan.
- The final chapter (Chapter 6) of this Plan, **Schedule and Maintenance**, provides a summary of the proposed Plan adoption, integration, and maintenance schedule. This section describes how the County will review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five years to continue to be eligible for mitigation project grant funding.

The resulting Ross County Hazard Mitigation Plan will be submitted to the Ohio Emergency Management Agency (Ohio EMA) and subsequently FEMA for their review. Following the agency review, the jurisdictions will then review the Plan for adoption. This hazard mitigation plan serves as a helpful tool for citizens, policymakers, local businesses, and other local stakeholders who all share a public interest in keeping Ross County as safe and resilient as possible. As such, this Plan aims to:

- Minimize property damage, economic loss, injury, and loss of human life – to achieve the Plan's main goal of reducing the impact of natural and manmade hazards on the County's economy and the well-being of its citizens.
- Enhance public awareness and education – to widen the public's understanding of natural and manmade hazards and how they might affect public health and safety, the environment, the local economy, and basic day-to-day operations.
- Coordinate inter-jurisdictional preparedness measures – to encourage and ensure multi-jurisdictional cooperation in County-wide mitigation actions and programs so that they may be implemented efficiently and effectively.

- Provide decision-making tools for interested stakeholders – to formulate a comprehensive, updated analysis of Ross County's vulnerability to hazards so that decision-makers can better prepare for natural and manmade disasters.
- Achieve regulatory compliance – to ensure that the County and its political subdivisions meet state and federal mitigation planning requirements so that they may be eligible to participate in and receive funding from grant programs, policies, and regulations.

1.2 Setting

Ross County is in the southern region of Ohio and has a total area of approximately 689 square miles. The County contains one city, six villages, and sixteen townships (**Tables 1.1.1 and 1.1.2**). The City of Chillicothe serves as the County seat. Ross County is bounded by seven Ohio counties: Pickaway to the north, Hocking to the northeast, Vinton to the east, Jackson to the southeast, Pike to the south, Highland to the southwest, and Fayette to the northwest.

Land use patterns in Ross County are shown in **Figure 1.2.1**. Land use types include residential, agricultural, industrial, commercial, parks/open space, transportation, public/semipublic land, and vacant. Land cover in Ross County is shown in **Figure 1.2.2**. Land cover types include cultivated crops, forested, developed, hay and pasture, herbaceous, wetlands, open water, and shrub and scrub.

Figure 1.2.1: Ross County Land Use Map

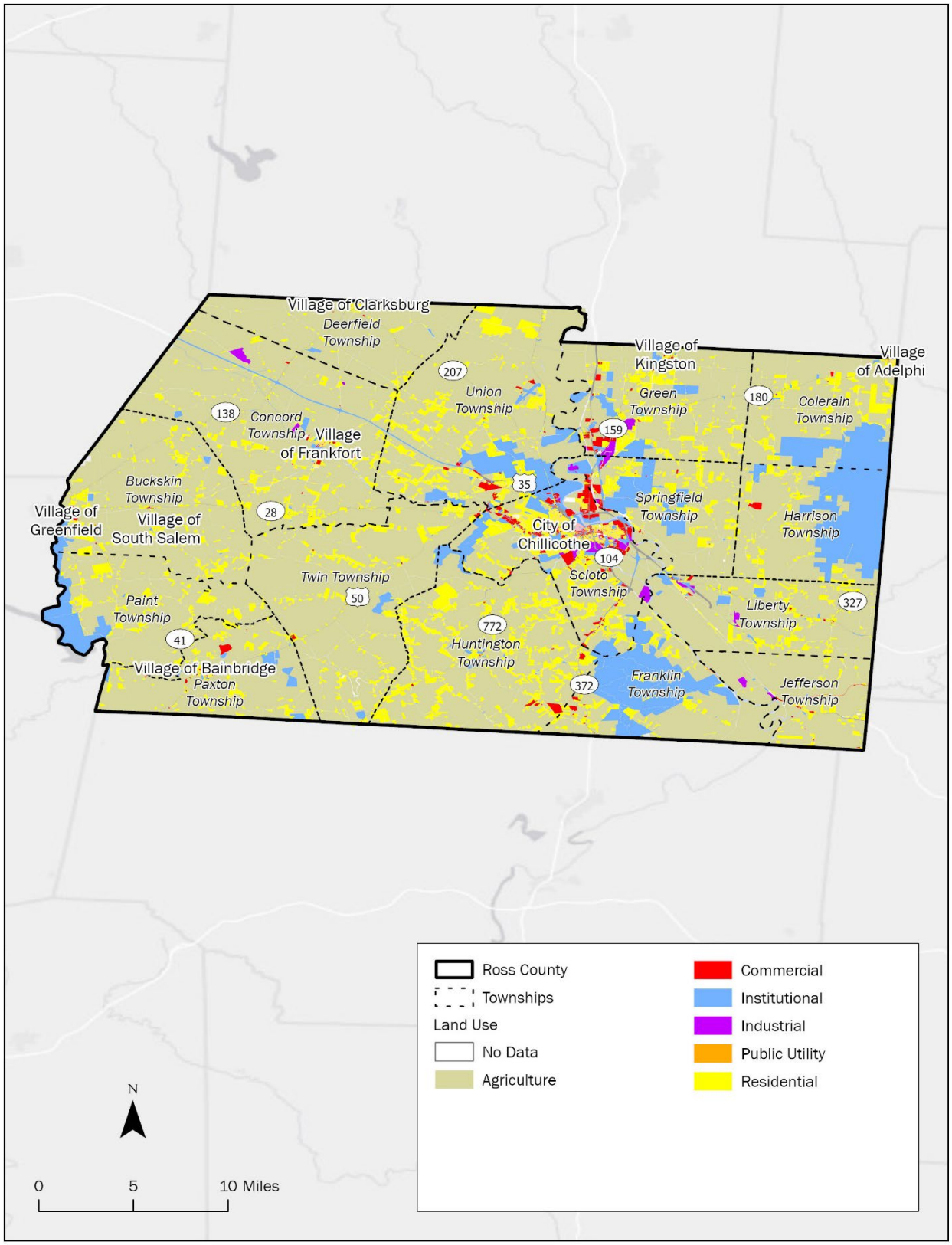
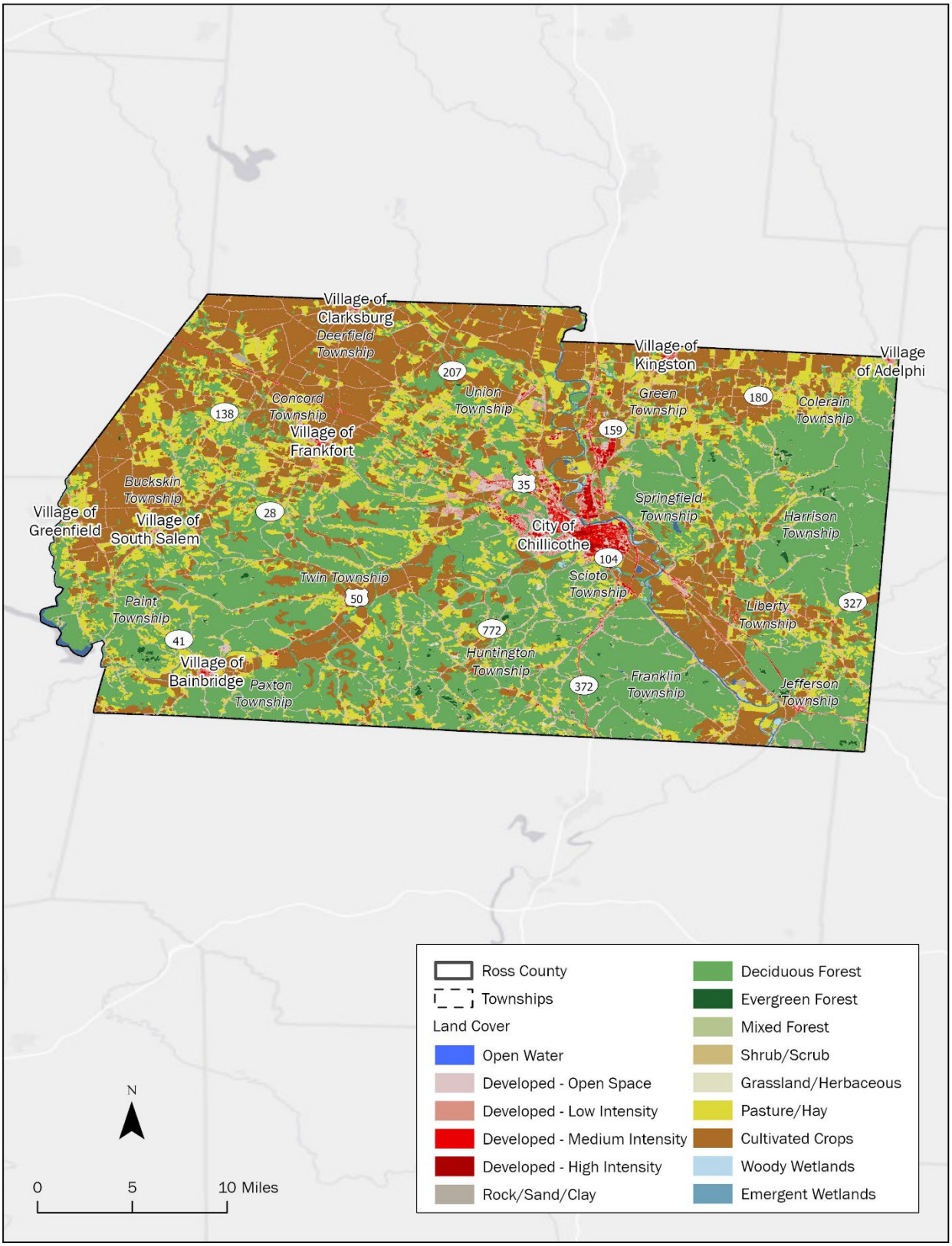


Figure 1.2.2: Ross County Land Cover Map



1.3 Region Features

Transportation

Ross County contains several major roadways, including several State Routes (SR) and 3 U.S. Highways (US), No Interstates (I) traverse Ross County. Major roadways in Ross County include SR-28, SR-41, SR-104, SR-138, SR-159, SR-180, SR-207, SR-327, SR-372, SR-772, US-23, US-35, and US-50.

Ross County has one public-use airport, Ross County Airport, which is located north of the City of Chillicothe.

CSX Corporation has two rail lines that operate in Ross County. The primary line runs from north to south through Chillicothe. The secondary line runs southeast between Chillicothe and Schooley. Norfolk Southern Corporation also operates a rail line in Ross County that runs north to south from Kingston, through Chillicothe, passing Higby before exiting the County in the south. Genesee & Wyoming, Inc. has one rail line that briefly enters Ross County on the western edge in Greenfield.

Natural Features

Table 1.3.1, below, Ross County has several parks and nature areas.

Table 1.3.1: Parks & Nature Areas in Ross County, Ohio

Parks & Nature Areas	
Buzzard's Roost	Metahqua
Great Seal State Park	North Fork Water Trail
Herron-Downs Fen Nature Preserve	Paint Creek Recreation Trail
Hopewell Culture National Historic Park	Pleasant Valley Wildlife Area
Kinnikinnick Fen	Ross Lake Wildlife Area
Maple Grove Prairie	Scioto Trail State Forest
Tar Hollow State Park	Yoctangee Park

Ross County also has several streams and water bodies which are listed in **Table 1.3.2** below.

Table 1.3.2: Ross County Streams and Water Bodies

Water Bodies	
Actons Run	Goose Creek
Anderson Run	Goshen Run
Beech Fork	Hay Run
Biers Run	Herrod Creek
Black Run	Hoddy Run
Blackwater Creek	Honey Creek
Bluelick Run	Hop Run
Brimstone Creek	Indian creek

Water Bodies	
Buckskin Creek	Kinnikinnick Creek
Bull Creek	Knoles Pond
Caldwell Lake	Lake Ellensmere
Campbells Run	Lake Hill
Cattail Run	Latta Run
Cave Run	Lick Run
Chapel Creek	Little Creek
Christian Union Church Lake	Little Walnut Creek
Cliff Creek	Lower Twin Creek
Corey Run	Mad Run
Cove Run	Massie Run
Cranberry Run	McCortney Run
Crawley Lake	Mead Foremens Club Pond
Deer Creek	Menary Run
Dewey Creek	Middle Fork Salt Creek
Dresbach Creek	Mine Run
Dry Run	Minnehan Run
Fergus Moores Run	Moore Run
Gilfillins Run	Mulgee Creek
Musselmans Run	Slate Run
North Branch Indian Creek	South Fork Kinnikinnick Creek
North Fork Buckskin Creek	Souther Silica Pond
North Fork Paint Creek	Spring Branch
Oldtown Run	Spud Run
Owl Creek	Squaw Lick
Paint Creek	Stall Run
Pine Lake	Stewart Lake
Piny Run	Stone Run
Pittengers Run	Stony Creek
Plug Run	Sugar Run
Plum Run	Sulphur Lick
Poe Run	Sun Valley Lake

Water Bodies	
Proud Run	Taylor Run
Ralston Run	Upper Twin Creek
Reeves Run	Walnut Creek
Ross Lake	Wasugh Run
Rozelle Creek	Whetstone Run
Rustic Acres Lakes	Whisky Run
Salt Creek	Wilcox Run
Salt Lick Creek	Wilsons Run
Sandy Bottom Creek	Yellow Run

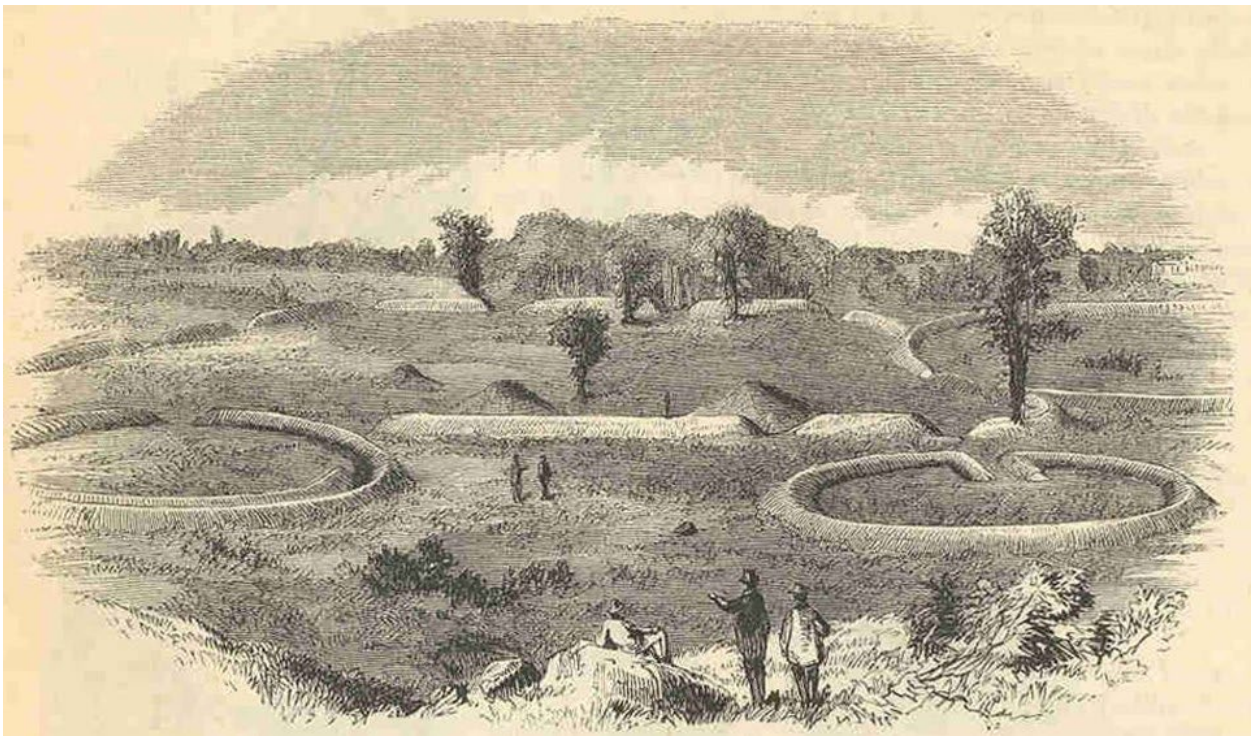
2 | History & Demographics

2.1 History

Ross County is a rural county in east central Ohio. The County has a total area of 693 square miles, of which 689 square miles are land, and 3.9 square miles are water. Ross County is the second largest (by land) county in Ohio. The County was established on August 20, 1798, when the Governor St. Clair formed it by proclamation. It was the sixth county formed in the Northwest Territory. Ross County is named after Federalist Senator James Ross of Pennsylvania.

Ross County has 44 properties listed on the National Register of Historic Places, with the first property being entered in 1974. The Hopeton Earthworks, **Figure 2.1.1**, was added to the National Register on October 15, 1966. The Hopeton Earthworks were built 1,600 – 2,000 years ago and are enormous geometric earthworks. They include a 7.3-hectare circle, a 7.86-hectare square, parallel walls, and at least two circles. These were built by the Hopewell Natives for ceremonial and religious purposes.

Figure 2.1.1: Hopeton Earthworks - Squier and Davis, 1848



Source: National Park Service

2.2 Communication Outlets

Ross County's primary communication outlets including websites, television, and social media are listed in **Table 2.2.1**, below:

Table 2.2.1: Communication Outlets and Social Media

Communication Type	Source
Website	Ross County: http://www.co.ross.oh.us/ Ross County EMA: https://rosscountyema.com/ Ross County Health District https://rosscountyhealth.org/ Ross County Sherriff's Office: https://rosssheriff.com/ The American Red Cross South Central Ohio Region: https://www.redcross.org/local/ohio/central-and-southern-ohio/about-us/locations/south-central-ohio.html?srsltid=AfmBOor85HLddI5rNGLkJZWdTNT1kAm4PQJsHxRKhTArJyBoL9f3A2yj
Social media	Ross County EMA: https://www.facebook.com/groups/398081137190956/ Ross County Health District: https://www.facebook.com/RossCoHD/ Ross County Sheriff: https://www.facebook.com/RossCoSheriff/?fref=ts
News/ Newspaper	Scioto Valley Guardian website: https://sciotovalleyguardian.com/ Scioto Valley Guardian Facebook: https://www.facebook.com/SciotoValleyGuardian/ Scioto Post: https://www.sciotopost.com/ Chillicothe Gazette: https://www.chillicothegazette.com/
Radio	Litter Media: https://littermedia.com/ WKKJ: https://wkkj.iheart.com/

2.3 Demographics Overview

This section provides select demographic information to help identify strategies to better serve the County residents during emergency hazard events. The information can be used to understand potential vulnerabilities in subgroups of the population. For example, knowing the number of senior citizens that live alone and that may require additional assistance during an emergency can help assistance organizations anticipate where additional services may be needed.

Table 2.3.1, below, provides a summary of the total population changes that have occurred in Ross County between the 2010 U.S. Census and the 2023 5-Year American Community Survey (ACS) Estimates based on census data. According to the U.S. Census, Ross County's population decreased by 1,316 people (-1.69 percent) between 2010 and 2023. For comparison, the U.S. population grew 9.04 percent and Ohio's population grew 2.49 percent during that period. Six townships – Concord, Deerfield, Franklin, Green, Jefferson, and Twin townships – experienced population growth. Of the townships experiencing population decline, Paint Township experienced the greatest population decline with a decrease of 445 people (-32.65 percent).

A more detailed description of population, housing, and income demographics for Ross County and each city and village jurisdiction is provided on the following pages.

Table 2.3.1: County And Township Population Growth Estimates Between 2010 Census and 2023 5-Year ACS Estimates

County/Township	Total Population 2010 Census	Total Population 2023 Estimate	2010-2023	
			Population Change	Percent Change
Ross County	78,064	76,748	-1,316	-1.69%
Buckskin Township	2,039	1,806	-233	-11.43%
Colerain Township	2,148	1,911	-237	-11.03%
Concord Township	4,460	4,675	215	4.82%
Deerfield Township	1,058	1,565	507	47.92%
Franklin Township	1,705	1,738	33	1.94%
Green Township	4,918	5,205	287	5.84%
Harrison Township	1,320	1,098	-222	-16.82%
Huntington Township	6,220	6,127	-93	-1.50%
Jefferson Township	991	1,435	444	44.80%
Liberty Township	2,619	2,585	-34	-1.30%
Paint Township	1,363	918	-445	-32.65%
Paxton Township	2,116	1,482	-634	-29.96%
Scioto Township	27,721	27,678	-43	-0.16%
Springfield Township	2,657	2,601	-56	-2.11%
Twin Township	3,384	3,387	3	0.09%
Union Township	13,345	12,537	-808	-6.05%

Social Vulnerability Index Score

The Social Vulnerability Index Score is a component of the Center for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) Social Vulnerability Index (SVI) that measures the susceptibility (risk) of social groups to the adverse impacts of natural hazards that may result in disproportionate deaths, injury, loss, or disruption of livelihood. As FEMA explains, the "Social Vulnerability score considers the social, economic, demographic, and housing characteristics of a community that influence its ability to prepare for, respond to, cope with, recover from, and adapt to environmental hazards. The score and rating represent the relative level of a community's social vulnerability compared to all other communities at the same level (e.g., county level). A community's Social Vulnerability score is proportional to a community's risk. A higher Social Vulnerability score results in a higher Risk Index score."

According to the Center for Disease Control and Prevention (CDC) and Agency for Toxic Substances and Disease Registry (ATSDR) Social Vulnerability Index (SVI) Ross County has a calculated Social Vulnerability Index of 0.61 (on scale of 0 to 1) on a state level, which is considered a medium to high susceptibility to the adverse impacts of natural hazards when compared to the rest of the U.S. For comparison, Ohio's average Social Vulnerability Index is 0.50 on a state level. Table 2.3.2 reports the SVI scores for socioeconomic status, housing type and transportation, race and ethnic minority status, and household characteristics for Ross County and Ohio at both the state and nation levels.

The score is calculated using U.S. Census data for 16 social factors, which research literature suggests contributes to the reduction in a community's ability to prepare for, respond to, and recover from hazards, thus making the community more vulnerable. Each county is subdivided into census tracts and each census track is ranked on the 16 social factors. The 16 social factors are organized into four themes. Each census track is ranked separately for each theme and receives an overall ranking. The four themes and social factors are described below according to the CDC/ATSDR Social Vulnerability Index:

1. **Socioeconomic Status**: this theme covers socioeconomic status, such as households with income below the 150-percentile poverty level, employment status, housing cost burden, high school diploma status, and if the household has health insurance.
2. **Housing Type and Transportation:** this theme covers multi-unit structures, mobile homes, crowding within households, households without a vehicle, and group quarters.
3. **Race and Ethnic Minority Status:** this theme covers the percentage of Hispanic or Latino (of any race); Black and African American (not Hispanic or Latino); American Indian and Alaska Native (not Hispanic or Latino); Native Hawaiian and Other Pacific Islander (not Hispanic or Latino); Two or More Races (not Hispanic or Latino); Other Races (not Hispanic or Latino).
4. **Household Characteristics:** this theme covers the elderly population (65 and older), children under 17 years of age, civilians with a disability, single-parent households, and the household's English language proficiency.

Table 2.3.2 Social Vulnerability Score per Theme for Ross County and Ohio

Theme	Ross County (Statewide)	Ohio (Statewide)	Ross County (Nationwide)	Ohio (Nationwide)
Socioeconomic Status	0.74	0.50	0.53	0.37
Housing Type and Transportation	0.18	0.50	0.15	0.42
Race and Ethnic Minority Status	0.22	0.50	0.08	0.28
Household Characteristics	0.98	0.50	0.76	0.40

2.4 Community Profiles

Ross County

Ross County is located in south central Ohio, and it is part of the Columbus-Marion-Zanesville Combined Statistical Area. Metropolitan Statistical Area. As of the 2023 5-Year ACS Estimates (census), the population was 76,748 making it the 32nd most populated county in Ohio. The City of Chillicothe is the largest city and serves as the County seat.

Tables 2.4.1 to 2.4.6 summarize Ross County's population, housing statistics, and income statistics. There are 29,429 households of which 25.0 percent have at least one member under 18 years of age, and 32.5 percent have members 65 years and over. The largest percentage of households (18.5 percent) had an income between $100,000 to $149,999; approximately 5.2 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Ross County was the White (non-Hispanic) group, which makes up 88.7 percent of the population. Black or African American is the second largest race (5.3 percent). Approximately 0.76 percent of the city's population speak Spanish at home. In addition, 0.54 percent speak another Indo-European language, 0.26 percent speak an Asian and Pacific Island language, and 0.11 percent speak another language.

Table 2.4.1: Ross County Population by Age Statistics 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	76,748	100%
Under 18 Years	16,288	21.22%
18 to 24 Years	5,806	7.57%
25 to 34 Years	9,969	12.99%
35 to 44 Years	10,077	13.13%
45 to 54 Years	10,416	13.57%
55 to 64 Years	10,760	14.02%
65 Years and Over	13,432	17.50%

Table 2.4.2: Ross County Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	32,042	100%
Occupied Housing Units	29,429	91.85%
Housing Units - Mobile Homes	4,076	13.85%
Vacant Housing Units	2,613	8.15%

Table 2.4.3: Ross County Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	29,429	-
Average Household Size	2.43	-
Households with People Under 18 Years	7,346	24.96%
Households with People 65+ Years	9,564	32.50%
Householder Living Alone 65+ Years	4,091	13.90%
No Vehicle Available	1,816	6.17%
With a Broadband Internet Subscription	25,677	87.25%

Table 2.4.4: Ross County Population by Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	76,748	100%
White	68,063	88.68%
Black or African American	4,094	5.33%
American Indian and Alaska Native	113	0.15%
Asian	414	0.54%
Native Hawaiian and other Pacific Islander	36	0.05%
Some Other Race	138	0.18%
Two or More Races	2,820	3.67%
Hispanic or Latino (of any race)	1,070	1.39%

Table 2.4.5: Ross County Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	72,476	100%
English only	71,265	98.33%
Spanish	548	0.76%
Other Indo-European languages	392	0.54%
Asian and Pacific Island languages	188	0.26%
Other languages	83	0.11%

Table 2.4.6: Ross County Household Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Number of Households
Less than $10,000	5.20%
$10,000 to $14,999	5.50%
$15,000 to $24,999	8.20%
$25,000 to $34,999	11.50%
$35,000 to $49,999	12.80%
$50,000 to $74,999	16.50%
$75,000 to $99,999	12.50%
$100,000 to $149,999	18.50%
$150,000 to $199,999	5.00%
$200,000 or more	4.30%
Median Household Income	$59,819
Mean Household Income	$78,138

City of Chillicothe

Tables 2.4.7 to 2.4.12 summarize the City of Chillicothe's population, housing statistics, and income statistics. There are 9,784 households of which 22.5 percent have at least one member under 18 years of age, and 35.3 percent have members 65 years and over. The largest percentage of households (18.8 percent) had an income between $50,000 to $74,999; approximately 6.0 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the City of Chillicothe was the White (non-Hispanic) group, which makes up 84.0 percent of the population. Black or African American is the second largest race (8.3 percent). Approximately 0.44 percent of the city's population speak Spanish at home. In addition, 0.57 percent speak another Indo-European language and 0.15 percent speak an Asian and Pacific Island language.

Table 2.4.7: City of Chillicothe Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	21,958	100%
Under 18 Years	4,328	19.71%
18 to 24 Years	1,716	7.81%
25 to 34 Years	2,710	12.34%
35 to 44 Years	3,035	13.82%
45 to 54 Years	2,644	12.04%
55 to 64 Years	2,755	12.55%
65 Years and Over	4,770	21.72%

Table 2.4.8: City of Chillicothe Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	10,820	100%
Occupied Housing Units	9,784	90.43%
Housing Units - Mobile Homes	344	3.52%
Vacant Housing Units	1,036	9.57%

Table 2.4.9: City of Chillicothe Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	9,784	-
Average Household Size	2.17	-
Households with People Under 18 Years	2,200	22.49%
Households with People 65+ Years	3,454	35.30%
Householder Living Alone 65+ Years	2,025	20.70%
No Vehicle Available	904	9.24%
With a Broadband Internet Subscription	8,377	85.62%

Table 2.4.10: City of Chillicothe Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	21,958	100%
White	18,449	84.02%
Black or African American	1,816	8.27%
American Indian and Alaska Native	23	0.10%
Asian	128	0.58%
Native Hawaiian and other Pacific Islander	6	0.03%
Some Other Race	11	0.05%
Two or More Races	1,391	6.33%
Hispanic or Latino (of any race)	134	0.61%

Table 2.4.11: City of Chillicothe Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	20,516	100%
English only	20,278	98.84%
Spanish	90	0.44%
Other Indo-European languages	117	0.57%
Asian and Pacific Island languages	31	0.15%
Other languages	0	0%

Table 2.4.12: City of Chillicothe Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	6.00%
$10,000 to $14,999	8.20%
$15,000 to $24,999	10.30%
$25,000 to $34,999	13.30%
$35,000 to $49,999	12.80%
$50,000 to $74,999	18.80%
$75,000 to $99,999	9.80%
$100,000 to $149,999	12.40%
$150,000 to $199,999	4.00%
$200,000 or more	4.30%
Median Household Income	$49,193
Mean Household Income	$69,691

Village of Adelphi

Tables 2.4.13 to 2.4.18 summarize the Village of Adelphi's population, housing statistics, and income statistics. There are 153 households of which 27.5 percent have at least one member under 18 years of age, and 28.8 percent have members 65 years and over. The largest percentage of households (19.0 percent) had an income between $15,000 to $24,999; approximately 3.9 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of Adelphi was the White (non-Hispanic) group, which makes up 93.9 percent of the population. Two or More Races is the second largest race (3.4 percent).

Table 2.4.13: Village of Adelphi Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	327	100%
Under 18 Years	81	24.77%
18 to 24 Years	32	9.79%
25 to 34 Years	31	9.48%
35 to 44 Years	45	13.76%
45 to 54 Years	63	19.27%
55 to 64 Years	23	7.03%
65 Years and Over	52	15.90%

Table 2.4.14: Village of Adelphi Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	157	100%
Occupied Housing Units	153	97.45%
Housing Units - Mobile Homes	33	21.57%
Vacant Housing Units	4	2.55%

Table 2.4.15: Village of Adelphi Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	153	-
Average Household Size	2.14	-
Households with People Under 18 Years	42	27.45%
Households with People 65+ Years	44	28.80%
Householder Living Alone 65+ Years	18	11.80%
No Vehicle Available	25	16.34%
With a Broadband Internet Subscription	116	75.82%

Table 2.4.16: Village of Adelphi Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	327	100%
White	307	93.88%
Black or African American	0	0%
American Indian and Alaska Native	0	0%
Asian	7	2.14%
Native Hawaiian and other Pacific Islander	0	0%
Some Other Race	2	0.61%
Two or More Races	11	3.36%
Hispanic or Latino (of any race)	0	0%

Table 2.4.17: Village of Adelphi Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	320	100%
English only	320	100%
Spanish	0	0%
Other Indo-European languages	0	0%
Asian and Pacific Island languages	0	0%
Other languages	0	0%

Table 2.4.18: Village of Adelphi iIncome Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	3.90%
$10,000 to $14,999	13.70%
$15,000 to $24,999	19.00%
$25,000 to $34,999	8.50%
$35,000 to $49,999	15.00%
$50,000 to $74,999	12.40%
$75,000 to $99,999	11.10%
$100,000 to $149,999	11.80%
$150,000 to $199,999	3.30%
$200,000 or more	1.30%
Median Household Income	$36,563
Mean Household Income	$57,534

Village of Bainbridge

Tables 2.4.19 to 2.4.24 summarize the Village of Bainbridge's population, housing statistics, and income statistics. There are 223 households of which 24.2 percent have at least one member under 18 years of age, and 32.7 percent have members 65 years and over. The largest percentage of households (18.4 percent) had an income between $100,000 to $149,999; approximately 9.4 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of Bainbridge was the White (non-Hispanic) group, which makes up 96.3 percent of the population. Two or More Races is the second largest race (2.3 percent). Approximately 0.37 percent speak another Indo-European language.

Table 2.4.19: Village of Bainbridge Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	574	100%
Under 18 Years	126	21.95%
18 to 24 Years	64	11.15%
25 to 34 Years	74	12.89%
35 to 44 Years	66	11.50%
45 to 54 Years	48	8.36%
55 to 64 Years	78	13.59%
65 Years and More	118	20.56%

Table 2.4.20: Village of Bainbridge Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	284	100%
Occupied Housing Units	223	78.52%
Housing Units - Mobile Homes	45	20.18%
Vacant Housing Units	61	21.48%

Table 2.4.21: Village of Bainbridge Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	223	-
Average Household Size	2.47	-
Households with People Under 18 Years	54	24.22%
Households with People 65+ Years	73	32.70%
Householder Living Alone 65+ Years	31	13.90%
No Vehicle Available	11	4.93%
With a Broadband Internet Subscription	185	82.96%

Table 2.4.22: Village of Bainbridge Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	574	100%
White	553	96.34%
Black or African American	8	1.39%
American Indian or Alaska Native	0	0%
Asian	0	0%
Native Hawaiian or Pacific Islander	0	0%
Some Other Race (One Race)	0	0%
Two or More Races	13	2.26%
Hispanic or Latino (of any race)	0	0%

Table 2.4.23: Village of Bainbridge Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	537	100%
English only	535	99.63%
Spanish	0	0%
Other Indo-European languages	2	0.37%
Asian and Pacific Island languages	0	0%
Other languages	0	0%

Table 2.4.24: Village of Bainbridge Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	9.40%
$10,000 to $14,999	5.40%
$15,000 to $24,999	12.60%
$25,000 to $34,999	13.90%
$35,000 to $49,999	17.00%
$50,000 to $74,999	9.40%
$75,000 to $99,999	6.70%
$100,000 to $149,999	18.40%
$150,000 to $199,999	6.30%
$200,000 or more	0.90%
Median Household Income	$41,250
Mean Household Income	$59,930

Village of Clarksburg

Tables 2.4.25 to 2.4.30 summarize the Village of Clarskburg's population, housing statistics, and income statistics. There are 168 households of which 47.0 percent have at least one member under 18 years of age, and 28.6 percent have members 65 years and over. The largest percentage of households (31.5 percent) had an income between $25,000 to $34,999; approximately 3.6 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of Clarskburg was the White (non-Hispanic) group, which makes up 95.8 percent of the population. Two or More Races is the second largest race (2.2 percent). Approximately 2.2 percent speak an Asian and Pacific Island language.

Table 2.4.25: Village of Clarksburg Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	543	100%
Under 18 Years	200	36.83%
18 to 24 Years	43	7.92%
25 to 34 Years	88	16.21%
35 to 44 Years	36	6.63%
45 to 54 Years	80	14.73%
55 to 64 Years	38	7.00%
65 Years and More	58	10.68%

Table 2.4.26: Village of Clarksburg Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	169	100%
Occupied Housing Units	168	99.41%
Housing Units - Mobile Homes	8	4.76%
Vacant Housing Units	1	0.59%

Table 2.4.27: Village of Clarksburg Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	168	-
Average Household Size	3.23	-
Households with People Under 18 Years	79	47.02%
Households with People 65+ Years	48	28.60%
Householder Living Alone 65+ Years	26	15.50%
No Vehicle Available	4	2.38%
With a Broadband Internet Subscription	150	89.29%

Table 2.4.28: Village of Clarksburg Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	543	100%
White	520	95.76%
Black or African American	0	0%
American Indian or Alaska Native	0	0%
Asian	0	0%
Native Hawaiian or Pacific Islander	11	2.03%
Some Other Race (One Race)	0	0%
Two or More Races	12	2.21%
Hispanic or Latino (of any race)	0	0%

Table 2.4.29: Village of Clarksburg Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	497	100%
English only	486	98%
Spanish	0	0%
Other Indo-European languages	0	0%
Asian and Pacific Island languages	11	2.21%
Other languages	0	0%

Table 2.4.30: Village of Clarksburg Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	3.60%
$10,000 to $14,999	2.40%
$15,000 to $24,999	7.70%
$25,000 to $34,999	31.50%
$35,000 to $49,999	10.70%
$50,000 to $74,999	17.90%
$75,000 to $99,999	19.60%
$100,000 to $149,999	6.00%
$150,000 to $199,999	0%
$200,000 or more	0.60%
Median Household Income	$47,727
Mean Household Income	$52,045

Village of Frankfort

Tables 2.4.31 to 2.4.36 summarize the Village of Frankfort's population, housing statistics, and income statistics. There are 618 households of which 20.6 percent have at least one member under 18 years of age, and 39.5 percent have members 65 years and over. The largest percentage of households (24.9 percent) had an income between $75,000 to $99,999; approximately 4.4 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of Frankfort was the White (non-Hispanic) group, which makes up 95.7 percent of the population. Two or More Races is the second largest race (3.1 percent).

