Cuyahoga County

2022 Hazard Mitigation Plan

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Section 1. Introduction

The safety of Cuyahoga County is a top priority, and planning for natural, technological, and man-made disasters is an important part of being proactive. Disasters can result in death, injuries, as well as significant damage to our communities, businesses, public infrastructure, and environment. The impacts of these damages result in the displacement of people and tremendous costs due to response and recovery dollars, economic loss, and burden. The Cuyahoga County Hazard Mitigation Plan (HMP) is an effort to mitigate the effects of hazards and return to normal operating status sooner with fewer impacts to people and infrastructure.

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

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

Background and Purpose

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

To reduce the community burden from the effects of all hazards, Cuyahoga County, in partnership with an HMP consultant, developed the 2022 Hazard Mitigation Plan. This plan was developed in accordance with the Disaster Mitigation Act of 2000 (DMA 2000). DMA 2000 provides the legislative basis for the Federal Emergency Management Agency (FEMA) hazard mitigation planning requirements and funding before and after a hazard event. FEMA requires that an HMP be updated every five years.

There have been 19 federal disaster declarations documented in Cuyahoga County since 1953, due to: severe storms, floods, tornados, COVID-19, hurricanes, power outage, and snow. These recorded hazard events provide a hazard footprint across the region which helps mitigation planners understand hazards that could occur in and around Cuyahoga County, and their associated risks to life and property. Understanding hazard risks provides a foundation for developing solutions to mitigate or eliminate potential impacts through public education and outreach, preparedness activities, and mitigation actions.

For those hazards that can be mitigated, the County must be prepared to implement efficient and effective short- and long-term actions where needed. The purpose of the 2022 HMP is to provide the County with a blueprint for hazard mitigation action planning. The plan identifies resources, information, and strategies for risk reduction, and acts as a tool to measure the success of mitigation implementation on a continual basis. The strategies identified in the updated HMP are developed with the following intentions:

- Risk reduction, through an all-hazards approach, creating a set of defined mitigation actions.
- Establishment of a basis for coordination and collaboration among participating agencies and public.
- Assisting in meeting the requirements of federal assistance programs.

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

Authority

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

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

Plan Organization

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

- **Section 1.** Introduction describes the background and purpose of the plan, as well as the authority for development of the plan.
- **Section 2.** Community Profile describes Cuyahoga County's history, geography, topography, climate, population, economy, housing, and land use and development trends.
- **Section 3.** The Planning Process describes the 10-Step HMP Planning Process, as well as the meetings and outreach activities undertaken to engage stakeholders.
- **Section 4.** Hazard Risk Assessment identifies and prioritizes all hazards affecting the County and assesses the vulnerability from the identified hazards.
- **Section 5.** Mitigation Strategy identifies mitigation goals and objectives and identifies and prioritizes new mitigation actions.
- **Section 6.** Plan Implementation and Maintenance discusses plan adoption and implementation, as well as the process to monitor, evaluate, update, and maintain the HMP. This section also includes a discussion on continued public involvement.

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Section 2. Community Profile

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

2.1. History of Cuyahoga County

Cuyahoga County's history extends back thousands of years, back to the earliest inhabitants who settled the area around 2000 BCE. Between 800 BCE and 1000 CE, the Adena and the Hopewell Mound Builder tribes flourished in the region. Later, the Wyandot, Huron, Shawnee, Miami, and Delaware tribes populated the area. It is their word, describing a twisted, crooked river, for which Cuyahoga County is named.

In the Seventeenth Century, as Europeans began to settle North America, moving west, the land nearest the southern shore of Lake Erie was given to the colony of Connecticut by King Charles II in 1662. This would be known as the Connecticut Western Reserve. Over a century later when the United States declared independence from England, Connecticut gave up all land except for the Western Reserve. In 1787, though, the Reserve was absorbed into the Northwest Territory, and was officially sold in 1796 for 40¢ an acre, for a total of $1.2 million.

General Moses Cleaveland was hired to survey the newly purchased area. During their journey, the group took canoes to explore the shoreline of Lake Erie, where they came across the mouth of a crooked river. They knew that this was a location where a city could be planned and built. They mapped out a small village around a common green area, New England-style. The name of the town was to be called Cleaveland, named for the leader of the expedition. A newspaper misprint in 1831 would drop the letter "a" from the name.

In March of 1803, the State of Ohio was officially formed, becoming the 17th of the Union. After the state's formation, one of the more vexing problems for the government was the creation of counties. Several large "parent" counties were formed, that would later be split apart depending on the size of their populations. On May 1st, 1810, Cuyahoga County was split off from Geauga County, which in turn had been separated from Trumbull County in 1806. The village of Cleaveland became the County Seat. Cuyahoga County was again reduced in size with the creation of Huron and Lorain Counties, and again in 1840 when Lake County was formed. The final change to the County's borders came in 1843 with a shuffle of land between Geauga and Cuyahoga. Despite one last external change, municipal boundaries within the County continued to shift well into the Twentieth Century.

Just after the turn of the Century, the County thrived alongside the booming automotive industry, with many of the earliest manufacturers calling the City of Cleveland home. After the Great Depression shook the nation, with industry-heavy cities taking the brunt of economic collapse, the County flourished up until the 1960s and 1970s when civil unrest and the infamous fire on the Cuyahoga River, pushed many residents of Cleveland to the suburban communities surrounding it. As a result, the County hit its peak census population in 1970 and has seen a trend of negative growth since.

In recent years, the economy of the County has begun to revitalize, once again becoming a hub behind major innovation, now with an emphasis on health care. As of 2018, nearly one in five employees within Cuyahoga County work in the field of Health Care and Social Assistance. The Cleveland Clinic and University Hospital have helped to establish the region as one of the forefront leaders of oncology, cardiopulmonary, and biomedical research.

The County Seat is located in the City of Cleveland. Unlike many other counties, Cuyahoga does not have a commission, but rather an elected Executive and a County Council. The Council is comprised of 11 members, including a president and vice-president. Each member represents a district within the County.

According to the National Park Service's National Register of Historic Places, Cuyahoga County is home to 422 historic places. The historic places in the County include districts, structures, residential homes, roads, churches, schools, and monuments. Appendix C provides the full list of historic places.

FIGURE 2-1 CUYAHOGA COUNTY, OHIO

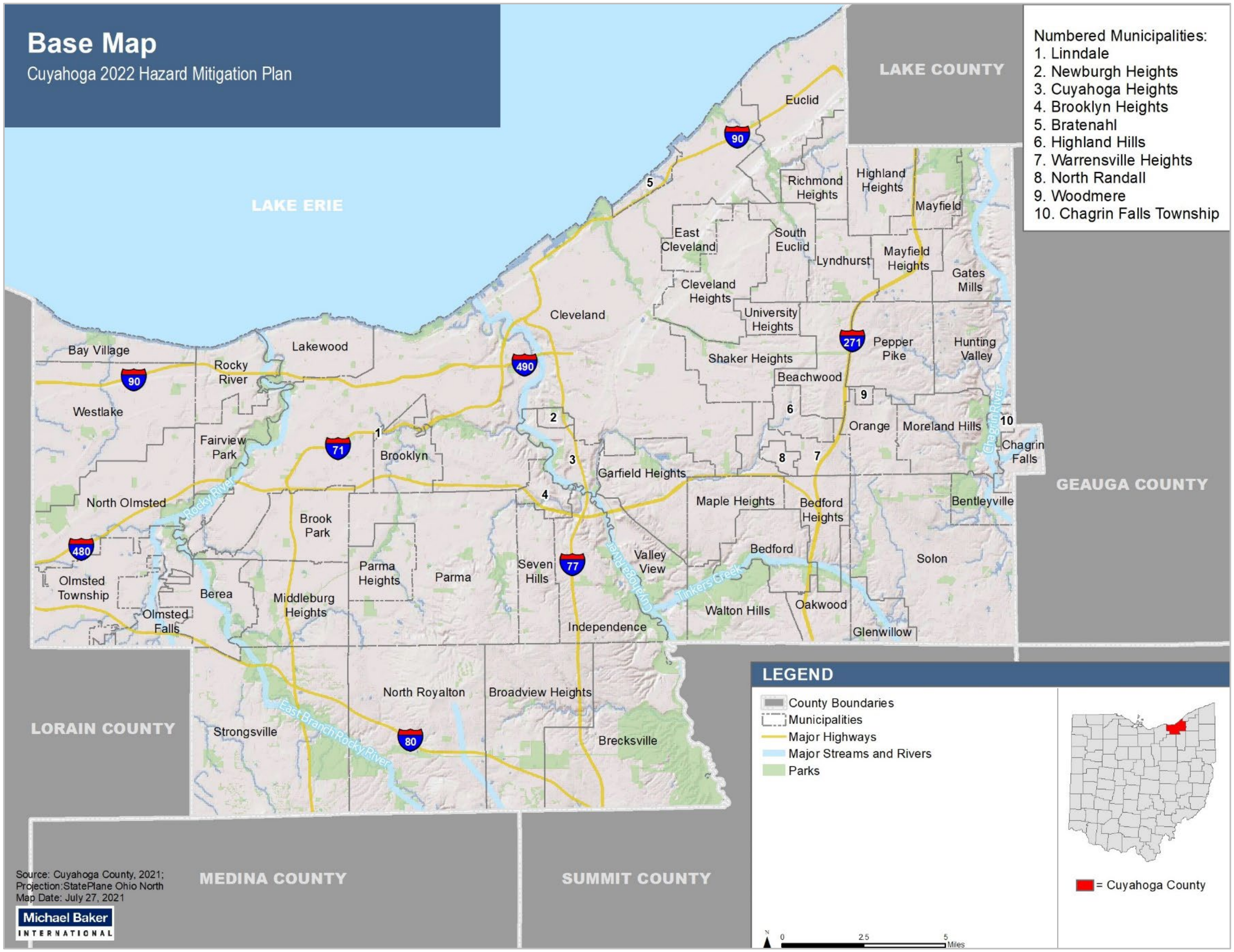
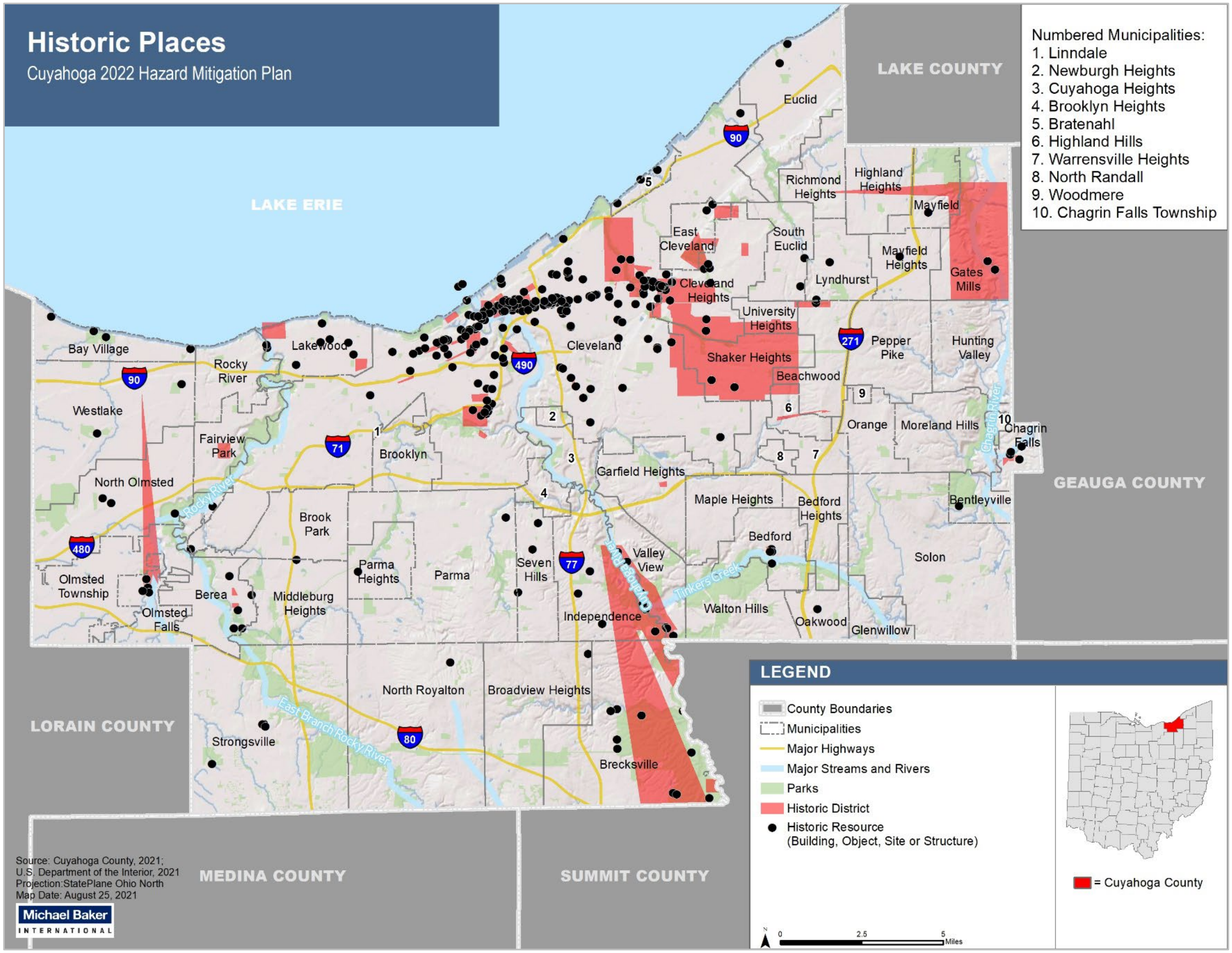


FIGURE 2-2 CUYAHOGA COUNTY HISTORIC PLACES



2.1.1 Geography

Cuyahoga is located in northeastern Ohio along Lake Erie, and is bordered by Lorain, Medina, Summit, Geauga, and Lake Counties. According to the United States Census Bureau, Cuyahoga County has a total of 1,246 square miles, 457 of which are land, and 786 of are water. A significant portion of the county extends into Lake Erie. The County has three major rivers that run through it, including the titular Cuyahoga River, Rocky River, and the Chagrin River, with numerous minor streams and tributaries connecting to them. Though all three major rivers run through the County, the Chagrin River empties into Lake Erie in the adjacent county, Lake County.

Cuyahoga County is split into 59 municipalities, including, the City of Bay Village, the City of Beachwood, the City of Bedford, the City of Bedford Heights, the Village of Bentleyville, the City of Berea, the Village of Bratenahl, the City of Brecksville, the City of Broadview Heights, the City of Brooklyn, the Village of Brooklyn Heights, the City of Brook Park, the Village of Chagrin Falls, Chagrin Township, the City of Cleveland, the City of Cleveland Heights, the Village of Cuyahoga Heights, the City of East Cleveland, the City of Euclid, the City of Fairview Park, the City of Garfield Heights, the Village of Gates Mills, the Village of Glenwillow, the City of Highland Heights, the Village of Highland Hills, the Village of Hunting Valley, the City of Independence, the City of Lakewood, the Village of Linndale, the City of Lyndhurst, the City of Maple Heights, the Village of Mayfield, the City of Mayfield Heights, the City of Middleburg Heights, the Village of Moreland Hills, the Village of Newburgh Heights, the City of North Olmsted, Olmsted Township, the Village of North Randall, the City of North Royalton, the Village of Oakwood, the City of Olmsted Falls, the Village of Orange, City of Parma, the City of Parma Heights, the City of Pepper Pike, the City of Richmond Heights, the City of Rocky River, the City of Seven Hills, the City of Shaker Heights, the City of Solon, the City of South Euclid, the City of Strongsville, the City of University Heights, the Village of Valley View, the Village of Walton Hills, the City of Warrensville Heights, the City of Westlake, and the Village of Woodmere.

There are several interstates that cross the County. The Ohio Turnpike, otherwise known as I-80, and I-90 cross the County east-west, along with the auxiliary highways of 480 and 490. Running north-south are I-71 and I-77, with I-271 as the auxiliary bypass highway. Several United States Highways run through the County, as well, including US-6, US-20, US-42, US-322, and US-422. The County is also home to three airports, including a major international hub: the Cuyahoga County Airport, the Cleveland Hopkins International Airport, and the Cleveland Burke Lakefront Airport.

2.1.2 Topography

Near the shoreline, the County is part of what is known as the Erie Lake Plain ecoregion. This ecoregion is a nearly level coastal strip of lacustrine deposits punctuated by beach ridges and swales. Its lake-modified climate sets it apart from other nearby ecoregions and its annual growing season is often several weeks longer than inland areas. Urban-industrial sites, ports, fruit-vegetable farms, and nurseries have developed along the plain.

In the western and eastern portions of the County is the Low Lime Drift Plain ecoregion. In contrast with the relatively flat Erie Lake Plain region, this ecoregion has a rolling landscape composed of low rounded hills with scattered end moraines and kettles. This type of terrain incorporates much of Cuyahoga County as well as counties as far north as Ashtabula County, and as far south as Perry County. This ecoregion is distinct from the unglaciated, wooded, hilly country that makes up eastern Ohio and much of West Virginia. Its soils are usually less naturally fertile and urban-industrial activity, as well as dairy, livestock, corn, and soybean farming are common; many ridges and lowlands are wooded. The growing season is shorter than the Erie Lake Plain and progressively decreases away from Lake Erie.

The Erie Gorges ecoregion makes up the south-central part of Cuyahoga County. The terrain here is a uniquely steep, dissected area along the Chagrin, Cuyahoga, and Grand rivers. Local relief can exceed 500 feet, rock exposures occur, and fluvial erosion rates are high. Originally, mixed mesophytic forests were common on well-drained sites; today, woodland, recreational areas, scattered farms, and housing is dominant.

TABLE 2-1 CUYAHOGA COUNTY LAND COVER, OHIO OFFICE OF RESEARCH 2020

Land Cover	Percent
Developed, Lower Intensity	55.95%
Developed, Higher Intensity	21.02%
Barren (strip mines, gravel pits, etc.)	0.18%
Forest	18.82%
Shrub/Scrub and Grasslands	1.02%
Pasture/Hay	1.39%
Cultivated Crops	0.12%
Wetlands	1.05%
Open Water	0.44%

2.1.3 Climate

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

TABLE 2-2 CUYAHOGA COUNTY CLIMATE SUMMARY

Climate Measurements	Cuyahoga County	United States
Avg. Annual Rainfall (in.)	38.6 in.	38.1 in.
Avg. Annual Snowfall (in.)	58.1 in.	27.8 in.
Avg. Annual Precipitation Days	149.2 days	106.2 days
Avg. Annual Sunny Days	163 days	205 days
Avg. Annual July High	82.5°F	85.8°F
Avg. Annual Jan. Low	21.4°F	21.7°F
Comfort Index (higher=better)	6.8	7
UV Index	3.7	4.3
Avg. Elevation FT.	855 ft.	2,443 ft.

2.2. Population, Occupancy, and Demographics

Population and demographic information provide baseline data about Cuyahoga County. Maintaining and reviewing up-to-date data on demographics allows the County to better assess hazard magnitudes and develop more specific mitigation plans.

TABLE 2-3 COUNTY BASELINE DEMOGRAPHICS, U.S. CENSUS BUREAU 2019

Demographic Information	Total Count	Percentage of Total Count
Male	589,073	47.7%
Female	645,999	52.3%
Total Population	**1,235,072**	**100%**
Race and Ethnicity	**Residents**	**Percentage of Total Residents**
White/Caucasian	720,622	58.4%
Black or African American	360,118	29.2%
Native American	2,168	0.2%
Asian American	40,682	3.3%
Native Islander	203	0%
Other	3,480	0.3%
Two or More Races	30,456	2.5%
Hispanic	77,343	6.3%
Previous Years	**Population of Previous Year**	
2018	1,241,718	
2017	1,247,581	
2010	1,280,122	
2000	1,393,978	
1990	1,415,140	
1980	1,498,400	
1970	1,721,300	
1960	1,647,895	
1950	1,389,532	

The County's residential population is 1,235,072 (US Census 2019 Estimates). With a land total of 457 square miles, the population density is 2,702.6 people per square mile. The racial makeup of the County is approximately 58.4% White/Caucasian, 29.2% Black or African American, 6.3% Hispanic, and 3.3% Asian American.

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

TABLE 2-4 COUNTY DEMOGRAPHIC PROFILE, OHIO OFFICE OF RESEARCH 2020

Municipality	Total Count
2010 Population	1,280,122
2019 Population Estimate	1,235,072
Population Change 2010 – 2019	-3.5%
Total Housing Units, 2019	618,792
Occupied Housing Units, 2018	538,531
Vacant Housing Units, 2018	80,261
County Area (sq. miles)	457.2

TABLE 2-5 2019 ESTIMATED INCORPORATED POPULATION

Community	Population
Bay Village	15,194
Beachwood	11,590
Bedford	12,457
Bedford Heights	10,460
Bentleyville	902
Berea	18,609
Bratenahl	1,379
Brecksville	13,604
Broadview Heights	19,102
Brook Park	18,382
Brooklyn	10,646
Brooklyn Heights	1,615
Chagrin Falls	4,032
Cleveland	381,009
Cleveland Heights	43,992
Cuyahoga Heights	677
East Cleveland	16,964
Euclid	46,550
Fairview Park	16,161
Garfield Heights	27,448
Gates Mills	2,189
Glenwillow	1,088
Highland Heights	8,373
Highland Hills	873
Hunting Valley	763
Independence	7,175
Lakewood	49,678
Linndale	160

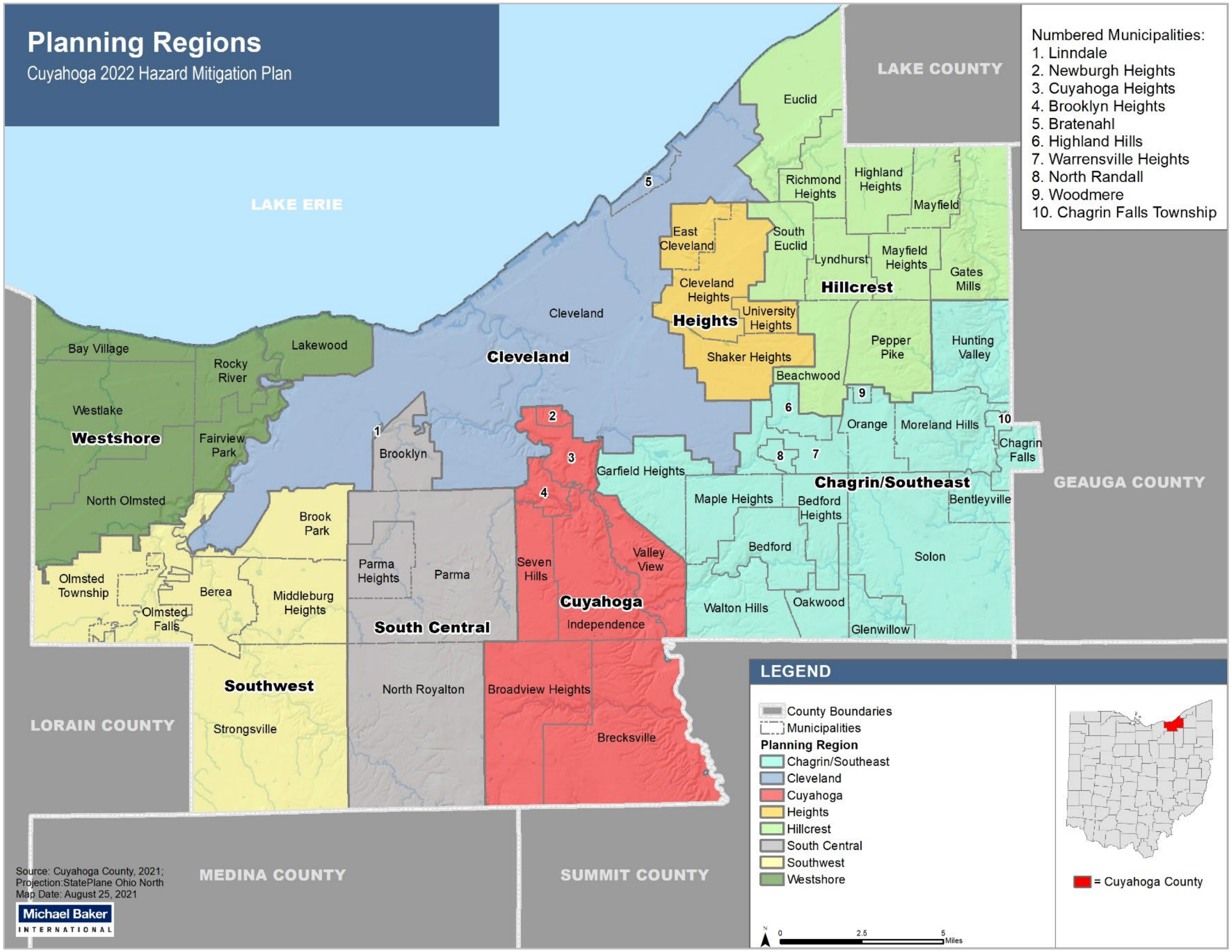
Community	Population
Lyndhurst	13,366
Maple Heights	22,078
Mayfield	3,372
Mayfield Heights	18,487
Middleburg Heights	15,432
Moreland Hills	3,306
Newburgh Heights	1,718
North Olmsted	31,341
North Randall	1,106
North Royalton	30,068
Oakwood	3,668
Olmsted Falls	8,828
Orange	3,276
Parma	78,103
Parma Heights	19,790
Pepper Pike	6,330
Richmond Heights	10,342
Rocky River	19,986
Seven Hills	11,590
Shaker Heights	27,027
Solon	22,779
South Euclid	21,297
Strongsville	44,660
University Heights	12,797
Valley View	2,024
Walton Hills	2,246
Warrensville Heights	13,108
Westlake	32,032
Woodmere	698
Total Incorporated Population	1,221,927
Unincorporated Cuyahoga County	13,145
Total Population	**1,235,072**

The Cuyahoga County Planning Commission divided Cuyahoga County into eight different planning regions: Chagrin/Southeast Region, Cleveland Region, Cuyahoga Region, Heights Region, Hillcrest Region, Southcentral Region, Southwest Region, and Westshore Region. Each Cuyahoga County Planning Commission board member represents one of the eight planning regions, plus three county representatives. The figure below shows where the various regions are located within the County.

- **Chagrin/Southeast Region:** Bedford, Bedford Heights, Bentleyville, Chagrin Falls, Chagrin Falls Township, Garfield Heights, Glenwillow, Highland Hills, Hunting Valley, Maple Heights, Moreland Hills, North Randall, Oakwood, Orange, Solon, Walton Hills, Warrensville Heights, Woodmere
- **Cleveland Region:** Bratenahl, Cleveland, Linndale

- **Cuyahoga Region:** Brecksville, Broadview Heights, Brooklyn Heights, Cuyahoga Heights, Independence, Newburgh Heights, Seven Hills, Valley View
- **Heights Region:** Cleveland Heights, East Cleveland, Shaker Heights, University Heights
- **Hillcrest Region:** Beachwood, Euclid, Gates Mills, Highland Heights, Lyndhurst, Mayfield Heights, Mayfield Village, Pepper Pike, Richmond Heights, South Euclid
- **Southcentral Region:** Brooklyn, North Royalton, Parma, Parma Heights
- **Southwest Region:** Berea, Brook Park, Middleburg Heights, Olmsted Falls, Olmsted Township, Strongsville
- **Westshore Region:** Bay Village, Fairview Park, Lakewood, North Olmsted, Rocky River, Westlake

FIGURE 2-3 CUYAHOGA COUNTY PLANNING REGIONS



2.2.1 Effects of Population Change on Mitigation

Housing occupancy impacts the community's overall resilience during and following a disaster. Well-maintained homes are less likely to contribute to damage and debris during hazard events. Vacant homes are more likely to sustain heavy damage during events such as thunderstorms, high winds, tornadoes, and winter storms than occupied homes.

When vacant homes deteriorate, they become more easily damaged or destroyed during hazard events (specifically high winds, thunderstorms, and tornadoes). The building materials from the homes can become projectiles and wind-borne debris, injuring people and damaging vehicles and structures, and causing a more difficult response and recovery. As communities within the planning area experience a population decline, blighted properties become a more and more significant issue.

Because the population has been decreasing since the 1970 Census, there would appear to be fewer people who are susceptible to hazards. However, that is not how it works. Cuyahoga County has an increasingly aging population, which leaves those in the county *more* susceptible to hazard events, particularly when additional shelter is required. Hazards such as extreme temperatures, tornadoes, severe winter storms, and severe thunderstorms can cause power outages that can cause the losses of heating and cooling, putting the elderly and the very young most at risk.

2.2.2 Social Vulnerability

FEMA National Risk Index

FEMA developed a National Risk Index map for Natural Hazards at the county-level and census tract-level for all counties and census tracts in the United States. The risk index is calculated through a combination of three factors: expected annual loss, social vulnerability, and community resilience. Expected annual loss is the amount of loss – building value, population, and agricultural value – that is likely to occur each year due to natural hazard events. Social vulnerability is the vulnerability or susceptibility of social groups to natural hazard impacts. Community resilience is a community's ability to withstand natural hazard events through preparation, recovery, and adaptability.

(Expected Annual Loss x Social Vulnerability) / Community Resilience = Risk Index

The Risk Index as a whole, as well as each factoring attribute, is ranked as a scale. The index, from low risk to high risk includes: Insufficient Data, Not Applicable, No Rating, Very Low, Relatively Low, Relatively Moderate, Relatively High, and Very High.

According to the National Risk Index Map, Cuyahoga County has a Risk Index of Relatively High, Expected Annual Loss risk of Relatively Moderate, Social Vulnerability risk of Very High, and Community Resilience of Relatively High. Ranking as a 23.96, Cuyahoga County's Risk Index is in the Relatively High ranking, 98.8% of the other Ohio counties have a Risk Index lower than Cuyahoga County's Risk Index; the average Risk Index ranking for Ohio is 8.69. Cuyahoga County's expected annual loss calculates to a total of $29,137,191.88 - $17,218,637.69 in building value losses, 1.57 fatalities, $11,898,654.76 population equivalence losses, and $19,899.43 in agricultural value losses – 97.7% of the other Ohio counties have an expected annual loss rating lower than Cuyahoga County. The social vulnerability rating for Cuyahoga County, measured by University of South Carolina's Hazards and Vulnerability Research Institute (HVRI), is 44.90. Compared to the state's average social vulnerability ranking, Cuyahoga County has a ranking of 10.62 points higher than the average; 97.7% of Ohio's counties have a lower social vulnerability than Cuyahoga. The community resilience rating for Cuyahoga County, measured by University of South Carolina's HVRI, is 56.16, only 0.68 points below Ohio's county average community resilience rating. However, 70.5% of the counties in Ohio have a higher community resilience score than Cuyahoga County.

CDC/ATSDR Social Vulnerability Index

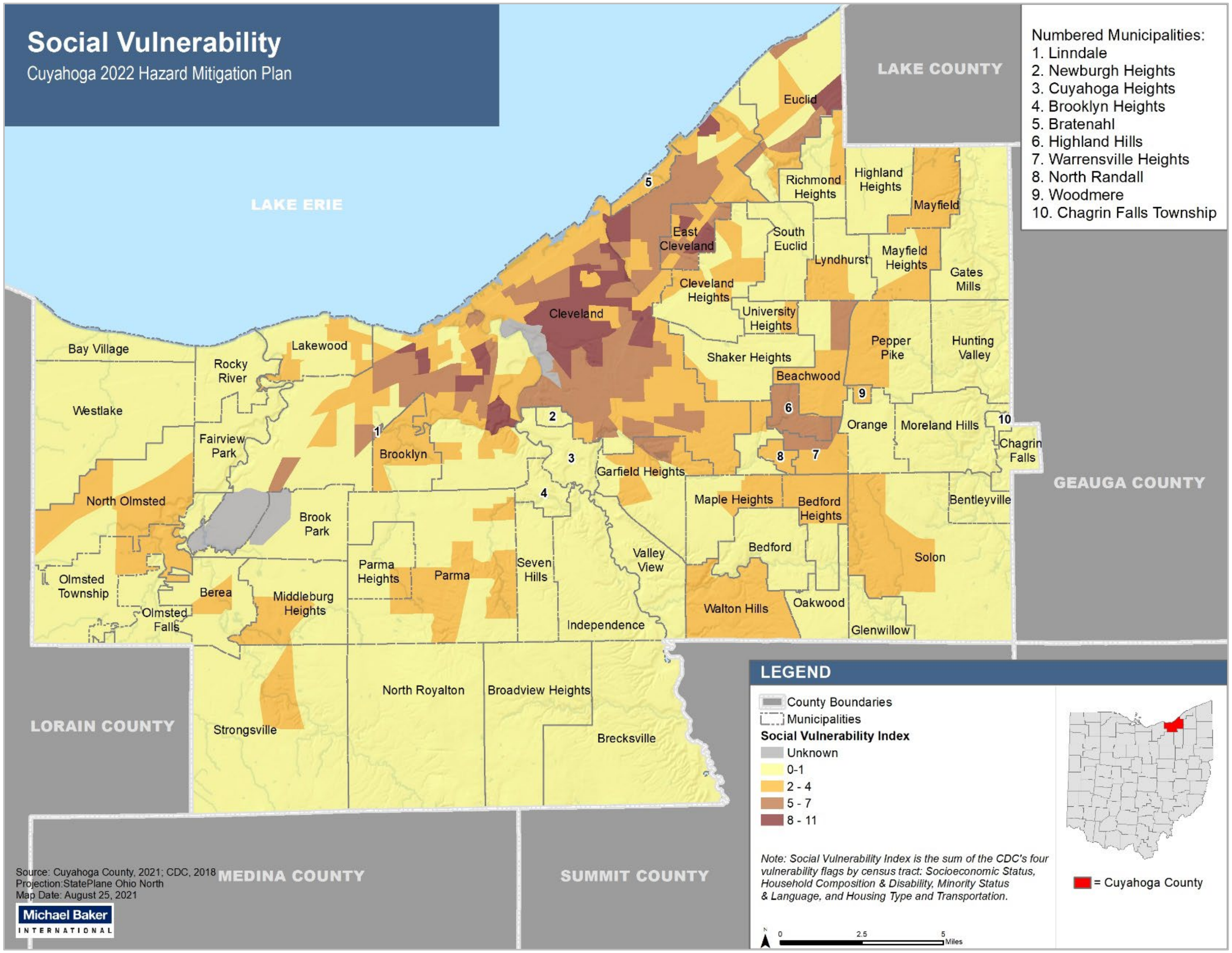
The Center for Disease Control and Prevention (CDC)/Agency for Toxic Substances and Disease Registry (ATSDR) developed a Social Vulnerability Index through the use of fifteen U.S. Census variables to identify social groups that are vulnerable to disaster events. The CDC/ATSDR social vulnerability definition is, "the potential negative effects on communities caused by external stresses on human health. Such stresses include natural or human-caused disasters or disease outbreaks. Reducing social vulnerability can decrease both human suffering and economic loss" (CDC, 2021). Socially vulnerable populations in a community are at more risk than the general population due to socioeconomic status, household composition, minority status, housing type, and/or means of transportation.

Socioeconomic factors that are considered vulnerable populations are also known as below poverty, unemployed, low income, or no high school diploma. Household compositions that are considered vulnerable include those with a disability, aged 65 years or older, aged 17 years or younger, older than 5 years of age with a disability, and single-parent households. Those with a minority status may not speak the English language or may not be able to communicate fluently through English. Lastly, the housing type and means of transportation indicates additional vulnerable groups of population. Those who live in multi-unit structures, mobile homes, have crowding conditions in their place of residence, have no vehicle, or reside in group quarters are all examples of socially vulnerable populations.

Cuyahoga County has an overall Social Vulnerability Index (SVI) score of 0.6809 in 2018, with 0 being the lowest vulnerability and 1 being the highest vulnerability. According to the score, the County ranks in a moderate to high level of social vulnerability. Cuyahoga County's socioeconomic ranking is 0.5541; the County's household composition and disability ranking is 0.5204; the County's minority status and language ranking is 0.8354; the County's housing type and transportation ranking is 0.6332.

The figure below display's the social vulnerability of each census tract within Cuyahoga County.

FIGURE 2-4 CUYAHOGA COUNTY SOCIAL VULNERABILITY



SVI scores and locations of vulnerable populations are important to know because they can help local officials target areas that may need additional assistance after a disaster, such as additional supplies needed like food, water, medicine or bedding, or additional emergency personnel that need to be dispatched to a certain area(s) within the County. Local officials can also use the SVI scores at the census tract level to identify areas that are in need of emergency shelters, develop evacuation plans, and other mitigation actions that can help alleviate disaster impacts on the identified communities.

2.2.3 Employment

According to the United States Census Bureau Longitudinal Employer-Household Dynamics (LEHD), there are a total of 753,293 persons employed in the County workforce as of 2018. The North American Industry Classification Systems (NAICS) keeps track of jobs based on census blocks. Health Care and Social Assistance makes up 19.9% of the jobs in the County, followed by Manufacturing at 9.2%. The next closest is Retail Trade at 8.5%.

TABLE 2-6 NAICS JOB INVENTORY, 2018

Industry	Count	Share
Agriculture, Forestry, Fishing and Hunting	209	0.0%
Mining, Quarrying, and Oil and Gas Extraction	441	0.1%
Utilities	3,150	0.4%
Construction	22,699	3.0%
Manufacturing	69,634	9.2%
Wholesale Trade	38,983	5.2%
Retail Trade	64,098	8.5%
Transportation and Warehousing	23,394	3.1%
Information	15,142	2.0%
Finance and Insurance	42,367	5.6%
Real Estate and Rental and Leasing	13,312	1.8%
Professional, Scientific, and Technical Services	51,330	6.8%
Management of Companies and Enterprises	27,647	3.7%
Administration & Support, Waste Management and Remediation	51,748	6.9%
Educational Services	54,434	7.2%
Health Care and Social Assistance	150,164	19.9%
Arts, Entertainment, and Recreation	17,076	2.3%
Accommodation and Food Services	60,570	8.0%
Other Services (excluding Public Administration)	22,223	3.0%
Public Administration	24,672	3.3%
TOTAL	**753,293**	**100%**

2.2.4 Effects of Employment on Mitigation Planning

Employment, like housing, can influence mitigation planning and disaster events. This is because employment is tied directly to housing and community stability. When a community's primary industry disappears or takes on a reduced role, the effects can be an economic downturn, resulting in blighted properties. Approximately 20% of Cuyahoga County's current workforce is employed in the Health Care and Social Assistance industry, but the remainder of the workforce is fairly spread out among the other nineteen industries NAICS classifies jobs as.

2.2.5 Land Use and Future Development Areas

New development has been reported across Cuyahoga County, particularly housing and commercial development since the previous plan was developed. New multi-family residential development was reported by several jurisdictions, especially Shaker Heights, Fairview Park, and Westlake. These jurisdictions also expressed concern for flood hazards with new impervious pavement. Commercial development was also reported in many jurisdictions, the most noteworthy being an Amazon distribution center in Glenwillow and the City of Independence. 18 jurisdictions reported no changes in development. Members of each participating jurisdiction completed a Changes in Development form to determine how they perceived their change in vulnerability to each hazard in comparison to development trends and larger factors. Each community's future development response is available in their respective annex.

In addition to the jurisdictions completing the Changes in Development form, stakeholders across the county as well as neighboring communities were invited to submit responses to how the physical planning area has changed in terms of development since the previous plan was created. County agencies, local businesses, and non-profit organizations submitted responses, displayed in the following table.

TABLE 2-7 CHANGES IN DEVELOPMENT

Jurisdiction/ Organization	Changes in Development Response
American Red Cross Northern OH Region/Northeast Chapter	None
CCF (Cleveland Clinic Fairlawn)	More national events (RNC, all-star game, and presidential debate) increased vulnerability
Center for Health Affairs	There is a lot of construction going on, more than usual. Development of the lakefront. Not much input here.
Chagrin River Watershed Partners	As people and business and move into our region greenfield sites continue to be developed. New development in and upstream of Cuyahoga County is contributing to stormwater and flooding hazards. Even though regulations are in place to manage stormwater from developments that disturb an acre or more of land, increases in impervious surface from small scale developments can degrade natural stream corridors that provide free flood control, erosion control and water quality services. This increases stormwater runoff and contributes to erosion and water pollution. It also increases vulnerability to the more frequent and intense storm events our region is already experiencing and that are projected to continue.
CHFD	N/A
Cuyahoga Community College (Tri-C)	There have been several renovations and new-builds within the last 5 years that have contributed to a variety of vulnerability mitigation.
Cuyahoga County	sewer district Project Clean Lake underground tunnels - positive for storm water concerns.
Cuyahoga County Board of Health	"Numerous housing, office and shopping complex developments in North Royalton (4 minimum), Brecksville 1, Parma 1. Mature trees and forest stands are clear cut. Subsequent construction adds large, black, tared, impervious paved areas. Limited wetland and ecosystem reconstruction is attempted. These affect stormwater runoff, flooding, water quality with increased sediment loads being added to the rivers and Lake Erie. The dark, impervious surfaces increase the heat island effect, exacerbating temperatures in inner-city areas with concomitant, negative health effects. Additionally, Cuyahoga County has had a minimum of A 6% tree canopy loss since 2010. This appears to be increasing with all the negative effects of clear felling, loss of carbon stored in mature forests and reduced carbon sequestration by tree canopy. This is both an issue of loss of resilience for climate mitigation and adaptation. The individual cities in Cuyahoga require more robust policy,

Jurisdiction/ Organization	Changes in Development Response
	with subsequent management strategies for climate impacts. Vulnerability is high in low-income areas, with overall vulnerability for Cuyahoga as moderate to high.
Cuyahoga County Emergency Management	Declining population, aging population, aging infrastructure, impervious surfaces, receding shoreline
Cuyahoga County Solid Waste District	No change
GCRTA	New Opportunity corridor that connects west to the eastside. Now downtown Cleveland has several apartment complexes, development, shopping centers, new corridors coming up. GCRTA changed mission statement - NextGen focusing on bus routes between businesses, colleges, and healthcare facilities. Moving towards outdoor shopping centers. Sporting events attract visitors to downtown. Visitors in metro parks as well, especially more during covid.
Greater Cleveland Regional Transit	Increasing dependency on IT.
Health and Human Services	No buildings are vulnerable.
Hunger Network	We were previously in the Rockefeller Building. We are now in Midtown. We are now more accessible to the community than we were before.
MetroHealth System	We are currently building a new 11 story hospital. We are the first Eco district in the nation. We are changing to 50% greenspace. Health is more faceted than taking a pill. We're building on the east side of the MetroHealth Cleveland Heights Health Centers. We're also looking at the social determinants of health; education, equity, crime. We've developed trauma response teams to respond to incidents in communities to help prevent that in the future. We also have a high school in the hospital right now. This helps expose students to health-adjacent jobs.
Northeast Ohio Areawide Coordinating Agency	There has been significant development in the NOACA region (including Cuyahoga County) within the past five years. See eNEO2050 (long range plan) Resource Document Chapters 5-7 (https://www.eneo2050.com/final-plan)
Cleveland Clinic	There are a lot more national level events (national conventions, all-star game), so with that Cleveland has gotten some nice improvements. With these events the healthcare system needs to make sure everyone is ready to respond to specific events. Plans for each event have been created and work closely with government counterparts.
Cleveland Clinic - NECO Region	Stormwater management plan and significant water improvement/flow projects
Cleveland Clinic Children's Hospital for Rehab. & Lerner School for Autism	Ongoing utilities and technology maintenance and updates as it relates to hospital resiliency
Cleveland Clinic Emergency Management Enterprise	Built education campus that held the presidential debate which had its own vulnerabilities. added a cancer center and dental school.
Cleveland Clinic Lutheran Hospital	Ongoing utilities and technology maintenance and updates as it relates to hospital resiliency.
Cleveland Clinic - Fairview Hospital	Maintenance updates
Cleveland Metroparks	There hasn't been any development that has affected our vulnerability.
Cleveland Public Health	The increased knowledge of quarantine and isolation procedures and CDC and FDA guidelines throughout both the community and city officials has increased our overall public health preparedness.
Cleveland State University	Recent architectural design of our newest buildings have favored open concept and glass facade which increase potential safety concerns surrounding active shooter (Julka Hall, Washkiewicz Hall and Center of Innovation for Medical Professions).
St. Vincent Charity Medical Center	We've had many staff receive vaccines. We've administered almost 10,000 vaccines. We had 2 vaccine clinics.
Hillcrest Hospital; South Pointe Hospital	No significant developments
Marymount / Euclid Hospitals	Road construction supporting emergency response

Cuyahoga County has identified that over the past five years, there has been a declining population as well as an aging population. For the physical environment, the aging infrastructure has impacted the county's vulnerability. Impervious surfaces and a receding shoreline have also impacted the county's vulnerability.

From 2015 to 2019, there have been 3,893 residential units constructed, according to the Cuyahoga County Profile 2020 Edition developed by the Ohio Office of Research. The table below shows the residential construction that has occurred within the County each year, broken down by residential building type.

TABLE 2-8 RESIDENTIAL DEVELOPMENT IN CUYAHOGA COUNTY, 2015-2019

Residential Construction	2015	2016	2017	2018	2019
Total Units Constructed	744	829	827	682	811
Total value of constructed units	$203,527,000	$207,582,000	$221,135,000	$190,263,000	$216,697,000
Single-Unit Buildings Constructed	702	719	728	644	570
Average Cost per Single Unit	$289,609	$286,838	$288,891	$293,702	$340,042
Multi-Unit Buildings Constructed	42	110	99	38	241
Average Cost per Unit in Multi-Unit	$5,282	$12,226	$109,324	$29,429	$94,910

According to the Cuyahoga County Planning Commission, Cuyahoga County will soon become the first "built-out" county within the State of Ohio. In 1948, approximately 26% of the County's land was developed. In the post-World War II era, suburban communities grew rapidly, and by 2002, nearly 90% of the County was developed. Over half of Cuyahoga County is residential land use, coming to a total of 57% of the land space, and 234.70 acres. The next largest land use is Green Space, with 57.25 acres, which accounts for about 14% of all land space. Industrial uses take up 43.12 acres, accounting for 11% of land space. Overall, there is very little agriculture; only 3.38 acres of agricultural land exist, making up 1% of land space. Government land use occupies 2.48 acres within the county, or 1% of the land use. Office land use occupies 7.95 acres within the county, or 2% of the total land use. Religious land use accounts for 1% of total land use with 4.74 acres. Retail land use occupies 6% of the county's land, with 23.37 acres. School land use accounts for 2% of the total land use with 8.02 acres. Transportation land use occupies 20.57 acres, or 5% of the county's land use. Lastly, utility land use occupies 1% of the county's land with 4.73 acres.

In 2002, the Cuyahoga County Greenways Plan and Greenprint was published as part of a goal of achieving a balance between urban development and a sustainable environment. "Unlike the past 50 years, where economic growth and new housing options were tied to the development of 'greenfield' sites at the edge of the urbanized area, the future health of the County will be based upon its attraction as a sustainable, desirable, and healthy place to work, live, and play," the 2002 Plan states. The original Plan functioned as a web-based inventory of maps that showed the location of parks, greenspace corridors, waterways, roadways, trails, and included community centers, activity centers, and town centers. As time passed, this data slowly began to become outdated. In June of 2015, the Plan was updated to accommodate advances in technologies. Recent developments in Geographic Information Systems (GIS) now allow the Plan to function as a live document that can be updated regularly and is fully interactive. As such, it can now reach a larger potential audience of users. The most recent iteration of the Cuyahoga Greenways plan was developed in 2019 and adopted by the Northeast Ohio Areawide Coordinating Agency (NOACA) in 2020. The updated Greenways Vision Plan continues to envision, plan, and implement greenways and urban trails throughout the county.

The web-based tools that the Greenprint offers will allow urban planners, watershed coordinators, economic development directors, land protection specialists, and other planning and design professionals to promote more effective land use decisions and best practices that:

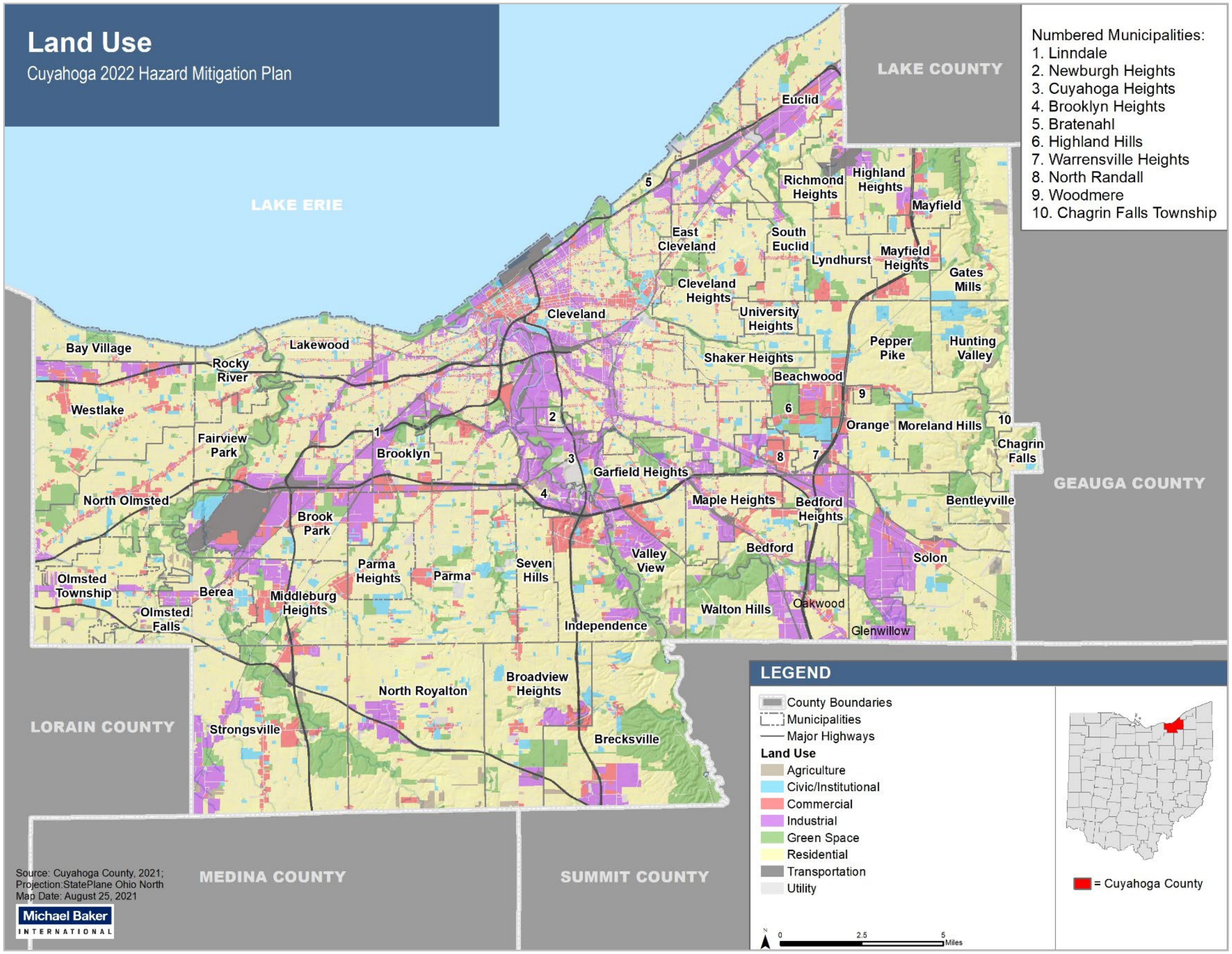
- Protect people and property from flooding and stormwater events,
- Protect biological diversity,
- Develop a regional trail and greenway system; and
- Provide places where residents can recreate for health and fitness.

The Cuyahoga County Planning Commission greenspace vision for the County seeks to:

- Build off of the County’s unique geography and natural history;
- Emphasize the environmental, community and economic importance of greenspace;
- Inspire decision makers to make greenspace a priority in the community;
- Promote connecting neighborhoods in the County to greenspace and the County’s natural resources; and
- Encourage the “regreening” of the more urban portions of the County to make them more desirable places to live.

This plan was created with the development of Cuyahoga County in mind. As the County’s populations and land uses have changed, their vulnerability to hazards have also changed. Because the population has decreased in recent years, the vulnerability to the population has changed. The County and its jurisdictions have also continued to push redevelopment plans and comprehensive plans, making the area more resilient to hazards.

FIGURE 2-5 CUYAHOGA COUNTY LAND USE



It is expected that redevelopment as well as new development will continue to occur in Cuyahoga County in both the cities and villages alike throughout the next 25 years. One reason is that the retail and service market is able to continue to grow through new and redevelopment methods in the jurisdictions of Cuyahoga County. Another reason is that high transportation costs which are expected to continue to rise are keeping more travelers closer to home and in their search for goods and services.

According to the Cuyahoga County Five Year Economic Development Plan, the focus for 2021-2026 is to restore, build, and recover after the COVID-19 pandemic. The first strategy, titled Restore Cuyahoga: The One-Year Immediate Focus, has three goals. The first goal focuses on the continued investment and support of small businesses. The second goal focuses on investing and expanding innovation. The last goal focuses on reducing unemployment by accelerating and scaling existing workforce initiatives. The second strategy, titled Build Cuyahoga: Continuation and Growth of Initiatives plans to market Cuyahoga County both locally and nationally. The last strategy, titled Long Term Recovery: Sustaining Growth, will be implemented in the next Five Year Economic Development Plan. Cuyahoga County is forecasting approximately 16,073 new jobs will be added to Cuyahoga County spanning from 2020 to 2024, with the highest number of jobs to be added in 2024 with 4,355.

According to the Ohio Department of Development, Cuyahoga County is projected to have a 1,113,950 population by 2040. The dataset, published in 2018, provides the 2010 Census population for each county in Ohio, as well as the state's population, and projects the population count for each county for the years of 2015, 2020, 2025, 2030, 2035, and 2040. The table below displays Cuyahoga County's 2010 Census population, and the projected population for the identified years.

TABLE 2-9 CUYAHOGA COUNTY POPULATION PROJECTIONS 2010-2040

Year	Population
2010 Census	1,280,122
2015	1,242,380
2020	1,209,550
2025	1,179,030
2030	1,154,210
2035	1,131,380
2040	1,113,950

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Section 3. The Planning Process

This section describes each stage of the planning process used to develop the 2022 HMP. The planning process provides a framework for document development and follows the FEMA recommended steps. The 2022 HMP follows a prescribed series of planning steps which includes organizing resources, assessing risk, developing the mitigation plan, drafting the plan, reviewing and revising the plan, and adopting and submitting the plan for approval. Each is described in this section.

3.1. Planning Process

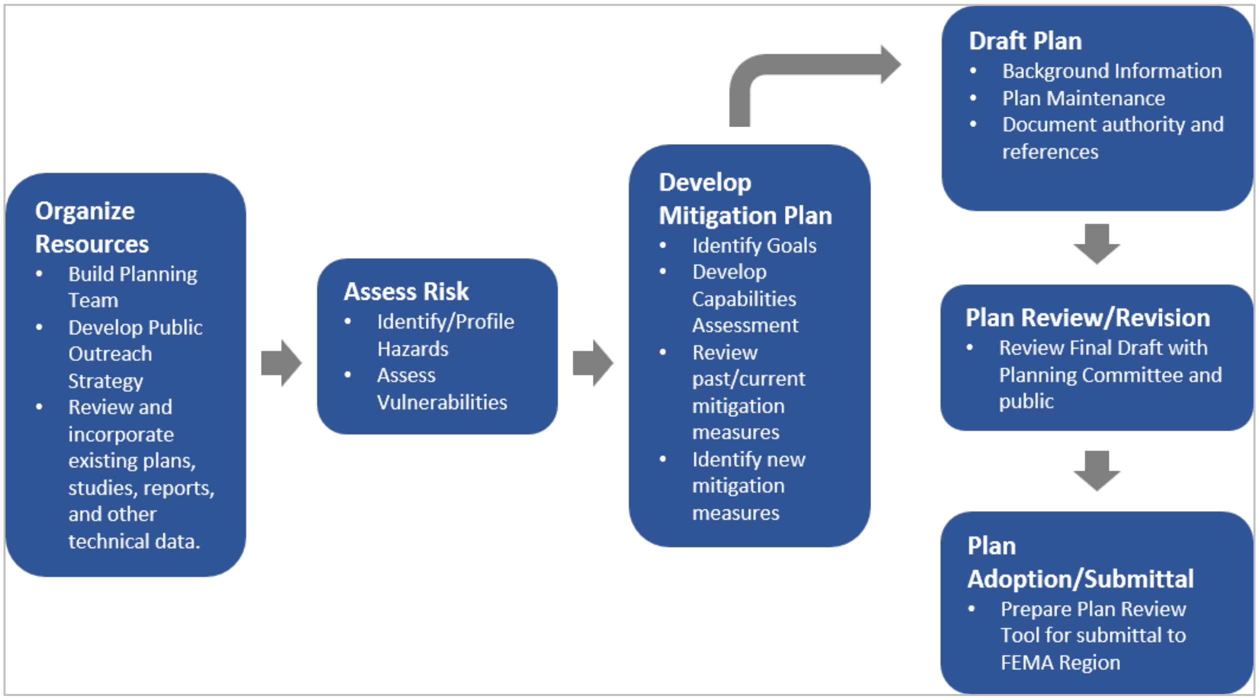
Hazard mitigation planning in the United States is guided by the statutory regulations described in the DMA 2000 and implemented through 44 Code of Federal Regulations (CFR) Part 201 and 206. FEMA's HMP guidelines outline a four-step planning process for the development and approval of HMPs. Table 3-1 lists the specific CFR excerpts that identify the requirements for approval.

TABLE 3-1 DMA 2000 CFR PLANNING PROCESS

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

For the development of the 2022 HMP, a planning process was customized to address the unique population and demographic. All basic federal guidance documents and regulations are met through the customized process. As shown in Figure , the HMP planning process (and documented in the corresponding sections) included organizing resources, assessing risk, developing the mitigation action strategy, drafting the plan, reviewing and revising the plan, and adopting and submitting the plan.

FIGURE 3-1 MITIGATION PLANNING PROCESS



3.2. Organize Resources

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

3.3. Building the Planning Team

The Planning Team, key to the backbone of the planning process, was critical for the development of the 2022 HMP. The planning team was built by Cuyahoga County, who invited private and non-profit agencies, as well as members of the consultant team. This group was known as the Hazard Mitigation Planning Committee (HMPC).

3.4. Hazard Mitigation Planning Committee

The 2022 HMPC consisted of key decision makers in specific County functions. The committee included stakeholders who actively participated in the planning process. Planning processes included:

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

The preparation of the 2022 HMP required a series of meetings and workshops intended to facilitate discussion and initiate data collection efforts with local community officials and stakeholders. More importantly, the meetings and workshops prompted continuous input and feedback from local officials throughout the update process.

A range of stakeholders, including neighboring communities, businesses, nonprofits, and other interested parties were invited and encouraged to participate in the development of the Plan. These stakeholders included the adjacent counties of Lake, Geauga, Summit, Medina, Lorain, and Portage, the Red Cross, prominent educational institutes, townships within the County, watershed groups located in the County, and local businesses. Stakeholder involvement was encouraged through the County's social media postings and email invitations to agencies and individuals to participate in Hazard Assessment Meeting and the Regional Open Houses. Table 3-2 provides a list of the 2022 HMP Planning Committee members.

TABLE 3-2 2022 CUYAHOGA COUNTY HMP PLANNING COMMITTEE

Name	Department	Title / Role	Meeting(s) Attended
Mathew Nickoson	Amateur Radio Emergency Service	District Emergency Coordinator	1
Rick Whitehead	American Red Cross – Northeast Ohio Chapter	Government Operations Chief / Northern Ohio Regional Emergency Management Lead	1
Dan Karp	Baldwin Wallace University	CMO	1
Karen K. Stenger	Baldwin Wallace University	Director of Risk Management	1
Gary Black	Baldwin Wallace University	Director of Safety and Security	1
Jonathan Liskovec	Bay Village	Director of Public Services and Properties	1
Chris Lyons	Bay Village	Fire Chief	2
Steven Holtzman	Beachwood	Fire Chief	1, Ind. Meeting
Shawn Francis	Bedford	Superintendent of Public Works	1, 2
Eric King	Bedford Heights	Supervisor, Department of Public Works	1, 2
Jesse Phan	Bentleyville	Captain, Fire Dept.	Ind. Meeting
Terry Ledwell	Berea	Fire Chief	1, Ind. Meeting
Ron Weidig	Brecksville	Service Director	1
Nick Zamiska	Brecksville	Fire Chief	2
Chuck Lobello	Bratenahl	Police Chief	Ind. Meeting
Jeff Hajek	Broadview Heights	Fire Chief	Ind. Meeting
John Verba	Brooklyn	Service Director	1
Kevin Paul	Brooklyn	Fire Chief	1
Thomas Maund	Brook Park	Fire Chief	Ind. Meeting
Joe Stefanko	Brooklyn Heights	Fire Chief	Ind. Meeting
Jesse Phan	Chagrin Falls	Captain, Chagrin Falls Fire Department	1, Ind. Meeting
Keely Davidson-Bennett	Chagrin River Watershed Partners	Senior Project Manager	1
Heather Elmer	Chagrin River Watershed Partners	Executive Director	2

Name	Department	Title / Role	Meeting(s) Attended
Mary Smigelski	CHN Housing Partners	CFO	1
Lauren Fletcher	Cleveland Clinic	Department Analyst with Emergency Management	2
James Meola	Cleveland Clinic	Senior Director, Emergency Management Chairman	2
Patrick Lafelice	Cleveland Clinic	Assistant Administrator	2
Collette Clinkscale	Cleveland Heights	Director of Public Works	1
Dave Freeman	Cleveland Heights	Fire Chief / Emergency Manager	1, 2
Greg Headley	Cleveland Metroparks	Director of Risk Management	1, 2
David Frey	Cleveland Metroparks	Civil Engineer	1, 2
Shimon Mermelstein	Cleveland Office of Emergency Management	Emergency Management Planner	1
Fred Szabo	Cleveland Office of Emergency Management	Emergency Manager	1, 2
Bob Horwatt	Cleveland Office of Emergency Management	Planner	1, 2
Tommy Doot	Cleveland Public Health	Preparedness Coordinator	2
Nicole Futoran	Cleveland Public Theatre	Donor Relations Associate	1
Nicole Sumlin	Cleveland Public Theatre	Education Director	1
Beverly Pettrey	Cleveland State University	Police Lieutenant / Emergency Management Manager	1, 2
Ben Carlson	Cuyahoga Community College Tri-C	Compliance & Risk Management Specialist	1, 2
Awatef Assad, Esq.	Cuyahoga County	Risk Manager	1
Mike Foley	Cuyahoga County	Director of Sustainability	1, 2
Mindy Naticchioni	Cuyahoga County Animal Shelter	Shelter Administrator	1
Heidi Scaife	Cuyahoga County Board of Health	Emergency Planning Coordinator	1
Robert Brand	Cuyahoga County Board of Health	Watershed Program Manager	1, 2
Rebecca Hysing	Cuyahoga County Board of Health	Regional Public Health Coordinator	2
Jim Hazimihalis	Cuyahoga County Department of Public Works, Road & Bridge Division	Chief Section Engineer	1, 2
Kevin Friis	Cuyahoga County EMA	Planning Manager	1
Sara Lippi	Cuyahoga County EMA	Emergency Management Specialist	1, 2
Mark Christie	Cuyahoga County EMA	Director	1, 2
Andrew Cox	Cuyahoga County EMA	Intern	1
Serena Steele	Cuyahoga County EMA	Senior Emergency Management Specialist	1
Nichole Curry	Cuyahoga County EMA	Administrative Assistant	1
Dan Meaney, GISP	Cuyahoga County Planning Commission	Manager, Information & Research	1
Janine Rybka	Cuyahoga County Soil & Water Conservation District	Director	1
Elizabeth Hiser	Cuyahoga County Soil & Water Conservation District	Watershed Program Manager	1

Name	Department	Title / Role	Meeting(s) Attended
Jessica Fenos	Cuyahoga County Solid Waste District	Assistant Director	1, 2
Maria Ortiz	Cuyahoga County Solid Waste District	Business Administrator	1
Thomas Burdyshaw	Cuyahoga Metropolitan Housing Authority Police Department	Commander	1
Gregory Drew	Cuyahoga Metropolitan Housing Authority Police Department	Lieutenant	1
Michael Suhy	Cuyahoga Heights	Fire Chief	Ind. Meeting
James Sickels	East Cleveland	Assistant Engineer	1
David Worley	East Cleveland	Fire Department Chief	1
Keisha Chambers	East Cleveland	City Engineer	Ind. Meeting
Dan Knecht	Euclid	Director of Public Service	1
Will Anderson	Euclid	Assistant Fire Chief	1, 2
Timothy O’Donnell	Euclid	Captain, Fire Department	1
Mary Kay Costello	Fairview Park	Director of Public Service & Development	2
Darnella Robertson	FirstEnergy	Regional External Affairs	1, 2
Elaine Marsh	Friends of the Crooked River	President	2
Deanna Bremer Fisher	FutureHeights	Executive Director	1, 2
James Sickels	Garfield Heights	Assistant Engineer	1, Ind. Meeting
Tom Majeski	Gates Mills	Assistant Chief, Fire Department	1
Michael Feig	Gates Mills	Lieutenant, Fire Department	1
P. Thomas Robinson	Gates Mills	Fire Chief	Ind. Meeting
Nadette Russo	Glenwillow	Police Sergeant	1
Miranda Moulton	Greater Cleveland Community Shares	Campaign Manager	1
Thomas Murawski	Greater Cleveland Regional Transit Authority	Intelligence Officer	2
Anthony Richardson	Greater Cleveland Regional Transit Authority	Acting Director – Service Quality	2
Remon Kaldas	Health and Human Services	Administrator	1, 2
Daniel Basta	Health and Human Services	Administrator	2
Bill Bernhard	Highland Heights	Assistant Fire Chief	1
William Turner	Highland Heights	Fire Chief	2
Thomas Cerveny	Highland Hills	Deputy Fire Chief	Ind. Meeting
Julie M. Johnson	Hunger Network	CEO	1
Erin Ogden	Hunger Network	Food & Nutrition Manager	1
Don Cunningham	Hunting Valley	Service Director	1
Jesse Phan	Hunting Valley	Captain, Fire Dept.	Ind. Meeting
Michael Cannon	Hunting Valley	Police Chief / Village Administrator	1
Steve Rega	Independence	Fire Chief	1, 2
Brian Hurd	John Carroll University	Chief of Police	1
Susan Hijjawi	Lakewood	Manager of Division of Aging	1

Name	Department	Title / Role	Meeting(s) Attended
Roman Ducu	Lakewood	Public Works Director	1, 2
Tim Dunphy	Lakewood	Fire Chief	Ind. Meeting
David Garber	Linndale	Police Sergeant	Ind. Meeting
Mike Carroll	Lyndhurst	Fire Chief	2
Vito Kavaliunas	Maple Heights	Fire Chief	Ind. Meeting
Eugene Carcioppolo	Mayfield	Fire Chief	1, 2
Bruce Elliot	Mayfield Heights	Fire Chief	1, 2
Briant Galgas	Middleburg Heights	Fire Chief	2
Jesse Phan	Moreland Hills	Captain, Fire Dept.	Ind. Meeting
Michelle Hall	Nature Center at Shaker Lakes	Accountant	1, 2
James Sickels	Newburgh Heights	Assistant Engineer	1
David Boatman	North Olmsted	Fire Captain	Ind. Meeting
Gerardo Colon	North Randall	Lieutenant Fire Chief	Ind. Meeting
Robert Chegan, Jr.	North Royalton	Fire Chief	Ind. Meeting
Kathy Sarli	Northeast Ohio Areawide Coordinating Agency (NOACA)	Chief Operating Officer	1
Joe MacDonald	Northeast Ohio Areawide Coordinating Agency (NOACA)	Director of Strategic and Environmental Planning	1, 2
Patrick Thomas	Northeast Ohio Regional Fusion Center	Intelligence Analyst	1
John Corn	Northeast Ohio Regional Sewer District	Emergency Manager	2
Keith McClintock	Northeast Ohio Regional Sewer District	Manager of Watershed Programs	2
David Ritter	Northeast Ohio Regional Sewer District	Manager of Watershed Technical Support	2, Ind. Meeting
George Remias, PE	Northeast Ohio Regional Sewer District	Manager of Stormwater Strategic Support	2
Rachel Webb	Northeast Ohio Regional Sewer District	Project Manager III	2
David Tapp	Oakwood	Assistant Chief of Oakwood Village Fire Department	1, 2
Brian DiRocco	Oakwood	Fire Captain	1
Matt Sheehan	Olmsted Falls	Fire Chief	1, 2
Eric Williams	Olmsted Township	Service Director	1
Bob Zugan	Orange	Service Director	1, Ind. Meeting
Terry Goldhamer	Orange	Crew Leader, Service Department	1
Bob Wilson	Orange	Fire Chief	1, 2
Tony Vannello	Parma	Public Works Coordinator	1, 2
Lou Davis	Parma	Fire Captain	1, 2
Matt Bernard	Parma Heights	Assistant Fire Chief	2
John Frazier	Pepper Pike	Fire Chief	Ind. Meeting
Marc Neumann	Richmond Heights	Fire Chief	1, 2
David Grice	Richmond Heights	Firefighter	2
Mark Filipic	Rocky River	Public Works Coordinator	1, 2
Jack Johnson	Seven Hills	Director of Public Service	1

Name	Department	Title / Role	Meeting(s) Attended
Patricia Speese	Shaker Heights	Public Works Director	1
Jim Heath	Shaker Heights	Assistant Fire Chief	1, 2
Mark Vedder	Solon	Fire Chief	1
William Drsek	Solon	Public Works Commissioner	1, 2
David Csire	South Euclid	Assistant Fire Chief	1, 2
Douglas Stefko	South Euclid	Fire Chief	1
Daniel J. Woodrow	St. Vincent Charity Medical Center	Director of Protective Services & Emergency Preparedness	1, 2
Cheryl Ross Appline	Step Forward	Senior Director of Planning, Research, & Evaluation	1
Justin Williams	Step Forward	Facilities Director	1
Ashley Buchanan	Step Forward	Staffing Specialist	2
Jack Draves	Strongsville	Fire Chief	1, 2
Andrea Bishop	The Center for Health Affairs	EP Project Manager	1
Tracy Pate	The Center for Health Affairs	NEO Healthcare Coalition Coordinator	1
Beth Gatlin	The Center for Health Affairs	NE Ohio Regional Healthcare Coordinator	2
Marek Owca	The MetroHealth System	Director of Office of Emergency Management	2
Pete Killmer	U.S. Coast Guard	Port Security Specialist	1
Robert Perko	University Heights	Fire Chief	2
Donald Barnes	University Hospitals Ahuja Medical Center Emergency Management	EMS Liaison	1
Lewis Davis	University Hospitals Parma Medical Center	O.R. Inventory Coordinator	1
Ken Papesh	Valley View	Fire Chief	2
Shannon Cartier	Walton Hills	Police Department Dispatch Supervisor	2
Herb Waugh	Warrensville Heights	Fire Chief	Ind. Meeting
Nick Ribich	Westlake	Police Officer	1
Michael Freeman	Westlake	Assistant Chief, Fire Department	1
Paul Quinn	Westlake	Public Service Director	2
Frank Paparone	Woodmere	Service Director	Ind. Meeting
Johnny J. Brewington	Woodmere	Fire Chief	Ind. Meeting

3.4.1 Planning Committee Meetings

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

TABLE 3-3 MEETING SUMMARY

Date	Meeting Type	Topics
June 9, 2021	Internal Kickoff	Review of Mitigation Planning Standards Schedule & Meetings Participation Relevant Data and Documentation Questions and Next Steps
July 15, 2021	Hazard Assessment Meeting	Planning Committee Introductions Hazard Mitigation Planning Process Hazard Identification & Risk Assessment (HIRA) Exercise Develop Mitigation Goals & Objectives Introduce Cuyahoga County HMP Website Develop Mitigation Actions Develop Mitigation Actions Plan
September 8-9, 2021	Regional Open Houses	Planning Committee Introductions Review of Hazard Mitigation Review of Planning Process Review of Risk Assessment Review Mitigation Techniques Categories of Action Cuyahoga County HMP Website to complete forms Risk Evaluation, Vulnerability Assessment, Changes in Development, Capability Assessment, Update on Previous Actions, and New Mitigation Actions
September 10, 2021 – January 4, 2022	Individual Meetings	Communities came in on an as-needed basis to provide required material

As the planning committee prepared to meet for the first time, the COVID-19 social distancing guidelines were continuing to be followed. All forms of in-person gatherings were canceled, postponed, or moved to a virtual setting. Rather than postpone the entire planning process until social gatherings were deemed safe, Cuyahoga County decided to hold virtual conferences through Cisco WebEx. The WebEx meeting information was created, and the County dispersed the announcement to the local jurisdictions and stakeholders.

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

For the Regional Open House meetings, as participants joined, they were placed into breakout rooms in the WebEx with a contracting team member to have one-on-one time to review hazard mitigation and components of a hazard mitigation plan, visit the website, submit the required forms, and ask any questions about the planning process or next steps for their community or organization.

The following table identifies how the eligible jurisdictions and stakeholders participated in the planning process. The first column is the jurisdictions located in Cuyahoga County which fully participated in the HMP planning process. Communities who did were not available to participate in the two scheduled meetings opted to complete an individual meeting to complete the planning process requirements. The second table shows the stakeholders who participated in the planning process and submitted forms, but they will not be adopting the plan. Stakeholders were strongly encouraged to submit four forms – Risk Evaluation, Vulnerability Assessment, Changes in Development, and Capability Assessment – but they were not required. If a stakeholder had a specific mitigation action they wished to submit, they were able to do so, and this is represented by the stakeholders that have an asterisk (*). However, none of the stakeholders expressed the intent to adopt the hazard mitigation plan.

TABLE 3-4 JURISDICTIONAL PARTICIPATION

Jurisdiction	Meeting Participation				Documentation Provided						2022 Status
	Meeting 1	Meeting 2	Ind. Meeting	Completed Meeting Participation	Risk Evaluation	Vulnerability Assessment	Changes in Development	Capability Assessment	Update on Previous Action	New Action	COMPLETE
Cuyahoga County	O	O		O	O	O	O	O	O	O	O
Bay Village	O	O		O	O	O	O	O	O	O	O
Beachwood	O		Sept. 30th, 2021	O	O	O	O	O	O	O	O
Bedford	O	O		O	O	O	O	O	O	O	O
Bedford Heights	O	O		O	O	O	O	O	O	O	O
Bentleyville			Oct. 29th, 2021	O	O	O	O	O	O	O	O
Berea	O		Sept. 23rd, 2021	O	O	O	O	O	O	O	O
Bratenahl			Oct. 26th, 2021	O	O	O	O	O	O	O	O
Brecksville	O	O		O	O	O	O	O	O	O	O
Broadview Heights			Sept. 23rd, 2021	O	O	O	O	O	O	O	O
Brook Park			Oct. 26th, 2021	O	O	O	O	O	O	O	O
Brooklyn	O			O	O	O	O	O	O	O	O
Brooklyn Heights			Sept. 9th, 2021	O	O	O	O	O	O	O	O
Chagrin Falls	O		Oct. 29th, 2021	O	O	O	O	O	O	O	O
Cleveland	O	O		O	O	O	O	O	O	O	O
Cleveland Heights	O	O		O	O	O	O	O	O	O	O
Cuyahoga Heights			Dec. 22nd, 2021	O	O	O	O	O	O	O	O
East Cleveland	O		Oct. 6th, 2021	O	O	O	O	O	O	O	O
Euclid	O	O		O	O	O	O	O	O	O	O
Fairview Park		O		O	O	O	O	O	O	O	O
Garfield Heights	O		Oct. 8th, 2021	O	O	O	O	O	O	O	O
Gates Mills	O		Oct. 18th, 2021	O	O	O	O	O	O	O	O
Glenwillow	O			O	O	O	O	O	O	O	O
Highland Heights	O	O		O	O	O	O	O	O	O	O

Jurisdiction	Meeting Participation				Documentation Provided						2022 Status
	Meeting 1	Meeting 2	Ind. Meeting	Completed Meeting Participation	Risk Evaluation	Vulnerability Assessment	Changes in Development	Capability Assessment	Update on Previous Action	New Action	COMPLETE
Highland Hills			Jan. 4th, 2022	O	O	O	O	O	O	O	O
Hunting Valley	O		Oct. 29th, 2021	O	O	O	O	O	O	O	O
Independence	O	O		O	O	O	O	O	O	O	O
Lakewood	O		Sept. 24th	O	O	O	O	O	O	O	O
Linndale			Oct. 5th, 2021	O	O	O	O	O	O	O	O
Lyndhurst		O		O	O	O	O	O	O	O	O
Maple Heights			Oct. 26th, 2021	O	O	O	O	O	O	O	O
Mayfield	O	O		O	O	O	O	O	O	O	O
Mayfield Heights	O	O		O	O	O	O	O	O	O	O
Middleburg Heights		O		O	O	O	O	O	O	O	O
Moreland Hills			Oct. 29th, 2021	O	O	O	O	O	O	O	O
Newburgh Heights	O		Oct. 8th, 2021	O	O	O	O	O	O	O	O
North Olmsted			Oct. 8th, 2021	O	O	O	O	O	O	O	O
North Randall			Nov. 8th, 2021	O	O	O	O	O	O	O	O
North Royalton			Sept. 20th, 2021 Sept. 22nd, 2021	O	O	O	O	O	O	O	O
Oakwood	O	O		O	O	O	O	O	O	O	O
Olmsted Falls	O	O		O	O	O	O	O	O	O	O
Olmsted Township	O			O	O	O	O	O	O	O	O
Orange	O	O	Sept. 22nd, 2021	O	O	O	O	O	O	O	O
Parma	O	O		O	O	O	O	O	O	O	O
Parma Heights		O		O	O	O	O	O	O	O	O
Pepper Pike			Oct. 26th, 2021	O	O	O	O	O	O	O	O
Richmond Heights	O	O		O	O	O	O	O	O	O	O
Rocky River	O	O		O	O	O	O	O	O	O	O

Jurisdiction	Meeting Participation				Documentation Provided						2022 Status
	Meeting 1	Meeting 2	Ind. Meeting	Completed Meeting Participation	Risk Evaluation	Vulnerability Assessment	Changes in Development	Capability Assessment	Update on Previous Action	New Action	COMPLETE
Seven Hills	O			O	O	O	O	O	O	O	O
Shaker Heights	O	O		O	O	O	O	O	O	O	O
Solon	O	O		O	O	O	O	O	O	O	O
South Euclid	O	O		O	O	O	O	O	O	O	O
Strongsville	O	O		O	O	O	O	O	O	O	O
University Heights		O		O	O	O	O	O	O	O	O
Valley View		O		O	O	O	O	O	O	O	O
Walton Hills		O		O	O	O	O	O	O	O	O
Warrensville Heights			Dec. 16th, 2021	O	O	O	O	O	O	O	O
Westlake	O	O		O	O	O	O	O	O	O	O
Woodmere			Oct. 4th, 2021 Oct. 14th, 2021	O	O	O	O	O	O	O	O

TABLE 3-5 STAKEHOLDER PARTICIPATION

Stakeholder	Meeting Participation			Documentation Provided			
	Meeting 1	Meeting 2	Ind. Meeting	Risk Evaluation	Vulnerability Assessment	Changes in Development	Capability Assessment
Amateur Radio Emergency Service	O						
American Red Cross – Northeast Ohio Chapter	O			O	O	O	O
Baldwin Wallace University	O						
Chagrin River Watershed Partners	O	O		O	O	O	O
CHN Housing Partners	O						
Cleveland Clinic		O		O	O	O	O
Cleveland Clinic – Children's Hospital for Rehabilitation and Lerner School for Autism				O	O	O	O
Cleveland Clinic – Emergency Management Enterprise				O	O	O	O
Cleveland Clinic – Fairlawn				O	O	O	O
Cleveland Clinic – Fairview Hospital				O	O	O	O
Cleveland Clinic – Hillcrest Hospital/South Pointe Hospital				O	O	O	O
Cleveland Clinic – Lutheran Hospital				O	O	O	O
Cleveland Clinic – Marymount Hospital/Euclid Hospital				O	O	O	O
Cleveland Clinic – NECO Region				O	O	O	O
Cleveland Metroparks*	O	O		O	O	O	O
Cleveland Public Health		O		O	O	O	O
Cleveland Public Theatre	O						
Cleveland State University*	O	O		O	O	O	O
Cuyahoga Community College (Tri-C)*	O	O		O	O	O	O
Cuyahoga County Animal Shelter	O						
Cuyahoga County Board of Health*	O	O		O	O	O	O
Cuyahoga County Department of Public Works, Road & Bridge Division	O	O					
Cuyahoga County Department of Sustainability*	O	O		O	O	O	O
Cuyahoga County Planning Commission	O						

Stakeholder	Meeting Participation			Documentation Provided			
	Meeting 1	Meeting 2	Ind. Meeting	Risk Evaluation	Vulnerability Assessment	Changes in Development	Capability Assessment
Cuyahoga County Soil & Water Conservation District	O						
Cuyahoga County Solid Waste District	O	O		O	O	O	O
Cuyahoga Metropolitan Housing Authority Police Department	O						
FirstEnergy	O	O					
Friends of the Crooked River		O					
FutureHeights	O	O		O	O		
Greater Cleveland Community Shares	O						
Greater Cleveland Regional Transit Authority		O		O	O	O	O
Health and Human Services	O	O		O	O	O	O
Hunger Network*	O			O	O	O	O
John Carroll University	O						
Nature Center at Shaker Lakes	O			O			
Northeast Ohio Areawide Coordinating Agency	O	O		O	O	O	O
Northeast Ohio Regional Fusion Center	O						
Northeast Ohio Regional Sewer District		O	Sept. 28th	O	O		
St. Vincent Charity Medical Center	O			O	O	O	O
Step Forward	O	O					
The Center for Health Affairs	O	O		O	O	O	O
The MetroHealth System		O		O	O	O	O
U.S. Coast Guard	O						
University Hospitals – Ahuja Medical Center Emergency Management	O						
University Hospitals – Parma Medical Center	O						

3.4.2 Public Outreach Strategy

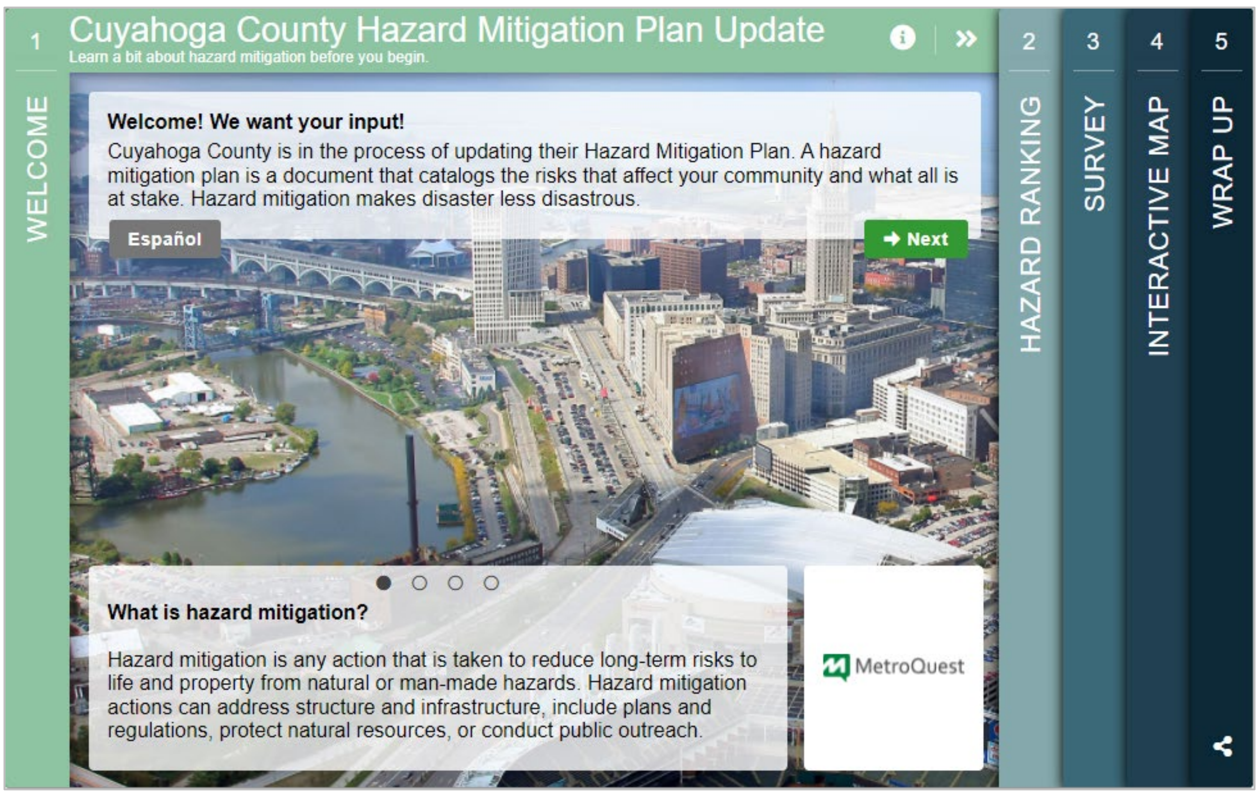
Public outreach is a major component of the 2022 HMP. Participation from the public, including the general citizenry, is necessary in order to gain a full picture of the potential issues and hazards that affect the County.

Cuyahoga County Hazard Mitigation Plan Public Survey

A public survey was developed through MetroQuest for the residents of Cuyahoga County to complete. The survey was offered from September 6, 2021, through October 27, 2021 for all residents of the county. MetroQuest, an online engagement platform, was used to develop the public survey which was available in both English and Spanish languages to ensure the survey was inclusive for residents of the county.

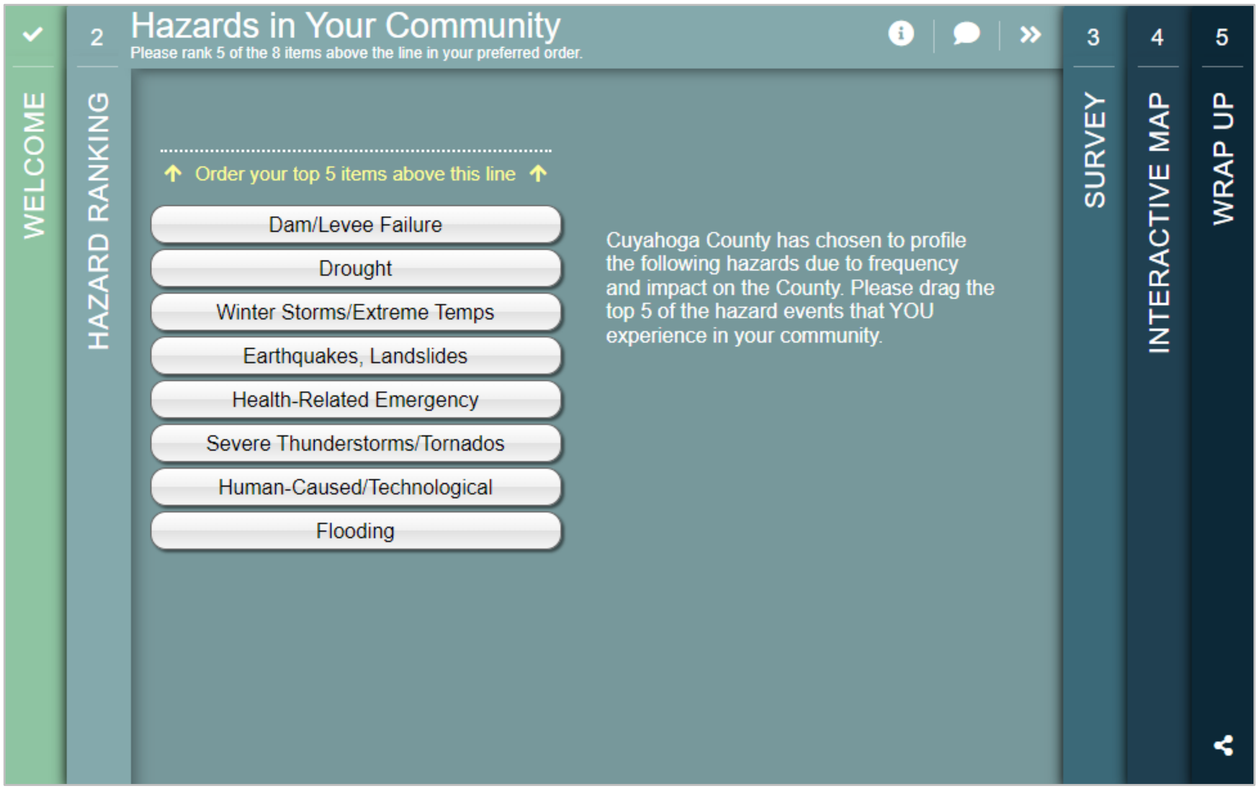
The survey itself included a beginning slide that provided the survey participant with context on hazard mitigation, the importance of the plan, how the survey results would be incorporated into the hazard mitigation plan, and alerted the participant to additional participation opportunities. The following image is the introductory slide to the virtual survey.

FIGURE 3-2 INTRODUCTORY SLIDE OF THE PUBLIC SURVEY



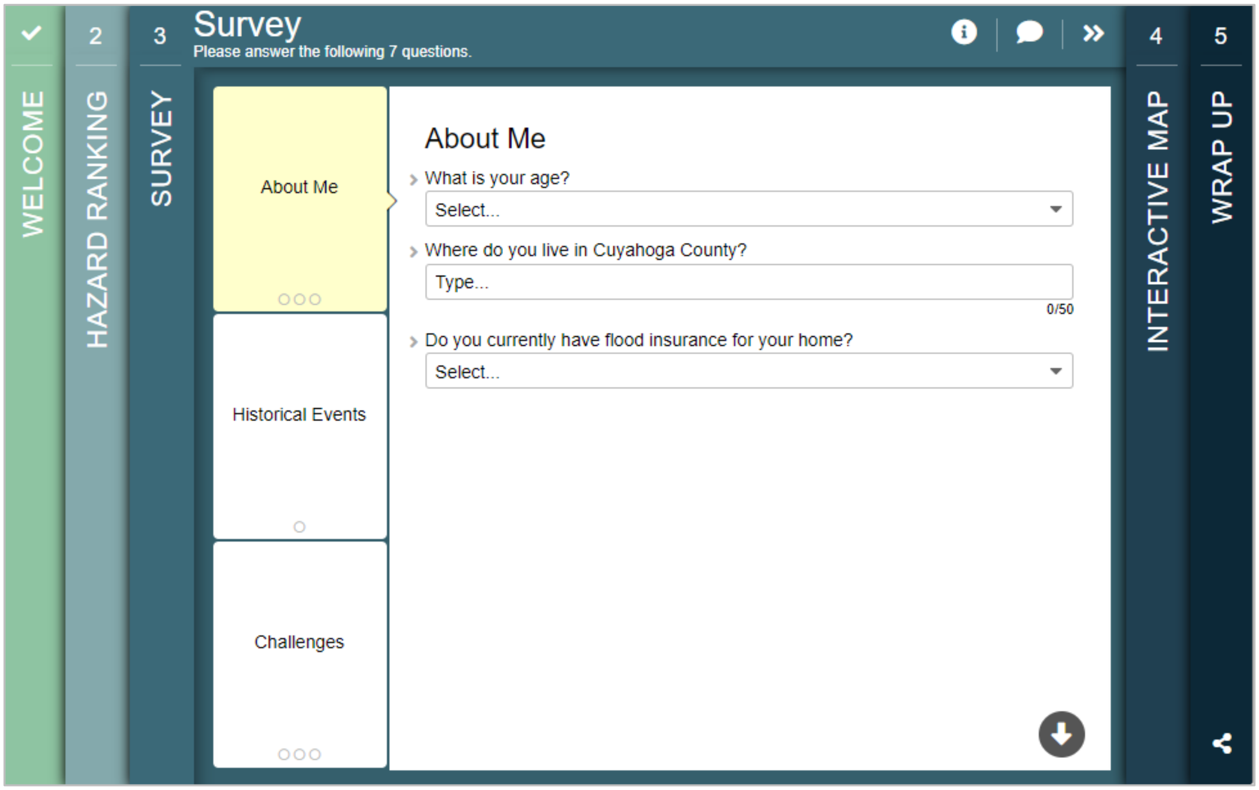
Following the introductory slide, the survey participant was asked to rank the top five hazards for where the participant lives in the county. The hazards were grouped together based on similarity of impacts, if applicable. The options to rank included: dam/levee failure, drought, winter storms/extreme temperatures, earthquakes/landslides, health-related emergency, severe thunderstorms/tornadoes, human-caused/technological, and flooding. The following image is the second slide of the virtual survey.

FIGURE 3-3 HAZARD RANKING SLIDE OF THE PUBLIC SURVEY



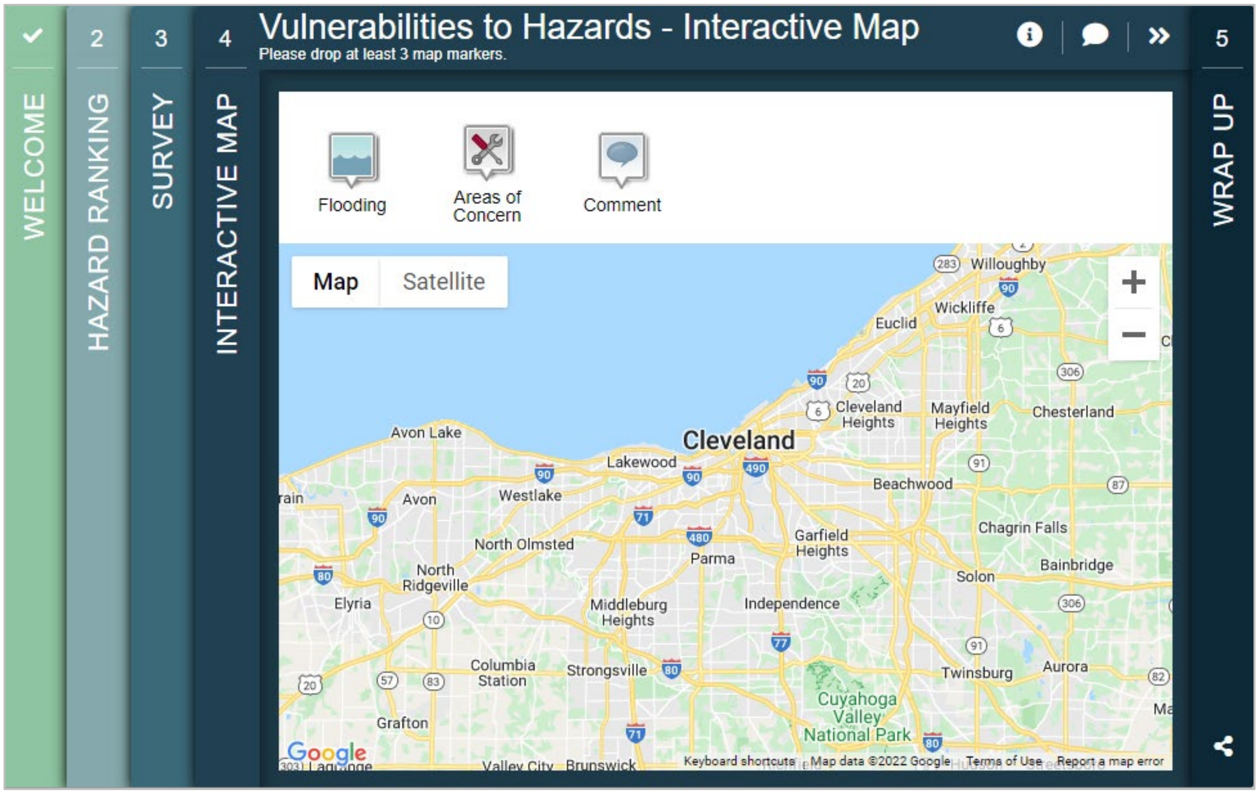
The third slide of the public survey included a brief survey of the participant, including asking the age range of the participant, community of which the participant lives in, if the participant currently has flood insurance. The third slide also asks the survey participant to provide information on the worst hazard event they have experienced in Cuyahoga County. Lastly, the third slide asks if there are any disaster events the survey participant's community is vulnerable to as well as any challenges the community faces that may delay disaster response. The following image is the third slide of the public survey.

FIGURE 3-4 THIRD SLIDE OF THE PUBLIC SURVEY



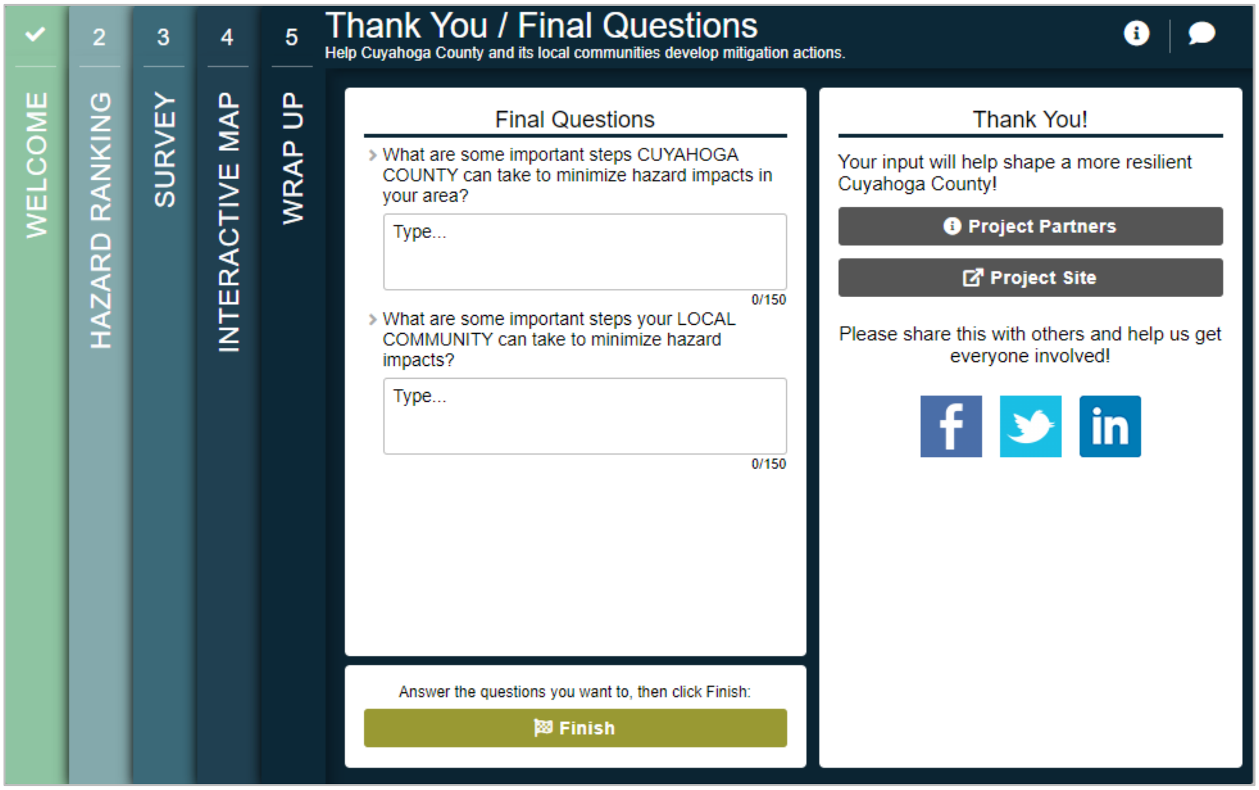
The fourth slide of the public survey asked participants to identify areas in their community that are known to constantly face issues from the hazards the community is vulnerable to through an interactive map that markers that were able to be placed on specific locations. The markers that the participant was able to place on the map included flooding, areas of concern, and general comment markers. The following image is the fourth slide of the public survey.

FIGURE 3-5 FOURTH SLIDE OF THE PUBLIC SURVEY



The last slide of the public survey included a Final Questions section that allowed the participant to identify important steps Cuyahoga County, as well as the respondent's local community, can take to minimize hazard impacts in the area. The survey participant was also able to share the public survey through their personal Facebook page, Twitter profile, and LinkedIn page. The following image is the last slide of the public survey.

FIGURE 3-6 FINAL SLIDE OF THE PUBLIC SURVEY



The following images are sample postings from the Cuyahoga County Emergency Management Agency's website, Twitter account, and Facebook account to spread awareness of the public survey. There were 73 participants in the English version of the survey, and there were no participants in the Spanish version of the public survey.

FIGURE 3-7 READYCUYAHOGA WEBSITE SURVEY POSTING

Cuyahoga County is updating its All-Hazards Mitigation Plan, and we want input from YOU! We have developed a public survey that provides background on what hazard mitigation is and asks participants to take an active role in the process. The survey includes ranking top hazards for your community, answering survey questions about past experiences with hazard events, and identifying areas of concern on a map.

The survey will be available to residents of Cuyahoga County from September 6th through October 27th at the following link: http://metroquestsurvey.com/4hk0v.

Thank you for doing your part to help Cuyahoga County in its update of the All-Hazards Mitigation Plan!

¡El condado de Cuyahoga lo invita a participar en la actualización del Plan de Mitigación de Riesgos Comprensivo! Hemos desarrollado una encuesta publica que provee información sobre la mitigación de riesgos y permite a los participantes tener un rol activo en el proceso. La encuesta incluye la clasificación de los peligros principales de la comunidad, preguntas sobre su experiencia durante eventos de riesgo anteriores y la identificación de áreas de preocupación en un mapa de la comunidad.

La encuesta estará disponible para todos los residentes del condado de Cuyahoga desde el 6 de septiembre hasta el 27 de octubre en el siguiente enlace: http://metroquestsurvey.com/ns0d0o.

¡Gracias por su participación en la actualización del Plan de Mitigación de Riesgos Comprensivo del condado de Cuyahoga!

FIGURE 3-8 CUYAHOGA COUNTY OFFICE OF EMERGENCY MANAGEMENT SURVEY TWEET

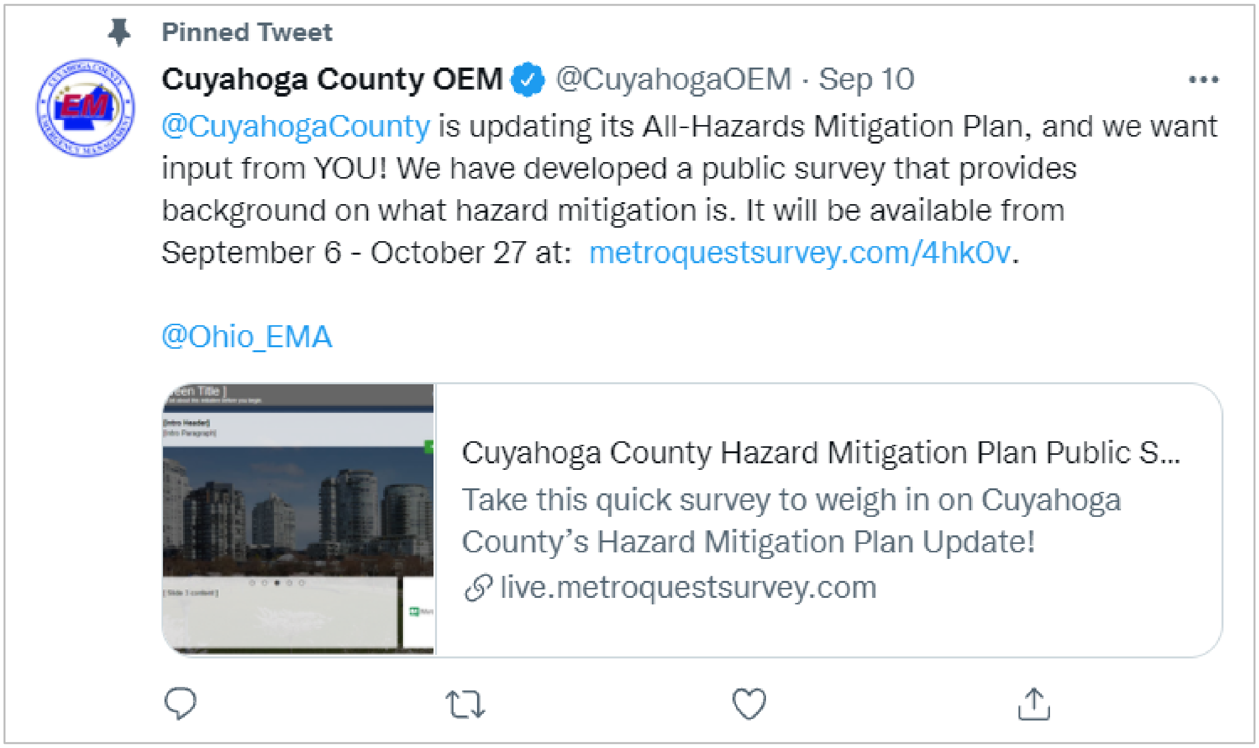
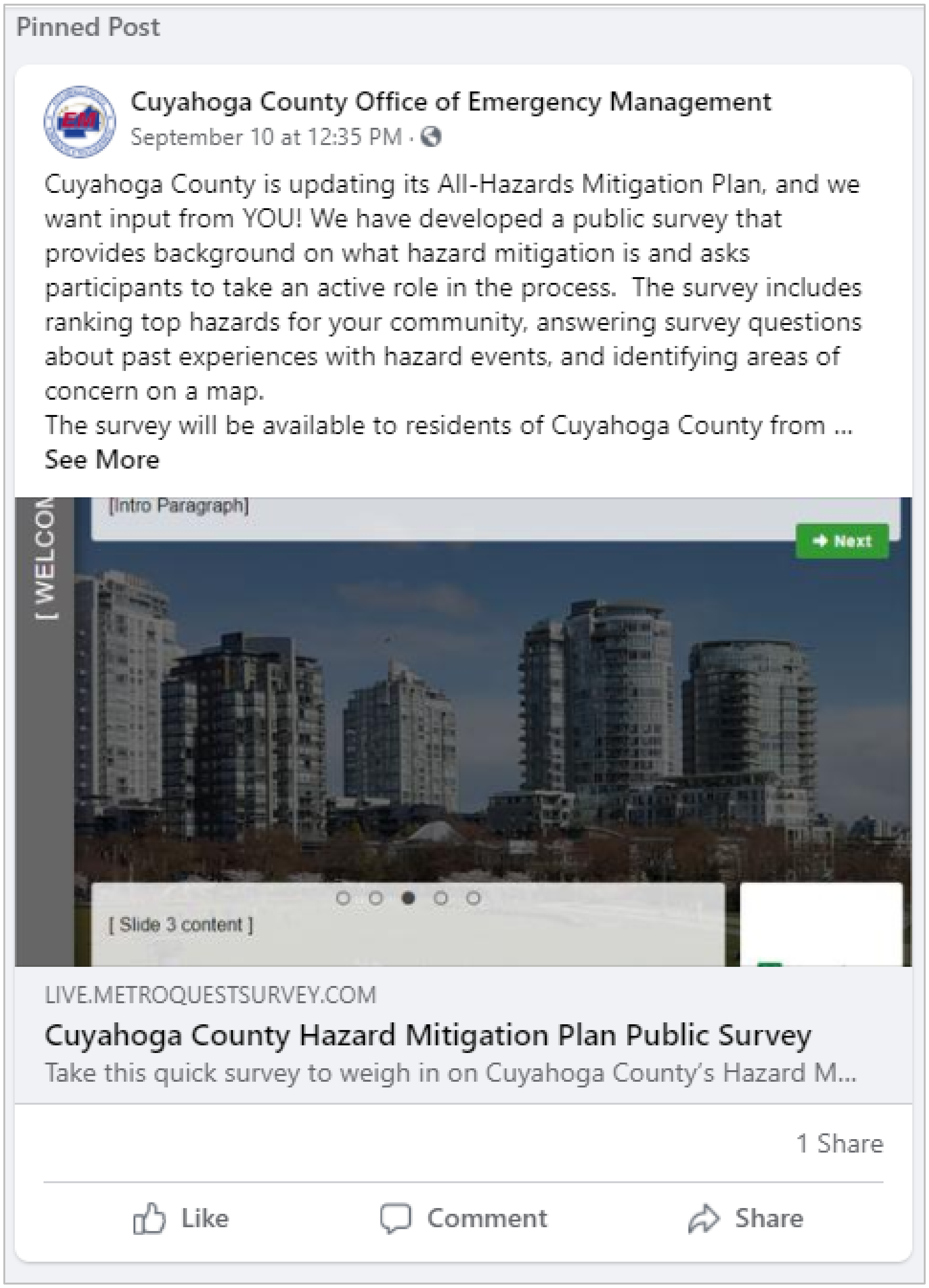


FIGURE 3-9 CUYAHOGA COUNTY OFFICE OF EMERGENCY MANAGEMENT FACEBOOK SURVEY POST



The summarized responses of the Cuyahoga County Hazard Mitigation Plan Public Survey are presented in the following narrative. All comments that were received in the public survey are summarized in the applicable narratives; the full list of public comments received as well as their status can be found in **Appendix F**.

TABLE 3-6 SURVEY PARTICIPATION WEEKLY BREAKDOWN

Week of Survey	Cumulative Total Number of Participants
Sept. 6th – Sept. 13th	13
Sept. 14th – Sept. 21st	17
Sept. 22nd – Sept. 29th	18
Sept. 30th – Oct. 7th	21
Oct. 8th – Oct. 15th	33
Oct. 16th – Oct. 23rd	69
Oct. 24th – Oct. 27th	73

The following table displays the results from the hazard ranking slide of the public survey with the Hazard, the Ranking Average with 1 being the highest ranked and five being the lowest ranked, and Number of Inputs identifying how often the hazard was ranked in the top five by each survey respondent. Overall, Winter Storms/Severe Temperatures was ranked the most by participants, a total of 65 times out of the 73 responses with an average ranking of 2.4. Severe Thunderstorms/Tornadoes was ranked the second often, a total of 62 times out of the 73 responses with an average ranking of 2.32. Health-Related Emergency was ranked the third most often, a total of 59 times out of the 73 responses with an average ranking of 2.89.

TABLE 3-7 HAZARD RANKING PUBLIC SURVEY RESULTS

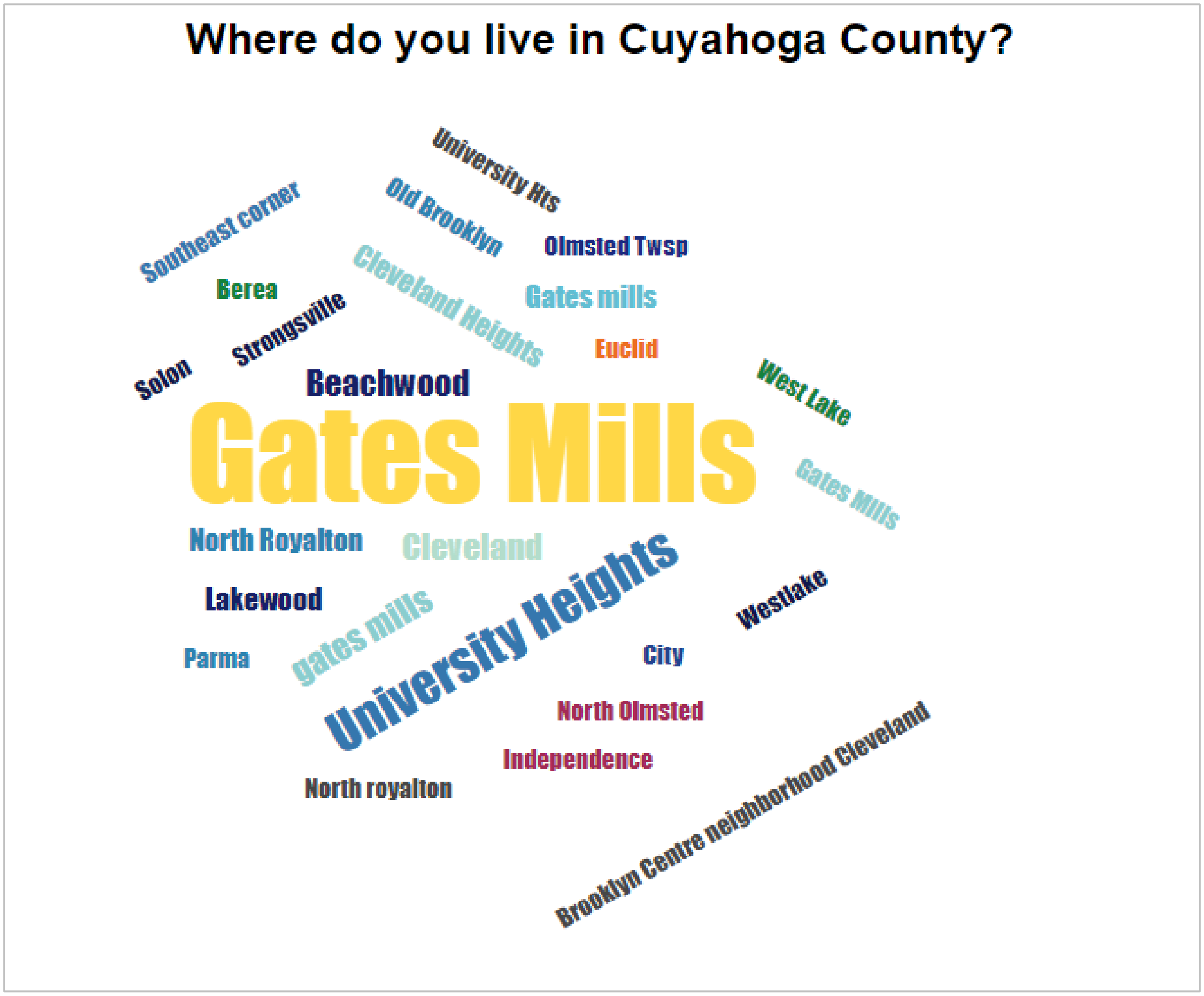
Hazard	Ranking Average	Number of Inputs
Severe Thunderstorms/Tornados	2.32	62
Drought	4.58	17
Human-Caused/Technological	3.16	56
Winter Storms/Extreme Temps	2.4	65
Dam/Levee Failure	2.66	3
Health-Related Emergency	2.89	59
Earthquakes, Landslides	3.75	4
Flooding	3.53	56

The following table displays the age groups that responded to the public survey with the age ranges that were included in the survey as well as the number of respondents that were in each age range.

Age Range	Number of Respondents
18-29 years old	3
30-39 years old	5
40-49 years old	21
50-59 years old	12
60-69 years old	20
70-79 years old	4
80+ years old	1

The following word cloud was generated by MetroQuest for the responses of where the survey participants live in Cuyahoga County. The larger the word appears in the graphic indicates that multiple participants live in that specific community.

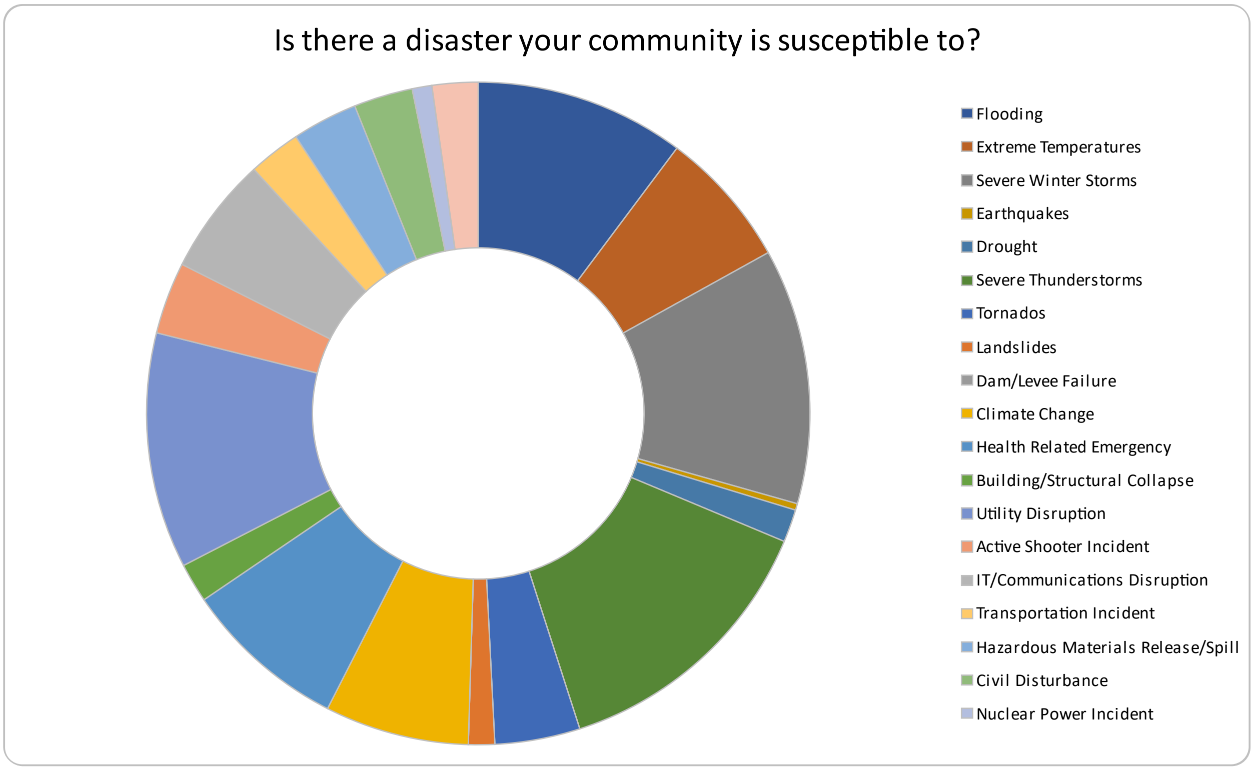
TABLE 3-8 WORD CLOUD FROM THE PUBLIC SURVEY



16 of the 73 survey participants currently have flood insurance for their home – 48 of the respondents indicated they do not have flood insurance currently. The top responses for the worst historical hazard event participants have experienced in Cuyahoga County were flooding, house flooding, severe thunderstorms, and power outages.

The following pie chart shows the hazards that the participants' communities are vulnerable to. 43 participants selected Severe Thunderstorms, 39 participants selected Severe Winter Storms, 36 participants selected Utility Disruption, 32 participants selected Flooding, and 25 participants selected Heath-Related Emergency.

FIGURE 3-10 HAZARD VULNERABILITY RESULTS FROM PUBLIC SURVEY



The following table displays the results from the question that asked what challenges the participant's community may delay disaster response. The table includes the challenges that the participant was able to pick from as well as the number of times the specific challenge was identified as applicable by a survey participant.

Challenge in Community	Number of Participant Selection
Lack of notice prior to a hazard event (i.e., tornado warning or no tornado sirens in area)	17
Not enough emergency personnel to respond to citizens in need	24
Community does not have a plan for post-disaster clean up	13
Post-disaster insurance issues	12
Other	7

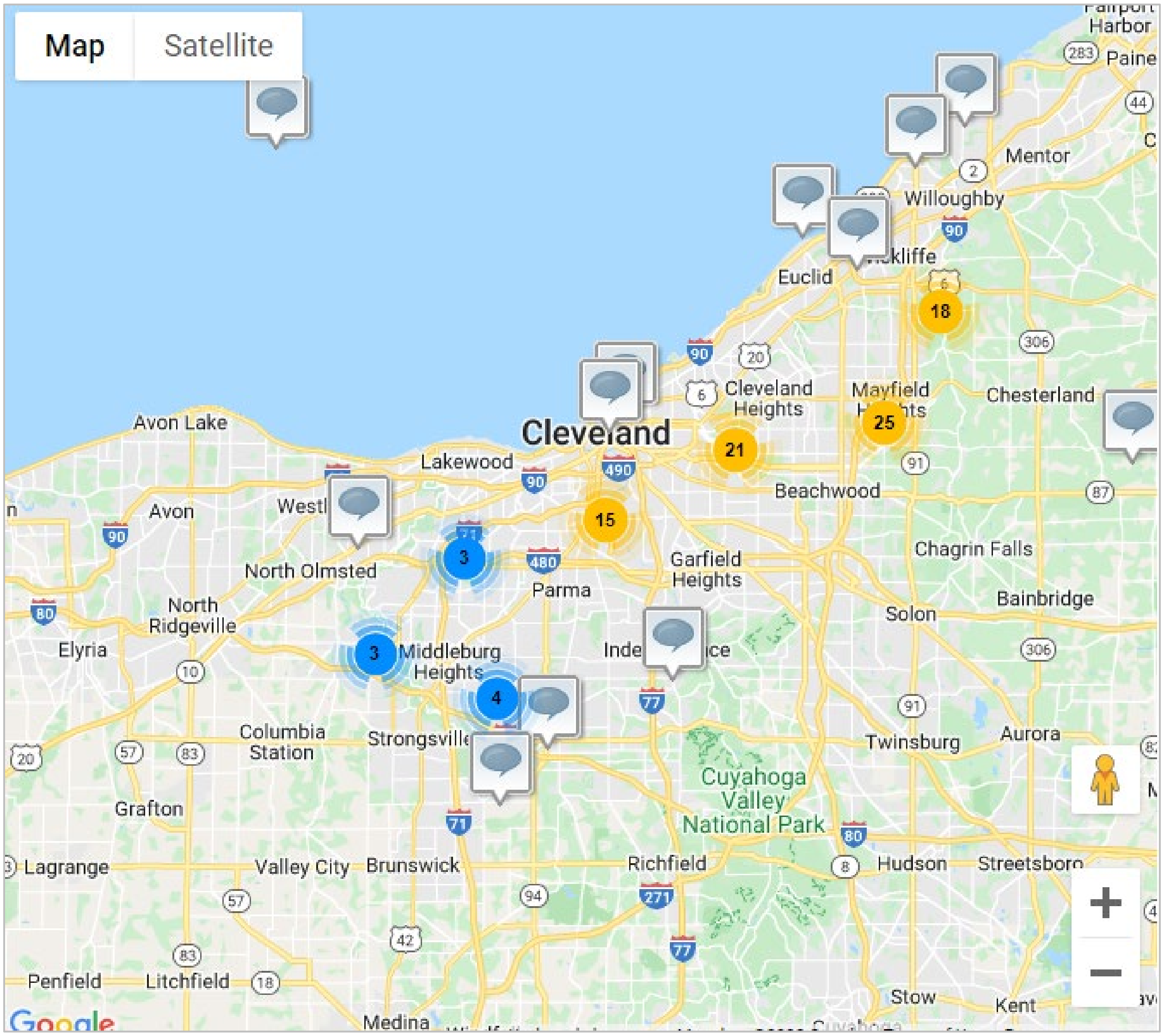
The responses that were given in the "Other" comment box were:

- No plan for climate crisis impacts due to rising temperatures, increased precipitation and related health hazards, infrastructure damage. Continuing to clear cutting of mature trees for construction reducing further the tree canopy cover adding more impermeable surfaces, exacerbating stormwater runoff, erosion, reducing water quality and biodiversity with added impacts on ecosystem services and functions.
- Not enough citizen participation or involvement in at-home disaster preparedness.

- Unofficial speculation and information overcome the timely and factual information reporting that is done by local and county officials.
- No money for proactive repairs and two-way communication between City/county governments and its citizens.
- Utility providers are not as communicative on how problems are going to be resolved.
- First Energy is the source of the emergency personnel, and they can become overwhelmed in a large power outage.
- Long power outages following thunderstorms and early season snow/ice storms are a problem. Twice in the past three years we have personally been without power for 5+ days. FirstEnergy simply couldn't keep up.

The following image shows the geographical results of the interactive map. Participants placed a total of 101 markers on the map – 51 of the markers identified specific flooding locations, 46 of the markers identified specific areas of concern, and 4 of the markers provided general comments of the specific location. The summary of comments included specific flooding locations as well as vulnerable populations and assets to flooding, locations of traffic accidents, property development and improvements to control erosion, power outage locations, and streets that can become increasingly hazardous in winter weather conditions.

FIGURE 3-11 INTERACTIVE MAP MARKER RESULTS FROM PUBLIC SURVEY



The final slide of the survey provided the participants an opportunity to share thoughts on important steps Cuyahoga County and their local community can take to minimize hazard impacts going forward. Overall, the summary of responses included local jurisdictions of the county adopting and utilizing the Cuyahoga County Climate Change Action Plan, additional regional planning efforts to improve stormwater throughout the county, public education of hazards and steps that can be taken to reduce hazard impacts, expand on the types of energy offered to residents, identify vulnerable power lines and maintain the power lines to avoid utility loss, and additional emergency responders to help during a hazard event.

3.4.3 Draft Plan Comments Received

The plan was posted for public review on Cuyahoga County's website and in 8 public libraries throughout the county on April 18th. The comment period for the public was open for two weeks, closing on May 2nd. Extensive efforts were made to gather public input during the draft plan comment period.

Cleveland.com published an article on April 18, 2022 informing the public of the comment period of the draft Cuyahoga County All Hazards Mitigation Plan. The article provided background on what hazard mitigation is and why it is important, where the draft plan can be reviewed either online or in person, how to submit comments, and the length of the comment period.

FIGURE 3-12 CLEVELAND.COM PUBLIC COMMENT ARTICLE

News

Community input sought to update Cuyahoga County's disaster mitigation plan

Published: Apr. 18, 2022, 5:41 p.m.

Advertisement

Ice piled up on the Rocky River as rain and melting snow prompted flood advisories across the greater Cleveland area on Jan. 23, 2019. (Joshua Gunter, cleveland.com) cleveland.com

ABC News 5 Cleveland published an online article and video regarding the Cuyahoga County All-Hazards Mitigation Plan on April 19, 2022. The article included interviews from the Cuyahoga County Office of Emergency Management Director, Northeast Ohio Regional Sewer District, and a resident of Valley View. The article also gave readers background of the county's updated HMP, where to review and submit online comments regarding the draft plan, and locations of the printed draft plan throughout Cuyahoga County.

FIGURE 3-13 ABC NEWS 5 CLEVELAND PUBLIC COMMENT ARTICLE

NEWS > LOCAL NEWS > CUYAHOGA COUNTY

Cuyahoga County wants resident input on all-hazards mitigation plan

Solving N.E. Ohio flooding issues tops list

Cuyahoga Co. wants resident input on all-hazards safety plan

By: Joe Pagonakis

Posted at 10:37 PM, Apr 19, 2022 and last updated 11:11 PM, Apr 19, 2022

CLEVELAND — Karen Lakus of Valley View has plenty of hope for the new Cuyahoga County All-Hazards Mitigation Plan currently being crafted, hoping it will be a big step toward solving chronic flooding in

Paper copies of the draft plan were printed out and posted in the following public library locations throughout Cuyahoga County:

- Fairview Park: 21255 Lorain Rd, Fairview Park, OH 44126
- Independence: 6361 Selig Dr, Independence, OH 44131
- Olmsted Falls: 8100 Mapleway Dr, Olmsted Falls, OH 44138
- Parma-Snow: 2121 Snow Rd, Parma, OH 44134
- Solon: 34125 Portz Pkwy, Solon, OH 44139
- South Euclid-Lyndhurst: 1876 S Green Rd, South Euclid, OH 44121
- Cleveland Heights-Lee: 2345 Lee Rd, Cleveland Heights, OH 44118
- City of Cleveland–Main: 325 Superior Ave, Cleveland, OH 44114

Three of the eight libraries that offered the draft HMP for public review and comment included displays dedicated to the draft Cuyahoga County All Hazards Mitigation Plan Update – City of Cleveland Main Branch, Fairview Park, and Olmsted Falls. The following images show the displays located in the three libraries.