Table 2.4.31: Village of Frankfort Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	1,419	100%
Under 18 Years	283	19.94%
18 to 24 Years	101	7.12%
25 to 34 Years	146	10.29%
35 to 44 Years	159	11.21%
45 to 54 Years	211	14.87%
55 to 64 Years	211	14.87%
65 Years and More	308	21.71%

Table 2.4.32: Village of Frankfort Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	707	100%
Occupied Housing Units	618	87.41%
Housing Units - Mobile Homes	22	3.56%
Vacant Housing Units	89	12.59%

Table 2.4.33: Village of Frankfort Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	618	-
Average Household Size	2.25	-
Households with People Under 18 Years	127	20.55%
Households with People 65+ Years	244	39.50%
Householder Living Alone 65+ Years	150	24.30%
No Vehicle Available	40	6.47%
With a Broadband Internet Subscription	505	81.72%

Table 2.4.34: Village of Frankfort Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	1,419	100%
White	1,358	95.70%
Black or African American	10	0.70%
American Indian or Alaska Native	0	0%
Asian	0	0%
Native Hawaiian or Pacific Islander	0	0%
Some Other Race (One Race)	5	0.35%
Two or More Races	44	3.10%
Hispanic or Latino (of any race)	2	0.14%

Table 2.4.35: Village of Frankfort Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	1,350	100%
English only	1,350	100%
Spanish	0	0%
Other Indo-European languages	0	0%
Asian and Pacific Island languages	0	0%
Other languages	0	0%

Table 2.4.36: Village of Frankfort Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	4.40%
$10,000 to $14,999	7.30%
$15,000 to $24,999	10.80%
$25,000 to $34,999	6.80%
$35,000 to $49,999	11.80%
$50,000 to $74,999	17.30%
$75,000 to $99,999	24.90%
$100,000 to $149,999	11.50%
$150,000 to $199,999	4.50%
$200,000 or more	0.60%
Median Household Income	$62,583
Mean Household Income	$66,446

Village of Greenfield

Tables 2.4.37 to 2.4.42 summarize the Village of Greenfield's population, housing statistics, and income statistics. There are 1,681 households of which 23.9 percent have at least one member under 18 years of age, and 37.0 percent have members 65 years and over. The largest percentage of households (17.5 percent) had an income between $50,000 to $74,999; approximately 13.0 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of Greenfield was the White (non-Hispanic) group, which makes up 90.6 percent of the population. Black or African American is the second largest race (4.9 percent). Approximately 1.5 percent of the city's population speak Spanish at home. In addition, 0.33 percent speak another Indo-European language and 0.38 percent speak an Asian and Pacific Island language.

Table 2.4.37: Village of Greenfield Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	4,047	100%
Under 18 Years	1,009	24.93%
18 to 24 Years	315	7.78%
25 to 34 Years	537	13.27%
35 to 44 Years	503	12.43%
45 to 54 Years	475	11.74%
55 to 64 Years	386	9.54%
65 Years and More	822	20.31%

Table 2.4.38: Village of Greenfield Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	1,951	100%
Occupied Housing Units	1,681	86.16%
Housing Units - Mobile Homes	27	1.61%
Vacant Housing Units	270	13.84%

Table 2.4.39: Village of Greenfield Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	1,681	-
Average Household Size	2.33	-
Households with People Under 18 Years	401	23.85%
Households with People 65+ Years	622	37.00%
Householder Living Alone 65+ Years	397	23.60%
No Vehicle Available	210	12.49%
With a Broadband Internet Subscription	1,377	81.92%

Table 2.4.40: Village of Greenfield Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	4,047	100%
White	3,666	90.59%
Black or African American	198	4.89%
American Indian or Alaska Native	0	0%
Asian	14	0.35%
Native Hawaiian or Pacific Islander	0	0%
Some Other Race (One Race)	0	0%
Two or More Races	71	1.75%
Hispanic or Latino (of any race)	98	2.42%

Table 2.4.41: Village of Greenfield Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	3,661	100%
English only	3,579	98%
Spanish	56	1.53%
Other Indo-European languages	12	0.33%
Asian and Pacific Island languages	14	0.38%
Other languages	0	0%

Table 2.4.42: Village of Greenfield Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	13.00%
$10,000 to $14,999	5.40%
$15,000 to $24,999	10.80%
$25,000 to $34,999	9.80%
$35,000 to $49,999	14.30%
$50,000 to $74,999	17.50%
$75,000 to $99,999	15.70%
$100,000 to $149,999	8.40%
$150,000 to $199,999	3.60%
$200,000 or more	1.40%
Median Household Income	$46,513
Mean Household Income	$56,905

Village of Kingston

Tables 2.4.43 to 2.4.48 Tables 2.4.43 to 2.4.48 summarize the Village of Kingston's population, housing statistics, and income statistics. There are 433 households of which 10.9 percent have at least one member under 18 years of age, and 36.5 percent have members 65 years and over. The largest percentage of households (21.0 percent) had an income between $35,000 to $49,999; approximately 8.8 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of Kingston was the White (non-Hispanic) group, which makes up 95.3 percent of the population. Two or More Races is the second largest race (4.4 percent). Approximately 0.48 percent of the city's population speak Spanish at home. In addition, 0.36 percent speak another Indo-European language and 0.61 percent speak an Asian and Pacific Island language.

Table 2.4.43: Village of Kingston Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	837	100%
Under 18 Years	116	13.86%
18 to 24 Years	28	3.35%
25 to 34 Years	121	14.46%
35 to 44 Years	66	7.89%
45 to 54 Years	167	19.95%
55 to 64 Years	123	14.70%
65 Years and More	216	25.81%

Table 2.4.44: Village of Kingston Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	528	100%
Occupied Housing Units	433	82.01%
Housing Units - Mobile Homes	42	9.70%
Vacant Housing Units	95	17.99%

Table 2.4.45: Village of Kingston Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	433	-
Average Household Size	1.93	-
Households with People Under 18 Years	47	10.85%
Households with People 65+ Years	158	36.50%
Householder Living Alone 65+ Years	90	20.80%
No Vehicle Available	20	4.62%
With a Broadband Internet Subscription	319	73.67%

Table 2.4.46: Village of Kingston Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	837	100%
White	798	95.34%
Black or African American	0	0%
American Indian or Alaska Native	0	0%
Asian	2	0.24%
Native Hawaiian or Pacific Islander	0	0%
Some Other Race (One Race)	0	0%
Two or More Races	37	4.42%
Hispanic or Latino (of any race)	0	0%

Table 2.4.47: Village of Kingston Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	826	100%
English only	814	98.55%
Spanish	4	0.48%
Other Indo-European languages	3	0.36%
Asian and Pacific Island languages	5	0.61%
Other languages	0	0%

Table 2.4.48: Village of Kingston Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	8.80%
$10,000 to $14,999	11.10%
$15,000 to $24,999	11.30%
$25,000 to $34,999	5.50%
$35,000 to $49,999	21.00%
$50,000 to $74,999	12.90%
$75,000 to $99,999	14.30%
$100,000 to $149,999	15.00%
$150,000 to $199,999	0%
$200,000 or more	0%
Median Household Income	$40,609
Mean Household Income	$54,195

Village of South Salem

Tables 2.4.49 to 2.4.54 summarize the Village of South Salem's population, housing statistics, and income statistics. There are 45 households of which 33.3 percent have at least one member under 18 years of age, and 26.7 percent have members 65 years and over. The largest percentage of households (17.8 percent) had an income between $75,000 to $99,999; approximately 8.9 percent of households had an annual income of less than $10,000. In 2023, the largest racial group in the Village of South Salem was the White (non-Hispanic) group, which makes up 95.6 percent of the population. Two or More Races is the second largest race (3.0 percent). Approximately 5.7 percent of the city's population speak Spanish at home.

Table 2.4.43: Village of South Salem Population by Age 2023 ACS 5-Year Estimates

Age	Number	Percentage
Total Population	135	100%
Under 18 Years	40	29.63%
18 to 24 Years	5	3.70%
25 to 34 Years	32	23.70%
35 to 44 Years	17	12.59%
45 to 54 Years	13	9.63%
55 to 64 Years	11	8.15%
65 Years and More	17	12.59%

Table 2.4.44: Village of South Salem Housing Statistics 2023 ACS 5-Year Estimates

Housing Statistics	Number	Percentage
Total Housing Units	58	100%
Occupied Housing Units	45	77.59%
Housing Units - Mobile Homes	1	2.22%
Vacant Housing Units	13	22.41%

Table 2.4.45: Village of South Salem Household Statistics 2023 ACS 5-Year Estimates

Household Statistics	Number	Percentage
Total Households	45	-
Average Household Size	3.00	-
Households with People Under 18 Years	15	33.33%
Households with People 65+ Years	12	26.70%
Householder Living Alone 65+ Years	5	11.10%
No Vehicle Available	0	0%
With a Broadband Internet Subscription	40	88.89%

Table 2.4.46: Village of South Salem Race and Ethnicity Statistics 2023 ACS 5-Year Estimates

Race and Ethnicity	Number	Percentage
Total Population	135	100%
White	129	95.56%
Black or African American	0	0%
American Indian or Alaska Native	0	0%
Asian	0	0%
Native Hawaiian or Pacific Islander	0	0%
Some Other Race (One Race)	0	0%
Two or More Races	4	2.96%
Hispanic or Latino (of any race)	2	1.48%

Table 2.4.47: Village of South Salem Language Spoken at Home Statistics 2023 ACS 5-Year Estimates

Language Statistics	Number	Percentage
Total Population (over 5 years old)	123	100%
English only	116	94.31%
Spanish	7	5.69%
Other Indo-European languages	0	0%
Asian and Pacific Island languages	0	0%
Other languages	0	0%

Table 2.4.48: Village of South Salem Income Statistics 2023 ACS 5-Year Estimates

Household Income Statistics	Percentage of Households
Less than $10,000	8.90%
$10,000 to $14,999	8.90%
$15,000 to $24,999	13.30%
$25,000 to $34,999	0%
$35,000 to $49,999	8.90%
$50,000 to $74,999	11.10%
$75,000 to $99,999	17.80%
$100,000 to $149,999	17.80%
$150,000 to $199,999	13.30%
$200,000 or more	0%
Median Household Income	$68,750
Mean Household Income	$77,687

3 | Planning Process

3.1 Methodology

The Planning Process chapter describes the steps involved in the development of the 2025 Ross County Hazard Mitigation Plan, including details about who participated, how community involvement was organized and promoted throughout the community, what hazards were included in the Plan and why, as well as how stakeholder involvement played a critical role in the planning process. This chapter also explains how the Core Planning Committee was formed and how member feedback contributed to the updating of the County's Hazard Mitigation Plan.

3.2 Existing Plans & Regulations

Ross County and the State of Ohio maintain several plans and tools that were pertinent to reference in the development of the 2025 Hazard Mitigation Plan, including:

- 2020 Ross County Hazards Mitigation Plan
- 2024 State of Ohio Hazard Mitigation Plan (SOHMP)
- Zoning Regulations for all Townships
- Ross County Subdivision Regulations

3.3 Ross County Authority to Adopt Plan

The Ross County Board of Commissioners are elected at large for four-year terms. The board members are the budgeting, appropriating, taxing, and purchasing authority. The Ross County Planning Commission was established by the Ross County Board of Commissioners in conformance with Section 713.21 of the Ohio Revised Code. The authority to adopt plans comes from statutory law and from Chapter 307 of the Ohio Revised Code. **Table 3.1.1** lists the existing authorities and regulations in place in Ross County and its municipalities.

Through Titles 3 and 7 of the Ohio Revised Code, the County and all municipal corporations have the authority to establish, maintain, and improve a large number of jurisdictional capabilities listed in **Table 3.3.1.** However, their ability to establish, maintain, or improve upon these capabilities vary based on their respective need, political will, and financial capacity. Compared to larger communities, smaller jurisdictions may have the same authority enabled to them by the Ohio Revised Code, but have less ability to establish, maintain, or improve these capabilities.

Table 3.1.1: Existing Authorities and Regulations in Ross County's Municipalities

Community	Planning Commission	Comprehensive Plan	Floodplain Regulation	Building Codes*	Zoning Codes	Capital Budget	Public Works Budget
Ross County	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City of Chillicothe	Yes	Yes	Yes	Yes	Yes	Yes	Limited in-kind wages only
Village of Adelphi	No	No	Yes	Yes	Yes	No	Limited in-kind wages only

Community	Planning Commission	Comprehensive Plan	Floodplain Regulation	Building Codes*	Zoning Codes	Capital Budget	Public Works Budget
Village of Bainbridge	No	No	Yes	Yes	Yes	No	Limited in-kind wages only
Village of Clarksburg	No	No	Yes	Yes	Yes	No	Limited in-kind wages only
Village of Frankfort	No	No	Yes	Yes	Yes	No	Limited in-kind wages only
Village of Kingston	No	No	Yes	Yes	Yes	No	Limited in-kind wages only
Village of South Salem	No	No	Yes	Yes	Yes	No	Limited in-kind wages only

* All jurisdictions within the state now follow the State Building Code (Ohio Administrative Code 4101:1)

3.4 Notification Process

Core Planning Committee members were invited to participate at the beginning of the planning process through a Kickoff Meeting announcement. Prior to each additional meeting, members of the Core Planning Committee were invited to participate via email notification. Representatives from the following entities were invited to participate in the planning process. Additionally, **Table 3.4.1** lists the participating jurisdictions and representatives and how they participated.

Ross County

- Ross County Auditor
- Ross County Board of Commissioners
- Ross County Board of Developmental Disabilities
- Ross Count EMA
- Ross County Engineer
- Ross County Health District
- Ross County Planning and Developmental
- Ross County Water

City and Village Members

- City of Chillicothe
- Village of Adelphi
- Village of Bainbridge
- Village of Clarksburg
- Village of Frankfort
- Village of Kingston
- Village of South Salem

Township Members

- Buckskin Township
- Colerain Township
- Concord Township
- Deerfield Township
- Franklin Township
- Green Township
- Harrison Township
- Huntington Township
- Jefferson Township
- Liberty Township
- Paint Township
- Paxton Township
- Scioto Township
- Springfield Township
- Twin Township
- Union Township

Local Schools and Universities

- Chillicothe City School District
- Paint Valley Local School District
- Southeastern Local School District

Other Organizations

- Adena Health
- American Red Cross
- Soil and Water Conservation District
- United Way of Ross County

Table 3.4.1: Participating Jurisdictions

Community/ Organization	Stakeholders	Surveys Completed				Meetings Attended		
		Goals	Hazard Priorities	Previous Mitigation Actions	New Mitigation Actions	1	2	Other
County								
Ross County	Jack Everson – Commissioner						√	
Ross County Board of Developmental Disabilities	Amy Beeler – Superintendent Jared Halm – Finance & Ops Director	√	√			√		
Ross County EMA	Mark Thompson – Director Josh Garrett – Deputy Director	√	√	√	√	√	√	
Ross County Health District	Kelly Ward – HP Director	√	√			√		
Ross County Planning and Development	Devon Shoemaker – Director	√	√		√		√	√
Ross County Water	Brad Long – GM Kayla Harmon – Chief Plant Operator Kevin Chester – Project Manager					√		
Jurisdictions								
City of Chillicothe	Nathan Prosch – Utilities Director Dean Carrol – City Engineer Jeff Carman – Safety/Service Director Brandon Gill – Chief Building Inspector		√	√	√			√
Village of Adelphi	Josh Hettinger – Mayor	√	√	√	√	√		√
Village of Bainbridge	Donald Conley – Mayor		√	√	√			√
Village of Clarksburg	Tucker Putman – Administrator		√	√	√			√
Village of Frankfort	Patti Cavender – Mayor	√	√	√	√	√		√
Village of Kingston	Eric Lloyd – Mayor		√	√	√			√
Village of South Salem	Michael Stroud - Mayor		√					√
Other								
Colerain Township	Bobbie Barron – Fiscal Officer Robert Delong – Trustee Aaron Swepston – Trustee					√	√	
Deerfield Township	Carey J. Maddux – Trustee James R. Grabill – Trustee	√	√			√		
Huntington Township	John Cottrill – Trustee				√		√	

Community/ Organization	Stakeholders	Surveys Completed				Meetings Attended		
		Goals	Hazard Priorities	Previous Mitigation Actions	New Mitigation Actions	1	2	Other
Paint Township	Dustin Lewis – Fiscal Officer	√				√		
Paxton Township	Vicky Mettler – Fiscal Officer JD Knisley – Trustee	√	√			√		
Scioto Township	Tammy J. Stotridge – Office Manager Richard Ray – Fire Chief Willard Taylor –Trustee	√	√			√	√	
Springfield Township	Chuck Schrader – Trustee	√	√		√			
Twin Township	Michael Darbyshire - President	√	√			√		
Union Township	Bryan Smith – Trustee Bob Whitten – Trustee Timothy Grimm – Fire Chief	√				√	√	

If representatives were unable to attend the virtual Core Planning Committee meetings, they participated via "Other" formats, including online surveys, as documented in **Appendix G**. The Village of South Salem did not fully participate in the planning process and will not be able to adopt the plan.

The following section details the meetings that took place during the planning process. Documentation of each meeting, including newspaper postings, email announcements and attachments, meeting materials, and completed surveys, can be found in **Appendix G**.

3.5 Meetings

Core Planning Committee Kick off

Several kickoff announcements were emailed to stakeholders on January 2, 2025, inviting them to participate in the 2025 Ross County Hazard Mitigation Plan update process as part of the Core Planning Committee. All kickoff materials were made available on the project's website (http://www.burtonplanning.com/Ross-hmp).

The Announcement outlined the following details regarding the planning process:

- Goals of the Hazard Mitigation Plan
- A summary of who is involved in the planning process
- Federal requirements of the hazard mitigation planning process
- An overview of the hazard mitigation planning process
- The proposed schedule for the Ross County Plan update
- The role of the Core Planning Committee in the update process
- Contact information for both Ross County EMA and Burton Planning Services
- Dates, times, and Microsoft Teams links of upcoming Core Planning and Public Meetings

Core Planning Meeting and Public Meeting 1

The first meetings were open to both the core planning members and the public. They were held both virtually and in-person on Friday, January 24, 2025, at 1:00 P.M and at 5:00 P.M at the Ross County

Service Center. The meetings began with a brief introduction from a Burton Planning Services (BPS) representative. This introduction included a description of the in-person and virtual engagement process, including multiple options for participants to sign into the meeting. Participants that attended virtually were reminded multiple times throughout the course of the meeting to sign in using the online survey, via the chat function, or by sending an email to the County EMA or BPS. Participants that attended in-person used the sign-in sheets for attendance. The introduction also informed attendees that they could ask questions using the chat feature, or by un-muting themselves and asking their questions at any time throughout the meeting.

A BPS representative then guided the attendees through a presentation which detailed the hazard mitigation planning process, including requirements of the planning process, potential hazards that could be addressed, benefits of hazard mitigation planning, and potential types of projects that could be federally funded because of the hazard mitigation plan. BPS also described the role that the Core Planning Committee would serve in the development of the 2025 Ross County Hazard Mitigation Plan.

A total of 24 people attended the afternoon meeting in person and five people attended virtually, including the Ross County EMA Director and Deputy Director, and representatives from the Ross County Health District, Ross County Water Department, Ross County Soil and Water Conservation District, and Ross County Board of Developmental Disabilities-Pioneer Center. The EMA directors of neighboring Jackson, Pike and Vinton Counties also attended, along with representatives of the Village of Adelphi, as well as representatives of Union, Deerfield, Scioto, Colerain, Frankfort, Paint and Paxton Townships. In addition, representatives of Adena Health, the United Way and Kenworth Truck Plant attended.

No stakeholders or members of the public attended the evening meeting. The Ross County EMA Director and Deputy Director along with representatives of BPS waited on the line for late participants for approximately 30 minutes before closing out the meeting.

Following the completion of the afternoon presentation, a BPS representative guided the attendees through three surveys detailed below. Each participant was provided with multiple methods of completing the survey, including a physical hard copy of the survey, a fillable PDF that could be completed on their computer, or an online version. Links to survey locations were provided throughout the meeting. Public input was requested using social media.

Goals Survey

The purpose of this survey was to reflect on the goals included in the 2020 Hazard Mitigation Plan to determine if they were still relevant to the 2025 Plan. Each attendee reviewed the previous goals and determined if they were still applicable, provided comments or edits to the goals that needed to be changed, and generated new goals to potentially be included in the 2025 Plan.

Discussion on the Goals Survey centered around the relevance of the goals. Attendees indicated a preference for adding a goal related to water treatment and water delivery systems. Other attendees mentioned the relevance of invasive species to the Plan.

Hazard Priority Survey

The purpose of this survey was to review all hazards that could be included in the 2025 Hazard Mitigation Plan and prioritize them. As such, attendees were asked to rate each hazard on a scale of zero to five, with five meaning the hazard poses the greatest possible threat to the County or their community and zero meaning the hazard should not be included in the 2025 Plan. Attendees rated hazards that were included in the 2025 Hazard Mitigation Plan, as well as all potential hazards that could be included in the 2025 Plan.

Following the completion of this survey, BPS guided a discussion on which hazards were deemed to be most important and which hazards attendees did not think needed to be included. As mentioned above, attendees emphasized invasive species during this part of the meeting.

Previous Mitigation Actions Status Survey

The purpose of the Previous Mitigation Actions Status Survey was to have attendees review the mitigation actions that were included in the 2020 Hazard Mitigation Plan, reflect on the status of each action, and determine if that action should be included in the 2025 Hazard Mitigation Plan.

Core Planning Meeting and Public Meeting 2

The second meetings were open to both the core planning members and the public. They were held both virtually and in-person on Friday, March 28, 2025, at 1:00 P.M and at 5:00 P.M at the Ross County Service Center. The meetings began with a brief introduction from a Burton Planning Services (BPS) representative. This introduction included a description of the in-person and virtual engagement process, including multiple options for participants to sign into the meeting. Participants that attended virtually were reminded multiple times throughout the course of the meeting to sign in using the online survey, via the chat function, or by sending an email to the County EMA or BPS. Participants that attended in-person used the sign-in sheets for attendance. The introduction also informed attendees that they could ask questions using the chat feature, or by un-muting themselves and asking their questions at any time throughout the meeting.

A BPS representative then guided the attendees through a presentation which detailed the hazard mitigation planning process, including requirements of the planning process, potential hazards that could be addressed, benefits of hazard mitigation planning, and potential types of projects that could be federally funded because of the hazard mitigation plan. BPS also described the role that the Core Planning Committee would serve in the development of the 202 Ross County Hazard Mitigation Plan.

A total of 11 people attended the afternoon meeting, including the Ross County EMA Director and Deputy Director, Ross County Commissioner, Ross County Engineer's Office, and representatives of Colerain, Scioto, Union, and Huntington Townships.

A total of 5 people attended the evening meeting, including the Ross County EMA Director and Deputy Director, Ross County Commissioner, the Hocking County EMA Director and a representative of the American Red Cross.

Following the completion of the presentation, a BPS representative guided the attendees through a survey detailed below. Each participant was provided with multiple methods of completing the survey, including a physical hard copy of the survey, a fillable PDF that could be completed on their computer, or an online version. Links to survey locations were provided throughout the meeting. Public input was requested using social media.

Hazard Mitigation Action Scoring Matrix

The purpose of this survey was to reflect on the hazard mitigation actions included in the 2020 Hazard Mitigation Plan to determine if they were still relevant to the 2025 Plan. New mitigation actions were developed for the 2025 Plan, and these actions were presented to the Core Planning Committee. Participants were asked to score the actions based on their priority for their jurisdiction. Participants were also told that the wording for the mitigation actions may be altered to better align with the needs of their communities. The remainder of the meeting functioned as a working session, where participants were able to ask questions as they completed their surveys. Once completed, the meeting was adjourned.

4 | Risk Assessments

4.1 Dam/Levee Failure

Description

FEMA defines a dam as "any artificial barrier of at least a minimum size, including appurtenant works, that impounds or diverts water or liquid-borne solids on a temporary or long-term basis." Dam failure occurs when that impounded water is suddenly released in an uncontrollable manner. A dam/levee failure can result in the uncontrolled release of floodwater downstream of a facility, resulting in a flood wave that can cause significant damage to buildings and infrastructure downstream. The unexpected nature of dam collapse also increases the likelihood of loss of life in the impacted area due to reduced warning times.

Dam infrastructure can be affected by natural hazards, such as floods or man-made threats, such as sabotage. An imbalance between a dam's age and amount of resources invested toward dam maintenance can be detrimental to the dam's condition. Maintenance issues include dam settlement and cracking, or movement of the dam's foundation. Dam failures can be caused by seepage, structural failure, or water overtopping the reservoir. Most dams in the U.S. are privately owned but regulated by the State or Federal government.

The National Flood Insurance Program (NFIP) defines a levee as "a man-made structure, usually an earthen embankment, designed and constructed in accordance with the sound engineering practice to contain, control, or divert the flow of water so as to reduce risk from temporary flooding." Levees are built parallel to waterways to reduce the risk of flood damage to neighboring infrastructure. Levee failure can occur from improper maintenance, erosion, seepage, subsidence, and when the man-made structure fails.

Common dam-related terms include:

- **Spillway**: A structure that is part of a dam or found beside a dam which allows the controlled release of water from a reservoir.
- **Outlet works:** Used to regulate or release water flow from a dam. An outlet works is a device which consists of one or more pipes or tunnels which move water through the dam.
- **Auxiliary spillway**: Also known as an emergency spillway, the auxiliary spillway is a secondary spillway only designed to operate during periods of increased water inflow or high reservoir levels.
- **Structural failure**: Caused by foundation defects such as settlement and slope instability or earthquakes.
- **Mechanical failure**: Dam failure due to malfunctioning gates, conduits, or valves.
- **Hydraulic failure**: Occurs when water overtops the dam, usually caused by inadequate spillway design, blockages in spillways, or dam crest settlement.
- **Levee System:** A flood protection system which consists of a levee or other structures, such as closure or drainage devices.

Normally, water passes through a dam via the main spillway or outlet works. During periods of increased water inflow or high reservoir levels, water should pass through an auxiliary spillway. Dam failure or partial failures are typically caused by structural, mechanical, or hydraulic failures, rather than during extreme storm events.

According to the U.S. Army Corps of Engineers (USACE), dams can be classified by their hazard potential. The three hazard potential classes are:

- **High Hazard Potential**: During the event of a dam failure loss of life is probable, which is the primary attribute for assigning this designation to a dam. Economic losses, environmental damages, and lifeline impacts are also likely, but are not required for this designation.
- **Significant Hazard Potential**: No loss of life is expected during a dam failure, but economic losses, environmental damages, and lifeline impacts are likely.
- **Low Hazard Potential**: No loss of life is expected during a dam failure and no lifeline impacts are expected. Environmental damages and economic losses are expected to be limited to the dam owner's property.

Location

Dam properties of High to Low Hazard Potential are listed in **Table 4.1.1.** The status of each dam's Emergency Action Plan as of March 9, 2025, is indicated in the table (Source: USACE). Dam locations can be seen in **Figure 4.1.2**.

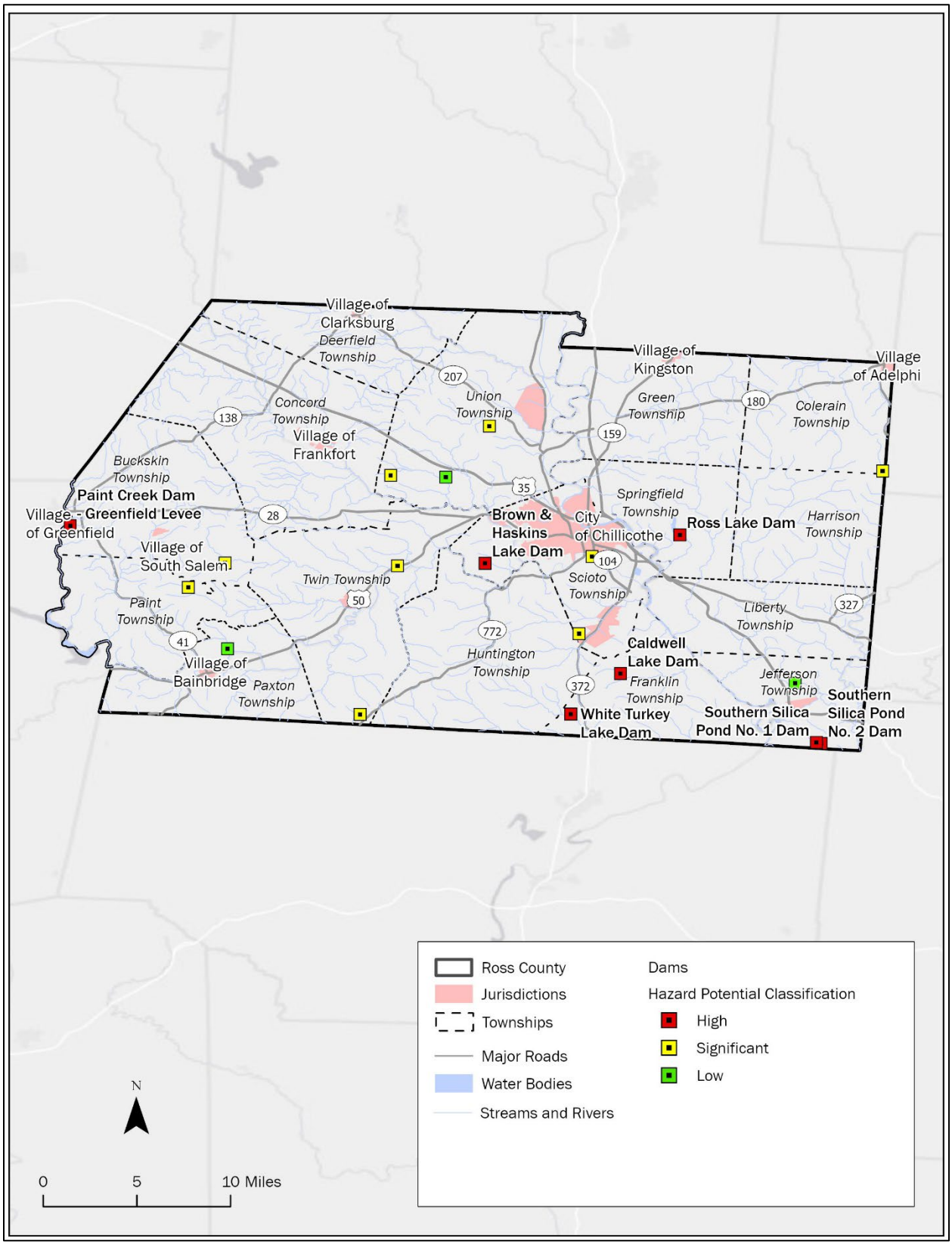
Table 4.1.1: Dam Properties in Ross County, Ohio

Hazard Potential Classification	Dam Name	Owner Type	Distance to Nearest City (Miles)	Condition Assessment	EAP Prepared
High	Brown & Haskins Lake Dam	Private	2.7	Satisfactory	No
High	Caldwell Lake Dam	State	3.3	Satisfactory	Yes
High	Paint Creek Dam - Greenfield Levee	Federal	Unknown	Not Available	Yes
High	Ross Lake Dam	State	2.3	Poor	Yes
High	Southern Silica Pond No. 1 Dam	Private	9	Unsatisfactory	No
High	Southern Silica Pond No. 2 Dam	Private	9	Poor	No
High	White Turkey Lake Dam	Private	1.3	Satisfactory	Yes
Significant	Christian Union Church Lake Dam	Private	5.9	Fair	No
Significant	Hutchison Lake Dam	Private	10	Fair	No
Significant	Knoles Pond Dam	Private	1.3	Satisfactory	Yes
Significant	Lake Royal Dam	Private	13.6	Satisfactory	No
Significant	Leeth Lake Dam	Private	7.6	Poor	No

Hazard Potential Classification	Dam Name	Owner Type	Distance to Nearest City (Miles)	Condition Assessment	EAP Prepared
Significant	Luehrs Lake Dam	Private	6.5	Poor	No
Significant	Pine Lake Dam	State	14	Satisfactory	No
Significant	Pixelle Upground Reservoir	Private	6.4	Poor	No
Significant	Rustic Acres Lake Dam	Private	7.5	Poor	No
Low	Lake Royce Dam	Private	1.5	Poor	No
Low	Sun Valley Lake Dam	Private	1.3	Fair	Yes
Low	Valley Vista Golf Course Lake Dam	Private	7.4	Fair	No

Source: U.S. Army Corps of Engineers

Figure 4.1.2: Dam Locations in Ross County, Ohio



Extent

The Hazard Priority dam classification system considers the effects of dam failure or mismanagement during both normal and flood flow conditions, as well as worst-case-scenario situations. Dam classification may decrease with physical modifications to the dam or by eliminating downstream infrastructure. The classifications are justifiable, reasonable, and consistent with the federal guidelines for dam safety. The hazard potential classification may change depending on anticipated consequences of a dam failure, such as new development below a dam or within the dam breach floodplain. Hazard potential classification may decrease with physical modifications to the dam or by eliminating downstream infrastructure.

There are seven High Hazard dams in Ross County Brown & Haskins Lake Dam, Caldwell Lake Dam, Paint Creek Dam - Greenfield Levee, Ross Lake Dam, Southern Silica Pond, No. 1 Dam, Southern Silica Pond No. 2 Dam, and White Turkey Lake Dam. Sudden failure of High Hazard dams could result in one of the following outcomes, depending on environmental conditions.

- Loss of human life.
- All items listed below for failure of Significant Hazard Potential Dams.

Sudden failures of Significant Hazard dams could result in at least one of the following conditions:

- Disruption of a public water supply or wastewater treatment facility, release of health hazardous industrial or commercial waste, or other health hazards.
- Flooding of residential, commercial, industrial, or publicly-owned structures.
- Flooding of high-value property.
- Damage or disruption to major roads including, but not limited to, interstate and state highways and the only access to residential or other critical areas such as hospitals, nursing homes, or correction facilities as determined by the chief.
- Damage or disruption to railroads or public utilities.
- Damage to downstream dams or levees. Damage to dams or levees can include, but is not limited to, overtopping of the structure. At the request of the dam owner, the chief may exempt dams from the criterion of this paragraph if the dam owner owns the potential affected property.
- Damage or disruption to local roads including, but not limited to, roads not otherwise listed as major roads.
- Damage to agricultural crops and livestock.

Sudden failures of Low Hazard dams could result in property losses restricted mainly to the dam and rural lands, and the loss of human life is not probable.

History

On October 10, 2017, White Turkey Lake Dam had a non-failure incident caused by a downstream sinkhole. The dam owner, a private entity, responded immediately by siphoning water out of the related lake. The incident was resolved within one week without causing a dam failure.

Probability

Dam failures are unlikely but not impossible. All dams, especially High and Significant Hazard Potential Dams, should have an Emergency Action Plan (EAP) in place. In addition, aging dam infrastructure coupled with climate change could result in more frequent dam failures. The Climate Change section in Future Trends discusses climate change further.

Dam conditions can provide insight into how likely it is that a dam will fail. The U.S. Army Corps of Engineers defines dam conditions as follows:

Satisfactory

No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the minimum applicable state or federal regulatory criteria or tolerable risk guidelines.

- No existing deficiencies or potentially unsafe conditions are recognized, with the exception of minor operational and maintenance items that require attention.
- Safe performance is expected under all loading conditions including the design earthquake and design flood.
- Permanent risk reduction measures (reservoir restrictions, spillway modifications, operating procedures, etc.) have been implemented to eliminate identified deficiencies.

Fair

No existing dam safety deficiencies are recognized for normal operating conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action. Note: Rare or extreme events are defined by the regulatory agency based on their minimum applicable state of federal criteria.