FIGURE 3-14 CLEVELAND LIBRARY MAIN BRANCH DISPLAY

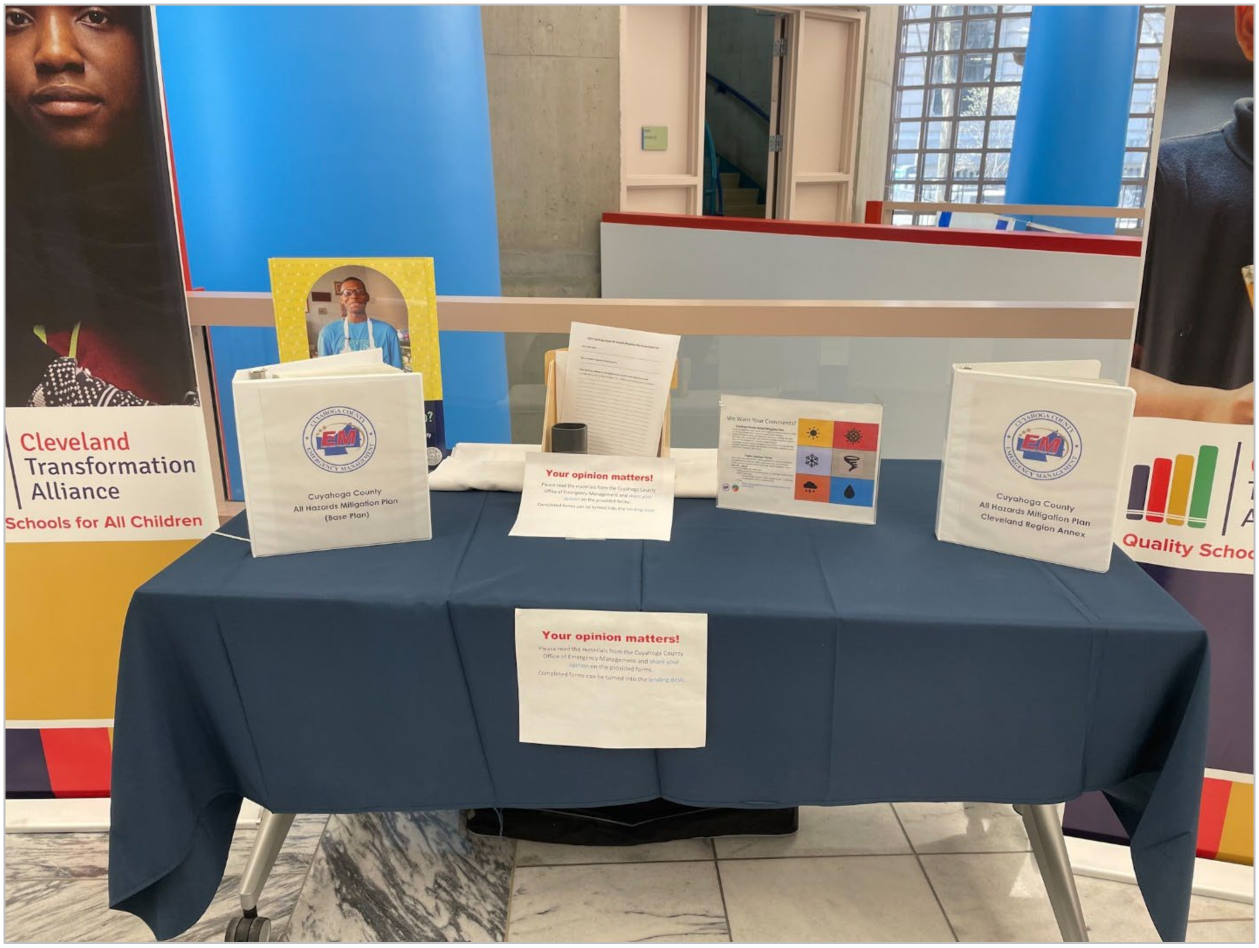


FIGURE 3-15 FAIRVIEW PARK LIBRARY DISPLAY

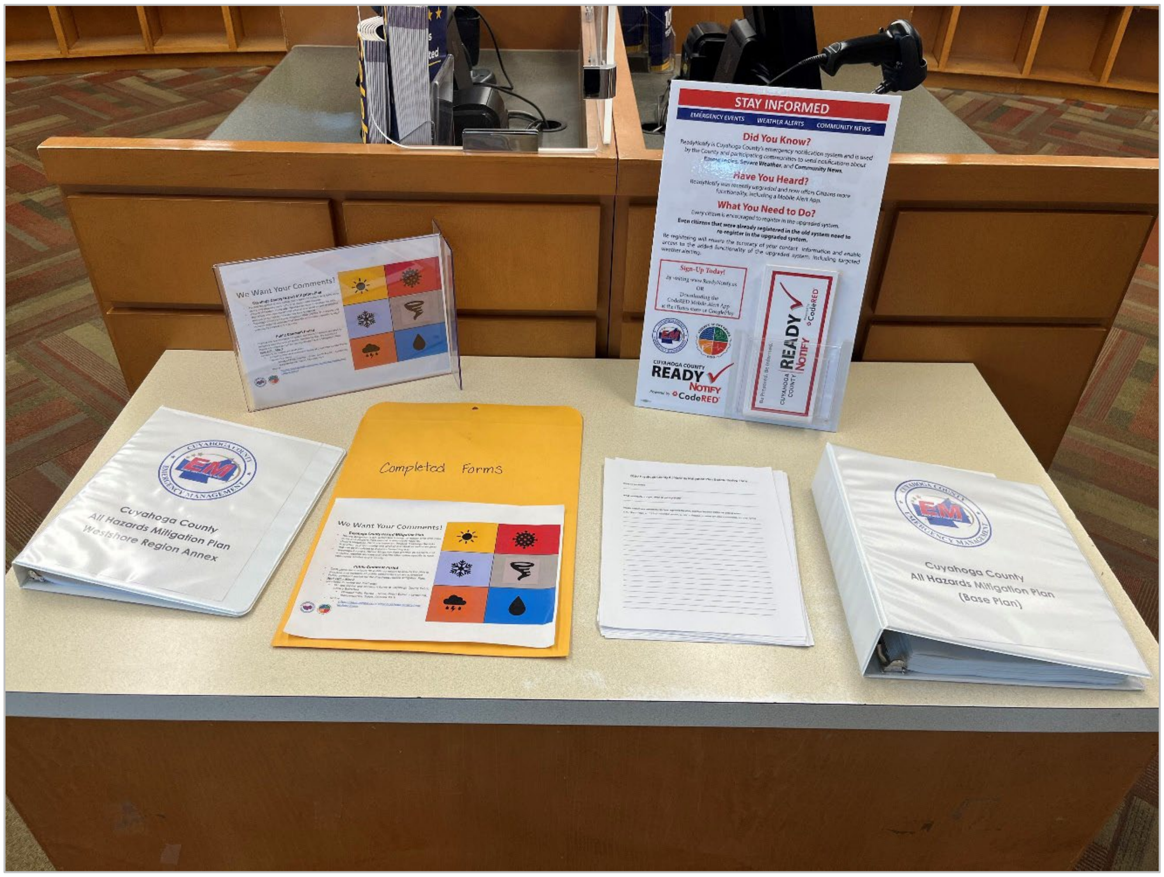


FIGURE 3-16 OLMSTED FALLS LIBRARY DISPLAY

There were no public comments submitted at any of the 8 public library locations where the draft plan was available. One comment was received through the online comment submission form. A homeowner in Valley View submitted a comment that identifies how the physical landscape of the community has changed over the past five years and the impacts of the changes in the landscape. The comment also includes a multitude of questions regarding limitations and obstacles for mitigation solutions. The homeowner also provided many thoughts on how the flooding in Valley View can be alleviated and included the current efforts made by the individual to further hazard mitigation in the community. The submitted comment has been forwarded to Cuyahoga County Office of Emergency Management for review and consideration. The full comment can be found in **Appendix F**.

Cuyahoga County Office of Emergency Management submitted many minor grammatical and formatting correction comments as well as comments regarding the clarity and approximation of the critical facility data used in the plan. All suggested edits were incorporated into the plan. A brief description was added to Section 4 that addresses the limitations of the critical facilities data used in the plan.

University Heights submitted a grammatical comment suggestion which was incorporated into the HMP. Cleveland submitted a comment appreciating the time and effort put into the plan update.

Cleveland Metroparks submitted a grammatical comment regarding the spelling of Cleveland Metroparks which was incorporated into the plan as well as proper titling of the Cleveland Metroparks Zoo and coastal erosion occurring at Wendy Park which was not depicted in the Coastal Erosion Map. Another comment submitted by Cleveland Metroparks requested that the ownership of Acacia Country Club Dam be updated to reflect that Board of Park Commissioners of Cleveland Metropolitan Park District does not own the dam – there is a license and easement agreement granting City of Lyndhurst to maintain the dam. All edits suggested were updated and reflected in the final draft of the plan.

3.4.4 Review and Incorporate Existing Information

The HMP Planning Committee reviewed and assessed existing plans, studies, and data available from local, state, and federal sources. Documents reviewed and incorporated as part of the HMP planning process are shown in Table 3-9.

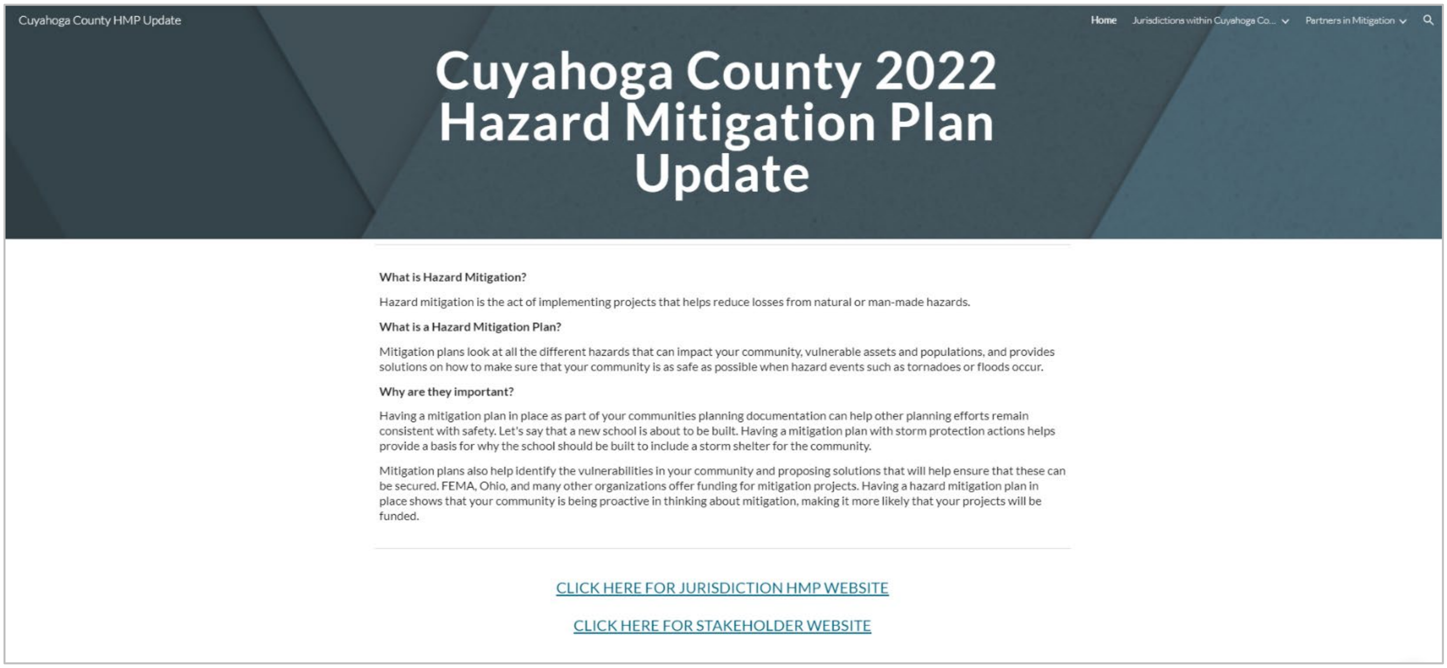
TABLE 3-9 EXISTING PLANS, STUDIES, REPORTS, AND TECHNICAL DATA

Existing Plans, Studies, Reports, and Other Technical Data/Information	Planning Process / Area of Document Inclusion
2017 Cuyahoga County Hazard Mitigation Plan	Used to assist with problem identification, mitigation goals, strategies and actions. Information from the previous plan was used for past data
Ohio Enhanced Mitigation Plan	This plan was consulted to assist with background information and hazard identification
FEMA Hazard Mitigation How-to Guides	2012 Hazard Mitigation Plan Development
FEMA Local Mitigation Planning Handbook	Local Plan Integration Methods
FEMA Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards, January 2013	Mitigation Strategy Development
NOAA Record Storm Events	Death and Injuries Report for past storm and disaster events
Department of Homeland Security GIS Hub	Spatial Data for critical facilities
State of Ohio Mitigation Assistance Resource Guide	Referenced to identify potential funding sources and programs to assist with mitigation action implementation

3.4.5 Cuyahoga County Hazard Mitigation Plan Website

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

FIGURE 3-17 CUYAHOGA COUNTY HMPU WEBSITE



3.4.6 Assess Risks

In accordance with FEMA requirements, the 2022 HMP Planning Committee identified and prioritized the natural, technological, and man-made hazards affecting the County and assessed the vulnerability from them. Results from this phase of the HMP planning process aided subsequent identification of appropriate mitigation actions to reduce risk in specific locations from hazards. This phase of the HMP planning process is detailed in Section 4.

Identify/Profile Hazards

Based on a review of past hazards, as well as a review of the existing plans, reports, and other technical studies/data/information, the 2022 HMPC developed and identified a list of hazards that could affect the County. Content for each hazard profile is provided in Section 4.

Assess Vulnerabilities

Hazard profiling exposes the unique characteristics of individual hazards and begins the process of determining which areas within the County are vulnerable to specific hazard events. Using these methodologies, vulnerable populations, infrastructure, and potential loss estimates impacted by each hazard were determined. Detailed information on vulnerability assessment for each hazard is provided in Section 4.

3.4.7 Develop Mitigation Plan

The 2022 HMP was prepared in accordance with DMA 2000 and FEMA's HMP guidance documents. This document provides an explicit strategy and blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and the County's ability to expand on and improve these existing tools. Developing the mitigation plan involved identifying goals, assessing existing capabilities, and identifying mitigation actions. This step of the HMP planning process is detailed in Section 5 and summarized below.

Identify Goals

The HMPC developed goals and objectives for the 2022 HMP based on current information. The Goals and Objectives that were developed are presented in Section 5.

Develop Capability Assessment

A Capability Assessment is a comprehensive review of all the various mitigation capabilities and tools currently available to the County to implement the mitigation actions that are prescribed in the 2022 HMP. The HMPC identified the technical, financial, and administrative capabilities to implement mitigation actions, as detailed in Section 5.

Identify Mitigation Actions

As part of the 2022 HMP planning process, the HMPC worked to identify and develop mitigation actions with implementation elements. Mitigation actions were prioritized, and detailed implementation strategies were developed during Planning Committee Meeting #1 and #2, as well as after the meeting. A detailed approach of the review of the existing mitigation actions, identification, and prioritization of new mitigation actions, and the creation of the implementation strategy is provided in Section 5.

Draft HMP

Once the risk assessment and mitigation strategy were completed, information, data, and associated narratives were compiled into the 2022 HMP.

Plan Review and Revision

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

Regional Approval

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

Plan Maintenance

Plan maintenance procedures, found in Section 6, include the measures the County will take to ensure the HMP's continuous long-term implementation. The procedures also include the way the HMP will be regularly monitored, reported upon, evaluated, and updated to remain a current and meaningful planning document.

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Section 4. Hazard Identification and Risk Assessment (HIRA)

Hazard Identification and Risk Assessment is the process of measuring the potential impact to life, property and the economy resulting from natural, technological, and man-made hazards. The intent of the risk assessment is to identify, as much as practical given existing/available data, the qualitative and quantitative vulnerabilities of a community. The results of the risk assessment provide a framework for a better understanding of potential impacts to the community and a foundation on which to develop and prioritize mitigation actions (see Section 5). Mitigation actions can reduce damage from all disasters and an implementation strategy can direct scarce resources to areas of greatest vulnerability described in this section.

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

1) Identify Hazards

2) Profile Hazard Events

3) Inventory Assets

4) Estimate Losses

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

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

Section 4, Sub-sections 1 through 20 describe each of the hazards that pose a threat to the County through hazard profiles. Information in each profile includes the location, extent/magnitude/severity, previous occurrences, and the likelihood of future occurrences.

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

Identifying the Hazards

Per FEMA Guidance, the first step in developing the Risk Assessment is identifying the hazards. The HMP Planning Committee reviewed several previously prepared hazard mitigation plans and other relevant documents to determine the universe of all-hazards planning with respect to the County.

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

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

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

TABLE 4-1 RISK FACTOR CRITERIA

Risk Assessment Category	Level	Degree of Risk Level	Index	Weight
Probability What is the likelihood of a hazard event occurring in a given year?	**Unlikely**	Less Than 1% Annual Probability	1	30%
	Possible	Between 1 & 10% Annual Probability	2	
	Likely	Between 10 &100% Annual Probability	3	
	Highly Likely	100% Annual Probability	4	
Impact *In terms of injuries, damage, or death, would you anticipate impacts to be minor, limited, critical, or catastrophic when a significant hazard event occurs?*	**Minor**	Very few injuries, if any. Only minor property damage & minimal disruption of quality of life. Temporary shutdown of critical facilities.	1	30%
	Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one day.	2	
	Critical	Multiple deaths/injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Geographic Location *How large of an area could be impacted by a hazard event? Are impacts localized or regional?*	**Negligible**	Less Than 1% Of Area Affected	1	20%
	Small	Between 1 & 10% Of Area Affected	2	
	Moderate	Between 10 & 50% Of Area Affected	3	
	Large	Between 50 & 100% Of Area Affected	4	
Warning Time *Is there usually some lead time associated with the hazard event? Have warning measures been implemented?*	**More than 24 HRS**	Self-Defined	1	10%
	12 to 24 HRS	Self-Defined	2	
	6 to 12 HRS	Self-Defined	3	
	Less than 6 HRS	Self-Defined	4	
Duration *How long does the hazard event usually last?*	**Less than 6 HRS**	Self-Defined	1	10%
	Less than 24 HRS	Self-Defined	2	
	Less than 1 week	Self-Defined	3	
	More than 1 week	Self-Defined	4	
RF Value = [(Probability x .30) + (Impact x .30) + (Geographic Location x .20) + (Warning Time x .10) + (Duration x .10)]				

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

Table 4-2 provides the risk factor that details the hazards profiled in this plan, as well as the numerical value assigned to that hazard. That Risk Factor is developed through assessing the probability, impact, spatial extent, warning time, and duration of each hazard type.

TABLE 4-2 CUYAHOGA COUNTY RISK FACTOR HAZARDS

Natural Hazards		Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Health Related Emergency	4	0.3	3	0.3	4	0.2	1	0.1	4	0.1	3.4
2	Severe Thunderstorms	4	0.3	2	0.3	4	0.2	2	0.1	2	0.1	3.0
3	Flooding	4	0.3	2	0.3	2	0.2	3	0.1	2	0.1	2.7
4	Extreme Temperatures	3	0.3	2	0.3	4	0.2	1	0.1	3	0.1	2.7
5	Severe Winter Storms	3	0.3	2	0.3	4	0.2	1	0.1	3	0.1	2.7
6	Tornadoes	3	0.3	3	0.3	2	0.2	4	0.1	1	0.1	2.7
7	Earthquakes	2	0.3	2	0.3	3	0.2	4	0.1	1	0.1	2.3
8	Drought	2	0.3	1	0.3	4	0.2	1	0.1	4	0.1	2.2
9	Landslides	2	0.3	1	0.3	1	0.2	4	0.1	1	0.1	1.6
Technological Hazards		**Probability**		**Impact**		**Spatial Extent**		**Warning Time**		**Duration**		**RF Factor**
1	Hazardous Materials Release/Spill	4	0.3	2	0.3	2	0.2	4	0.1	3	0.1	2.9
2	Nuclear Power Incident	2	0.3	3	0.3	4	0.2	2	0.1	4	0.1	2.9
3	Utility Disruption	4	0.3	1	0.3	3	0.2	4	0.1	3	0.1	2.8
4	Climate Change	4	0.3	1	0.3	4	0.2	1	0.1	4	0.1	2.8
5	Terrorism/CBNRE Incident	2	0.3	3	0.3	2	0.2	4	0.1	4	0.1	2.7
6	Dam/Levee Failure	2	0.3	3	0.3	2	0.2	3	0.1	4	0.1	2.6
7	IT/Communications Disruption	3	0.3	2	0.3	2	0.2	4	0.1	3	0.1	2.6
8	Transportation Incident	2	0.3	3	0.3	1	0.2	4	0.1	3	0.1	2.4
9	Civil Disturbance	2	0.3	2	0.3	2	0.2	3	0.1	2	0.1	2.1
10	Building/Structural Collapse	3	0.3	1	0.3	1	0.2	4	0.1	1	0.1	1.9
11	Active Shooter Incident	2	0.3	2	0.3	1	0.2	4	0.1	1	0.1	1.9

Table 4-3 shows the hazards that are included in the State of Ohio's HMP, and those hazards covered in the previous version of the plan, implemented in 2017. For this plan update, several new hazards are included: landslides, hazardous materials spills, and climate change.

TABLE 4-3 HAZARDS INCLUDED IN THE 2022 PLAN UPDATE

Hazard Addressed	Ohio HMP	Cuyahoga 2017	Cuyahoga 2022	Notes
Health Related Emergencies	X	O	O	
Flooding	O	O	O	
Temperature Extremes	X	O	O	
Severe Winter Weather	O	O	O	Ohio HMP calls this hazard "Winter Storm"
Earthquake	O	O	O	
Severe Thunderstorms	O	O	O	Ohio HMP calls this hazard "Severe Summer Storms"
Tornadoes	O	O	O	
Drought	O	O	O	
Landslide	O	O	O	Landslide was briefly covered in the earthquake profile in the previous Cuyahoga County HMP; the hazard has its own profile in the 2022 Cuyahoga County HMP update
Wildfire	O	X	X	Not a concern for the County at this time
Seiche/Coastal Flooding	O	O	O	Covered in the Flooding profile
Coastal Erosion	O	O	O	Covered in the Flooding profile
Invasive Species	O	X	X	Not a concern for the County at this time
Land Subsidence	O	X	X	Not a concern for the County at this time
Terrorism/CBNRE Incident	X	O	O	
Building/Structural Collapse	X	O	O	
Utility Disruptions	X	O	O	
IT/Communications Disruption	X	O	O	
Active Shooter Incident	X	O	O	
Hazardous Materials Release/Spill	X	O	O	
Transportation Incident	X	O	O	
Dam Failure/Levee Failure	O	O	O	Levee Failure was not included in Cuyahoga County's previous HMP, but it is included in the plan update
Civil Disturbance	X	O	O	
Nuclear Power Incident	X	O	O	
Climate Change	X	X	O	

Previous hazard occurrences were used to validate existing hazards and identify new hazard risks. Previous hazard occurrences provide a historical view of hazard risk, and a window into potential hazards that can affect Cuyahoga County and its population in the future. Information about Federal and State disaster declarations in the County was compiled from FEMA and Ohio databases, as shown in the table below. According to the FEMA, to date Cuyahoga County has been a part of 19 disaster declarations, 4 of which received public assistance dollars; 6 have received individual assistance.

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

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-191	4/14/1965	Tornadoes & Severe Storms	-	-
DR-266	7/15/1969	Tornadoes, Severe Storms & Flooding	-	-
DR-345	7/19/1972	Tropical Storm Agnes	-	-
DR-377	4/27/1973	Severe Storms & Flooding	-	-
DR-480	9/11/1975	Winds, Tornadoes, Heavy Rains & Flooding	-	-
EM-3055	1/26/1978	Blizzards & Snowstorms	-	-
DR-831	6/10/1989	Severe Storms & Flooding	-	-
DR-951	8/4/1992	Severe Storms, Tornadoes & Flooding	-	-
DR-1444	11/18/2002	Severe Storms and Tornadoes	$ 0	$ 579,893.02*
DR-1484	8/1/2003	Tornadoes, Flooding, Severe Storms, and High Winds	$ 10,875,976.79*	$ 74,781,195.51*
EM-3187	9/23/2003	Power Outage	-	-
DR-1519	6/3/2004	Severe Storms and Flooding	$ 10,648,040.68*	$ 19,193,921.30*
DR-1556	9/19/2004	Severe Storms and Flooding	$ 25,804,256.17*	$ 23,662,227.18*
EM-3250	9/13/2005	Hurricane Katrina Evacuation	-	-
DR-1651	7/2/2006	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	-	$ 8,830,355.16*
EM-3346	6/30/2012	Severe Storms	-	-
DR-4098	1/3/2013	Severe Storms and Flooding Due to the Remnants of Hurricane Sandy	-	-
EM-3457	3/13/2020	COVID-19	-	-
DR-4057	3/31/2020	COVID-19 Pandemic	$ 203,426,233.94*	$ 19,652,069.11*

*Indicates data from FEMA's Disaster Declarations website. Totals provided on the webpage are for total funds delegated to all counties within the declared disaster rather than just for Cuyahoga County.

Based on the review of hazards identified in similar and relevant documents, previous incidents, historical knowledge of localized events, and hazard trends, the HMPC identified a total of 20 hazards. There are 9 natural hazards which included Health Related Emergency, Flooding, Extreme Temperatures, Severe Winter Storms, Earthquake, Drought, Severe Thunderstorms, Tornadoes, and Landslides. Terrorism/CBNRE Incident, Building/Structural Collapse, Utility Disruption, Active Shooter Incident, IT/Communications Disruption, Transportation Incident, Hazardous Materials Release/Spill, Dam Failure, Civil Disturbance, Nuclear Power Incident, and Climate Change are identified as the eleven man-made hazards that pose significant risk to the County.

The following table displays the results of the Risk Evaluation form completed by each Cuyahoga County as well as stakeholders that submitted responses. Each jurisdiction's Risk Evaluation response can be found in their respective planning region annex. The form asks respondents to evaluate how the hazards from the previous plan have changed in regards to risk to the jurisdiction. “I” indicates that the jurisdiction has seen an increase in risk to the hazard; “D” indicates that the jurisdiction has seen a decrease in risk to the hazard; and “NC” indicates the jurisdiction has seen no change in risk to the hazard.

TABLE 4-5 CUYAHOGA COUNTY RISK EVALUATION

	American Red Cross NE OH Chapter	Center for Health Affairs	Cuyahoga Community College	Cuyahoga County	Cuyahoga County Board of Health	Cuyahoga County Solid Waste District	Cuyahoga County Sustainability	Future Heights	Health and Human Services	Hunger Network	MetroHealth System	NOACA	NE OH Areawide Coordinating Agency	Cleveland Metroparks	Cleveland Public Health Department	Cleveland State University	Cleveland Clinic	Marymount/Euclid Hospital	NE OH Regional Sewer District	Nature Center at Shaker Lake	Chagrin River Watershed Partners	St. Vincent Charity Medical Center
Flooding	NC	NC	NC	I	I	I	I	I	NC	NC	NC	I	I	NC	NC	NC	I	NC	I	I	I	NC
Extreme Temperatures	NC	I	NC	I	I	I	I	I	NC	I	I	I	I	I	I	NC	NC	NC	I	I	I	NC
Severe Winter Storms	NC	NC	NC	NC	NC	I	NC	NC	NC	D	NC	D	D	NC	I	NC	NC	NC	NC	NC	I	NC
Earthquakes	NC	I	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	NC	NC	NC
Drought	NC	NC	NC	NC	NC	NC	D	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	NC
Severe Thunderstorms	NC	D	NC	I	I	NC	I	I	NC	NC	I	I	NC	I	NC	NC	I	NC	I	NC	I	NC
Tornadoes	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	NC	NC	NC	NC	NC
Terrorism/CBNRE Incident	NC	I	I	I	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	I	I	NC	NC	NC	NC
Building/Structural Collapse	NC	NC	NC	I	NC	NC	I	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	NC	NC	NC	NC
Utility Disruption	NC	D	NC	NC	NC	I	I	I	NC	NC	I	I	I	NC	I	I	I	I	NC	I	I	NC
Active Shooter Incident	D	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	I	I	NC	I	NC	I	I	NC	NC	NC	NC

	American Red Cross NE OH Chapter	Center for Health Affairs	Cuyahoga Community College	Cuyahoga County	Cuyahoga County Board of Health	Cuyahoga County Solid Waste District	Cuyahoga County Sustainability	Future Heights	Health and Human Services	Hunger Network	MetroHealth System	NOACA	NE OH Areawide Coordinating Agency	Cleveland Metroparks	Cleveland Public Health Department	Cleveland State University	Cleveland Clinic	Marymount/Euclid Hospital	NE OH Regional Sewer District	Nature Center at Shaker Lake	Chagrin River Watershed Partners	St. Vincent Charity Medical Center
IT/Communications Disruption	NC	I	I	I	I	I	I	NC	I	NC	I	I	I	NC	I	I	I	I	I	NC	I	NC
Transportation Incident	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	NC	NC	NC	NC	NC
Hazardous Materials Incident	NC	D	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	NC	NC	NC	NC	NC
Dam Failure	NC	NC	NC	NC	NC	NC	I	I	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	I	I	I	NC
Civil Disturbance	I	I	I	I	I	I	NC	NC	I	I	I	I	I	NC	I	I	I	I	I	NC	I	I
Nuclear Power Incident	NC	NC	NC	NC	NC	NC	I	NC	NC	NC	NC	D	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Health Related Emergencies	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

Hazard Event Data

A variety of information sources were consulted in developing the hazard profiles within this plan, including data from the National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center (NCDC), and the regional National Weather Service (NWS) locations. Data is largely available at a countywide scale, but often have jurisdictional-level detail, as well.

NOAA did not record data events for all of the hazards that it currently reports for beginning in 1950. From 1950-1954, the only data recorded was for tornado hazard events. Then from 1955-1992, NOAA began recorded event data for the hazards of tornado, thunderstorm wind and hail. Starting in 1996 to present day, NOAA began to record and report event data for the forty-eight hazards that users can select to view on the database's page. The hazards the NOAA reports event data for are: astronomical low tide, avalanche, blizzard, coastal flood, cold/wind chill, debris flow, dense fog, dense smoke, drought, dust devil, dust storm, excessive heat, extreme cold/wind chill, flash flood, flood, freezing fog, frost/freeze, funnel cloud, hail, heat, heavy rain, heavy snow, high surf, high wind, hurricane (typhoon), ice storm, lake-effect snow, lakeshore flood, lightning, marine hail, marine high wind, marine strong wind, marine thunderstorm wind, rip current, seiche, sleet, sneakerwave, storm surge/tide, strong wind, thunderstorm wind, tornado, tropical depression, tropical storm, tsunami, volcanic ash, waterspout, wildfire, winter storm, and winter weather.

Event Narratives

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

Hazard Profiles

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

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

Critical Facilities

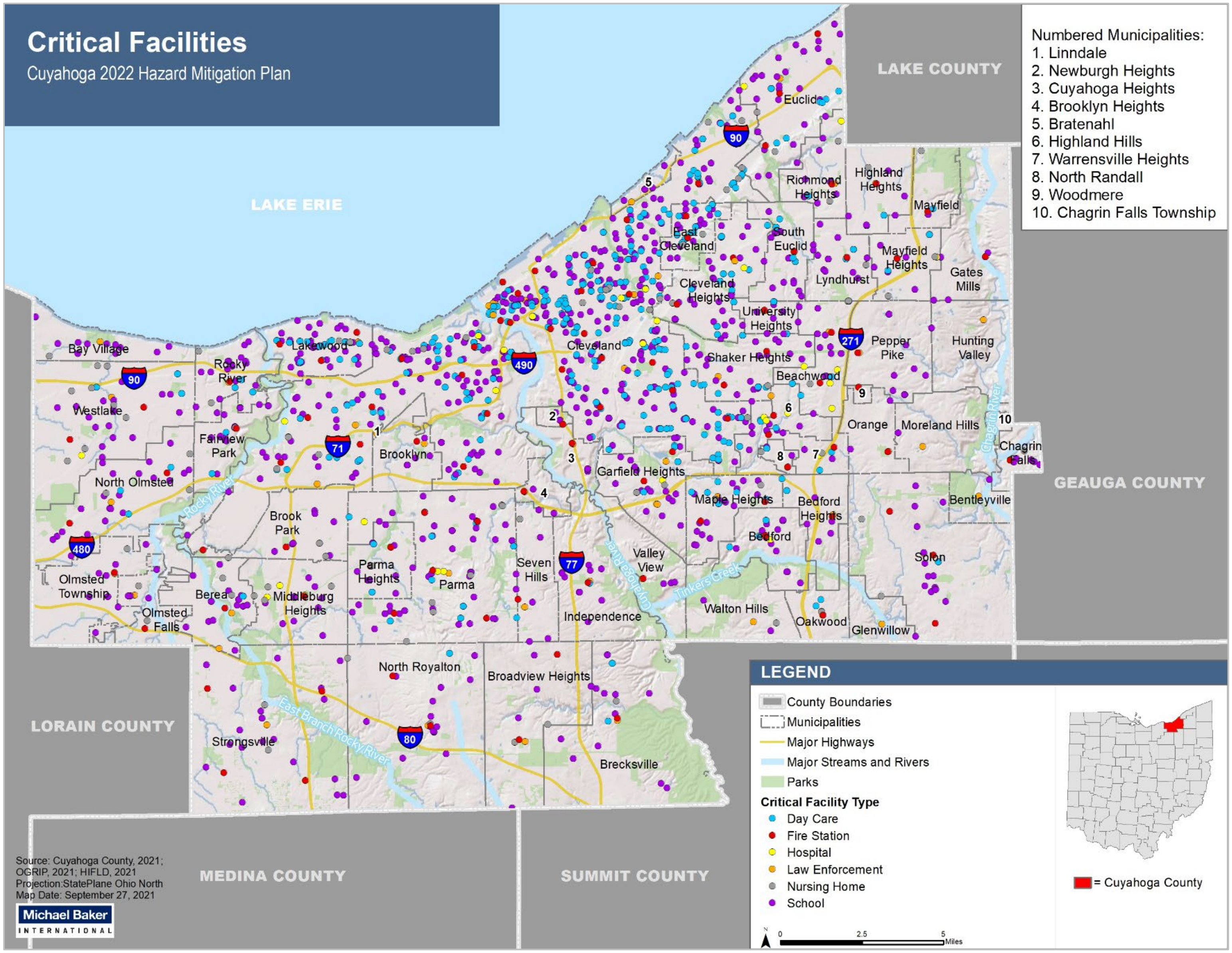
The Planning Committee identified the types of structures that they consider to be "critical" to the day-to-day operations of the County. This includes day cares, fire stations, hospitals, law enforcement buildings, nursing homes, and schools. There is a total of 1,756 critical facilities in Cuyahoga County. A map of County critical facilities can be found in Figure 4-1.

TABLE 4-6 COUNTY CRITICAL FACILITIES NUMBERS, SOURCES, AND YEAR OF DATA

Category	Number	Source
Day Cares	481	Ohio Geographically Referenced Information Program (OGRIP), 2021
Fire Stations	101	Ohio Geographically Referenced Information Program (OGRIP), 2021
Hospitals	29	Ohio Geographically Referenced Information Program (OGRIP), 2021
Law Enforcement Buildings	73	Homeland Infrastructure Foundation-Level Data (HIFLD), 2021
Nursing Homes	95	Ohio Geographically Referenced Information Program (OGRIP), 2021
Schools	977	Ohio Geographically Referenced Information Program (OGRIP), 2021
Grand Total	**1,756**	

As the critical facility data was pulled from state and national GIS databases, the critical facility data may have limitations and not reflect the total number of critical facilities of each category since it is not local-level data provided by the county or its jurisdictions. Additionally, day care facilities may be considered as schools because they may offer pre-kindergarten schooling as well as offer day care services to younger children. In conclusion, the critical facility data used in the Cuyahoga County 2022 All-Hazards Mitigation Plan Update serves as approximation and is used to model the vulnerabilities each jurisdiction may have to the hazards profiled in the plan.

FIGURE 4-1 COUNTY CRITICAL FACILITIES



Natural Hazards

4.1. Health Related Emergency

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Health Related Emergency	4	0.3	3	0.3	4	0.2	1	0.1	4	0.1	3.4
High Risk Hazard (3.0 – 4.0)											

4.1.1 Health Related Emergency Description

Pandemic

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

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

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

- **COVID-19**, also known as Coronavirus, is a respiratory disease that spreads from person-to-person contact. This specific coronavirus, COVID-19, comes from a large group of viruses that infect people and different species of animals. Only a few strains of animal coronaviruses can infect people, but SARS-CoV-2, the virus behind the pandemic, is one of the three that can infect and spread between people. The virus has its origin from bats. The first cases of the pandemic originated in Wuhan, China. Symptoms of the virus can appear as early as two days or as late as fourteen days after exposure. Fever, cough, and shortness of breath are associated with the virus, and they can range from mild to severe to death. The severity of the illness can also increase in patients who older in age, have chronic medical conditions such as heart disease, diabetes, or lung disease, and those who have compromised immune systems. Since the initial spread of COVID-19, the virus has mutated to create new variants. Variants of SARS-CoV-2 are similar to the original strain of the virus, but they may spread easier or prove to be more resilient against the vaccines that were developed to combat SARS-CoV-2. Currently, there are six variants of SARS-CoV-2 in the United States, all of which are a concern according to the CDC. The vaccines that were developed in response to the COVID-19 pandemic protect the vaccinated people against the variants. Vaccinated people can still contract the virus variants, but the vaccine can fight against severe illness, hospitalization, and death.

- B.1.1.7 (Alpha) – detected in the United States in December 2020, originated in the United Kingdom. This variant spreads much faster than other variants, but treatments are effective against the variant. The Alpha variant may cause a more severe sickness in those who contract the virus variant.
- B.1.351 (Beta) – detected in the United States in January 2021, originated in South Africa. The Beta variant may spread faster than other variants, and some monoclonal antibody treatments are less effective against the variant.
- P.1 (Gamma) – detected in the United States in January 2021, originated in Brazil but was detected in Japan. The Gamma variant spreads faster than other variants, and certain monoclonal antibody treatments are not as effective against the variant.
- B.1.427 and B1.429 (Epsilon) – originated and detected in California in February 2021. This variant is not identified as a variant of concern at this time.
- B.1.617.2 (Delta) – detected in the United States in March 2021, originated in India. Spreads much faster than other variants, and certain monoclonal antibody treatments are not as effective. The Delta variant may cause more severe sickness in the patient who contracts the variant than the original strain of SARS-CoV-2.
- B.1.1.529 (Omicron) – first identified in South Africa. Omicron spreads more easily than the original virus that caused COVID-19. However, Omicron is generally less severe than the other variants.

Epidemic

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

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

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

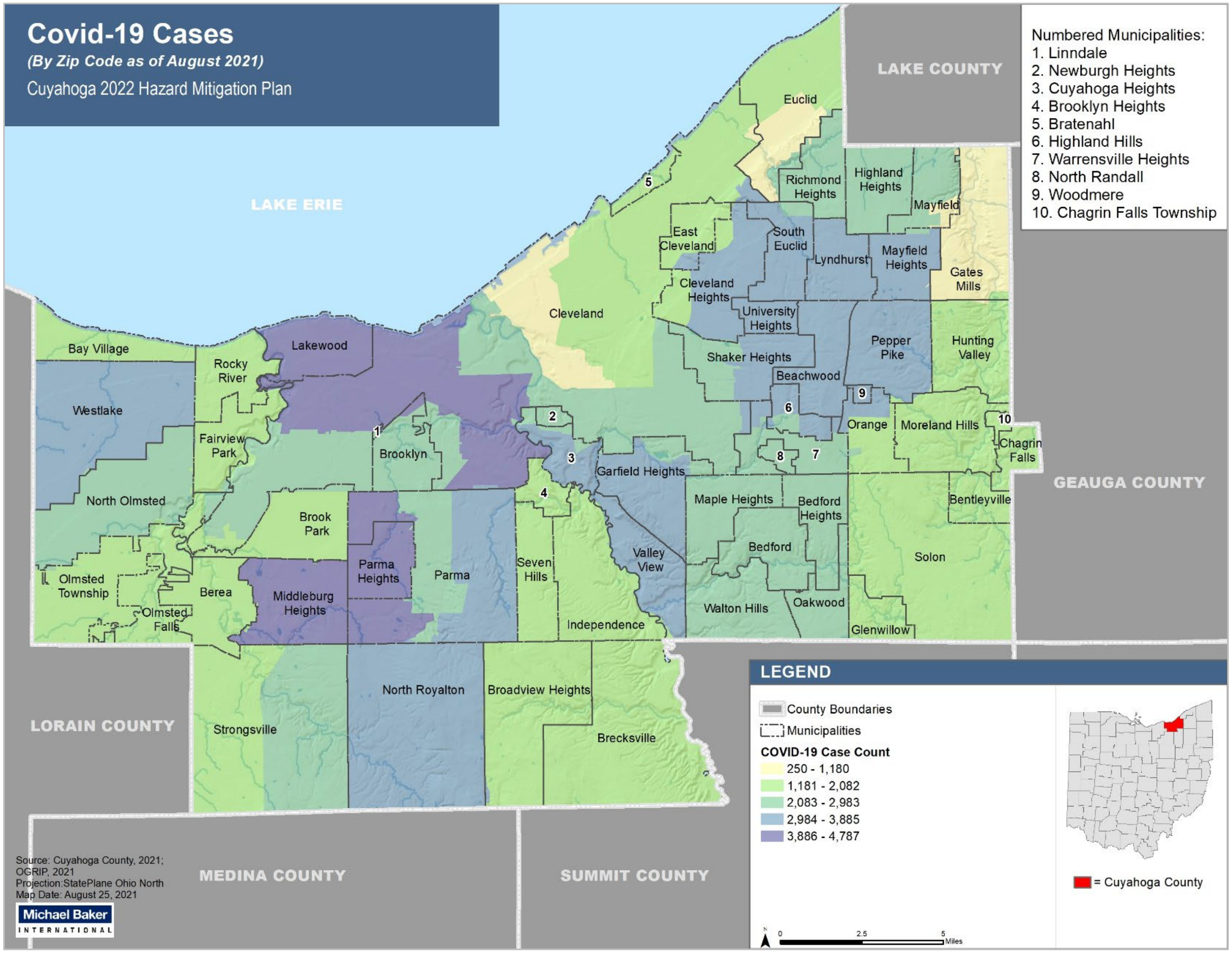
Epidemics occur when an agent and susceptible hosts are present in adequate numbers, and the agent can be effectively conveyed from a source to the susceptible hosts. More specifically, an epidemic may result from:

- A recent increase in amount or virulence of the agent,
- The recent introduction of the agent into a setting where it has not been before,
- An enhanced mode of transmission so that more susceptible persons are exposed,
- A change in the susceptibility of the host response to the agent, and/or
- Factors that increase host exposure or involve introduction through new portals of entry

4.1.2 Health Related Emergency Location

As this hazard initially affects humans, the location of the hazard is the entire County. Due to community spread, each jurisdiction within Cuyahoga County is susceptible to a public health emergency. The figure below depicts the severity of COVID-19 cases by zip code throughout the County as of August 2021.

FIGURE 4-2 COVID-19 CASES BY ZIP CODE IN CUYAHOGA COUNTY



4.1.3 Extent

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

In contrast, the severity of illness from the 2009 H1N1 influenza flu virus has varied, with the gravest cases occurring mainly among those considered at high risk. High risk populations considered more vulnerable include children, the elderly, pregnant women, and chronic disease patients with reduced immune system capacity. Most people infected with H1N1 in 2009 have recovered without needing medical treatment. According to the CDC, about 70% of those who have been hospitalized with the 2009 H1N1 flu virus in the United States have belonged to a high-risk group (CDC, 2009).

COVID-19 has brought an unprecedented time upon Cuyahoga County, Ohio, the United States of America, and the entire globe. The extent of the virus has changed the way of life for Ohioans. According to Ohio's COVID-19 Dashboard, the overall hospitalization rate for confirmed cases of the virus in Ohio is 5.38% with 13.42% of the cases requiring ICU admission. When Ohio was experiencing extremely high cases per day – approximately November 2020 through January 2021, the hospitalization rate was 17.9%, with 26.9% of cases requiring ICU admission. The community spread aspect of COVID-19 not only sparked a shutdown of the entire State's economy except for essential businesses for approximately a month and a half, but it has also set forth guidelines for Ohioans to follow as businesses begin to open back up. Wearing masks while having a six-foot distance between consumers when possible was required for approximately fifteen months, with all state-mandated orders ending on June 2, 2021. Increased surveillance employee and consumer health is also a best-practice guideline.

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

4.1.4 Historical Occurrences

General Trends

Since 2001, there has been 3 health related emergency events in Cuyahoga County. Cuyahoga County has been a part of 2 Federal Disaster Declarations that included public health emergencies. One has resulted in Public Assistance and Individual Assistance.

TABLE 4-7 DECLARED DISASTERS AFFECTING CUYAHOGA COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
EM-3457	3/13/2020	COVID-19	-	-
DR-4057	3/31/2020	COVID-19 Pandemic	$ 203,426,233.94*	$ 19,652,069.11*

**Indicates data from FEMA's Disaster Declarations website. Totals provided on the webpage are for total funds delegated to all counties within the declared disaster rather than just for Cuyahoga County.*

Event Narratives

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

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

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

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

2020/2021: On March 11, 2020, the outbreak of COVID-19 was characterized as a pandemic by the World Health Organization. Originating from the Hubei Province in China, the virus reached the United States on January 22, 2020. As of August 2021, there have been over 39 million confirmed cases in all fifty states. Community spread remains to be the biggest culprit of infection. In order to slow the spread in Ohio, Governor Mike DeWine placed a Stay at Home order on March 23 at 11:59 P.M. for two weeks. A new order was put into place on April 6 as a continuation of the Stay at Home order which was later extended until May 29th. Many other health orders, guidelines, and curfews have been implemented to slow the spread of COVID over 2020 and into the middle of the 2021 year. As of August 31 2021, Ohio has recorded 1,220,900 cases, 65,771 hospitalizations with 8,836 requiring ICU admission, and 20,866 deaths resulting from the illness. Cuyahoga County has had 124,761 confirmed cases, 7,619 people have been hospitalized, and 2,291 people have passed away due to the virus. The shortage of testing available for the state, and nation, at the beginning of the pandemic made it difficult to test all those who are reporting symptoms. Tests were reserved for those who are showing the most severe symptoms, so the numbers reported may not reflect the totality of the infected.

Vaccines were rapidly developed and received emergency approval from the Food and Drug Administration (FDA) for distribution. Pfizer-BioNTech is a two-shot vaccination that is approved for people 12 years and older, with the vaccines given 21 days apart. Moderna is a two-shot vaccine that is approved for people 18 years and older, with the vaccines given 28 days apart. Johnson & Johnson's Janssen is a one-shot vaccination that is approved for people 18 years and older. All three vaccines require a two-week waiting period to become considered "fully vaccinated." Vaccines were made available to the general public, without priority other than being over the age of 12 years old, on March 29, 2021. Children aged 12-17 years old are only able to receive the Pfizer vaccination at this time.

Ohio Department of Health lists the following phases for the vaccine distribution in the state:

- Phase 1A: began December 14, 2020
    - Healthcare workers and personnel who are routinely involved n the care of COVID-19 patients
    - Residents and staff in nursing homes.
    - Residents and staff in assisted living facilities.
    - Patients and staff at state psychiatric hospitals.
    - People with developmental disabilities and those with mental health disorders, including substance-use disorders, who live in group homes, residential facilities, or centers, and staff at those locations.
    - Residents and staff at our two state-run homes for Ohio veterans.
    - EMS responders
- Phase 1B: began January 19, 2021
    - Ohioans, age 65 and up.
    - Ohioans born with or who have early childhood conditions that are carried into adulthood, which put them at a higher risk for adverse outcomes due to COVID-19.
        - Sickle cell anemia.
        - Down syndrome.
        - Cystic fibrosis.
        - Muscular dystrophy.
        - Cerebral palsy.
        - Spina bifida.
        - People born with severe heart defects, requiring regular specialized medical care.

        - People with severe type 1 diabetes, who have been hospitalized for this in the past year.
        - Phenylketonuria (PKU), Tay-Sachs, and other rare, inherited metabolic disorders.
        - Epilepsy with continuing seizures; hydrocephaly; microcephaly, and other severe neurological disorders.
        - Turner syndrome, fragile X syndrome, Prader-Willi syndrome, and other severe genetic disorders.
        - People with severe asthma, who have been hospitalized for this in the past year.
        - Alpha and beta thalassemia.
        - Solid organ transplant candidates and recipients
    - Adults/employees in K-12 schools that want to go back to, or to remain with, in-person or hybrid learning models.
- Phase 1C: began March 4, 2021
    - Individuals who have additional medical conditions that may increase their risk of severe illness and death from COVID-19. The new qualifying conditions are not already covered through Ohio's age-based approach to vaccine eligibility.
        - People with amyotrophic lateral sclerosis (ALS), bone marrow transplant recipients, people with type 1 diabetes, pregnant women
    - Ohioans who work in certain occupations, including childcare services, funeral services, and law enforcement and correction services.
    - Eligible individuals can receive a vaccine from the provider of their choice. Individuals may be asked to confirm during the registration or screening process that they are eligible to receive the vaccine based on a qualifying medical condition or based on their occupation.
- Phase 1D: began March 11, 2021
    - Individuals who have the specified medical conditions listed below that may increase their risk of severe illness and death from COVID-19.
        - People with type 2 diabetes, people with end-stage renal disease
    - These individuals are not already eligible through Ohio's age-based approach to vaccine eligibility.
    - Eligible individuals can receive a vaccine from the provider of their choice. Individuals may be asked to confirm during the registration or screening process that they are eligible to receive the vaccine based on a qualifying medical condition.
- Phase 1E: began March 19, 2021
    - Individuals who have the specified medical conditions listed below that may increase their risk of severe illness and death from COVID-19.
        - Cancer, chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), heart disease, obesity
    - These individuals are not already eligible through Ohio's age-based approach to vaccine eligibility.
    - Eligible individuals can receive a vaccine from the provider of their choice. Individuals may be asked to confirm during the registration or screening process that they are eligible to receive the vaccine based on a qualifying medical condition.
- Phase 2A: began March 4, 2021
    - Individuals age 60 and older
- Phase 2B: began March 11, 2021

    - Individuals age 50 and older
- Phase 2C: began March 19, 2021
    - Individuals age 40 and older
- Phase 2D: began March 29, 2021
    - Individuals age 16 and older

4.1.5 Probability of Future Occurrence

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

Reported health related emergency events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County experiencing a health related emergency event can be difficult to quantify but based on historical record of 3 events since 2001, this type of event has occurred once every 6.67 years from 2001 through 2021.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**20 Years**) / (**3 Events**) = **6.67 Years Between Events**

Furthermore, the historic frequency calculates that there is an 15% chance of this type of event occurring each year. The HMPC, based on their knowledge, determined that health related emergency events are “Highly Likely,” meaning that there is a 100% annual chance of occurring.

4.1.6 Assets Exposed to Health Related Emergencies

Potential Losses

Health-related emergencies are unlikely to directly impact buildings and infrastructure. However, losses can be measured in lost productivity from employees unable to perform their job duties and students not able to attend classes. In Ohio alone, three months after the declaration of the pandemic, 1.5 million people had filed for unemployment in the state. As of June 2021, the unemployment rate for the state is 5.2%. In the United States, over 57.4 million people had filed for unemployment benefits from the start of state shutdowns in mid-March 2020 to mid-August 2020, according to Forbes. According to an article The Century Foundation from March 2021, one in four workers relied on unemployment aid during the pandemic.

TABLE 4-8 POTENTIAL LOSSES FROM HEALTH-RELATED EMERGENCIES

Impact	Description
People	People are likely to bear the brunt of a health-related emergency, as they are the ones who will be impacted by diseases. They can become extremely sick and possibly die depending on the illness.
Infrastructure	There are no expected impacts on Infrastructure from this hazard.
Economy	The economy can be damaged due to drops in productivity due to illness.
Natural Systems	There are no expected impacts on Natural Systems from this hazard.
Transportation	There are no expected impacts on Transportation from this hazard.

Community Vulnerability

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

TABLE 4-9 POPULAGE AGE ESTIMATES, 2019

Age Group	Population	Percent
Under 5 years	70,399	5.7%
65 and up	229,723	18.6%

Cuyahoga Community College Public Health Vulnerability

Cuyahoga Community College services over 20 thousand students a year with a staff of over 2 thousand. Due to experiences and lessons learned from Covid-19 over the past two-plus years, the college has a better understanding of their vulnerability to significant health emergencies, and is working to better prepare its staff and students for dealing with those issues going forward. This is largely a result of the fluctuations in federal, state, and regional guidelines regarding viral spread, social distancing, etc.

4.1.7 Land Use and Development Trends

Denser areas are more susceptible to the spread of diseases as people tend to live closer to one another. Because of this, 43 of the 57 incorporated areas have populations over 3,000 people, are the most vulnerable to a rapidly spready disease.

Regulatory Environment

There are a variety of regulations which drive the health industry, and as a result, the treatment of pandemics and epidemics. The Ohio Revised Code, Chapter 3701-59 specifically deals with hospitals. Cleveland Clinic, Western Reserve, University Hospitals, Regency Hospitals, Grace Hospital, and MetroHealth have all been accredited by The Joint Commission with its Gold Seal of Approval for demonstrating compliance with their national standard for health care quality. The Joint Commission is an independent, not-for-profit organization.

The Joint Commission accredits and certifies nearly 21,000 health care organizations and programs in the United States. Joint Commission accreditation and certification is recognized nationwide as a symbol of quality that reflects an organization's commitment to meeting certain performance standards.

Cuyahoga County, according to the Ohio Office of Research County Profiles 2020 Edition, has 7,604 physicians, 23 registered hospitals with 7,229 beds, 98 licensed nursing homes with 11,258 beds, and 87 licensed residential care facilities with 7,991 beds. As for persons covered with health insurance within Cuyahoga County, 92.6% of people ages 0-64 have health insurance. 91.4% of adults aged 18-64 are insured, and 95.9% of persons under 19 years old are insured.

4.1.8 Health Related Emergencies Summary

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

4.2. Severe Thunderstorms

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Severe Thunderstorms	4	0.3	2	0.3	4	0.2	2	0.1	2	0.1	**3.0**
High Risk Hazard (3.0 – 4.0)											

4.2.1 Severe Thunderstorm Description

Extreme weather conditions can exist during any season in Ohio. Thunderstorms, associated with strong winds, heavy precipitation, and lightning strikes can all be hazardous under the right conditions and locations. Strong winds and tornadoes can take down trees, damage structures, tip high profile vehicles, and create high velocity flying debris. Large hail can damage crops, dent vehicles, break windows, and injure or kill livestock, pets, and people. Even the remnants of tropical storms and hurricanes have been known to bring severe wind damage and flooding to the state.

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

- **Downburst winds**, which can cause more widespread damage than a tornado, occur when air is carried into a storm's updraft, cools rapidly, and comes rushing to the ground. Cold air is denser than warm air, and therefore, wants to fall to the surface. On warm summer days, when the cold air can no longer be supported up by the storm's updraft, or an exceptional downdraft develops, the air crashes to the ground in the form of strong winds. These winds are forced horizontally when they reach the ground and can cause significant damage. These types of strong winds can also be referred to as straight-line winds. Downbursts with a diameter of less than 2.5 miles are called microbursts and those with a diameter of 2.5 miles or greater are called macrobursts. A derecho, or bow echo, is a series of downbursts associated with a line of thunderstorms. This type of phenomenon can extend for hundreds of miles and contain wind speeds in excess of 100 mph.

- **Lightning**, although not considered severe by the National Weather Service definition, can accompany heavy rain during thunderstorms. Lightning develops when ice particles in a cloud move around, colliding with other particles. These collisions cause a separation of electrical charges. Positively charged ice particles rise to the top of the cloud and negatively charged ones fall to the middle and lower sections of the cloud. The negative charges at the base of the cloud attract positive charges at the surface of the Earth. The negatively charged area of the cloud sends a charge called a stepped leader toward the ground. As the stepped leader extends to the ground, it is reflected as light, visible to the naked eye. The negative charge makes contact with the ground and the positive and negative charges exchange accordingly, creating the electrical transfer through this channel known as lightning. The channel rapidly heats to 50,000 degrees Fahrenheit and contains approximately 100 million electrical volts. When the negative charge makes contact with the positive charge at the surface and the positive charges begin to move up the current to the cloud, the negative charge expands out away from the lightning bolt and rapidly contracts back to the current. The charges collide with one another as they reach the bolt, and the collision of the charges make the thunder sound.

- **Hail** develops when a super cooled droplet collects a layer of ice and continues to grow, sustained by the updraft. Once the hail stone cannot be held up any longer by the updraft, it falls to the ground. Nationally, hailstorms cause nearly $1 billion in property and crop damage annually, as peak activity coincides with peak agricultural seasons. Severe hailstorms also cause considerable damage to buildings and automobiles, but rarely result in loss of life. Hailstones are usually less than two inches in diameter and can fall at speeds of 120 miles per hour (mph), which can be destructive to roofs, buildings, automobiles, vegetation, and crops.

- **Heavy Rain** is defined as rainfall amounts larger than 0.49 inches in an hour. In the winter months, heavy rain is defined as rainfall amounts greater than 0.24 inches an hour. Typically, heavy rainfalls occur between 6 PM and midnight. Rain develops as air rises, cools, and the water vapor within the air condenses into droplets of water, eventually condensing enough to create a cloud of many water droplets around condensation nuclei. As the water droplets within the condensed cloud continue to grow, they begin to fall as rain drops to the earth.

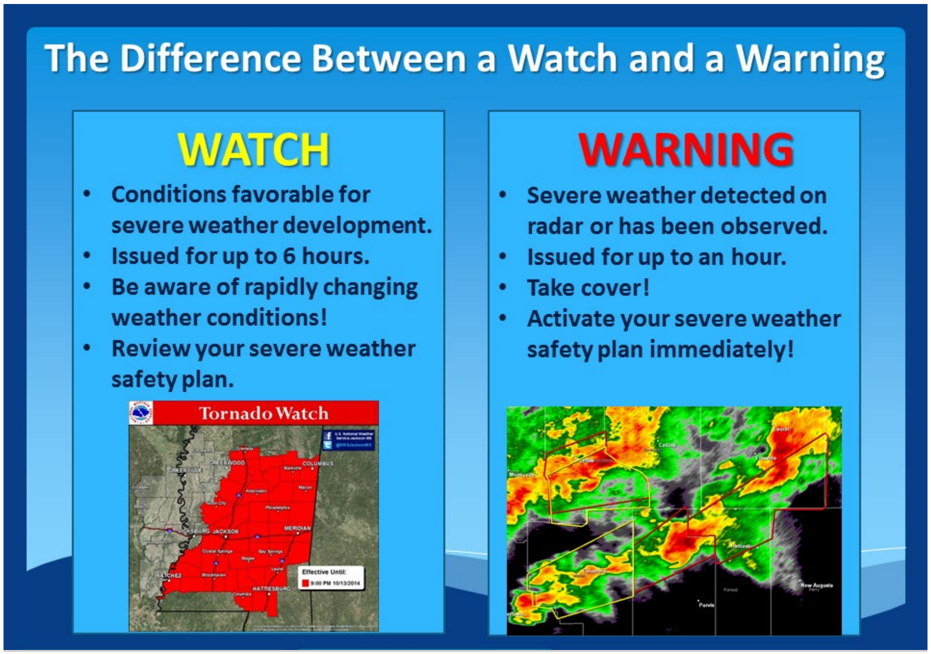
4.2.2 Severe Thunderstorm Location

Severe thunderstorm events are generally county-wide or region-wide events that could affect the entirety of Cuyahoga County. All communities can be affected during these occurrences. On occasion, only part of the County could experience the weather due to the original development location of the storm and the path it travels, but it is not possible to precisely pinpoint where a severe thunderstorm could happen prior to hours before the event.

4.2.3 Extent

Thunderstorm watches and warnings are issued by the National Weather Service. There are no watches or warnings for lightning. Figure 4-3 explains the difference between watches and warnings, as used by the National Weather Service (NWS).

FIGURE 4-3 NWS WATCH VS. WARNING



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

TABLE 4-10 BEAUFORT SCALE

Beaufort Number	MPH	Description	Observation
0	<1	Calm	Calm. Smoke rises vertically.
1	1-3	Light air	Wind motion visible in smoke
2	3-7	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-17	Moderate breeze	Dust and loose paper raised. Small branches begin to move.
5	18-24	Fresh breeze	Branches of a moderate size move. Small trees begin to sway.
6	25-30	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over.

Beaufort Number	MPH	Description	Observation
7	31-38	High wind, Moderate Gale, Near Gale	Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors.
8	39-46	Fresh Gale	Twigs broken from trees. Cars veer on road.
9	47-54	Strong Gale	Larger branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over. Damage to circus tents and canopies.
10	55-63	Whole Gale/Storm	Trees are broken off or uprooted, saplings bent and deformed, poorly attached asphalt shingles and shingles in poor condition peel off roofs.
11	64-72	Violent storm	Widespread vegetation damage. More damage to most roofing surfaces, asphalt tiles that have curled up and/or fractured due to age may break away completely.
12	≥73	Hurricane-force	Considerable and widespread damage to vegetation, a few windows broken, structural damage to mobile homes and poorly constructed sheds and barns. Debris may be hurled about.

TABLE 4-11 HAIL SIZE COMPARISON CHART

Common Object	Size in Diameter
Pea	0.25 Inch
Penny or Dime	0.75 Inch
Quarter	1.00 Inch
Half Dollar	1.25 Inch
Golf Ball	1.75 Inch
Tennis Ball	2.50 Inch
Baseball	2.75 Inch
Grapefruit	4.00 Inch

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

Heavy rain can be measured by rate of accumulation within an hour or twelve-hour timeframe.

TABLE 4-12 NOAA HEAVY RAINFALL CLASSIFICATIONS

Heavy Rain in a 1-Hour Timeframe		Heavy Rain in a 12-Hour Timeframe	
Classification	Accumulation Rate	Classification	Accumulation Rate
Light	0.01-0.49 inches	Light	< 3.0 inches at two or more weather stations OR < 6.0 inches or more at one station
Heavy	> 0.49 inches	Heavy	3.0 inches or more at two or more weather stations OR 6.0 inches or more at one station

4.2.4 Historical Occurrences

General Trends

Dangerous and damaging aspects of a severe storm are tornadoes, hail, lightning strikes, flash flooding from heavy rain, and winds associated with downbursts and microbursts. Reported severe weather events over the past 20 years provides an acceptable framework for determining the magnitude of such storms that can be expected and planned for accordingly. FEMA places this region in Zone IV (250 MPH) for structural wind design (Federal Emergency Management Agency, 2004b).

A complete list of severe thunderstorm events from 1955 to current day can be found in **Appendix B**.

TABLE 4-13 SUMMARY OF SEVERE THUNDERSTORMS (JANUARY 1, 2001-MARCH 31, 2021)

Type	Count	Injuries	Deaths	Property Damage	Crop Damage	Avg Property Damage	Avg Crop Damage
Hail	174	0	0	$ 1,189,000	$ 0	$6,833	$0
Heavy Rain	35	0	0	$ 0	$ 0	$0	$0
Lightning	2	1	0	$ 80,000	$ 0	$40,000	$0
Strong Wind	7	0	0	$ 230,000	$ 0	$32857	$0
Thunderstorm Wind	272	4	0	$ 14,595,000	$ 0	$53,658	$0
Grand Total	**455**	**5**	**0**	**$ 16,094,000**	**$ 0**		

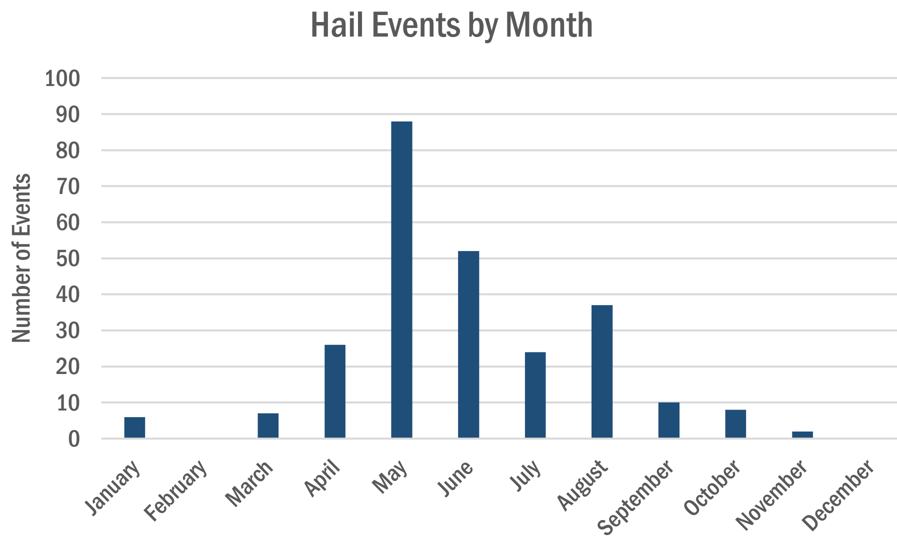
Hail Events

Large hail can damage structures, break windows, dent vehicles, ruin crops, and kill or injure people and livestock. Based on past occurrences, hail sizes greater than 2.75 inches in diameter are possible and should be included in future planning activities.

There have been 174 recorded hail events associated with thunderstorms that have either directly or indirectly impacted the County and the immediately surrounding jurisdictions since 2001. The most recent hail event occurred in 2020.

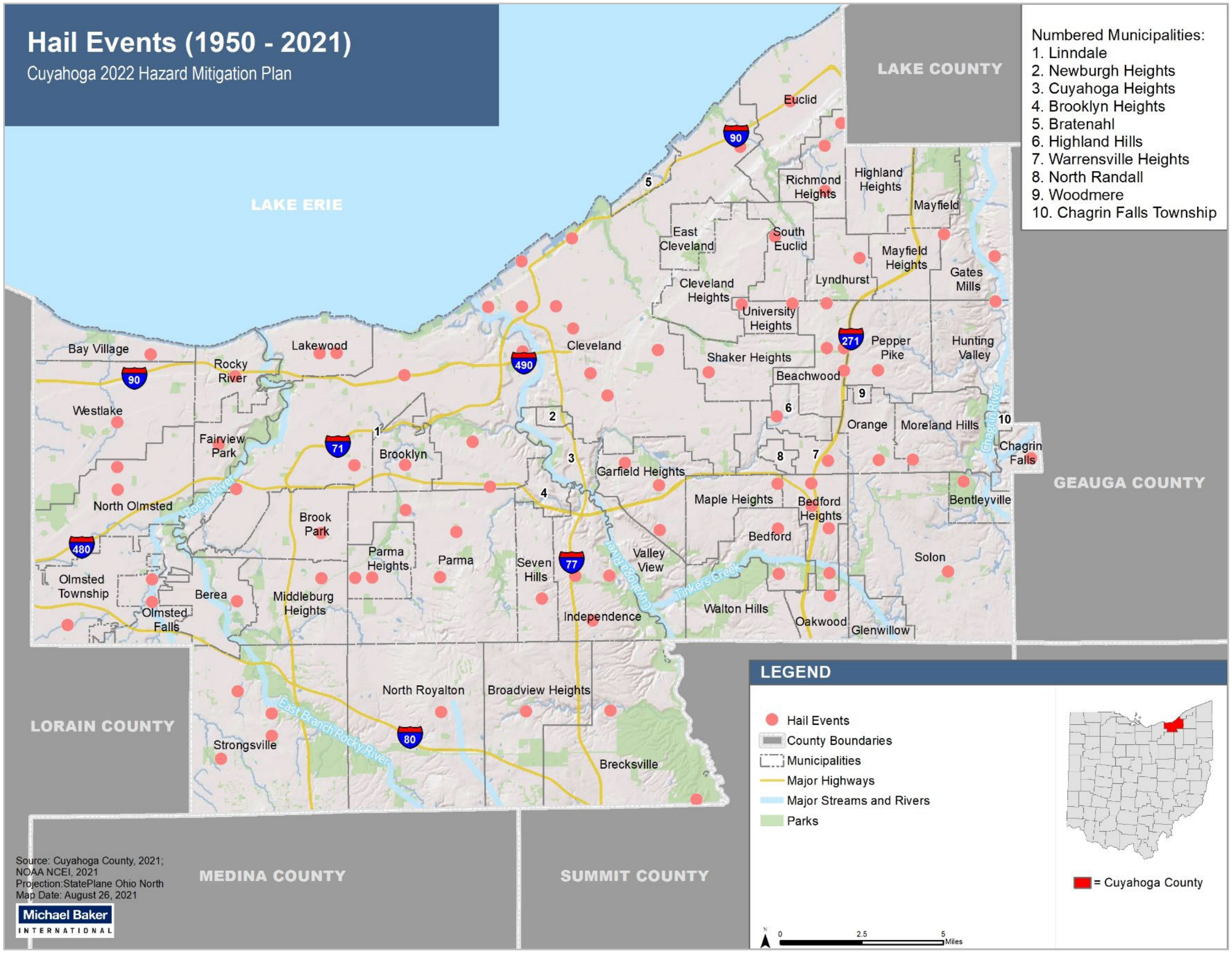
Furthermore, the historic frequency calculates that there is a 100% chance of this type of event occurring each year.

FIGURE 4-4 CUYAHOGA COUNTY HAIL EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021



The following figure spatially represents where all previous hail events have occurred within Cuyahoga County.

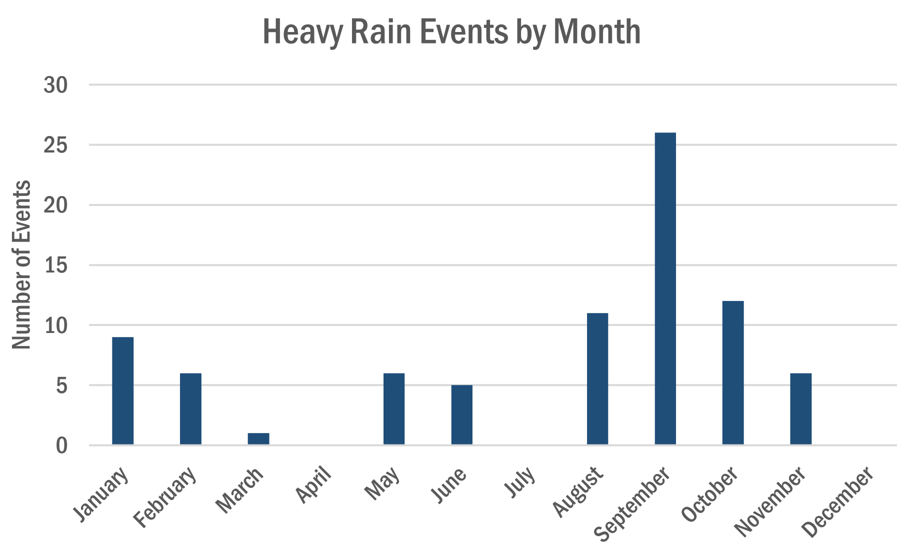
FIGURE 4-5 PREVIOUS HAIL EVENTS IN CUYAHOGA COUNTY



Heavy Rain Events

There have been 35 recorded heavy rain events associated with thunderstorms since 2001. The historic frequency calculates that there is a 100% chance of this type of event occurring each year. The most recent heavy rain event occurred in 2002.

FIGURE 4-6 CUYAHOGA COUNTY HEAVY RAIN EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021



Lightning Events

Except in cases where significant forest or range fires are ignited, lightning generally does not result in disasters. There have been two recorded instances of lightning-related incidents in Cuyahoga County since 2001, with the most recent event occurring in 2005, giving the historic frequency of 10% chance this type of event will occur annually. Cuyahoga County, from 2009-2018, saw approximately 6-12 flashes of lightning per square mile per year.

FIGURE 4-7 CUYAHOGA COUNTY LIGHTNING EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

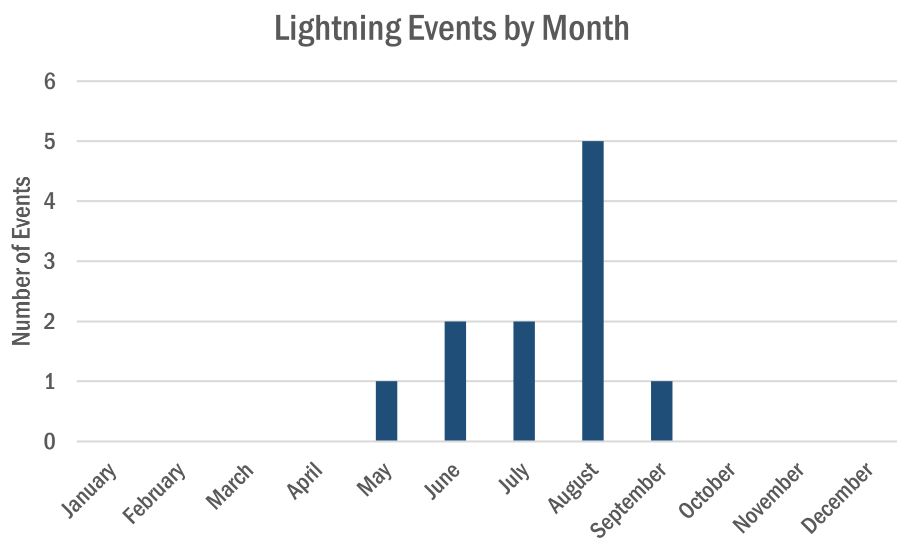
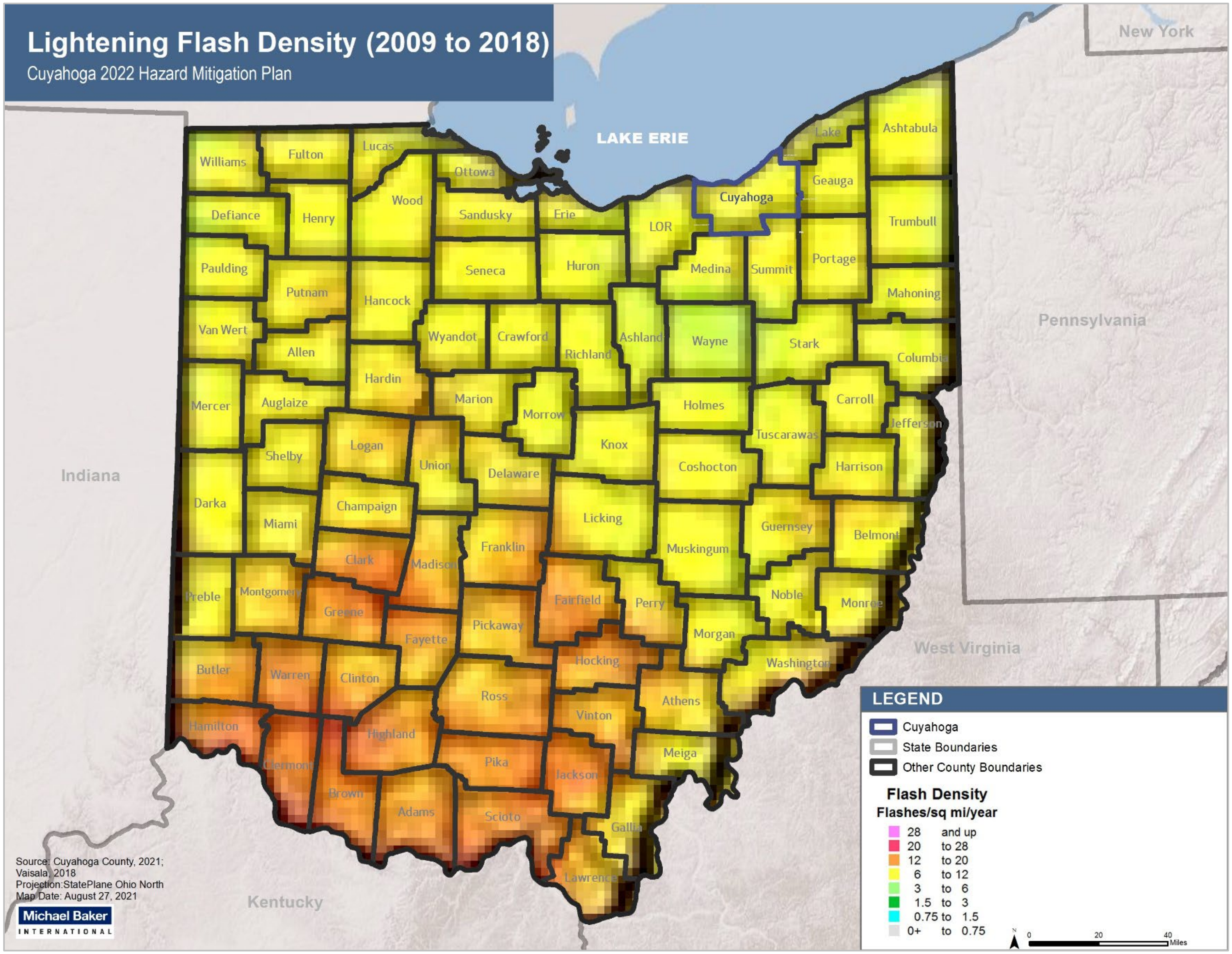


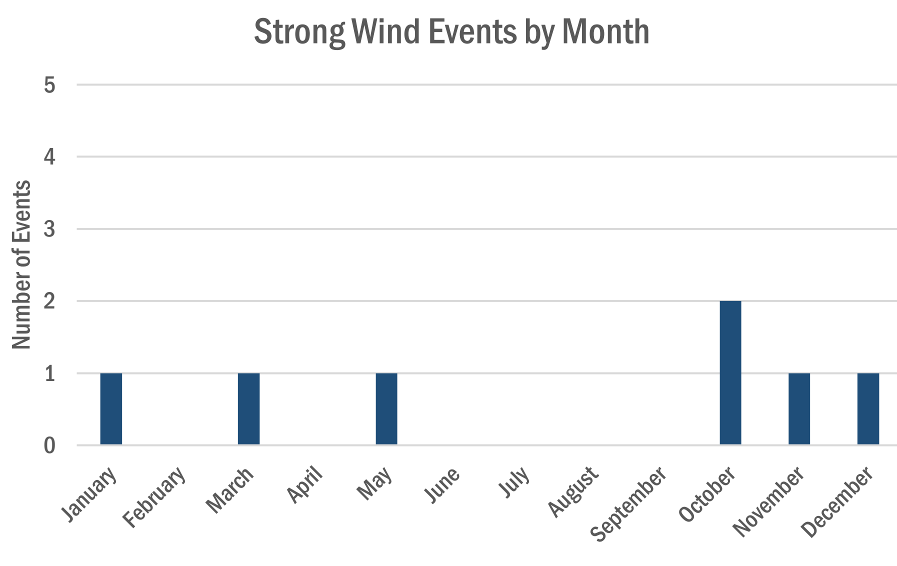
FIGURE 4-8 LIGHTNING FLASH DENSITY IN OHIO



Strong Wind Events

There have been seven recorded instances of strong wind events in Cuyahoga County since 2001, with the most recent event occurring in 2019, giving the historic frequency of 35% chance this type of event will occur annually.

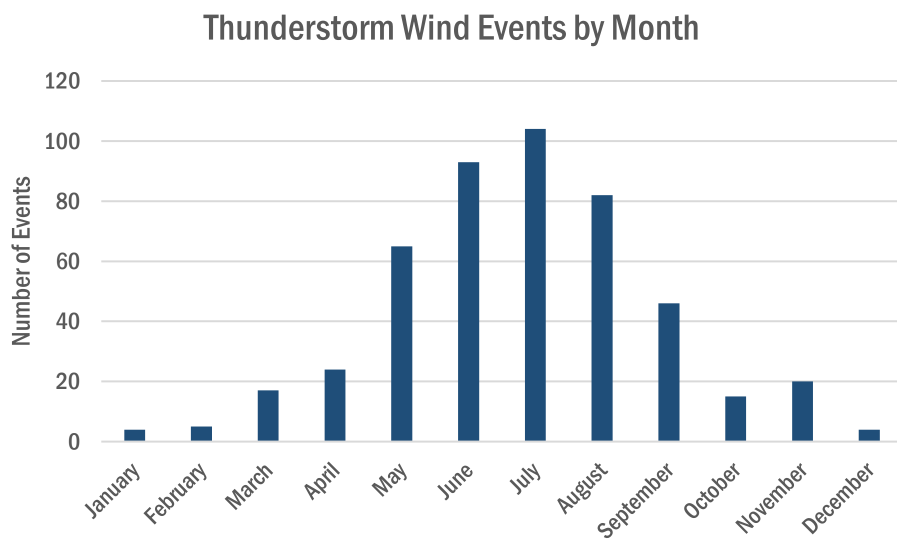
FIGURE 4-9 CUYAHOGA COUNTY STRONG WIND EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021



Thunderstorm Wind Events

Non-tornadic, thunderstorm and non-thunderstorm winds over 100 mph should also be considered in future planning initiatives. These types of winds can remove roofs, move mobile homes, topple trees, take down utility lines, and destroy poorly built or weak structures. There have been 272 recorded thunderstorm wind events associated with thunderstorms since 2001, with the most recent event occurring in 2021. The historic frequency calculates that there is a 100% chance of this type of event occurring each year.

FIGURE 4-10 CUYAHOGA COUNTY THUNDERSTORM WIND EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021



Since 1953, 15 federally or state declared severe thunderstorm weather events have occurred in Cuyahoga County as shown in the table below. According to FEMA Declarations (1953 to present), these events include: severe storms, straight-line winds, flooding, tropical storms, hurricanes, and tornadoes.

TABLE 4-14 SEVERE STORM DISASTER DECLARATIONS

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-191	4/14/1965	Tornadoes & Severe Storms	-	-
DR-266	7/15/1969	Tornadoes, Severe Storms & Flooding	-	-
DR-345	7/19/1972	Ohio Tropical Storm Agnes	-	-
DR-377	4/27/1973	Severe Storms & Flooding	-	-
DR-480	9/11/1975	Winds, Tornadoes, Heavy Rains & Flooding	-	-
DR-831	6/10/1989	Severe Storms & Flooding	-	-
DR-951	8/4/1992	Severe Storms, Tornadoes & Flooding	-	-
DR-1444	11/18/2002	Severe Storms and Tornadoes	-	$ 579,893.02*
DR-1484	8/1/2003	Tornadoes, Flooding, Severe Storms, and High Winds	$ 10,875,976.79*	$ 74,781,195.51*
DR-1519	6/3/2004	Severe Storms and Flooding	$ 10,648,040.68*	$ 19,193,921.30*
DR-1556	11/19/2004	Severe Storms and Flooding	$ 25,804,256.17*	$ 23,662,227.18*
EM-3250	11/13/2005	Hurricane Katrina Evacuation	-	-
DR-1651	7/2/2006	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	-	$ 8,830,355.16*
EM-3346	6/30/2012	Severe Storms	-	-
DR-4098	1//3/2013	Severe Storms and Flooding Due To The Remnants Of Hurricane Sandy	-	-

**Indicates data from FEMA's Disaster Declarations website. Totals provided on the webpage are for total funds delegated to all counties within the declared disaster rather than just for Cuyahoga County.*

Event Narratives

- **Lightning – September 22, 2005:** When lightning struck a house on September 22nd, a fire was started on the residential structure. The local fire department responded and put the fire out, but the house suffered damage from both the fire and water used to extinguish the fire. A total of $80,000 in property damages was reported, but no injuries, deaths, or crop damages occurred from the event.

- **Hail – May 30, 2015:** A system of severe thunderstorms and heavy rain moved through the region on the late afternoon and evening of May 30th. As the severe thunderstorms struck the area, trees were downed from severe winds, and hail sizes ranging from 0.75 inches to 1 inch were reported in Cuyahoga County. In Cuyahoga County alone, it was estimated that 13,000 people lost power during the thunderstorms, and flash flooding was reported in the central portion of the County due to the rainfall amounts in a short period of time. Parma, Brooklyn, Brooklyn Center, Cuyahoga Heights, and Cleveland Heights had water standing up to car bumper height, and 1-77 was closed due to up to 3 feet of water flooding the highway. I-480 and I-490 also had flooding on the entrance and exit ramps. In total, the thunderstorms brought 2.5 to 4 inches of rain to Cuyahoga County, with 1.5 to 3 inches of the rain falling within 2 hours. No injuries, deaths, or crop damages were reported; $10,000 of property damages were reported in Cuyahoga County.

- **Strong Wind – December 31, 2018:** A low pressure system moved into the Great Lakes region on the evening of the 31st, bringing strong winds. Cleveland Hopkins International Airport reported a wind gust at 55 MPH; Burke Lakefront Airport reported a wind gust at 53 MPH. Trees and power lines were downed around the County but mostly in the southern region. Tens of thousands woke up to the new 2019 year without power. $25,000 in property damages were reported – no injuries, deaths, or crop damages were reported.

- **Thunderstorm Wind – November 15, 2020:** A line of scattered thunderstorms passed through northern Ohio on November 15th, bringing thunderstorm wind gusts that broke 60 MPH often. Two people were injured in Lake County, but Cuyahoga County did not report any injuries, deaths, or damages to property or crops from the event. However, a tree was reported down across Fitch Road in Olmsted Township. Additional damage from the storm included tree damage, power poles and roof damage, and over 150,000 people losing power during the storm.

4.2.5 Probability of Future Occurrences

The HMPC, based on their knowledge and experience, decided that Severe Thunderstorm events are “Highly Likely,” meaning that they have a 100% chance of occurring each year. Reported thunderstorm conditions over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing thunderstorm winds associated with damages or injury can be difficult to predict. Based on the historical record of 455 thunderstorm events from 2001 through 2021 (22.75 thunderstorm events per year), it can reasonably be assumed that this type of event will occur multiple times per year.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**455 Events**) / (**20 Years**) = **22.75 Events each Year**

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

4.2.6 Assets Exposed to Severe Thunderstorms

Potential Losses

TABLE 4-15 POTENTIAL IMPACTS FROM THUNDERSTORMS

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

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

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

A March 2017 report by Willis Re found that the average annual loss for severe storms in the United States is $11.23 billion.

Community Vulnerability

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

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

4.2.7 Land Use & Development Trends

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

Regulatory Environment

There are negligible formal regulations that pertain to thunderstorm events. All structures in the County are meant to be wind resistant as recommended by the International Building Code.

4.2.8 Thunderstorm Summary

Cuyahoga County is subject to severe storms ranging from thunderstorms to tropical storms which have the potential to cause flash flooding, tornadoes, downbursts, and debris. The Severe Thunderstorms profile is primarily concerned with past and future damages from high winds, lightning, and hail. Flooding is covered as a separate hazard, including flooding that occurs from a heavy precipitation event.

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

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

4.3. Flooding

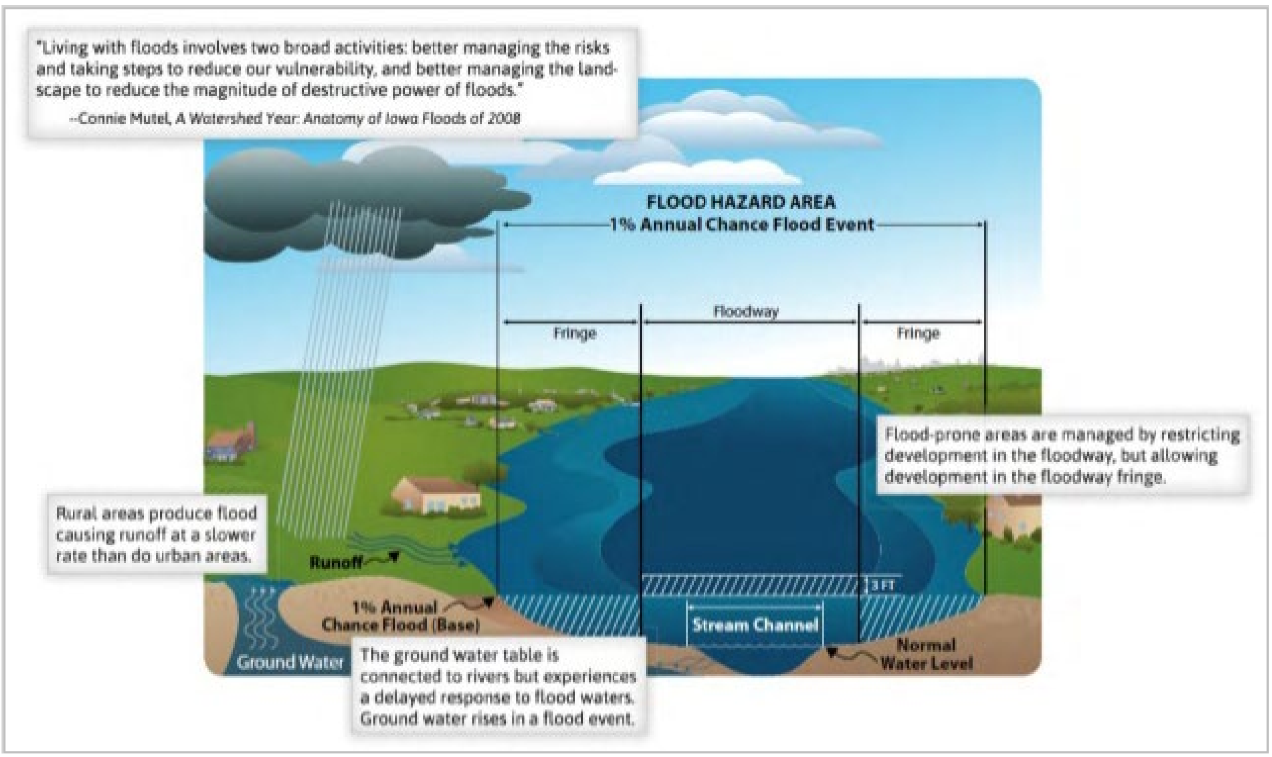
Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Flooding	4	0.3	2	0.3	2	0.2	3	0.1	2	0.1	2.7
Moderate Risk Hazard (2.0 – 2.9)											

4.3.1 Flooding Description

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

FEMA develops Flood Insurance Rate Maps (FIRMs) to identify the 1% annual chance flood zone for land use planning and the National Flood Insurance Program (NFIP). This 1% annual chance flood zone is used to delineate the Special Flood Hazard Area (SFHA) and identify Base Flood Elevations. The figure below illustrates these terms. Cuyahoga County's FIRM was updated effective December 3, 2010 and August 15, 2019

FIGURE 4-11 DIAGRAM IDENTIFYING THE SPECIAL HAZARD FLOOD AREA



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

- **Riverine flooding** originates from a body of water, typically a river, creek, or stream, as water levels rise onto normally dry land. Water from snowmelt, rainfall, freezing streams, ice flows, or a combination thereof, causes the river or stream to overflow its banks into adjacent floodplains. Winter flooding usually occurs when ice in the rivers creates dams or streams freeze from the bottom up during extreme cold spells. Spring flooding is usually the direct result of melting winter snowpacks, heavy spring rains, or a combination of the two.
- **Coastal flooding** can occur when storm surges and wave actions breach the shoreline of a large body of water, such as a lake or ocean. A storm surge, or an increase in water surface elevation above normal levels, occurs when low barometric pressure and high winds pulls the water towards the shoreline. Coastal flooding may only inundate a small section of the coast or as large as a mile inland from the shoreline. The severity of the storm surge (i.e., height of storm surge) depends on the strength of storm or hurricane that causes the storm surge as well as the shape of the shoreline that is affected. Wave actions can cause coastal flooding and damage through breaking waves battering the shoreline as well as any manmade structures.
- **Flash floods** can occur anywhere when a large volume of water flows or melts over a short time period, usually from slow moving thunderstorms or rapid snowmelt. Because of the localized nature of flash floods, clear definitions of hazard areas do not exist. These types of floods often occur rapidly with significant impacts. Rapidly moving water only a few inches deep can lift people off their feet, and only a depth of a foot or two is needed to sweep cars away. Most flood deaths result from flash floods.
- **Urban flooding** is the result of development and the ground's decreased ability to absorb excess water without adequate drainage systems in place. Typically, this type of flooding occurs when land uses change from fields or woodlands to roads and parking lots. Urbanization can increase runoff two to six times more than natural terrain (National Oceanic and Atmospheric Administration, 1992). Flooding in developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it.
- **Stream Bank Erosion** is measured as the rate of the change in the position or horizontal displacement of a stream bank over a period of time. It is generally associated with riverine flooding and discharge and may be exacerbated by human activities such as bank hardening and dredging.
- **Coastal Erosion** is the wearing away of land and the removal of beach or dune sediments by wave action, tidal currents, wave currents, drainage, or high winds. Due to its location along Lake Erie, Cuyahoga County is prone to coastal erosion.
- **Seiche** is an oscillating standing wave in a body of water. Usually caused by strong winds and changes in atmospheric pressure, pushing water from one end of the basin to the other end. When the wind stops, water rapidly moves to the opposite end, creating a large wave that can break shorelines and seawalls. Seiches can also be caused by earthquakes. Seismic waves may rock an enclosed body of

water (e.g., lake or reservoir), creating an oscillating wave referred to as a seiche. Although not a common cause of damage in past Ohio earthquakes, there is a potential for large, forceful waves similar to tsunami ("tidal waves") to be generated on the large lakes of the state. Such a wave would be a hazard to shoreline development and pose a significant risk on dam-created reservoirs. A seiche could either overtop or damage a dam leading to downstream flash flooding. Lake Erie is known for seiches when winds blow from the southwest to the northeast. According to the NOAA, there was a 22-foot seiche in 1844 near Niagara Falls that breached the 14-foot seawall and killed 78 people.

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

Flood reduction, prevention, and mitigation are major challenges to Cuyahoga County residents and its floodplain manager. Many areas of the County are at risk of flooding, especially properties near creeks. Heavy seasonal rainfall, which typically occurs from late October through April, can result in stream overflows.

4.3.2 Flooding Location

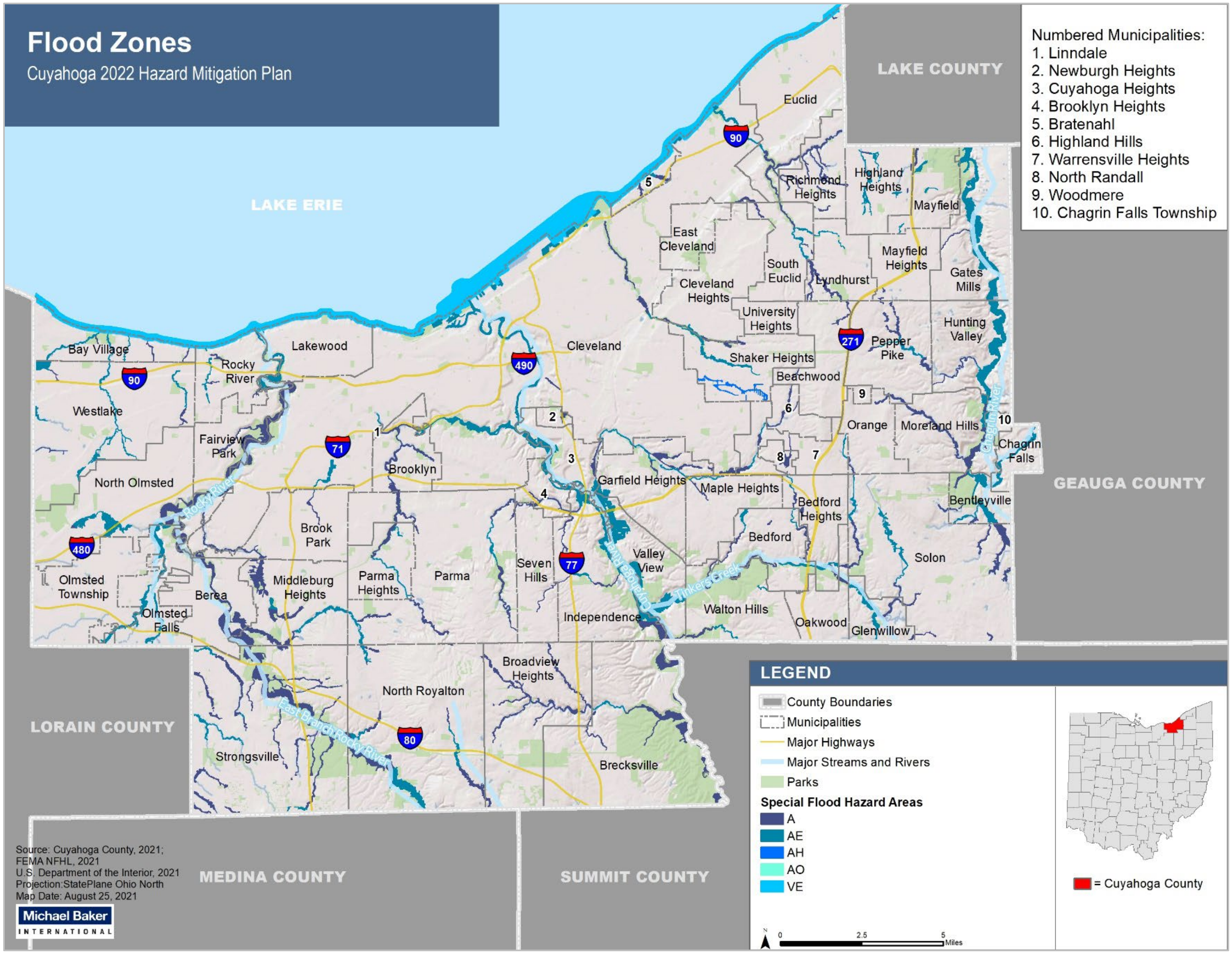
The Flood Insurance Study (FIS) for Cuyahoga County was revised on August 15, 2019. The riverine and coastal flooding sources identified in the study are as follows:

- Anthony Lane Tributary to Big Creek
- Aurora Branch
- Aurora Branch Tributary 1
- Baker Creek
- Baker Creek Tributary 1
- Baker Creek Tributary 2
- Baldwin Creek
- Baldwin Creek Tributary 2
- Baldwin Creek Tributary 7
- Bear Creek
- Big Creek
- Blodgett Creek
- Cahoon Creek/Dover Ditch
- Chagrin River
- Chagrin River Tributary 1
- Chagrin River Tributary 2
- Chagrin River Tributary 2.1
- Chippewa Creek
- Countrymans Creek
- Cuyahoga River
- Cuyahoga River Tributary 1
- Doan Brook
- East Branch Rocky River
- East Branch Rocky River Tributary 1
- East Branch Rocky River Tributary 2
- East Branch Rocky River Tributary 2.1
- East Branch Rocky River Tributary 3
- East Branch Rocky River Tributary 4
- East Branch Rocky River Tributary 5
- East Branch Rocky River Tributary 5.1
- East Branch Rocky River Tributary 6
- East Branch Rocky River Tributary 7
- Euclid Creek
- Euclid Creek Tributary 1.5
- Euclid Creek Tributary 1.5.1
- Euclid Creek Tributary 1.6
- Euclid Creek Tributary 2
- Fitch Lateral
- Hawthorne Creek
- Kirk Lateral
- Lake Erie
- Mill Creek

- Nine Mile Creek
- Pepper Creek
- Pepper Creek Tributary 4.1.1
- Plum Creek
- Pond Brook
- Porter Creek (Huntington Creek)/Gifford-Avon Ditch
- Reservoir Creek
- Rocky River
- Roots Ditch
- Rose Lateral
- Sagamore Creek
- Shwartz Ditch
- Spencer Creek
- Sperry Creek
- Stone Water Creek
- Stone Water Creek Tributary 1
- Tinkers Creek
- Tinkers Creek Tributary 1
- Tinkers Creek Tributary 2
- Tinkers Creek Tributary 2.1
- Tinkers Creek Tributary 3
- West Branch Rocky River
- West Branch Rocky River Tributary 1
- West Creek
- Wilhelmy Creek
- Wischmeyer Creek
- Wood Creek

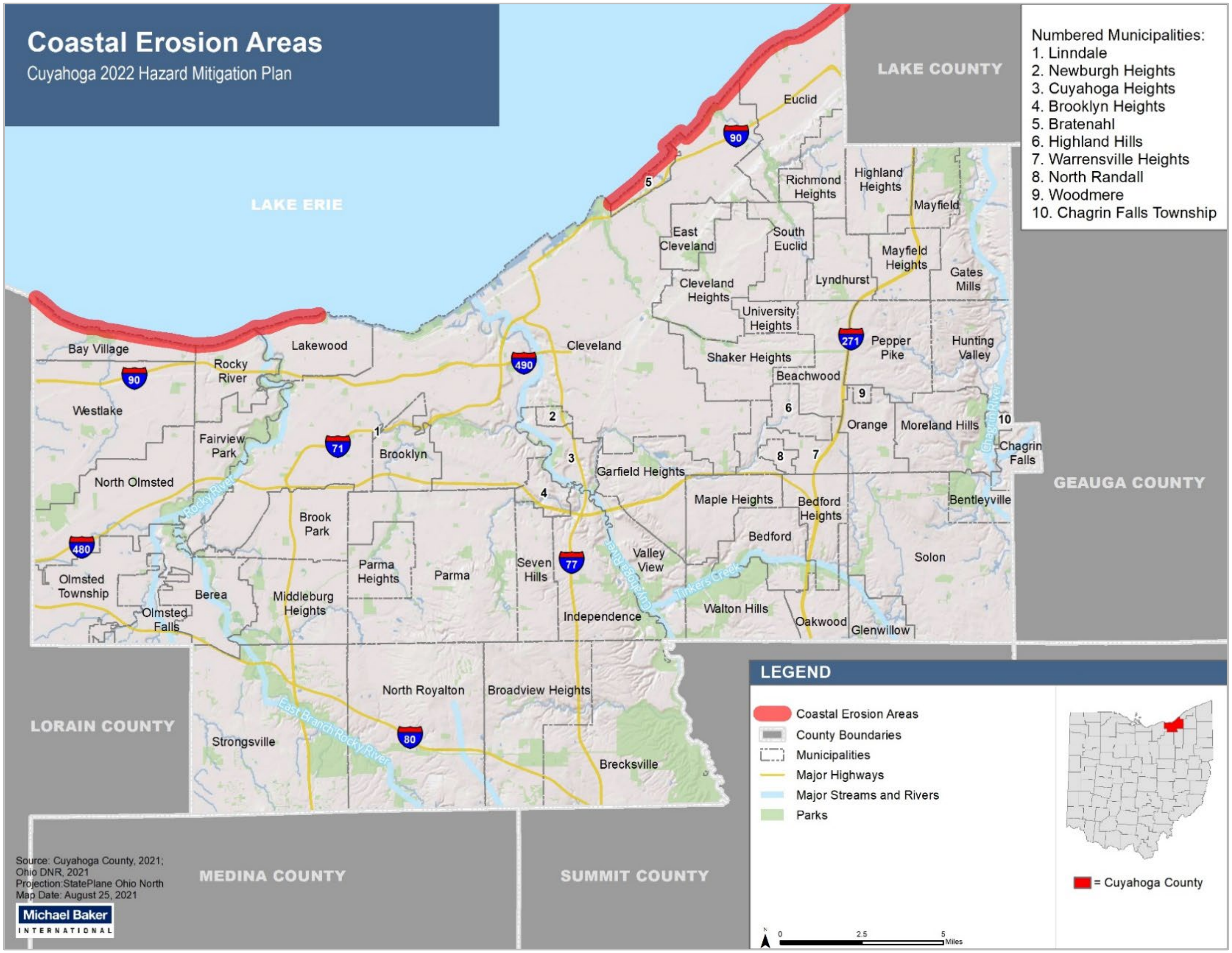
Flooding in Cuyahoga County is most likely to occur in the floodplain identified in the figure below. Smaller-scaled flooding can also occur outside of the identified flood zones.

FIGURE 4-12 CUYAHOGA COUNTY FLOOD ZONES



Coastal erosion occurs along the shorelines of large bodies of water. Cuyahoga County has 30 miles of Lake Erie shoreline, according to the Cuyahoga County Planning Commission. The figure below depicts where coastal erosion occurs within the County. In addition to the coastal erosion areas shown on the map, Cleveland Metroparks identified that coastal erosion is also occurring in Wendy Park, located in Cleveland.

FIGURE 4-13 CUYAHOGA COUNTY COASTAL EROSION AREAS



4.3.3 Extent

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

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

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

FEMA defines flood-prone areas and their associated risk through zone designation. The following table includes the different flood zone designations as well as the description of the flood zone. Cuyahoga County has flood zones A, AE, AH, AO, and VE.

TABLE 4-16 FEMA FLOOD ZONE DESIGNATIONS

Zone	Description
Moderate to Low Risk Areas	
B and X	Area of moderate flood hazard, usually the area between the limits of the 100- year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile
C and X	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100- year flood
High Risk Areas	
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.
High Risk – Coastal Areas	
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1-30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
Undetermined Risk Areas	
D	Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

Coastal erosion rates along Lake Erie can occur over varied times and space. The factors that affect coastal erosion rates include: erodibility of material, soil slope and composition, water level fluctuations, nearshore lakebed shoals and slopes, storm wave energy and duration, precipitation, ground water and soil conditions, ice cover, shoreline orientation, beach composition, width, and slope, and shore protection structures. ODNR maintains a complete map database of coastal erosion along Lake Erie as well as the Lake Erie Shoreline Erosion Management Plan (LESEMP).

TABLE 4-17 ODNR COASTAL EROSION AREA DATA

	CUYAHOGA COUNTY[1]	BAY VILLAGE	ROCKY RIVER	LAKEWOOD	CLEVELAND W[2]	BRATENAHL	CLEVELAND E[3]	EUCLID
Shoreline length	22.4	5.4	2.0	3.9	1.5	2.7	2.9	4.0
LONG-TERM (1877 TO 1973) RECESSION (all figures approximate)								
Average recession distance (ft)	19	11	30	12	23	31	16	11
Average recession rate (ft/yr)	0.2	0.1	0.3	0.1	0.2	0.3	0.2	0.1
Maximum recession distance (ft)	137	50	71	46	137	64	66	47
Maximum recession rate (ft/yr)	1.4	0.5	0.7	0.5	1.4	0.7	0.7	0.5
Estimated acreage lost	45	7.4	7.3	5.6	4.1	10	5.6	5.3
1973-1990 RECESSION								
Average recession distance (ft)	3.6	3.4	2.6	3.6	3.0	2.5	3.7	6.4
Average recession rate (ft/yr)	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.4
Maximum recession distance (ft)	86	21	20	34	33	86	57	84
Maximum recession rate (ft/yr)	5.0	1.2	1.2	2.0	1.9	5.0	3.4	4.9
Estimated acreage lost	10	2.2	0.6	1.7	0.5	0.8	1.3	3.1
1990-2004 RECESSION (CURRENT CEA MAPPING)								
Average recession distance (ft)	3.2	5.4	2.0	3.9	1.5	2.7	2.9	4.0
Average recession rate (ft/yr)	0.1	0.1	0.1	0.2	0.1	0.02	0.1	0.1
Maximum recession distance (ft)	28	13	17	14	17	6.0	19	28
Maximum recession rate (ft/yr)	2.0	0.9	1.2	1.0	1.2	0.4	1.3	2.0
Estimated acreage lost	4.4	1.0	0.3	1.1	0.3	0.1	0.6	1.0
Length of shore affected by measurable recession, 1990-2004	8.4 mi	2.5 mi	0.5 mi	2.1 mi	0.4 mi	0.3 mi	1.1 mi	1.5 mi
Length of shore currently under a CEA designation	1.2 mi	0.1 mi	0.04 mi	0.1 mi	0.2 mi	0.0 mi	0.2 mi	0.3 mi
Average 30-year anticipated recession distance, ft (per the current CEA maps)	3.1	3.0	2.0	4.8	3.6	0.6	3.3	4.2
Maximum 30-year anticipated recession distance, ft (per the current CEA maps)	31	15	15	19	18	5.0	27	31
Anticipated 30-year acreage to be lost (estimated)	6.4	0.1	0.3	0.8	1.5	0.0	0.8	2.9

The extent of a seiche can be measured by the height of wave that is produced by the oscillation. Lake Erie has produced seiches as tall as 22 feet. Typical seiches for Lake Erie range in heights of 12 to 16 feet high waves. The time period between the high and low parts of a seiche, or water-level oscillation period, can last between four to seven hours.

Flood Warning and Notification

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

Cuyahoga County's River Characteristics

Information on historical floods along the Cuyahoga River and Rocky River was obtained from stream gauging stations maintained by the National Oceanic and Atmosphere Administration (NOAA). The tables below shows the flood stage categories for Rocky River and Cuyahoga River as determined by the NOAA and NWS The follow tables display the highest historical crests for Rocky River at Berea and Cuyahoga River recorded at the Independence gauge. The highest historical crests for Rocky River are unknown. However, the 2019 FIS report identifies historic flooding events have occurred in 1913, 1924, 1927, 1928, 1929, 1933, 1935, 1947, 1952, 1959, and 2004. Data for Chagrin River was not available for Cuyahoga County through the NOAA website. However, the 2019 FIS report identifies that the Chagrin River reached a historic peak of 610.93 Feet NAVD88 in 1948 and had additional historic flooding events with unknown peaks in 1913, 1929, 1931, 1959, and 1969.

TABLE 4-18 FLOOD CATEGORIES FOR ROCKY RIVER AT BEREA

Flood Category	Crest (ft)
Action Stage	7.5
Flood Stage	14
Moderate Flood Stage	16
Major Flood Stage	18

TABLE 4-19 FLOOD CATEGORIES FOR CUYAHOGA RIVER AT INDEPENDENCE

Flood Category	Crest (ft)
Action Stage	14
Flood Stage	17
Moderate Flood Stage	18.5
Major Flood Stage	21

TABLE 4-20 HIGHEST HISTORICAL CRESTS ON THE CUYAHOGA RIVER AT INDEPENDENCE

Crest (ft)	Date of Crest
23.29	6/23/2006
22.73	2/28/2011
22.41	1/22/1959
22.06	9/15/1979
21.77	12/30/1990

4.3.4 Historical Occurrences

General Trends

According to the NCDC, since 2001, there have been 84 flood or flash flood events in Cuyahoga County, which have resulted in zero injuries or deaths. These events have caused a total of $114,141,000 in property damage but no crop damages. A complete list of flood events from 1996 to current day can be found in **Appendix B**. The NCDC does not identify any previous occurrence events for coastal flooding or seiches in Cuyahoga County, although such events are possible to occur. Coastal erosion is an ongoing event for Cuyahoga County.

TABLE 4-21 CUYAHOGA COUNTY FLOOD EVENTS (JANUARY 1, 2001-MARCH 31, 2021)

Event	Count	Deaths	Injuries	Property Damage	Crop Damage
Flash Flood	63	0	0	$ 91,383,000	-
Flood	21	0	0	$ 22,758,000	-
Grand Total	**84**	**0**	**0**	**$ 114,141,000**	**-**

FIGURE 4-14 CUYAHOGA COUNTY FLOOD EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

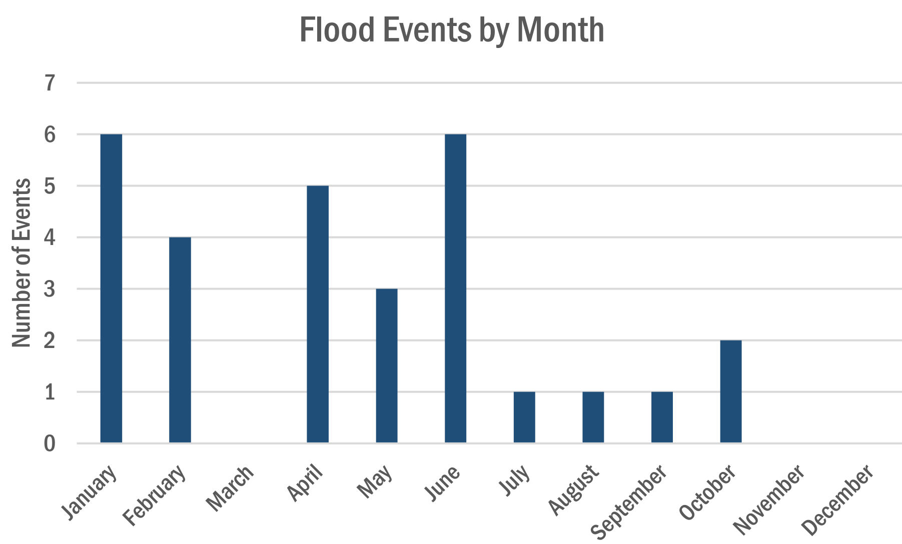
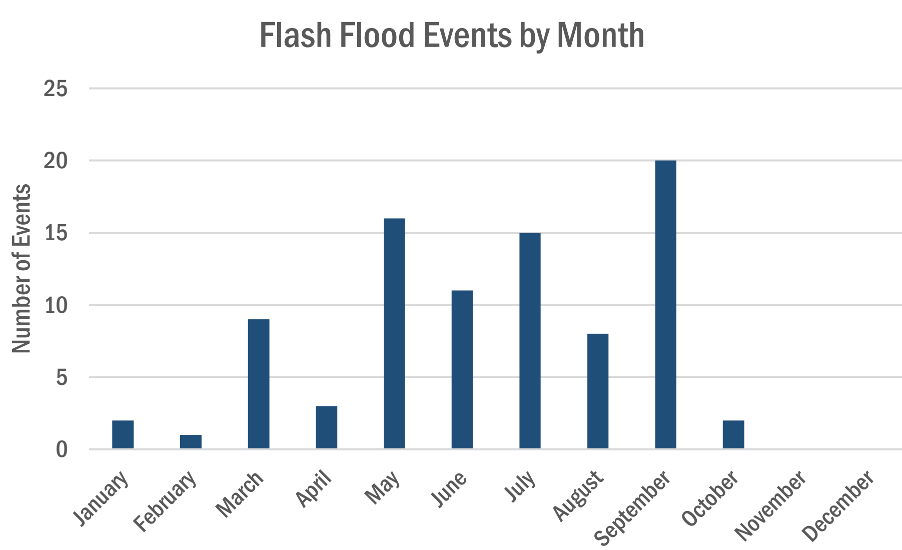


FIGURE 4-15 CUYAHOGA COUNTY FLASH FLOOD EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021



Cuyahoga County has been a part of 10 Federal Disaster Declarations that included flooding. Three resulted in public assistance, and four have resulted in Individual Assistance.

TABLE 4-22 DECLARED DISASTERS AFFECTING CUYAHOGA COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-266	7/15/1969	Tornadoes, Severe Storms & Flooding	-	-
DR-377	4/27/1973	Severe Storms & Flooding	-	-
DR-480	9/11/1975	Winds, Tornadoes, Heavy Rains & Flooding	-	-
DR-831	6/10/1989	Severe Storms & Flooding	-	-
DR-951	8/4/1992	Severe Storms, Tornadoes & Flooding	-	-
DR-1484	8/1/2003	Tornadoes, Flooding, Severe Storms, and High Winds	$ 10,875,976.79*	$ 74,781,195.51*
DR-1519	6/3/2004	Severe Storms and Flooding	$ 10,648,040.68*	$ 19,193,921.30*
DR-1556	9/19/2004	Severe Storms and Flooding	$ 25,804,256.17*	$ 23,662,227.18*
DR-1651	7/2/2006	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	-	$ 8,830,355.16*
DR-4098	1/3/2013	Severe Storms and Flooding Due to the Remnants of Hurricane Sandy	-	-

**Indicates data from FEMA's Disaster Declarations website. Totals provided on the webpage are for total funds delegated to all counties within the declared disaster rather than just for Cuyahoga County.*

Event Narratives

- **September 7, 1996:** Four to six inches of heavy rain from the remnants of Hurricane Fran caused flooding of streets, basements and low lying areas in several locations, especially in Cleveland, Parma, Strongsville and Olmsted Falls. Monkey Island, at the Cleveland zoo, was inundated, and picnic tables, asphalt and fences were damaged, but no animals were injured. There was up to one foot of water on some streets in Parma.

- **August 10, 1998:** Heavy thunderstorm rain caused widespread flash flooding of roads and low lying areas in Cleveland and surrounding suburbs. In Newburgh Heights, Interstate 77 was flooded with three to four feet of water and an elderly couple had to be rescued from their floating car. Over five inches of rain was measured in some southern and eastern sections as storms repeatedly crossed the area for several hours.

- **July 21, 2003:** Runoff from very heavy thunderstorm rains caused the Cuyahoga River to leave its banks late on the 21st. The river crested at 12.64 feet at Old Portage around 10 p.m. on the 21st. The river fell back below its flood stage of 9 feet just after midnight on the 24th. At Independence, the Cuyahoga River went into flood around 6 a.m on the 22nd and crested at 21.12 feet around 6 p.m. on the 22nd. The river fell back below flood stage early in the afternoon of 23rd. Considerable damage was caused by the flooding in both Cuyahoga and Summit Counties. Over 20 miles of foot trails, several miles of railroad tracks and eight bridges were washed out in the Cuyahoga Valley National Recreation Area. Damage in the park topped $1 million. Significant flooding occurred along Canal and Tinkers Creek Roads in Valley View. Many homes on the east side of the river along Gleeson, Charles, Frances and Stone Streets sustained major damage. Flooding also occurred along the river in Cuyahoga Falls and Monroe Falls near Kennedy Park. Over 20 businesses along the river also suffered flood related losses.

- **May 22, 2004:** Thunderstorms rained heavily on Cuyahoga County for third time in less than 24 hours during the early morning hours of May 22nd. Areas already saturated from earlier rains saw another one to two inches of rain fall in just a few hours. The Rocky River quickly rose during the early morning hours causing significant damage. Two very rapid rises in the river occurred. The first one was around 2:45 a.m. and was described by witnesses as a "wall of water" moving down the basin. The second jump in water levels occurred around daybreak. Six marinas along the river were heavily damaged. Piers and docks at the marinas were swept away, as were over 100 boats. Around 35 of the boats were found tangled and smashed along a bridge abutment near the mouth of the river. Big Creek also went into flood during the early morning hours causing Brookpark Road to be closed. Widespread urban and lowland flooding occurred elsewhere in the county. Many roads and streets had to be closed because of flood waters up to three feet deep. A spotter in North Royalton measured 1.36 inches of rain during the early morning storm. Damage to roads and other public property from the flash flood events of May 21st and 22nd and from the subsequent flooding along the Cuyahoga River totaled approximately $3.6 million. 1,095 homes in the county sustained flood damage during these events.

- **June 22, 2006:** Thunderstorms dumped torrential rainfall on much of Cuyahoga County during the late afternoon and early evening hours of June 22nd. With the ground already saturated from heavy rains the previous 24 hours, flash flooding quickly developed. The eastern and southern portions of the county were especially hard hit with significant damage reported in Brecksville, Broadview Heights, Parma, North Royalton and Solon. Spotters in Solon measured 5.0 inches of rain between 3:30 and 7:30 pm. A spotter in Parma reported a 24 rainfall total of 6 inches. Two to three feet of water was reported on many streets effectively turning them into rivers. Dozens of motorists had to be rescued from their vehicles. In Independence, 21 passengers had to be rescued from a scenic railway train after the railroad's tracks became flooded. In Brecksville, Chippewa Creek turned into a raging torrent and caused extensive damage in the city. A lumberyard near the creek saw much of its inventory washed away and around 450 homes in the area were damaged with 50 sustaining major damage. As much as two to three feet of water was reported on the ground floors of homes in Independence. In Parma, a sink hole 10 feet wide and 13 feet deep developed on State Road (State Route 94). The City of Parma spent over $1 million for emergency response, street repairs, materials and personnel. Around 200 homes, most of them east of State Road were damaged in the city. Several hundred homes and six school buildings were damaged by flooding in North Royalton. The damage was even more widespread in Broadview Heights and Solon. In Broadview Heights, around 1800 homes were affected by flooding with over 200 sustaining major damage. Most of this damage was north of State Route 82. Another 2000 homes were damaged in Solon. Numerous roads and culverts in these areas were washed out. At the peak of the flooding, nearly two dozen streets were impassable in Solon alone. In Walton Hills, flood waters were reported flowing over guard rails lining streets. Nearly 4,000 homes, 475 businesses and 21 public buildings in the county were damaged by flooding.
- **May 13, 2014:** Between 8 and 10 pm in the evening of May 12th rainfall observations in Olmsted Falls show 2.5-4.44 inches of rain. The rainfall rates were measured at 2.52 inches per hour. A dozen water rescues were conducted however no significant injuries were reported. In all nearly 1,000 homes were inundated in the towns of Olmsted Falls, North Olmsted, and Westlake. The City Hall in Olmsted Falls sustained significant flood damage to their basement. At the Great Northern Mall in North Olmsted 15 cars were submerged and a department store sustained significant damage. Dozens of roads and intersections were closed due to flooding with several feet of water. The major thruway Interstate 480 was closed around 10:19 PM. Lewis Road in Olmsted Falls was damaged due to embankment failures.

- **August 10, 2017:** After heavy rain fell in the region, flash flooding occurred in Beachwood, resulting in $2 million in property damages. At the peak of the storm, just under an inch (0.94 inches) of rain fell within ten minutes according to the real-time rain gauge in Beachwood, totaling to a rainfall rate of 6.36 inches per hour. The total rainfall accumulated to 3.26 inches in Beachwood and an unofficial rainfall total of 4.5 inches in Pepper Pike. Road closures and flooded basements, yards, garages, and first floors were reported in the approximately 200 homes that had water damage. The majority of the flash flooding occurred due to obstructed storm drainage.

- **September 7, 2020:** Widespread flash flooding occurred in Cuyahoga County after a series of isolated thunderstorms moved through the region. Communities saw a range of 2-5 inches of rain and hail up to 2 inches in diameter. Cuyahoga County reported an average of 4.09 inches of rainfall from the storm systems. The Horseshoe Lake Dam in Shaker Heights, that had been drained after ODNR deemed the dam to be structurally deficient, filled and water overtopped the dam after the heavy rainfall amounts. The high-hazard dam did not fail even though emergency management officials were concerned about the dam eroding and collapsing. Flooding also occurred in Doan Brook, causing the intersection of Coventry Road and North Park Blvd to flood as well as the Cleveland Cultural Gardens. Multiple vehicles were stranded in the high waters, requiring assistance from the Swift Water Rescue Team. Doan Brook crested at 11.39 feet with peak flow rates equaling that of a 50-year to 100-year flood. Roads were also washed out due to the flood.

4.3.5 Probability of Future Occurrences

Reported flood events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the County experiencing a flood event can be difficult to quantify but based on historical record of 84 flood events since 2001, this type of event has occurred once every 0.24 years from 2001 through 2021.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**20 Years**) / (**84 Events**) = **.24 Years Between Events**

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

The HMPC, based on their knowledge, determined that flood events are “Highly Likely,” meaning that there is a 100% annual chance of occurring.

4.3.6 Assets Exposed to Flooding

Potential Losses from Flooding

TABLE 4-23 POTENTIAL IMPACTS FROM FLOODING

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

Community Vulnerability

In Cuyahoga County, there are a total of 647 structures in the Special Flood Hazard Area (SFHA); 9 of the County's critical facilities are located in the SFHA. Valley View has the highest number of structures in the SFHA with 161 structures, North Olmsted has the second highest with 145 structures, and Shaker Heights has the third highest with 44 structures. Valley View also has the highest percent of structures in the SFHA with 24% of total structures located in the SFHA, North Randall has 6% of its total structures located in the SFHA, and Gates Mills has 5% of its total structures located in the SFHA. Shaker Heights has the highest number of critical facilities located in the SFHA with 3 critical facilities, and both Cleveland and Gates Mills have 2 critical facilities located in the SFHA. South Euclid and Westlake both have 1 critical facility located in the SFHA.

Cleveland Metroparks Flood Vulnerability

- The existing culvert under Chippewa Creek in Cleveland Metroparks Brecksville Reservation is undersized and contributes to flooding and streambank erosion.
- Cleveland Metroparks manages Wendy Park and the Wildwood Marina along Lake Erie. Wendy Park is located on Whiskey Island west of the airport. Wildwood Marina is located between Bratenahl and Euclid on Lake Erie. Both of these facilities feature breakwaters that have been impacted by numerous storm events and is being impacted by coastal erosion as well. Metroparks will eventually need to address these issues to prevent future degradation of the beach and the marina facility.

TABLE 4-24 COMMUNITY FLOOD VULNERABILITY IN CUYAHOGA COUNTY

Municipality	Total Structures	Structures in SFHA	Percent Structures in SFHA	Total Critical Facilities	Critical Facilities in SFHA	Percent Critical Facilities in SFHA
Bay Village	4,092	4	0%	13	0	0%
Beachwood	2,352	0	0%	29	0	0%
Bedford	3,562	34	1%	21	0	0%
Bedford Heights	2,284	2	0%	8	0	0%
Bentleyville	203	1	0%	2	0	0%
Berea	4,561	3	0%	25	0	0%
Bratenahl	326	1	0%	8	0	0%
Brecksville	3,596	6	0%	18	0	0%
Broadview Heights	4,818	8	0%	11	0	0%
Brook Park	5,087	1	0%	15	0	0%
Brooklyn	2,793	3	0%	8	0	0%
Brooklyn Heights	520	0	0%	4	0	0%
Chagrin Falls	1,126	1	0%	9	0	0%
Chagrin Falls Township	27	0	0%	0	0	0%
Cleveland	99,020	25	0%	731	2	0%
Cleveland Heights	10,733	0	0%	58	0	0%
Cuyahoga Heights	215	0	0%	6	0	0%
East Cleveland	5,169	0	0%	41	0	0%
Euclid	11,074	0	0%	48	0	0%
Fairview Park	4,164	0	0%	19	0	0%
Garfield Heights	7,757	19	0%	33	0	0%
Gates Mills	650	30	5%	6	2	33%
Glenwillow	239	0	0%	1	0	0%
Highland Heights	2,187	2	0%	10	0	0%
Highland Hills	115	0	0%	7	0	0%
Hunting Valley	150	1	1%	2	0	0%
Independence	2,088	32	2%	13	0	0%
Lakewood	11,206	7	0%	59	0	0%
Linndale	45	0	0%	1	0	0%
Lyndhurst	3,835	2	0%	17	0	0%
Maple Heights	6,618	0	0%	32	0	0%
Mayfield	869	2	0%	6	0	0%
Mayfield Heights	3,786	0	0%	14	0	0%
Middleburg Heights	4,080	4	0%	19	0	0%
Moreland Hills	916	4	0%	2	0	0%
Newburgh Heights	568	0	0%	6	0	0%
North Olmsted	7,835	145	2%	31	0	0%
North Randall	145	8	6%	7	0	0%
North Royalton	6,993	19	0%	22	0	0%

Municipality	Total Structures	Structures in SFHA	Percent Structures in SFHA	Total Critical Facilities	Critical Facilities in SFHA	Percent Critical Facilities in SFHA
Oakwood	1,096	0	0%	6	0	0%
Olmsted Falls	2,177	5	0%	8	0	0%
Olmsted Township	3,465	6	0%	12	0	0%
Orange	863	0	0%	3	0	0%
Parma	20,666	19	0%	78	0	0%
Parma Heights	4,595	0	0%	17	0	0%
Pepper Pike	1,652	1	0%	17	0	0%
Richmond Heights	2,254	1	0%	17	0	0%
Rocky River	4,622	0	0%	29	0	0%
Seven Hills	3,351	0	0%	8	0	0%
Shaker Heights	5,839	44	1%	42	3	7%
Solon	5,671	5	0%	23	0	0%
South Euclid	5,852	1	0%	23	0	0%
Strongsville	11,101	22	0%	28	1	4%
University Heights	2,896	0	0%	12	0	0%
Valley View	660	161	24%	5	0	0%
Walton Hills	669	1	0%	4	0	0%
Warrensville Heights	2,703	0	0%	25	0	0%
Westlake	7,590	17	0%	35	1	3%
Woodmere	165	0	0%	2	0	0%
Grand Total	**313,691**	**647**	**0%**	**1,756**	**9**	**1%**

In Cuyahoga County, there are 959 mobile homes. Out of the 959 mobile homes, only 6, or 1%, are located in the SFHA. All 6 mobile homes located in the SFHA are in Garfield Heights, 86% of their total mobile home amount.