- Lack of maintenance requires attention to prevent developing safety concerns.
- Maintenance conditions may exist that require remedial action greater than routine work and/or secondary studies or investigations.
- Interim or permanent risk reduction measures may be under consideration.

Poor

A dam safety deficiency is recognized for normal operating conditions which may realistically occur. Remedial action is necessary. 'Poor' may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Investigations and studies are necessary.

- Dam has multiple deficiencies or a significant deficiency that requires remedial work.
- Lack of maintenance (erosion, sinkholes, settlement, cracking, unwanted vegetation, animal burrows, inoperable outlet gates) has affected the integrity or the operation of the dam under normal operational conditions and requires remedial action to resolve.
- Critical design information is needed to evaluate the potential performance of the dam. For example, a field observation or a review of the dam's performance history has identified a question that can only be answered by review of the design and construction history for the dam. Uncertainty arises when there is no design and/or construction documentation available for review and additional analysis is needed to better understand the risk associated with operation under normal operational conditions.
- Interim or permanent risk reduction measures may be under consideration.

Unsatisfactory

A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

- A critical component of the dam has deteriorated to unacceptable condition or failed.
- A safety inspection indicates major structural distress (excessive uncontrolled seepage, cracks, slides, sinkholes, severe deterioration, etc.), advanced deterioration, or operational

deficiencies which could lead to failure of the dam or its appurtenant structures under normal operating conditions.
- Reservoir restrictions or other interim risk reduction measures are required.
- A partial or complete reservoir drawdown may be mandated by the state or federal regulatory agency.

The State of Ohio Dam Safety Program focuses on deficient Class I dams (High Hazard Potential Dams) and dams in poor condition. Two of the seven High Hazard Potential Dams (HHPDs) in Ross County meet these conditions: Ross Lake Dam and Southern Silica Pond No. 2 Dam, which are both in poor condition. Southern Silica Pond No. 2 Dam does not have an EAP in place.

Vulnerability Assessment

Infrastructure Impact

Failures of Significant Hazard Potential Dams could flood roadways, including major routes and local roads. Utility infrastructure (wastewater, drinking water, and commercial and industrial waste lines) may be disrupted or destroyed.

Population Impact

The local population could be impacted by loss of utilities, including the local water supply. Health hazards may also be released into the flood waters during a dam failure which may cause indirect harm to the local population. The local population could be impacted economically as well.

For social vulnerability, dam failure is not in the National Risk Index as it is not a natural disaster. However, natural disasters like flooding can occur due to or because of dam failure the National Risk Index, “riverine flooding” had a score of 73.9 (“Relatively Low”). People that are most vulnerable to flooding are those who live within the 100-year floodplain in structures that are not elevated about the base flood elevation. The index indicates an expected annual loss of $1,159,188 due to flooding events with 2.4 events occurring per year.

Property Damage

At least one residential or commercial property is likely to face structural collapse during a High Hazard Potential Dam failure. Dam failure has the potential to damage high value properties. Residential, commercial, industrial, and/or high value properties may be damaged by a Significant Hazard Potential Dam failure, as well as publicly owned properties. Properties that are owned by the dam owner may be exempt from the property damage calculation.

Loss of Life

Loss of life because of a High Hazard Potential Dam failure is likely. Loss of life during a Significant or Low Hazard Potential Dam failure is not expected.

Economic Losses

Economic losses can include damage from flooding crops, flooding livestock, damaged goods, and the flooding of vital roadways.

Emergency Action Plans (EAPs) have been completed for all but four of the dams in the County (**Table 4.1.1**); however, the data is subjected to agreements where it cannot be published publicly. The Ohio Department of Natural Resources (ODNR) holds a record of these EAPs.

Future Trends

Land Use and Development Trends

Development that has occurred in areas that will flood after a dam failure should be prepared for rapid flooding. Land use plans can limit development in these areas to prevent the increase of dam hazard potential. To better understand where development should be limited, dam failure inundation maps

should be completed for as many dams as possible. If new residential construction units are within the inundation/breach areas of dams, it would increase property and population vulnerabilities despite county-wide population loss.

The current total value of taxable real estate in Ross County is $1,631,861,800. In 2022 and 2023, Ross County authorized 41 new residential units at a total value of $11,777,000. The population is expected to decrease by 4.1 percent, or 3,182 people between 2020 and 2030. An additional decrease of 5.3% is expected between 2030 and 2040. Given these estimates, there are no known significant changes in risks associated with dam failures.

Climate Change

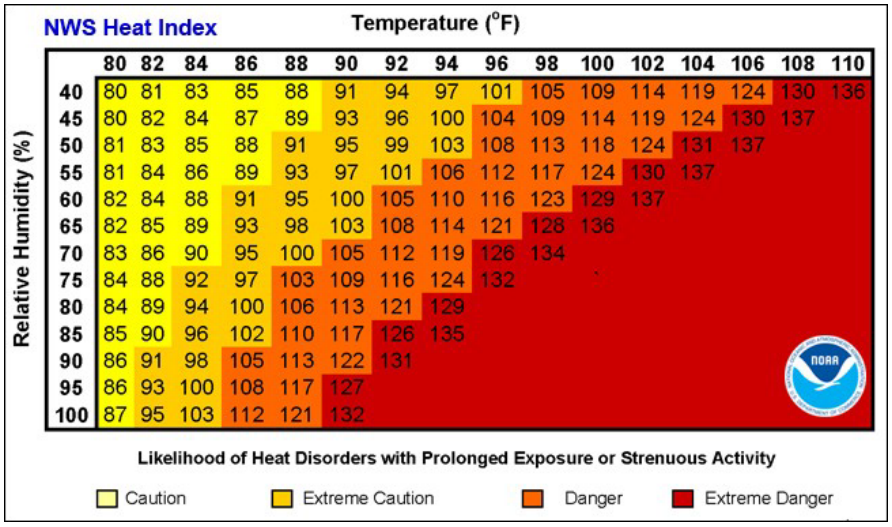
Climate change may increase the frequency and/or the severity of the impacts from a dam failure event. Climate change is having an uneven effect on precipitation (rain and snow) in the U.S. – some areas are experiencing increased precipitation and flooding, while others suffer from drought. If Ross County experiences effects of climate change related to heavy rainfall, more frequent and severe flooding could occur, which could lead to or be caused by dam failure. Aging dam infrastructure coupled with climate change could result in more frequent dam failures. According to the 2018 National Climate Assessment, dams and levees can fail after moderate or extreme rainfall. If Ross County experiences the effects of climate change related to more frequent droughts, dams and levees can be compromised because of the ground cracking due to drying, reduced soil strength, erosion, and subsidence. As drought or precipitation frequency and intensity increase with climate change, the probability and severity of dam failure may increase as well, especially if this infrastructure is not maintained, upgraded, or, if necessary, redesigned.

4.2 Drought and Extreme Heat

Description

According to the Federal Emergency Management Agency (FEMA), extreme heat is a period of high heat and humidity with temperatures above 90 degrees for at least two to three days. In extreme heat the human body works extra hard to maintain a normal temperature, which can lead to death. Extreme heat is responsible for the highest number of annual deaths among all weather-related hazards. Humid conditions, which add to the discomfort of high temperatures, occur when a high-pressure weather system traps hazy, moist air near the ground. Extreme heat may also contribute to the formation of a drought if moisture and precipitation are lacking. The National Weather Service's Heat Index Chart is provided in **Figure 4.2.1**.

Figure 4.2.1: Heat Index Chart



Source: National Weather Service

Extreme heat events are often accompanied by drought conditions when the events are prolonged. A drought is a shortage in precipitation over an extended period of time. Droughts are common throughout all climatic zones and can range in length from a couple of weeks to multiple years or decades in some areas. The longest drought in Ross County was in 2012 and lasted 30 weeks.

According to the National Oceanic and Atmospheric Administration (NOAA), there are three common types of droughts: Meteorological, Agricultural, and Hydrological. Meteorological drought severity is calculated by the amount of the rainfall deficit (compared to annual averages) and the length of the dry period. Agricultural drought is based on the effects to agriculture by factors such as rainfall and soil water deficits or diminished groundwater/reservoir levels needed for irrigation. Hydrological drought is based on the effects of rainfall shortages on the water supply, such as stream flow, reservoir and lake levels, and groundwater table decline.

Location

Drought is a countywide hazard that can affect all locations and jurisdictions in Ross County. More specifically, these hazards typically occur at a regional scale. Droughts most commonly occur in Ohio from spring through autumn; however, they may occur at any time throughout the year.

Extent

Due to the regional nature of droughts and extreme heat events, effects may be noticed throughout the County in both the urbanized and rural areas. All jurisdictions within the County may be affected in

a single drought event. In Ross County, droughts are often linked to prolonged periods of above average temperatures and little to no precipitation.

Initial effects of drought can be noticed within a short period, as soil may dry out and plants may wither and die. When drought conditions persist over several weeks, months, or years, effects may be more pronounced with reductions in water levels of wells, lakes, reservoirs, streams, and rivers. Water supply issues for agriculture, commercial/industrial activities, and private consumption may arise if drought conditions persist over a long term.

The extent of the drought is determined by the Palmer Drought Severity Index (PDSI), shown below in **Table 4.2.2**. In this way, the Index can be utilized as a tool to help define disaster areas and indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and potential for forest fires. The Palmer Drought Severity Index depicts prolonged (in months or years) abnormal dryness or wetness and is slow to respond, changing little from week to week. It also reflects long-term moisture runoff, recharge, and deep percolation, as well as evapotranspiration.

Table 4.2.2: Palmer Drought Severity Index Classifications and Federal Drought Categories

Palmer Drought Severity Index	Category	Description
-1.0 to -1.9	D0	Abnormally Dry
-2.0 to -2.9	D1	Moderate Drought
-3.0 to -3.9	D2	Severe Drought
-4.0 to -4.9	D3	Extreme Drought
-5.0 or less	D4	Exceptional Drought

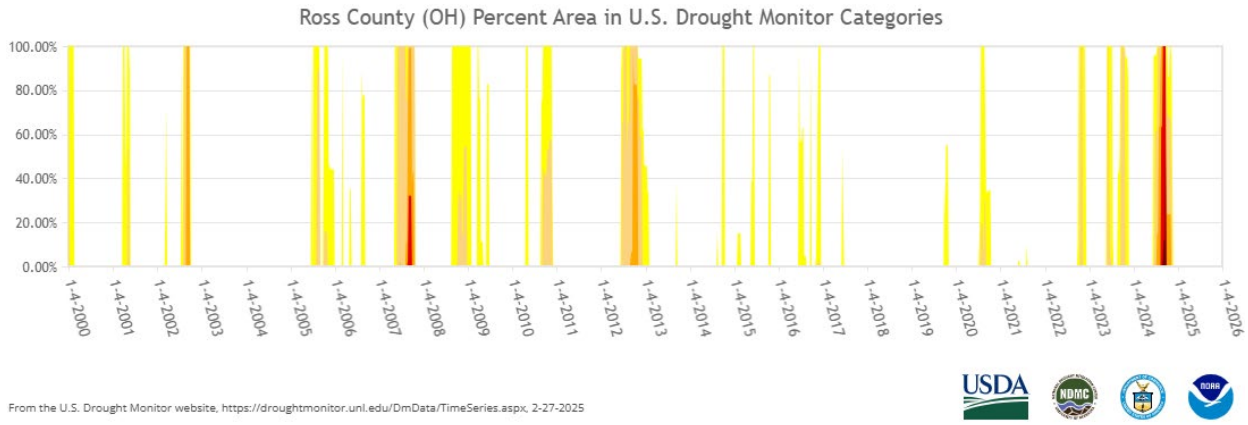
The Palmer Drought Severity Index is a standardized index with values typically falling between -4.0 and +4.0, although extreme conditions can be greater in value (including federal drought categories). Negative values indicate drought conditions while positive values represent wet conditions. Values around zero represent near normal conditions.

Abnormally dry (D0) and moderate drought (D1) conditions occur frequently and typically do not adversely affect agricultural activities unless conditions are sustained in nature. Severe and extreme drought (D2 and D3, respectively) conditions begin to impact agricultural crops, leading to potential economic losses. These more severe events also may impact drinking water resources, especially if the source is a lake or reservoir. Sustained severe droughts may alter the ability of the soil to absorb water, leading to potential flash flooding when rainfall resumes.

History

U.S. Drought Monitor (USDM) describes severe drought as a time when crops suffer, the numbers of wildfires are high and the soil is dry, cracked and pulling away from foundations. In an extreme drought, yields are minimal, livestock are stressed, and lawns go dormant. Data shows that Ross County has spent 282 weeks in abnormally dry conditions, 137 weeks in moderate drought, 42 weeks in severe drought, 13 weeks in extreme, and four weeks in exceptional drought since 2000. **Figure 4.2.3** depicts the drought monitor history for Ross from 2000 through February 2024. The most extensive periods of moderate drought specific to Ross County are provided in **Table 4.2.4** (Source: U.S. Drought Monitor).

Figure 4.2.3: Drought in Ross County from 2000 to 2024



D0 = Abnormally Dry, D1 = Moderate Drought, D2 = Severe Drought, D3 = Extreme Drought, D4= Exceptional Drought

Source: U.S. Drought Monitor

Table 4.2.4: Periods of Moderate Drought in Ross County, Ohio, 2000-2024

Start Date	End Date	# of Consecutive Weeks
6/25/2024	11/12/2024	21
9/26/2023	10/24/2023	5
6/6/2023	7/4/2023	5
10/25/2022	11/8/2022	3
7/28/2020	9/1/2020	6
11/15/2016	12/6/2016	4
6/26/2012	1/15/2013	30
9/14/2010	11/23/2010	11
10/14/2008	12/23/2008	11
6/5/2007	10/23/2007	21
10/11/2005	11/1/2005	4
8/9/2005	8/30/2005	4
8/13/2002	9/24/2002	7
5/8/2001	5/15/2001	2
1/4/2000	1/18/2000	3

Source: U.S. Drought Monitor

Severe, Extreme, and Exceptional Drought

There have been four severe drought events, two extreme drought events, and one exceptional drought event in Ross County since January 1, 2020. There was one additional drought in 1999, according to NOAA, that caused extensive crop damage. Each drought is described in more detail below.

Severe, Extreme, and Exceptional Drought (D2 – D4), July to November 2024:

In June 2024, 95 percent of Ross County was experiencing abnormally dry conditions and five percent of the County was experiencing moderate drought conditions. Minimal rainfall across Ohio exacerbated drought conditions. On July 16, 2024, 15 percent of Ross County started experiencing moderate drought conditions. The moderate drought conditions spread across Ross County and by August 20, 2024, 100 percent of the County was experiencing moderate drought conditions and 63 percent was experiencing extreme drought conditions. The extreme drought worsened and by September 3, 2024, 100 percent of the County was in severe drought and four percent was in exceptional drought. The Board of Commissioners declared a local emergency due to the exceptional drought in September 2024. After four weeks in exceptional drought, the drought conditions went back down to severe drought and then ended in late November 2024. The drought lasted a total of 23 weeks.

Severe Drought (D2), August 2012 – October 2012:

In June 2012, 100 percent of Ross County was experiencing abnormally dry conditions and 65 percent of the County was experiencing moderate drought conditions. Minimal rainfall across Ohio exacerbated drought conditions. Drought conditions persisted throughout July and on August 08, 2012, 0.07 percent of Ross County was in a severe drought. The severe drought worsened each week and on September 25, 2012, 97.5 percent of the County was in a severe drought. The majority of Ross County stayed in severe drought conditions through the beginning of November 2012 before going back to moderate drought. The County stayed in abnormally dry and moderate drought through January 2013. The drought lasted 30 weeks.

Severe and Extreme Drought (D2 – D3), June 2007 – October 2007

In June 2007, 100 percent of Ross County was experiencing abnormally dry and moderate drought conditions. Minimal rainfall across Ohio exacerbated drought conditions. Moderate drought conditions persisted throughout June and July. On August 14, 2007, 11.07 percent of Ross County was in a severe drought. The severe drought worsened each week and on August 28, 2007, 2.47 percent of the County was in an extreme drought. The County spent 10 weeks in severe drought, with seven of those weeks having portions of the County in extreme drought. The drought lasted through the end of October 2007 and lasted for 21 weeks.

Severe Drought (D2), August 2002 – September 2002

In August 2002, 100 percent of Ross County was experiencing abnormally dry and moderate drought conditions. On September 3, 2002, 100 percent of the County was in severe drought. The drought lasted for seven weeks, ending on September 30, 2002. Four of the seven weeks were in severe drought.

Drought (D2 – D3), July 1999 – September 1999

Very little rain occurred in Spring 1999, creating abnormally dry conditions. These conditions continued throughout the summer with only inches of precipitation occurring. Water restrictions were put in place for most of the state and several other states. Most of the east coast experienced moderate to extreme drought conditions. Up to 50 percent of crops were lost. The exact numerical value of crop loss was not reported.

Extreme Heat

There have been two heat events in Ross County since January 1, 1995. All events are listed individually in **Appendix A**.

Heat Event, June 28 through July 7, 2012:

High temperatures in the 90's across Ross County were reported for the last week of June 2012. The County was already experiencing widespread power outages due to the June 29 derecho, when temperatures rose. Temperatures continued to stay elevated through mid-July.

Excessive Heat Event, July 19 through July 31, 1999:

High temperatures in the 90's across Ross County and northern Ohio were recorded for the month of July 1999. Several counties reported temperatures in the 100's.

Probability

Ross County has experienced droughts in the past, and the potential exists for the County to experience droughts in the future. Ross County has had 21 drought events since 2000, including abnormally dry. Ross County has an 88 percent chance of having a drought and/or experiencing abnormally dry conditions each year based on historical data. Ross County had two heat events between 1995 and 2012. Ross County has a low chance of having a heat event each year based on historical data.

Seasons of drought and extreme heat have the potential to occur during any particular year when necessary conditions are met. According to the Midwest Chapter of the Fifth National Climate Assessment, the frequency of major heat waves in the Midwest has increased over the last six decades. In addition, it is predicted that as the climate gets warmer, there will be an associated increase in the number and severity of summer droughts and extreme heat events. The Climate Change section in Future Trends discusses climate change further.

Vulnerability Assessment

Drought projections suggest that some regions of the U.S. will become drier and that most will have more extreme variations in precipitation. Even if current drought patterns remain unchanged, warmer temperatures will amplify drought effects. Drought and warmer temperatures may increase risks of large-scale insect outbreaks and wildfires, in addition to accelerating tree and shrub death and changing habitats and ecosystems in favor of drought-tolerant species. Forest and rangeland managers can mitigate some of these impacts and build resiliency in forests through appropriate management actions.

Infrastructure Impact

Drought does not have a significant impact on infrastructure or structures. The greatest impacts of drought are on agricultural interests, as crops may fail, and livestock may not have sufficient water resources. For social vulnerability, the FEMA National Risk Index indicates that the agricultural (crop only) in Ross County has a score of 35.0 (very low). This risk is only based on agricultural impacts and not population impact. The index indicates an expected annual loss of $28,000 due to drought events with 0.2 events occurring per year.

Population Impact

Extreme heat can have an impact on the population of the entire County. Groups who live in areas with minimal tree cover or urban areas may experience higher temperatures relative to outlying areas due to the urban heat island effects. Groups that are particularly vulnerable to extreme heat, such as older adults and people with chronic health conditions may experience illness or injury, such as heat cramps, heat exhaustion, and heat stroke.

For social vulnerability, the National Risk Index indicates that the population in Ross County has a score of 68.6 ("relatively low") for heat wave. The index indicates an expected annual loss of $225,000 due to heat wave events with 0.9 events occurring per year.

Property Damage

During extreme heat events, utility failure may occur due to overuse of electricity for cooling. Property damage is a possibility due to extreme heat. Vehicles are at risk of breaking down from excessive heat, as heat can reduce battery life and reduce the efficiency of the cooling system resulting in overheated engines. Extreme heat can also cause a home to dry out and prematurely age. Excessive heat in combination with lack of rainfall (drought) can cause soil to shrink and crack, which puts stress on a home's foundation that can be costly to fix. Drought and warmer temperatures may increase risks of large-scale insect outbreaks and wildfires. Drought and warmer temperatures may also accelerate tree and shrub death, changing habitats and ecosystems in favor of drought-tolerant species.

Table 4.2.5 summarizes expected annual losses (EAL) for buildings, expected annual loss for population equivalence (EALPE) in Ross County, and the expected annual loss for agriculture (EALA) for the census tracts according to FEMA's National Risk Index. The census tracts are listed most vulnerable to least vulnerable.

Table 4.2.5: Structure and Population Vulnerability from Heat Wave

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955604	$25	$19,916	$162	$20,102
39141955500	$33	$17,603	$590	$18,225
39141955700	$27	$16,142	$1,006	$17,175
39141956800	$22	$16,834	$96	$16,952
39141956000	$23	$15,865	$8	$15,895
39141956600	$23	$14,670	$239	$14,932
39141956700	$21	$13,687	$446	$14,154
39141955603	$17	$11,566	$1,242	$12,825
39141955801	$22	$12,349	$299	$12,670
39141956900	$20	$12,335	$295	$12,650
39141955900	$20	$12,257	$50	$12,328
39141955802	$13	$11,128	$54	$11,195
39141956500	$40	$10,880	$42	$10,961
39141956100	$19	$10,105	$0	$10,124
39141956400	$13	$9,588	$0	$9,601
39141956300	$64	$8,799	$43	$8,906
39141956200	$11	$6,589	$0	$6,600
Grand Total	**$411**	**$220,312**	**$4,573**	**$225,296**

Source: FEMA National Risk Index

Loss of Life

Loss of life is possible during drought and extreme heat events, especially for young children, the elderly, and individuals with respiratory conditions.

Economic Losses

Economic losses are a threat from extreme heat and droughts in Ross County. Crops and livestock may be compromised during prolonged extreme heat events. Human productivity can also be affected when working conditions become too hot. According to the 2022 Census of Agriculture developed by the U.S. Department of Agriculture (USDA), top crop items based on acreage for Ross County include soybeans for beans, corn for grain, wheat for grain, forage-land used for all hay and haylage, and corn for silage/greenchop (animal feed). Based on data from the U.S. Department of Agriculture, Ross County's crop yields may have been impacted from previous drought events. Acreage farmed for Corn (Grain and Silage/Greenchop), Hay & Haylage, and Soybeans increased, while acreage for wheat decreased between 2017 and 2022. Yield per acre decreased in 2022 versus 2017 for all crops except Hay & Haylage and Soybeans (**Table 4.2.6**). Corn for Silage/Greenchop had the largest yield decrease per acre (-3.4 tons/acre or -18 percent). Agricultural land use can be seen on the land use map in Chapter 1 (**Figure 1.2.1).**

Table 4.2.6: Ross County Crop Yields 2017 - 2022

Commodity	2017		2022	
	Acres	Crop Yield	Acres	Crop Yield
Corn, Grain	46,351	8,312,395 bushels	58,401	10,115,271 bushels
Hay & Haylage	15,143	17,929 tons	15,659	35,316 tons
Soybeans	63,869	3,264,981 bushels	73,605	3,865,585 bushels
Wheat	8,163	619,940 bushels	6,721	456,316 bushels
Corn, Silage/Greenchop	812	17,929 tons	955	17,832 tons

Source: United States Department of Agriculture Census

Future Trends

Land Use and Development Trends

Drought and extreme heat are most likely to impact agriculture land uses and land uses that house or serve vulnerable populations, such as schools, daycares, hospitals, and nursing homes. Less people can mean generally less people vulnerable to extreme heat/drought events. However, the increase of people aged 65+ from 2017 (11,882) to 2023 (13,233) could mean more vulnerability to Extreme Heat for that population group. Increase of agricultural land use, crop yields, and livestock cash receipts can mean more vulnerability to drought in those areas.

Climate Change

Climate change may increase the frequency and/or the severity of the impacts from drought and extreme heat events. As the climate gets warmer, there will be an associated increase in the number and severity of droughts and extreme heat events. Warmer global temperatures may be associated with a prolonged growing season, but this trend may also increase the risk of crop stress due to excessive heat and crop damage due to increased pests and disease. The longer growing season may help some crops but crops like corn and soybean will be negatively affected by the severe heat in the summer, which will decrease these crops' yields. Additionally, increased frequency and severity may negatively impact infrastructure. For example, dams and levees may be compromised after a prolonged drought if drying, reduction of soil strength, erosion, subsidence, or ground cracking occurs.

Climate change is expected to increase the occurrence and duration of heat waves in the coming decades.

4.3 Earthquakes

Description

Earthquakes are sudden and rapid movements of the Earth's crust and are caused by the abrupt shifting of rocks deep underneath the earth's surface. These movements vary in length and may last from a few seconds to several minutes.

The seismicity, or seismic activity, of an area refers to the frequency, type, and size of earthquakes experienced over time. Earthquakes are measured using observations from seismometers. The Moment Magnitude Scale (MMS), which was developed in the 1970's, is the most common scale on which earthquakes larger than approximately 5.0 in magnitude are reported for the entire world. Earthquakes smaller than magnitude 5.0, which are more numerous, are reported by national seismological observatories and measured most on the local magnitude scale – also referred to as the Richter Scale. These two scales are numerically similar in their range of validity. Earthquakes of magnitude 3.0 or lower are often almost imperceptible or weak, while earthquakes of magnitude 7.0 or greater can potentially cause serious damage over larger areas.

Damage from an earthquake also depends on the earthquake's depth in the Earth's crust. The shallower an earthquake's epicenter, the more damage to structures it will cause. Alternatively, an earthquake can also be measured by its intensity. The Modified Mercalli Intensity Scale (MMI) ranges in value I to XII, in roman numerals (**Table 4.3.1**).

Earthquakes can happen anywhere without warning; they are low-probability, high-consequence events. Most major earthquakes in the U.S. have occurred in California as well as in Alaska, Hawaii, Oregon, Puerto Rico, Washington, and the entire Mississippi River Valley. There have been recorded earthquakes throughout the U.S., and the Ohio River Valley has experienced earthquakes exceeding the 3.0 magnitude within the last 25 years.

Location

Earthquakes are countywide hazards and can affect all areas and jurisdictions within Ross County. According to the Ohio Department of Natural Resources (ODNR), Ohio is located on the periphery of the New Madrid Seismic Zone, an area in and around Missouri that was the site of the largest earthquake sequence to occur in the country in the 1800's. Additionally, seismic activity is concentrated in the western Ohio region known as the *western Ohio seismic zone* (also referred to as the *Fort Wayne (Anna) seismogenic zone*), where more than 40 earthquakes have been felt since 1875.

There is an unnamed fault line in Ross County, which is located in the northwest corner stretching into Pickaway and Fayette Counties. The fault is a Precambrian fault and is known, meaning it is verified (**Figure 4.3.2**).

Extent

Earthquakes pose a risk to life and property depending on severity. To monitor earthquakes, the State of Ohio and the ODNR Division of Geological Survey coordinates a 29-station network (**Figure 4.3.3**) of seismograph stations throughout the state to continuously record earthquake activity. The Ohio Seismic Network (OhioSeis) stations are distributed across the state but are concentrated in the most seismically active areas or in areas that provide optimal conditions for detecting earthquakes. While the seismic network cannot predict earthquakes or provide an alert prior to an event, it can provide insight into earthquake risks in the state so that intelligent decisions about building and facility design and construction, insurance coverage, and other planning decisions can be made by individuals, business and industry, and governmental agencies.

According to the ODNR, there is one Ohio Seismic Network monitoring station in Ross County and one in the neighboring county, Jackson County.

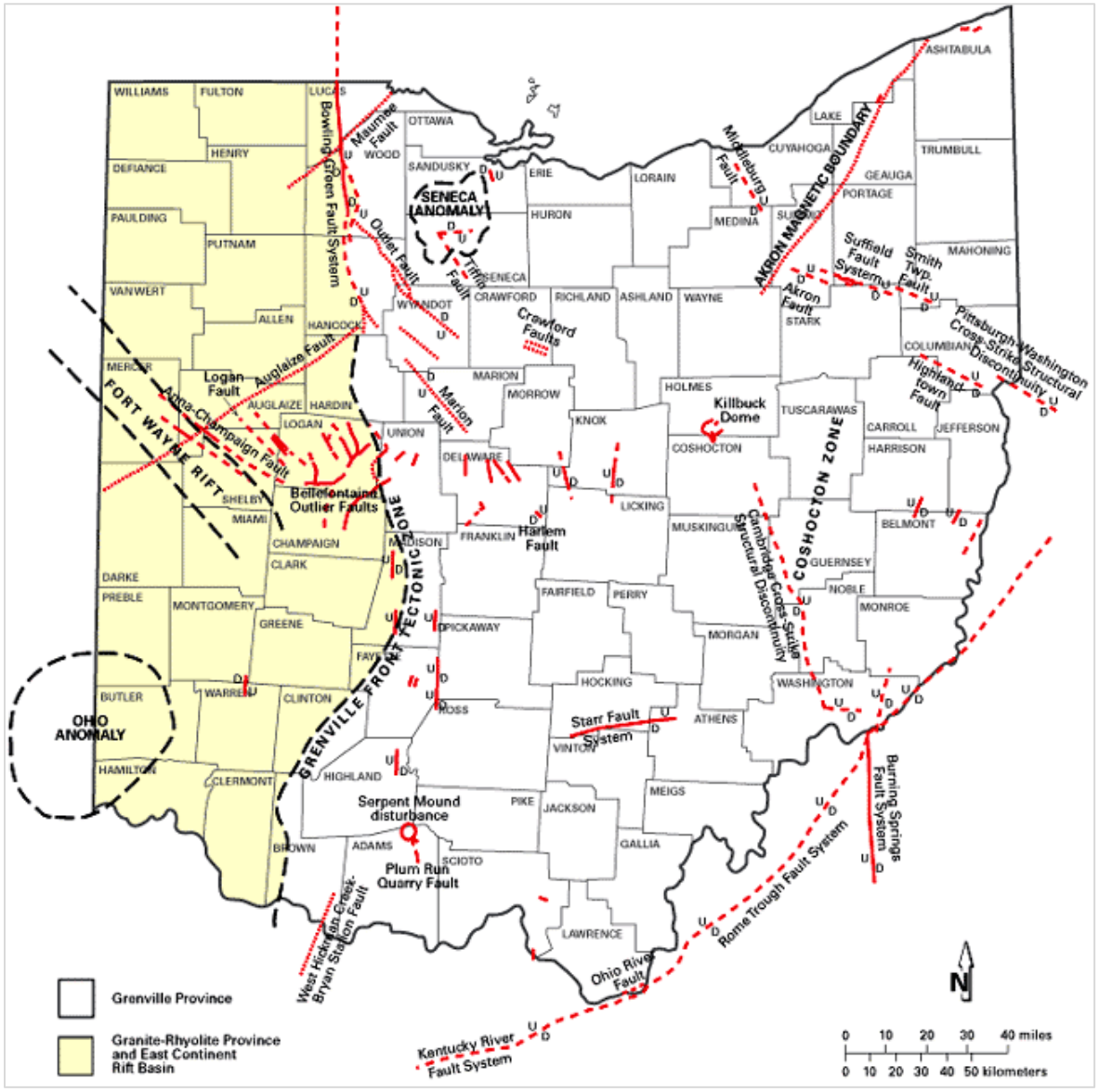
Earthquakes can yield a variety of different outcomes. With the ground shaking associated with earthquake events, buildings have a high potential to be impacted. If soil liquefaction, or the mixing of sand and soil with groundwater occurs, buildings can sink into the ground. Earthquakes also have the potential to rupture dams or levees along a river, resulting in flooding and even tsunamis (see Dam Failure section). Earthquakes can cause landslides or avalanches in high-risk areas and can cause mines to subside. Furthermore, earthquakes that break gas and power lines can result in fires.

Table 4.3.1: Modified Mercalli Intensity Scale

Modified Mercalli Intensity Scale		Magnitude
I	Detected only by sensitive instruments.	1.5
II	Felt by few persons at rest, especially on upper floors; delicately suspended objects may swing.	2
III	Felt noticeably indoors, but not always recognized as earthquake; standing autos rock slightly, vibrations like passing truck.	2.5
IV	Felt indoors by many, outdoors by few, at night some awaken; dishes, windows, doors disturbed; standing autos rock noticeably.	3
V	Felt by most people; some breakage of dishes, windows, and plaster; disturbance of tall objects.	3.5
VI	Felt by all, many frightened and run outdoors, falling plaster and chimneys, damage small.	4
VII	Everybody runs outdoors; damage to buildings varies depending on quality of construction; noticed by drivers of autos.	4.5
VIII	Panel walls thrown out of frames; walls, monuments, chimneys fall; sand and mud ejected; drivers of autos disturbed.	5
IX	Buildings shifted off foundations, cracked, thrown out of plumb; ground cracked; underground pipes broken.	5.5
X	Most masonry and frame structures destroyed; ground cracked, rails bent, landslides.	6
XI	Few structures remain standing; bridges destroyed, fissures in ground, pipes broken, landslides, rails bent.	6.5
XII	Total damage; waves seen on ground surface, lines of sight and level distorted, objects thrown up into air.	7 7.5 8

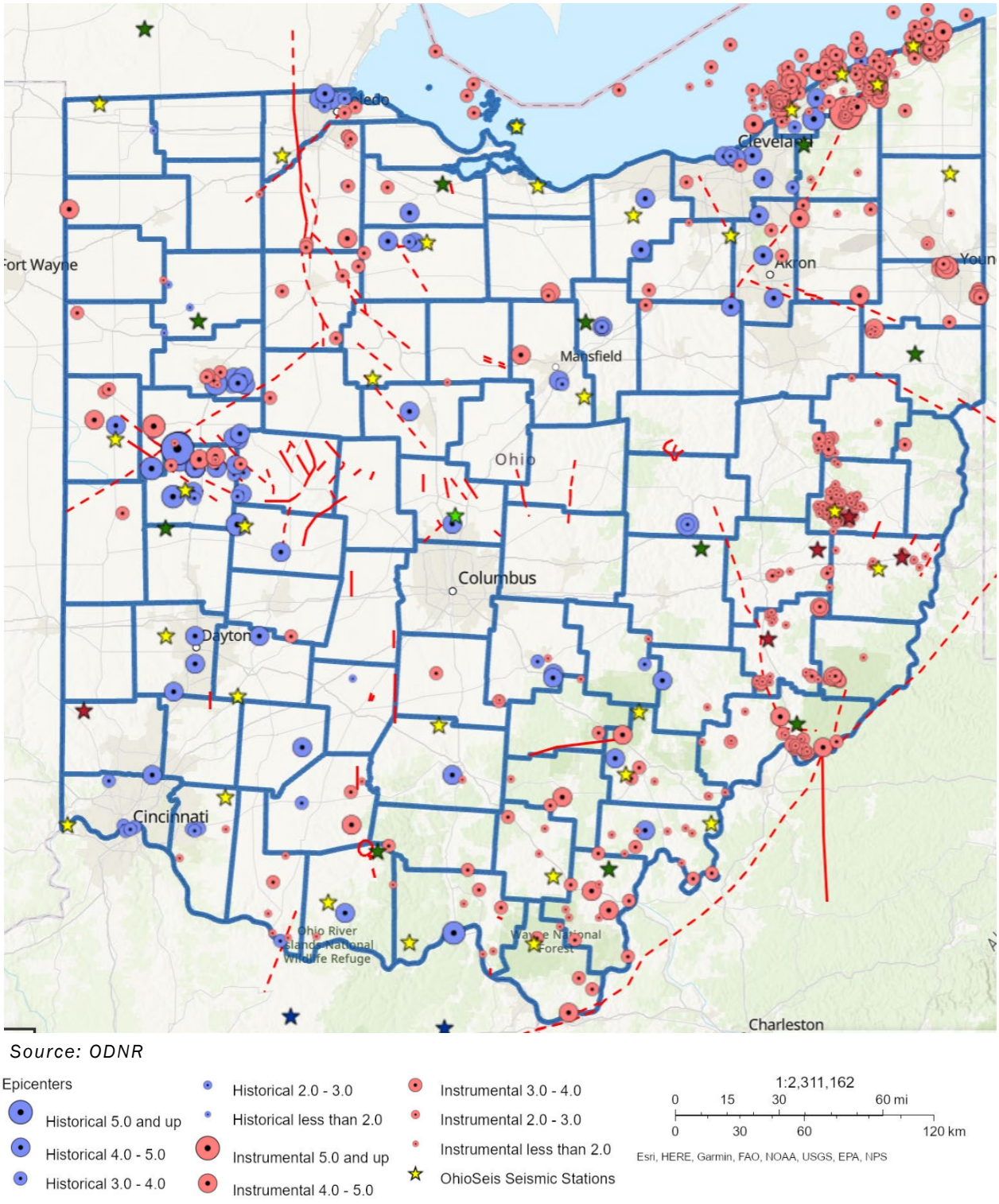
Source: ODNR

Figure 4.3.2: Ohio Faults and Seismic Zones



Source: ODNR

Figure 4.3.3: Earthquake Epicenters and Seismic Monitoring Stations in Ohio



Source: ODNR

History

More than 300 earthquakes of 2.0 magnitude or greater with epicenters in Ohio have occurred since 1776. Most of these events have been small, in the 2.0 to 3.0 magnitude range, while 15 earthquakes

have caused minor-to-moderate damage and no recorded deaths. Ross County has had two earthquakes recorded, one on November 12, 1899, and one on July 10, 2023. The earthquake in 1899 had a 3.0 magnitude and the earthquake in 2023 had a magnitude less than 2.0. There is limited data available on any property damage.

Figure 4.3.4, below, displays epicenters of all historical earthquakes with a magnitude greater than 1.0. Locations and magnitudes of non-instrumental earthquakes correspond to felt area or maximum epicentral Modified Mercalli Intensities and may be in error by a considerable distance.

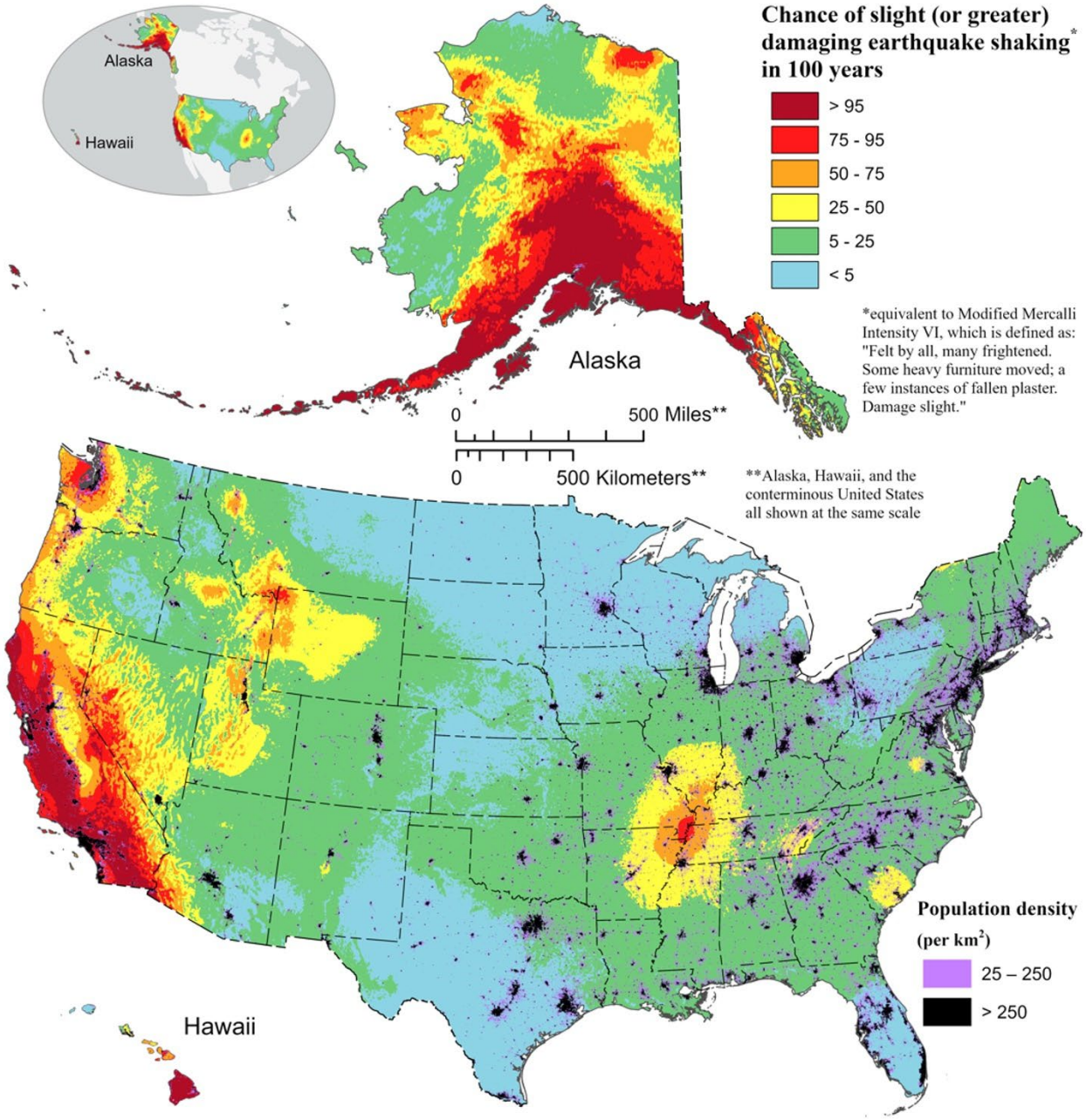
Probability

The USGS has both long-term and short-term probabilistic seismic hazard forecasts. In the 2024 one-hundred-year probabilistic seismic hazard forecast, the United States Geological Survey estimated that there is a 5 to 25 percent chance of potentially minor-damage ground shaking for Ross County (**Figure 4.3.4**).

The USGS also prepared national seismic hazard maps (NSHMP) for the United States. These time-independent maps are shown for two percent and ten percent probability of earthquake ground-shaking exceedance levels at specified probabilities over a 50-year period at several hundred thousand sites across the United States. The map (**Figure 4.3.5)** identifies that Ross County has an eight percent to ten percent peak ground acceleration for two percent probability of exceedance in 50 years.

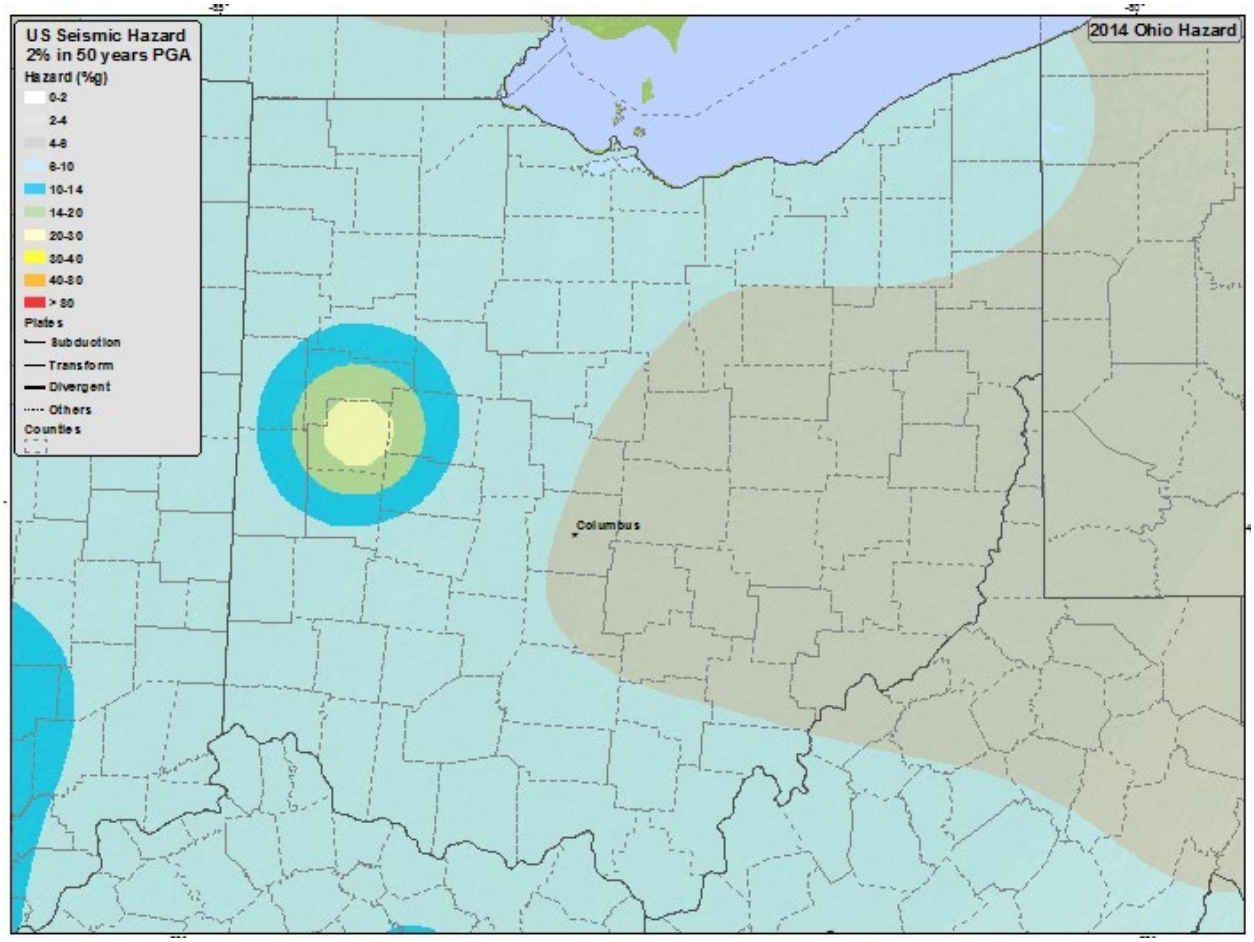
Furthermore, the ODNR indicates that the brief historic record of Ohio earthquakes suggests a risk of moderately damaging earthquakes in the western, northeastern, and southeastern parts of the State.

Figure 4.3.4: Earthquake Shaking and Seismic Design Categories



Source: USGS

Figure 4.3.5: 2014 Seismic Hazard Map of the State of Ohio



Source: USGS

Vulnerability Assessment

Infrastructure Impact

There have been two earthquakes with a 3.0 magnitude and less than 2.0 magnitude in Ross County since 1899. The earthquakes occurred on November 12, 1899, and on July 10, 2023 (respectively). Magnitudes under three are not generally noticed by people and cause little, if any, damage. Buildings, roadways, gas and power lines have the potential to be affected. Since the probability of an earthquake occurring in Ross County is less than one percent, there is a low risk of impact to infrastructure as a result.

Population Impact

There is a relatively low risk of earthquakes occurring in Ross County. Accordingly, there is low risk of impact to the population. If an earthquake occurs within Ross, the population could be impacted by loss of homes, loss of utilities, and a potential reduction of air quality.

For social vulnerability, the National Risk Index indicates that the population in Ross County has a score of 58.6 (“very low”) for earthquakes. Earthquakes are unlikely to occur in Ross County; therefore, the population is unlikely to be affected by earthquakes. Socially vulnerable populations may be more affected by earthquakes if they live in older housing units or apartment complexes that do not have

adequate earthquake-resilient infrastructure. The index indicates an expected annual loss of $200,000 due to earthquakes with a less than 0.026 percent chance of an event occurring per year.

Property Damage

With any earthquake event, there is potential for property damage to occur, as ground shaking can lead to damaged buildings. Due to the non-site-specific nature of this hazard, **Table 4.3.6** lists the census tracts in Ross County, ranked with the highest vulnerability to the lowest vulnerability.

Loss of Life

Ross County has no recorded earthquake events that have resulted in loss of life; however, if an earthquake occurs, there is potential for loss of life. If there are more people and structures in an earthquake prone location, there is likely to be more of an impact. Loss of life can be mitigated by educating the public on proper protection in the event of an earthquake. For example, the USGS resources on preparing for an Earthquake hazard (USGS Resources for Earthquake Preparedness) as well as the Ready Campaign (Ready.gov) are national public service campaigns designed to educate and empower the American people to prepare for, respond to, and mitigate disasters.

Economic Losses

Earthquakes have the potential to damage infrastructure, resulting in the economic burden of clean up and repairs. Potential economic losses and damage associated with Ross County for earthquakes according to FEMA's National Risk Index are recorded in **Table 4.3.6** below. Expected annual loss (EAL) rates, calculated by FEMA, identify the total value of loss expected each year for a particular community, in this case the census tracts for Ross County. Expected losses for buildings, population, and agriculture for earthquakes are listed in the tables below by most vulnerable census tract to least vulnerable census tract. All census tracts for Ross County are listed in the tables. Compared with other hazards, earthquakes are relatively unlikely to occur in Ross County, meaning there is a low risk of economic loss as a result of an earthquake.

Table 4.3.6: Structure and Population Vulnerability from Earthquakes

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956300	$35,712	$7,098	$0	$42,811
39141955604	$18,668	$4,829	$0	$23,497
39141955500	$13,969	$3,936	$0	$17,904
39141956500	$13,069	$1,593	$0	$14,661
39141955700	$9,103	$3,606	$0	$12,710
39141955603	$9,231	$3,337	$0	$12,568
39141956800	$7,317	$2,843	$0	$10,160
39141956600	$7,072	$2,536	$0	$9,608
39141956700	$6,744	$2,632	$0	$9,376
39141956900	$6,487	$2,498	$0	$8,985
39141955801	$6,618	$1,742	$0	$8,361
39141956100	$4,950	$1,605	$0	$6,555
39141956000	$4,462	$1,296	$0	$5,758

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955900	$4,129	$1,173	$0	$5,302
39141955802	$2,911	$1,453	$0	$4,364
39141956200	$2,763	$1,093	$0	$3,856
39141956400	$2,739	$896	$0	$3,635
Grand Total	**$155,944**	**$44,167**	**$0**	**$200,111**

Source: FEMA National Risk Index

Future Trends

Land Use and Development Trends

Because the incidence and likelihood of earthquakes is low in Ross County, all communities are at low risk. By planning for and managing land use to accomplish social, ecological, and economic sustainability, communities can reduce the negative impacts caused by earthquakes. This can be accomplished through comprehensive land-use plans and supportive federal and state policies. As such, enforcement of stricter building codes that ensure that all new developments are built up to code can reduce risk. Infrastructure (constructed facilities and lifelines) should be designed and constructed to resist earthquake shaking following the current state-of-the-art engineering and technology practices.

In 2023, Ross County authorized 21 new residential units at a total value of $5,790,000. Though there are more buildings being built, Ross County's population is on a downward trend with a decrease of 592 persons from 2020 to 2023 (0.77 percent). The decrease in population is set to continue in 2030 by an additional 2,590 persons (3.93 percent). More buildings but less people may potentially mean more property loss but less population vulnerability. However, with state-of-the-art engineering there is very little potential damage. Given these estimates, there are no known changes in risks associated with earthquakes in Ross County.

Climate Change

Climate change has no known effect on the probability or extent of earthquakes.

4.4 Flood

Description

FEMA describes a flood as "a general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters [and] the unusual and rapid accumulation or runoff of surface waters from any source." Floods are typically riverine, coastal, or shallow. Flash floods are floods that occur quickly, even occurring without visible signs of precipitation.

Urban flooding is a type of flood that can occur in areas of development that have a high level of impervious surfaces such as concrete. The level of development and the level of stormwater management practices impact the severity of urban flooding.

Common flood-related terms include:

- **100-Year Flood:** A flood that has a one percent chance of occurring each year. The 100-year floodplain can be seen in **Figure 4.4.1: Flood Hazard Map**. The elevation of the water from the 100-year flood is called the Base Flood. Mitigation strategies should be based on the base flood elevation.
- **Floodplain:** An area that has the potential to flood from any source.
- **Floodway:** Sometimes referred to as a regulatory floodway. FEMA defines a floodway as "the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the Base Flood without cumulatively increasing the water surface elevation more than a designated height."
- **Flash flood:** Flash floods are typically caused by heavy rainfall over a short period of time. These floods are particularly dangerous because they can occur in minutes and can sometimes occur even without rainfall such as when an ice jam breaks or dissolves. Areas impacted by wildfires are particularly susceptible to flash floods. Flash floods can occur just about anywhere with enough rainfall and are not restricted to the 100-year floodplain. Development/restriction to drainage or increased impervious surfaces can contribute to flash flood frequency.

Location

Flooding can occur throughout Ross County. Flash flooding is more likely to occur in developed areas or along lakes and rivers. **Figure 4.4.1** shows the location of the 100-year floodplain. Floods can and do occur outside the FEMA defined 100-year flood zone. Sometimes very small watersheds are not included in the FEMA analyses, but floods can occur in these smaller watersheds as well.

Extent

Ross County currently has 32 flood insurance maps (see **Appendix F**). The most recent update is from December 2023.

Ross County and 4 communities within the County, including the City of Chillicothe and the Villages of Bainbridge, Clarksburg, and Frankfort participate in the National Flood Insurance Program (NFIP) **(Table 4.4.2)**. The Villages of Adelphi, Kingston, and South Salem do not participate in the NFIP.

Figure 4.4.1: Flood Hazard Map of Ross County, Ohio

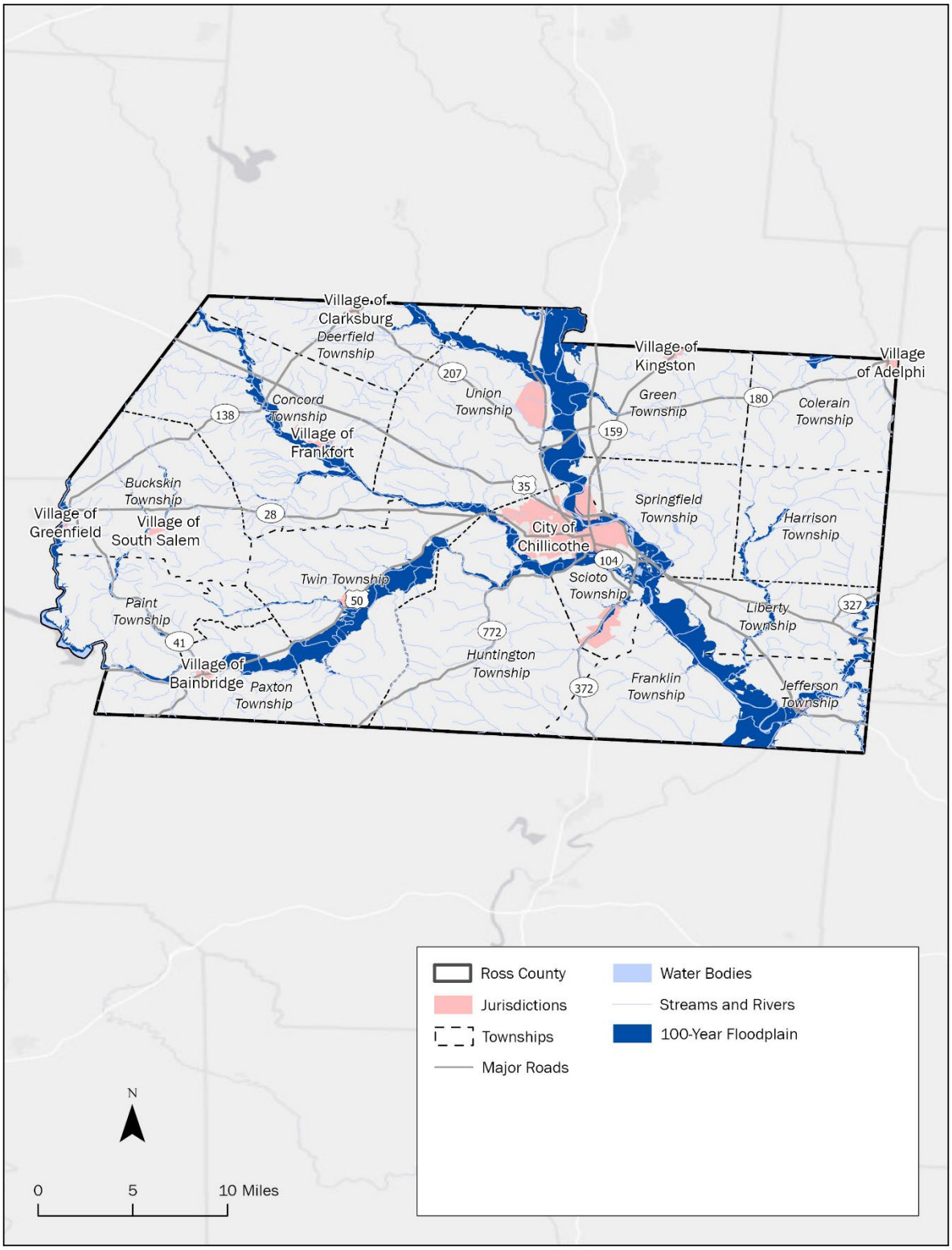


Table 4.4.2: National Flood Insurance Program Participation for Ross County, Ohio

Community Name	County	NFIP Coordinator	Init FHBM Identified	Init FIRM Identified	Effective Map Date	Reg-Emer Date	Participating in NFIP
Ross County*	Ross County	Devon Shoemaker	02/07/75	04/02/91	12/07/23	04/02/91	Yes
City of Chillicothe	Ross County	David Fishel	06/28/74	03/17/84	12/07/23	06/03/86	Yes
Village of Adelphi	Ross County						No
Village of Bainbridge	Ross County	Donald Conley	03/29/74	04/02/03	07/22/10	09/29/78	Yes
Village of Clarksburg	Ross County	Frances Downing	11/15/74	04/02/03	NSFHA	05/25/78	Yes
Village of Frankfort	Ross County	Patti Cavendar	04/12/74	09/24/84	07/22/10	09/24/84	Yes
Village of Kingston	Ross County	Linda Snyder					No
Village of South Salem	Ross County	Dennis Crouse	08/23/74	04/02/03	07/22/10	08/23/75	No

Source: NFIP Community Status Book

Repetitive Loss

There are 11 repetitive loss properties and 1 severe repetitive loss properties in or near Ross County, Ohio, detailed in **Table 4.4.3**. FEMA defines a repetitive loss property as an insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period since 1978. FEMA defines a severe repetitive loss property as a single family property that is covered under flood insurance by the NFIP and has incurred flood-related damage for which four or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least two separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

Table 4.4.3: Repetitive Loss Properties in Ross County, Ohio

Jurisdiction Occupancy	Total RL/SRL Structures	RL Structures	SRL Structures	Total Losses	Total Paid
Ross County (Unincorporated) Single Family Residential	2	2	0	5	$60,489
Ross County (Unincorporated) Other Residential	7	7	9	20	$256,575
City Of Chillicothe Single Family Residential	2	1	1	4	$34,261
Village of Frankfort Single Family Residential	1	1	0	2	$21,608
Total	**12**	**11**	**1**	**31**	**$372,933**

Source: Ohio EMA

History

There have been 93 floods or flash floods in Ross County between January 1995 and December 2023. These events have caused $2,573,000 in property damage and $0 in crop damage. Two deaths were reported. One person lost their life during a flood on March 1, 2018, when they were swept away in the creek. Another death was reported from a flash flood on May 4, 1996, when a person was swept away in the flood waters. There have been two major disaster declarations related to flooding in Ross County since May 1953. There have been no disaster declarations since the last hazard mitigation plan. The two major disaster declarations, as well as floods that caused the greatest amount of damage, and floods that caused deaths or injuries, are described below.

Flooding in Ross County on February 17, 2022:

Rain spread across the region throughout the day as a low-pressure system moved through the Ohio Valley. The heavy rainfall, totaling between 1.5 to 2.5 inches, caused widespread flooding. As a result, Snyder Road and Sulphur Spring Road were closed due to high water, and a water rescue was required to help a person stranded in their car. Ross County reported $10,000 in property damage. No deaths or injuries were reported.

Major Disaster Declaration for Severe Storms, Flooding, and Landslides on April 08, 2019:

From February 5, 2019, through February 13, 2019, several waves of low pressure moved along a stalled front, bringing a prolonged period of heavy rain to the region. An isolated tornado also occurred as a convective segment moved through. West Junction Road near Salt Creek remained flooded, and trees and mud were washed onto a section of U.S. 23, forcing the closure of one lane. Due to high water, several roads were closed, and many remained inaccessible because of flooding. A Major Disaster Declaration (DR-4424-OH) was issued on April 8, for 21 counties including Ross County. Those same 21 counties were offered public assistance totaling $55,978,275.77.

Flooding in Ross County on March 01, 2018:

Showers and isolated thunderstorms developed during the afternoon as a cold front moved through the Ohio Valley. Trego Creek, already running high from recent heavy rains, became dangerous. Tragically, an 8-year-old boy drowned after being swept away by the fast-moving water in the creek. Ross County reported no property or crop damage.

Flash Flood in Ross County on October 4, 2006:

On the second night of heavy rainfall, creeks and streams began to rise out of their banks. Several roads were covered by high water and 32 homes were damaged by flood waters. There were several evacuations due to the flood. There was $250,000 reported in property damage. There were no deaths or injuries reported.

Flooding in Ross County on May 18, 2001:

Heavy rainfall throughout the afternoon led to widespread flooding across the County, resulting in the closure of 36 roads. Several culverts were washed away, and emergency crews rescued three people stranded in high water on Buckskin Creek. Ross County reported $2,000,000 in property damage. No deaths or injuries were reported.

Flash Flood in Ross County on March 2, 1997:

A line of severe thunderstorms brought heavy rain causing a flash flood in the City of Chillicothe. Three automobiles were trapped in the flood waters, one of which required a water evacuation. There were several homes that voluntarily evacuated due to the high water. There was $100,000 in property damage reported. No deaths or injuries were reported.

Flooding in Ross County on May 04, 1996:

On May 4th, flooding along creeks and streams caused a tragic incident when an individual got too close to the water and was swept away, resulting in their death. Ross County reported $5,000 in property damage.

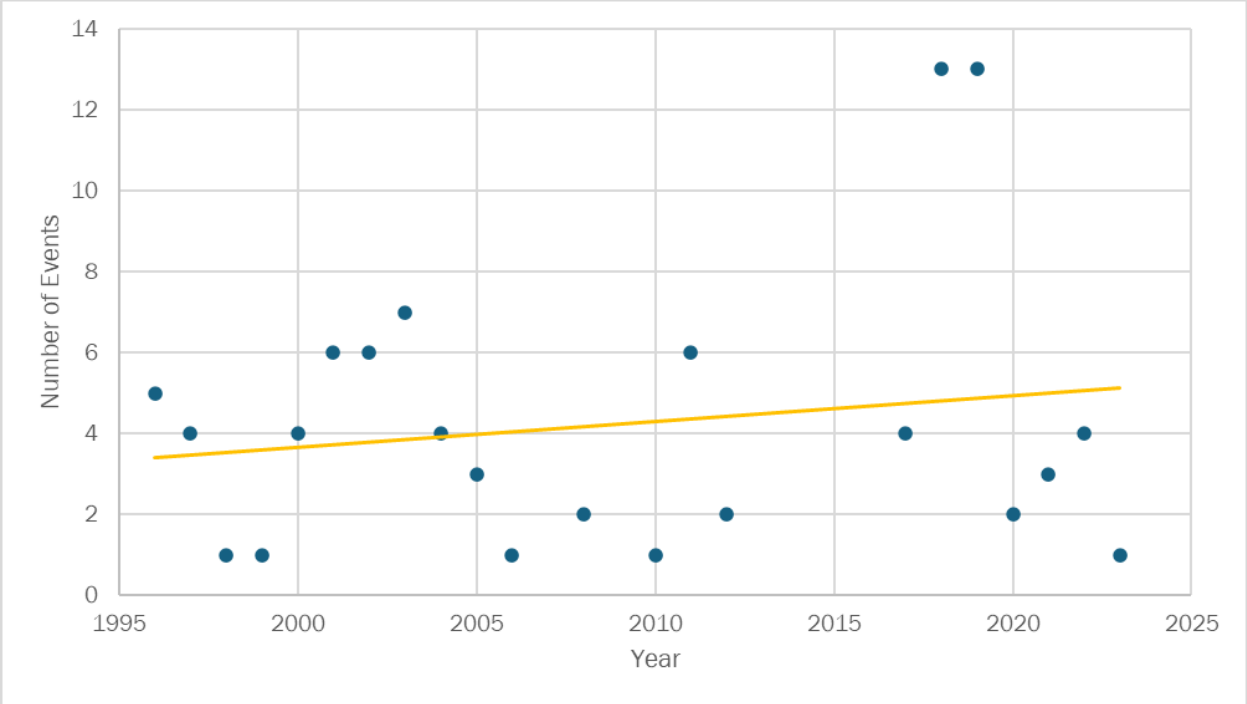
Major Disaster Declaration for Flooding on June 05, 1968:

In June of 1968 heavy rainfall hit the region, causing rivers and creeks to overflow, resulting in significant damage to dams, roads, and personal property. Streets became impassable, bridges were washed out, farm fields were flooded, and many residential areas were affected in several states. A Major Disaster Declaration (DR-243-OH) was issued on June 5, 1968, for 28 counties in Ohio. These same 28 counties were offered public assistance. Total assistance amounts were not reported.

Probability

Figure 4.4.4 Between 1995 and 2023, Ross County experienced 93 flooding events, including both floods and flash floods. Annually, this amounts to approximately three floods or flash floods per year. The yellow trendline of flood occurrences per year is increasing, which may suggest that Ross County can expect a similar frequency of flood events each year or more. According to the State of Ohio Hazard Mitigation Plan (SOHMP), increased precipitation and variability by climate change will increase the likelihood and intensity of flood events. The Climate Change section in Future Trends discusses climate change further.

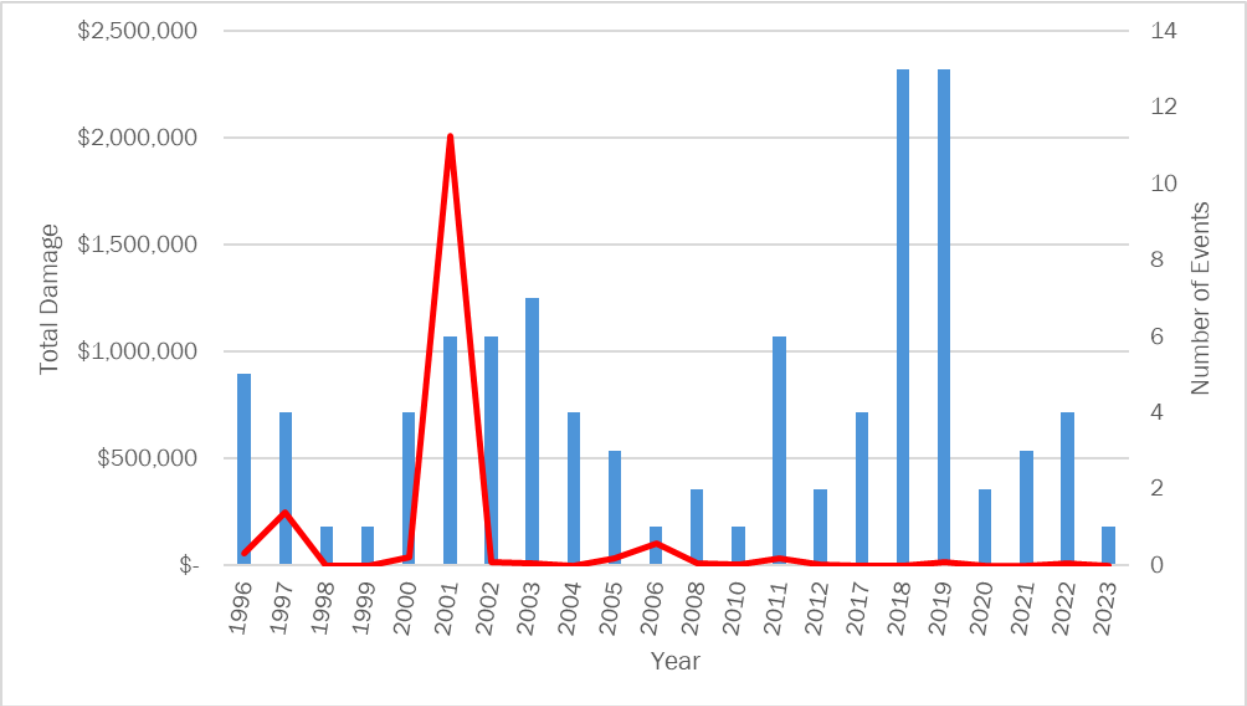
Figure 4.4.4: Probability of Flooding



Data Source: NOAA

Figure 4.4.5 shows both the trend of flood events and affiliated cost over time since January 1995. Between 1995 and 2023, floods or flash flood events have resulted in $2,573,000 in property damage (Source: NCEI). Annually, this amounts to approximately $91,892 in property damage. The trendline (show in red) indicates a steady decrease in cost in property damages.

Figure 4.4.5: Probability and Cost of Flooding



Data Source: NOAA

Vulnerability Assessment

Infrastructure Impact

Floods can impact roadways, including interstates and state routes, by blocking them due to high water, filling them with debris or washing away the road altogether.

Population Impact

Floods and flash floods have caused damage to occupied homes and businesses in the past. During flood events, shelter and temporary housing may need to be provided to those impacted by flooding.

For social vulnerability, in the National Risk Index, "riverine flooding" had a score of 73.9 ("Relatively Low"). People that are most vulnerable to flooding are those who live within the 100-year floodplain in structures that are not elevated about the base flood elevation. The index indicates an expected annual loss of $1,159,188 due to flood events with 2.4 events occurring per year.

Property Damage

Floods have the potential to damage infrastructure, resulting in the economic burden of clean up and repairs. Potential economic losses and damage associated with Ross County for riverine flooding according to FEMA's National Risk Index are recorded in **Table 4.4.6** below. This table summarizes the expected annual loss (EAL) for agriculture, expected annual loss (EAL) for buildings, and expected annual loss (EALP) for population equivalence in Ross County from riverine flooding. Compared with other hazards, riverine flooding has an average rating of relatively moderate for the County's 17 census tracts, meaning there is moderate risk of economic loss because of a flood in Ross County.

Table 4.4.6: Structure and Population Vulnerability from Riverine Flooding

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956700	$40,154	$143,504	$92,854	$276,512
39141956300	$71,575	$60,169	$11,358	$143,102
39141956800	$24,202	$103,250	$7,857	$135,309
39141956500	$98,403	$10,838	$19,836	$129,078
39141956900	$8,991	$22,783	$47,819	$79,593
39141955700	$7,392	$34,571	$37,460	$79,423
39141955603	$3,303	$15,156	$56,955	$75,414
39141955801	$10,603	$34,333	$17,741	$62,676
39141956600	$8,721	$27,050	$12,497	$48,268
39141955900	$7,792	$20,312	$13,210	$41,313
39141955500	$4,967	$14,058	$18,008	$37,033
39141955604	$4,152	$3,615	$27,564	$35,330
39141955802	$3,335	$10,231	$2,334	$15,900
39141956400	$125	$84	$28	$237
39141956200	$0	$0	$0	$0
39141956000	$0	$0	$0	$0
39141956100	$0	$0	$0	$0
Grand Total	**$293,714**	**$499,955**	**$365,519**	**$1,159,188**

Source: FEMA National Risk Index

Loss of Life

There were two reported deaths from flood events in Ross County between January 1995 through December 2023. Both deaths were from persons being swept away in flood waters. Loss of life is possible in future floods or flash floods.

Economic Losses

Floods can halt economic activity, block roadways, and destroy agricultural crops. Businesses may need to shut down their operations due to flood water damage or road closures. Crop losses are also possible during floods or flashfloods.

Future Trends

Land Use and Development Trends

Any development that occurs in flood zones will be at risk. Development in these areas should be limited. Flash flooding is more likely to occur in areas with a high percentage of impervious surfaces. Future land use practices should limit the percentage of impervious surfaces. **Chapter 5** contains mitigation actions that address these issues.

If construction practices, including the location of the new housing units, follow best practices for floodplain management, there are no known changes in the risks associated with riverine flooding.

Communities that are participating in the National Flood Insurance Program (NFIP) are required to adopt and enforce regulations and codes that apply to new developments in Special Flood Hazard Areas (SFHAs). These local floodplain management regulations must contain, at a minimum, NFIP requirements and standards that apply not only to new structures, but also to existing structures which are Substantially Improved (SI), or Substantially Damaged (SD) from any cause, whether natural or human-induced hazards.