TABLE 4-25 MOBILE HOME FLOOD VULNERABILITY IN CUYAHOGA COUNTY

Municipality	Planning Region	Total Mobile Homes	Total Mobile Homes in SFHA	Percent Mobile Homes in SFHA
Bay Village	Westlake Region	0	0	0%
Beachwood	Hillcrest Region	0	0	0%
Bedford	Chagrin/Southeast Region	0	0	0%
Bedford Heights	Chagrin/Southeast Region	276	0	0%
Bentleyville	Chagrin/Southeast Region	0	0	0%
Berea	Southwest Region	0	0	0%
Bratenahl	Cleveland Region	0	0	0%
Brecksville	Cuyahoga Region	0	0	0%
Broadview Heights	Cuyahoga Region	0	0	0%
Brook Park	Southwest Region	0	0	0%
Brooklyn	Southcentral Region	0	0	0%
Brooklyn Heights	Cuyahoga Region	0	0	0%
Chagrin Falls	Chagrin/Southeast Region	0	0	0%
Chagrin Falls Township	Chagrin/Southeast Region	0	0	0%
Cleveland	Cleveland Region	468	0	0%
Cleveland Heights	Heights Region	0	0	0%
Cuyahoga Heights	Cuyahoga Region	0	0	0%
East Cleveland	Heights Region	0	0	0%
Euclid	Hillcrest Region	0	0	0%
Fairview Park	Westlake Region	0	0	0%
Garfield Heights	Chagrin/Southeast Region	7	6	86%
Gates Mills	Hillcrest Region	0	0	0%
Glenwillow	Chagrin/Southeast Region	60	0	0%
Highland Heights	Hillcrest Region	0	0	0%
Highland Hills	Chagrin/Southeast Region	0	0	0%
Hunting Valley	Chagrin/Southeast Region	0	0	0%
Independence	Cuyahoga Region	0	0	0%
Lakewood	Westlake Region	0	0	0%
Linndale	Cleveland Region	0	0	0%
Lyndhurst	Hillcrest Region	0	0	0%
Maple Heights	Chagrin/Southeast Region	0	0	0%
Mayfield	Hillcrest Region	0	0	0%
Mayfield Heights	Hillcrest Region	0	0	0%
Middleburg Heights	Southwest Region	0	0	0%
Moreland Hills	Chagrin/Southeast Region	0	0	0%
Newburgh Heights	Cuyahoga Region	0	0	0%
North Olmsted	Westlake Region	0	0	0%
North Randall	Chagrin/Southeast Region	0	0	0%

Municipality	Planning Region	Total Mobile Homes	Total Mobile Homes in SFHA	Percent Mobile Homes in SFHA
North Royalton	Southcentral Region	0	0	0%
Oakwood	Chagrin/Southeast Region	46	0	0%
Olmsted Falls	Southwest Region	0	0	0%
Olmsted Township	Southwest Region	102	0	0%
Orange	Chagrin/Southeast Region	0	0	0%
Parma	Southcentral Region	0	0	0%
Parma Heights	Southcentral Region	0	0	0%
Pepper Pike	Hillcrest Region	0	0	0%
Richmond Heights	Hillcrest Region	0	0	0%
Rocky River	Westlake Region	0	0	0%
Seven Hills	Cuyahoga Region	0	0	0%
Shaker Heights	Heights Region	0	0	0%
Solon	Chagrin/Southeast Region	0	0	0%
South Euclid	Hillcrest Region	0	0	0%
Strongsville	Southwest Region	0	0	0%
University Heights	Heights Region	0	0	0%
Valley View	Cuyahoga Region	0	0	0%
Walton Hills	Chagrin/Southeast Region	0	0	0%
Warrensville Heights	Chagrin/Southeast Region	0	0	0%
Westlake	Westlake Region	0	0	0%
Woodmere	Chagrin/Southeast Region	0	0	0%
Grand Total		**959**	**6**	**1%**

There are a total of 647 structures in the SFHA in Cuyahoga County. 55 of the structures are commercial buildings, 21 of the parcels are green space, 90 structures are industrial buildings, 5 structures are institutional buildings, 473 structures are residential buildings, and 3 are utility structures.

TABLE 4-26 STRUCTURES IN SFHA BY LAND USE TYPE PER MUNICIPALITY FOR CUYAHOGA COUNTY

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Bay Village	0	0	0	0	4	0	4
Beachwood	0	0	0	0	0	0	0
Bedford	0	0	0	0	34	0	34
Bedford Heights	1	0	1	0	0	0	2
Bentleyville	0	0	0	0	1	0	1
Berea	0	2	0	0	1	0	3
Bratenahl	0	0	0	0	1	0	1
Brecksville	0	0	0	0	6	0	6
Broadview Heights	0	0	0	0	8	0	8
Brook Park	0	0	1	0	0	0	1
Brooklyn	2	0	0	0	1	0	3
Brooklyn Heights	0	0	0	0	0	0	0
Chagrin Falls	0	0	0	0	1	0	1
Chagrin Falls Township	0	0	0	0	0	0	0
Cleveland	1	2	11	2	9	0	25
Cleveland Heights	0	0	0	0	0	0	0
Cuyahoga Heights	0	0	0	0	0	0	0
East Cleveland	0	0	0	0	0	0	0
Euclid	0	0	0	0	0	0	0
Fairview Park	0	0	0	0	0	0	0
Garfield Heights	2	0	9	0	8	0	19
Gates Mills	7	1	0	3	18	1	30
Glenwillow	0	0	0	0	0	0	0
Highland Heights	0	0	0	0	2	0	2
Highland Hills	0	0	0	0	0	0	0
Hunting Valley	0	1	0	0	0	0	1
Independence	1	3	21	0	6	1	32
Lakewood	0	0	0	0	7	0	7
Linndale	0	0	0	0	0	0	0
Lyndhurst	0	0	0	0	2	0	2
Maple Heights	0	0	0	0	0	0	0
Mayfield	0	0	0	0	2	0	2
Mayfield Heights	0	0	0	0	0	0	0
Middleburg Heights	0	0	0	0	4	0	4
Moreland Hills	0	0	0	0	4	0	4
Newburgh Heights	0	0	0	0	0	0	0
North Olmsted	13	1	0	0	131	0	145
North Randall	8	0	0	0	0	0	8
North Royalton	0	2	0	0	17	0	19
Oakwood	0	0	0	0	0	0	0

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Olmsted Falls	0	0	0	0	5	0	5
Olmsted Township	0	0	0	0	6	0	6
Orange	0	0	0	0	0	0	0
Parma	8	0	0	0	11	0	19
Parma Heights	0	0	0	0	0	0	0
Pepper Pike	0	0	0	0	1	0	1
Richmond Heights	0	0	0	0	1	0	1
Rocky River	0	0	0	0	0	0	0
Seven Hills	0	0	0	0	0	0	0
Shaker Heights	0	0	1	0	43	0	44
Solon	1	0	1	0	3	0	5
South Euclid	0	0	0	0	1	0	1
Strongsville	0	5	0	0	16	1	22
University Heights	0	0	0	0	0	0	0
Valley View	11	3	44	0	103	0	161
Walton Hills	0	1	0	0	0	0	1
Warrensville Heights	0	0	0	0	0	0	0
Westlake	0	0	1	0	16	0	17
Woodmere	0	0	0	0	0	0	0
Grand Total	**55**	**21**	**90**	**5**	**473**	**3**	**647**

Hazus-MH 100-Year Flood Scenario

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

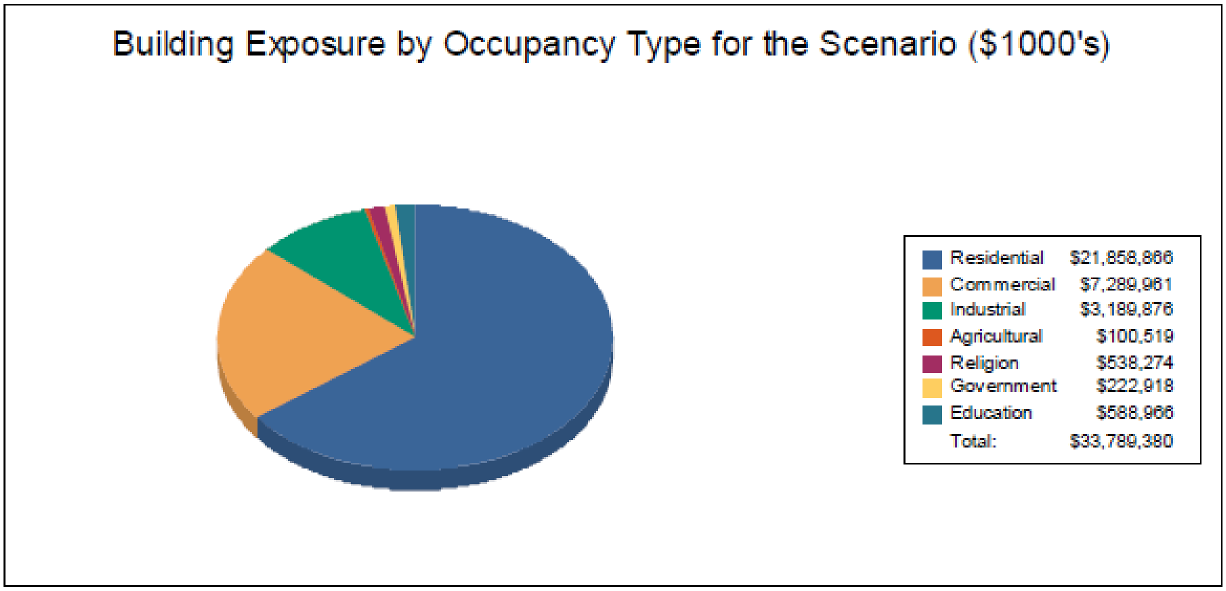
The geographical size of the region is approximately 459 square miles and contains 15,334 census blocks. The region contains over 545 thousand households and has a total population of 1,280,122 people (2010 Census Bureau data).

There are an estimated 489,225 buildings in the region with a total building replacement value (excluding contents) of 190,187 million dollars. Approximately 91.68% of the buildings (and 70.40% of the building value) are associated with residential housing.

For essential facilities, there are 29 hospitals in the region with an unknown total bed capacity. There are 977 schools, 101 fire stations, 73 law enforcement stations, and 2 emergency operation centers.

TABLE 4-27 BUILDING EXPOSURE BY OCCUPANCY TYPE FOR THE SCENARIO

Occupancy	Exposure ($1000)	Percent of Total
Residential	21,858,866	64.7%
Commercial	7,289,961	21.6%
Industrial	3,189,876	9.4%
Agricultural	100,519	0.3%
Religion	538,274	1.6%
Government	222,918	0.7%
Education	588,966	1.7%
Total	**33,789,380**	**100%**



General Building Stock Damage

Hazus estimates that about 528 buildings will be at least moderately damaged. This is over 76% of the total number of buildings in the scenario. There are an estimated 27 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Flood Technical Manual. The first table below summarizes the expected damage by general occupancy for the buildings in the region. The second table summarizes the expected damage by general building type. The last table summarizes the expected damage to essential facilities.

TABLE 4-28 EXPECTED BUILDING DAMAGE BY OCCUPANCY

	1-10		11-20		21-30		31-40		41-50		>50	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	7	47	6	40	2	13	0	0	0	0	0	0
Education	2	40	2	40	1	20	0	0	0	0	0	0
Government	0	0	1	100	0	0	0	0	0	0	0	0
Industrial	2	33	2	33	2	33	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	255	33	300	39	119	16	44	6	22	3	27	4
Total	266		311		124		44		22		27	

TABLE 4-29 EXPECTED DAMAGE BY BUILDING TYPE

Building Type	1-10		11-20		21-30		31-40		41-50		>50	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	1	50	0	0	1	50	0	0	0	0	0	0
ManufHousing	0	0	0	0	0	0	0	0	0	0	4	100
Masonry	39	41	39	41	11	12	3	3	1	1	2	2
Steel	3	50	2	33	1	17	0	0	0	0	0	0
Wood	221	33	266	39	108	16	41	6	21	3	21	3

TABLE 4-30 EXPECTED DAMAGE TO ESSENTIAL FACILITIES

		# Facilities		
Classification	Total	At Least Moderate	At Least Substantial	Loss of Use
Emergency Operation Centers	1	0	0	0
Fire Stations	101	1	0	1
Hospitals	29	0	0	0
Police Stations	73	0	0	0
Schools	977	4	0	3

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 2,512 households (or 7,536 of people) will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 291 people (out of a total population of 1,280,122) will seek temporary shelter in public shelters.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood. The total building-related losses were 812.06 million dollars. 47% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 21.30% of the total loss. The table below provides a summary of the losses associated with the building damage.

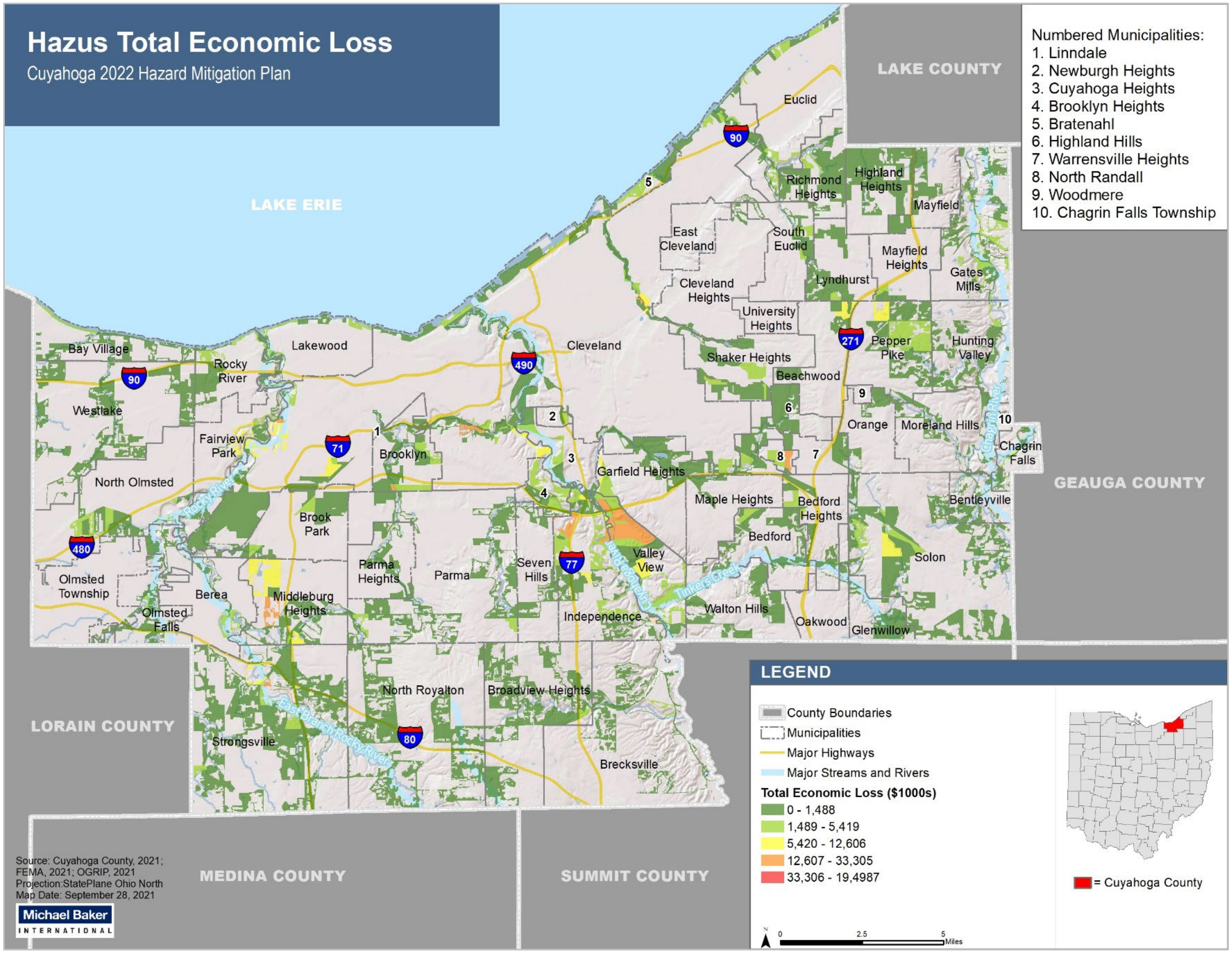
TABLE 4-31 BUILDING-RELATED ECONOMIC LOSS ESTIMATES

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	168.99	77.82	39.46	15.99	302.25
	Content	92.22	196.79	101.02	100.06	490.09
	Inventory	0.00	4.73	14.58	0.41	19.73
	Subtotal	**261.21**	**279.33**	**155.07**	**116.46**	**812.06**
Business Interruption						
	Income	3.60	145.39	3.62	51.08	203.69
	Relocation	36.16	35.67	3.29	19.53	94.65
	Rental Income	17.95	25.39	0.76	2.56	46.66
	Wage	8.56	143.95	4.37	223.27	380.15
	Subtotal	**66.26**	**350.40**	**12.03**	**296.44**	**725.13**
ALL	**Total**	**327.47**	**629.73**	**167.10**	**412.90**	**1,537.20**

The entire County is susceptible to flooding, either directly or through cleanup efforts and lasting economic impacts. Those closest to rivers and larger streams as well as the numerous small streams throughout the County, will be actual river waters. It is still possible for the rest of the County to be affected by localized flash flooding.

FIGURE 4-16 HAZUS TOTAL ECONOMIC LOSS



4.3.7 Land Use & Development Trends

Cuyahoga County is 55.95% Lower-Intensity developed and 21.02% Higher-Intensity developed, making the County mostly urban. Much of the existing development, as well as trends, tend to place new development in the larger cities as redevelopment occurs and in areas that are not fully developed yet. Localized flooding continues to remain a possibility throughout the County, especially in the many low-lying areas. It is essential that land use plans consider not only the dollar amount of damage that buildings near waterways could incur, but also the added risk of flood debris and narrowing the floodplains by building close to the rivers.

Regulatory Environment

There are numerous laws at the federal, state, and local levels throughout the country regarding floodplain management. Cuyahoga County continues to work to enforce the local floodplain management ordinance requirements set forth by all flooding programs, including the National Flood Insurance Program.

Cuyahoga County Building and Floodplain Codes

These regulations authorize a Floodplain Manager/Administrator and duties to be performed. Duties include, but are not limited to, routine monitoring of the floodplains, enforcing floodplain regulations, and providing community assistance, such as encouraging owners to maintain flood insurance. Flood regulations are codified in each jurisdiction’s zoning code through the floodplain administrator’s duties and responsibilities, floodplain development permits, and floodplain application requirements.

ODNR Coastal Erosion Areas

Property located in the Coastal Erosion Areas (CEA) is required to abide by the regulations set forth by ODNR. Should a property located in the CEA be sold or transferred, the Residential Property Disclosure Form must disclose the property’s location in the CEA. Additionally, property located within the CEA is subject to a CEA permit prior to any new building constructions, installation of a septic system, or any new additions to existing structures larger than 500 square feet.

RiskMAP

Cuyahoga County had an FIS study revised on August 15, 2019 and FIRMs completed in 2010 and 2019. A Discovery Report for the Cuyahoga Watershed was published in November 2011. Cuyahoga County also participated in the Great Lakes Coastal Flood Study in December 2017.

Cuyahoga County’s FIS reported principal flood problems for Big Creek, Chagrin River, Cuyahoga River, Doan Brook, Euclid Creek, Kingsbury Run, Kingsbury Run Tributary 2, Lake Erie, Mill Creek, Plum Creek, Rocky River, Roots Ditch, Tinkers Creek, and Wolf Creek.

Big Creek has localized flooding due to runoff from heavy rain. When the heavy rain exceeds the sewer capacity, Big Creek receives the runoff and floods in low-lying areas in streets, generally around Cleveland Metroparks Zoo. Chagrin River generally produces damaging floods in the late winter or early spring due to heavy rainfall and rapid snowmelt. Ice jams have also reportedly been an issue in the lower portion of the Chagrin River. The Cuyahoga River, while no general information was available at the time of the FIS revision for flooding impacts, has had multiple historic flooding events with discharge reaching 24,800 cubic feet per second (cfs). Doan Brook and Euclid Creek have periodic flooding due to runoff exceeding the sewer capacity in Cleveland. Kingsbury Run and Kingsbury Run Tributary 2 both flood when high intensity storms pass through the area and overload the storm drains. Lake Erie levels fluctuate due to long-term impacts, seasonal impacts, and short period impacts. Long-term level fluctuations are caused by an increase, or decrease, of precipitation over the Great Lakes basin. A higher amount of precipitation than normal can cause shoreline flooding. Seasonal level fluctuations occur generally in the spring when snowmelt and low rates of evaporation occurs, causing the lake level to rise. Short period level fluctuations occur when wind blows over the lake's surface, driving water in the direction of the wind. As volumes of water shift in the wind's direction, low water levels are left at the opposite end. Mill Creek has periodic flooding due to runoff exceeding sewer capacity in Cleveland, accumulations and ponding hilly terrain, incomplete drainage system, and obstructions in the creeks flow path. Plum Creek may flood after a local thunderstorm passes through the area, but flooding generally occurs in later winter or early spring. Rocky River generally floods in the late winter or early spring due to spring rain and snowmelt, causing damaging impacts to the area. The river also floods after intense summer storms pass through the area and when ice jams occur during the spring melt. However, the U.S. Coast Guard, USACE, and other government agencies break up any significant ice jams to deter damaging floods. Roots Ditch floods approximately less than ten years apart during the springtime, or during summer storms due to culverts that are not large enough. Tinkers Creek has flooded structures in its floodplain in 1968, 1969, and 1976. Lastly, Wolf Creek floods due to a variety of factors, such as runoff, accumulations and ponding hilly terrain, infrastructure that is not properly sized within the City of Garfield, and obstructions within the creek.

The Cuyahoga Watershed Discovery Report, prepared by ODNR and published in November 2011, is the process of collecting data to decide if a flood risk project could be useful for the area, and how beneficial the RiskMAP support would be the for area. Data collected includes information from local officials, spatial data presentation, and discussion with all stakeholders. The Discovery project was initiated in July 2011 by FEMA Region V. The Project Team for the Cuyahoga Watershed Discovery included representatives from FEMA Region V Risk Analysis Branch, FEMA Region V Floodplain Management and Insurance Branch, FEMA Region V Hazard Mitigation Assistance Branch, Ohio Department of Natural Resources (ODNR), and Ohio Emergency Management Agency (OEMA). Discovery meetings were held watershed-wide for local officials and selected stakeholders to participate in. The report highlights the many areas where mapping is needed, including the flooding source, study length of the flooding source, study type, and priority of mapping need. The Discovery process also yielded a high amount of Areas of Mitigation Interest (AOMI) that identifies the community that identified the AOMI, the county the community is located in, the flooding source, and comments provided by local official(s) of the community.

Cuyahoga County participated in the Great Lakes Coastal Flood Study in December 2017. This process was initiated to produce updated Digital Flood Insurance Rate Maps (DFIRMS), which will also account for strong winds and storm surge, making these more accurate to reflect current conditions.

The Consultation Coordination Officer (CCO) meetings were held where representatives from FEMA and the State of Ohio to inform the general public about updates to the Flood Insurance Rate Maps (FIRM). These maps determine the approximate rates that property owners will pay for flood insurance based on where they are physically located. CCO meetings provide the public an opportunity to review the preliminary maps to see if they will be affected, as well as talk with representatives to learn more and ask questions.

More information on the CCO meetings can be found at:

https://www.greatlakescoast.org/great-lakes-coastal-analysis-and-mapping/outreach/cco-materials/

FIGURE 4-17 GREAT LAKES COASTAL FLOOD STUDY FLYER

National Flood Insurance Program (NFIP)

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. As a participating member of the NFIP, Cuyahoga County is dedicated to protecting homes, with 1,607 NFIP policies currently in force. There are no Special Flood Hazard Areas (SFHA) identified in East Cleveland, University Heights, or Woodmere.

TABLE 4-32 CUYAHOGA COUNTY NFIP STATUS SUMMARY

CID	Community	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Re-Emerg-Date
390093	Bay Village	4/12/1974	12/1/1977	8/15/2019	12/1/1977
390094	Beachwood	7/11/1975	4/20/1979	12/3/2010	4/20/1979
390096	Bedford Heights	3/22/1974	9/17/1980	12/3/2010	9/17/1980
390095	Bedford	2/8/1974	1/2/1981	12/3/2010	1/2/1981
390682	Bentleyville	2/7/1975	8/1/1980	12/3/2010	8/1/1980
390097	Berea	2/1/1974	6/1/1979	12/3/2010	6/1/1979
390734	Bratenahl	7/11/1975	6/15/1981	8/15/2019	6/15/1981
390098	Brecksville	2/8/1974	1/16/1981	12/3/2010	1/16/1981
390099	Broadview Heights	6/21/1974	3/2/1979	12/3/2010	3/2/1979
390102	Brook Park	6/7/1974	6/1/1979	12/3/2010	6/1/1979
390101	Brooklyn Heights	2/8/1974	6/15/1981	12/3/2010	6/15/1981
390100	Brooklyn	3/22/1974	6/1/1979	12/3/2010	6/1/1979
390103	Chagrin Falls	3/15/1974	7/2/1980	12/3/2010	7/2/1980
390105	Cleveland Heights	3/29/1974	12/3/2010	12/3/2010	6/25/1976
390104	Cleveland	6/7/1974	8/1/1978	8/15/2019	8/1/1978
390766	Cuyahoga County	1/3/1981	4/2/1986	12/3/2010	4/2/1986
390654	Cuyahoga Heights	3/29/1974	6/15/1981	12/3/2010	6/15/1981
390107	Euclid	4/5/1974	8/17/1981	8/15/2019	8/17/1981
390108	Fairview Park	1/16/1974	2/4/1983	12/3/2010	2/4/1983
390109	Garfield Heights		7/10/1971	12/3/2010	7/9/1971
390593	Gates Mills	11/9/1973	4/3/1978	12/3/2010	4/3/1978
390735	Glenwillow	8/8/1975	2/18/1981	12/3/2010	2/18/1981
390110	Highland Heights	7/25/1975	6/1/1979	12/3/2010	6/1/1979
390111	Independence	2/1/1974	2/18/1981	12/3/2010	2/18/1981
390112	Lakewood	11/16/1973	2/1/1978	8/15/2019	2/1/1978
390113	Lyndhurst	4/12/1974	4/23/1982	12/3/2010	4/23/1982
390114	Maple Heights	2/8/1974	9/17/1980	12/3/2010	9/17/1980
390115	Mayfield Heights	7/25/1975	12/3/2010	12/3/2010	6/10/1980
390116	Mayfield	11/23/1973	12/24/1976	12/3/2010	12/24/1976
390117	Middleburg Heights	1/16/1974	8/17/1981	12/3/2010	8/17/1981
390118	Moreland Hills	2/8/1974	6/1/1979	12/3/2010	6/1/1979
390120	North Olmsted	4/5/1974	9/5/1979	12/3/2010	9/5/1979
390121	North Royalton	3/29/1974	9/17/1980	12/3/2010	9/17/1980
390122	Oakwood	5/17/1974	3/2/1979	12/3/2010	3/2/1979
390672	Olmsted Falls	6/14/1974	6/1/1979	12/3/2010	6/1/1979
390737	Orange	4/18/1975	2/4/1983	12/3/2010	2/4/1983
390124	Parma Heights	3/22/1974	8/17/1981	12/3/2010	8/17/1981
390123	Parma	5/17/1974	8/17/1981	12/3/2010	8/17/1981
390125	Pepper Pike	4/5/1974	8/17/1981	12/3/2010	8/17/1981
390126	Richmond Heights	3/22/1974	1/4/1985	12/3/2010	1/4/1985

CID	Community	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Re-Emerg-Date
395372	Rocky River		9/18/1971	8/15/2019	9/17/1971
390128	Seven Hills	3/22/1974	6/1/1979	12/3/2010	6/1/1979
390129	Shaker Heights	8/1/1975	6/15/1981	12/3/2010	6/15/1981
390130	Solon	4/5/1974	2/4/1981	12/3/2010	2/4/1981
390131	South Euclid	3/22/1974	8/17/1981	12/3/2010	8/17/1981
390132	Strongsville	6/21/1974	1/3/1979	12/3/2010	1/3/1979
390133	University Heights		12/3/2010	(NSFHA)	7/31/1979
390134	Valley View	1/23/1974	2/18/1981	12/3/2010	2/18/1981
390636	Walton Hills	1/10/1975	2/18/1981	12/3/2010	2/18/1981
390135	Warrensville Heights	3/15/1974	8/17/1981	12/3/2010	8/17/1981
390136	Westlake	4/12/1974	1/16/1980	8/15/2019	1/16/1980

Cuyahoga County entered the NFIP on January 3, 1981, approximately 6 years after the other jurisdictions in the County. The fifty-one participating jurisdictions of the County joined in the years of 1973-1975. As a participant in the NFIP, the County and its jurisdictions are dedicated to regulating development in the FEMA floodplain areas in accordance with NFIP criteria. Structures permitted or built in the County before the NFIP regulatory requirements were incorporated into the ordinances (before the effective date of the County's FIRM) and are called "pre-FIRM" structures.

The following communities are currently sanctioned by the NFIP: Highland Hills was sanctioned on 12/3/11; Linndale was sanctioned on 12/3/11; and North Randall was sanctioned on 4/18/76. Hunting Valley and Newburgh Heights have been suspended by the NFIP on 2/23/78 and 8/15/89 respectively. The sanctioned communities have been sanctioned due to lack of participation in the NFIP although each community has identified special flood hazard areas. The suspended communities were suspended due to failure to adopt the NFIP regulations. To become compliance with the NFIP, the five communities have developed mitigation actions, located in their respective planning region annex.

TABLE 4-33 CUYAHOGA COUNTY NFIP POLICIES AND CLAIM INFORMATION AND INSURANCE REPORT

CID	Community	Number of Policies	Total Coverage	Total Premiums	Total Claims Since 1978	Total Paid Since 1978	V-Zone Policies	A-Zone Policies
390093	Bay Village	39	$10,482,600	$32,776	32	$86,328	0	11
390094	Beachwood	28	$7,995,000	$13,681	31	$31,555	0	0
390096	Bedford Heights	11	$3,254,300	$6,060	39	$871,458	0	0
390095	Bedford	37	$7,036,200	$30,494	14	$53,808	0	12
390682	Bentleyville	14	$4,552,000	$6,889	11	$16,738	0	5
390097	Berea	7	$1,932,000	$3,029	7	$234,692	0	0
390734	Bratenahl	5	$1,405,000	$2,264	0	$0	0	1
390098	Brecksville	80	$19,244,500	$41,345	27	$857,710	0	11
390099	Broadview Heights	35	$9,287,000	$18,875	26	$331,403	0	1
390102	Brook Park	8	$2,270,500	$10,668	1	$76,768	0	2
390101	Brooklyn Heights	1	$650,000	$2,093	0	$0	0	0
390100	Brooklyn	4	$850,000	$2,163	10	$128,638	0	1
390103	Chagrin Falls	21	$7,047,800	$16,077	7	$36,233	0	4
390105	Cleveland Heights	24	$6,293,000	$11,528	12	$33,719	0	1
390104	Cleveland	318	$24,429,000	$117,302	136	$1,486,288	0	9
390766	Cuyahoga County	12	$2,600,100	$8,774	16	$137,169	0	5
390654	Cuyahoga Heights	0	$0	$0	3	$792	0	0
390107	Euclid	15	$2,877,000	$4,958	18	$16,130	0	0
390108	Fairview Park	5	$2,004,900	$4,735	4	$5,014	0	0
390109	Garfield Heights	16	$4,443,100	$47,917	34	$894,464	0	4
390593	Gates Mills	30	$9,365,300	$73,609	36	$100,395	0	13
390735	Glenwillow	2	$700,000	$884	0	$0	0	0
390110	Highland Heights	10	$2,806,000	$6,339	2	$1,119	0	0
390111	Independence	48	$19,801,700	$431,854	216	$15,167,937	0	28
390112	Lakewood	24	$6,732,800	$36,880	52	$650,386	0	9
390113	Lyndhurst	6	$1,575,000	$2,369	3	$80	0	0
390114	Maple Heights	5	$850,400	$4,675	6	$1,804	0	1
390115	Mayfield Heights	7	$1,715,000	$2,726	5	$23,600	0	0
390116	Mayfield	7	$2,548,700	$10,198	22	$985,587	0	1
390117	Middleburg Heights	33	$6,165,000	$34,702	38	$527,675	0	5
390118	Moreland Hills	21	$7,045,000	$12,028	13	$62,995	0	3
390120	North Olmsted	95	$19,038,600	$123,537	73	$232,517	0	44
390121	North Royalton	51	$13,106,800	$30,053	63	$506,766	0	4
390122	Oakwood	1	$350,000	$442	4	$14,519	0	0
390672	Olmsted Falls	12	$2,706,000	$4,701	3	$410	0	3

CID	Community	Number of Policies	Total Coverage	Total Premiums	Total Claims Since 1978	Total Paid Since 1978	V-Zone Policies	A-Zone Policies
390737	Orange	8	$2,478,000	$3,402	1	$0	0	0
390124	Parma Heights	3	$322,000	$809	7	$4,404	0	0
390123	Parma	37	$8,237,900	$23,241	43	$498,136	0	7
390125	Pepper Pike	30	$9,712,000	$19,169	29	$148,500	0	3
390126	Richmond Heights	8	$2,256,700	$6,112	9	$46,546	0	1
395372	Rocky River	34	$11,465,800	$19,893	45	$597,519	0	4
390128	Seven Hills	3	$700,000	$1,181	6	$41,513	0	0
390129	Shaker Heights	82	$23,250,300	$63,513	65	$58,210	0	25
390130	Solon	70	$19,474,000	$43,755	21	$353,517	0	6
390131	South Euclid	14	$3,700,000	$9,872	16	$13,477	0	2
390132	Strongsville	97	$24,184,500	$98,585	49	$988,067	0	20
390133	University Heights	7	$2,450,000	$3,047	9	$9,174	0	0
390134	Valley View	108	$37,838,500	$254,344	374	$5,835,697	0	73
390636	Walton Hills	6	$1,755,900	$4,725	9	$45,218	0	1
390135	Warrensville Heights	3	$311,100	$1,160	15	$507,578	0	0
390136	Westlake	64	$18,898,300	$38,136	23	$445,404	0	6
390594	Hunting Valley	1	$105,000	$513	0	$0		

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

- Not everyone is required to carry flood insurance. Structures carrying federally backed mortgages that are in a SFHA are required to carry flood insurance in the County;
- Owners who have completed the terms of the mortgage or who purchased their property outright may not choose to carry flood insurance and instead bear the costs of recovery on their own;
- The owner of a flooded property that does carry flood insurance may choose not to file a claim;
- Even insured properties that are flooded regularly with filed claims may not meet the $1,000 minimum threshold to be recognized as an RL property; or
- The owner adopted mitigation measures that reduce the impact of flooding on the structure, removing it from the RL threat, and the RL list (in accordance with FEMA's mitigation reporting requirements).

The following table breaks down the repetitive losses in Cuyahoga County. The data provided by the State of Ohio is the most recent data available for use as it is from 12/24/2020. There are 125 repetitive loss properties in Cuyahoga County, with a total of $5,526,870.56 in building payments, $1,752,857.89 in contents payments, and 342 losses.

TABLE 4-34 REPETITIVE LOSS PROPERTIES

Community	Type	Bldg. Payment	Cont. Payment	Losses	# of RL Properties
Bay Village	Single Family	$31,394.66	$641.36	3	1
Bedford	Single Family	$8,949.48	$0	2	1
Bedford Heights	Single Family	$54,898.02	$16,743.36	5	2
Bentleyville	Single Family	$12,026.24	$0	3	1
Berea	Single Family	$4,337.04	$533.79	2	1
Brecksville	Single Family	$43,579.47	$16,333.82	4	2
	2-4 Family	$437,126.70	$39,403.84	9	3
Broadview Heights	Single Family	$58,409.66	$19,970.62	8	4
Brooklyn	Business – Nonresidential	$103,109.40	$22,778.55	3	1
Cleveland	Single Family	$4,570.46	$1,263.82	2	1
	Assmd Condo	$5,667	$3,270	2	1
	Other Residential	$200,417.01	$0	7	3
	Business – Nonresidential	$73,500	$0	2	1
	Other – Nonresidential	$190,141.69	$114,772.28	5	2
Cleveland Heights	Single Family	$20,635.51	$2,756.21	2	1
Cuyahoga County	Single Family	$68,614.22	$6,972.79	8	2
	Other – Nonresidential	$0	$18,084.25	2	1
Euclid	Single Family	$10,289.08	$0	2	1
	Other – Nonresidential	$0	$2,914.16	1	1
Garfield Heights	Single Family	$44,633	$12,899.64	3	1
	Business – Nonresidential	$97,752.72	$13,463.95	2	1
	Other – Nonresidential	$9,291.30	$34,317.74	5	2
Gates Milles	Single Family	$38,691.07	$0	4	2
Independence	Single Family	$144,985.58	$70,967.96	6	3
	Assmd Condo	$263,516.51	$30,000	3	1
	Business – Nonresidential	$326,297.25	$28,431.49	7	2
	Other – Nonresidential	$139,669.91	$559,124.52	4	2
Lakewood	Single Family	$9,372.50	$0	2	1
Mayfield	Single Family	$23,096.53	$9,300.32	6	2
Middleburg Heights	Single Family	$44,840	$0	4	2
	Other – Nonresidential	$53,417.77	$11,880.59	4	2
North Olmsted	Single Family	$91,394.44	$9,869.45	13	6
North Royalton	Single Family	$93,471.97	$10,692.83	11	4
	Other Residential	$12,460.54	$0	4	1
Oakwood	Single Family	$13,852.19	$667.19	2	1
Parma	Single Family	$64,065.76	$3,679.76	10	5

Community	Type	Bldg. Payment	Cont. Payment	Losses	# of RL Properties
Pepper Pike	Single Family	$111,638.82	$8,671.91	10	4
Richmond Heights	Single Family	$38,511.46	$3,044.95	4	1
Rocky River	Single Family	$26,016.26	$7,435.38	5	1
Seven Hills	Single Family	$40,597.16	$0	3	1
Solon	Single Family	$95,347.40	$100,000.00	2	1
Strongsville	Single Family	$222,265.78	$27,419.49	16	7
Valley View	Single Family	$1,827,731.34	$482,087.05	128	36
	Business - Nonresidential	$43,692.09	$795.77	4	2
	Other – Nonresidential	$0	$9,462.39	1	1
Walton Hills	Assmd Condo	$11,908.14	$15,032.41	2	1
Westlake	Single Family	$73,013.25	$9,922.42	3	1
	Other – Nonresidential	$237,674.18	$27,251.83	2	1

Extensive FEMA NFIP databases are used to track claims for every participating community. FEMA databases maintain all NFIP claims which allow for the examination of single-loss (SL) properties and RL properties. There are 36 Severe Repetitive Loss properties in the County.

TABLE 4-35 SEVERE REPETITIVE LOSS PROPERTIES IN CUYAHOGA COUNTY

Community	Type	Bldg. Payment	Cont. Payment	Losses	# of RL Properties
Bedford Heights	Other – Nonresidential	$191,752.53	$442,414.37	21	1
Cleveland	Other – Nonresidential	$12,157.79	$286,970.07	4	1
Garfield Heights	Business – Nonresidential	$154,530.90	$31,957.45	5	1
Independence	Assmd Condo	$514,759.74	$210,905.17	20	2
	Business – Nonresidential	$4,632,284.23	$5,309,627.65	62	7
	Other – Nonresidential	$1,016,682.07	$708,312.25	27	4
Lakewood	Single Family	$91,302.54	$35,761.15	5	1
	2-4 Family	$60,803.06	$12,804.12	5	1
Mayfield	Business – Nonresidential	$945,008.88	$0	5	1
Middleburg Heights	Other Residential	$238,864.04	$0	8	2
North Royalton	Single Family	$118,125.51	$19,463.64	7	1
Valley View	Single Family	$1,047,987.12	$226,895.60	81	13
	Other – Nonresidential	$264,347.23	$765,496.10	20	1

NFIP Community Rating System (CRS)

The NFIP Community Rating System is an additional step in the NFIP that local communities can participate in to lower their residents' flood insurance premiums through a percentage amount based off of the credit points the community accumulates. CRS is a voluntary incentive program that recognizes and rewards communities to go above and beyond the minimum requirements of the NFIP. Communities that participate in CRS abide by the three goals of the program:

- Reduce and avoid flood damage to insurable property,
- Strengthen and support the insurance aspects of the National Flood Insurance Program, and
- Foster comprehensive floodplain management.

A participating community in CRS can have different degrees of participation, which is calculated through the credit points the community receives. Communities can earn credit points through the nineteen different of activities completed in the categories of Public Information, Mapping & Regulations, Flood Damage Reduction, and Flood Preparedness. Additional credit points can also be earned by regulating development outside the SFHA, future flood condition assessments, state-based credit, and other activities listed in the CRS Coordinator's Manual. The table below displays the different rate classes, the corresponding discounts, and the credit points required to achieve the rate class.

TABLE 4-36 CRS CREDIT POINT SYSTEM

Rate Class	Discount for SFHA	Discount for Non-SFHA	Credit Points Required
1	45%	10%	4,500+
2	40%	10%	4,000-4,499
3	35%	10%	3,500-3,999
4	30%	10%	3,000-3,499
5	25%	10%	2,500-2,999
6	20%	10%	2,000-2,499
7	15%	5%	1,500-1,999
8	10%	5%	1,000-1,499
9	5%	5%	500-999
10	0	0	0-499

In Cuyahoga County, there are three communities that participate in the NFIP CRS program as of April 2021 according to FEMA. Highland Heights, Orange, and South Euclid all joined the CRS on 10/1/1991.

TABLE 4-37 CUYAHOGA COUNTY COMMUNITIES THAT PARTICIPATE IN CRS

Community Number	Community Name	CRS Entry Date	Current Effective Date	Current Class	% Discount for SFHA	% Discount for Non-SFHA	Status
390110	City of Highland Heights	10/1/1991	10/1/1992	10	0	0	R
390737	Village of Orange	10/1/1991	10/1/2016	7	15	5	C
390131	City of South Euclid	10/1/1991	10/1/2016	8	10	5	C

4.3.8 Flooding Summary

Severe flooding has the potential to cause significant damage along the rivers and small creeks that run throughout the County. Assessing flood damage requires residents throughout the County to remain alert and notify local officials of potential flood prone areas near infrastructure such as roads, bridges, and buildings. While flooding remains a highly likely occurrence for the County, smaller floods caused by heavy rains and inadequate drainage capacity will be more frequent, but not as costly as the large-scale floods which may occur at much less frequent intervals.

4.4. Extreme Temperatures

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Extreme Temperatures	3	0.3	2	0.3	4	0.2	1	0.1	3	0.1	2.7
Moderate Risk Hazard (2.0 – 2.9)											

Climate change may exacerbate the impact of hazardous extreme temperatures. According to the State Hazard Mitigation Plan, extreme heat and heat waves are existing hazards that will be exacerbated by climate change. Heat is the leading weather-related killers in the United States, resulting in hundreds of fatalities each year. Extreme Cold can cause hazardous driving conditions, communications and electrical power failure, community isolation and can adversely affect business continuity. This section provides definitions and profiles for the hazard of extreme heat and extreme cold.

4.4.1 Extreme Temperature Description

Extreme Heat

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

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

Extreme temperatures can result in elevated utility costs to consumers and also can cause human risks. Extremely high temperatures cause heat stress which can be divided into four categories (see Table 4-38). Each category is defined by apparent temperature which is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, heat syncope, heat exhaustion, heatstroke, and death.

Extreme Cold

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

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

Extreme Cold is also responsible for several fatalities each year. Threats, such as hypothermia and frostbite, can lead to loss of fingers and toes or cause permanent kidney, pancreas and liver injury and even death. Major winter storms can last for several days and be accompanied by high winds, freezing rain or sleet, heavy snowfall and cold temperatures. Fifty percent of cold-related injuries happen to people over 60 years of age. More than 75 percent of injuries happen to males, and almost 20 percent occur within the home.

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

4.4.2 Extreme Temperature Location

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

4.4.3 Extent

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

Extremely high temperatures cause heat stress which can be divided into four categories. Each category is defined by apparent temperature. Apparent temperature is the general term for the perceived outdoor temperature, caused by the combined effects of air temperature, relative humidity, and wind speed. Apparent temperature is associated with a heat index value that captures the combined effects of dry air temperature and relative humidity on humans and animals. Major human risks for these temperatures include heat cramps, fainting, heat exhaustion, heatstroke, and death. Note that while the temperatures in Table 4-38 serve as a guide for various danger categories, the impacts of high temperatures will vary from person to person based on individual age, health, and other factors.

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

TABLE 4-38 FOUR CATEGORIES OF HEAT STRESS

Danger Category	Heat Disorders	Apparent Temperature (°F)
I (Caution)	Fatigue possible with prolonged exposure and physical activity.	80 to 90
II (Extreme Caution)	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and physical activity.	90 to 105
III (Danger)	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105 to 130
IV (Extreme Danger)	Heatstroke or sunstroke imminent.	>130

FIGURE 4-18 NWS SEVERE HEAT INDEX

Temperature

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

TABLE 4-39 EXTREME COLD TEMPERATURE AND ASSOCIATED THREAT

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

FIGURE 4-19 NWS WINDCHILL CHART

Temperature (F)

Wind Chill (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	155	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill } (^\circ F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (ºF) V= Wind Speed (mph)

Effective 11/01/01

4.4.4 Historical Occurrences

General Trends

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

According to the NCDC, there have been no documented cases of Extreme Heat in Cuyahoga County. A complete list of extreme temperature events from 1996 to current day can be found in **Appendix B.**

TABLE 4-40 CUYAHOGA COUNTY EXTREME TEMPERATURE EVENTS (JANUARY 1, 2001-MARCH 31, 2021)

Event	Count	Death	Injury	Property Damage	Crop Damage
Extreme Cold/Wind Chill	8	3	0	$ 300,000	$ 0
Excessive Heat	0	0	0	$ 0	$ 0
Total	**8**	**3**	**0**	**$ 300,000**	**$ 0**

Event Narratives

- Cold – **January 15-17, 2009:** A large dome of high pressure with artic air settled into the Ohio Valley between the 16th and 17th of January. In eastern Ohio, western Pennsylvania, northern West Virginia, and Garrett County, Maryland, morning temperatures were between ten below zero to twenty-two below zero. Cuyahoga County saw bitterly cold temperatures for the 15th, 16th, and 17th of January, with morning lows ranging from 7°F to -13°F at Cleveland Hopkins and Cleveland Burke Lakefront Airport. Windchills were reported to be -30°F in the region, closing schools in Cuyahoga County for at least the 15th and 16th.

- Cold – **April 29, 2012:** An unseasonable dip in the temperature caused by a strong high pressure over the upper Ohio Valley caused severe loss in vegetation. About 80% of grape crops were destroyed from the below freezing temperatures for many hours as well as fruit trees suffering loss as well. The temperature remaining in the lower 20°Fs from clear skies and calm winds reported $14,950,000 in property damages during the event.

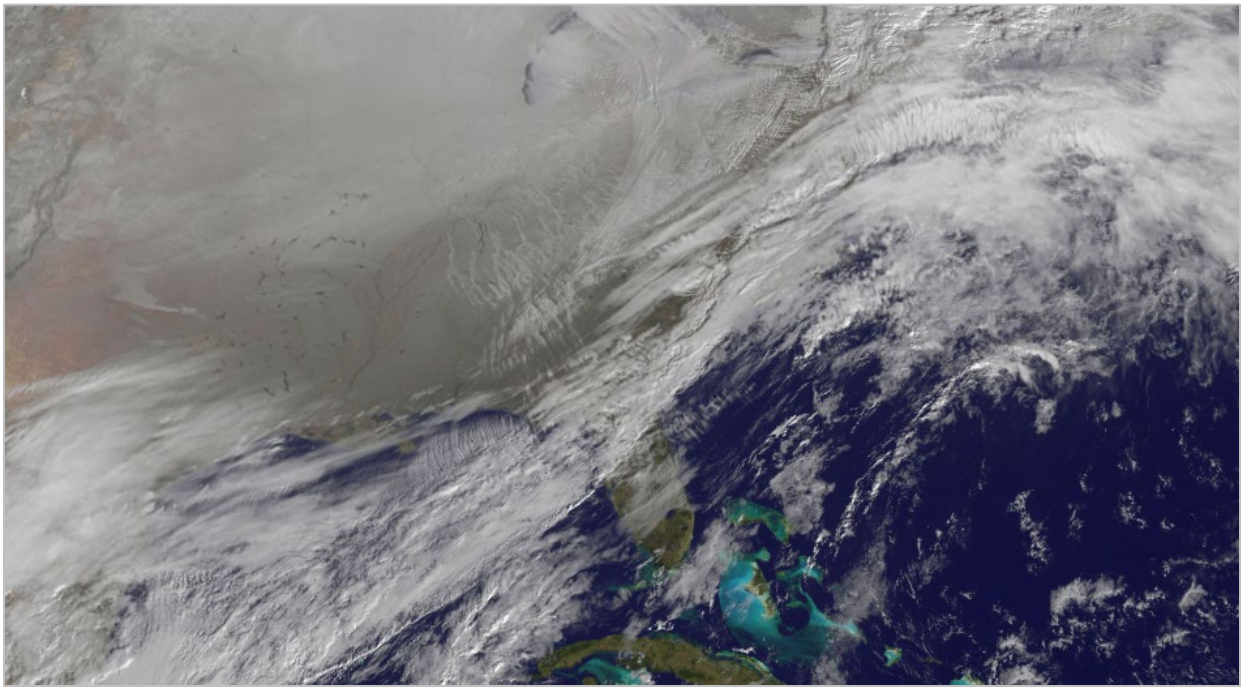
- Cold – **January 6-7, 2014:** Brutal cold weather settled over the area on January 6th and 7th. This event was categorized as a polar vortex. This is a whirling and persistent large area of low pressure, found typically over both North and South poles. The northern polar vortex was pushing southward over western Wisconsin and eastern Minnesota on Monday, Jan. 6, 2014, and brought frigid temperatures to half of the continental United States. Extreme temperatures were reported for much of the US. Cleveland Hopkins Airport reported lows of -11°F and -11°F on January 6th and January 7th. Cleveland Burke Lakefront Airport reported lows of -10°F and -10°F during the polar vortex.

- Cold – **February 20, 2015:** A bitter cold Arctic high-pressure system settled over Cuyahoga County on February 20, 2015 for the second time in a week. Temperatures set records in the morning of the 20th for Cleveland as the morning low of -17°F was recorded – the coldest temperature ever recorded in February. Combined with cold gusts of winds, wind chills of -25°F or colder closed schools in the region.

- Cold – **January 30-31, 2019:** Beginning on January 30, extremely cold temperatures were felt from a low-pressure system settling over the Great Lakes region. Arctic high pressure built up, causing blistering cold temperatures with wind chills ranging from -35°F to -40°F. The temperatures were some of the coldest the region had seen in five years, closing schools in the area for both the 30th and 31st. A water main break occurred in Tremont Neighborhood, flooding nearby streets, cars and property. Three deaths also occurred during the extreme cold event. One man experiencing homelessness passed way from hypothermia in a vacant home in Cleveland; a woman in Olmsted

Township passed away from hypothermia; and a man passed away in Euclid from hypothermia. There were $100,000 reported property damages from the extreme cold event.

FIGURE 4-20 JANUARY 2014 POLAR VORTEX



4.4.5 Probability of Future Occurrences

The probability of Cuyahoga County experiencing an extreme temperature can be difficult to quantify. Climate models suggest summer global temperatures are likely to increase while changes between temperature extremes would be more pronounced. The length of days above 100 degrees may also extend significantly.

The HMPC, based on their own knowledge, concluded that Extreme Temperature events are "Likely" each year. This means that they have between at 10% and 100% chance of happening annually. Reported extreme temperatures events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. Based on the historical record of 8 extreme temperature events from 2001 through 2021, it can reasonably be assumed that extreme temperature events will occur every 2.5 years.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**20 Years**) / (**8 Events**) = **2.5 Years between Events**

The historic frequency indicates that there is a 40% chance of this type of event occurring each year.

4.4.6 Assets Exposed to Extreme Temperatures

Potential Losses

TABLE 4-41 POTENTIAL IMPACTS FROM EXTREME TEMPERATURES

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

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

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

Community Vulnerability

It is evident that extreme temperatures are dangerous and can be potentially life-threatening. Therefore, it is important to understand how many people are exposed to such conditions, and how many buildings exist, where potential problems could arise should power be lost. Extreme cold can cause damage to structures; for example, burst pipes will damage buildings and will necessitate repairs.

All property located within the County is susceptible to the effects of extreme temperatures. While temperature extremes are not usually thought of as damaging to structures, they can make structures unusable. The age of a structure is also important to consider when discussing temperature extremes. Older homes are more susceptible to the effects of temperature extremes, due to the prevalent construction methods used at the time.

According to the 2019 U.S. Census Bureau Estimates, there were approximately 70,399 children under the age of 5, which is equal to about 5.7% of the total population. There were an estimated 229,723 people above the age of 65, equating to about 18.6% of the population.

TABLE 4-42 CUYAHOGA COUNTY POPULAGE AGE ESTIMATES, 2019

Total	Population	Percent
Under 5 years	70,399	5.7%
65 and up	229,723	18.6%

TABLE 4-43 DATE OF BUILDING CONSTRUCTION, OHIO OFFICE OF RESEARCH 2020

Year Built	Percent	Number
Built 1939 or earlier	30.0%	185,812
Built 1940 to 1949	9.5%	58,703
Built 1950 to 1959	20.0%	123,828
Built 1960 to 1969	13.9%	85,961
Built 1970 to 1979	10.0%	61,591
Built 1980 to 1989	5.4%	33,531
Built 1990 to 1999	5.9%	36,504
Built 2000 to 2009	4.2%	26,070
Built 2010 to 2013	0.7%	4,212
Built 2014 or later	0.4%	2,580
Total:	**100%**	**618,792**

Hunger Network Vulnerability to Temperature Extremes

The Hunger Network works to provide hunger relief, health resources, and relief from disasters within Cuyahoga County and has done so for over 25 years. Recent temperature extremes have had a significant impact on the most vulnerable of their network. Recent events have pushed their existing shelter network to its limits. As weather events continue to change, the Hunger Network has realized a need to expand their current shelter operation to account for possible future events.

4.4.7 Land Use & Development Trends

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

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

Regulatory Environment

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

4.4.8 Temperature Extreme Summary

Temporary periods of extreme hot or cold temperatures typically do not have significant environmental impact. However, prolonged periods of hot temperatures may be associated with drought conditions and can damage or destroy vegetation, dry up rivers and streams, and reduce water quality. Prolonged exposure to extremely cold temperatures can kill wildlife and vegetation and poses a potentially grave danger to the residents of Cuyahoga County.

4.5. Severe Winter Storms

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Severe Winter Storms	3	0.3	2	0.3	4	0.2	1	0.1	3	0.1	**2.7**
Moderate Risk Hazard (2.0 – 2.9)											

4.5.1 Severe Winter Storm Description

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

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

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

Lake effect snow occurs in regions that are near the Great Lakes. Most common during late fall and winter, lake effect snow is the result of cold air, which generally originates in Canada, travels along the unfrozen and warmer Great Lakes, and develops narrow snow systems that are the result of warm and moist air rising in the atmosphere to create clouds that produce 2 to 3 inches of snow per hour, or greater amounts.

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

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

Extreme Cold, in extended periods, although infrequent, could occur throughout the winter months in the County. While heating systems are mostly able to compensate for the cold outside, people limit their time outside during extreme cold conditions. Common complaints usually include pipes freezing and cars refusing to start. When cold temperatures and wind combine, dangerous wind chills can develop. A full hazard profile regarding extreme temperatures can be found in Section 4.4.

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

The State of Ohio has an extensive history of severe winter storms. In the winter of 2005, the state was hit by a series of winter storms. These storms included ice storms, followed by unseasonably high temperatures and high rainfall totals, all of which resulted in extensive flooding and mudslides. This series of storms resulted in Presidential Declaration FEMA-DR-1580-OH. This declaration provided over $140 million dollars in recovery funds. These funds included Individual assistance, Public assistance, Hazard Mitigation Grant Funds, and a state match to the federal hazard mitigation funds.

Winter storms are extremely difficult to predict in advance, but they can be monitored and tracked once they develop. Understanding the historical frequency, duration, and spatial extent of winter storms assists in determining the likelihood and potential severity of future occurrences. The characteristics of past severe winter events provide benchmarks for projecting similar conditions into the future.

4.5.2 Winter Storm Location

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

4.5.3 Extent

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

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

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

TABLE 4-44 WINTER STORM WATCH DEFINITIONS

Watch Type	Description
Blizzard Watch	Conditions are favorable for a blizzard event in the next 24 to 72 hours. Sustained wind or frequent gusts greater than or equal to 35 mph will accompany falling and/or blowing snow to frequently reduce visibility to less than 1/4 mile for three or more hours.
Lake Effect Snow Watch	Conditions are favorable for a lake effect snow event to meet or exceed local lake effect snow warning criteria in the next 24 to 72 hours. Widespread or localized lake induced snow squalls or heavy snow showers which produce snowfall accumulation to 7 or more inches in 12 hours or less. Lake effect snow usually develops in narrow bands and impacts a limited area within a county or forecast zone. Use "mid-point" of snowfall range to trigger a watch (i.e. 5 to 8 inches of snow = watch).
Wind Chill Watch	Conditions are favorable for wind chill temperatures to meet or exceed local wind chill warning criteria in the next 24 to 72 hours. Wind chill temperatures may reach or exceed -25°F.
Winter Storm Watch	Conditions are favorable for a winter storm event (heavy sleet, heavy snow, ice storm, heavy snow and blowing snow or a combination of events) to meet or exceed local winter storm warning criteria in the next 24 to 72 hours. Criteria for snow is 7 inches or more in 12 hours or less; or 9 inches or more in 24 hours covering at least 50 percent of the zone or encompassing most of the population. Use "mid-point" of snowfall range to trigger a watch (i.e. 5 to 8 inches of snow = watch). Criteria for ice is 1/2 inch or more over at least 50 percent of the zone or encompassing most of the population.

- **Advisory** - Advisories are issued when a hazardous winter storm event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). An advisory is for less serious conditions that cause significant inconvenience and, if caution is not exercised, could lead to situations that may threaten life and/or property. Advisories are issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast.

- Table 4-45 shows the different type of winter Storm advisories and the conditions that it takes for them to be met.

TABLE 4-45 WINTER STORM ADVISORY DEFINITIONS

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

- **Warning** - Warnings are issued when a hazardous winter storm event is occurring, is imminent, or has a very high probability of occurrence (generally greater than 80%). A warning is used for conditions posing a threat to life or property. Warnings are issued using the WSW Winter Weather Message product and will appear as a headline in some text products such as the Zone Forecast.

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

TABLE 4-46 WINTER STORM WARNING DEFINITIONS

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

4.5.4 Historical Occurrences

General Trends

Since 2001, there have been 87 winter storm events according to NOAA, resulting in over $34 million in property damage and 10 deaths. There have been no reported crop damages or injuries from the winter storms events according to the NOAA. A complete list of winter storm events from 1996 to current day can be found in **Appendix B**.