According to 44 CFR 59.1, substantial improvement means any reconstruction, rehabilitation, addition or other improvement to a structure, the total cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. Likewise, substantial damage means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. SI/SD requirements are also triggered when any combination of costs to repair and improvements to a structure in an SFHA equals or exceeds 50 percent of the structure's market value (excluding land value).

$$\frac{(Cost\ to\ Repair) + (Cost\ of\ Improvements)}{Market\ Value\ of\ Structure} \geq 50\ Percent$$

Enforcing the SI/SD requirements is a very important part of a community's floodplain management responsibilities. The purpose of the SI/SD requirements is to protect the property owner's investment and safety, and, over time, to reduce the total number of buildings that are exposed to flood damage, thus reducing the burden on taxpayers through the payment of disaster assistance. SD/SI requirements are enforced by the local floodplain administrator and monitored by the Ohio Department of Natural Resources (ODNR) Floodplain Management Program during Community Assistance Visits. If a local floodplain administrator is overwhelmed by the number of SD/SI inspections after a large event, ODNR has developed a network of building code officials that are trained in conducting SD/SI field determinations. Help with SD/SI inspections can be requested through the county emergency management agency director.

For more information regarding Substantial Improvement and Substantial Damage, please refer to FEMA's Substantial Improvement/ Substantial Damage Desk Reference, P-758 or contact the ODNR Floodplain Management Program.

Climate Change

According to the International Panel on Climate Change, climate change has impacted human and natural systems. For example, infrastructure and stormwater systems in the Midwest are threatened by increased precipitation frequency and intensity induced by climate change (NCA 2018). According to the SOHMP, increased precipitation and variability by climate change will also increase the likelihood and intensity of flood events, which will mostly occur during the summer and fall months. These events will mainly occur from late summer to early winter, increasing the likelihood of cool season flood events in the late autumn and early winter. Additionally, heavy precipitation events and precipitation are projected to increase during winter and spring, causing flooding, sewer overflow, inundated roadways, delayed growing season and crop damage, and infrastructure damage. Emergency action plans, green infrastructure, and anticipating extreme events are important steps to prepare for climate change.

4.5 Invasive Species

Description

Invasive species are non-native and have potential negative impacts on the environment and economy of Ross County. The National Oceanic and Atmospheric Administration (NOAA) defines an invasive species as "an organism that causes ecological or economic harm in a new environment and is not native." Harmful species are species that are native to a region, but that also cause significant ecological, public health, or economic harm. Their growth is often encouraged through human activity.

Invasive species can be terrestrial (land dwelling) or aquatic (water dwelling). Terrestrial species include plants, trees, shrubs, animals, birds, and insects, as well as fungi, bacteria, molds, and viruses. Aquatic species include aquatic plants and algae, fish, mollusks, amphibians, and insects, as well as fungi, bacteria, molds, and viruses.

Location

Invasive species have the potential to impact any location within the County. The most invasive terrestrial species degrade the State's woodlands, wetlands, and prairies. Aquatic invasive species use rivers to spread. Ohio has over 66,000 miles of streams, 312 miles of Great Lakes shoreline, nearly 2,000 inland lakes and reservoirs, and shares major watersheds with other states and Canada. Ross County is part of the Mississippi River basin, which is an ecologically diverse river system, and is susceptible to invasions through the Ohio River and its tributaries. The Scioto River, which winds 231 miles through southern Ohio including Ross County, is part of the Mississippi River basin as it flows into the Ohio River and eventually the Mississippi River.

Extent

Once invasive species become widely established, controlling their spread is both technically difficult and expensive, making eradication nearly impossible. Invasive species can alter species diversity and natural wildlife habitat in regions where they become established. State and federal quarantine programs aim to prevent the further spread of various invasives. While the federal invasive species quarantine program attempts to control numerous species across all 50 states and territories, Ohio has two insects in quarantine programs, the spotted lantern fly and the box tree moth, although Ross County is not a quarantine program for either insect. Several invasive species in Ross County that are of particular concern and / or species with federal or state quarantine programs are described in more detail below.

Ross County is not one of 51 of Ohio's 88 counties currently in federal quarantine for the spongy moth (*Lymantria dispar*) **(Figure 4.5.1)**; however, both Hocking and Vinton Counties to the east are in quarantine, increasing the possibility of the moth's spread. The Spongy Moth is an invasive forest pest that moved west into Ohio from Pennsylvania. Each female can lay an egg mass that can contain 500-1,000 eggs and once the larvae hatch, they can successfully feed on over 300 different tree and shrub varieties. According to the Ohio Department of Agriculture, each larva can consume up to one square foot of foliage every 24 hours. Transportation of newly hatched caterpillars is via wind on silk threads, allowing them to travel hundreds of yards to as much as one mile to new areas. As caterpillars grow their transportation changes to crawling to new food sources.

Figure 4.5.1: Spongy Moth (*Lymantria dispar*)

Source: Ohio Department of Agriculture

The Asian long-horned tick **(Figure 4.5.2)** has been identified in Ross, along with 10 other central and southeastern Ohio counties, since it was first spotted in the state in 2020. The ticks prefer large livestock and wildlife and carry various pathogens that can cause disease in animals and humans. They also carry bovine theileriosis (*Theileria orientalis),* which causes increased heart and respiratory rates, anemia, jaundice, and increased mortality, posing a threat to Ohio's livestock. Because the females breed asexually, laying up to 2,000 eggs at a time, they are able to increase their numbers quickly. No other North American tick can do that. Heavy tick infestation has led to the deaths of several cows from the sheer blood loss.

Figure 4.5.2: Asian Long-horned Tick (*Haemaphysalis longicornis*)

Source: Risa Pesapane

Approximately 2,300 plant species occur in the wild in Ohio. Of these, about 78 percent are native, that is, they existed in the region before European settlement. Of the remaining 22 percent, fewer than 100 have been identified to be problems in natural areas. According to the Ohio Invasive Plants Council, there are 38 invasive plant species in Ohio that have been banned and more under consideration (**Table 4.5.3**). These plants cannot be sold, distributed, or imported.

Table 4.5.3: Plant Invasive Species in Ohio as of January 7, 2018

Scientific Name	Common Name
Ailanthus altissima	Tree-of-heaven

Scientific Name	Common Name
Alliaria petiolate	Garlic mustard
Berberis vulgaris	Common barberry
Butomus umbellatus	Flowering rush
Celastrus orbiculatus	Oriental bittersweet
Centaurea stoebe ssp. Micranthos	Spotted knapweed
Dipsacus fullonum	Common teasel
Dipsacus laciniatus	Cutleaf teasel
Egeria densa	Brazilian elodea
Elaegnus angustifolia	Russian olive
Elaegnus umbellate	Autumn olive
Epilobium hirsutum	Hairy willow herb
Frangula alnus	Glossy buckthorn
Heracleum mantegazzianum	Giant hogweed
Hesperis matronlis	Dame's rocket
Hydrilla verticillata	Hydrilla
Hydrocharis morsus-ranae	European frog-bit
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	Amur honeysuckle
Lonicera morrowii	Morrow's honeysuckle
Lonicera tatarica	Tatarian honeysuckle
Lythrum salicaria	Purple loosestrife
Lythrum virgatum (effective January 7, 2019)	European wand loosestrife
Microstegium vimineum	Japanese stiltgrass
Myriophyllum aquaticum	Parrotfeather
Myriophyllum spicatum	Eurasian watermilfoil
Nymphoides peltata	Yellow floating heart
Phragmites australis	Common reed
Potamogeton crispus	Curley-leaved pondweed
Pueraria montana var. lobate	Kudzu
Pyrus calleryana (effective January 7, 2023)	Callery pear
Ranunculus ficaria	Fig buttercup, lesser celandine
Rhamnus cathartica	Common buckthorn

Scientific Name	Common Name
Rosa multiflora	Multiflora rose
Trapa natans	Water chestnut
Typha angustifolia	Narrow-leaved cattail
Typha x glauca	Hybrid cattail
Vincetoxicum nigrum	Black swallow-wort

Studies conducted by Ohio Department of Natural Resources, Ohio Sea Grant, and the Ohio State University have identified over 70 invasive aquatic species in Ohio (**Table 4.5.4**). With the exception of white perch, it is unlawful to possess, import, or sell these species live.

Table 4.5.4: Aquatic Invasive Species in Ohio

Type	Scientific Name	Common Name
Fish	*Alosa pseudoharengus*	Alewife
Fish	*Carassius auratus*	Goldfish
Fish	*Carassius carassius*	Crucian carp
Fish	*Carassius gibelio*	Prussian carp
Fish	*Channa app. and Parachanna app.*	Snakeheads
Fish	*Claris batrachus*	Walking catfish
Fish	*Ctenopharyngodon idella*	Diploid grass carp - white amur
Fish	*Ctenopharyngodon Idella*	Grass carp
Fish	*Cyprinus carpio*	Common carp
Fish	*Fundulus catenatus*	Northern studfish
Fish	*Fundulus diaphanus*	Eastern banded killifish
Fish	*Gambusia holbrooki and Gambusia affinis*	Eastern & western mosquitofish
Fish	*Gasterosteus aculeatus*	Three-spined stickleback
Fish	*Gymnocephalus cernuus*	Ruffe
Fish	*Hypophthalmichthys harmandi*	Large-scale silver carp
Fish	*Hypophthalmichthys molitrix*	Silver carp
Fish	*Hypophthalmichthys nobilis*	Bighead carp
Fish	*Lates niloticus*	Nile perch
Fish	*Leuciscus idus*	Ide
Fish	*Morone americana*	White perch
Fish	*Mylopharyngodon piceus*	Black carp
Fish	*Neogobius melanostomus*	Round goby
Fish	*Osmerus mordax*	Rainbow smelt

Type	Scientific Name	Common Name
Fish	*Perca fluviatilis*	European perch
Fish	*Perccottus glenii*	Amur sleeper
Fish	*Petromyzon marinus*	Sea lamprey
Fish	*Phoxinus phoxims*	Eurasian minnow
Fish	*Proterorhinus marmoratus*	Tubenose goby
Fish	*Pseudorasbora parva*	Stone moroko
Fish	*Rhodeus sericeus*	Bitterling
Fish	*Rutilus sericeous*	Roach
Fish	*Sander lucioperca*	Zander
Fish	*Scardinius erythrophthalmus*	European rudd
Fish	*Scardinius erythrophthalmus*	Rudd
Fish	*Silurus glanis*	Wels catfish
Fish	*Tinca tinea*	Tench
Mollusks	*Bellamya (Cipangopaludina)*	Mystery snails
Mollusks	*Bithynia tentaculata*	Faucet snail
Mollusks	*Corbicula fluminea*	Asian clam
Mollusks	*Dreissena bugensis*	Quagga mussel
Mollusks	*Dreissena polymorpha*	Zebra mussel
Mollusks	*Limnoperna fortune*	Golden mussel
Mollusks	*Potamopyrgus antipodarum*	New Zealand mud snail
Crustaceans	*Bythotrephes longimanus*	Spiny water flea
Crustaceans	*Cercopagis pengoi*	Fishhook water flea
Crustaceans	*Cherax destructor*	Yabby
Crustaceans	*Cherax tenuimanus*	Marron
Crustaceans	*Dikerogammarus villosus*	Killer shrimp
Crustaceans	*Eriocheir sinensis*	Chinese mitten crab
Crustaceans	*Faxonius virilis*	Virile crayfish
Crustaceans	*Hemimysis anomala*	Bloody-red shrimp
Crustaceans	*Procambarus clarki*	Red Swamp crayfish
Plant	*Butomus umbellatus*	Flowering-rush
Plant	*Egeria densa*	Brazilian waterweed
Plant	*Hydrilla verticillata*	Hydrilla

Type	Scientific Name	Common Name
Plant	*Hydrocharis morsus-ranae*	European frog-bit
Plant	*Iris pseudacorus*	Yellow iris
Plant	*Ludwigia peploides*	Creeping water primrose
Plant	*Lysimachia nummularia*	Moneywort
Plant	*Lythrum salicaria*	Purple loosestrife
Plant	*Marsilea quadrifolia*	European water clover
Plant	*Myriophyllum aquaticum*	Parrotfeather
Plant	*Myriophyllum spicatum*	Eurasian watermilfoil
Plant	*Najas minor*	Brittle naiad
Plant	*Nelumbo nucifera*	Pink lotus
Plant	*Nitellopsis obtusa*	Starry stonewort
Plant	*Nymphoides peltata*	Yellow floating heart
Plant	*Phalaris arundinacea*	Reed canary grass
Plant	*Phragmites australis*	Common reed
Plant	*Pistia stratiotes*	Water lettuce
Plant	*Potamogeton crispus*	Curly-leaf pondweed
Plant	*Trapa natans*	Water chestnut
Plant	*Typha angustifolia*	Narrow-leafed cattail
Plant	*Typha x glauc*	Hybrid cattails (cross of invasive and common)

Another invasive species that has the potential to impact Ross County include:

Mute Swans are invasive species found on public lakes across Ohio, originally known as winter visitors with the first published record in the United States in 1936 and Ohio in 1987. During the breeding season, March through May, adult mute swans become highly territorial and will fight to push native birds out of their nesting area. Mute swans have attacked humans and pets during this time as well. Mute swans can consume submerged aquatic vegetation and usually uproot the whole plant leaving nothing behind. This takes away natural habitat from fish and leaves little food source for native waterfowl. The removal of aquatic vegetation can also cause water quality issues and erosion problems.

History

Beyond species already identified as established in Ross County, it is possible that any of the other species listed above have at one point affected the County and its residents.

Probability

Since there are many invasive species throughout Ohio, it is probable that Ross County will experience some of the invasive species listed above (**Tables 4.5.3 and 4.5.4**).

Vulnerability Assessment

Infrastructure Impact

There are no likely impacts to public roadways or utilities. Public trees may be destroyed or impacted by various invasive species. Aquatic invasive species could destroy water quality, make poor habitat for fish, and clog water intake pipes. Some species also increase fire potential and can be problematic to levees, dams, and irrigation systems.

Population Impact

There are no likely impacts on the local population. Recreational activities such as boating and fishing may be mildly impacted.

Property Damage

Property damage, in the form of reduced values from impacts on landscaping, is possible.

Loss of Life

Loss of life because of invasive species is very unlikely. Some of these species consumed as food could lead to diseases and other health impacts in humans.

Economic Losses

Economic impacts can vary greatly depending on the target and the invasive species and their impacts on those targets. Agricultural and horticultural revenue losses may be experienced if crops and plants are affected by an invasive species. Also, there may be indirect economic losses with degradation of forested lands and tree canopies. Examples include reduction in viable lumber for construction, increased heating and cooling costs, and reduced property value.

Future Trends

Land Use and Development Trends

Slight impacts on development and land use due to invasive species are possible. Some invasive species can be particularly damaging to crops, agricultural land, and wetlands. Future development may involve site investigation to identify any potential invasive species on a property.

Climate Change

According to the Fifth National Climate Assessment, warming temperatures caused by climate change are aiding in the spread of invasive species. Climate change can favor non-native invading species over native ones due to the tolerance of invasive species to warmer climate zones and native communities' decreased resistance to the new weather conditions.

4.6 Landslide and Mine Subsidence

Description

The Ohio Department of Natural Resources (ODNR) defines a landslide as "a variety of downslope movements of earth materials. Some slides are rapid, occurring in seconds, whereas others may take hours, weeks, or even longer to develop." Landslides are commonly triggered by human-induced vibrations, over-steepened slopes, increased weight on a slope, and removal of vegetation on areas with landslide-prone slopes. Landslides can also be caused by heavy precipitation.

Subsidence is the motion of the earth's surface as it shifts downward relative to a benchmark (often sea level) of the surrounding terrain. In Ohio, the two primary causes are abandoned underground mines (AUMs) and karst. Karst is a topographic feature formed when carbonate rock, such as limestone, dolomite, and gypsum, is eroded by water draining or moving from these areas. Karsts are commonly represented as caves. There are several karst fields and two verified carbonate fields in Ross County.

According to the Ohio Administrative Code 3901-1-48, mine subsidence is loss caused by the collapse or lateral or vertical movement of structures resulting from the caving in of underground mines including coal mines, clay mines, limestone mines, and salt mines. Mine subsidence does not include loss caused by earthquakes, landslides, volcanic eruptions, or collapse of strip mines, storm and sewer drains, or rapid transit tunnels. Several factors determine the potential for mines to collapse including depth, mining technique used, types of rock and/or soils, and the development on the ground surface. Additionally, abandoned underground coal mines in Ohio have the potential to discharge acidic water which, if discharged into creeks or streams, can alter the chemical composition of the water habitat and cause considerable harm to sensitive aquatic life.

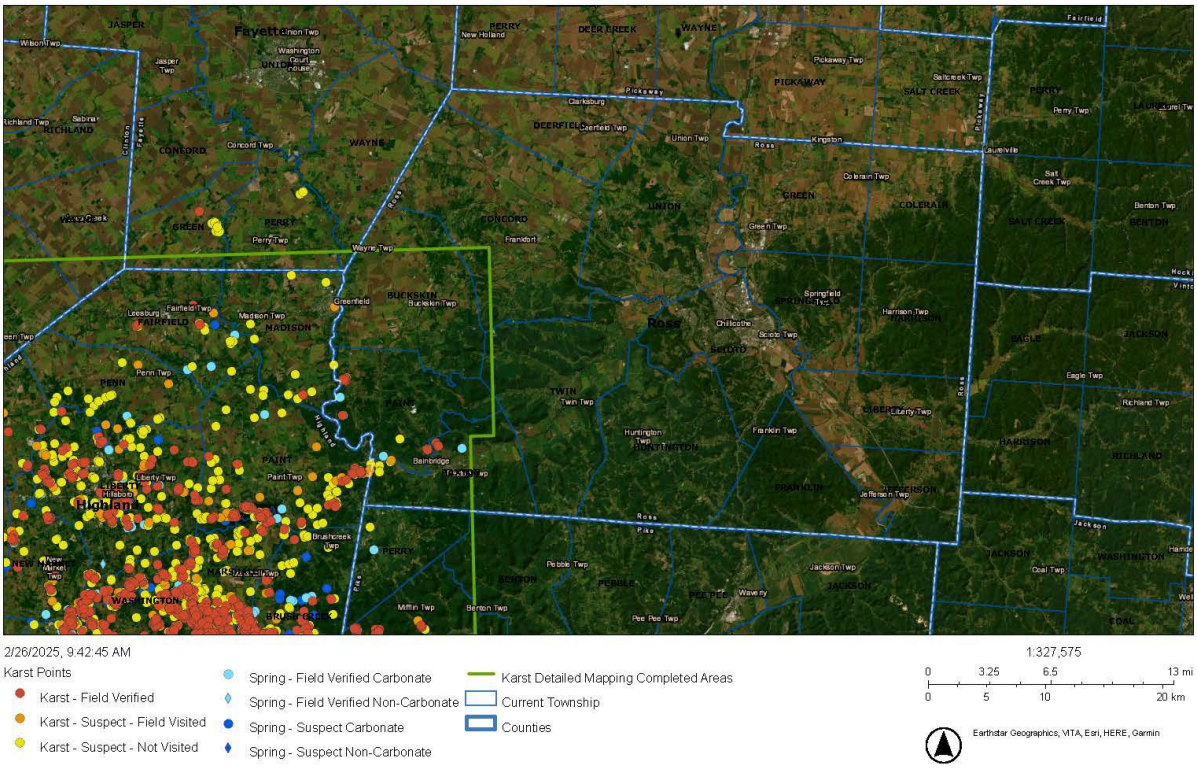
Location

Figure 4.6.1 is a snapshot of the ODNR Karst Interactive Map for Ross County. The map shows areas of verified Karst fields, verified springs with carbonate, and suspected Karst fields (visited and not visited). All karst features are located in eastern Ross County. Figure 4.6.2 shows the location of areas impacted by bedrock and glacial drift overlay. The map shows that in east Ross County there is carbonate greater than 20 feet underground.

Figure 4.6.3 shows the location of abandoned underground mines in Ohio and which counties have the option or are required to obtain mine subsidence insurance. The majority of abandoned underground mines can be found in region three or in nearby counties. All but six counties in region three require land subsidence insurance. Ross County is one of the six counties in the region that do not require insurance. Ross County doesn't have any abandoned underground mines.

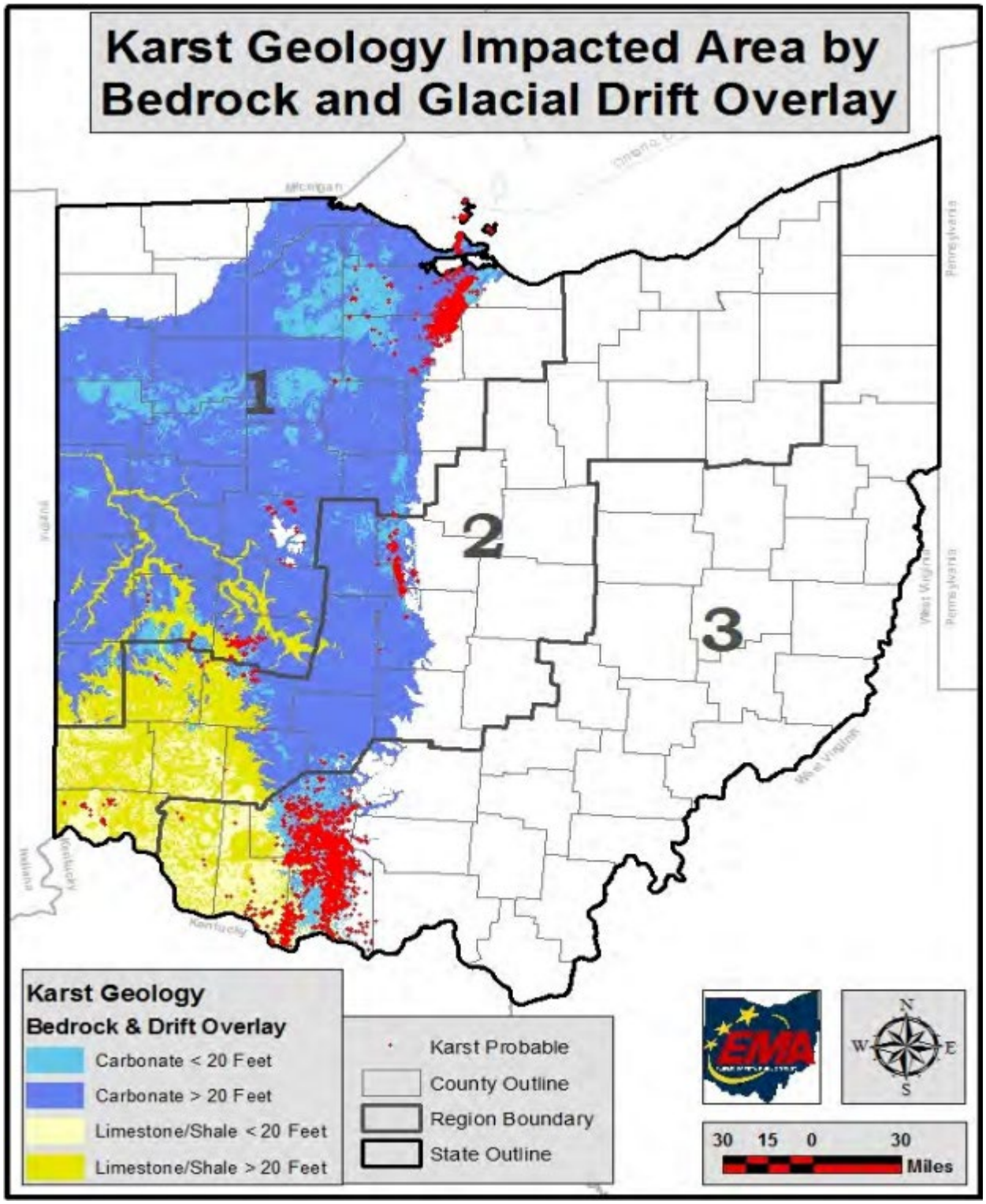
Figure 4.6.4 shows the location of areas at risk for landslides. Ross County is in region three and has moderate incidence and high susceptibility of landslides. The map displays both the incidence of landslides and susceptibility of the land surface to landslides. Briefly, the map was constructed by evaluating geologic units shown on the geologic map of the United States (King and Beikman, 1974) and classifying them as having high, medium, or low landslide incidence based on number of known landslides, and as having the high, medium, or low susceptibility to landslide. High incidence was assigned to map units (indicated in red on the map) having more than 15 percent of their area involved in landslide; moderate incidence (in tan) to those having between 15 and 1.5 percent; and low incidence (in yellow) to those having less than 1.5 percent.

Figure 4.6.1: ODNR Karst Interactive Map



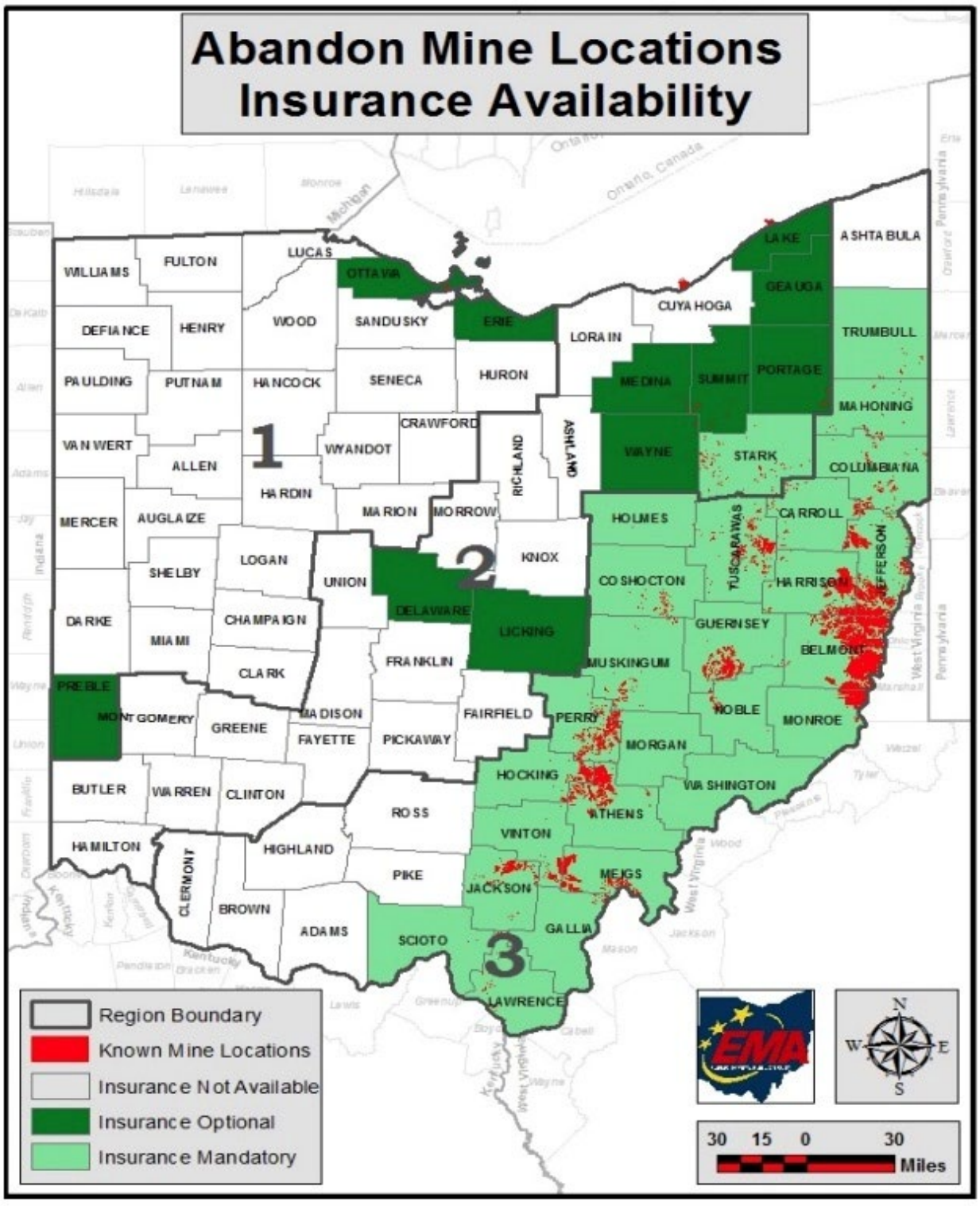
Source: Ohio Department of Ohio Natural Resources

Figure 4.6.2: Karst Geology Impacted Area by Bedrock and Glacial Drift Overlay



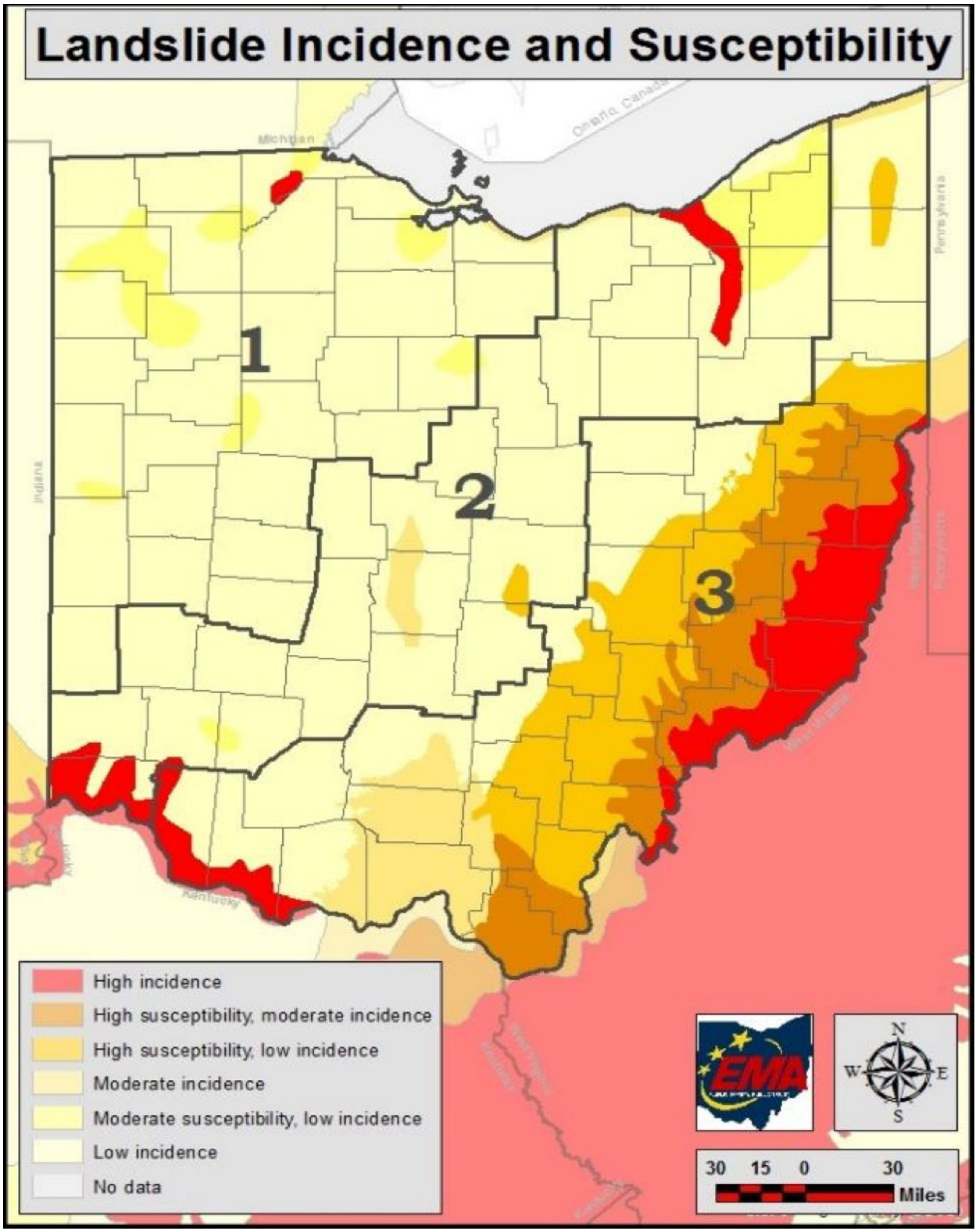
Source: State of Ohio Enhanced Hazard Mitigation Plan

Figure. 4.6.3: Abandon Mine Locations and Insurance Availability



Source: State of Ohio Enhanced Hazard Mitigation Plan

Figure 4.6.4: Landslide Incidence and Susceptibility Map



Source: State of Ohio Enhanced Hazard Mitigation Plan

Extent

According to ODNR Division of Geologic Survey, Ross County is home to 10 bedrock formations: the Logan and Cuyahoga Formations Undivided; Allegheny and Pottsville Groups Undivided; Sunbury Shale, Berea Sandstone, and Bedford Shale Undivided; Ohio and Olentangy Shales Undivided; Tymochtee Dolomite, Greenfield Dolomite, and Peebles Dolomite, Lilley Formation, and Bisher Formation Undivided; Salina Undifferentiated; Tymochtee Dolomite; Peebles Dolomite, Lilley Formation, Bisher Formation Undivided; Greenfield Dolomite; and Estill Shale. These formations include a mix of shale and interbedded sandstone, shale interbedded with mine sandstone and siltstone grading to massive sandstone, argillaceous dolomite and minor shale, shale and minor dolomite interbedded, argillaceous dolomite, dolomite, and dolomite with brownish black to gray shale laminae.

There are three major types of landslides:

1. Rotational slump, or a mass of weak rock or sediment moving as a block unit along a slope. These are the largest types of landslides found in Ohio.
2. Earthflow, or a mass of rock or sediment flowing downslope. These are the most common landslides in Ohio.
3. Rock fall, or a rapid downslope movement of large blocks of bedrock. Most rockfalls in Ohio involve sandstone or limestone that have been weakened by surface water.

According to the Ohio Mine Subsidence Insurance Underwriting Association, mine subsidence is caused by the collapse of underground mines causing damage or movement to a property and/or structure located above. Mine Subsidence insurance is required for 26 counties and optional for 11 counties in Ohio State. Insurance for the mandatory counties has an annual premium of $1.00 and $5.00 for optional counties. Ross County residents do not have the option of enrolling in Mine Subsidence Insurance. According to the ODNR there aren't any abandoned underground mines in Ross County. The most common mines in Ross County are surface mines.

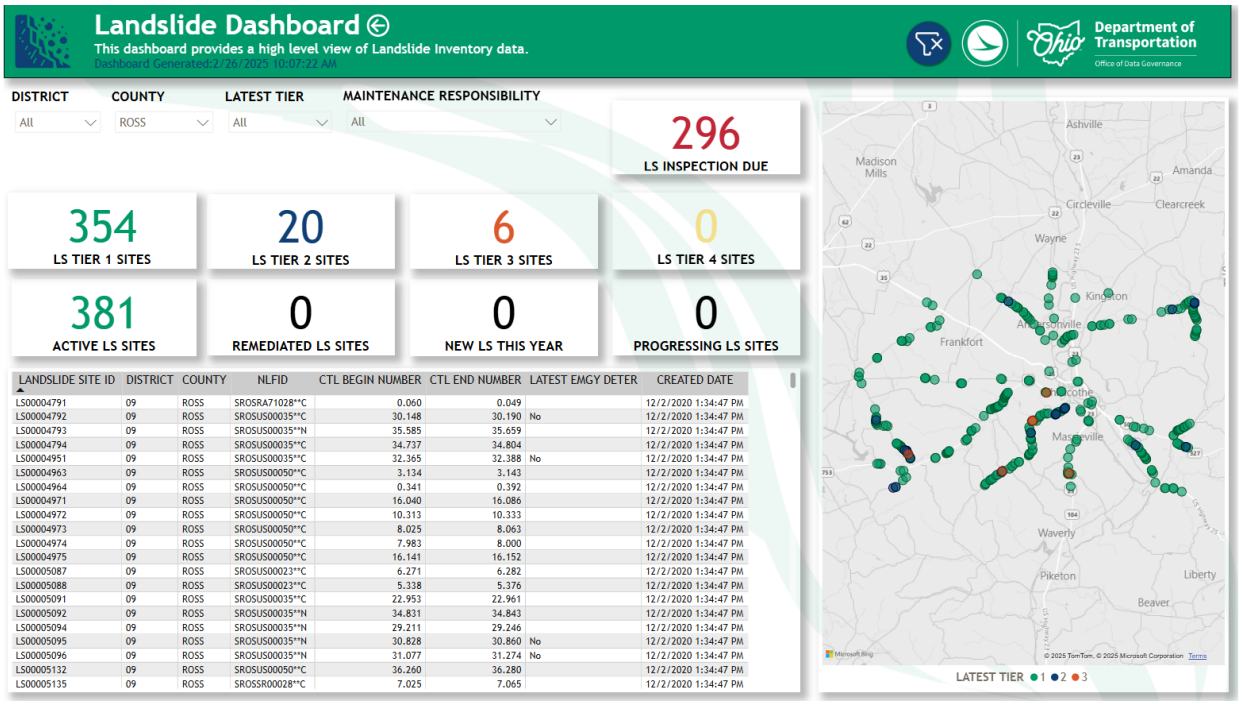
History

According to the Ohio Department of Transportation (ODOT) there have been 381 landslides in Ross County. Most of the landslides occur along major roadways, such as S.R. 772, S.R. 207, S.R. 180, S.R. 327, S.R. 41, U.S. Highway 23, U.S. Highway 50 W, and State Highway 138 (**Figure 4.6.5**). Of the 381 landslides, six are rated Tier 3, 20 are Tier 2 and 354 are Tier 1. Tier 1 ratings do not require a detailed rating and have a low probability of additional movement and a low probability of significant impact to an ODOT asset or adjacent property. Tier 2 ratings are for sites with moderate risk and do require a re-inspection every three years. Tier 3 ratings are for sites with high risk and require a re-inspection every two years. The landslide manual, developed by ODOT Office of Geotechnical Engineering (OGE), provides detailed information on the procedure for landslide data collection and landslide hazard assessment using the ODOT rating matrix.

There have been 46 rock slopes in Ross County. Most of the rock slopes occur along major roadways, such as, S.R. 772, U.S. Highway 23, U.S. Highway 35, and U.S. Highway 50 (**Figure 4.6.6**). Of the 46 rock slopes, one is rated Tier 4, two are rated Tier 3, 15 are rated Tier 2, and 28 are rated Tier 1. Similar to landslides, tier 1 rock slopes are non-rated and do not require a detailed data collection. The ODOT OGE developed a rock slope manual that details the data collection procedures for rock slopes.

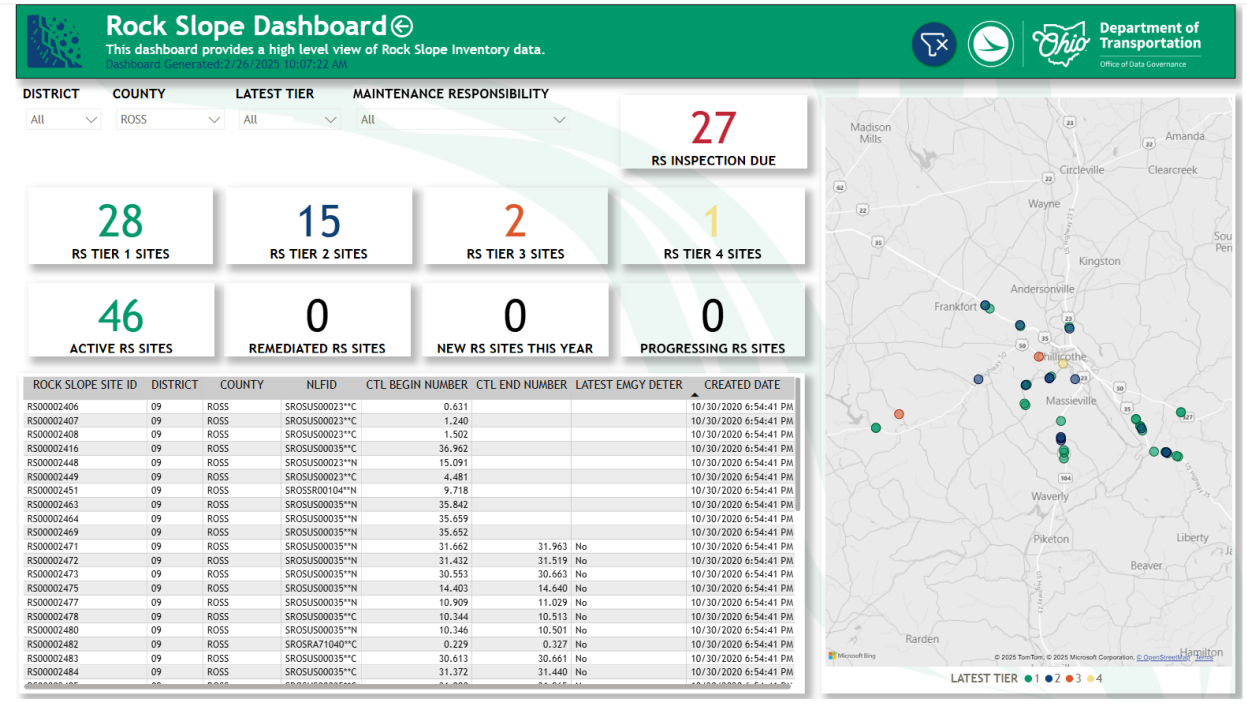
Since incidents of landslides and rockslides often go unreported, individual sites are an accurate way to discuss both past problem areas and future probability of events. The most common tier in the County is Tier 1, with 328 Tier 1 sites.

Figure 4.6.5: Landslide Dashboard for Ross County



Source: Ohio Department of Transportation Geohazards Dashboard

Figure 4.6.6: Rock Slope Dashboard for Ross County



Source: Ohio Department of Transportation Geohazards Dashboard

Probability

According to the ODNR, Ross County falls within an area of moderate risk for slope failure and landslides and rock slopes should be considered a likely event. The 1870 Ohio Mine Law required a mine be registered if it had more than ten employees and mined more than 200,000 tons of coal. This leaves an undocumented number of smaller mines that closed prior to 1870. There are a known 6,000 underground mines in Ohio. On February 08, 2022, the federal government granted the State of Ohio $46.4 million to reclaim abandoned coal mines. There are no documented mine collapses in Ross County and mine subsidence should be considered an unlikely event.

Vulnerability Risk Assessment

Infrastructure Impact

Landslides can block or damage roadways, and damage existing utility infrastructure. Mine subsidence can occur under existing roadways or utility infrastructure causing anything from minor damage to complete destruction.

Population Impact

Landslides and mine subsidence can cause injury or death if a person is struck by or trapped under falling earthen material. Mine subsidence can cause sinkholes under occupied structures which could lead to injuries.

For social vulnerability, mine subsidence is not listed in the National Risk Index, but landslide is listed with a score of 93.6 (relatively moderate). The index indicates an expected annual loss of $200,000 due to landslides with zero events occurring per year.

Property Damage

Properties caught in the path of a landslide can be destroyed or severely damaged. Properties, including their structures, can be destroyed by mine subsidence.

Potential economic losses and damage associated with Ross County for Landslides according to FEMA's National Risk Index are recorded in **Table 4.6.7** below. This table lists expected annual losses (EAL) for buildings, expected annual loss for population equivalence, and expected annual loss (EAL) for agriculture in Ross County. The census tracts are sorted below by total expected annual loss, high to low.

Table 4.6.7: Structure and Population Vulnerability from Landslides

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956800	$69,361	$18,677	$0	$88,038
39141956300	$21,129	$619	$0	$21,748
39141956500	$12,098	$1,182	$0	$13,281
39141956000	$8,964	$2,106	$0	$11,070
39141955900	$8,114	$1,600	$0	$9,715
39141956100	$7,165	$1,167	$0	$8,332
39141955500	$5,663	$1,109	$0	$6,773
39141956900	$5,347	$1,260	$0	$6,607
39141956200	$5,341	$1,141	$0	$6,482

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956600	$5,069	$1,174	$0	$6,242
39141956700	$4,470	$1,085	$0	$5,555
39141955700	$3,375	$762	$0	$4,137
39141955801	$3,443	$590	$0	$4,033
39141955604	$2,708	$406	$0	$3,114
39141955603	$1,482	$376	$0	$1,858
39141955802	$1,309	$440	$0	$1,749
39141956400	$1,000	$140	$0	$1,140
Grand Total	**$166,038**	**$33,836**	**$0**	**$199,874**

Source: FEMA National Risk Index

Loss of Life

Loss of life is possible during sudden mine subsidence or landslides. However, there are no known fatalities in Ross County due to mine subsidence or landslides.

Economic Losses

Landslides and mine subsidence can block or destroy sections of roadways vital to shipping. Stores, storage facilities, and other structures that are important to economic activity can also be severely damaged or destroyed. It can also be quite expensive to repair sinkholes when they occur.

Future Trends

Land Use and Development Trends

Uses that serve vulnerable populations, such as schools and hospitals, should not be placed in areas that are in high-risk zones for landslides. Development should be limited to areas with minimal slope to reduce potential losses during landslides. Development should also consider low-impact techniques to reduce the likelihood of runoff from precipitation and therefore reduce the risk of landslides. If new residential construction units are within areas with steep slopes, it would increase property and population vulnerabilities in those areas.

Using the United States Geological Survey Landslide Inventory and Susceptibility map as a resource for mapping, future land use changes can reduce the potential of property damage. The map depicts areas that have increasing susceptibility to landslides. For Ross County there are several long stretches of state highways, roads, and rivers that have increasing susceptibility to landslides.

Climate Change

According to the Midwest chapter of the Fifth National Climate Assessment, the likelihood of precipitation has increased five to 15 percent, and the amount of rain falling during heavy precipitation events has increased by 45 percent on average between 1958 to 2021. Extreme precipitation could increase the likelihood of landslides in areas with steep slopes. Flooding caused by heavy precipitation could also increase the rate of runoff for acid mine drainage along rivers and streams. More frequent and intense rain events can also increase erosion rates and lead to greater amounts of sediment runoff into rivers, lakes, and streams (U.S. Environmental Protection Agency 2023).

4.7 Severe Summer Weather

Description

Severe summer weather events may include severe thunderstorms and thunderstorm winds, hail, and lightning. High winds, tornadoes, and flooding may also be related to severe summer storms, and due to the potential threat of these events, they are each discussed in separate risk assessments. While tropical storms and hurricanes are also forms of severe storms, Ross County does not have any record of such events affecting the County; therefore, the County has not deemed tropical storms and hurricanes to be a threat, and these specific types of weather will not be addressed further.

According to the National Weather Service (NWS), a severe thunderstorm is a thunderstorm that produces a tornado, has winds of at least 58 MPH, and/or hail at least one inch in diameter. A Severe Thunderstorm Watch is issued by the NWS if conditions are favorable for the development of severe thunderstorms. A watch is usually in place for four to eight hours, during which time people should be prepared to move to a safe place if threatening weather approaches.

A Severe Thunderstorm Warning is issued if either the WSR-88D radar indicates a severe thunderstorm or if a spotter reports a storm producing hail or winds meeting the criteria outlined in the description above. The WSR-88D radar is an advanced Weather Surveillance Doppler Radar utilized by the NWS to generate a radar image. The NWS recommends that people in the affected area seek safe shelter immediately, as severe thunderstorms have the potential to produce tornadoes with little-to-no advance warning. Lightning frequency is not a criterion for issuing a severe thunderstorm warning. The warnings are usually issued for one hour and can be issued without a Severe Thunderstorm Watch already in effect. The National Weather Service Forecast Office in Wilmington, Ohio is responsible for issuing Severe Thunderstorm Watches and Warnings for Ross County.

Lightning is caused by a rapid discharge of electrical energy that has built up in the atmosphere between clouds, the air, or the ground. Lightning strikes can be either direct or indirect. A direct strike is when lightning strikes a building or a specific zone, which can result in fusion points melting holes of varying sizes at the point of impact of materials with high resistivity. An indirect lightning strike is when lightning causes power surges that disrupt electrical equipment.

Severe summer weather can also create strong winds – often called “straight-line” winds – to differentiate thunderstorm winds from tornadic winds. These winds, which have the potential to cause damage, are caused by an outflow generated by a thunderstorm downdraft.

Hail is a type of frozen precipitation that occurs when thunderstorm updrafts carry raindrops upward into extremely cold atmospheric zones where they freeze before falling to the ground. The resulting hailstones can fall at speeds greater than 100 MPH and range in size from smaller than 0.50 inches (the size of a pea) to 4.5 inches (the size of a softball) (Source: National Weather Service).

The NWS can issue various types of wind advisories and warnings. A **wind advisory** is issued when sustained winds of 31 to 39 MPH are reached for an hour or more and/or if there are wind gusts of 46 to 57 MPH for any duration. A **High Wind Watch** indicates that sustained, strong winds are possible and outdoor items should be secured. People should modify plans, so they are not caught outside. Additionally, a **High Wind Warning** indicates that sustained, strong winds (40 MPH or greater) with even stronger gusts (greater than 58 MPH) are happening. People should seek shelter, and those driving should keep both hands on the wheel and slow down. An **extreme wind warning** is issued for surface winds of 115 MPH or greater associated with non-convective, downslope, derecho (not associated with a tornado), or sustained hurricane winds that are expected to occur within one hour.

Location

Severe summer weather is a countywide hazard, and all of Ross County is susceptible to severe summer weather.

Extent

Severe summer weather events have the potential to create large-scale damage in Ross County. Specifically, lightning is responsible for approximately 20 deaths annually across the United States, as well as hundreds of injuries (Source: NOAA). Winds associated with severe summer storms have the potential to cause damage by bringing down tree limbs and generating widespread power outages. Additionally, hail can result in property damage. Severe summer storms can lead to flooding, downed trees and power lines, and other dangerous conditions.

History

According to the National Centers for Environmental Information (NCEI), there have been 184 high-, strong- or thunderstorm-wind events, four lightning events, three heat events, two excessive heat events, and 72 hail events recorded in Ross County from January 1995 to December 2023. These events resulted in $10,373,256 in property damage and $33,000 in crop damage. There were two deaths and eight injuries caused by severe summer weather events in Ross County. The two deaths were caused by lightning on June 12, 1996, when lightning struck a propane tank and caused a nearby home to explode, and on June 29, 2005, when an inmate was struck and killed by lightning in the yard at the Chillicothe Correctional Institute. There were two injuries due to lightning on June 12, 1996; one injury due to lightning on September 29, 1999; and one injury due to lightning on June 29, 1999. All severe storm events from 1995 to 2023 are summarized in **Table 4.7.1**, below:

Table 4.7.1: Thunderstorm-Related Events in Ross County since 1995

Severe Storm Event Type	Number of Events	Injuries	Deaths	Property Damage	Crop Damages
Hail	72	0	0	$86,000	$6,000
Heat	3	0	0	$0	$0
Excessive Heat	2	0	0	$0	$0
Lightning	4	8	2	$80,000	$0
High Wind	13	0	0	$8,947,000	$0
Strong Wind	1	0	0	$5,000	$0
Thunderstorm Wind	170	0	0	$1,255,256	$27,000
Total	**265**	**8**	**2**	**$10,373,256**	**$33,000**

Source: NOAA Storm Events Database

Ross County has not had any disaster declarations for severe storms since the previous hazard mitigation plan. However, the County has been subject to four Major Disaster Declarations (DR) and one emergency declaration (EM) for severe storms, flooding, and a hurricane (Hurricane Katrina Evacuation) since January 1995. Several of the most damaging events and/or events that resulted in deaths and/or injuries are described in more detail below.

Emergency Declaration for Severe Storms in Ross County, June 30, 2012

A very hot and unstable airmass, combined with northwesterly flow aloft, produced a derecho across northern Illinois. This derecho quickly moved east-southeast across the Ohio Valley, causing widespread straight-line wind damage. Nearly every county in southeast Indiana, northern Kentucky, and southwestern Ohio experienced severe winds, leading to widespread power outages that lasted several days in some areas. Isolated large hail also occurred with the stronger parts of the system. Thunderstorm winds removed a metal roof from a building on Race Street, and numerous trees and

power lines were knocked down in Massieville and Tar Hollow State Forest. An emergency declaration (EM-3346-OH) was declared on June 30, 2012, offering public assistance for every county in Ohio. There were no injuries or deaths. However, $45,000 in property damages were reported because of this storm.

Major Disaster Declaration for Severe Storms and Flooding in Ross County, April 4, 2011 – May 15, 2011

Numerous severe storms affected Ross County between April 4 and May 15, 2011, causing extensive damage. Hail was sighted during multiple storms. The largest had a diameter of 1.75 inches (the size of a golf ball). The thunderstorms caused flash floods as well (more details located in the Flood Risk Assessment). A major disaster declaration (DR-4002-OH) was declared on July 13, 2011, offering public assistance to 21 counties. Ross County reported a total of $42,000 in property damage, $10,000 from thunderstorm wind and $32,000 from floods. No deaths or injuries were reported in Ross County from the events.

High Wind Event in Ross County on September 14, 2008:

A low-pressure system, remnant of Hurricane Ike, caused high winds throughout the State of Ohio, with the highest sustained wind measured at 54 mph and the highest wind gust at 74 mph. Wind gusts over 70 mph were common in Ross County. The winds caused extensive damage to utilities, properties, and crops. Thousands of trees fell on roofs and utility pools. Residents of Ross County were out of power for several days and some up to two weeks. There were no deaths or injuries reported in Ross County. This storm caused a total of $8.9 million in property damage.

Lightning Event in Ross County, June 29, 2005

An inmate in the yard at the Chillicothe Correctional Institute was struck and killed and five others were injured by a lightning strike on June 29, 2005. There were no property damages reported as a result of this storm event.

Lightning Event in Ross County, September 29, 1999

A man was struck by lightning and suffered injuries in Ross County on September 29, 1999. There were no deaths, additional injuries, or property damage reported as a result of this storm event.

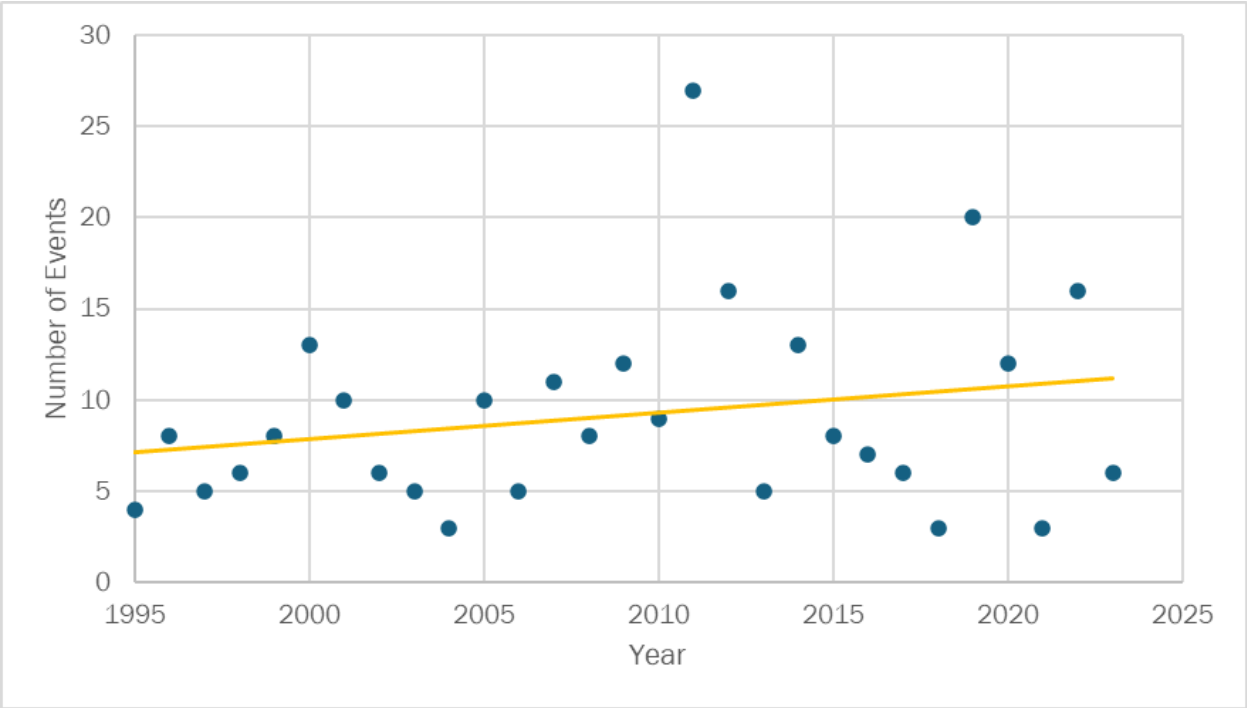
Lightning Event in Ross County, June 12, 1996

On June 12, 1996, lightning struck a propane tank which caused a nearby home to explode resulting in the death of one person and injuring two others. There were no additional deaths or injuries reported as a result of this storm event, however, there was $50,000 in property damage reported.

Probability

According to the NCEI, there have been 265 severe summer storm events reported in Ross County from January 1995 to December 2023 with total losses reaching at least $10,373,256 in property damage and $33,000 in crop damage. This amounts to around 9.46 severe summer storm events annually with average annual damages of approximately $371,652. **Figure 4.7,2** below shows the trend in number of severe summer weather events per year since 1995. The year 2011 had 27 severe summer weather events, the highest out of the last 28 years. Preliminary research suggests that the frequency and intensity of severe thunderstorms could increase as the climate changes, according to the National Climate Assessment. The Climate Change section in Future Trends discusses climate change further.

Figure 4.7.2: Severe Summer Storm Probability



Source: NOAA

Vulnerability Assessment

Infrastructure Impact

Above-ground infrastructure is at risk for storm damage by wind and falling debris. For infrastructure, high winds and hail are the most damaging part of a severe storm. Thunderstorm winds can strip bark from trees and detach limbs. If large branches fall, they can damage buildings and supporting above-ground infrastructure. In the most severe storms with high winds, large trees can be uprooted and have the potential to fall on buildings including houses, which can cause harm or death.

Utilities are at risk for damage by severe summer storms, as well. Electrical lines are spread throughout the County connecting homes, businesses, and other facilities. Severe storms are likely to down tree limbs and generate other debris that can affect above-ground electrical lines causing power outages. Downed power lines that are still live are extremely hazardous and can cause death by electrocution.

Population Impact

Summer storms are random in nature and affect the entire area of the County. Everyone within the County should be prepared during a storm event. Populations residing in mobile home parks are particularly vulnerable and should seek shelter.

For social vulnerability, according to the National Risk Index, hail, lightning, and strong wind had scores of 27.9 (“very low”), 85.7 (“relatively moderate”), and 65.6 (“relatively moderate”) for Ross County. This information indicates that severe summer storms are exposing the population of Ross County to relatively low risk from storm events. The index indicates an expected annual loss of $31,000 due to hail events, $410,000 due to lightning events, and $510,000 due to strong wind events, with 3.5, 74, and 1.9 events occurring per year, respectively.

Property Damage

As described above, severe summer weather events have caused an average of $10,373,256 in property damage and $33,000 in crop damage annually. Due to the non-site-specific nature of this hazard, **Tables 4.7.3-4.7.5** list all structures within Ross County as having potential impacts from severe storms.

Loss of Life

There have been two death and eight injuries in Ross County because of severe summer weather. There is always potential for injuries and fatalities during severe summer weather.

Economic Losses

Severe summer weather has the potential to damage infrastructure, resulting in the economic burden of clean up and repairs. Potential economic losses and damage associated with Ross County for hail, strong wind events, and lightning are recorded in **Tables 4.7.3-4.7.5** below.

Expected annual loss (EAL) rates, calculated by FEMA, identify the total value of loss expected each year for a particular community, in this case the census tracts for Ross County. Expected losses are assessed for buildings, population equivalence ($11.6 million for each fatality or 10 injuries), and agriculture per census tract. The tables below show the census tracts in Ross County by order of the highest total EAL to the lowest for hail, strong wind events, and lightning events. The EAL Total column combines the buildings, population, and agricultural losses for each census tract.

Table 4.7.3: Structure and Population Vulnerability from Hail

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955700	$1,227	$246	$2,141	$3,614
39141955603	$766	$175	$2,603	$3,544
39141956300	$2,854	$133	$91	$3,078
39141955500	$1,459	$266	$1,236	$2,961
39141956700	$937	$206	$931	$2,074
39141956500	$1,776	$164	$88	$2,029
39141955801	$999	$186	$627	$1,813
39141955604	$1,108	$301	$339	$1,748
39141956600	$1,018	$221	$499	$1,738
39141956900	$910	$186	$619	$1,715
39141956800	$971	$254	$202	$1,427
39141956000	$1,023	$240	$16	$1,278
39141955900	$906	$185	$106	$1,197
39141956100	$867	$153	$0	$1,019
39141955802	$585	$168	$112	$866
39141956400	$568	$145	$1	$714

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956200	$486	$99	$0	$585
Grand Total	**$18,461**	**$3,328**	**$9,613**	**$31,401**

Source: FEMA National Risk Index

Table 4.7.4: Structure and Population Vulnerability from Lightning

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955604	$545	$33,933	$0	$34,478
39141956800	$542	$31,964	$0	$32,505
39141955700	$681	$30,738	$0	$31,419
39141955500	$728	$30,219	$0	$30,947
39141956000	$529	$27,966	$0	$28,495
39141956600	$555	$27,387	$0	$27,942
39141956700	$547	$27,104	$0	$27,651
39141956900	$516	$23,692	$0	$24,208
39141955900	$507	$23,487	$0	$23,993
39141956500	$1,015	$21,035	$0	$22,050
39141955801	$480	$20,639	$0	$21,119
39141955802	$305	$19,768	$0	$20,073
39141955603	$364	$18,882	$0	$19,247
39141956400	$310	$17,826	$0	$18,136
39141956100	$445	$17,540	$0	$17,985
39141956300	$1,501	$15,788	$0	$17,288
39141956200	$273	$12,651	$0	$12,924
Grand Total	**$9,839**	**$400,620**	**$0**	**$410,459**

Source: FEMA National Risk Index

Table 4.7.5: Structure and Population Vulnerability from Strong Winds

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956300	$59,966	$4,843	$6	$64,815
39141956500	$37,318	$5,989	$6	$43,312
39141955500	$30,647	$9,687	$78	$40,412
39141955700	$26,290	$9,147	$139	$35,576

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955604	$23,285	$10,963	$21	$34,269
39141956000	$21,490	$8,733	$1	$30,224
39141956800	$20,402	$9,266	$13	$29,681
39141956600	$21,355	$8,053	$31	$29,439
39141955801	$20,993	$6,798	$39	$27,830
39141956700	$19,558	$7,430	$58	$27,046
39141956900	$19,113	$6,790	$39	$25,942
39141955900	$19,030	$6,747	$7	$25,784
39141956100	$18,211	$5,562	$0	$23,774
39141955603	$16,105	$6,366	$163	$22,634
39141955802	$12,301	$6,126	$7	$18,433
39141956400	$11,939	$5,278	$0	$17,216
39141956200	$10,208	$3,627	$0	$13,835
Grand Total	**$388,210**	**$121,405**	**$607**	**$510,222**

Source: FEMA National Risk Index

Future Trends

Land Use and Development Trends

Severe summer storms can occur anywhere, bringing an entire community or region to a standstill, including commuter and emergency transportation and medical services. Any development that has occurred since the adoption of the previous plan, and any future development, has the potential to be impacted by severe summer storms. All land uses are equally impacted by severe summer weather.

Building design and construction are also impacted by the intensity of summer storms. Areas prone to severe storms should have buildings designed to withstand high winds, heavy rainfall, and potential flooding to avoid structural damage. On the other hand, proper ventilation and cooling systems are essential to manage the heat and humidity that often accompany summer storms.

It is important to maintain consistency between emergency planning, financial plans and budgets, and development planning. Zoning codes should ensure that there is adequate greenspace in existing and new developments to foster drainage and provide space for water runoff. Locating emergency facilities, and partnering with emergency organizations during the planning process, will help develop improved contingency responses in cases where emergency transportation and services are cut off during an extreme weather event.

More buildings but less people can mean more property loss but less general population vulnerability. Similar median structure year built but older relative to today could mean more vulnerability to properties and inhabitants. Increase of people age 65+ from 2016 to 2021 could mean more vulnerability to summer storms. In Ross County, 6.0 percent of the land is developed with lower intensity land uses and 1.70 percent is developed with higher intensity uses. Approximately 91.47 percent of the County's land area is undeveloped with the remaining area being classified as barren or open water. The current total value of taxable real estate in Ross County is $ 1,631,861,800. In

2023, Ross County authorized 21 new residential units at a total value of $5,790,000. In 2023, the estimated population of Ross County was 76,501. The population is expected to decrease by 3.3 percent, or 2,590 people by 2030. An additional decrease of 10.5 percent is expected by 2040. Given these estimates, there are no known changes in risks associated with severe summer weather in Ross County.

Climate Change

Preliminary research suggests that the frequency and intensity of severe thunderstorms could increase as the climate changes, according to the National Climate Assessment. A warming climate may also increase the number of days with conditions conducive to a severe thunderstorm. Future modeling techniques could reveal additional information about the correlation between atmospheric changes and severe thunderstorm formation and intensity.

4.8 Severe Winter Weather

Description

Severe winter weather includes winter storms, heavy snow, and extreme cold. Winter storms including blizzards are events that have heavy snow, sleet, ice, freezing rain, or high winds as their primary type of precipitation. While the precipitation itself is typically not dangerous, frozen roads and exposure to cold can cause death and injury.

A winter storm forms under the correct combination of three causes:

1. Below freezing temperatures in the clouds and near the ground, which are necessary to make snow and ice.
2. Lift, which raises the moist air from the clouds and causes precipitation. Warm air colliding with cold air and being forced to rise over the cold is an example of lift.
3. Moisture is needed to form clouds and precipitation. Air blowing across a body of water is a common source of moisture.

Winter storms are categorized by their type: blizzards, ice storms, lake effect storms, and snow squalls. Extreme cold events often accompany winter storms, bringing low temperatures and higher risks of frostbite and hypothermia.

- **Blizzards** are winter storms that are a combination of blowing snow and wind which lead to very low visibility. Heavy snowfalls and severe cold often accompany blizzards, but this is not required. Ground blizzards occur when strong winds pick up snow that has already fallen.
- **Ice Storms** occur when at least a quarter inch of ice accumulates on exposed surfaces. Roads and sidewalks can become dangerously slick, and trees and powerlines can easily break under the weight of accumulated ice.
- **Lake Effect Storms** are cold, dry air masses that move over the Great Lakes regions and drop the moisture as snow in the northeastern portion of Ohio near the Great Lakes area.
- **Snow Squalls** are brief, intense snow showers accompanied by strong winds. Impacts may be significant.
- **Extreme Cold Events** occur when temperatures drop below normal for the given area and they generally coincide with winter storms or are the lasting effect of a winter storm.

Location

Winter storms are typically large events that impact large areas at once. Winter storms will impact the entire County and have the potential to impact multiple counties.

Extent

The State of Ohio Hazard Mitigation Plan 2024 lists winter storms as one of the three highest threat hazards in Ohio. The average annual snowfall in Ross County is 12 to 24 inches according to NOAA, similar to the state average of about 27 inches. Snowfall typically occurs between November and April with January being the coldest month on average.

History

There have been at least 38 winter storm events, and another 73 winter weather events including heavy snow, extreme cold/wind chill, cold/wind chill, frost freeze, and ice storm in Ross County since January 1995. These events caused $521,000 in property damage and $540,000 crop damage according to The National Centers for Environmental Information (NCEI). There was one reported death in Miami County due to a winter storm that also affected Ross County. There were no deaths or injuries

in Ross County. All severe winter weather and extreme cold events from 1995 to 2023 are summarized in **Table 4.8.1**, below:

Table 4.8.1: Severe Winter Related Events in Ross County since 1995

Severe Storm Event Type	Number of Events	Deaths	Injuries	Property Damage	Crop Damages
Cold/Wind Chill	1	0	0	$20,000	$0
Extreme Cold/Wind Chill	2	0	0	$0	$0
Heavy Snow	12	0	0	$1,000	$0
Frost/Freeze	1	0	0	$0	$540,000
Ice Storm	4	0	0	$0	$0
Winter Storm	38	0	0	$500,000	$0
Winter Weather	53	0	0	$0	$0
Total	**111**	**0**	**0**	**$521,000**	**$540,000**

Ross County has not had any disaster declarations for winter storms since the previous hazard mitigation plan. However, the County has been subject to two Major Disaster Declarations (DR) for snowstorms since January 1995. The most damaging events are described in more detail below.

Major Disaster Declaration for Severe Winter Storms, Flooding, and Mudslides, December 22, 2004 - February 1, 2005:

A fast-moving low-pressure system descended from Canada moving southeast across the Ohio Valley and bringing snow and sleet to southern Ohio, which turned into freezing rain. Ice accumulated on surfaces to a quarter inch thick before the precipitation turned back to snow. A major disaster declaration (Dr-1580-OH) was declared on February 15, 2005. There were no reports of property damage, injuries, or deaths from this event. Ross County was eligible for both individual and public assistance due to the disaster declaration.

Winter Storm in Ross County, January 6, 1996:

The Blizzard of '96 formed near the Gulf Coast and traveled up the East Coast, producing record-breaking snowfall at the Greater Cincinnati/Northern Kentucky Airport. This storm alone brought 14.3 inches of snow to the airport, which typically sees 23 inches over an entire season. The heaviest snowfall occurred near the Ohio River in the extreme south. West Central areas experienced the worst blizzard conditions, with dry, powdery snow being blown around by high winds, causing whiteouts. Some regions endured over 30 continuous hours of snowfall. Many residents in Southern Ohio considered this the worst winter storm since the Blizzard of '78. In Fayette County, the airport recorded a wind gust of 56 mph at the storm's peak. By the storm's end, many homes and businesses had roofs collapse or partially collapse due to the weight of the new snow combined with snow from an earlier storm. By late on the 7th, arctic air was moving into the region. Tragically, a 47-year-old man died of exposure under an overpass in Miami County, and a 76-year-old man died of exposure on his front porch in Montgomery County. There was $500,000 in property damage reported in Ross County as a result of this storm. There were no deaths or injuries reported in Ross County.

Emergency Declaration for Blizzards and Snowstorms in Ross County on January 26, 1978:

The worst winter storm in Ohio's history struck before dawn on Thursday, January 26th, 1978. The Blizzard of '78 raged through Thursday and into Friday, shutting down transportation, businesses,

industries, and schools statewide for two days. Normal activities didn't resume for five days. The rapidly intensifying storm brought bitter cold air from the west, with winds reaching 50 to 70 miles per hour by Thursday morning. These conditions, combined with heavy snowfall and blowing snow already on the ground, created full blizzard conditions across Ohio. The blizzard first hit Cincinnati at 1:00 a.m., reached Dayton an hour later, Columbus and Toledo around 3:00 a.m., and extended northeast to Akron, Youngstown, and Cleveland by 7:00 a.m. on January 26th. Prolonged blizzard conditions caused enormous snowdrifts, halting highway and rail transportation and isolating thousands of people. Air travel was suspended for two to three days due to low visibility and deep snowdrifts on runways. Ohio remained almost completely immobilized through Friday. An emergency declaration (EM-3055-OH) was declared on January 26th, 1978, offering public assistance for every county in Ohio.