TABLE 4-47 WINTER STORM EVENTS IN CUYAHOGA COUNTY (JANUARY 1, 2001-MARCH 31, 2021)

Event	Count	Deaths	Property Damage	Crop Damage	Avg Property Damage	Avg Crop Damage
Blizzard	0	0	$ 0	$ 0	N/A	N/A
Heavy Snow	17	0	$ 2,620,000	$ 0	$154,117	$0
Lake Effect Snow	20	0	$ 5,815,000	$ 0	$290,750	$0
Ice Storm	1	0	$ 1,300,000	$ 0	$1,300,000	$0
Winter Storm	40	0	$ 24,650,000	$ 0	$616,250	$0
Extreme Cold/Wind Chill	8	3	$ 300,000	$ 0	$37,500	$0
Cold/Wind Chill	1	7	$ 0	$ 0	$0	$0
Grand Total	87	10	$ 34,685,000	$ 0		

FIGURE 4-21 CUYAHOGA COUNTY BLIZZARD EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

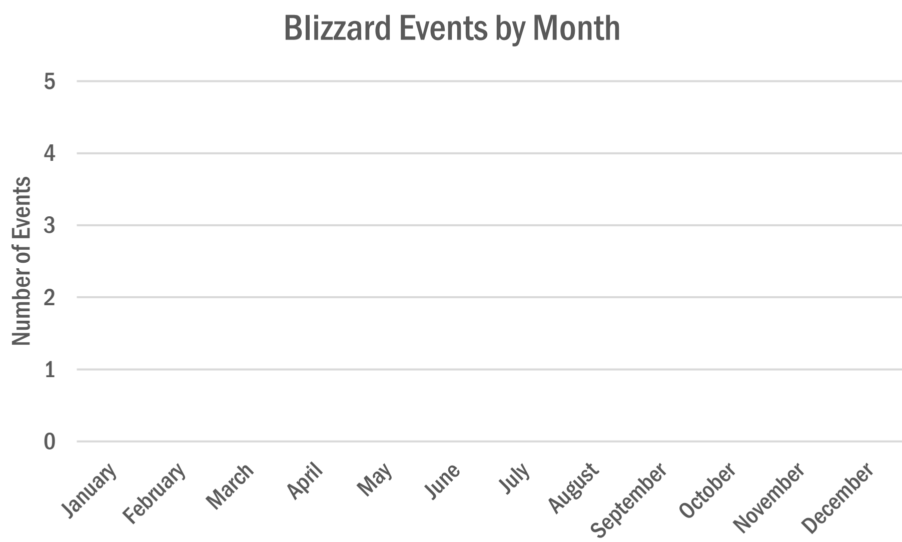


FIGURE 4-22 CUYAHOGA COUNTY HEAVY SNOW EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

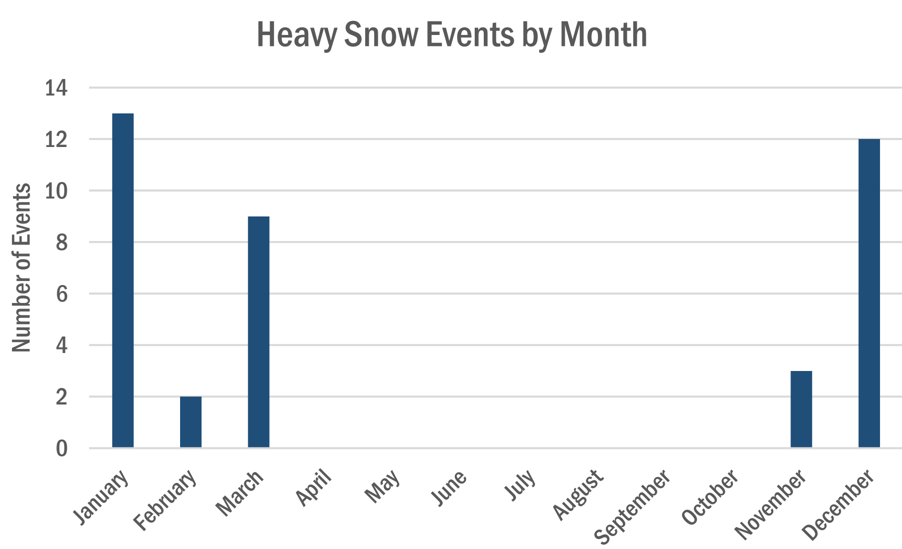


FIGURE 4-23 CUYAHOGA COUNTY LAKE EFFECT SNOW EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

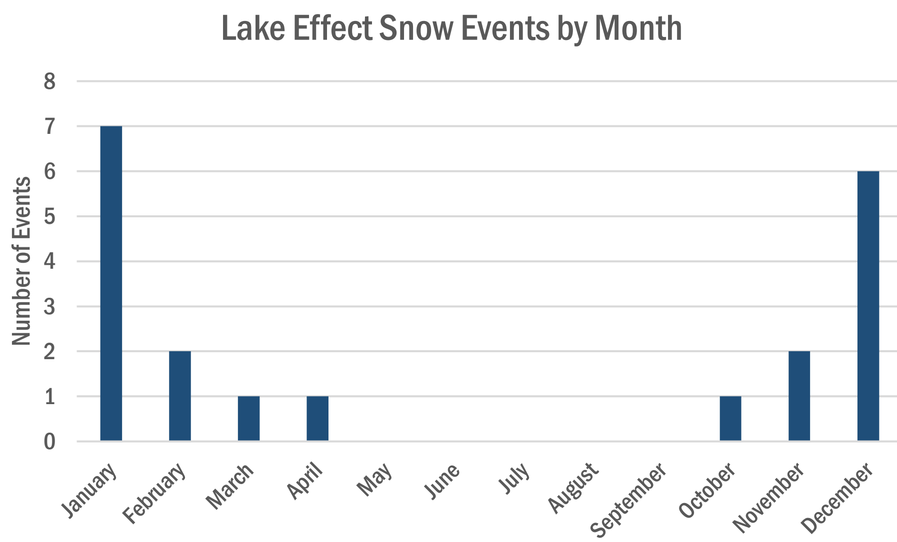


FIGURE 4-24 CUYAHOGA COUNTY ICE STORM EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

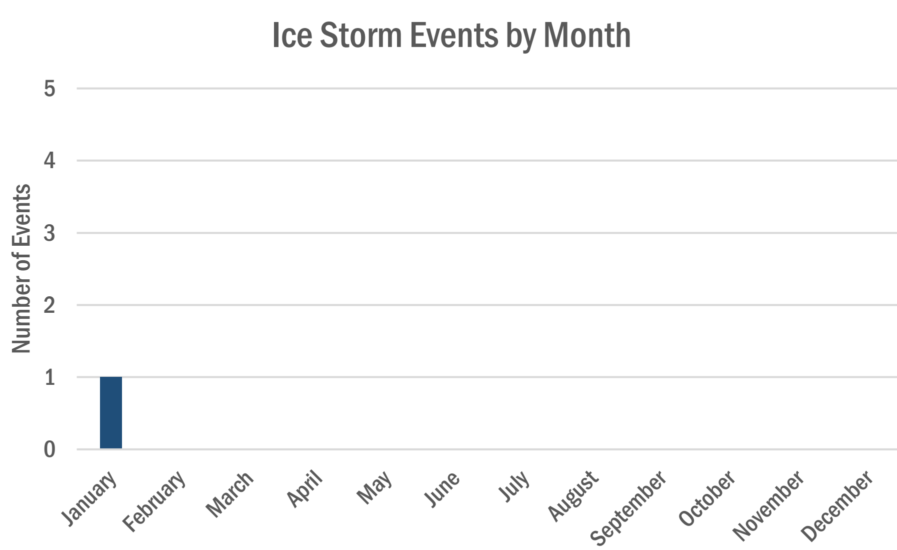


FIGURE 4-25 CUYAHOGA COUNTY WINTER STORM EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

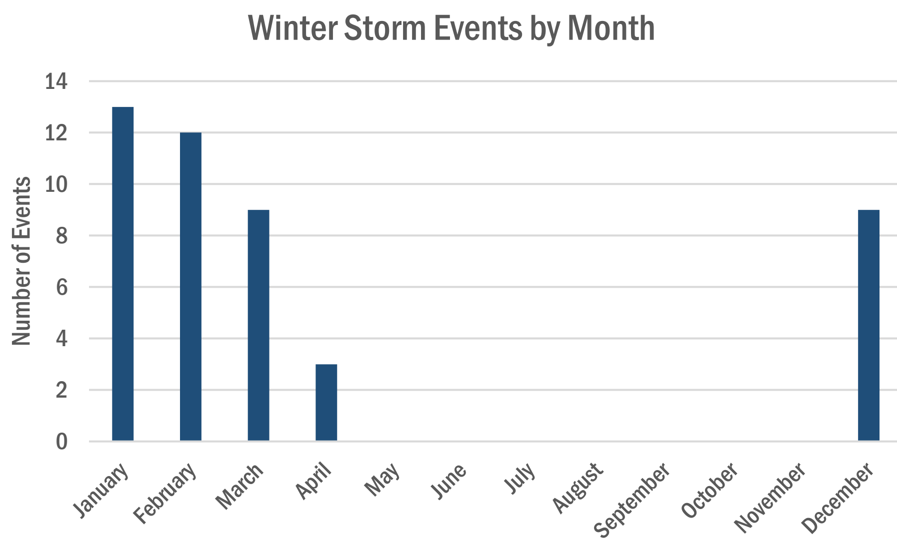


FIGURE 4-26 CUYAHOGA COUNTY EXTREME COLD/WIND CHILL EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

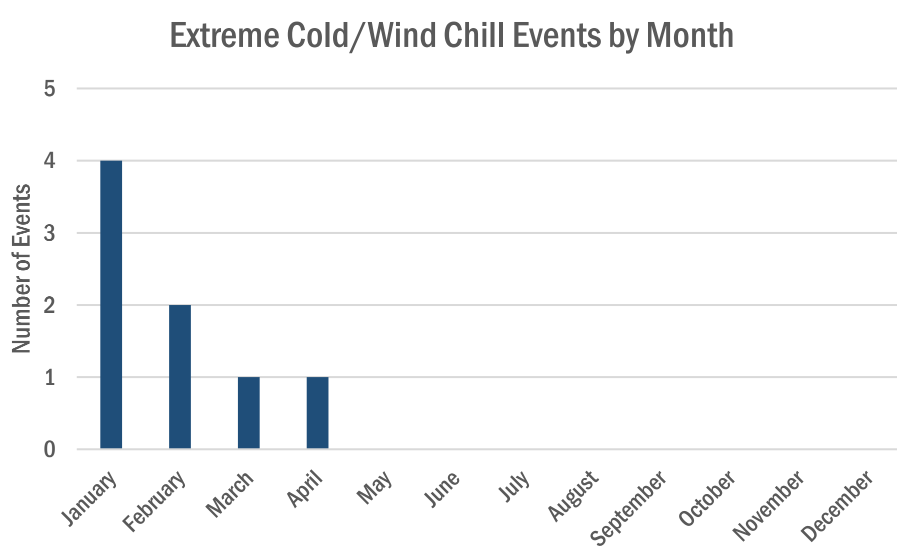
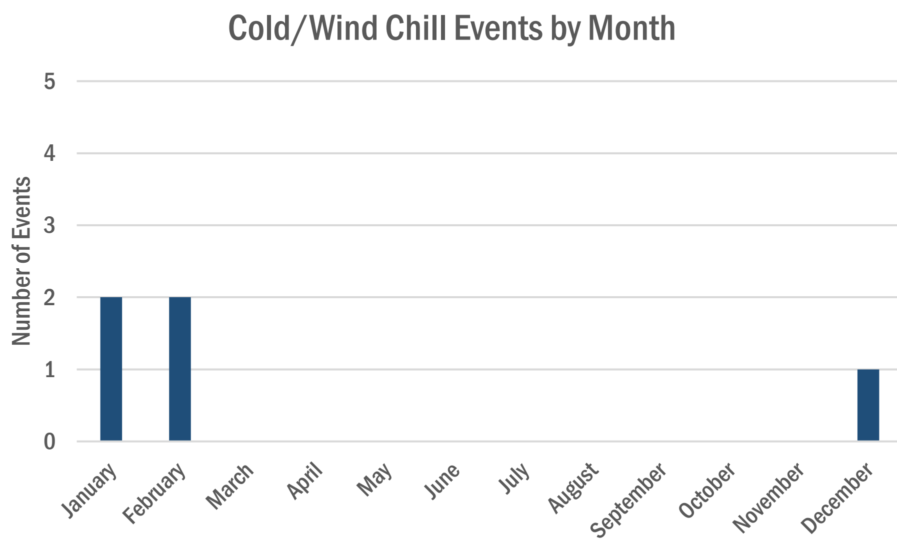


FIGURE 4-27 CUYAHOGA COUNTY COLD/WIND CHILL EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021



Since 1953, one federally declared severe winter storm events has occurred in Cuyahoga County, as shown in Table 4-48. According to FEMA Declarations and Ohio Emergency and Disaster Proclamations (1953 to present), the event included blizzards and snowstorms.

TABLE 4-48 DECLARED WINTER DISASTERS

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
EM-3055	1/26/1978	Blizzards & Snowstorms	-	-

Event Narratives

- **Ice Storm – January 5-6, 2005:** An ice storm on January 5th and 6th brought $1.3 million in reported property damages to Cuyahoga County. No injuries, deaths, or crop damages were reported from the event. Mixtures of rain and snow turned into freezing rain in the morning of the 5th. As freezing rain continued throughout the day and into the morning of the 6th, ice accumulated greater than 0.75 inches in some locations with as little as 0.25 inches in others. Scattered power outages were reported in areas near Lake Erie. The region in which the storm hit reported approximately 1 million people losing power with counties reporting at minimum $1 million in damages.

- **Heavy Snow – January 1-2, 2014:** A system of heavy snow developed from an area of low pressure moving east through the Tennessee Valley just before midnight on January 1st. As the storm moved into the Lake Erie region, the system developed intense snowfalls, with visibilities dropping below a quarter mile for several hours. Snowfall rates were near two inches an hour, and the evening commute on the 2nd was affected with dozens of accidents reported in Cleveland. After the heavy snow ceased, wind gusts created drifting conditions. The Cleveland metropolitan area reported six to eight inches of snow with the majority of the snow falling between 1 and 6 PM on the 2nd. Cuyahoga County reported $250,000 in property damages from the event.

- **Lake Effect Snow – December 15, 2016:** As a cold front moved across northern Ohio, cold westerly winds behind the front developed a lake effect snow shower system to develop. Because the system was moving extremely slow through the northern Ohio region, snowfall amounts accumulated quickly, causing visibility to drop below a half a mile at Cleveland Hopkins Airport around 6 AM. Cuyahoga County reported total snowfall amounts ranging from 7.8 inches at Kamm's Corners to 8.5 inches in Lakewood. $500,000 in property damages were reported with no crop damage, injuries, or deaths.
- **Winter Storm – March 1-3, 2018:** The winter storm developed as low pressure moved through the Ohio Valley on 1st. Initially, the precipitation fell as rain, but cold air blowing through the region changed the precipitation into snowfall in the early evening. Snow that began as light to moderate accumulation changed to heavy snow with visibility at 0.5 miles or less. The winter storm also brought wind gusts around 45 MPH to the maximum 53 MPH reported at Cleveland Burke Lakefront Airport. Cuyahoga County reported 6.0-8.0 inches of snowfall and $250,000 in property damages. No crop damages, injuries, or deaths were reported.
- **Cold/Wind Chill – February 1-17, 2021:** During the first half of February, seven people passed away due to exposure to cold weather and inadequate housing in Cuyahoga County, according the Cuyahoga County Medical Examiner Office. The first half of February brought temperatures below freezing with many of the nights have single digit temperatures with wind chills below zero.

4.5.5 Probability of Future Occurrences

Reported winter events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. Winter storms have been recorded 87 times in the past 20 years (since 2001), a frequency of 0.23 years between winter storm events.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**20 Years**) / (**87 Events**) = **0.23 Years Between Events**

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

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

4.5.6 Assets Exposed to Severe Winter Storms

Potential Losses

TABLE 4-49 POTENTIAL IMPACTS FROM WINTER STORMS

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

Community Vulnerability

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

A winter storm can adversely affect roadways, utilities, business activities, and can cause loss of life, frostbite and freezing conditions. They can result in the closing of secondary roads, particularly in rural locations, loss of utility services and depletion of heating supplies.

Environmental impacts often include damage to shrubbery and trees due to heavy snow loading, ice build-up, and/or high winds which can break limbs or even bring down large trees. Gradual melting of snow and ice provides excellent groundwater recharge; however, high temperatures following a heavy snowfall can cause rapid surface water runoff and severe flash flooding.

Winter storms do not generally have a negative impact on structures. While cold temperatures and power losses can render a structure uninhabitable for a time, they are unlikely to cause structural damages. However, snow and ice accumulation can impact structures and infrastructure. Older structures in particular are more susceptible to the impacts from winter storms due to older construction and insulation methods. Most structures, including the County's critical facilities, could suffer damage from snow load on rooftops and large deposits of ice. Those facilities with back-up generators are better equipped to handle a severe weather situation should the power go out, even if only certain systems are powered by that generator.

In addition to the infrastructure of the County, the population needs to be taken into consideration. The County is home to an estimated 1,235,072 people according to the 2019 U.S. Census Estimates. At particular risk are elderly individuals. The US Census Bureau estimates that approximately 18.6% of the County's population, or 229,723 individuals, are above the age of 65 and at risk of severe winter storms.

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

A timely forecast may not be able to mitigate property loss but could reduce the casualties and associated injury. In severe winter storm events, buildings are vulnerable to widespread utility disruptions, including loss of heat and electricity, as well as building collapse or damage from downed trees. Cuyahoga County is also subject to outages resulting from damages to the electrical grid in other parts of the state.

Winter storms affect the entirety of Cuyahoga County, as well as all communities and jurisdictions, and all above-ground structures and infrastructure. Although losses to structures are typically minimal and covered by insurance, there can be impacts with lost time, maintenance costs, and contents within structures.

4.5.7 Land Use & Development Trends

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

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

Regulatory Environment

The jurisdictions within Cuyahoga County enforce the Ohio Building Code and Residential Code of Ohio that require structures to be able to withstand the identified snow loads, wind speeds, seismic design category, damage from weathering, damage from frost line depth, damage from termites, damage from decay, winter design temperature, ice shield, flood hazards, air freezing index, and mean annual temperature.

4.5.8 Winter Storm Summary

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

4.6. Tornado

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Tornado	3	0.3	3	0.3	2	0.2	4	0.1	1	0.1	2.7
Moderate Risk Hazard (2.0 – 2.9)											

4.6.1 Tornado Description

A **tornado** is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes result from hurricanes or tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of high wind velocities and wind-blown debris. According to the National Weather Service, tornado wind speeds can range between 30 to more than 300 miles per hour.

FIGURE 4-28 EXAMPLE OF A TORNADO

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

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

4.6.2 Tornado Location

Tornado events are region-wide events that can affect the entirety of Cuyahoga County. All communities are affected during these occurrences. Tornadoes can touch down in any location without any way to predict where they will occur. Tornado watches and warnings are issued for regions in the shape of a polygon that reflects the path of the expected tornado.

4.6.3 Extent

The Enhanced Fujita Scale, also known as the “EF-Scale,” measures tornado strength through its associated damages and is the current scale used to define the intensity of a tornado in the United States. The EF-Scale is an update to the earlier Fujita scale that was published in 1971, which is defined in the first table below. Both the Fujita Scale and Enhanced Fujita Scale classify United States tornadoes into six intensity categories, based upon the estimated maximum winds occurring within the wind vortex. The EF-Scale, defined in the second table below, has become the definitive metric for estimating wind speeds within tornadoes based upon the damage done to buildings and structures since it was implemented through the National Weather Service in 2007.

TABLE 4-50 FUJITA SCALE AND ASSOCIATED DAMAGE

Fujita Scale Number	Wind Speed (MPH)	Type of Damage Possible
F0	< 73	**Light damage:** Some damage to chimneys, branches broken off trees, shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	**Moderate damage:** The lower limit is the beginning of hurricane wind speed; peels surface off roofs, mobile homes pushed off foundations or overturned, moving vehicles pushed off the roads, attached garages may be destroyed.
F2	113-157	**Considerable damage:** Roofs torn off frame houses, mobile homes demolished, boxcars overturned, large trees snapped or uprooted, high-rise windows broken and blown in, light object missiles generated.
F3	158-206	**Severe damage:** Roofs and some walls torn off well-constructed homes, trains overturned, most trees in forests uprooted, heavy cars lifted off the ground and thrown.
F4	207-260	**Devastating damage:** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
F5	261-318	**Incredible damage:** Strong frame houses lifted off of foundations and carried considerable distances to disintegrate, automobile-sized missiles fly through the air farther than 110 yards, trees debarked, steel-reinforced concrete structures badly damaged, skyscrapers toppled.

TABLE 4-51 ENHANCED FUJITA SCALE AND ASSOCIATED DAMAGE

EF-Scale Number	Wind Speed (MPH)	Type of Damage Possible
EFO	**65-85**	**Minor damage**: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.
EF1	**86-110**	**Moderate damage**: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	**111-135**	**Considerable damage**: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	**136-165**	**Severe damage**: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	**166-200**	**Devastating damage**: Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	**>200**	**Extreme damage**: Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (300 ft.); steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

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

TABLE 4-52 SPC INSTITUTIONAL BUILDING DAMAGE INDICATORS

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

Source: Storm Prediction Center, 2009

TABLE 4-53 SPC EDUCATIONAL INSTITUTIONS (ELEMENTARY) DAMAGE INDICATORS

Damage Description	Wind Speed Range (Expected, in Parentheses)
Threshold of visible damage	55-83 MPH (68 MPH)
Loss of roof covering (<20%)	66-99 MPH (79 MPH)
Broken windows	71-106 MPH (87 MPH)
Exterior door failures	83-121 MPH (101 MPH)
Uplift of metal roof decking; significant loss of roofing material (>20%); loss of rooftop HVAC	85-119 MPH (101 MPH)
Damage to or loss of wall cladding	92-127 MPH (108 MPH)
Collapse of tall masonry walls at gym, cafeteria, or auditorium	94-136 MPH (114 MPH)
Uplift or collapse of light steel roof structure	108-148 MPH (125 MPH)
Collapse of exterior walls in top floor	121-153 MPH (139 MPH)
Most interior walls of top floor collapsed	133-186 MPH (158 MPH)
Total destruction of a large section of building envelope	163-224 MPH (192 MPH)

Source: Storm Prediction Center, 2009

TABLE 4-54 SPC METAL BUILDING SYSTEMS DAMAGE INDICATORS

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

Source: Storm Prediction Center, 2009

TABLE 4-55 SPC ELECTRIC TRANSMISSION LINES DAMAGE INDICATORS

Damage Description	Wind Speed Range (Expected, in Parentheses)
Threshold of visible damage	70-98 MPH (83 MPH)
Broken wood cross member	80-114 MPH (99 MPH)
Wood poles leaning	85-130 MPH (108 MPH)
Broken wood poles	98-142 MPH (118 MPH)

Source: Storm Prediction Center, 2009

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

4.6.4 Historical Occurrences

General Trends

The County may experience intense winds from thunderstorms, tornadoes, and even the remnants of hurricanes and tropical storms. Tornadoes can occur any time of the year, though, peak tornado occurrences are in March through July as past county records indicate. The last tornado event the County experienced was in 2019. A complete list of tornado events from 1950 to current day can be found in **Appendix B**.

FIGURE 4-29 CUYAHOGA COUNTY TORNADO EVENTS BY MONTH, JANUARY 1, 1950-MARCH 31, 2021

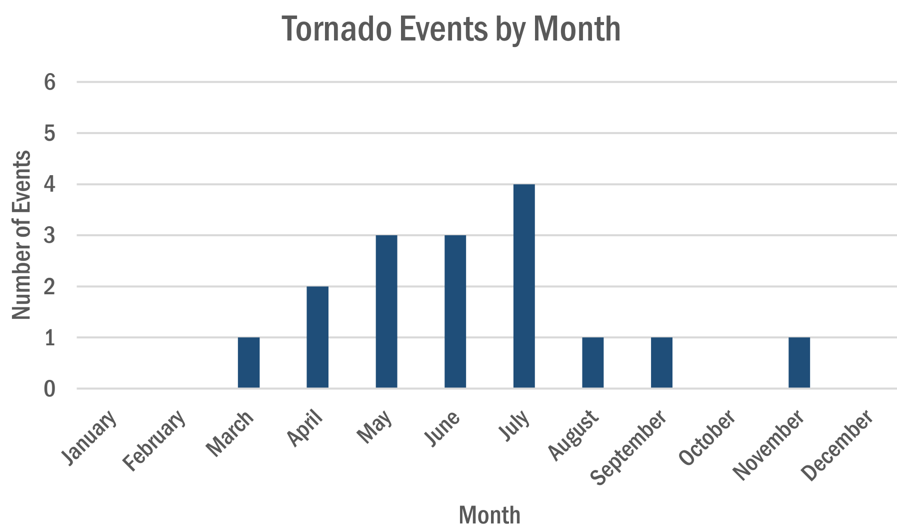


TABLE 4-56 TORNADO EVENTS IN CUYAHOGA COUNTY (JANUARY 1, 2001-MARCH 31, 2021)

Location	Date	Time	Mag	Deaths	Injuries	Property Damage	Crop Damage
Solon	11/10/2002	7:08 PM	F1	0	0	$ 6,800,000	$ 0
Lyndhurst	7/20/2013	2:35 AM	EF1	0	0	$ 350,000	$ 0
Oakwood	6/16/2019	2:23 PM	EF1	0	0	$ 10,000	$ 0

Event Narratives

- **June 8, 1953:** A tornado developed on the border of Cuyahoga County and Lorain County where I-80 intersects the border. Building into a magnitude F4 tornado, it traveled 15.6 miles with an average width of 33 yards. Six people were killed, 300 people were injured, and no crop or property damages were reported from the tornado event.

- **April 11, 1965:** An F4 tornado originating in Lorain County traveled approximately 8.6 miles into Cuyahoga County with an average width of 400 yards. $25,000,000 in property damages were reported and no crop damages. One hundred people were injured in the event and one person was killed during the tornado.

- **May 2, 1983:** An F3 tornado touched down in Broadview Heights and traveled through Brecksville, Bedford Heights, and Solon for a total of 12 miles and an average width of 100 yards. Twenty-five people were injured, and one death resulted from the tornado when debris fell into a bedroom a woman was sheltering in. $25 million in property damage was reported from approximately twenty-five large homes being completely destroyed and one hundred homes damaged.

- **November 10, 2002:** Originating in Summit County, an F1 tornado entered Cuyahoga County south of Glenwillow. The tornado traveled four miles through the County with an approximate width of 100 yards. The path of the tornado included open fields, Solon, subdivisions, Solon Middle School, and cars parked along the roads in the area. It is estimated that 100 homes were damaged, dozens of cars were destroyed, hundreds of trees suffered impacts, and power lines were downed. No injuries, deaths, or crop damages were reported, but there was $6.8 million in property damage reported, with over $2 million of the damages coming from the middle school due to roof and structural damages.
- **June 16, 2019:** Developed from a stationary front thunderstorm interacting with a northward moving boundary, an EF-1 tornado touched down east of the intersection of I-271 and I-480 near Oakwood. Several trees were snapped and uprooted in the area as the tornado traveled approximately two miles east before it lifted off the ground. No injuries, fatalities, or crop damages were reported; $10,000 of property damage was reported from the tornado event.

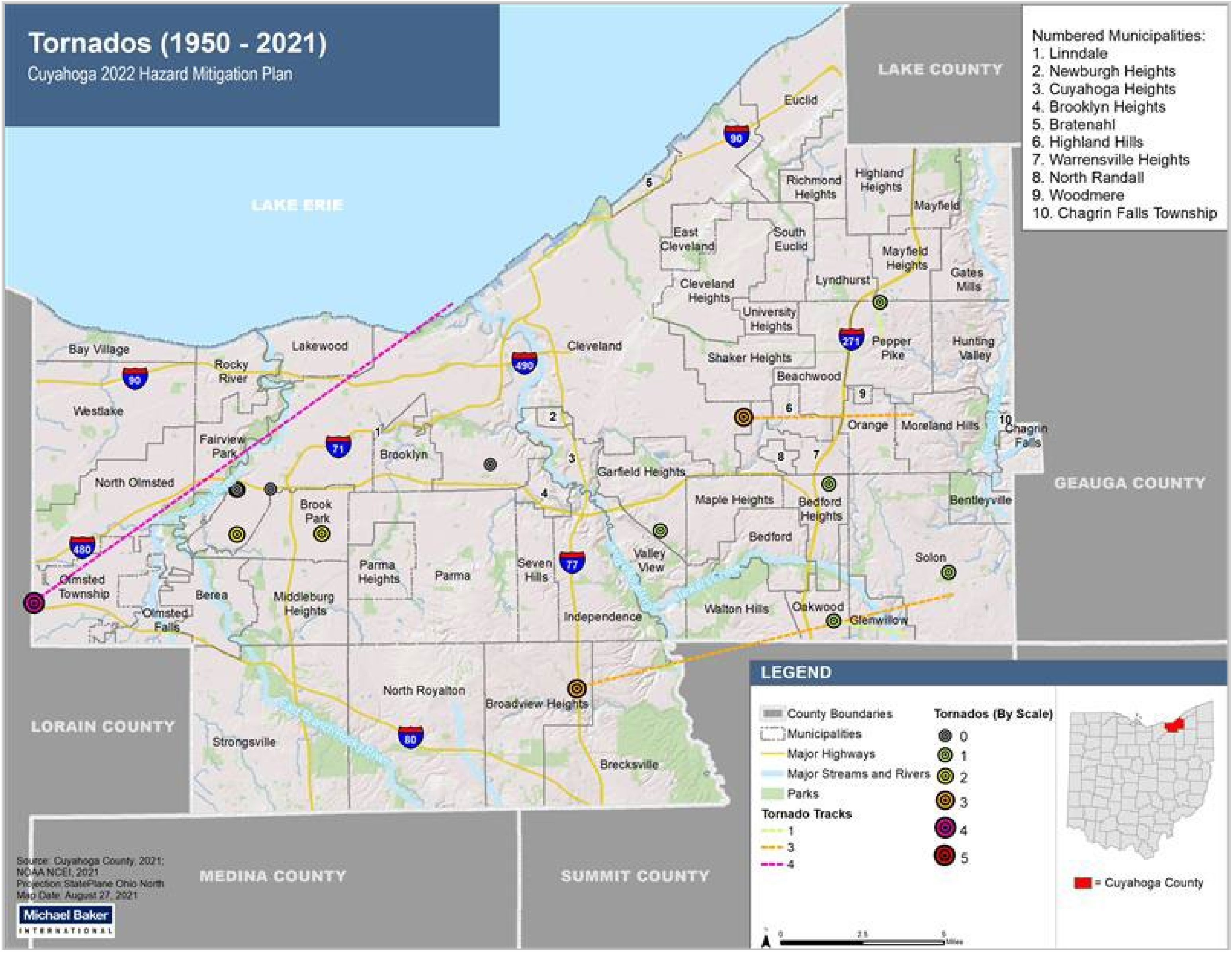
Cuyahoga County has been directly impacted by 16 tornadoes since 1950. The County has been a part of 7 disaster declarations where tornadoes were a factor in the overall emergency.

TABLE 4-57 DECLARED DISASTERS AFFECTING CUYAHOGA COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
DR-191	4/14/1965	Tornadoes & Severe Storms	-	-
DR-266	7/15/1969	Tornadoes, Severe Storms & Flooding	-	-
DR-480	9/11/1975	Winds, Tornadoes, Heavy Rains & Flooding	-	-
DR-951	8/4/1992	Severe Storms, Tornadoes & Flooding	-	-
DR-1444	11/18/2002	Severe Storms and Tornadoes	$ 0	$ 579,893.02*
DR-1484	8/1/2003	Tornadoes, Flooding, Severe Storms, and High Winds	$ 10,875,976.79*	$ 74,781,195.51*
DR-1651	7/2/2006	Severe Storms, Tornadoes, Straight Line Winds, and Flooding	-	$ 8,830,355.16*

*Indicates data from FEMA's Disaster Declarations website. Totals provided on the webpage are for total funds delegated to all counties within the declared disaster rather than just for Cuyahoga County.

FIGURE 4-30 HISTORICAL TORNADOES IN CUYAHOGA COUNTY



4.6.5 Probability of Future Occurrences

Reported tornado events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a tornado event, although infrequent, can be difficult to quantify, but based on historical record of 3 tornado events since 2001, it can reasonably be assumed that this type of event has occurred once every 6.67 years from 2001 through 2021.

(2021 CY) - (2001 HY) = 20 Years on Record

(20 Years) / (3 Events) = 6.67 Years Between Events

The historic frequency indicates that there is a 15% chance of this type of event occurring each year.

The HMPC, based on their knowledge, determined that tornadoes are “Likely,” meaning there is between a 10% and 100% of these events occurring each year.

4.6.6 Assets Exposed to Tornadoes

Potential Losses

TABLE 4-58 POTENTIAL IMPACTS FROM TORNADOES

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

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

Community Vulnerability

All assets located in Cuyahoga County can be considered at risk from tornadoes and wind events. This includes 100% of the County’s population and all critical facilities, structures, and infrastructure. Mobile homes can have a heightened vulnerability to strong wind and tornado events if they are not anchored in place. There are an estimated 959 mobile homes within Cuyahoga County. Cleveland has the highest number of mobile homes, with 468 structures on mobile home parcels. Bedford Heights has the second highest number of structures on mobile home parcels with 276, and Olmsted Township has 102 mobile homes. Glenwillow has the largest percentage of mobile homes in relation to total structures, with 25% of its total structures are mobile home parcels. Bedford Heights has the second highest percentage, with 12% of its total structures are mobile home parcels. Oakwood has the third highest percentage, with 4% of its total structures are mobile home parcels.

TABLE 4-59 ESTIMATED MOBILE HOMES PER MUNICIPALITY IN CUYAHOGA COUNTY

Municipality	Total Structures	Structures on Mobile Home Parcels	Percent Mobile Homes
Bay Village	4092	0	0%
Beachwood	2,352	0	0%
Bedford	3,562	0	0%
Bedford Heights	2,284	276	12%
Bentleyville	203	0	0%
Berea	4561	0	0%
Bratenahl	326	0	0%
Brecksville	3596	0	0%
Broadview Heights	4818	0	0%
Brook Park	5,087	0	0%
Brooklyn	2793	0	0%
Brooklyn Heights	520	0	0%
Chagrin Falls	1,126	0	0%
Chagrin Falls Township	27	0	0%
Cleveland	99020	468	0%
Cleveland Heights	10,733	0	0%
Cuyahoga Heights	215	0	0%
East Cleveland	5,169	0	0%
Euclid	11,074	0	0%
Fairview Park	4164	0	0%
Garfield Heights	7757	7	0%
Gates Mills	650	0	0%
Glenwillow	239	60	25%
Highland Heights	2,187	0	0%
Highland Hills	115	0	0%
Hunting Valley	150	0	0%
Independence	2,088	0	0%
Lakewood	11,206	0	0%
Linndale	45	0	0%
Lyndhurst	3,835	0	0%
Maple Heights	6618	0	0%
Mayfield	869	0	0%
Mayfield Heights	3786	0	0%
Middleburg Heights	4,080	0	0%
Moreland Hills	916	0	0%
Newburgh Heights	568	0	0%
North Olmsted	7,835	0	0%
North Randall	145	0	0%

Municipality	Total Structures	Structures on Mobile Home Parcels	Percent Mobile Homes
North Royalton	6,993	0	0%
Oakwood	1,096	46	4%
Olmsted Falls	2,177	0	0%
Olmsted Township	3,465	102	3%
Orange	863	0	0%
Parma	20,666	0	0%
Parma Heights	4,595	0	0%
Pepper Pike	1652	0	0%
Richmond Heights	2,254	0	0%
Rocky River	4622	0	0%
Seven Hills	3351	0	0%
Shaker Heights	5839	0	0%
Solon	5671	0	0%
South Euclid	5852	0	0%
Strongsville	11101	0	0%
University Heights	2896	0	0%
Valley View	660	0	0%
Walton Hills	669	0	0%
Warrensville Heights	2,703	0	0%
Westlake	7,590	0	0%
Woodmere	165	0	0%
Grand Total	**313,691**	**959**	**0%**

4.6.7 Land Use & Development Trends

Improved and consistent building codes have been considered as a key measure to mitigate life and property losses associated with tornadoes and wind events. All of Cuyahoga County property is equally at risk to tornado damage, and there are no locations of high-risk exposure.

Regulatory Environment

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

4.6.8 Tornadoes Summary

It's difficult to separate the various wind components that cause damage from other wind-related natural events that often occur to generate tornadoes. For example, hurricanes with intense winds often spawn numerous tornadoes or generate severe thunderstorms producing strong, localized downdrafts. Due to this difficulty, tornadoes are difficult to predict, and the entire County is subject to all categories of windstorms.

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

4.7. Earthquakes

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Seismic Activity	2	0.3	2	0.3	3	0.2	4	0.1	1	0.1	**2.3**
Moderate Risk Hazard (2.0 – 2.9)											

4.7.1 Earthquake Description

Cuyahoga County has a highly varied terrain that is conducive to several types of hazards relating to the geography and topography. Much of the land is highly uneven, making it conducive to landslides. There is a fault line, Middleburg Fault, located in the western portion of the County, and several fault lines that are located east and south of the County, making Cuyahoga County susceptible to earthquakes and earthquake impacts. The Akron Magnetic Boundary, located just outside of Cuyahoga County, is one of the two major centers of seismic activity in Ohio.

Earthquake Characteristics

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

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

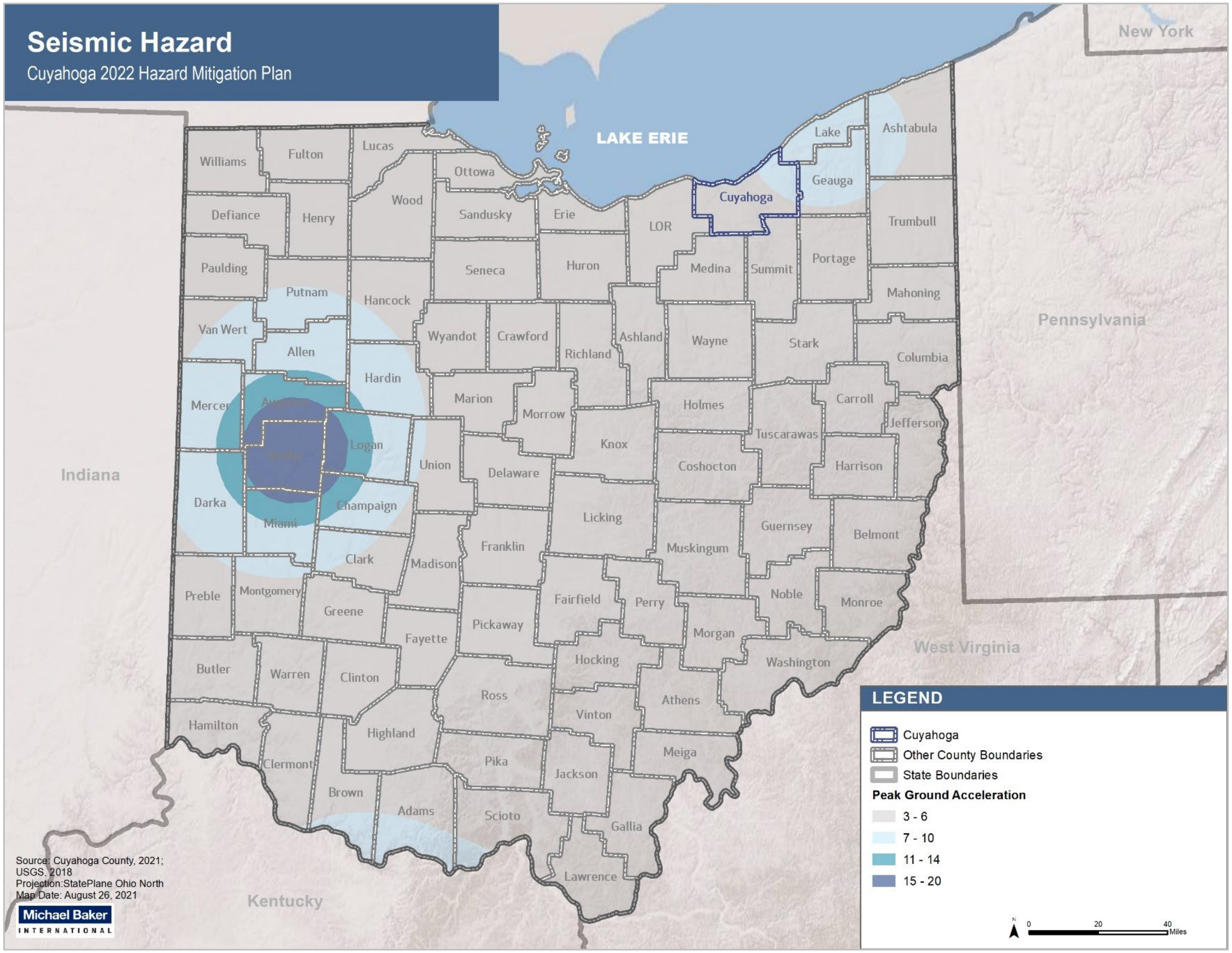
Ohio lies on the outermost boundaries of the New Madrid fault, centrally located at New Madrid, Missouri. This particular fault has created significant activity over the last 200 years. The most intense activity occurred in the years 1811-1812. Two earthquakes estimated to be 7's on the Richter scale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

Ohio has recorded 300 earthquakes with a magnitude of 2.0 or greater since 1776. Of these earthquakes, 15 were reported to have caused noticeable to moderate damage statewide. Two (2) major centers of seismic activity in Ohio are 1) the Anna Seismogenic Area located in Shelby and Auglaize Counties, and 2) the northeast area of the state on the eastern side of Lake Erie, which is referred to as the Akron Magnetic Boundary. The Anna area has been home to 40 earthquakes, while northeastern Ohio has recorded over 100. None of these earthquakes were reported to cause major damage or loss of life. Most sources in the geology science predict that the largest magnitude earthquake that might occur in the state of Ohio would register no higher than five (5). Predicting the amount of damage would be difficult due to lack of historic activity in the area.

Cuyahoga County has had a history of some earthquake activity, though none have been strong, and only a few have been felt. The lack of noticeable activity in the County can be partly attributed to the Peak Ground Acceleration (PGA). PGA is partly determined by what soils and bedrocks are present in the area. In regards to the County, the PGA is very low.

According to the Ohio Seismic Network, when the peak acceleration nears 0.1g, damage may be caused to poorly constructed buildings while acceleration nearing 0.2 would create loss of balance and greater damage to lesser quality structures. Cuyahoga County has peak acceleration much below that number, thus providing a buffer from most seismic activity. The following figure depicts Cuyahoga County's PGA.

FIGURE 4-31 CUYAHOGA COUNTY PEAK GROUND ACCELERATION



Earthquake Mechanics

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

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

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

Factors Contributing to Damage

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

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

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

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

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

Types of Damage

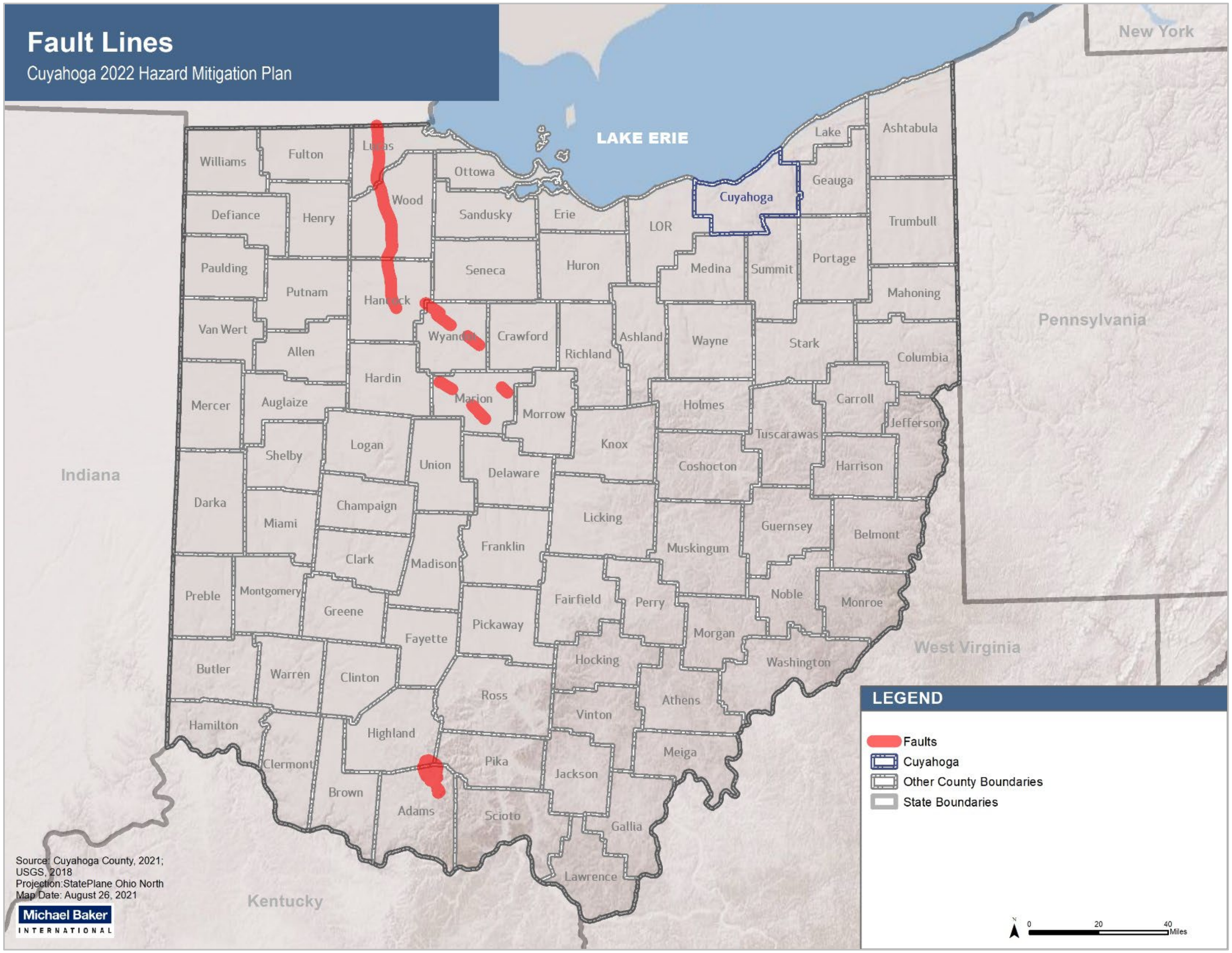
- **Shaking:** In minor events, objects fall from shelves and dishes are rattled. In major events, large structures may be torn apart by the forces of the seismic waves. Structural damage is generally limited to older structures that are poorly maintained, constructed, or designed in all but the largest quakes. Un-reinforced masonry buildings and wood frame homes not anchored to their foundations are typical victims. Loose or poorly secured objects also pose a significant hazard when they are loosened or dropped by shaking. These "non-structural falling hazard" objects include bookcases, heavy wall hangings, and building facades. Home water heaters pose a special risk due to their tendency to start fires when they topple over and rupture gas lines. Crumbling chimneys may also be responsible for injuries and property damage. Dam and bridge failures are significant risks during stronger earthquake events, and due to the consequences of such failures, may result in considerable property damage and loss of life. In areas of severe seismic shaking hazard, Intensity VII or higher can be experienced even on solid bedrock. In these areas, older buildings especially are at significant risk.

- **Ground Displacement:** Often, the most dramatic evidence of an earthquake results from displacement of the ground along a fault line. Utility lines and roads may be disrupted but damage directly attributable to ground displacement is generally limited. In rare instances, structure located directly on the fault line may be destroyed by the displacement.
- **Landslides and Avalanches:** Even small earthquake events can cause landslides. Rock falls are common as unstable material on steep slopes is shaken loose, but significant landslides or even debris flows can be generated if conditions are ripe. Roads may be blocked by landslide activity, hampering response and recovery operations.
- **Liquefaction and Subsidence:** Soils may liquefy and/or subside when impacted by the seismic waves. Fill and previously saturated soils are especially at risk. The failure of the soils can lead to possibly widespread structural damage and may result in increased water flow and/or failure of wells as the subsurface flows are disrupted and sometimes permanently altered. Increased flows may be dramatic, resulting in geyser-like waterspouts and/or flash floods. Similarly, septic systems may be damaged creating both inconvenience and health concerns.

4.7.2 Earthquake Location

While there are multiple sources of seismic activity in Ohio, the location of seismic activity varies as well. Many earthquakes do occur along faults. Information about faults can be obtained from the Ohio Seismic Network.

FIGURE 4-32 FAULT LINES IN OHIO



4.7.3 Extent

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

The magnitude of an earthquake is related to the total area of the fault that ruptured, as well as the amount of offset (displacement) across the fault. As shown in Table 4-60, there are seven earthquake magnitude classes, ranging from great to micro. A great class of magnitude can cause tremendous damage to infrastructure in the County, compared to a micro class, which results in minor damage to infrastructure.

TABLE 4-60 MOMENT MAGNITUDE SCALE

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

The MMI Scale measures earthquake intensity as shown in

Table 4-61, the MMI Scale has 12 intensity levels. Each level is defined by a group of observable earthquake effects, such as ground shaking and/or damage to infrastructure. Levels I through VI describe what people see and feel during a small to moderate earthquake. Levels VII through XII describe damage to infrastructure during a moderate to catastrophic earthquake.

TABLE 4-61 MODIFIED MERCALLI SCALE WITH ASSOCIATED IMPACTS

Scale	Intensity	Description of Effects	Corresponding Richter Scale Magnitude
I	**Instrumental**	Usually detected only on seismographs.	<4.2
II	**Feeble**	Felt only by a few persons at rest, especially on upper floors of buildings.	
III	**Slight**	Felt quite noticeably indoors, especially on upper floors. Most people don't recognize it as an earthquake (i.e. a truck rumbling).	
IV	**Moderate**	Can be felt by people walking; dishes, windows, and doors are disturbed.	
V	**Slightly Strong**	Sleepers are awoken; unstable objects are overturned.	<4.8
VI	**Strong**	Trees sway; suspended objects swing; objects fall off shelves; damage is slight.	<5.4
VII	**Very Strong**	Damage is negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, and considerable in poorly built or badly designed structures; some chimneys are broken.	<6.1
VIII	**Destructive**	Damage is slight in specially designed structures; considerable in ordinary, substantial buildings. Moving cars become uncontrollable; masonry fractures, poorly constructed buildings damaged.	<6.9
IX	**Ruinous**	Some houses collapse, ground cracks, pipes break open; damage is considerable in specially designed structures; buildings are shifted off foundations.	
X	**Disastrous**	Some well-built wooden structures are destroyed; most masonry and frame structures are destroyed along with foundations. Ground cracks profusely; liquefaction and landslides widespread.	<7.3
XI	**Very Disastrous**	Most buildings and bridges collapse, roads, railways, pipes and cables destroyed.	<8.1
XII	**Catastrophic**	Total destruction; trees fall; lines of sight and level are distorted; ground rises and falls in waves; objects are thrown upward into the air.	>8.1

4.7.4 Historical Occurrences

General Trends

There have been twenty-one recorded earthquakes in Cuyahoga County, six of which occurred in the timeframe 2001-2021. The earthquakes recorded during the 2001-2021 timeframe range in magnitudes 1.8 to 2.4 with Modified Mercalli Intensity ranging from NF to F. In the adjacent counties, many earthquake epicenters have been recorded by the Ohio Department of Natural Resources (ODNR), with the majority of events located in Lake County. The table below lists the earthquake epicenters that have been recorded by ODNR from 2001 to 2021 in Cuyahoga County and the surrounding counties of Lorain, Medina, Summit, Portage, Geauga, and Lake; a complete list of earthquake events from the ODNR Earthquake Epicenter website can be found in **Appendix B**.

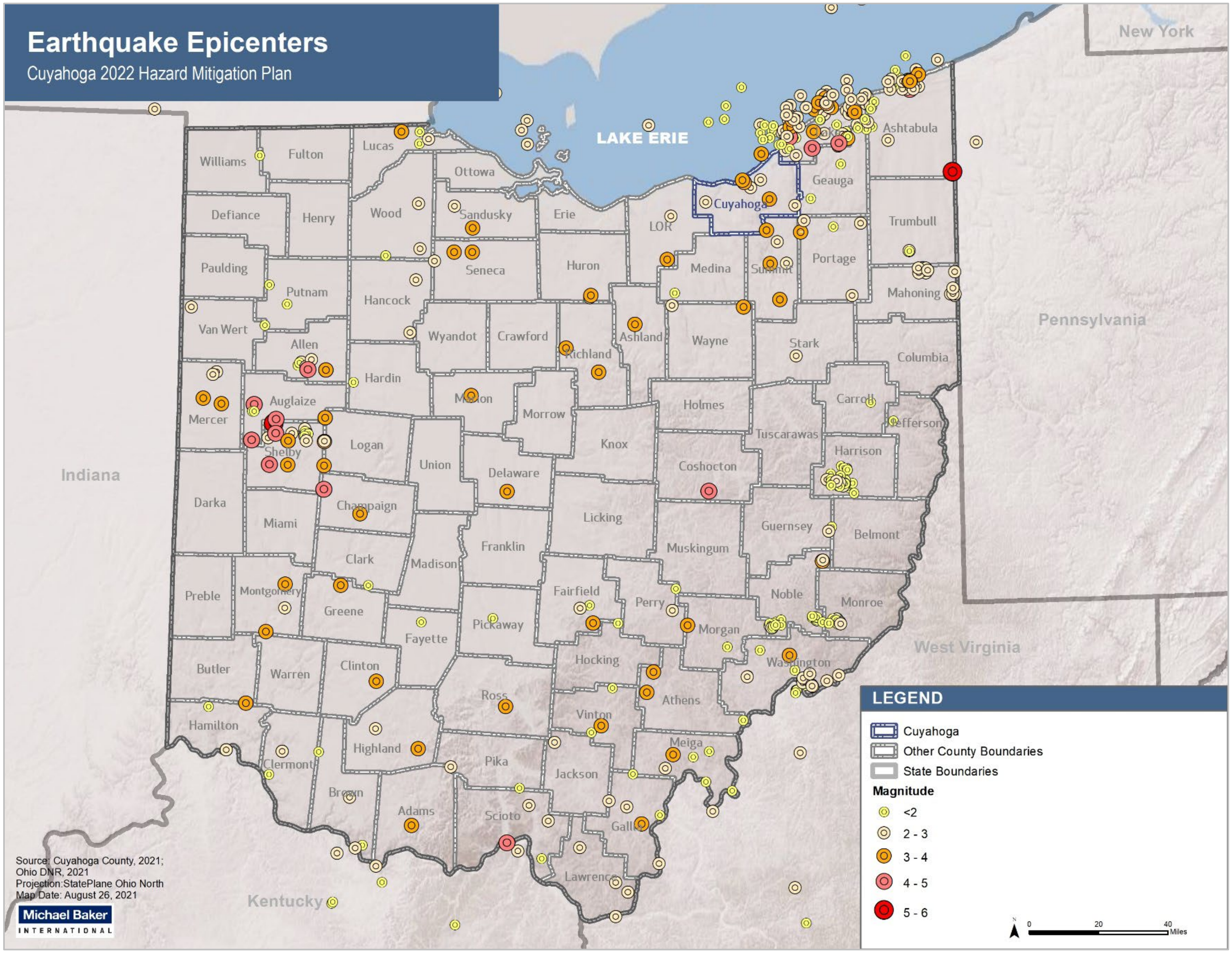
TABLE 4-62 RECORDED EARTHQUAKES IN CUYAHOGA AND SURROUNDING COUNTIES, 2001-2021

Location	Magnitude	Year	MMF
Lake Co.	2.7	2002	F
Lake Co.	2	2003	NF
Lake Co.	3.4	2003	NF
Lake Co.	3..5	2003	IV
Lake Co.	3.3	2004	III
Lake Co.	2.4	2004	III
Lake Co.	2.5	2005	F
Lake Co.	2.2	2005	F
Lake Co.	2.3	2006	F
Lake Co.	2.3	2006	NF
Lake Co.	2.1	2006	NF
Lake Co.	2.2	2006	NF
Lake Co.	2.2	2006	NF
Lake Co.	2.2	2006	NF
Lake Co.	2.3	2006	F
Lake Co.	2.6	2006	F
Lake Co.	2.2	2006	-
Lake Co.	3	2006	F
Lake Co.	2.6	2006	F
Lake Co.	2.1	2006	NF
Portage Co.	3.3	2007	F
Lake Co.	2.4	2007	NF
Lorain Co.	2.7	2007	NF
Lake Co.	3.2	2007	III
Lake Co.	2..1	2007	F
Lake Co.	2.3	2008	F
Lake Co.	2.8	2008	F
Lake Co.	2.3	2008	NF
Lake Co.	3.1	2008	F
Lake Co.	2.4	2009	NF
Lake Co.	2.2	2009	NF

Location	Magnitude	Year	MMF
Summit Co.	2.5	2010	NF
Lake Co.	2.1	2010	II
Lake Co.	2.3	2010	F
Lake Co.	2.5	2010	III
Lake Co.	2.5	2010	F
Cuyahoga Co.	2	2011	NF
Medina Co.	2	2011	II
Lake Co.	2.1	2011	NF
Lake Co.	2.5	2013	NF
Lake Co.	2.4	2013	F
Lake Co.	3.2	2013	F
Lake Co.	2.7	2013	F
Cuyahoga Co.	2.1	2014	NF
Cuyahoga Co.	2	2014	NF
Lake Co.	2.2	2014	F
Lake Co.	2.1	2014	NF
Lake Co.	2.1	2017	NF
Cuyahoga Co.	1.8	2017	NF
Cuyahoga Co.	1.8	2017	NF
Geauga Co.	2	2018	NF
Lake Co.	2.2	2018	NF
Lake Co.	2.1	2018	NF
Cuyahoga Co.	2.4	2019	F
Lake Co.	2.4	2019	NF
Lake Co.	2.7	2019	F
Lake Co.	2.1	2019	NF
Lake Co.	2.5	2019	NF
Lake Co.	2.4	2019	NF
Lake Co.	2.3	2019	NF
Lake Co.	4.2	2019	F
Lake Co.	2.6	2019	NF
Lake Co.	2.6	2019	NF
Lake Co.	2.4	2019	NF
Lake Co.	2.5	2020	NF

The figure below shows epicenters in the State of Ohio from 1970 – 2021 from Ohio Department of Natural Resources Earthquake Epicenters Database.

FIGURE 4-33 OHIO HISTORIC EARTHQUAKE EPICENTERS



4.7.5 Probability of Future Occurrences

Based on their local knowledge, the HMPC determined that earthquakes have an “Possible” chance of occurring, or between 1% and 10% annual probability. Recorded earthquakes over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing earthquakes associated with damages or injury can be difficult to predict. Based on the historical record of 6 earthquake event from 2001 through 2021, it can reasonably be assumed that this type of event will occur once every 3.33 years, or there is a 30% chance it will occur annually.

(2021 CY) - (2001 HY) = 20 Years on Record

(20 Years) / (6 Events) = 3.33 Years Between Events

4.7.6 Assets Exposed to Earthquakes

Potential Losses from Earthquakes

TABLE 4-63 POTENTIAL IMPACTS FROM EARTHQUAKES

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

Community Vulnerability

Cuyahoga County is at a very low vulnerability to disastrous seismic activity. The nearest major fault, the New Madrid Fault, is hundreds of miles away. The lack of major historical events in the County, along with the relatively low PGA associated with the lands around the area put seismic events very low in the category of probability of occurrence. However, if a severe event were to occur with the County near the epicenter, damages would significant.

HAZUS-MH 5.0 Magnitude Earthquake

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

Although a 5.0-magnitude has never occurred within the planning area for this document, this is the accepted baseline for simulating potential losses due to seismic events. The software takes into account the depth of the epicenter, as well as its location. In addition, the program helps to determine the potential losses based on the prevailing soil types in the region.

FIGURE 4-34 PEAK GROUND VELOCITY FOR 5.0 EARTHQUAKE IN CUYAHOGA COUNTY

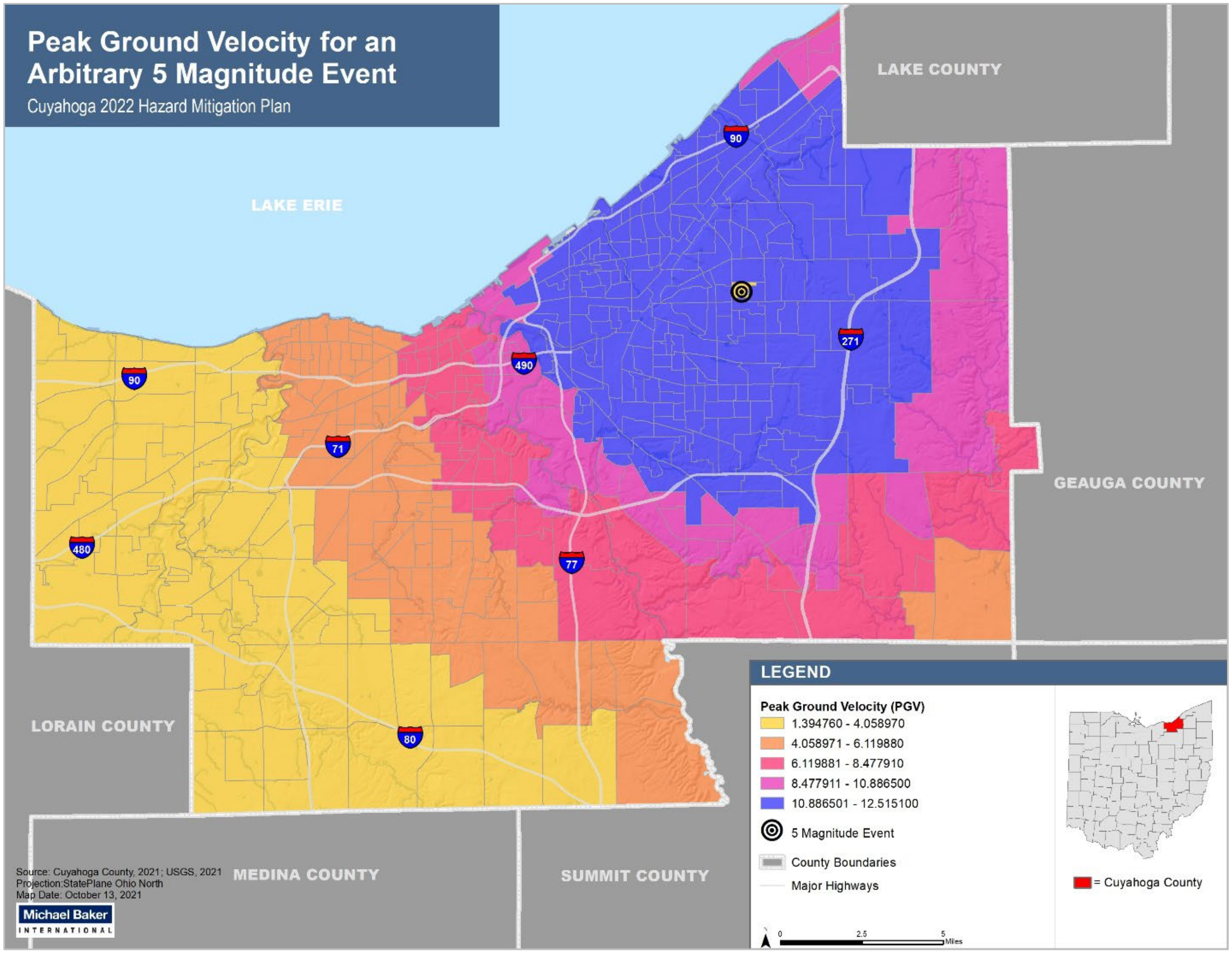
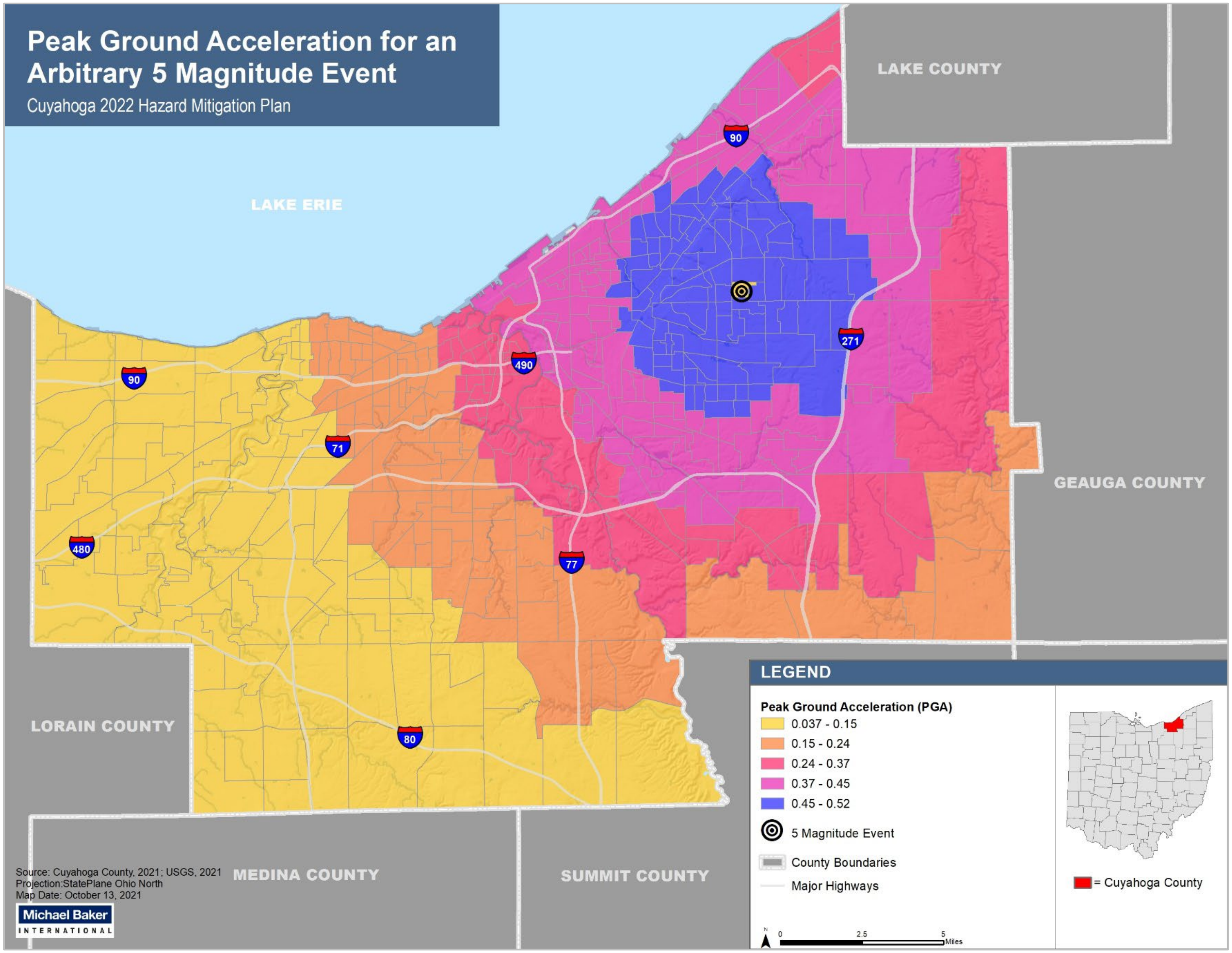


FIGURE 4-35 PEAK GROUND ACCELERATION FOR 5.0 EARTHQUAKE IN CUYAHOGA COUNTY



Hazus estimates that about 66,230 buildings will be at least moderately damaged. This is over 14.00% of the buildings in the region. There are an estimated 3,989 buildings that will be damaged beyond repair. The definition of the ‘damage states’ is provided in Volume 1: Chapter 5 of the Hazus technical manual. The first table below summarizes the expected damage by general occupancy for the buildings in the region. The second table below summarizes the expected damage by general building type. The third table summarizes the expected damage to the transportation systems in Cuyahoga County.