Emergency Declaration for Snowstorms on February 2, 1977:

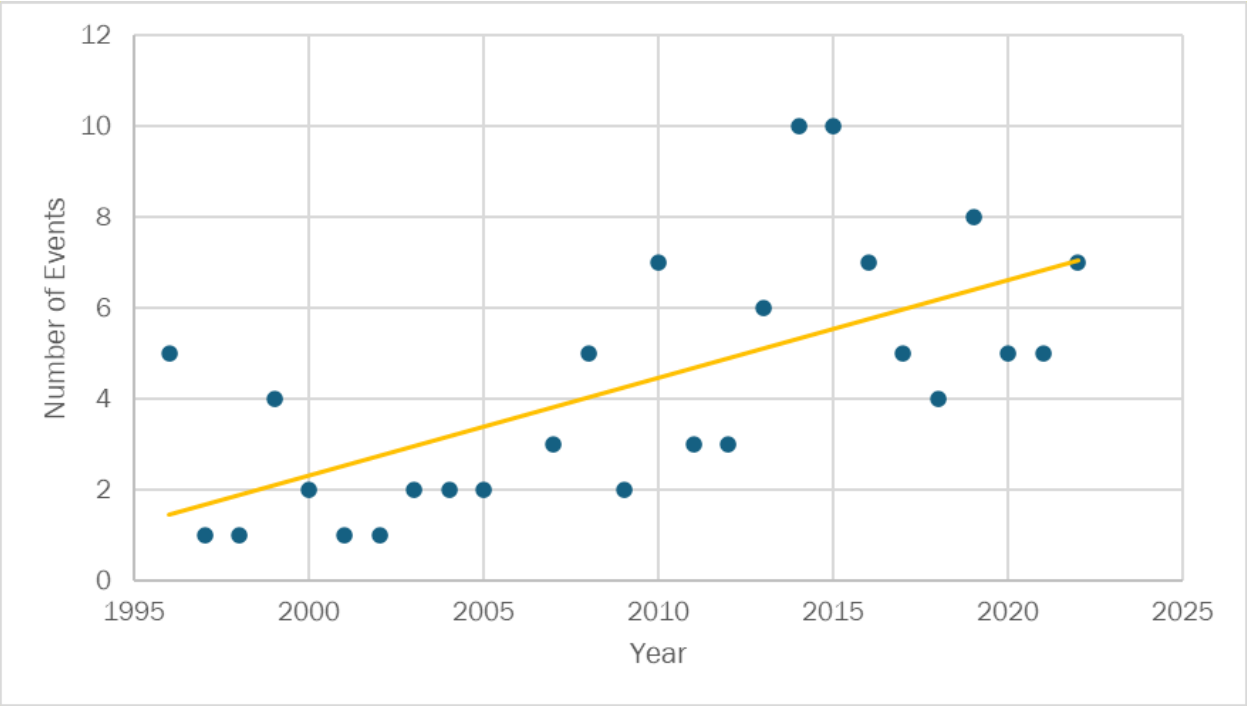
An emergency declaration (EM-3029-OH) was declared on February 2nd, 1977, for snowstorms for every county in Ohio. Ross County received public assistance.

Probability

According to the NCEI, there have been a total of 111 winter storms and winter weather events reported in Ross County from January 1995 to December 2023, with total losses amounting to $521,000 in property damage and $540,000 in crop damage. This amounts to approximately 3.96 winter storm events annually with average annual damages of $37,892. According to the Fifth National Climate Assessment, due to the warming climate, extreme winter weather will be less severe and less frequent in Ohio, and heavy snowfall will manifest as heavy rainfall in future years. The Climate Change section in Future Trends discusses climate change further.

Figure 4.8.2 shows the trend of severe winter weather events over time between January 1995 and December 2025. The trend line increases over the 28 years, illustrating an increase in winter weather activity in Ross County.

Figure 4.8.2: Severe Winter Weather Probability



Source: NOAA

Vulnerability Assessment

Infrastructure Impact

Winter storms can cause damage to overhead utilities. Wires can collapse under the weight of accumulated snow and ice leading to disruption in communication and power supply for days. Debris can block roadways or damage property as tree limbs can also collapse under the weight of accumulated snow and ice. Water pipes can be frozen under extremely low temperatures that may accompany severe winter storms. Roads and sidewalks can be blocked by the accumulation of snow, as well as being iced over. Bridges and overpasses are particularly dangerous because they freeze before other surfaces. Heavy snow fall and accumulation can cause business and private homes to have partial or full roof collapses.

Population Impact

All residents of Ross County are expected to be affected by severe winter storms. Infants, older adults, sick people, and pets are more vulnerable to injuries and health conditions related to exposure to heavy snow, ice, and lasting extreme cold temperatures. It is advisable to equip vulnerable populations with indoor easy-to-read thermometers and heating devices in locations where they are highly visible.

For social vulnerability, according to the National Risk Index, cold wave, ice storm, and winter weather had scores of 41.6 (“relatively low”), 91.6 (“relatively high”), 73.8 (“relatively moderate”) for Ross County. This information indicates that severe winter weather events are exposing the population of Ross County to relatively moderate risk from winter storm events. The index indicates an expected annual loss of $28,000 due to cold wave events, $621,000 due to ice storm events, and $127,000 due to winter weather events, with 0.2, 0.9, and 3.2 occurring per year, respectively.

Property Damage

Property can be damaged by accumulated snow and ice, debris, and falling trees and utility poles. Extreme low temperatures can also freeze the water in pipes which could cause them to explode. All buildings in the County are exposed and vulnerable to winter storms. The State of Ohio Hazard Mitigation Plan 2024 estimates annual potential losses due to damage caused by winter storms in Ross County to be $197,686.

Property owners should weatherproof their homes and buildings and conduct regular inspections to eliminate impacts from extreme weather conditions. The Federal Emergency Management Agency (FEMA) suggests that individuals with damaged property should contact their insurance company and take photos of any damage. If individuals are uninsured or underinsured, they should seek assistance by visiting www.DisasterAssistance.gov.

Loss of Life

There have been zero deaths due to winter weather events in Ross County. Likely causes of death are from iced-over and dangerous roads which lead to vehicular accidents, frostbite or hypothermia from prolonged exposure to cold, heart attacks from heavy snow shoveling, and carbon monoxide poisoning due to toxic fumes from heating sources.

A few ways to prepare and protect from extreme winter weather conditions include, but are not limited to, staying indoors and dressing warmly, staying off roads, avoid driving if already in a vehicle, equipping vehicles with an emergency supply kit, preparing for power outages and using heating devices intended for indoor use only, staying updated about emergency information and alerts, seeking medical assistance on signs of hypothermia or frostbite, and checking on neighbors.

Economic Losses

Economic losses can occur from businesses shutting down for potentially long periods of time. Economic activity can be completely halted during winter storms including transportation of goods and people. Electricity outages may lead to spoiled goods. Since winter storms occur during the winter season, damage to crops is unlikely but possible. Damaged buildings and pipes, fallen trees and power lines, and costs to repair damages and remove snow further impact the economy of cities and towns. **Tables 4.8.3-4.8.5** show the potential economic impacts if all structures within Ross County were damaged.

Expected annual loss (EAL) rates, calculated by FEMA, identify the total value of loss expected each year for a particular community, in this case the census tracts for Ross County. Expected losses are assessed for buildings, population equivalence ($11.6 million for each fatality or 10 injuries), and agriculture per census tract. The tables below show the census tracts in Ross County by order of the highest total EAL to the lowest for cold wave, ice storm, and winter weather events. The EAL Total column combines the buildings, population, and agricultural losses for each census tract.

Table 4.8.3: Structure and Population Vulnerability from Cold Wave

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955603	$68	$237	$5,900	$6,205
39141955700	$109	$330	$4,778	$5,217
39141955500	$130	$360	$2,801	$3,292
39141956700	$84	$280	$2,118	$2,483
39141955801	$89	$253	$1,422	$1,764

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956900	$81	$252	$1,404	$1,737
39141956600	$91	$300	$1,137	$1,528
39141955604	$99	$407	$769	$1,276
39141956800	$87	$344	$458	$889
39141956300	$255	$180	$206	$641
39141956500	$159	$223	$200	$582
39141955900	$81	$251	$240	$571
39141955802	$52	$228	$255	$535
39141956000	$91	$325	$36	$452
39141956100	$77	$207	$0	$284
39141956400	$51	$196	$2	$249
39141956200	$43	$135	$0	$178
Grand Total	**$1,649**	**$4,508**	**$21,725**	**$27,882**

Source: FEMA National Risk Index

Table 4.8.4: Structure and Population Vulnerability from Ice Storm

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956300	$90,441	$1,357	$0	$91,798
39141956500	$56,282	$1,678	$0	$57,960
39141955500	$46,264	$2,715	$0	$48,979
39141955700	$40,754	$2,636	$0	$43,391
39141955604	$35,118	$3,072	$0	$38,189
39141956000	$32,410	$2,447	$0	$34,857
39141956600	$32,275	$2,263	$0	$34,538
39141955801	$31,661	$1,905	$0	$33,566
39141956800	$30,770	$2,596	$0	$33,367
39141956700	$29,819	$2,111	$0	$31,930
39141956900	$28,826	$1,902	$0	$30,729
39141955900	$28,701	$1,891	$0	$30,592
39141956100	$27,466	$1,559	$0	$29,025
39141955603	$24,289	$1,784	$0	$26,073

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955802	$18,552	$1,716	$0	$20,268
39141956400	$18,006	$1,479	$0	$19,485
39141956200	$15,395	$1,016	$0	$16,412
Grand Total	**$587,031**	**$34,127**	**$0**	**$621,158**

Source: FEMA National Risk Index

Table 4.8.5: Structure and Population Vulnerability from Winter Weather

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956300	$8,778	$2,802	$3	$11,583
39141955500	$4,490	$5,605	$42	$10,137
39141955604	$3,409	$6,341	$12	$9,762
39141955700	$3,741	$5,140	$72	$8,953
39141956500	$5,463	$3,464	$3	$8,930
39141956800	$2,987	$5,360	$7	$8,354
39141956000	$3,146	$5,052	$1	$8,198
39141956600	$3,133	$4,671	$17	$7,821
39141956700	$2,894	$4,358	$32	$7,284
39141955801	$3,073	$3,932	$21	$7,026
39141956900	$2,798	$3,928	$21	$6,746
39141955900	$2,786	$3,903	$4	$6,692
39141955603	$2,357	$3,683	$89	$6,129
39141956100	$2,666	$3,218	$0	$5,883
39141955802	$1,801	$3,543	$4	$5,348
39141956400	$1,748	$3,053	$0	$4,801
39141956200	$1,494	$2,098	$0	$3,592
Grand Total	**$56,763**	**$70,151**	**$326**	**$127,240**

Source: FEMA National Risk Index

Future Trend

Land Use and Development Trends

Winter storms can occur anywhere bringing an entire community or region to a standstill, including commuter and emergency transportation and medical services. Any development that has occurred since the adoption of the previous plan, and any future development, has the potential to be impacted by winter storms. All land uses are equally impacted by severe winter weather.

Building design and construction is also impacted by the amount of snowfall. Areas that receive high snowfall should have buildings designed to withstand the weight of the snow to avoid sagging, cracking, and collapsing roofs. On the other hand, snow is a natural insulator, and snow accumulated on rooftops helps hold heat in buildings and, consequently, reduces heating costs.

It is important to maintain consistency between emergency planning, financial plans and budgets, and development planning. Zoning codes should ensure that there is adequate greenspace in existing and new developments to foster drainage and offers space to pile cleared snow. Locating emergency facilities, and partnering with emergency organizations during the planning process, will help develop improved contingency responses in cases where emergency transportation and services are cut off during an extreme weather event.

In Ross County, 6.0 percent of the land is developed with lower intensity land uses and 1.70 percent is developed with higher intensity uses. Approximately 91.47 percent of the County's land area is undeveloped with the remaining area being classified as barren or open water. The current total value of taxable real estate in Ross County is $ 1,631,861,800. In 2023, Ross County authorized 21 new residential units at a total value of $5,790,000. In 2023, the estimated population of Ross County was 76,501. The population is expected to decrease by 3.3 percent, or 2,590 people by 2030. An additional decrease of 10.5 percent is expected by 2040. Given these estimates, there are no known changes in risks associated with severe winter weather in Ross County.

Climate Change

According to the Midwest chapter of the Fourth National Climate Assessment, the average Midwest air temperature increased by more than 1.5 degrees Fahrenheit between 1900 and 2010. In recent years, however, warming has increased three times as quickly between 1980 and 2010. By the end of 2030, Ohio's climate may trend towards the climate of Southern Illinois. By 2100, Ohio might feel like Arkansas or Texas. As a result, the warming climate suggests that extreme winter weather will be less severe and less frequent in Ohio, and heavy snowfall will manifest as heavy rainfall in future years.

4.9 Tornadoes

Description

FEMA defines a tornado as "a violently rotating column of air extending from a thunderstorm to the ground." Tornadoes can generate wind speeds greater than 250 miles per hour. Tornado paths can be as large as one mile wide and 50 miles long. Nationally, there is an average of 800 tornadoes reported annually across all 50 states.

In general, the midsection of the United States experiences a higher rate of tornadoes than other parts of the country because of the recurrent collision of moist, warm air moving north from the Gulf of Mexico with colder fronts moving east from the Rocky Mountains. Supercells, which form from rotating thunderstorms, are the most destructive type of tornado.

Tornado Warnings are issued by the Wilmington, Ohio, Forecast Office when a tornado is indicated by the WSR-88D radar or sighted in person by spotters. The WSR-88D radar is an advanced Weather Surveillance Doppler Radar utilized by the NWS to generate a radar image. Once a warning has been issued, people in the warning area should seek shelter immediately. Warnings will include the location of the tornado, as well as what communities will be in its path. A tornado warning can be issued without a tornado watch, and they are typically issued for 30 minutes at a time. If the thunderstorm responsible for the formation of the tornado is also producing large volumes of rain, the tornado warning may be combined with a Flash Flood Warning. The NWS Office will follow up any Tornado Warnings with Severe Weather Statements to provide up-to-date information on the tornado and inform the public when the warning is no longer in effect (Source: NWS).

Location

Tornadoes can occur anywhere in Ross County. All areas and jurisdictions should be considered at risk for a tornado.

Extent

Tornadoes are measured by damage scale for their winds with greater damage equating greater wind speed. The original Fujita Tornado Damage Scale (F-scale) was developed in 1971 without much consideration to a structure's integrity or condition as it relates to the wind speed required to damage it. The Enhanced Fujita-scale (EF-Scale) took effect on February 1, 2007. This scale starts with the original F-scale's F0 through F5 ratings and classifies tornado damage across 28 different types of damage indicators. These indicators mostly involve building/structure type and are assessed at eight damage levels from 1 through 8. Therefore, construction types and their relative strengths and weaknesses are incorporated into the EF classification given to a particular tornado. The most intense damage within the tornado path will generally determine the EF scale given the tornado. Table 4.9.1 lists the classifications under the EF- and F-scale. It should be noted that the wind speeds listed in this table are estimates based on damage rather than measurements.

There are no plans by the National Oceanic Atmospheric Administration (NOAA) or the National Weather Service to re-evaluate the historical tornado data using the enhanced scale. Therefore, this Plan and subsequent plans will reference both scales until a complete switchover is deemed necessary.

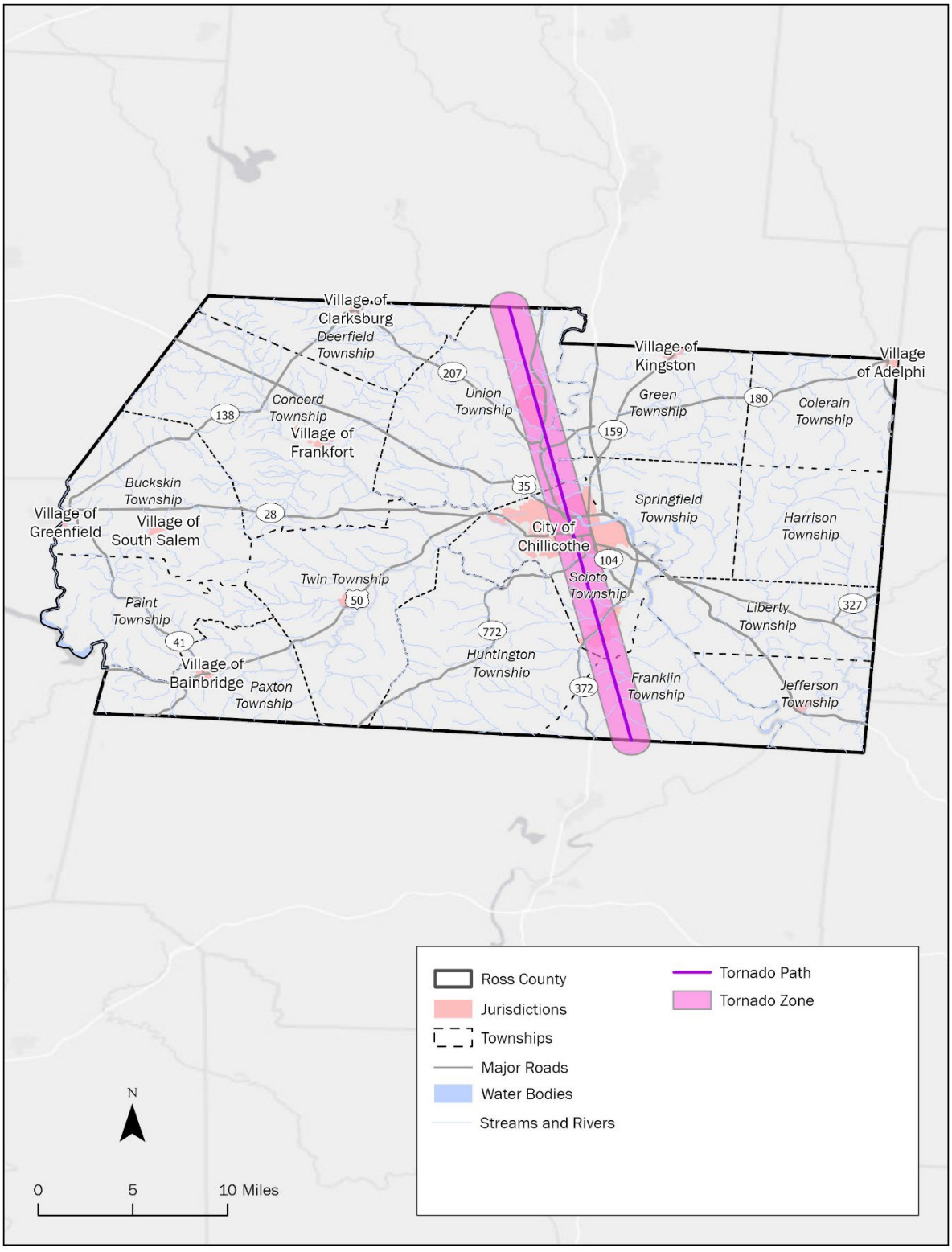
Figure 4.9.2 simulates an extremely destructive, worst-case scenario EF5 tornado and its impacts on Ross County assets and infrastructure. The worst-case scenario is simulated by running the EF5 tornado on a straight path through the most populated areas of the County. This theoretical scenario is performed to determine maximum potential damage within the County. The damages associated with this theoretical scenario are used to identify the County's potential vulnerability to tornadoes (Table 4.9.3).

Table 4.9.1: Fujita and Enhanced Fujita Scale Classifications

Fujita Scale 3-Second Wind Gust (MPH)		Damage Levels	Enhanced Fujita Scale 3-Second Wind Gust (MPH)	
F0	45-78	Light Damage: Tree branches down.	EF-0	65-85
F1	79-117	Moderate damage: Roof damage.	EF-1	86-110
F2	118-161	Considerable damage: Houses damaged.	EF-2	111-135
F3	162-209	Severe damage: Buildings damaged.	EF-3	136-165
F4	210-261	Devastating damage: Structures leveled.	EF-4	166-200
F5	262-317	Incredible damage: Whole towns destroyed.	EF-5	Over 200

Source: SOHMP

Figure 4.9.2: Worst Case Tornado Scenario



History

There have been 10 tornado events in Ross County between March 1995 and December 2023 resulting in a total of $655,000 in property damage and $18,000 in crop damage. No deaths were reported, however, one child sustained minor injuries during a tornado event on October 16, 2021, due to flying glass. Average annual damages from 1995 to 2023 are approximately $24,035.71 in property damages. There haven't been any disaster declarations related to tornadoes declared since the 2020 Hazard Mitigation Plan.

An EF0 Tornado in the Village of Frankfort on March 3, 2023:

An EF0 tornado touched down southwest of Adena Middle/High School on March 3, 2023. The short-lived tornado traveled northeast, uprooting trees just west of County Road 550. Tree damage was reported between Climer Lane and Adena Middle/High School. A concession stand's roof sustained minor damage at the athletic fields and a chain-link fence was damaged as well. The tornado then traveled northeast causing damage to a barn/outbuilding near the cul-de-sac of Climer Lane before dissipating. No injuries or deaths were reported. There was approximately $15,000 in property damage reported.

An EF0 and EF2 Tornado in the Village of South Salem and an EF0 in Deerfield Township on October 16, 2021:

A cold front moved through the Ohio Valley, producing damaging winds and isolated tornadoes on October 16, 2021. Three tornadoes, two EF0 and one EF2, were reported in Ross County. An EF0 tornado touched down briefly on a residential property, damaging a few outbuildings and a large shipping container. A child was minorly injured by flying glass. An EF2 tornado touched down near South Salem Cemetery and caused damage to trees, then traveled toward Stewart Street, causing damage to two structures. The tornado damaged power poles as it moved southeast to Main Street, where it continued to cause tree and structure damage. The final tornado to touch down during the storm was an EF0. The tornado touched down near Volmar Road, then traveled toward Cattail Road and damaged trees and roofs along its path. No deaths were reported and only one person sustained injuries. There was approximately $430,000 property damage reported.

An EF1 Tornado in Huntington Township on July 11, 2009:

An EF1 tornado touched down in Summithill within Huntington Township on July 11, 2009. The tornado touched down near a grocery store close to State Route 772 and Valley Road, then traveled toward Schaffer Road, causing damage to six homes and two mobile homes. In addition, several trees were snapped and/or uprooted. The tornado caused widespread crop damage and destroyed two barns off Denver Road. No deaths or injuries were reported. There was approximately $95,000 in property damage and $15,000 in crop damage reported.

Probability

There have been 10 tornado events in Ross County between January 1995 and December 2023 resulting in a total of $637,000 in property damages. Average annual damages amount to about $24,035.

There were five tornadoes reported between 1995 and 2009, and five tornadoes reported between 2020 and 2023. Overall, there is a 36% chance that Ross County will experience a tornado during any year.

Although it is difficult to predict future tornado activity, a study completed in 2018 on spatial trends of tornadoes saw an eastward shift in tornado frequency. Two other studies (2015 and 2016) showed an increase in tornado frequency in the eastern United States and a decrease in tornado activity in central United States. The study published in 2016 on spatial redistribution of tornado activity stated that there is a documented increase in hazardous conductive weather (HCW) in the lower Ohio valley

regions. The studies do note that the number of tornadoes produced from a single storm are increasing. For instance, in 2020 there were a total of 20 documented tornadoes in Ohio, with a single storm capable of producing up to seven tornadoes.

Vulnerability Assessment

Infrastructure Impact

Above-ground infrastructure can be damaged by tornadoes. Debris caught in tornadoes as well as fallen trees can cause damage to buildings and infrastructure. Debris can lead to closure. Above ground utility infrastructure can be damaged or destroyed, which can cause service outages.

Population Impact

Tornadoes are random in nature and have the potential to occur anywhere in the County. Everyone within the County should be prepared for a tornado. Residents in mobile home parks are particularly vulnerable and should have a plan in place.

For social vulnerability, according to the National Risk Index, tornadoes have a score of 57.4. ("relatively low") in Ross County. Tornadoes that have occurred in Ross County are typically weaker tornadoes, rated EF-2 or lower. The index indicates an expected annual loss of $1.3 million due to tornadoes, with 0.4 events occurring per year.

Property Damage

Tornadoes can cause significant damage to buildings and properties. In the last 28 years the property damage in Ross County has been related to major structural damage to businesses and homes, roof damage, siding damage, and extensive tree damage. The average amount of property damage is $63,700 per tornado. One of the tornadoes that hit Ross County resulted in $300,000 in property damage.

Additionally, there are currently 129 state-owned and state-leased critical facilities located within Ross County, according to the Ohio Emergency Management Agency. One of these facilities is located within a relatively high tornado risk area and has a value of approximately $1,156,000. Of these facilities, 124 are located within a relatively moderate tornado risk area and have a value of approximately $508,377,826.

Loss of Life

There have been no reports of deaths, but one injury since 1995. Loss of life and injuries are always possible during tornadoes. Falling debris is the main the cause of death in a tornado, along with becoming airborne.

Economic Losses

Tornadoes can cause major damage to structures and roads. Higher severity tornadoes have the potential to destroy structures. Debris also has the potential to cause damage to structures by breaking windows, damaging walls, or falling directly onto buildings and above-ground infrastructure. Potential economic losses and damage associated with Ross County for tornadoes are recorded in **Table 4.9.3** below.

This table summarizes expected annual loss for agriculture (EALA), expected annual losses (EAL) for buildings, and the expected annual loss for population equivalence (EALPE) in Ross County, for the census tracts according to FEMA's National Risk Index. Damage to utilities and roadways may also cause economic damage due to business closures, destruction of goods that require electricity, and the halt of economic activity.

Table 4.9.3: Structure and Population Vulnerability from Tornado

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141956300	$125,923	$17,381	$7	$143,312
39141956500	$78,364	$21,492	$7	$99,862
39141955500	$64,351	$34,763	$106	$99,220
39141955700	$56,068	$33,426	$218	$89,712
39141955604	$48,895	$39,342	$34	$88,272
39141956000	$45,128	$31,343	$2	$76,472
39141956800	$42,845	$33,257	$38	$76,139
39141956600	$44,832	$28,881	$63	$73,776
39141955801	$44,083	$24,395	$65	$68,542
39141956700	$41,016	$26,585	$88	$67,689
39141956900	$40,135	$24,366	$88	$64,589
39141955900	$39,962	$24,214	$12	$64,187
39141956100	$38,242	$19,962	$0	$58,203
39141955603	$33,818	$22,847	$204	$56,869
39141955802	$25,832	$21,988	$10	$47,830
39141956400	$25,070	$18,940	$0	$44,010
39141956200	$21,435	$13,016	$0	$34,451
Grand Total	**$815,999**	**$436,197**	**$941**	**$1,253,137**

Source: FEMA National Risk Index

Future Trends

Land Use and Development Trends

Tornadoes can occur anywhere. Any development that has occurred since that previous plan and any future development has the potential to be impacted by tornadoes. While the location of development will not be impacted by tornadoes, shelters should be installed in high occupancy buildings, parks, fairs and festivals, mobile home parks, and similar developments.

In 2023, Ross County authorized 21 new residential units at a total value of $5,790,000. Though there are more buildings being built, Ross County's population is on a downward trend with a decrease of 592 persons from 2020 to 2023 (0.77 percent). The decrease in population is set to continue in 2030 by an additional 2,590 persons (3.93 percent). More buildings but less people can mean more properties potentially exposed in a tornado event but generally less population vulnerability. Similar median structure built but older relative to today could mean more vulnerability to properties and inhabitants.

Climate Change

While rainfall, heat, and drought have clear links to climate change, the link between climate change and tornadoes is not yet fully understood. Tornado records in the United States are often only available starting during the 1950s. This limited data set makes it difficult to compare trends over long periods of time. Additionally, tornado reporting was not fully standardized until 2007, when the Enhanced Fujita Scale was released.

However, some short trends have been identified, although not yet linked directly to climate change. The number of days with tornadoes in the United States has fallen, but tornado outbreaks, or the number of tornadoes in one day, have increased. The density and strength of tornadoes has also increased. Finally, tornado distribution has shifted eastwards, which includes a move toward Ohio (Center for Climate and Energy Solutions).

According to the Fifth National Climate Assessment, severe storms are brief and cover small areas, thus the effects of climate change are difficult to measure. It is known that tornado activity has become more variable, with a decrease in the number of days per year with tornadoes but an increase in the number of tornadoes that occur on these days. In general, there is some indication that the frequency and intensity of thunderstorms will increase in a warmer climate. However, the effect on tornadoes is unclear.

4.10 Wildfire

Description

A wildfire is an uncontrolled fire that burns in a natural area of combustible vegetation such as a forest, grassland, or prairie, and typically occurs in rural areas. Non-wilderness fires are uncontrolled burning in residential or commercial development that are out of the scope of this plan. However, it is important to note that non-wilderness fires often accidentally cause wildfires. They can happen at any time or place, and more than half of the wildfires recorded have been started due to human activity. While wildfires can be caused by human activity or a natural phenomenon such as lightning, it is often the weather conditions that determine how much a wildfire grows.

Location

According to the State of Ohio Hazard Mitigation Plan (SOHMP), Ross County is within Region 3, which is within the Ohio Department of Natural Resources (ODNR) Division of Forestry's Forest Fire Protection Area. Counties within this region tend to have abundant forest lands and grasslands. Region 3 is not as flat as western Ohio, having more ridges and hollows, which contributes to the more complex wildfire behavior. The ODNR requires wildfire data from fire departments by all counties within the region. The Ohio Wildfire Protection Areas are shown in **Figure 4.10.1**.

Extent

Several factors can contribute to the escalation of risk for wildfires, including the prevalence of forests and agricultural lands and their proximity to homes, residences, and structures, as well as the distance between fire and emergency management services. In these cases, the presence of fire near structures causes fire departments to shift focus away from fire suppression and toward structure protection.

According to the SOHMP, 99.9 percent of wildfires in Ohio are caused by human action or accident. As such, many wildfires in Ohio burn in proximity to homes and structures. From 2018 to 2022, the main causes of wildfires in Ohio included debris burning, incendiary (arson), equipment, smoking, campfires, children (playing with matches), lightning, and railroad.

History

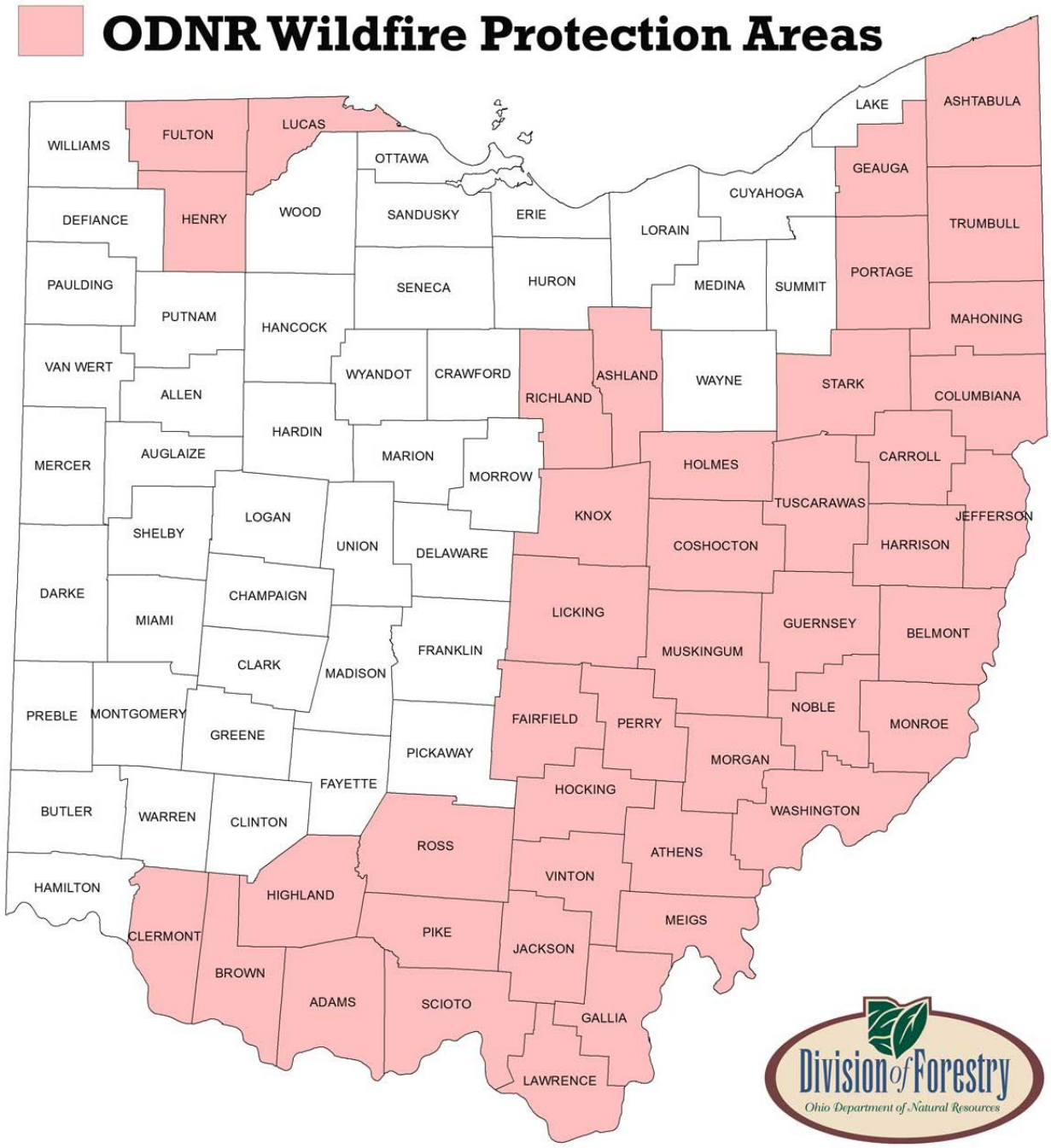
The SOHMP identifies 98 total fire events from 2018 to 2022, with an average of 4.57 acres burned per incident. These events burned a total of 448 acres. There were 22 structures damaged during the wildfire events and five injuries were reported.

Estimating the monetary losses associated with wildfires is difficult because most of these events occur on open land or fields with monetary losses often not being recorded. This lack of data may result in inconsistencies if an analysis was done based on reported monetary loss. As such, acres burned per fire event is a more consistent method of analysis for this hazard.

Probability

According to the State of Ohio Hazard Mitigation Plan, there is a 100 percent probability that a wildfire will occur within any county in any given year. Based on the reported 98 fire events in Ross County from 2018 to 2022, an average of approximately 19.6 fire events is estimated to occur annually in the County. In addition, according to the U.S. EPA, the average total area burned by wildfires has increased since the 1980s, and the record-breaking fires tend to occur during record-breaking warm years. The Climate Change section in Future Trends discusses climate change further.

Figure 4.10.1: Ohio Wildfire Protection Areas



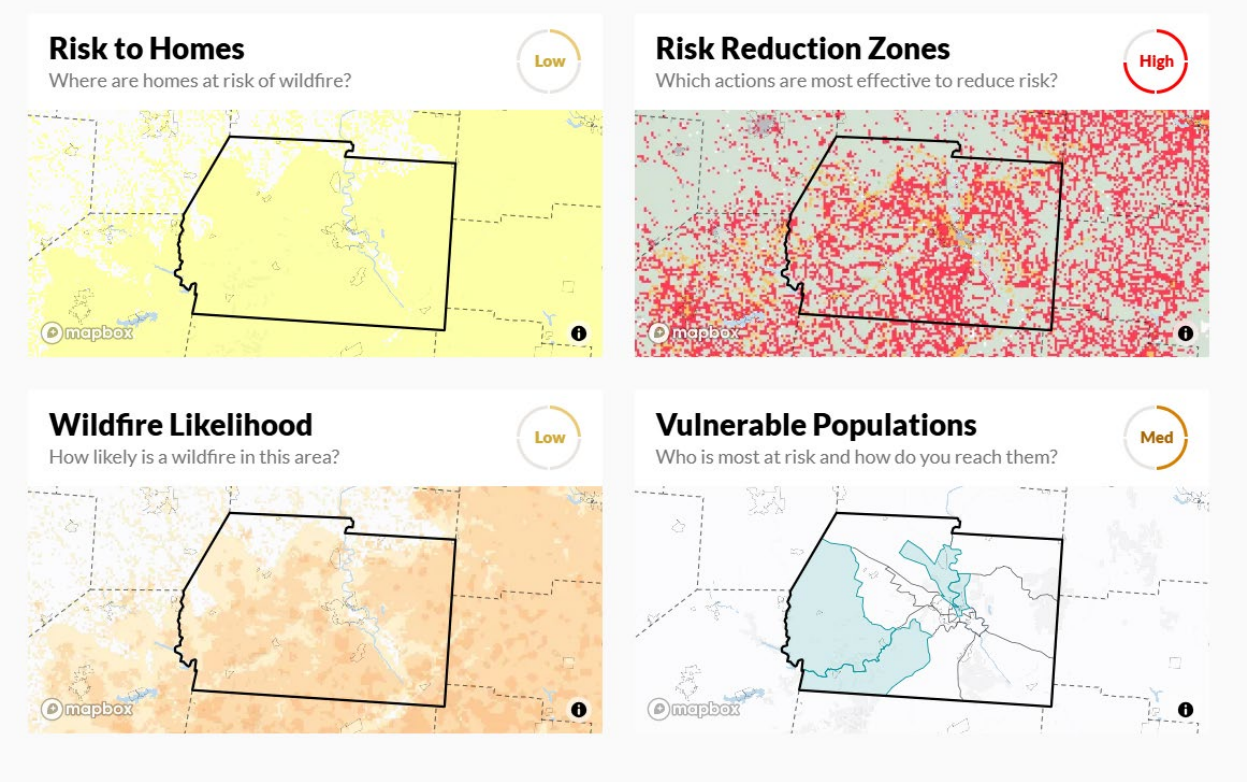
Source: ODNR Ohio Division of Forestry

Vulnerability Assessment

Infrastructure Impact

According to the USDA Forest Service Wildfire Risk to Communities, a free website with interactive maps and charts, Ross County has a medium-high risk of wildfire damage to infrastructure (**Figure 4.10.2**).