TABLE 4-64 EXPECTED BUILDING DAMAGE BY OCCUPANCY

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	551.56	0.17	166.20	0.18	191.71	0.40	101.79	0.70	26.74	0.67
Commercial	13343.43	4.01	4987.32	5.50	5300.25	11.12	2486.64	17.07	689.35	17.28
Education	504.70	0.15	185.89	0.21	206.85	0.43	90.22	0.62	27.34	0.69
Government	393.42	0.12	155.64	0.17	178.58	0.37	69.29	0.48	20.08	0.50
Industrial	4322.75	1.30	1423.84	1.57	1677.14	3.52	879.09	6.04	230.17	5.77
Other Residential	29789.31	8.96	10215.30	11.27	5540.16	11.62	1683.35	11.56	432.89	10.85
Religion	1314.46	0.40	473.94	0.52	422.12	0.89	205.47	1.41	59.01	1.48
Single Family	282143.91	84.89	73022.64	80.57	34159.98	71.65	9048.09	62.13	2504.39	62.77
Total	332,364		90,631		47,677		14,564		3,990	

TABLE 4-65 EXPECTED BUILDING DAMAGE BY BUILDING TYPE (ALL DESIGN LEVELS)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	258045.67	77.64	64016.90	70.63	21927.78	45.99	2639.07	18.12	188.96	4.74
Steel	5721.05	1.72	1765.18	1.95	2887.09	6.06	1843.56	12.66	521.95	13.08
Concrete	1710.92	0.51	531.55	0.59	625.57	1.31	302.65	2.08	59.96	1.50
Precast	1654.77	0.50	441.18	0.49	688.32	1.44	458.76	3.15	78.82	1.98
RM	936.85	0.28	215.13	0.24	342.99	0.72	215.01	1.48	24.08	0.60
URM	62339.10	18.76	23063.07	25.45	20520.35	43.04	8830.03	60.63	3059.67	76.68
MH	1955.19	0.59	597.75	0.66	684.69	1.44	274.85	1.89	56.52	1.42
Total	332,364		90,631		47,677		14,564		3,990	

*Note:
RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

TABLE 4-66 EXPECTED DAMAGE TO TRANSPORTATION SYSTEMS

System	Component	Number of Locations				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 % After Day 1	With Functionality > 50 % After Day 7
Highway	Segments	625	0	0	625	625
	Bridges	859	2	0	857	859
	Tunnels	3	0	0	3	3
Railways	Segments	735	0	0	735	735
	Bridges	201	0	0	201	201
	Tunnels	0	0	0	0	0
	Facilities	27	8	0	27	27
Light Rail	Segments	49	0	0	49	49
	Bridges	5	0	0	5	5
	Tunnels	0	0	0	0	0
	Facilities	50	35	0	50	50
Bus	Facilities	5	2	0	5	5
Ferry	Facilities	0	0	0	0	0
Port	Facilities	39	1	0	39	39
Airport	Facilities	6	3	0	6	6
	Runways	6	0	0	6	6

The following tables summarize the impact the simulated earthquake would have on the utility systems in Cuyahoga County. None of the utility systems would suffer complete damage, but 22 waste water locations, 7 communication locations, 3 electrical power locations, and 1 potable water location would suffer at least moderate damage from a 5.0 magnitude earthquake. It is expected that there would be 1,104 potable water pipelines, 554 waste water pipelines, and 3 natural gas pipelines would leak due to the earthquake. A total of 416 pipelines would break.

TABLE 4-67 EXPECTED UTILITY SYSTEM FACILITY DAMAGE

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 % After Day 1	with Functionality > 50 % After Day 7
Potable Water	1	1	0	0	1
Waste Water	50	22	0	16	50
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	4	3	0	1	4
Communication	34	7	0	31	34

TABLE 4-68 EXPECTED UTILITY SYSTEM PIPELINE DAMAGE (SITE SPECIFIC)

System	Total Pipelines Length (miles)	Number of Leaks	Number of Breaks
Potable Water	9,025	1104	276
Waste Water	5,415	554	139
Natural Gas	86	3	1
Oil	0	0	0

TABLE 4-69 EXPECTED POTABLE WATER AND ELECTRIC POWER SYSTEM PERFORMANCE

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	545,056	10,638	5,490	519	0	0
Electric Power		192,434	116,997	42,855	6,818	243

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. Hazus uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 11 ignitions that will burn about 0.14 sq. mi 0.03 % of the region's total area.) The model also estimates that the fires will displace about 1,225 people and burn about 139 (millions of dollars) of building value.

Debris Generation

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

The model estimates that a total of 3,906,000 tons of debris will be generated. Of the total amount, Brick/Wood comprises 47.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 156,240 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

FIGURE 4-36 EARTHQUAKE DEBRIS

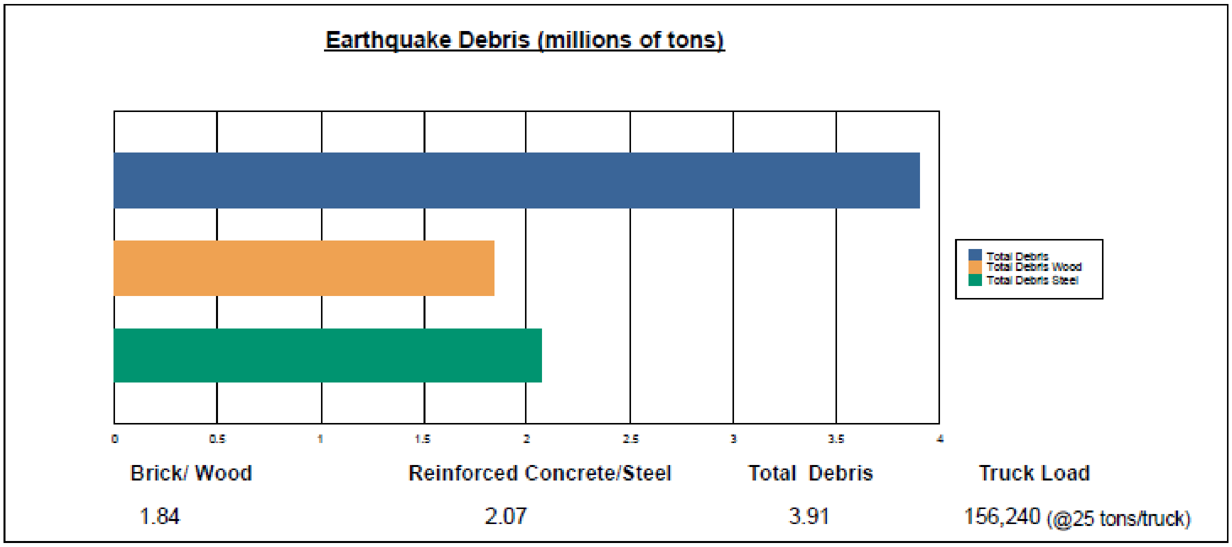
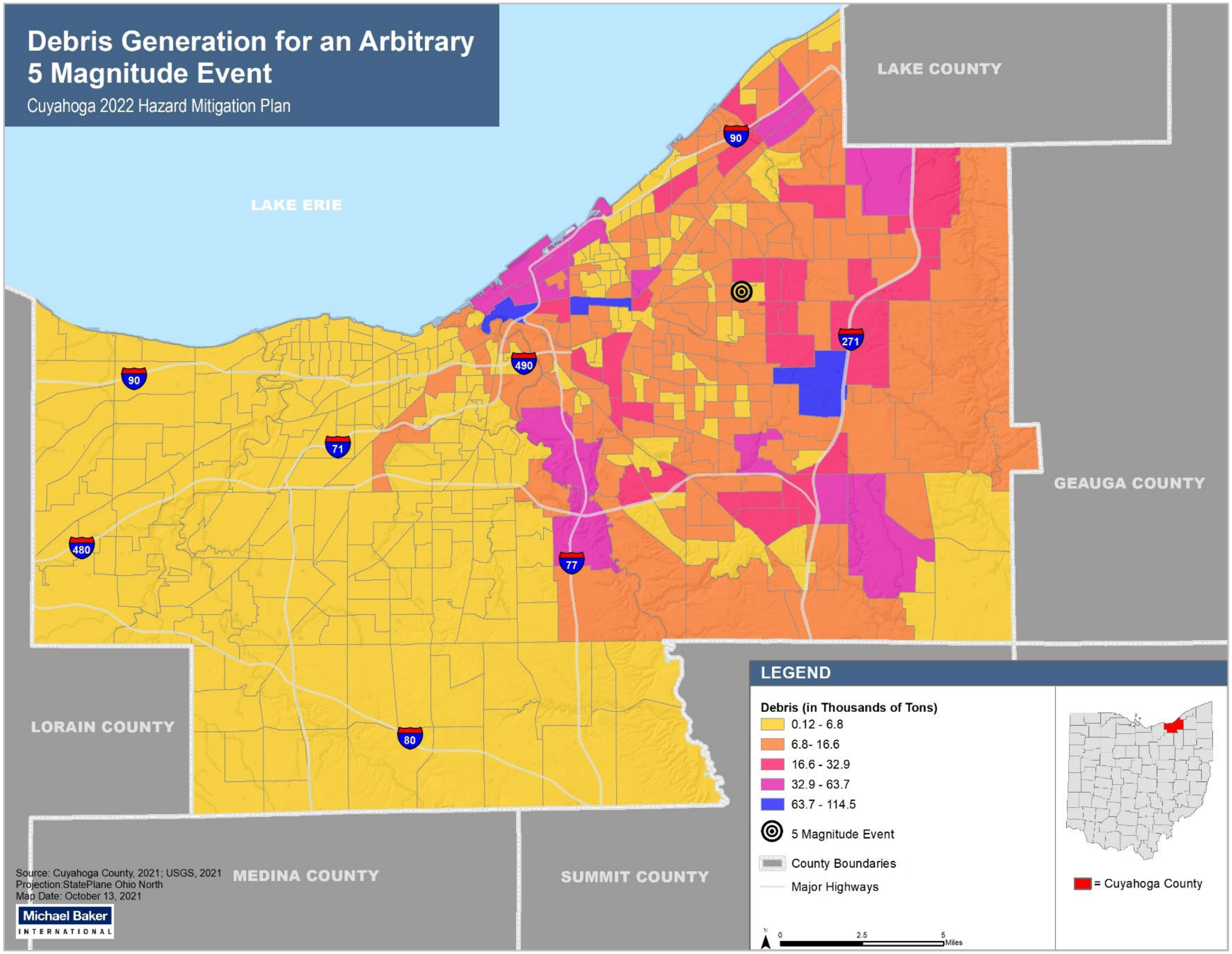


FIGURE 4-37 DEBRIS GENERATION IN CUYAHOGA COUNTY



Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 9,268 households to be displaced due to the earthquake. Of these, 6,581 people (out of a total population of 1,280,122) will seek temporary shelter in public shelters.

Casualties

Hazus estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

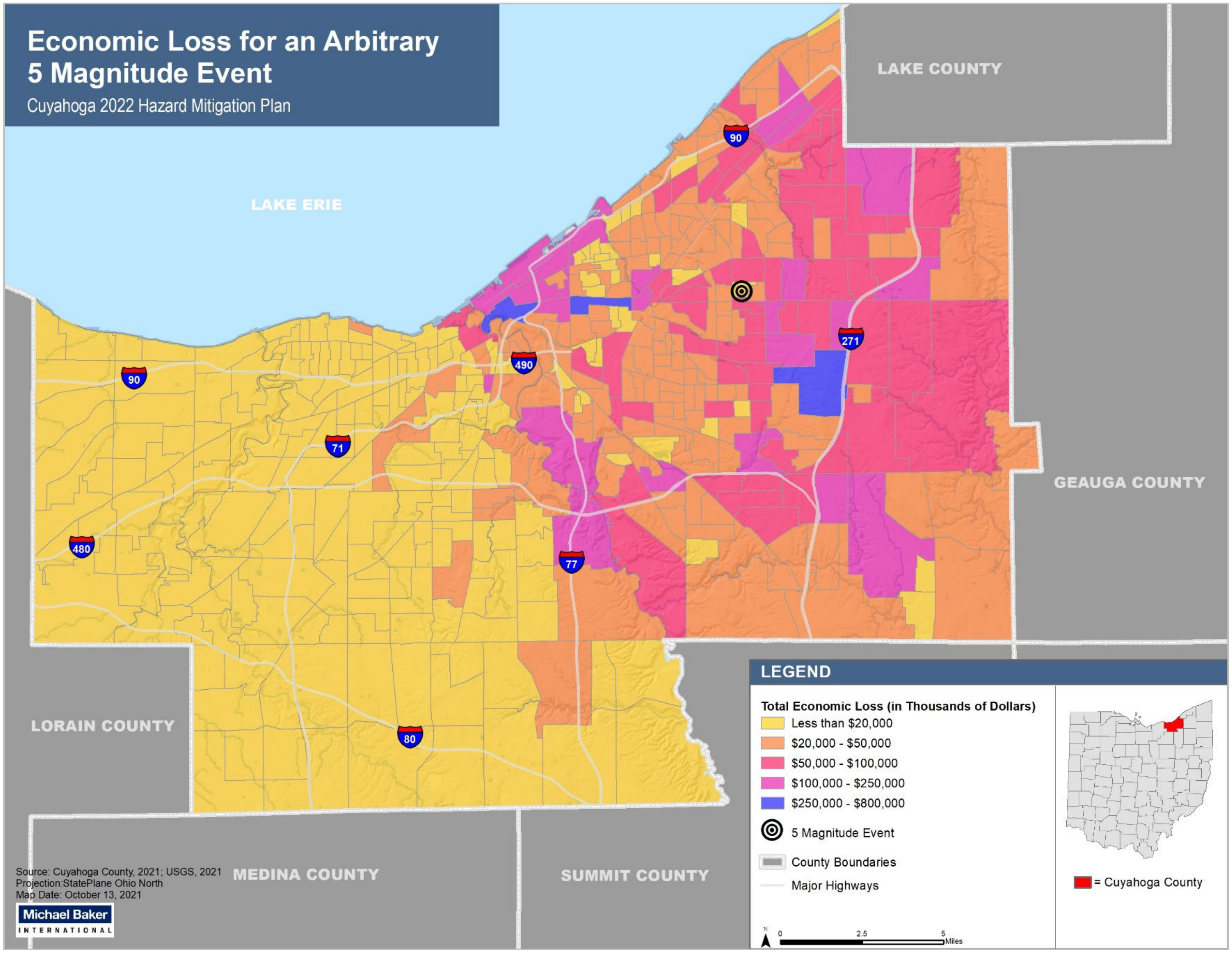
TABLE 4-70 CASUALTY ESTIMATES

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	36.86	8.36	1.06	2.07
	Commuting	0.03	0.04	0.07	0.01
	Educational	0.00	0.00	0.00	0.00
	Hotels	0.00	0.00	0.00	0.00
	Industrial	33.27	7.38	0.91	1.76
	Other-Residential	750.46	167.73	22.66	44.43
	Single Family	1345.72	293.17	38.75	75.89
	Total	**2,166**	**477**	**63**	**124**
2 PM	Commercial	2188.31	498.13	63.84	123.47
	Commuting	0.27	0.35	0.61	0.12
	Educational	854.31	206.12	29.47	57.07
	Hotels	0.00	0.00	0.00	0.00
	Industrial	245.31	54.62	6.76	12.99
	Other-Residential	190.17	43.77	6.15	11.54
	Single Family	315.40	71.18	9.85	18.43
	Total	**3,794**	**874**	**117**	**224**
5 PM	Commercial	1523.93	348.70	45.19	86.34
	Commuting	4.60	5.97	10.27	1.98
	Educational	92.90	22.62	3.25	6.32
	Hotels	0.00	0.00	0.00	0.00
	Industrial	153.32	34.14	4.23	8.12
	Other-Residential	299.31	68.71	9.65	18.11
	Single Family	539.71	121.40	16.77	31.39
	Total	**2,614**	**602**	**89**	**152**

Economic Loss

The total economic loss estimated for the earthquake is 16,647.08 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following figure shows the extent of economic loss by location, and three sections provide more detailed information about these losses.

FIGURE 4-38 ECONOMIC LOSS AFTER A 5.0 EARTHQUAKE IN CUYAHOGA COUNTY



Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes.

The total building-related losses were 15,348.01 (millions of dollars); 19 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 46% of the total loss. The following table below provides a summary of the losses associated with the building damage.

TABLE 4-71 BUILDING-RELATED ECONOMIC LOSS ESTIMATES (MILLIONS OF DOLLARS)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	24.3026	627.5893	41.2800	37.3040	730.4759
	Capital-Related	0.0000	10.3246	492.9392	26.8442	9.4746	539.5826
	Rental	102.7436	130.1295	264.8955	14.3143	18.2641	530.3470
	Relocation	361.4952	86.5839	506.4589	64.4016	148.3129	1,167.2525
	Subtotal	**464.2388**	**251.3406**	**1891.8829**	**146.8401**	**213.3556**	**2967.6580**
Capital Stock Losses							
	Structural	645.8633	222.3087	679.8848	244.5932	147.2546	1,939.9046
	Non_Structural	2487.5273	1460.8747	1853.3027	734.3022	454.9282	6,990.9351
	Content	999.9982	475.6008	1058.5564	529.2601	262.7741	3,326.1896
	Inventory	0.0000	0.0000	21.2365	100.7737	1.3090	123.3192
	Subtotal	**4133.3888**	**2158.7842**	**3612.9804**	**1608.9292**	**866.2659**	**12380.3485**
	Total	**4597.63**	**2410.12**	**5504.86**	**1755.77**	**1079.62**	**15348.01**

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, Hazus computes the direct repair cost for each component only. There are no losses computed by Hazus for business interruption due to lifeline outages. The following tables provide a detailed breakdown in the expected lifeline losses.

TABLE 4-72 TRANSPORTATION SYSTEM ECONOMIC LOSSES (MILLIONS OF DOLLARS)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	6612.1065	0.0000	0.00
	Bridges	7125.5642	91.2343	1.28
	Tunnels	10.8736	0.7190	6.61
	Subtotal	**13748.5443**	**91.9533**	
Railways	Segments	769.8401	0.0000	0.00
	Bridges	923.1153	4.5168	0.49
	Tunnels	0.0000	0.0000	0.00
	Facilities	71.9010	19.8383	27.59
	Subtotal	**1764.8564**	**24.3551**	
Light Rail	Segments	69.4416	0.0000	0.00
	Bridges	0.5323	0.0051	0.96
	Tunnels	0.0000	0.0000	0.00
	Facilities	146.9636	50.7987	34.57
	Subtotal	**216.9375**	**50.8038**	
Bus	Facilities	7.3481	1.7854	24.30
	Subtotal	**7.3481**	**1.7854**	
Ferry	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Port	Facilities	113.1987	32.6199	28.82
	Subtotal	**113.1987**	**32.6199**	
Airport	Facilities	431.9941	40.4996	9.38
	Runways	503.1943	0.0000	0.00
	Subtotal	**935.1884**	**40.4996**	
	Total	**16,786.07**	**242.02**	

TABLE 4-73 UTILITY SYSTEM ECONOMIC LOSSES (MILLIONS OF DOLLARS)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.0000	0.0000	0.00
	Facilities	34.9650	9.6390	27.57
	Distribution Lines	290.4974	4.9662	1.71
	Subtotal	**325.4624**	**14.6052**	
Waste Water	Pipelines	0.0000	0.0000	0.00
	Facilities	6567.4375	885.1658	13.48
	Distribution Lines	174.2984	2.4946	1.43
	Subtotal	**6741.7359**	**887.6604**	
Natural Gas	Pipelines	87.2297	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Distribution Lines	116.1990	0.8546	0.74
	Subtotal	**203.4287**	**0.8546**	
Oil Systems	Pipelines	0.0000	0.0000	0.00
	Facilities	0.0000	0.0000	0.00
	Subtotal	**0.0000**	**0.0000**	
Electrical Power	Facilities	639.2918	153.5931	24.03
	Subtotal	**639.2918**	**153.5931**	
Communication	Facilities	3.5700	0.3367	9.43
	Subtotal	**3.5700**	**0.3367**	
	Total	**7,913.49**	**1,057.05**	

4.7.7 Land Use & Development Trends

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

Regulatory Environment

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

4.7.8 Earthquake Summary

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

4.8. Drought

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Drought	2	0.3	1	0.3	4	0.2	1	0.1	4	0.1	**2.2**
Moderate Risk Hazard (2.0 – 2.9)											

4.8.1 Drought Description

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

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

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

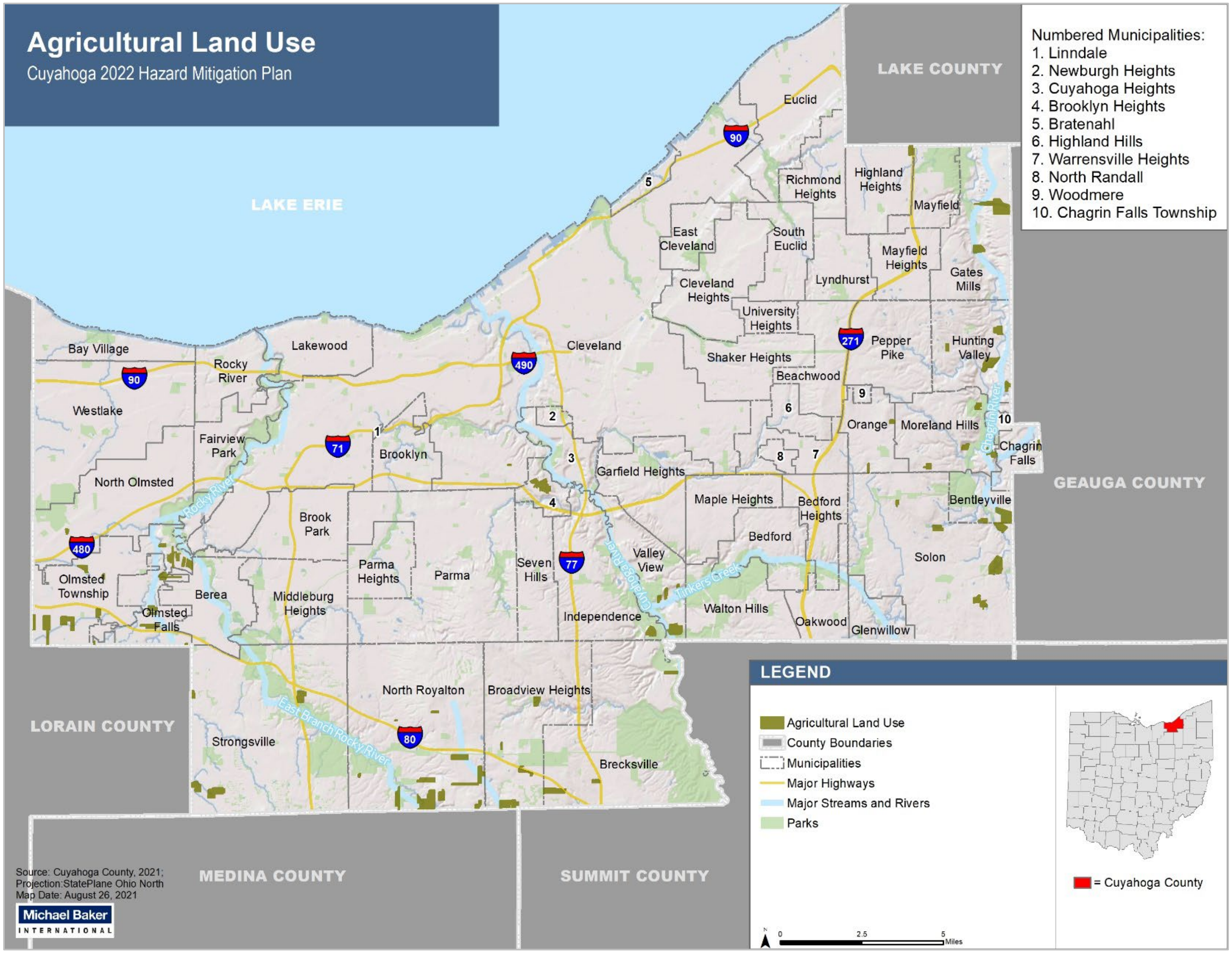
Drought risk is assessed based on a combination of the frequency, severity, and spatial extent (the physical nature of drought) and the degree to which a population or activity is vulnerable to the effects of drought. The degree of the County's vulnerability to drought depends on the environmental and social characteristics of the region and is measured by its ability to anticipate, cope with, resist, and recover from drought.

Because drought is usually considered a regional hazard, it is not enhanced or analyzed by County-level mapping. Mapping of the current drought status is published by the National Integrated Drought Information System (NIDIS).

4.8.2 Drought Location

Drought events are region-wide events that can affect the entirety of Cuyahoga County. All communities are affected during these occurrences. Drought impacts can be magnified in agricultural land use, shown below.

FIGURE 4-39 CUYAHOGA COUNTY AGRICULTURAL LAND USE



4.8.3 Extent

The Palmer Drought Severity Index (PDSI) was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index. The Palmer Index is most effective in determining long term drought—a matter of several months—and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought.

TABLE 4-74 PALMER DROUGHT SEVERITY INDEX

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

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

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

4.8.4 Historical Occurrences

General Trends

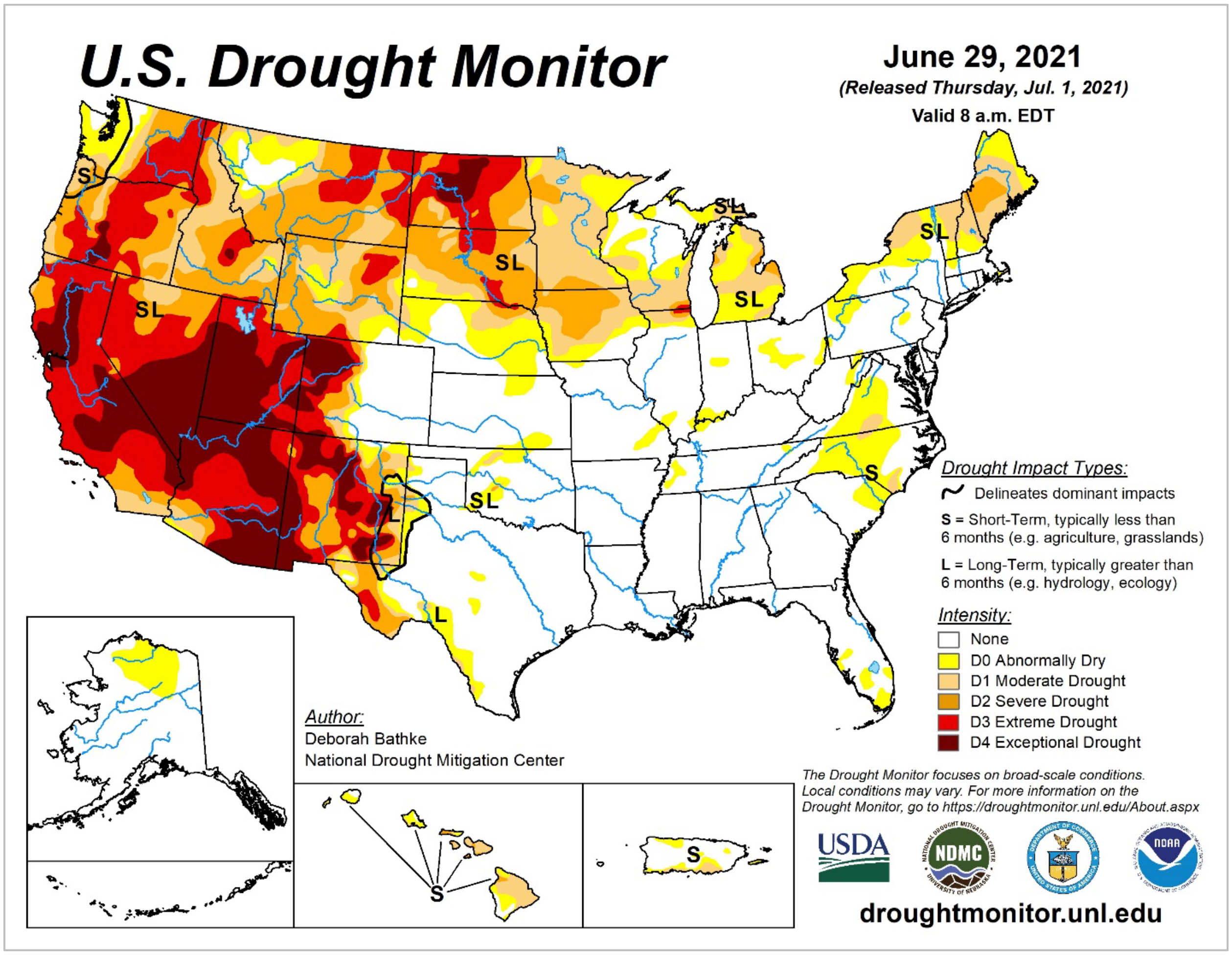
According to the NOAA, Cuyahoga County as a whole, has had five drought events since 1950, but none have occurred 2001-2021 timeframe. A complete list of drought events from 1996 to current day can be found in **Appendix B**.

Event Narratives

- **Drought of 1996:** In northern Ohio, lack of rainfall during the month of August created a drought, ranging in severity. North central and northwest Ohio averaged a few tenths of an inch of rainfall to one to two inches in the northeast region of Ohio. Typical rainfall amounts for the region are three and four inches. At the Cleveland Airport, the total amount of rainfall for August was 0.71 inches, ranking August 1996 one of the top five driest Augusts to date. Crops experienced severe losses, ranging from 10%-30%, but specific dollar amounts are unknown.

- **Drought of 1999:** Small amounts of rainfall beginning in May 1999 created drought events for the months of June, July, August, and September 1999. Starting in June, communities enacted water use restrictions after the northern and eastern region saw 1.66 inches of rainfall or less during the entire month. On August 10th, the U.S. Department of Agriculture declared all of Eastern Ohio an agricultural disaster area. In the entire month of August, only 1.80 inches of rain fell in Cleveland. In the following month, Cleveland saw less than two inches below the average rainfall amount. Precipitation deficits for the period of May through August show the area to be anywhere between 2 and 8 inches below normal. Crops suffered an average 30% loss during the growing season, with an estimate of $200 million in losses for the northern Ohio region alone.

FIGURE 4-40 EXAMPLE US DROUGHT MONITOR MAP



4.8.5 Probability of Future Occurrences

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

Drought is difficult to predict but warning indicators can be tracked and monitored. Understanding the historical frequency, duration, and spatial extent of drought assists in determining the likelihood and potential severity of future droughts. The characteristics of past droughts provide benchmarks for projecting similar conditions into the future. The probability of the County experiencing a drought event in any given year can be difficult to predict. However, the County has not experienced a drought in past twenty years.

(2021 CY) - (2001 HY) = 20 Years on Record

(20 Years) / (0 Events) = Greater than 20 Years Between Events

The historic frequency indicates that there is a 0% chance of this type of event occurring each year. However, the HMPC, based on their knowledge, determined that droughts are "Possible," meaning they have between a 1% and 10% chance of occurring each year.

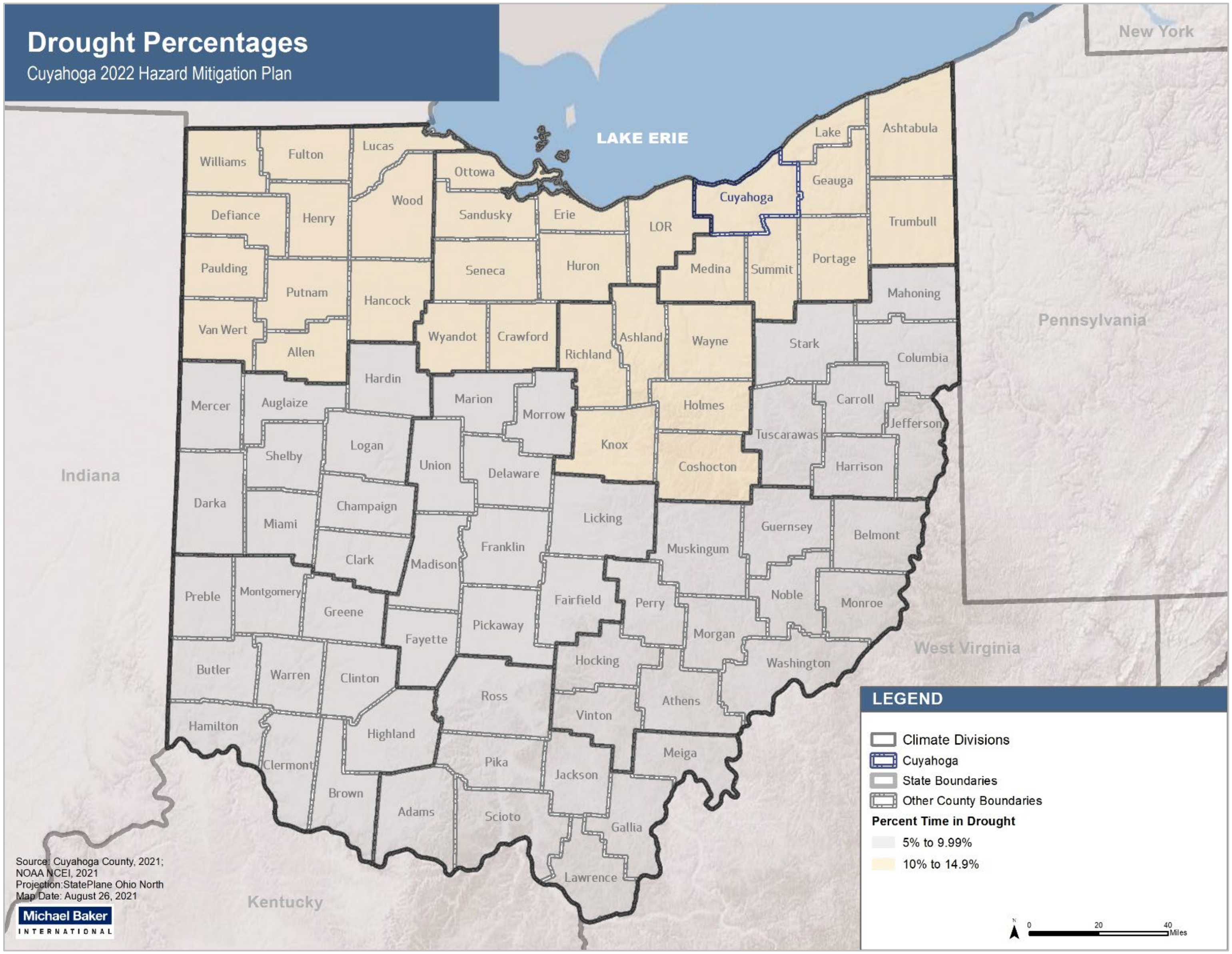
The National Oceanic and Atmospheric Administration Paleoclimatology Program studies drought by analyzing records from tree rings, lake and dune sediments, archaeological remains, historical documents, and other environmental indicators to obtain a broader picture of the frequency of droughts in the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

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

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

The following figure depicts the percentage of time that each county within Ohio spends in drought. The northern part of the state, including Cuyahoga County, spends approximately 10-14% of the time in a drought.

FIGURE 4-41 CUYAHOGA COUNTY DROUGHT PERCENTAGE



4.8.6 Assets Exposed to Drought

Potential Losses

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

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

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

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

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

TABLE 4-75 POTENTIAL IMPACTS FROM DROUGHT

Impact	Description
People	Dehydration can occur during drought if water reserves run out.
Infrastructure	Lack of moisture in the ground can cause roadways to crack after long periods of time. Water reservoirs can dry up.
Economy	Rural areas that rely on crops will suffer the most damage economically. Farmers will lose large amounts of money during extended drought.
Natural Systems	Vegetation severely damaged. Rivers and streams can dry up.
Transportation	Cracks in roads can cause delays or detours.

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

Droughts are not likely to impact structures or infrastructure. The prolonged absence of precipitation is more likely to have an impact on agricultural operations than on more urban settings. While the County's infrastructure may not be susceptible to the effects of a drought, the agricultural program's various project areas may be impacted.

There is an estimated $11,107,340 in agriculture value within the County, according to the Ohio Office of Research Cuyahoga County Profile 2020 Edition. A 1% loss would result in $111,073.40 in lost crops, and a 5% loss would be $555,367.

Community Vulnerability

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

Due to the nature of drought, all property in the County is expected to be impacted equally due to drought conditions. Agricultural land throughout the County would be affected the most. No injuries, death, or property damage has been recorded as a result of drought in Cuyahoga County.

4.8.7 Land Use & Development Trends

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

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

Regulatory Environment

There are negligible formal regulations that pertain to drought events.

4.8.8 Drought Summary

Drought is extremely difficult to predict, but drought indicators can be identified and monitored. Several mitigation measures will be reviewed and considered by the County for incorporation into future Plan updates.

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

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

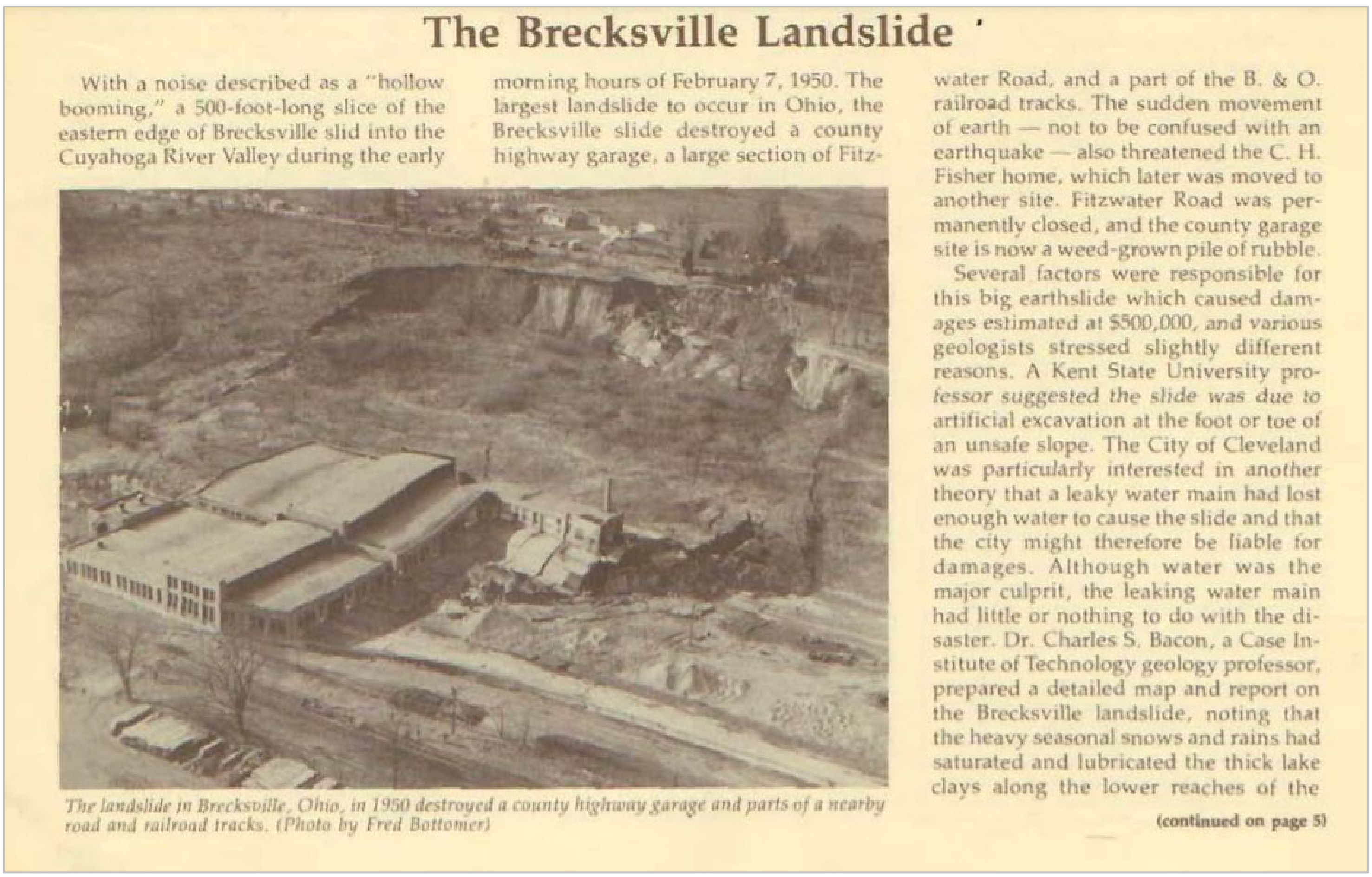
4.9. Landslides

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Landslide	2	0.3	1	0.3	1	0.2	4	0.1	1	0.1	**1.6**
Low Risk Hazard (0.1 – 1.9)											

4.9.1 Landslide Description

"Landslide" refers to a sudden movement of landmass downhill. This movement is typically sudden and unexpected. Landslides can occur with little to no warning, though oftentimes, they are coupled with other hazard events such as heavy rains or earthquakes. Landslides rarely happen on their own without a primary cause.

FIGURE 4-42 HISTORIC BRECKSVILLE LANDSLIDE, IMAGE FROM OSU.EDU KNOWLEDGE BANK



The Brecksville Landslide

With a noise described as a "hollow booming," a 500-foot-long slice of the eastern edge of Brecksville slid into the Cuyahoga River Valley during the early morning hours of February 7, 1950. The largest landslide to occur in Ohio, the Brecksville slide destroyed a county highway garage, a large section of Fitzwater Road, and a part of the B. & O. railroad tracks. The sudden movement of earth — not to be confused with an earthquake — also threatened the C. H. Fisher home, which later was moved to another site. Fitzwater Road was permanently closed, and the county garage site is now a weed-grown pile of rubble.

Several factors were responsible for this big earthslide which caused damages estimated at $500,000, and various geologists stressed slightly different reasons. A Kent State University professor suggested the slide was due to artificial excavation at the foot or toe of an unsafe slope. The City of Cleveland was particularly interested in another theory that a leaky water main had lost enough water to cause the slide and that the city might therefore be liable for damages. Although water was the major culprit, the leaking water main had little or nothing to do with the disaster. Dr. Charles S. Bacon, a Case Institute of Technology geology professor, prepared a detailed map and report on the Brecksville landslide, noting that the heavy seasonal snows and rains had saturated and lubricated the thick lake clays along the lower reaches of the

The landslide in Brecksville, Ohio, in 1950 destroyed a county highway garage and parts of a nearby road and railroad tracks. (Photo by Fred Bottomer)

(continued on page 5)

4.9.2 Landslide Location

Cuyahoga County, located in northeastern Ohio, has moderate to high susceptibility to the landslide hazard in the eastern portion of the County. However, Southeast Ohio has by far the highest concentration of landslides throughout the state. Landslides occur primarily in colluvial (loose) soil and old landslide debris on steep slopes. Most major and minor highways have sections cut in rock or soil that can fail. Steep mountain slopes across the state have experienced debris avalanches associated with extreme rainfall or rain-on-snow events. Glacial and glacial-lake sediments underlie stream bank and lake bluff slumps and other failure areas across the much of the northern part of the state.

Urban and rural land development is increasing both the number of landslides and the economic effects of natural slides. Major highway construction with large excavations and fills located in mountainous areas creates potential for many landslides.

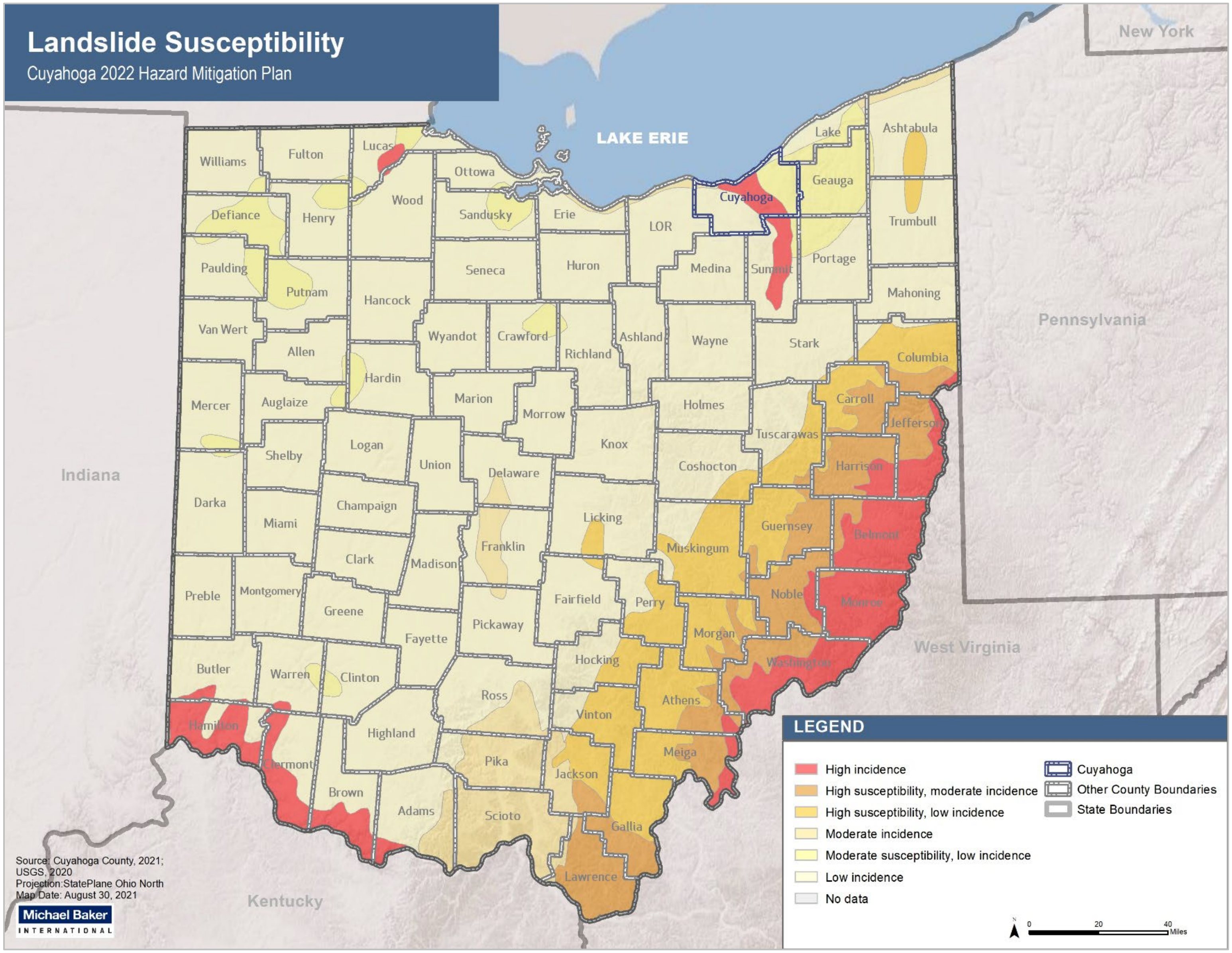
Landslides cause damage to transportation routes, utilities, and buildings, create travel delays and other side effects. Fortunately, deaths and injuries due to landslides are rare in Ohio. Almost all of known deaths due to landslides have occurred when boulders/rocks fall along highways and involve vehicles. Storm-induced debris flows are the only other type of landslide likely to cause death and injury. Most landslides that do occur in Ohio are slow to moderate moving and damage infrastructure rather than people. The Ohio Department of Transportation and large municipalities incur substantial costs due to landslide damage and to extra construction costs for new roads in known landslide-prone areas.

Due to Cuyahoga County's hilly and varied terrain, the north and eastern portions of the County and its communities are at risk from landslides. According to mapping data obtained by the USGS, a little over half of the County lies in a moderate or high susceptibility zone for landslides as shown in the following figure.

Roadways that run through valleys or alongside ridgeways are the most easily susceptible to landslides. This includes but is not limited to local streets, state routes, and county roads. These are located in rural areas where there are no other easily accessible roadways. A closure at any of these locations would result in significant delays for those living in those communities, especially during emergency events.

The *Low Incidence* zone, meaning that these areas have low susceptibility to landslides with a low incidence of occurrence. The other zones identified on the map are: *Moderate susceptibility, low incidence* zone, meaning that these areas have moderate susceptibility to landslides with a low incidence of occurrence; *High susceptibility, low incidence* zone, meaning that these areas have high susceptibility to landslides with a low incidence of occurrence; *Moderate Incidence* zone, meaning that this area has moderate susceptibility to landslides with a moderate incidence of occurrence; *High susceptibility, moderate incidence* zone, meaning these areas have high susceptibility to landslides with a moderate incidence of occurrence; and *High Incidence* zone, meaning that these areas have high susceptibility to landslides with a high incidence of occurrence.

FIGURE 4-43 LANDSLIDE SUSCEPTIBILITY IN OHIO



4.9.3 Extent

Approximately 25% of Cuyahoga County lies within a High Incidence zone. Approximately 25% lies within a Moderate Susceptibility, Low Incidence zone, and approximately 5% of the County lies in a Moderate Incidence zone.

4.9.4 Historical Occurrences

General Trends

The United States Geological Survey maintains a GIS-based database for probable landslides in the country. The database identifies the landslides reported are categorized by level of confidence, or the likelihood there was a landslide in the area. USGS uses the following rankings as its categorization:

- Possible landslide in the area (1)
- Probable landslide in the area (2)
- Likely landslide at or near this location (3)
- Confident consequential landslide at this location (5)
- High confidence in extent or nature of landslide (8)

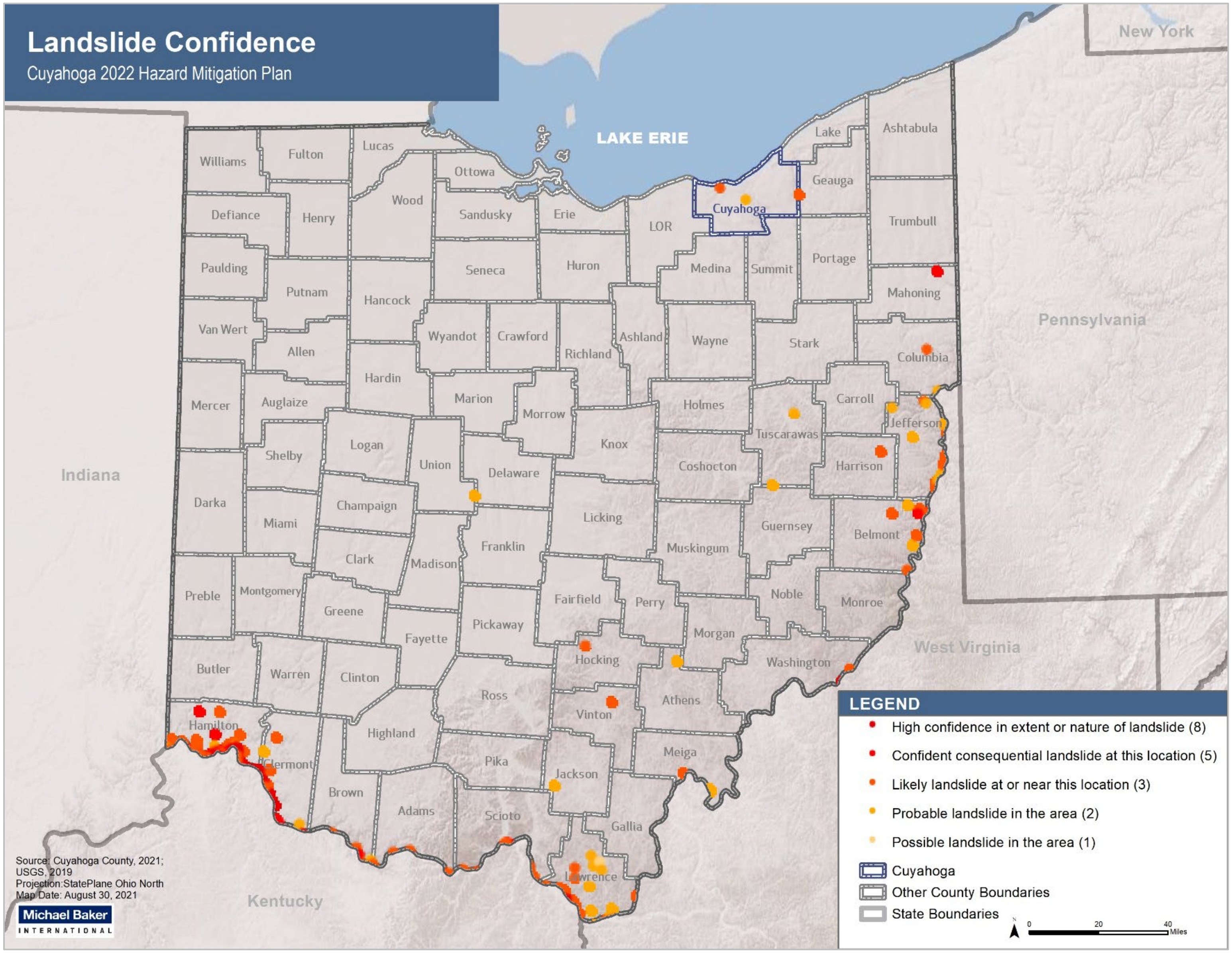
It can be concluded that a minimum of 3 landslides have occurred in the County in the past 20 years and many smaller landslides could have occurred that were not recorded.

TABLE 4-76 LANDSLIDES IN CUYAHOGA COUNTY (JANUARY 1, 2001-MARCH 31, 2021)

Landslide Location	Date	USGS Confidence Level	Fatalities
Hogsback Lane, Cleveland	4/8/2011	3	0
I-480 at Rt. 176	5/12/2011	2	0
Chagrin River	6/27/2015	3	0

Landslides and mudslides have not been a factor in any declared disasters for Cuyahoga County. The figure below depicts the landslides that have occurred in Cuyahoga County and in the rest of the state of Ohio.

FIGURE 4-44 PREVIOUS LANDSLIDES IN OHIO



Event Narratives

- **April 8, 2011:** On April 8th, Cleveland engineers had to close the upper third of Hogsback Lane after a landslide caused a guardrail to slip four feet. The slipped guardrail, protecting cars from a slope that ends in the Rocky River, made the road unsafe for cars to travel due to the steep slope that was exposed. The landslide, however, did not make the road vulnerable to collapsing, so pedestrians and cyclists were still able to utilize the full extent of the road. Hogsback Road was constructed on a shale hill, making it susceptible to crumbling. A plan to rebuild the road was developed in 2008 by Cleveland Metroparks for over $2 million, but the landslide delayed the plans.

- **June 27, 2015**: Police responded to calls regarding a landslide in Chagrin Falls around 1 P.M. The landslide occurred where a new bridge and walkway had been constructed over the Chagrin River. The road and walkway were closed to traffic and pedestrians until the engineer's office was able to evaluate the landslide causes and impacts.

4.9.5 Probability of Future Occurrences

The HMPC determined that it is "Possible" that Landslides will continue to occur in Cuyahoga County, meaning that they have a 1% and 10% chance of occurring annually.

Reported landslide events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a landslide event, although infrequent, can be difficult to quantify, but based on historical record of 3, according to the USGS data, landslide events since 2001, it can reasonably be assumed that this type of event has occurred once every 6.67 years from 2001 through 2021.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**20 Years**) / (**3 Events**) = **6.67 Years Between Events**

The historic frequency indicates that there is a 15% chance of this type of event occurring each year.

4.9.6 Assets Exposed to Landslides

Potential Losses

TABLE 4-77 POTENTIAL IMPACTS FROM LANDSLIDES

Impact	Description
People	While it is unlikely for people to be directly impacted by a landslide, it is possible for them to be in danger due to a lack of emergency services being able to reach them in a timely manner.
Infrastructure	Roadways will bear the brunt of landslides as they are the most likely to be near these locations. Homes may also be damaged by some slips.
Economy	The economy is unlikely to be affected by landslides, barring one happened along a major interstate.
Natural Systems	Trees and outcroppings are most likely to be damaged in landslides. If trees are moved significantly, they will likely die in the process.
Transportation	Transportation systems are most likely to be adversely affected in the process. Large slips can result in significant delays and road closures that can force changes to the transportation network.

Community Vulnerability

Incorporated communities within the County have zoning codes that have regulations based on slope and terrain. These communities account for approximately 99% of Cuyahoga County's population, for a total of 1,221,927 people. However, this leaves 13,145 people in unincorporated areas of the County, which are more susceptible to landslides.

TABLE 4-78 INCORPORATED COMMUNITY POPULATIONS, 2019

Community	Population
Bay Village	15,194
Beachwood	11,590
Bedford	12,457
Bedford Heights	10,460
Bentleyville	902
Berea	18,609
Bratenahl	1,379
Brecksville	13,604
Broadview Heights	19,102
Brook Park	18,382
Brooklyn	10,646
Brooklyn Heights	1,615
Chagrin Falls	4,032
Cleveland	381,009
Cleveland Heights	43,992
Cuyahoga Heights	677
East Cleveland	16,964
Euclid	46,550
Fairview Park	16,161
Garfield Heights	27,448
Gates Mills	2,189
Glenwillow	1,088
Highland Heights	8,373
Highland Hills	873
Hunting Valley	763
Independence	7,175
Lakewood	49,678
Linndale	160
Lyndhurst	13,366
Maple Heights	22,078
Mayfield	3,372
Mayfield Heights	18,487
Middleburg Heights	15,432
Moreland Hills	3,306
Newburgh Heights	1,718

Community	Population
North Olmsted	31,341
North Randall	1,106
North Royalton	30,068
Oakwood	3,668
Olmsted Falls	8,828
Orange	3,276
Parma	78,103
Parma Heights	19,790
Pepper Pike	6,330
Richmond Heights	10,342
Rocky River	19,986
Seven Hills	11,590
Shaker Heights	27,027
Solon	22,779
South Euclid	21,297
Strongsville	44,660
University Heights	12,797
Valley View	2,024
Walton Hills	2,246
Warrensville Heights	13,108
Westlake	32,032
Woodmere	698

4.9.7 Land Use and Development Trends

The varied terrain of Cuyahoga County can create pockets of land vulnerable to landslides. Development tends to occur on top of hills or within the valleys of the County, making buildings vulnerable from slippage, either undermining the foundation, or otherwise weakening the underlying foundation.

Regulatory Environment

Cuyahoga County itself does not have zoning codes that regulate the types of land that can be built upon, making it difficult to manage construction of buildings in the unincorporated parts of the County. Only the incorporated communities have zoning and development codes based on terrain and slope.

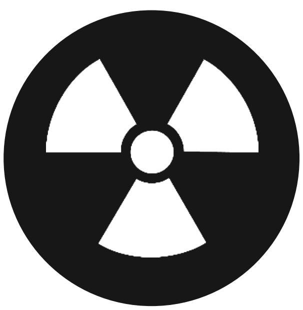
4.9.8 Mitigation Successes

The City of Cleveland has begun a mitigation project to protect Carter Road, and the assets that would be impacted, from a landslide. The riverbank of the Cuyahoga River is susceptible to landslides between the north side of Carter Road and east of the Columbus Road lift bridge. Potential vulnerable assets are a wastewater pipe located on the slope, infrastructure and utilities in the Carter Road right-of-way, the Cleveland Metroparks multipurpose trail, and Carter Road itself. With planned future development at risk to landslides, the City of Cleveland has taken action to remedy the landslide risk by developing the Carter Road Landslide Stabilization Project. The Carter Road Landslide Stabilization Project focuses on the restoration of the sloped riverbank and protection of the assets of the immediate area through installation of a retaining wall to mitigate any further landslide impacts. The mitigation project is currently in the funding stage, specifically the City is evaluating applicable funding sources that could be utilized to support the project.

4.9.9 Landslide Summary

Landslides can impact almost every part of Cuyahoga County. Where they do not have direct impacts, they can still be felt through road closures and long detours. Landslides can occur any time of year, particularly after heavy rainfall or during snowmelt events. They are considered likely to occur due to the County's varied terrain.

Man-Made Hazards

4.10. Hazardous Materials Release/Spill

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Hazardous Materials Release/Spill	4	0.3	2	0.3	2	0.2	4	0.1	3	0.1	**2.9**
Moderate Risk Hazard (2.0 – 2.9)											

4.10.1 Hazardous Materials Release/Spill Description

Traditional Hazardous Materials

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

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

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

When a release occurs, one of four Hazmat teams are dispatched depending on the location of the spill, the Cleveland Fire Department Hazardous Materials Team, the Westshore Hazmat Team, the Chagrin/Southeast Hazmat Team, or the Southwest Emergency Response Team. The County has also established a FEMA Type 1 HazMat team. This is comprised of the previous four teams and provides additional training and resources.

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

Hospital Radioactive Isotopes

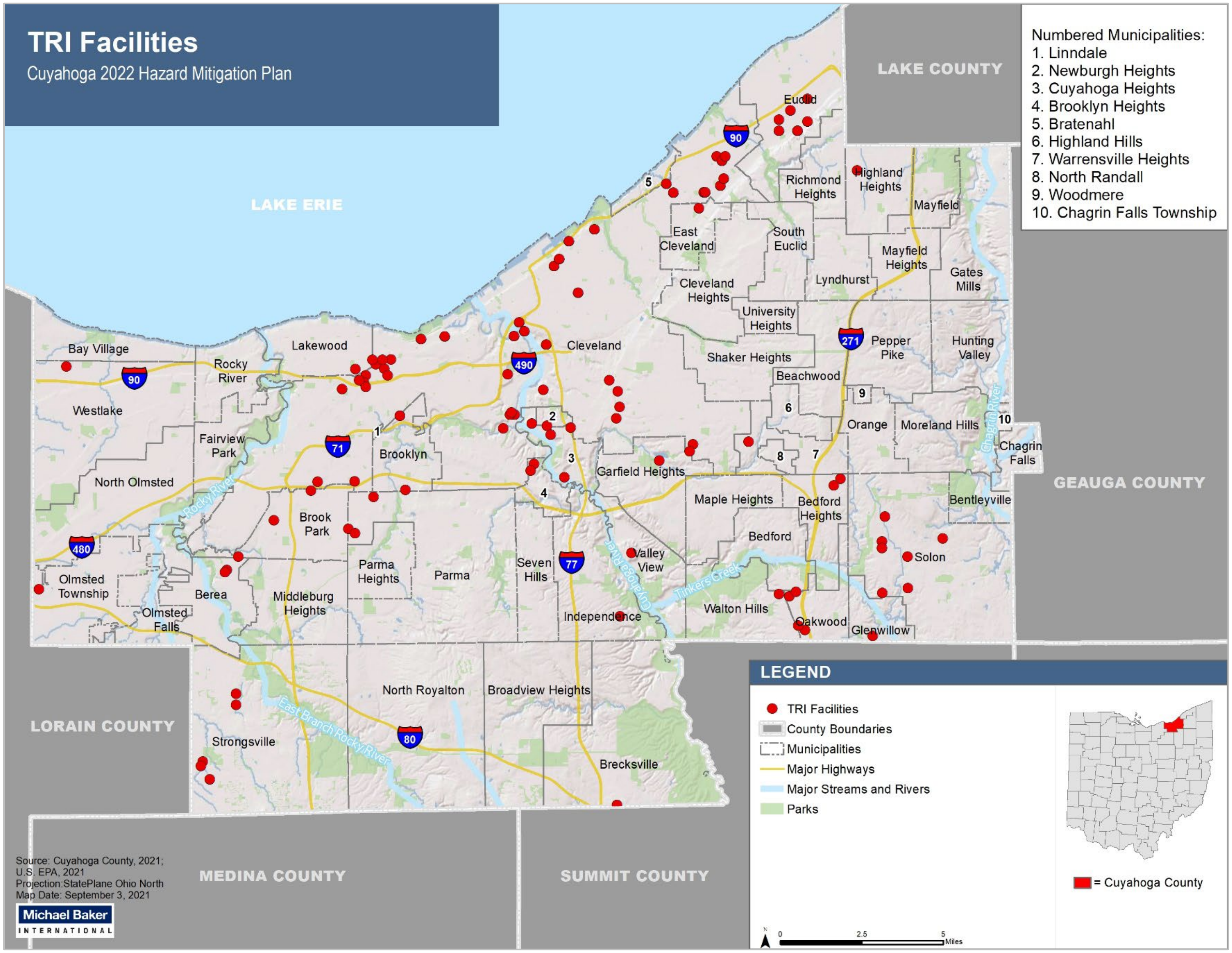
Hospitals are increasingly using radioactive isotopes for diagnostic and therapeutic applications. The bulk of the hospital radioactive waste is commonly generated in the department of Nuclear Medicine. Generally, most of the radioactive waste is liquid. Some lesser amounts of the waste are solid and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

4.10.2 Hazardous Materials Release/Spill Location

While the initial incident may occur on a roadway, railroad, or in a facility that houses hazardous materials, the hazard could expand to the entire County. Contamination of hazardous materials can spread through the air, soil, and water of surrounding resources thus carrying the toxin throughout the area. There are several major US Routes and State Routes that intersect Cuyahoga County. Hazardous Materials incidents can occur on any roadway, railroad, or in a facility, but roadways that see heavier traffic have a higher probability of being a location for an event.