Figure 4.10.2: Wildfire Risk for Ross County



Source: USDA Forest Wildfire Risk to Communities

Population Impact

Figure 4.10.2 also shows vulnerable populations within Ross County. The highlighted-blue polygons are for areas that rank above the local median for residents that live in mobile homes and for residents with disabilities. Overall, Ross County residents have a medium risk of wildfire. If a wildfire occurs within the County, the population could be impacted by loss of homes and crops.

For social vulnerability, according to the National Risk Index, wildfires have a score of 68.0 ("relatively low") in Ross County. The wildfires that have occurred in Ross County have only had some impact on properties and crops. The index indicates an expected annual loss of $131,000 due to wildfires with a less than 0.030 percent change of a wildfire event occurring per year.

Property Damage

There were 98 recorded wildfire events between 2018 and 2022 in Ross County, and 22 structures reported damage due to the wildfires. it is assumed that the County has experienced some property and crop damage because of wildfires. Occasionally, in the event of a wildfire, fire engines belonging to local fire departments can be damaged while suppressing wildfires, although there are no reports of this in Ross County. Potential economic losses and damage associated with Ross County for wildfires are recorded in **Table 4.10.3** below.

This table summarizes expected annual loss for agriculture (EALA), expected annual losses (EAL) for buildings, and the expected annual loss for population equivalence (EALPE) in Ross County, for the census tracts according to FEMA's National Risk Index. The census tracts are listed most vulnerable to least vulnerable.

Table 4.10.3: Structure and Population Vulnerability from Wildfire

Census Tract	Expected Annual Loss (Agriculture)	Expected Annual Loss (Building)	Expected Annual Loss (Population Equivalence)	Expected Annual Loss (Total)
39141955500	$24,884	$2,368	$5	$27,256
39141955604	$24,609	$1,510	$2	$26,121
39141955700	$20,349	$2,364	$7	$22,721
39141955802	$12,151	$2,047	$1	$14,199
39141955801	$10,397	$1,111	$2	$11,510
39141955603	$9,034	$1,372	$3	$10,408
39141956600	$7,160	$758	$1	$7,918
39141956900	$3,917	$358	$1	$4,276
39141956000	$3,727	$488	$0	$4,216
39141956800	$697	$103	$0	$801
39141956300	$760	$38	$0	$798
39141955900	$691	$72	$0	$764
39141956700	$217	$22	$0	$239
39141956400	$89	$3	$0	$92
39141956100	$55	$5	$0	$60
39141956500	$39	$4	$0	$44
39141956200	$32	$1	$0	$34
Grand Total	**$118,808**	**$12,625**	**$23**	**$131,456**

Source: FEMA National Risk Index

Loss of Life

Ross County has no recorded wildfire events resulting in loss of life, however, there have been several injuries reported. Injuries caused by wildfires are not widely publicized, so information is limited. With any wildfire event, there is potential for loss of life. Advanced evacuation warnings can reduce the likelihood of death because of wildfires.

Economic Losses

Wildfires have the potential to damage agricultural crops and tree plantations, which can result in economic losses. According to the SOHMP, there are 96 state-owned or state-leased community lifelines (critical facilities) within regions of moderate wildfire hazard exposure. These facilities have a total replacement cost of $483,523,985. There are 13 state-owned or state-leased community lifelines (critical facilities) within regions of relatively low wildfire hazard exposure. These facilities have

a total replacement cost of $10,351,796. There are 20 state-owned or state-leased community lifelines (critical facilities) within regions of low wildfire hazard exposure. These facilities have a total replacement cost of $16,922,739.

Future Trends

Land Use and Development Trends

Communities should monitor areas that are especially susceptible to wildfires and avoid development in such areas. New developments in these areas should implement fire protective measures. Slight increase in forested and pasture/hay areas can mean slightly more vulnerability to wildfire. If newer structures are built closer to the Wildland Urban Interface, it could result in increased vulnerability to the structures and inhabitants.

Figures 1.2.1 and 1.2.2 in **Chapter 1** show areas susceptible to drought and heatwaves. New construction should reference the figures and resources outlined in this plan in order to minimize risk of drought and heatwaves, which can increase wildfire spread.

Climate Change

According to the U.S. EPA and National Climate Assessment, the national average total area burned by wildfires has increased since the 1980's, and the record-breaking fires tend to occur during record-breaking warm years. Combustion from wildfires also releases carbon dioxide into the atmosphere, contributing to climate change and negatively impacting human health. If climate change increases the frequency and intensity of drought in the region, then the risk of wildfire can also increase.

5 | Hazard Mitigation Strategy

5.1 Hazard Mitigation Strategy

Hazard Priorities

Potential hazards, including natural, geological, and human-caused hazards, were rated by members of the Core Planning Committee, which included representatives from each jurisdiction in Ross County. Each potential hazard was rated on a scale of zero to five, with zero indicating the hazard should not be studied and five indicating the most significant threat to the representative's jurisdiction. A priority score was developed for each hazard by averaging the representatives' ratings. The hazards were then ranked by their priority score, where the highest priority score was given a hazard rank of one for each jurisdiction within the County and for the County itself. If hazards received the same rank they were ranked alphabetically. The resulting hazard rank and associated priority score for each hazard are shown in Tables 5.1.1 –5.1.8.

Table 5.1.1: Ross County Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Tornadoes	4.36	2
Flooding	4.27	3
Severe Winter Weather and Extreme Cold	3.73	4
Wildfire	3.27	5
Landslides and Land Subsidence	3.18	6
Severe Summer Weather	3.18	7
Dam/Levee Failure	2.82	8
Drought and Extreme Heat	2.73	9
Invasive Species	2.09	10
Earthquakes	1.27	11

Table 5.1.2: City of Chillicothe Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Flooding	5.00	2
Drought and Extreme Heat	4.00	3
Severe Summer Weather	4.00	4
Tornadoes	4.00	5
Invasive Species	3.00	6
Severe Winter Weather and Extreme Cold	3.00	7
Wildfire	3.00	8
Earthquakes	2.00	9
Dam/Levee Failure	1.00	10

Hazard	Priority Score	Hazard Rank
Landslides and Land Subsidence	1.00	11

Table 5.1.3: Village of Adelphi Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Severe Winter Weather and Extreme Cold	5.00	2
Tornadoes	5.00	3
Landslides and Land Subsidence	4.00	4
Severe Summer Weather	4.00	5
Invasive Species	3.00	6
Wildfire	3.00	7
Drought and Extreme Heat	2.00	8
Dam/Levee Failure	Do Not Include	
Earthquakes	Do Not Include	
Flooding	Do Not Include	

Table 5.1.4: Village of Bainbridge Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Tornadoes	5.00	2
Severe Summer Weather	4.00	3
Flooding	3.00	4
Severe Winter Weather and Extreme Cold	3.00	5
Dam/Levee Failure	2.00	6
Drought and Extreme Heat	2.00	7
Wildfire	2.00	8
Earthquakes	1.00	9
Invasive Species	Do Not Include	
Landslides and Land Subsidence	Do Not Include	

Table 5.1.5: Village of Clarksburg Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Tornadoes	4.00	2
Drought and Extreme Heat	3.00	3

Hazard	Priority Score	Hazard Rank
Severe Summer Weather	3.00	4
Severe Winter Weather and Extreme Cold	3.00	5
Flooding	2.00	6
Dam/Levee Failure	1.00	7
Invasive Species	1.00	8
Landslides and Land Subsidence	1.00	9
Wildfire	1.00	10
Earthquakes	Do Not Include	

Table 5.1.6: Village of Frankfort Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Flooding	4.00	2
Severe Winter Weather and Extreme Cold	3.00	3
Tornadoes	3.00	4
Dam/Levee Failure	2.00	5
Severe Summer Weather	2.00	6
Drought and Extreme Heat	1.00	7
Earthquakes	1.00	8
Landslides and Land Subsidence	1.00	9
Wildfire	1.00	10
Invasive Species	Do Not Include	

Table 5.1.7: Village of Kingston Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Tornadoes	5.00	2
Flooding	4.00	3
Wildfire	3.00	4
Invasive Species	2.00	5
Landslides and Land Subsidence	2.00	6
Severe Summer Weather	2.00	7
Severe Winter Weather and Extreme Cold	2.00	8
Drought and Extreme Heat	1.00	9

Hazard	Priority Score	Hazard Rank
Earthquakes	1.00	10
Dam/Levee Failure	Do Not Include	

Table 5.1.8: Village of South Salem Hazard Priorities

Hazard	Priority Score	Hazard Rank
Multiple Hazards	5.00	1
Dam/Levee Failure	5.00	2
Tornadoes	5.00	3
Severe Winter Weather and Extreme Cold	4.00	4
Drought and Extreme Heat	3.00	5
Flooding	3.00	6
Wildfire	3.00	7
Landslides and Land Subsidence	2.00	8
Severe Summer Weather	2.00	9
Invasive Species	1.00	10
Earthquakes	Do Not Include	

Hazards Not Assessed

Below is a discussion covering hazards that were not included in this Plan update, as compared to the hazards included in the SOHMP and in Ross County's previous 2020 HMP.

Coastal Erosion

Coastal erosion is a hazard that is not applicable to Ross County due to the County's inland location, so it was not assessed.

Dam/Levee Failure

The Village of Adelphi and the Village of Kingston have opted to not include any mitigation actions for the hazard.

Earthquakes

The Village of Adelphi, Village of Clarksburg, and Village of South Salem have opted to not include any mitigation actions for the hazard.

Flooding

The Village of Adelphi has opted to not include any mitigation actions for the hazard.

Hurricanes/Tropical Storms

Hurricanes/tropical storms are hazards that are not directly applicable to Ross County due to the County's inland location, so they were not assessed. However, if remnants of hurricanes or tropical storms were experienced as thunderstorms, thunderstorm winds, or high/severe winds, those events were included in the severe summer storms and/or tornado assessments.

Invasive Species

The Village of Bainbridge and the Village of Frankfort have opted to not include any mitigation actions for the hazard.

Landslides and Land Subsidence

The Village of Bainbridge has opted to not include any mitigation actions for this hazard.

Seiche/Coastal Flooding

Seiche/coastal flooding is a hazard that is not applicable to Ross County due to the County's inland location, so it was not assessed.

5.2 Hazard Mitigation Goals

Developing achievable goals forms the foundation for all mitigation actions and activities that will aid Ross County in attaining the overall mission of the Core Planning Committee. As such, the Core Planning Committee and participating jurisdictions assessed the goals of the 2020 Hazard Mitigation Plan and updated them for this Plan update. Goals were established and reviewed based upon their relationship to the hazard priorities and potential adverse impact of those hazards upon the community. The goals, as well as the hazards assessed for this Plan, informed the development of actions that the County and participating jurisdictions can take to mitigate the impacts of the hazards. The goals of the Ross County Hazard Mitigation Plan are as follows:

- Goal 1: Reduce or eliminate impact on public safety, lives, and property.
- Goal 2: Provide timely warning.
- Goal 3: Create self-sufficiency.
- Goal 4: Plan for safe development.
- Goal 5: Increase public awareness.

Hazard Mitigation Actions & Priorities

Members of the Core Planning Committee completed a Previous Mitigation Action Status survey, which indicated the status of mitigation actions included in the 2020 Hazard Mitigation Plan. This survey asked representatives to indicate whether the mitigation actions from the previous plan were completed, deleted, deferred, unchanged, or ongoing. It also asked the representative if the mitigation action should be included in this Plan update. The results are included in Appendix B. In addition, new mitigation actions were developed and considered for inclusion in this Plan update that address gaps in the previous plan or new issues that have arisen since the 2020 Plan.

All new and previous mitigation actions were reviewed and rated by members of the Core Planning Committee and local jurisdictions based on five criteria: cost-effectiveness, technical feasibility, environmental soundness, immediate need, and total risk reduction. For each action, each of the five criteria were rated on a scale of one to five (low to high). All of the surveys were collected and the individual criteria for each mitigation action were averaged and then added together to develop a single raw score for each individual mitigation action per jurisdiction. The raw score for each action was used in combination with the rankings of the associated hazard, as determined by the Hazard Priority Survey (Tables 5.1.1 – 5.1.8), to develop a score for each mitigation action. The scores were then ranked to indicate the priority of each specific action. The mitigation action with the highest score was given a priority of one, indicating that it received the highest priority. Hazard Mitigation Action priorities are organized by hazard in Table 5.2.1 – Table 5.2.8. Each table is specific to the jurisdiction. The information used to develop the priorities from the jurisdictions' surveys and comments can be found in Appendix G, along with all completed surveys that were used to prioritize the hazards and develop the goals.

Mitigation projects will only be implemented if the benefits outweigh the associated costs of the proposed projects. The Core Planning Committee, in coordination with the Ross County EMA, performed a general assessment of each action that would require FEMA funding as part of the planning process. A detailed cost-benefit analysis of each mitigation action will be required during the project planning phase to determine the economic feasibility of each action. Projects will also be evaluated for social and environmental impact-related feasibility, as well as technical feasibility and any other criteria that evaluate project effectiveness. This evaluation of each project will be performed during the pre-application phase of a grant request. Project implementation will be subject to the availability of FEMA grants and other funding sources, as well as local resources.

Projects that are determined to be infeasible during this review process will be re-evaluated by members of the Core Planning Committee for re-scheduling or deletion.

Table 5.2.1: Mitigation Actions Priority Table by Hazard for Ross County

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure								
1	Ensure all high-hazard potential dams have updated Emergency Action Plans (EAPs) in place.	Ross County, Huntington Township, Springfield Township	8	21	Ross County EMA, Ross County Floodplain Manger, Township Trustees	General Operating Budget	11/2025 - 11/2030	New
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Included with Multiple Hazards)								
Flooding								
2	Coordinate rain and stream gauges.	Ross County, Huntington Township, Springfield Township	3	19	Ross County EMA, Ross County Floodplain Manger, Township Trustees	General Operating Budget	11/2025 - 11/2030	Previous
3	Ensure all eligible jurisdictions are participating in the NFIP.	Ross County, Huntington Township, Springfield Township	3	16	Ross County EMA, Township Trustees	General Operating Budget	11/2025 - 11/2030	New
4	Reinforce stream banks along Trego Creek to reduce flooding and erosion.	Huntington Township	3	17	Huntington Township Trustees	General Operating Budget	11/2025 - 11/2030	New
5	Mitigate Structures at Risk.	Ross County, Huntington Township, Springfield Township	3	15	Ross County EMA, Township Trustees	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
6	Obtain or create inundation maps for all dams.	Ross County, Huntington Township, Springfield Township	3	18	Ross County EMA, Township Trustees	Staff Time	11/2025 - 11/2030	New
Invasive Species (Included with Multiple Hazards)								
Landslides and Mine Subsidence (Included with Multiple Hazards)								
7	Repair or replace bridges on Schrake Road in Springfield Township based on inspection reports.	Huntington Township	6	20	Springfield Township Trustees	General Operating Budget	11/2025 - 11/2030	New
Multiple Hazards								
8	Construct an Emergency Operations Center (EOC)	Ross County	1	1	Ross County EMA	General Operating Budget	11/2025 - 11/2030	New
9	Construct safe rooms - Community.	Ross County, Huntington Township, Springfield Township	1	14	Ross County EMA, Township Trustees	Hazard Mitigation Grant Program (HMGP)	11/2025 - 11/2030	Previous
10	Construct Safe Rooms - Residential.	Ross County, Huntington Township, Springfield Township	1	13	Ross County EMA, Township Trustees	Hazard Mitigation Grant Program (HMGP)	11/2025 - 11/2030	Previous
11	Construct Storm Shelter/EMA Office/EOC/Combined County-City Dispatch Center at Ross Fairgrounds.	Ross County, Huntington Township, Springfield Township	1	10	Ross County EMA, Township Trustees	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
12	Develop and conduct a public education program.	Ross County, Huntington Township, Springfield Township	1	8	Ross County EMA, Township Trustees	General Operating Budget	11/2025 - 11/2030	Previous
13	Install generators at critical facilities.	Ross County, Huntington Township, Springfield Township	1	7	Ross County EMA, Township Trustees	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
14	Provide timely warning.	Ross County, Huntington Township, Springfield Township	1	2	Ross County EMA, Township Trustees	General Operating Budget	11/2025 - 11/2030	Previous

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
15	Rebuild, restore, reinforce ditches and stream banks.	Ross County, Huntington Township, Springfield Township	1	6	Ross County EMA, Township Trustees	United States Army Corps of Engineers (USACE) Flood Control Program	11/2025 - 11/2030	Previous
16	Rehabilitate dams known to be of high hazard potential.	Ross County, Huntington Township, Springfield Township	1	11	Dam Owners	United States Army Corps of Engineers (USACE) Ohio Environmental Infrastructure Program	11/2025 - 11/2030	Previous
17	Review and update laws and regulations.	Ross County, Huntington Township, Springfield Township	1	12	Ross County EMA, Township Trustees	General Operating Budget	11/2025 - 11/2030	Previous
18	Update Dam Emergency Actions plans; update inundation data for dams without EAPs or no current inundation data.	Ross County, Huntington Township, Springfield Township	1	9	Ross County EMA, Township Trustees	Staff Time	11/2025 - 11/2030	Previous
19	Upgrade siren system.	Ross County, Huntington Township, Springfield Township	1	4	Ross County EMA, Township Trustees	General Operating Budget	11/2025 - 11/2030	Previous
20	Work with all jurisdictions on filling in gaps and strengthening capabilities in enacting mitigation strategies.	Ross County, Huntington Township, Springfield Township	1	3	Ross County EMA, Township Trustees	General Operating Budget	11/2025 - 11/2030	New
Severe Summer Weather								
21	Purchase salt for winter weather events and build storage shelter for the salt.	Huntington Township	4	5	Huntington Township Trustees	General Operating Budget	08/2025 - 08/2030	Previous
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes (Included with Multiple Hazards)								
Wildfire (Included with Multiple Hazards)								

Table 5.2.2: Mitigation Actions Priority Table by Hazard for City of Chillicothe

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure								
1	Ensure all high-hazard potential flood walls have updated Emergency Action Plans (EAPs) in place.	City of Chillicothe	10	12	Mayor or Administrator of City of Chillicothe	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Included with Multiple Hazards)								
Flooding								
2	Clear debris, brush, and trees from the islands in the middle of the Scioto.	City of Chillicothe	2	8	Mayor or Administrator of City of Chillicothe	General Operating Budget	11/2025 - 11/2030	New
3	Conduct a I & I Study for the Bellevue area in the City of Chillicothe and complete projects recommended as indicated and necessary by the study.	City of Chillicothe	2	6	Mayor or Administrator of City of Chillicothe	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
4	Ensure all eligible jurisdictions are participating in the NFIP.	City of Chillicothe	2	11	Mayor or Administrator of City of Chillicothe	General Operating Budget	11/2025 - 11/2030	New
5	Install emergency generators for the four stormwater pump stations for the flood wall.	City of Chillicothe	2	7	Mayor or Administrator of City of Chillicothe	Hazard Mitigation Grant Program (HMGP)	11/2025 - 11/2030	New
6	Mitigate Structures at Risk.	City of Chillicothe	2	10	Mayor or Administrator of City of Chillicothe	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
7	Obtain or create inundation maps for all flood walls.	City of Chillicothe	2	9	Mayor or Administrator of City of Chillicothe	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
Invasive Species (Included with Multiple Hazards)								
Landslides and Mine Subsidence (Included with Multiple Hazards)								
Multiple Hazards								
8	Conduct study to develop a comprehensive approach to handling stormwater runoff.	City of Chillicothe	1	2	Mayor or Administrator of City of Chillicothe	United States Army Corps of Engineers (USACE) Flood Control Program	11/2025 - 11/2030	Previous
9	Implement stormwater runoff solutions.	City of Chillicothe	1	4	Mayor or Administrator of City of Chillicothe	Staff Time	11/2025 - 11/2030	Previous

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
10	Rebuild, restore, reinforce ditches and stream banks.	City of Chillicothe	1	3	Mayor or Administrator of City of Chillicothe	General Operating Budget	11/2025 - 11/2030	Previous
11	Rehabilitate stormwater infrastructure.	City of Chillicothe	1	5	Mayor or Administrator of City of Chillicothe	United States Army Corps of Engineers (USACE) Ohio Environmental Infrastructure Program	11/2025 - 11/2030	Previous
12	Work with all jurisdictions on filling in gaps and strengthening capabilities in enacting mitigation strategies.	City of Chillicothe	1	1	Mayor or Administrator of City of Chillicothe	General Operating Budget	11/2025 - 11/2030	New
Severe Summer Weather (Included with Multiple Hazards)								
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes (Included with Multiple Hazards)								
Wildfire (Included with Multiple Hazards)								

Table 5.2.3: Mitigation Actions Priority Table by Hazard for Village of Adelphi

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure (Do Not Include)								
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Do Not Include)								
Flooding (Do Not Include)								
Invasive Species (Included with Multiple Hazards)								
Landslides and Mine Subsidence (Included with Multiple Hazards)								
Multiple Hazards								
1	Ensure all eligible jurisdictions are participating in the NFIP.	Village of Adelphi	1	2	Mayor or Administrator of Village of Adelphi	General Operating Budget	11/2025 - 11/2030	Previous
2	Ensure all high-hazard potential dams have updated Emergency Action Plans (EAPs) in place.	Village of Adelphi	1	4	Mayor or Administrator of Village of Adelphi	General Operating Budget	11/2025 - 11/2030	Previous
3	Obtain or create inundation maps for all dams.	Village of Adelphi	1	5	Mayor or Administrator of Village of Adelphi	General Operating Budget	11/2025 - 11/2030	Previous
4	Review and update laws and regulations.	Village of Adelphi	1	3	Mayor or Administrator of Village of Adelphi	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
Severe Summer Weather (Included with Multiple Hazards)								
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes (Included with Multiple Hazards)								
Wildfire (Included with Multiple Hazards)								

Table 5.2.4: Mitigation Actions Priority Table by Hazard for Village of Bainbridge

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure								
1	Ensure all high-hazard potential dams have updated Emergency Action Plans (EAPs) in place.	Village of Bainbridge	6	6	Mayor or Administrator of Village of Bainbridge	General Operating Budget	11/2025 - 11/2030	New
2	Obtain or create inundation maps for all dams.	Village of Bainbridge	6	5	Mayor or Administrator of Village of Bainbridge	General Operating Budget	11/2025 - 11/2030	New
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Included with Multiple Hazards)								
Flooding								
3	Ensure all eligible jurisdictions are participating in the NFIP.	Village of Bainbridge	4	1	Mayor or Administrator of Village of Bainbridge	General Operating Budget	11/2025 - 11/2030	New
Invasive Species (Do Not Included)								
Landslides and Mine Subsidence (Do Not Included)								
Multiple Hazards								
4	Clean out streambeds, ditches, storm drains and culverts; repair/replace undersized and failing storm drains and culverts.	Village of Bainbridge	1	7	Mayor or Administrator of Village of Bainbridge	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
5	Conduct study to develop a comprehensive approach to handling stormwater runoff.	Village of Bainbridge	1	8	Mayor or Administrator of Village of Bainbridge	Staff Time	11/2025 - 11/2030	Previous
6	Construct safe rooms - Community.	Village of Bainbridge	1	2	Mayor or Administrator of Village of Bainbridge	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
7	Implement stormwater runoff solutions.	Village of Bainbridge	1	4	Mayor or Administrator of Village of Bainbridge	General Operating Budget	11/2025 - 11/2030	Previous
8	Install generators at critical facilities.	Village of Bainbridge	1	11	Mayor or Administrator of Village of Bainbridge	General Operating Budget	11/2025 - 11/2030	Previous
9	Update Dam Emergency Actions plans; update inundation data for dams without EAPs or no current inundation data.	Village of Bainbridge	1	10	Dam Owners	General Operating Budget	11/2025 - 11/2030	Previous
10	Work with all jurisdictions on filling in gaps and strengthening capabilities in enacting mitigation strategies.	Village of Bainbridge	1	3	Mayor or Administrator of Village of Bainbridge	Staff Time	11/2025 - 11/2030	New

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Severe Summer Weather								
11	Remove at-risk trees.	Village of Bainbridge	3	9	Mayor or Administrator of Village of Bainbridge	Staff Time	11/2025 - 11/2030	Previous
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes (Included with Multiple Hazards)								
Wildfire (Included with Multiple Hazards)								

Table 5.2.5: Mitigation Actions Priority Table by Hazard for Village of Clarksburg

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure								
1	Ensure all high-hazard potential dams have updated Emergency Action Plans (EAPs) in place.	Village of Clarksburg	7	12	Mayor or Administrator of Village of Clarksburg	General Operating Budget	11/2025 - 11/2030	New
2	Obtain or create inundation maps for all dams.	Village of Clarksburg	7	11	Mayor or Administrator of Village of Clarksburg	General Operating Budget	11/2025 - 11/2030	New
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Do Not Include)								
Flooding								
3	Eliminate stormwater runoff into wastewater treatment plant and re-line sewage system.	Village of Clarksburg	6	7	Mayor or Administrator of Village of Clarksburg	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
4	Ensure all eligible jurisdictions are participating in the NFIP.	Village of Clarksburg	6	10	Mayor or Administrator of Village of Clarksburg	General Operating Budget	11/2025 - 11/2030	Previous
5	Install catch basin on North Street.	Village of Clarksburg	6	8	Mayor or Administrator of Village of Clarksburg	United States Army Corps of Engineers (USACE) Flood Control Program	11/2025 - 11/2030	New
6	Install storm drain and culverts on 5th street.	Village of Clarksburg	6	9	Mayor or Administrator of Village of Clarksburg	United States Army Corps of Engineers (USACE) Flood Control Program	11/2025 - 11/2030	New
Invasive Species (Included with Multiple Hazards)								
Landslides and Mine Subsidence (Included with Multiple Hazards)								
Multiple Hazards								
7	Clean out streambeds, ditches, storm drains and culverts; repair/replace undersized and failing storm drains and culverts.	Village of Clarksburg	1	1	Mayor or Administrator of Village of Clarksburg	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	Previous
8	Conduct study to develop a comprehensive approach to handling stormwater runoff.	Village of Clarksburg	1	2	Mayor or Administrator of Village of Clarksburg	Staff Time	11/2025 - 11/2030	Previous

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
9	Install generators at critical facilities.	Village of Clarksburg	1	4	Mayor or Administrator of Village of Clarksburg	General Operating Budget	11/2025 - 11/2030	Previous
10	Purchase an automatic new emergency generator for wastewater treatment plant.	Village of Clarksburg	1	3	Mayor or Administrator of Village of Clarksburg	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
11	Rebuild, restore, reinforce ditches and stream banks.	Village of Clarksburg	1	6	Mayor or Administrator of Village of Clarksburg	General Operating Budget	11/2025 - 11/2030	Previous
12	Work with all jurisdictions on filling in gaps and strengthening capabilities in enacting mitigation strategies.	Village of Clarksburg	1	5	Mayor or Administrator of Village of Clarksburg	Staff Time	11/2025 - 11/2030	Previous
Severe Summer Weather								
13	Remove at-risk trees.	Village of Clarksburg	4	7	Mayor or Administrator of Village of Clarksburg	General Operating Budget	11/2025 - 11/2030	Previous
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes (Included with Multiple Hazards)								
Wildfire (Included with Multiple Hazards)								

Table 5.2.6: Mitigation Actions Priority Table by Hazard for Village of Frankfort

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure (Included with Multiple Hazards)								
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Included with Multiple Hazards)								
Flooding								
1	Construct storm drains and catch basins at the intersection of High Street and 2nd Street and at the intersection of Walnut Street and Main Street.	Village of Frankfort	2	2	Mayor or Administrator of Village of Frankfort	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
2	Replace/reline sewer lines going to Beechwood Station.	Village of Frankfort	2	3	Mayor or Administrator of Village of Frankfort	Hazardous Materials Emergency Planning Grant (HMEP)	11/2025 - 11/2030	New
Invasive Species (Do not Include)								
Landslides and Mine Subsidence (Included with Multiple Hazards)								
Multiple Hazards								
3	Work with all jurisdictions on filling in gaps and strengthening capabilities in enacting mitigation strategies.	Village of Frankfort	1	1	Mayor or Administrator of Village of Frankfort	Staff Time	11/2025 - 11/2030	New
Severe Summer Weather (Included with Multiple Hazards)								
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes (Included with Multiple Hazards)								
Wildfire (Included with Multiple Hazards)								

Table 5.2.7: Mitigation Actions Priority Table by Hazard for Village of Kingston

#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/End	Status
Dam/Levee Failure (Do not Include)								
Drought & Extreme Heat (Included with Multiple Hazards)								
Earthquakes (Included with Multiple Hazards)								
Flooding								
1	Replace and enlarge culvert on Eastern Avenue.	Village of Kingston	2	3	Mayor or Administrator of Village of Kingston	Hazardous Materials Emergency Planning Grant (HMEP)	11/2025 - 11/2030	New
Invasive Species (Included with Multiple Hazards)								
Landslides and Mine Subsidence (Included with Multiple Hazards)								
Multiple Hazards								
2	Work with all jurisdictions on filling in gaps and strengthening capabilities in enacting mitigation strategies.	Village of Kingston	1	1	Mayor or Administrator of Village of Kingston	Staff Time	11/2025 - 11/2030	New
Severe Summer Weather (Included with Multiple Hazards)								
Severe Winter Weather and Extreme Cold (Included with Multiple Hazards)								
Tornadoes								
3	Build tornado shelter in the trailer park located in the Village of Kingston.	Village of Kingston	2	2	Mayor or Administrator of Village of Kingston	Hazard Mitigation Assistance (HMP)	11/2025 - 11/2030	New
Wildfire (Included with Multiple Hazards)								

6 | Schedule & Maintenance

6.1 Participation Overview

The Ross County Hazard Mitigation Plan will be adopted by all jurisdictions in Ross County, except for the Village of South Salem. Ross County's EMA director reached out to the Village of South Salem multiple times to obtain participation. The Village of South Salem may still participate once the plan has been approved but will need to complete the surveys. After the jurisdictions have adopted the plan, their signed resolutions or ordinances will be added to the plan in **Appendix G**.

6.2 Continued Public Involvement

Because local government plays a key role in the execution and implementation of mitigation strategies, each community will be responsible for understanding which items they are accountable for implementing. Annually, jurisdictions and responsible agencies should provide a status update for each mitigation action that is under their purview. This meeting will be where the jurisdictions and responsible parties assess the implementation and effectiveness of the hazard mitigation plan. This meeting should coincide with the budget process so that future funding sources can be determined and set aside for actions slated for that particular year. This meeting will also be available to the public. Additionally, each jurisdiction and the County will review the Hazard Mitigation Plan during other planning processes, such as development of comprehensive plans or capital improvement plans and incorporate appropriate goals and mitigation actions into such documents.

The public will continue to provide feedback on the Plan, as the Plan will be available through the Ross County Emergency Management Agency and Ohio Emergency Management Agency websites. Ross County will provide access to the Plan to all county, municipal, and township offices, and will make the Plan available in hardcopy and electronic format to the public as appropriate. The Ross County EMA Director will post notices of any meetings for updating and evaluating the Plan, using the usual methods for posting meeting announcements in the County to invite the public to participate. All meetings will be open to the public. Ross County will publicly announce the mitigation action items that are slated for development in the current year, as well as any updates to the Plan as part of the annual review process.

6.3 Previous Integration Efforts

Local governments and public entities, such as hospitals, play a major role in enforcing and implementing mitigation strategies because their daily operations guide the development of the communities in Ross County. Ross County has implemented the 2020 Hazard Mitigation Plan into its Emergency Operations Plan (EOP) by improving tornado warning systems throughout the County.

6.4 Future Integration Efforts

Ross County and its participating jurisdictions will make a concerted effort to integrate the Hazard Mitigation Plan and its mitigation actions into existing plans and regulations, such as comprehensive plans, capital improvement plans, zoning codes and subdivision regulations, parks and open space plans, active shooter plans, and emergency operations plans. Every village in Ross County has a planning commission or a zoning board that deals with development and growth issues in their jurisdiction, referencing regulations, development plans, and mitigation strategies as they make decisions. These jurisdictions are small and have limited full-time staff, so the County as an organization provides strong leadership and oversight of economic development, community development, and land use planning. Many local officials wear numerous hats as they guide, direct, and facilitate local growth and development through regulation. Mitigation efforts are considered simultaneously with building code enforcement, zoning regulations, and land use rules at the County level. There is significant overlap between County officials when it comes to growth and development, including plan approval, issuance of permits, and occupancy approval responsibilities.

The Ross County EOPshould facilitate integration of mitigation into response and recovery activities where appropriate, so key staff responsible for administering and updating the EOP should coordinate with the Core Planning Committee to identify integration areas and perform them. For the jurisdictions with floodplain regulations (Ross County and all jurisdictions), this Plan includes an action to "develop a floodplain management plan and update it regularly" so as floodplain regulations are reviewed and updated, the local floodplain coordinator(s) should continue to participate in the National Flood Insurance Program and should keep their maps updated. The Core Planning Committee should also engage the local floodplain coordinators and include them in their annual meetings for coordination, support, and to ensure this action is being met. For the zoning and land use regulations, this plan can be integrated in several ways. When zoning and/or land use regulations are reviewed and updated, related to flooding and dam failure, potential impact areas should be designated for limited to no development. For landslides and land subsidence, land bordering waterways should either be left free of development or be reinforced to resist erosion. The Core Planning Committee should also engage the staff involved in administering and updating zoning codes and land use regulations and include them in their annual meetings for coordination, support, and assistance in integrating these recommendations from the plan.

Ross County also has a Floodplain Manager who works with the Ross County Engineer to help plan, approve, modify, and regulate new facilities, subdivisions, and neighborhoods not only in the context of building codes, but also with consideration for flood risk. They also collaborate to be sure that new structures are not placed within flood risk zones without taking compensatory measures, like elevation, as early as the site development stage of construction. The Ross County Engineer works with the Ross County Auditor to manage the floodplain mapping and parcel identification and documentation by developing and maintaining GIS mapping. The Ross County Engineer also ensures that mitigation actions, like elevation, are properly included in the submitted building and occupancy permits during the approval process. The Ross County Engineer is also responsible for County ditch maintenance, which ties the County Engineer's office to the Ross Soil & Water Conservation District, as well as the Farm Service Agency director, as agricultural drainage concerns are shared and resolved. These officials work with the Floodplain Manager to check and evaluate the floodplain maps as introduced by FEMA to ensure accuracy through the map adoption process.

In addition, Ross County EMA, and the Core Planning Committee, consisting of leadership from participating jurisdictions, will work with the top-elected officials and authorities within their jurisdictions to integrate the hazard mitigation plan into the relevant existing and future planning mechanisms and capabilities listed in **Table 3.3.1** of the plan.

6.5 Updating the Plan

The Hazard Mitigation Plan must be updated within five years and re-adopted by the County and all participating jurisdictions to maintain compliance with federal regulations and ensure eligibility for certain federal mitigation grant funds. Ross County will meet HHPD requirements for their 2025 Hazard Mitigation Plan and will amend them when/where necessary. Ross County will identify any necessary modifications to the Plan, including changes to mitigation goals and actions that should be incorporated into the next update. The Ross County EMA Director and the County Commissioners will initiate the process of updating the Plan in accordance with federal guidelines in sufficient time to meet state and federal deadlines.