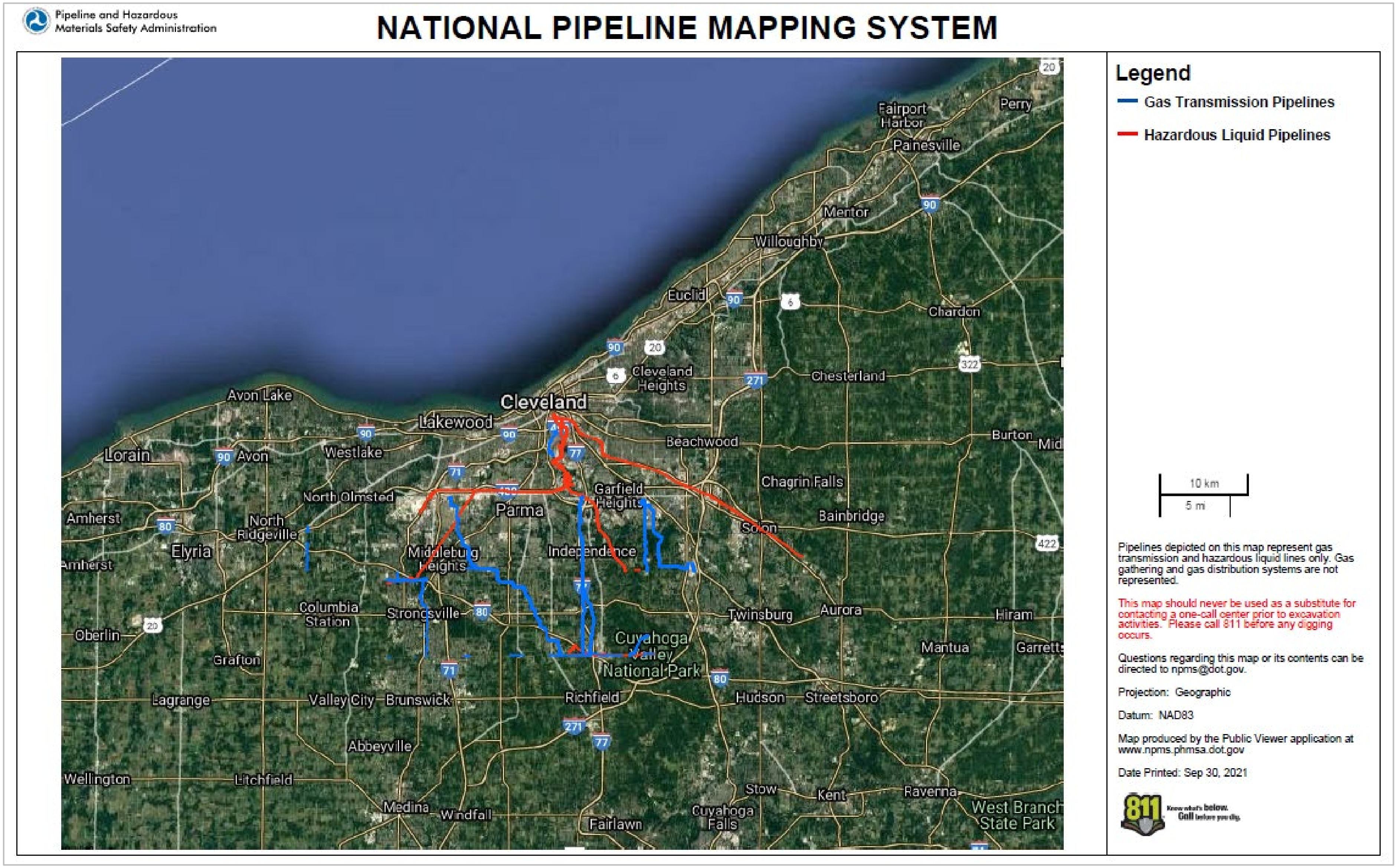
Cuyahoga County has 233 Toxics Release Inventory (TRI) facilities according to the United States Environmental Protection Agency (EPA) website. TRI facilities are industrial and federal facilities that are releasing certain toxic chemicals through the air, water, or land disposal. These facilities' releases are tracked and regulated by the EPA as the chemicals they are releasing may pose a threat to human health and the environment. The toxic chemicals that facilities are required to report when released include chemicals that cause cancer or other chronic human health effects, significant adverse acute human health effects, and significant adverse environmental effects. As these facilities are regulated, thus required to safely release toxic chemicals, they are not considered to be a hazardous materials incident. However, it is still important to identify the locations of where toxic chemicals are being released.

FIGURE 4-45 TRI FACILITIES IN CUYAHOGA COUNTY



The following figure shows the locations of gas transmission pipelines and hazardous liquid pipelines within Cuyahoga County. The pipelines are possible locations for a hazardous materials incident should the structures fail.

FIGURE 4-46 OIL AND GAS PIPELINES WITHIN CUYAHOGA COUNTY



4.10.3 Extent

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

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

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

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

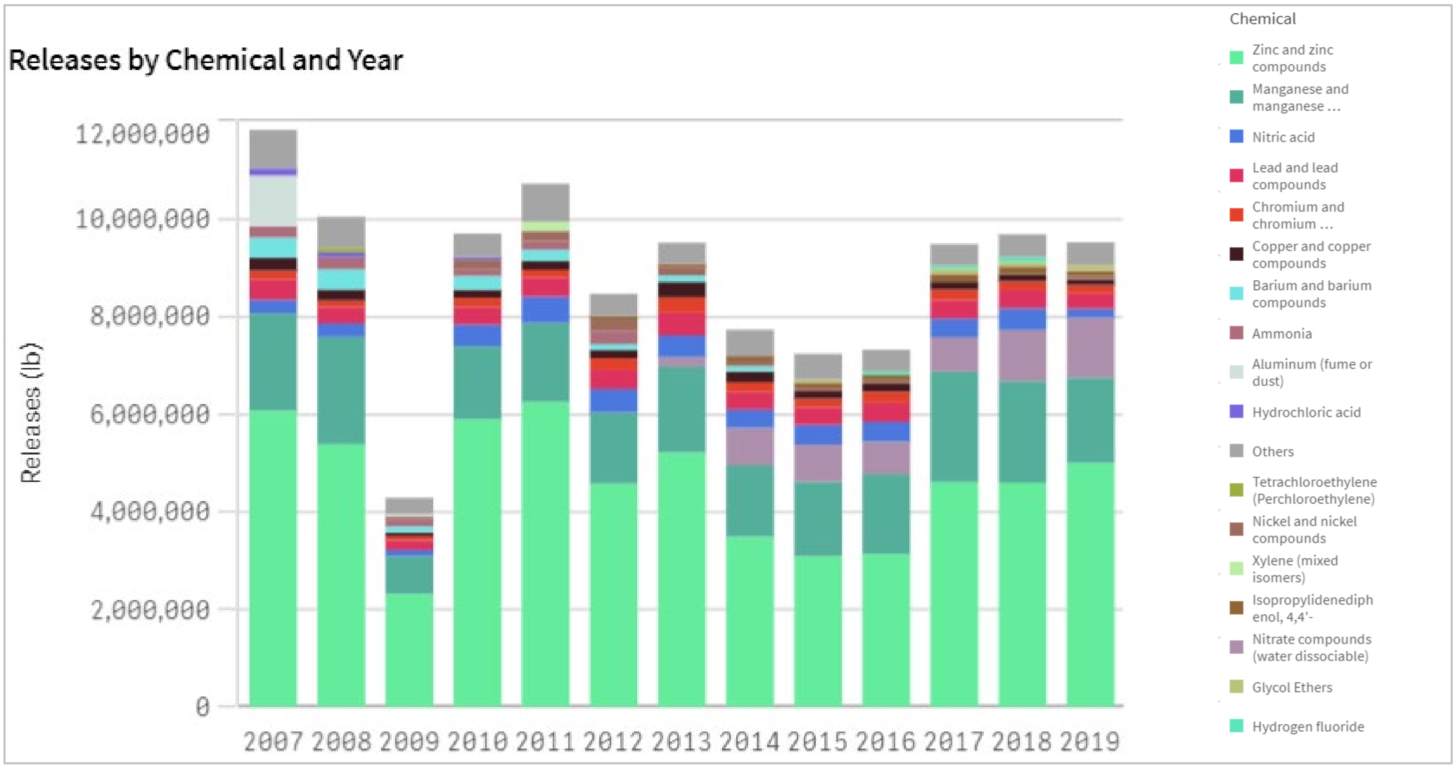
4.10.4 Historical Occurrences

There are small-scale spills and hazardous materials incidents that occur on a regular basis. These usually consist of mostly innocuous incidents such as traffic accidents that leave gasoline on the roadway. However, large-scale incidents are far rarer and more catastrophic when they occur.

General Trends

From 2007 to 2019, Cuyahoga County has seen a reduction in chemicals being released into the air, off-site, land, and water. The addition of approximately 115 million pounds of chemicals have occurred over the twelve-year snapshot. While zinc and zinc compound releases, the top chemical release in the County, have generally declined over the timeframe, nitrate compounds (water dissociable) has increased as one of the top releases in the past 5 years. However, these releases of chemicals are reported to the EPA from the facilities in Cuyahoga County and do not account for hazardous materials spills or accidents.

FIGURE 4-47 CUYAHOGA COUNTY TRI CHEMICAL RELEASES



Since 2011, there have been 398 hazardous materials spill events according to the Cuyahoga County Office of Emergency Management data. The table below shows the number of events per year from 2011-2019.

TABLE 4-79 HAZARDOUS MATERIALS SPILLS IN CUYAHOGA COUNTY

Year	Number of Hazardous Materials Spills Recorded
2011	46
2012	69
2013	41
2014	44
2015	33
2016	38
2017	41
2018	37
2019	49
Total	**398**

4.10.5 Probability of Future Occurrences

Hazardous materials incidents happen every day throughout the county. Small-scale incidents will continue to occur as normal operation around the County. Larger incidents will remain seldom but can still occur at any time. The HMPC determined that it is “Highly Likely” that Hazardous Materials Release/Spill will continue to occur in Cuyahoga County, meaning that they will remain as an annual event.

Reported hazardous material release or spill events over the past 9 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of experiencing a hazardous material release/spill event, although infrequent, can be difficult to quantify, but based on historical record of 398 events according to the County’s data since 2011, it can reasonably be assumed that this type of event has occurred once every 6.67 years from 2011 through 2019.

(**2019** CY) - (**2011** HY) = **9 Years on Record**

(**9 Years**) / (**398 Events**) = **0.02 Years Between Events**

The historic frequency indicates that there is a 100% chance of this type of event occurring each year.

4.10.6 Assets Exposed to Hazardous Materials Release/Spill

Potential Losses

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

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

  Possible losses to structures include:

    - Inaccessibility
    - Contamination
    - Structural and contents losses, if an explosion is present
- **Possible ecologic losses include:**
    - Loss of wildlife
    - Habitat damage
    - Reduced air and water quality
- **Possible social losses include:**
    - Canceled activities
    - Emotional impacts of significant population losses and illnesses

TABLE 4-80 POTENTIAL IMPACTS FROM HAZMAT INDICENTS

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

Community Vulnerability

All County assets can be considered at risk from hazardous materials releases. This includes 100 percent of the County population and all buildings and infrastructure. The presence of the major highways that run throughout the County, as well as railways and pipelines, present a high risk of hazardous materials incidents occurring.

The following table shows the structures that are within 1.5 miles of the hazardous materials facilities that are located within Cuyahoga County, including critical facilities. Structures that are located in close proximity to hazardous material facilities are vulnerable to a release or spill incident. Cleveland has the highest number of structures located near a hazardous material facility with 84,647 structures. Euclid has the second highest number of structures located within 1.5 miles of a hazardous material facility with 8,046 structures, and Lakewood has the third highest with 6,777 structures. There are numerous jurisdictions in which 100% of its structures are 1.5 miles away from a hazardous materials facility: Bratenahl, Brooklyn Heights, Cuyahoga Heights, Glenwillow, Linndale, Newburgh Heights, and Oakwood. Cleveland has the highest number of its critical facilities located within 1.5 miles of a hazardous material facility. Euclid has the second highest number of critical facilities located within 1.5 miles of hazardous material facilities with 40 structures, and East Cleveland has the third highest number with 39 structures.

TABLE 4-81 VULNERABILITY OF STRUCTURES NEAR HAZARDOUS MATERIALS SITES

Municipality	Total Structures	Structures Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Percent Structures Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Total Critical Facilities	Critical Facilities Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Percent Critical Facilities Vulnerable to Hazardous Material Facilities (within 1.5 miles)
Bay Village	4,092	1,873	46%	13	7	54%
Beachwood	2,352	0	0%	29	0	0%
Bedford	3,562	1,009	28%	21	5	24%
Bedford Heights	2,284	1,839	81%	8	7	88%
Bentleyville	203	73	36%	2	0	0%
Berea	4,561	2,924	64%	25	22	88%
Bratenahl	326	326	100%	8	8	100%
Brecksville	3,596	967	27%	18	4	22%
Broadview Heights	4,818	13	0%	11	0	0%
Brook Park	5,087	4,960	98%	15	14	93%
Brooklyn	2,793	2,770	99%	8	8	100%
Brooklyn Heights	520	520	100%	4	4	100%
Chagrin Falls	1,126	0	0%	9	0	0%
Chagrin Falls Township	27	0	0%	0	0	0%
Cleveland	99,020	84,647	85%	731	621	85%
Cleveland Heights	10,733	1,735	16%	58	6	10%
Cuyahoga Heights	215	215	100%	6	6	100%
East Cleveland	5,169	4,120	80%	41	39	95%
Euclid	11,074	8,046	73%	48	40	83%
Fairview Park	4,164	0	0%	19	0	0%
Garfield Heights	7,757	6,555	85%	33	31	94%
Gates Mills	650	0	0%	6	0	0%
Glenwillow	239	239	100%	1	1	100%
Highland Heights	2,187	1,550	71%	10	5	50%
Highland Hills	115	90	78%	7	4	57%
Hunting Valley	150	0	0%	2	0	0%

Municipality	Total Structures	Structures Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Percent Structures Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Total Critical Facilities	Critical Facilities Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Percent Critical Facilities Vulnerable to Hazardous Material Facilities (within 1.5 miles)
Independence	2,088	1,368	66%	13	10	77%
Lakewood	11,206	6,777	60%	59	35	59%
Linndale	45	45	100%	1	1	100%
Lyndhurst	3,835	0	0%	17	0	0%
Maple Heights	6,618	2,000	30%	32	10	31%
Mayfield	869	0	0%	6	0	0%
Mayfield Heights	3,786	0	0%	14	0	0%
Middleburg Heights	4,080	798	20%	19	4	21%
Moreland Hills	916	0	0%	2	0	0%
Newburgh Heights	568	568	100%	6	6	100%
North Olmsted	7,835	552	7%	31	1	3%
North Randall	145	143	99%	7	7	100%
North Royalton	6,993	0	0%	22	0	0%
Oakwood	1,096	1,096	100%	6	6	100%
Olmsted Falls	2,177	2	0%	8	0	0%
Olmsted Township	3,465	704	20%	12	0	0%
Orange	863	354	41%	3	1	33%
Parma	20,666	5,019	24%	78	11	14%
Parma Heights	4,595	2,487	54%	17	11	65%
Pepper Pike	1,652	0	0%	17	0	0%
Richmond Heights	2,254	1,567	70%	17	12	71%
Rocky River	4,622	0	0%	29	0	0%
Seven Hills	3,351	315	9%	8	1	13%
Shaker Heights	5,839	584	10%	42	1	2%
Solon	5,671	4,564	80%	23	23	100%
South Euclid	5,852	421	7%	23	0	0%
Strongsville	11,101	5,299	48%	28	15	54%

Municipality	Total Structures	Structures Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Percent Structures Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Total Critical Facilities	Critical Facilities Vulnerable to Hazardous Material Facilities (within 1.5 miles)	Percent Critical Facilities Vulnerable to Hazardous Material Facilities (within 1.5 miles)
University Heights	2,896	0	0%	12	0	0%
Valley View	660	461	70%	5	3	60%
Walton Hills	669	413	62%	4	3	75%
Warrensville Heights	2,703	2,562	95%	25	25	100%
Westlake	7,590	1,466	19%	35	8	23%
Woodmere	165	0	0%	2	0	0%
Total	**313,691**	**164,036**	**52%**	**1,756**	**1,026**	**58%**

The following table displays the structures that are vulnerable to hazardous materials release by land use type per municipality. There are a total of 164,036 structures within 1.5 miles of a hazardous material facility in Cuyahoga County. 8,087 of the structures are commercial buildings, 277 of the parcels are green space, 4,918 structures are industrial buildings, 1,069 structures are institutional buildings, 149,369 structures are residential buildings, and 176 are utility structures.

TABLE 4-82 STRUCTURES VULNERABLE TO HAZARDOUS MATERIALS RELEASE BY LAND USE TYPE PER MUNICIPALITY

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Bay Village	18	3	3	4	1,844	1	1,873
Beachwood	0	0	0	0	0	0	0
Bedford	93	1	51	12	852	0	1,009
Bedford Heights	48	3	143	6	1,637	2	1,839
Bentleyville	0	5	0	0	68	0	73
Berea	131	0	70	48	2,673	2	2,924
Bratenahl	1	0	0	2	323	0	326
Brecksville	29	0	102	1	832	3	967
Broadview Heights	0	0	0	0	13	0	13
Brook Park	100	83	132	13	4,629	3	4,960
Brooklyn	112	2	71	14	2,569	2	2,770
Brooklyn Heights	7	1	126	1	385	0	520
Chagrin Falls	0	0	0	0	0	0	0
Chagrin Falls Township	0	0	0	0	0	0	0
Cleveland	4,941	74	2,484	696	76,245	92	84,647
Cleveland Heights	20	5	0	4	1,706	0	1,735
Cuyahoga Heights	7	2	49	3	145	9	215
East Cleveland	203	4	29	24	3,856	4	4,120
Euclid	192	3	140	28	7,674	8	8,046
Fairview Park	0	0	0	0	0	0	0
Garfield Heights	279	4	136	30	6,099	5	6,555
Gates Mills	0	0	0	0	0	0	0
Glenwillow	7	3	32	0	193	4	239
Highland Heights	9	3	15	0	1,523	0	1,550
Highland Hills	1	0	0	2	87	0	90
Hunting Valley	0	0	0	0	0	0	0
Independence	74	12	54	15	1,207	6	1,368
Lakewood	415	1	28	37	6,293	2	6,777
Linndale	5	0	8	3	29	0	45
Lyndhurst	0	0	0	0	0	0	0
Maple Heights	116	0	13	7	1,859	2	2,000
Mayfield	0	0	0	0	0	0	0
Mayfield Heights	0	0	0	0	0	0	0
Middleburg Heights	40	1	157	2	597	1	798

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Moreland Hills	0	0	0	0	0	0	0
Newburgh Heights	17	2	9	3	535	2	568
North Olmsted	9	0	31	0	511	1	552
North Randall	45	0	3	1	94	0	143
North Royalton	0	0	0	0	0	0	0
Oakwood	32	1	99	6	958	0	1,096
Olmsted Falls	0	0	0	0	2	0	2
Olmsted Township	11	10	9	0	674	0	704
Orange	7	1	0	2	344	0	354
Parma	270	0	116	28	4,587	1	5,019
Parma Heights	157	2	0	12	2,315	1	2,487
Pepper Pike	0	0	0	0	0	0	0
Richmond Heights	26	5	8	8	1,517	3	1,567
Rocky River	0	0	0	0	0	0	0
Seven Hills	2	0	0	0	312	0	315
Shaker Heights	0	2	0	0	582	0	584
Solon	194	8	267	26	4,066	3	4,564
South Euclid	0	0	0	0	421	0	421
Strongsville	191	23	122	12	4,934	17	5,299
University Heights	0	0	0	0	0	0	0
Valley View	19	11	108	2	320	1	461
Walton Hills	7	1	49	1	355	0	413
Warrensville Heights	85	0	167	12	2,297	1	2,562
Westlake	167	1	87	4	1,207	0	1,466
Woodmere	0	0	0	0	0	0	0
Grand Total	**8,087**	**277**	**4,918**	**1,069**	**149,369**	**176**	**164,036**

4.10.7 Land Use & Development Trends

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

Regulatory Environment

Extensive regulations are in place, set forth by both the State of Ohio and the United States government on the handling and transport of hazardous materials. Newer hazards, such as those introduced through fracking, also have many regulations pertaining to their safety and use.

The US EPA's Toxic Release Inventory (TRI) program tracks hazardous materials release and disposal data for communities throughout the nation. Disposals in Cuyahoga County largely include Zinc and zinc compounds, Manganese and manganese compounds, nitrate compounds (water dissociable), Nitric acid, and lead and lead compounds. The TRI data also provides data regarding the effect on the public of releases or disposals of hazardous materials.

4.10.8 Hazardous Materials Release/Spill Summary

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

Mitigation Best Practices

FEMA has published a series of prevention and mitigation measures that is geared toward residents and households on what they can do to help reduce the number of hazardous materials incidents, or the severity of these events. These can be used in educational materials distributed by the County or its jurisdictions, and are a good way of preventing smaller scale incidents.

Prevention

- Use all materials in accordance with their instructions.
- Store pesticides and other hazardous chemicals in safe places where children and animals cannot be exposed. Storage areas must guard against freezing and overheating of hazardous materials. They should also have separate locks.
- Store chemicals on the floor or on lower shelves to prevent spills. Lips are recommended for all shelving upon which hazardous materials are stored.
- Properly dispose of any unsafe or excess materials and containers.

Protection Actions

- Ask your local fire department or emergency management agency for information on hazardous materials in your community.
- Find out what clinical signs these toxins may cause if a person or an animal has been exposed.
- Take a training course in hazardous materials.
- FEMA may provide resource information and technical and financial assistance to States for developing emergency plans for hazardous materials accidents and other types of emergencies, and assist State and local governments in hazardous materials training.
- The Environmental Protection Agency (EPA) also conducts technical and environmental training programs related to hazardous materials. At the request of community officials, the EPA can provide technical expertise on the full range of environmental contamination issues.

Mitigation Measures

- Install and label sinks and eye wash stations.
- Store appropriate absorbent materials near hazardous materials in the event of a spill.
- Post warning signs on storage areas.
- Post and review Material Safety Data Sheets (MSDS) for commonly used chemicals.

The full guide can be found at https://emilms.fema.gov/is10a/AID0107030text.htm

4.11. Nuclear Power Incident

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Nuclear Power Incident	2	0.3	3	0.3	4	0.2	2	0.1	4	0.1	**2.9**
Moderate Risk Hazard (2.0 – 2.9)											

4.11.1 Nuclear Power Incident Description

While there are no nuclear facilities located in Cuyahoga County, the Perry Nuclear Energy Generating Station is in the adjacent Lake County. The fifty-mile radius of the Ingestion Exclusion Zone (IEZ) from the plant encompasses almost the entirety of Cuyahoga County.

Nuclear accidents generally refer to events involving the release of significant levels of radioactivity or exposure of workers or the general public. These types of incidents generally only occur as a result of equipment malfunction or human error. Immediately following a nuclear event, the primary concern is the extent of radiation, and the inhalation and ingestion of radioactive isotopes. Nuclear accidents and incidents are classified under three categories:

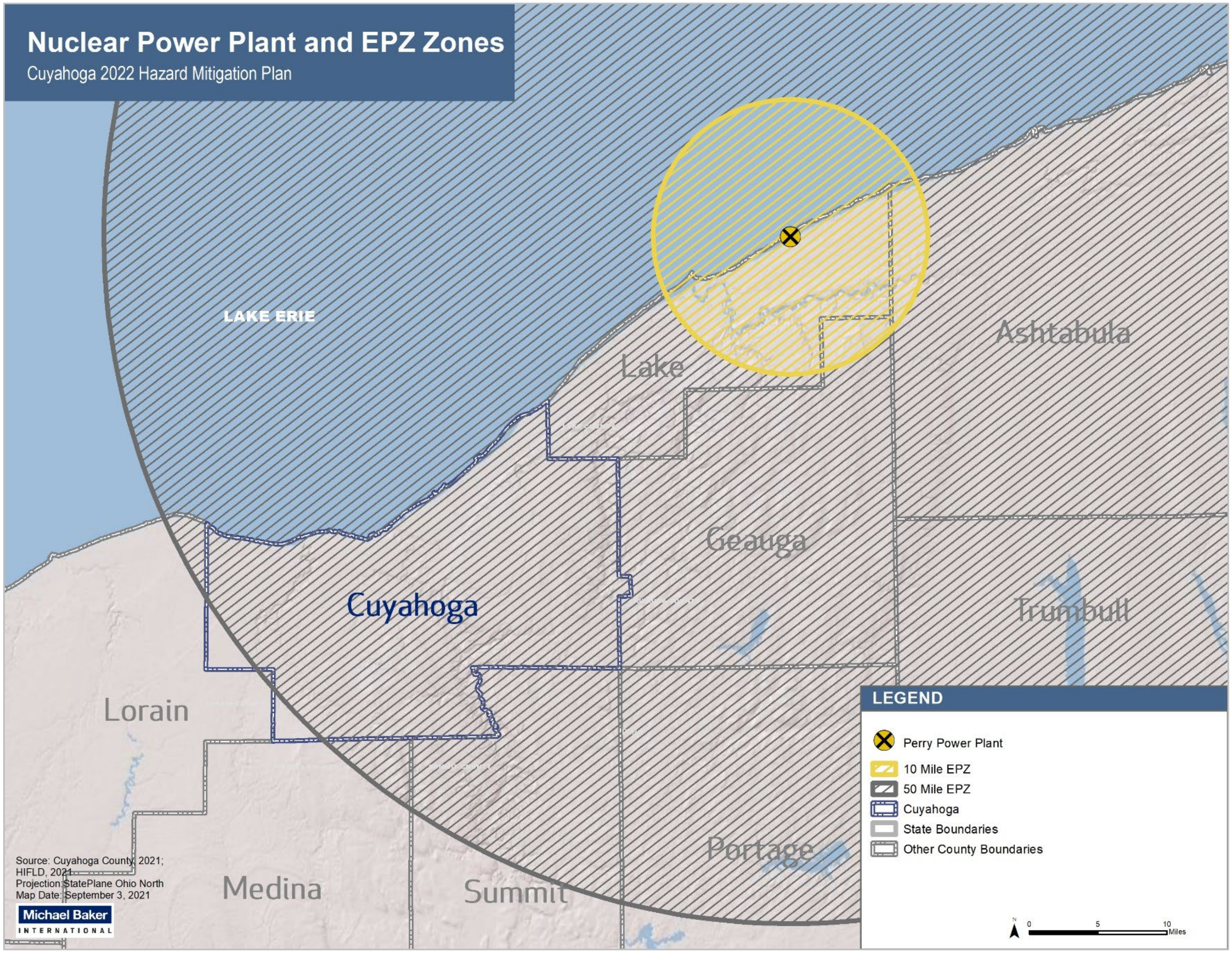
- **Criticality incidents**: Involve nuclear assemblies, research, production or power reactors, and chemical operation. Worldwide, these incidents have resulted in fatalities, radiation exposure, and release of radioactivity into the environment.
- **Loss-of-coolant**: Accidents result when a reactor coolant system experiences a breach large enough that coolant inventory can no longer be maintained by the normally operating makeup system.
- **Loss-of-containment**: Accidents involve the release of radioactivity. Points of release for this type of incident can be containment vessels at power facilities or damaged packages during transportation.

Nuclear accidents can result in acute health problems such as death, burns, and severe impairment, chronic health effects such as cancer, as well as persistent psychological effects.

4.11.2 Nuclear Power Incident Location

Although Cuyahoga County does not have any nuclear power plants within the County itself, there is a Nuclear Power Plant in Lake County, a county adjacent to Cuyahoga. Almost all of Cuyahoga County is located in the 50-mile emergency planning zone of Perry Power Plant, putting the County's population and assets at risk to a nuclear power incident. The following figure shows the location of the nuclear power plant, Perry Power Plant, in Lake County, as well as the two emergency planning zones around the plant.

FIGURE 4-48 NUCLEAR POWER PLANT AND EPZ ZONES



4.11.3 Extent

To facilitate a preplanned strategy for protective actions during an emergency, there are two emergency planning zones (EPZs) around each nuclear power plant. The exact size and shape of each EPZ is a result of detailed planning which includes consideration of the specific conditions at each site, unique geographical features of the area, and demographic information. This preplanned strategy for an EPZ provides a substantial basis to support activity beyond the planning zone in the extremely unlikely event it would be needed.

The plume exposure pathway (PEP) EPZ has a radius of about 10 miles from the reactor site. Predetermined protective action plans are in place for this EPZ and are designed to avoid or reduce dose from potential exposure of radioactive materials. These actions include sheltering, evacuation, and the use of potassium iodide where appropriate.

The ingestion exposure pathway (IEP) EPZ has a radius of about 50 miles from the reactor site. Predetermined protective action plans are in place for this EPZ and are designed to avoid or reduce dose from potential ingestion of radioactive materials. These actions include a ban of contaminated food and water.

The NRC uses four classification levels for nuclear incidents:

- Unusual Event: Under this category, events are in process or have occurred which indicate potential degradation in the level of safety of the plant. No release of radioactive material requiring offsite response or monitoring is expected unless further degradation occurs.
- Alert: If an alert is declared, events are in process or have occurred which involve an actual or potential substantial degradation in the level of safety of the plant. Any releases of radioactive material from the plant are expected to be limited to a small fraction of the Environmental Protection Agency Protective Action Guides.
- Site Area Emergency: A site area emergency involves events in process or which have occurred that result in actual or likely major failures of plant functions needed for protection of the public. Any releases of radioactive material are not expected to exceed the EPA PAGs except near the site boundary.
- General Emergency: A general emergency involves actual or imminent substantial core damage or melting of reactor fuel with the potential for loss of containment integrity. Radioactive releases during a general emergency can reasonably be expected to exceed the EPA PAGs for more than the immediate site area.

FIGURE 4-49 NRC NUCLEAR INCIDENT CLASSIFICATION

Phase	Symptom	Whole-body absorbed dose (Gy)				
		1–2 Gy	2–6 Gy	6–8 Gy	8–30 Gy	Greater Than 30 Gy
Immediate Effects	Nausea and vomiting	5–50%	50–100%	75–100%	90–100%	100%
	Time of onset	2–6 hours	1–2 hours	10–60 minutes	< 10 minutes	< 5 Minutes
	Duration	< 24 hours	24–48 hours	< 48 hours	< 48 hours	Patients die within 48 hours
	Diarrhea	None	None to mild (< 10%)	Heavy (> 10%)	Heavy (> 95%)	Heavy (100%)
	Time of onset	—	3–8 hours	1–3 hours	< 1 hours	< 1 hours
	Headache	Slight	Mild to moderate (50%)	Moderate (80%)	Severe (80–90%)	Severe (100%)
	Time of onset	—	4–24 hours	3–4 hours	1–2 hours	< 1 hours
	Fever	None	Moderate increase (10-100%)	Moderate to severe (100%)	Severe (100%)	Severe (100%)
	Time of symptom onset	—	1–3 hours	< 1 hours	< 1 hours	< 1 hours
	Central nervous system function	No impairment	Cognitive impairment 6–20 h	Cognitive impairment > 24 h	Rapid incapacitation	Seizures, Tremor, At axia, Lethargy
Latent period		28–31 days	7–28 days	< 7 days	None	None
Illness	Various	Mild to moderate Leukopenia	Moderate to severe Leukopenia	Severe leukopenia	Nausea	Patients die within 48 hours
		Fatigue	Purpura	High fever	Vomiting	
		Weakness	Hemorrhage	Diarrhea	Severe diarrhea	
			Infections	Vomiting	High fever	
			Epilation after 3 Gy	Dizziness and disorientation	Electrolyte disturbance	
				Hypotension	Shock	
				Electrolyte disturbance		
Mortality	Without care	0–5%	5–95%	95–100%	100%	100%
	With care	0–5%	5–50%	50–100%	100%	100%
	Death	6 – 8 weeks	4 – 6 weeks	2 – 4 weeks	2 days – 2 weeks	1 – 2 days

Radioactive fallout is the main danger during nuclear incidents. Gamma rays, a product of radioactivity, can result in acute and long-term sickness, with large doses leading to death. The unit for an absorbed dose of radiation is the Gray (Gy). One Gy is equivalent to one joule of energy in the form of ionizing radiation, per kilogram of matter. While any radiation absorption is dangerous, any exposure of 8 Gy or greater will result in certain death within a short period of time.

4.11.4 Historical Occurrences

There have been no incidents involving nuclear materials in Cuyahoga County or its adjacent counties. The only nuclear accident in the State of Ohio happened at the Davis-Besse Nuclear Power Station located in Ottawa County. In 2002, boric acid dissolved almost entirely through a 6-inch-thick steel cap in the station's reactor. For two years, the plant was shut down while $600 million in repairs were conducted. The plant also suffered other issues, though none nearly as severe, including getting directly struck by an F2 tornado in 1998. In that incident, all backup systems operated successfully to keep critical cooling online until external power could be restored.

The worst nuclear accident in United States history was the 1979 incident at Three Mile Island Nuclear Generating Station in Dauphin County, Pennsylvania. The failures began in non-nuclear secondary systems, and were compounded by a stuck-open relief valve in the primary system, which allowed coolant to escape. Poorly designed user interfaces in the control room of the plant, combined with inadequate training and preparation, caused the station operation to believe that there was too much coolant present, causing a steam pressure release. The highest level of emergency was declared, a general emergency, meaning that there was a potential for serious radiological consequences to the general public. The aftermath would not be fully cleaned up until 1993.

4.11.5 Probability of Future Occurrences

There have been no recorded nuclear accidents at the Perry Nuclear Generating Station. There is no indication that an accident is imminent, and the probability is "Possible," as defined by the risk factor assessment, meaning there is a between 1% and 10% probability of a nuclear power incident occurring. While the probability of an event is not likely, nuclear incidents could be triggered by external factors such as tornadoes, earthquakes, or terrorism, or by internal malfunctions and leaks.

4.11.6 Assets Exposed to Nuclear Power Incidents

Potential Losses

TABLE 4-83 POTENTIAL IMPACTS FROM A NUCLEAR POWER INCIDENT

Impact	Description
People	People can experience a range of symptoms, from immediate effects to lasting symptoms. Seriousness of illness can range from light to moderate symptoms to death, depending on amount of absorbed dosage and care received.
Infrastructure	Structure of plant itself could be seriously damaged.
Economy	Loss of business if businesses near incident close.
Natural Systems	Radiation could cause health problems in wild animals as well as in vegetation. Any chemicals that mixed into water systems could spread throughout the waterways.
Transportation	Road closures near nuclear power plant could cause delay in traffic flow or detours.

Community Vulnerability

All County assets can be considered at risk from a nuclear power incident. This includes 100% of the County population and all buildings and infrastructure. Most structures, including critical facilities, should be able to provide adequate protection but people outside or closer to the incident could be more vulnerable to ingestion.

4.11.7 Land Use & Development Trends

Very little of Cuyahoga County land is classified as agriculture, thus substantially decreasing the effect of nuclear incidents on the economic well-being of the County. The County should have an adequate number of shelters in place to absorb evacuees from Lake County.

Regulatory Environment

Nuclear energy and waste is heavily regulated by the Federal government through the United States Nuclear Regulatory Commission (NRC). The NRC was created as an independent agency by Congress in 1974 to ensure the safe use of radioactive materials for beneficial civilian purposes while protecting people and the environment. The NRC has five main components that make up its regulatory process:

1) Developing regulations and guidance for our applicants and licensees,
2) Licensing or certifying applicants to use nuclear materials or operate nuclear facilities or decommissioning that permits license termination,
3) Overseeing licensee operations and facilities to ensure that licensees comply with safety requirements,
4) Evaluating operational experience at licensed facilities or involving licensed activities, and
5) Conducting research, holding hearings to address the concerns of parties affected by agency decisions, and obtaining independent reviews to support our regulatory decisions.

4.11.8 Nuclear Power Incident Summary

Nuclear Incidents have the ability to affect the population within 50 miles of a plant. Though a nuclear accident is unlikely, Cuyahoga County should be prepared for possible fallout around its agricultural areas. There will likely be a sudden influx of evacuees from Lake County. Education, training, and cooperation is paramount when attempting to mitigate the effects of a nuclear incident. While the County does not have a nuclear facility within its borders, it will be affected by the Perry Nuclear Generating Station in the event of an incident. The best thing that Cuyahoga County jurisdictions can do to prepare is adequately train first responders in dealing with evacuees and potential fallout.

Mitigation Best Practices

People receive radiation exposure each day from the sun, radioactive elements in soil and rocks, household appliances like television sets and microwave ovens, and medical and dental x-rays. These exposures may prompt controversy, but they do not pose the risk of imminent danger from radiation release that might occur if a nuclear power plant had a meltdown. Serious radiological accidents can occur anywhere radioactive materials are used, stored, or transported. A nuclear power plant, hospital, university, research laboratory, industrial plant, major highway, railroad line, or shipping yard could be the site of a radiological emergency.

- **Users of Radiological Materials**: Users, transporters, and disposers of radiological materials are required to follow strict procedures that prevent or minimize radiation release.
- **Emergency Planning for Transportation Routes**: Communities located along major transportation routes should develop and practice an emergency plan for handling transportation accidents involving radiological materials.
- **Radiological Emergency Preparedness for Nuclear Plants**: Radiological Emergency Preparedness (REP) for communities surrounding nuclear power plants requires proper awareness of, training on, and

implementation of radiological emergency procedures. Specific planning requirements for communities within primary and secondary Emergency Planning Zones are found in the Code of Federal Mitigation Ideas, FEMA-R5, 9/02 Page 28 of 30 Regulations (44 CFR § 350, 351, 352) and in a Nuclear Regulatory Commission guidance document (NUREG-0654).

- **Three Ways to Minimize Exposure**: A community can promote the following three ways to minimize radiation exposure: 1) distance; 2) shielding; and 3) time. The more distance between a person and the source of the radiation, the less radiation received. Like distance, the heavier, dense materials between a person and the source of the radiation, the better. Finally, most radioactivity loses its strength fairly quickly. Limiting the time spent near the source of radiation reduces the amount of radiation received.
- **Shelters and Warning Systems**: Communities can promote awareness of designated fallout shelters and accident warning systems. They also may develop and promote workable population protection plans, i.e., evacuation and in-place sheltering plans.
- **Safe Rooms**: Concrete safe rooms or shelters can be constructed in houses, trailer parks, community facilities, and business districts.
- **Building Materials**: Public buildings and critical facilities can be constructed using laminated glass, metal shutters, structural bracing, and other hazard-resistant, durable construction techniques.

Source: Wisconsin DEM, Mitigation Ideas: Possible Mitigation Measures by Hazard Type, 2002.

4.12. Utility Disruption

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Utility Disruption	4	0.3	1	0.3	3	0.2	4	0.1	3	0.1	**2.8**
Moderate Risk Hazard (2.0 – 2.9)											

4.12.1 Utility Disruption Description

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

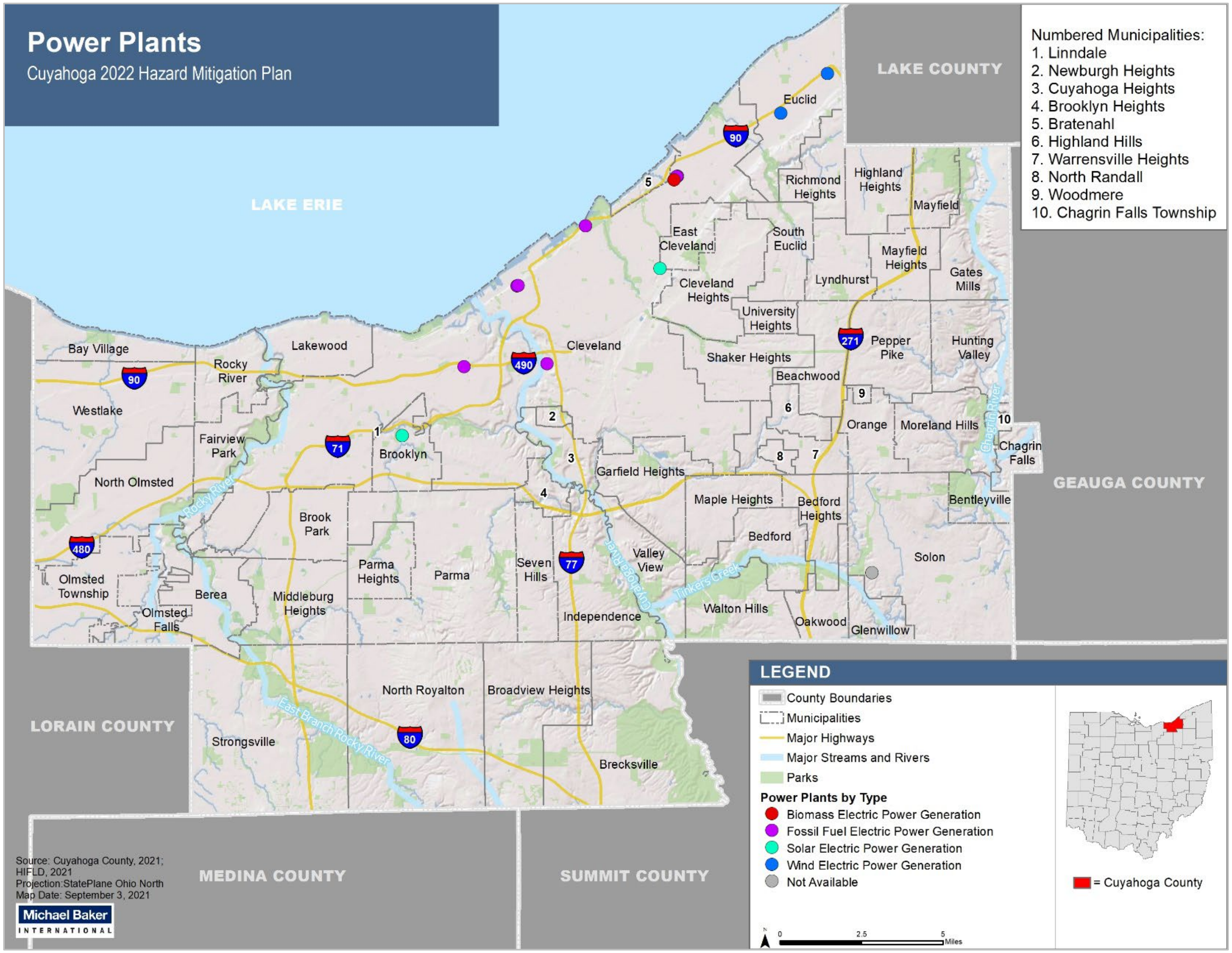
Utility interruptions in Cuyahoga County focus primarily on power failures which are often a secondary impact of another hazard event. For example, severe thunderstorms or winter storms could bring down power lines and cause widespread disruptions in electricity service. Strong heat waves may result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

Cuyahoga County utilities are predominantly served by The Illuminating Company for electric countywide, Dominion East Ohio Gas and Columbia Gas of Ohio, and the Cleveland Division of Water.

4.12.2 Utility Disruption Location

The following figure shows where the various power plants are located within Cuyahoga County. Cuyahoga County has five types of power plants: biomass electric power generation, fossil fuel electric power generation, solar electric power generation, wind electric power generation, and an unknown type. Utility disruption can occur outside of power plants, but the location of where power is generated is important to note.

FIGURE 4-50 POWER PLANTS WITHIN CUYAHOGA COUNTY



4.12.3 Extent

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

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

4.12.4 Historical Occurrences

Event Narratives

August 14, 2003, Northeast Utility Blackout: On the afternoon of the 14th of August, 2003, a series of generator shut downs over the course of a few hours led to the overload of the power grid across much of the Midwest and Northeast, resulting in a blackouts across 8 states. The events leading to the blackout began in Cuyahoga County when a transmission line between the Harding and Chamberlin substations went out for unknown reasons. Several otherwise minor incidents across the grid in several different states over the course of several hours that led a cascade reaction causing the historic shutdown just after 4:10 PM. The loss of power meant that there was no way for pumps to continue functioning, leaving 1.5 million people without water. Cell phones were rendered inert as their batteries died and the cellular towers burned through their backup generator fuel. Corded phones, still prevalent at the time, were overload by the sheer volume of calls being made as customers tried to figure out what was going on. One common thought was terrorism, with 9/11 having occurred less than two years prior.

September 15, 2008, Hurricane Ike: Forming from a tropical wave west of Cape Verde, Africa, a Category 4 hurricane named Ike intensified before striking the United States Gulf Coast on September 13th. Though the storm dissipated, remnants tracked across the US, up into Canada, and even as far as Iceland, causing considerable damage over the course of two days. A great number of trees fell during the storm, damaging homes and businesses across the state. A year after Ike, the Ohio Insurance Institute had estimated a total cost of $1.244 billion. In Northeast Ohio, an estimated 274,000 customers of FirstEnergy were without electricity. Bay Village, Shaker Heights, and Brecksville were used as examples of how far north the storm had reached.

At daybreak on September 14th, the remnants of Hurricane Ike were centered over southeastern Missouri. This low moved rapidly northeast during the day reaching Northwest Ohio during the afternoon of the 14th. The low then moved up Lake Erie and over Lake Huron by the late evening hours. Damaging winds accompanied this storm system and caused widespread wind damage across northern Ohio. Reports of high winds and wind damage began during the mid-afternoon hours of September 14th and tapered off late in the evening. The damage across the area was extensive with thousands of trees, power lines and utility poles downed. The time of year of this event contributed greatly to the amount of damage that occurred since the trees in the area were still foliated. Thousands of homes and buildings sustained varying degrees of damage from the high winds. Two deaths and several injuries occurred as a result of this storm.

As many as two million people in northern Ohio lost power as a result of this storm. Some residents were without power for as long as two weeks. Utility crews from Pennsylvania, New Jersey, New Hampshire, Connecticut and Massachusetts were dispatched to the region to help the restoration efforts. Local electrical companies were forced to recall crews sent to Texas.

Travel during this event was difficult in some areas because of the large number of downed trees, power lines and utility poles. Power outages caused many traffic lights to be inoperable which further hampered travel. Hundreds of vehicles were damaged by fallen trees or limbs.

Crop losses from the high winds were also significant across portions of northern Ohio. Estimates suggest that corn yields were reduced by an average of three to five percent. Soybean losses were much more variable and ranged from little damage up to a ten percent loss in yield in some fields.

June 29, 2012 Derecho: On the second day of a developing heat wave, under a sunny sky, afternoon temperatures reached the upper 90s to above 100 degrees across most of southeast Ohio. Meanwhile, an area of multi-cellular convection had moved out of northern Illinois that morning. It continued to organize and strengthen, as it propagated east and southeast across northern Indiana into western Ohio during the afternoon. As it moved toward southeast Ohio, it had already formed into a large arch of storms, or bow, with a developing cool pool in its wake. The temperature contrast between the air ahead of the developing derecho, compared to that in its wake was reaching 30 to 35 degrees. The resultant wind shift in the cool pool resulted in strong moisture convergence on the leading edge of the complex. This in turn, helped drive the storms further southeast, away from the mid and upper level wind support. However, the complex was diving right into that hot air that had obtained large convective available potential energy. The derecho reached southeast Ohio near the hottest time of the day, after 4PM, moving at 65 MPH. As the system matured, strong gusts were longer in duration, in some cases around 10 minutes. Widespread wind gusts of 60 to 85 mph were likely with the leading gust front across southeast Ohio. The wind caused trees and large branches to fall in scattered locations, causing structural damage. Corrugated metal and siding were ripped off a few buildings. Trees fell onto houses and vehicles. The fallen trees and power lines also caused roads to be temporarily blocked. The largest impact was on the electric power grid. Prolonged power outages occurred, with some areas without electricity for 4 to 7 days. There were no direct deaths or injuries. The lack of electricity in the midst of the heat wave, disrupted the daily routines of most citizens for several days. Water and ice were in high demand. An emergency declaration by President Obama allowed federal supplies to be quickly delivered. Family and retail refrigerated food lost was substantial. Rural citizens with private wells may have been hit harder than those living in towns on public water systems. Citizens that relied on well water had no power to pump the water from their wells. With limited gas stations available to pump gas, long lines developed for a few days in the wake of the storm. Workers trying to restore the electricity had to take frequent breaks due to the heat and the safety equipment they had to wear.

October 29 – 30, 2012, Hurricane Sandy: Hurricane Sandy tracked up the east coast of the United States and merged with an upper level trough on October 29, 2012. Sandy transitioned to a post-tropical cyclone and came onshore around 8 pm EDT in Southern New Jersey with an impressive central pressure of 946 mb. The post-tropical cyclone tracked west across Pennsylvania overnight on October 29 and brought damaging winds and prolonged rainfall to Northern Ohio. Northerly winds were especially strong downwind of Lake Erie with a peak gust to 68 mph reported at Cleveland Hopkins Airport. The strong winds caused extensive tree damage with widespread power outages and caused structural damage to some buildings. Power outages associated with this storm exceeded 250,000 customers across Northern Ohio, with over 160,000 outages in Cuyahoga County alone. Power wasn't restored in some areas for over a week. The Cleveland Metro area was particularly hard hit by this storm with many area schools closed for 2 days. Air traffic was stopped at Cleveland Hopkins

International Airport from late on October 29 to approximately noon on October 30. Some significant damage to note included siding torn off the exterior of the Rock and Roll Hall of Fame.

Other peak winds gusts included 67 mph at Cleveland Burke Lakefront Airport; 63 mph at the Lorain County Airport; 61 mph at the Conneaut Lighthouse in Ashtabula County; 60 mph at the Fairport Harbor Lighthouse in Lake County; 59 mph at Marblehead Lighthouse in Ottawa County and 58 mph at the Huron Lighthouse in Erie County.

Also to note was a 2-3 foot storm surge along the south shore of Lake Erie accompanied by 15 to 20 foot waves. Water crashing over the break wall closed Interstate 90 on the east side of Cleveland for several hours. Area marinas sustained damage with reports of many personal watercraft submerged and additional boats drifting out into the lake. According to the Coast Guard, 118 vessels were either sunk or significantly damaged. Beach erosion was reported at numerous beaches and sand had to be cleared from the roadways along E. Perry St. in Port Clinton.

November 14-17, 2020: Due to windy weather and storms in Ohio, and especially the northeast region of the state, over 146,000 residents were without power. 43,000 of the 146,000 residents were located in Cuyahoga County. Summit County reported over 22,000 residents without power.

August 11-12, 2021: Widespread power outages across Cuyahoga County occurred after a series of strong storms passed through Northeast Ohio. The series of thunderstorms that passed through the region had winds reaching over 80 mph, with gusts of winds reported over 60 mph in Cleveland. Trees and power lines were knocked over across the Cuyahoga, Geuaga, Lake, Lorain, Medina, and Summit counties. Over 56,000 power outages were reported the evening of August 11th in Cuyahoga County, and 41,000 of those outages were still confirmed at 4 A.M. on the morning of August 12th. 18,000 of the 41,000 power outages were within the City of Cleveland alone, according to FirstEnergy.

Cuyahoga County has been a part of 1 disaster declaration where Utility Disruption was a factor in the overall emergency.

TABLE 4-84 DECLARED DISASTERS AFFECTING CUYAHOGA COUNTY

Disaster Number	Declaration Date	Title	Public Assistance	Individual Assistance
EM-3187	9/23/2003	Power Outage	-	-

4.12.5 Probability of Future Occurrences

Minor power failure events (i.e. short outage) events may occur several times a year for any given area in the County, while major (i.e. widespread, long outage) events take place once every few years. Power failures are likely occurrences during severe weather and therefore, should be expected during those events. The probability of future utility outages impacting the County can be considered “Highly Likely” according to the Risk Factor Methodology meaning there is a 100% probability of annual occurrence.

Because power failures are often tied to severe storm events, there is a 100 percent chance that Cuyahoga County will experience minor utility failures in the future. There is not enough historical precedence to predict when a large-scale incident may occur.

4.12.6 Assets Exposed to Utility Disruption

Potential Losses

Utility failure in and of itself would be unlikely to cause any sort of physical losses. However, losses from utility failure can be measured in lost productivity (due to IT issues) and loss of use in structures (due to loss of water/electric/heat).

Emergency medical facilities, including retirement homes and senior centers are particularly vulnerable to power outages. While back-up power generators are often used at these facilities, loss of electricity may result in hot or cold temperatures for which elderly populations are particularly vulnerable. Conservation and improved technology have resulted in more efficient use of energy sources. The increasing use of alternative fuel supplies, such as kerosene heaters, wood burning stoves, coal burners, etc., has also decreased our vulnerability to future shortages. However, severe weather extremes, accidents, labor strikes, terrorism, or nationwide shortages could cause significant energy shortage problems. There is no accurate way to predict potential utility failure.

If the entire County were to lose a full day of work from a mass utility disruption, based on the Gross Regional Product from 2019, the estimated loss would be approximately $277,209.75.

TABLE 4-85 POTENTIAL IMPACTS FROM UTILITY DISRUPTIONS

Impact	Description
People	People would be impacted by loss of utility in the hot summer or cold winter months. Elderly and young populations could be adversely impacted.
Infrastructure	Infrastructure may not be impacted. Loss of heat in extreme cold situations could cause pipes to burst inside buildings, causing water damages.
Economy	Loss of business function and productivity.
Natural Systems	No impacts would occur due to utility disruption.
Transportation	Loss of ability to fuel electric or natural gas-powered transportation vehicles.

Community Vulnerability

According to the 2019 ACS 5-Year Estimate Data Profiles, Cuyahoga County has a wide variety of house heating fuels that are utilized by households. The following table shows the house heating fuels, the household estimate that uses the fuel, and the percentage of households within the County that use them.

TABLE 4-86 CUYAHOGA COUNTY HOUSE HEATING FUELS, ACS 2019 5-YEAR ESTIMATES

House Heating Fuel	Population Estimate	Percentage
Utility gas	446,825	82.6%
Bottled, tank, or LP gas	6,039	1.1%
Electricity	79,045	14.6%
Fuel oil, kerosene, etc.	1,005	0.2%
Coal or coke	157	0.0%
Wood	592	0.1%
Solar energy	49	0.0%
Other fuel	3,665	0.7%
No fuel used	3,588	0.7%
Grand Total Housing Units	540,965	100%

4.12.7 Land Use & Development Trends

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

Regulatory Environment

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

4.12.8 Utility Disruption Summary

The probability of a catastrophic utility failure is low, but there is the potential for mild to moderate interruptions. Cuyahoga County is the most populated County in Ohio, meaning that there is a large demand for utilities by residents and businesses alike. The biggest impacts of utility failures will typically be felt economically through lost time and productivity. Utility Disruptions can affect the entire County.

Mitigation Best Practices

Healthcare planners, healthcare workers, and citizens as a whole are encouraged to read the public ASPR TRACIE – Utility Failures Topic Collection reference guide created on 2/6/2017. The guide is full of useful articles, tools, lessons learned, and partners that work on a daily basis to mitigate utility failure in the workplace. The Guide can be found at: https://asprtracie.hhs.gov/documents/utility-failure.pdf

4.13. Climate Change

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Climate Change	4	0.3	1	0.3	4	0.2	1	0.1	4	0.1	**2.8**
Moderate Risk Hazard (2.0 – 2.9)											

4.13.1 Climate Change Description

Climate change refers to "a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use" (Intergovernmental Panel on Climate Change, 2018).

Since the 1800s and the industrial revolution, humans have been the main cause of climate change. Burning fossil fuels – like coal, oil, and gas – create greenhouse gas emissions in the atmosphere. As emissions build up, heat from the sun gets trapped under the blanket-like atmosphere, raising the average temperature. Greenhouse gas emissions include carbon dioxide, nitrous oxide, chlorofluorocarbons, and methane. According to the United Nations, greenhouse gas concentrations are at their highest levels in 2 million years, causing an increase in earth's temperature of approximately 1.1°F since the 1800s. As emissions continue to increase and fuel climate change, there are many consequences. Intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity are among the top impacts to the world from climate change.

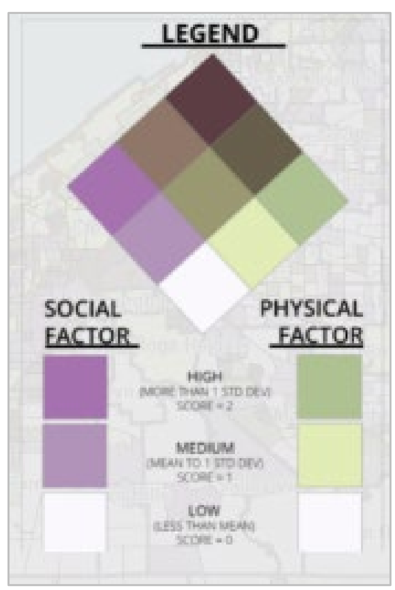
4.13.2 Climate Change Location

Climate change is a global crisis and is not limited to one location. All of Cuyahoga County is at risk to climate change.

4.13.3 Extent

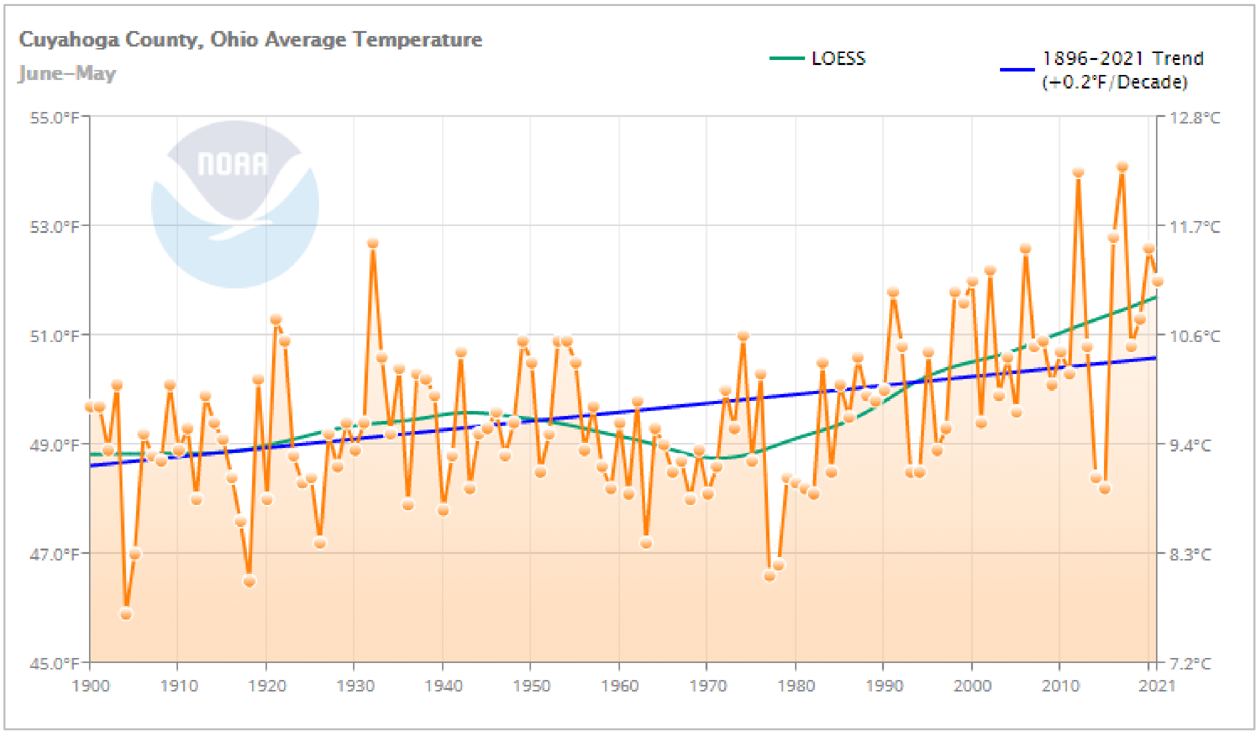
The extent of Climate Change can be measured by how much the average global temperature increases per year. The average temperature of Cuyahoga County continues to warm by approximately 0.32°F (0.18°C) since 1981. The County's Climate Change Vulnerability Assessment identifies both social and physical factors that contribute to the vulnerability of each community to climate change:

- Physical
    - Heat Island Effect
    - Flood Plain
    - Older Residential Buildings
    - Impervious Cover
    - Lack of Tree Canopy
- Social
    - Population Under Age 5
    - Population Aged 65 and Over
    - Population Below Poverty
    - Minority Population
    - Households Without a Vehicle



- Rental Housing
- Population Lacking High School Diploma
- Persons with Disability

FIGURE 4-51 CLIMATE TREND SINCE 1900, NCDC, CLIMATE AT A GLANCE



4.13.4 Historical Occurrences

General Trends

According to the Cuyahoga County Climate Change Action Plan, Cuyahoga County has seen an increase in temperature averages as well as precipitation. Additionally, the ice cover on Lake Erie during the winter months has changed, and growing season characteristics have been affected by the changing climate as well. The annual average precipitation over the past 100 years, 30 years, and 10 years shows an increase of approximately 4 inches in additional precipitation when comparing the 100-year average precipitation to the 10-year average precipitation.

TABLE 4-87 CUYAHOGA COUNTY'S ANNUAL AVERAGE PRECIPITATION

Annual Average Precipitation	Inches per Period
100-Year Average (Historical)	38.4
30-Year Average (Normal)	40.2
10-Year Average (Most Recent)	42.9

The annual average temperature over the past 100 years, 30 years, and 10 years shows an increase of approximately 0.9°F in the average temperature when comparing the 100-year average annual temperature to the 10-year average annual temperature.

TABLE 4-88 CUYAHOGA COUNTY'S ANNUAL AVERAGE TEMPERATURE

Annual Average Temperature	Average Temperature (°F)
100-Year Average	49.1
30-Year Average	49.3
10-Year Average	50

4.13.5 Probability of Future Occurrences

The HMPC, based on their knowledge, determined that climate change is “Highly Likely,” meaning there is a 100% chance of climate change occurring each year. There is a 100% chance that Climate Change will continue to be an issue. Climate Change is currently in progress and is expected to worsen considerably over the next century.

4.13.6 Assets Exposed to Climate Change

Potential Losses

Climate Change is unlike the other hazards profiled in this plan in that its main threat is that it exacerbates those same hazards. For instance, rainfall events are becoming more frequent, winters are becoming wetter and colder, and extreme temperature events will see higher and lower extremes.

TABLE 4-89 POTENTIAL IMPACTS FROM CLIMATE CHANGE

Impact	Description
People	Secondary impacts to human health from climate change could include increased respiratory and cardiovascular disease, injuries and premature deaths from extreme weather events, increased food and water-borne diseases, and mental health impacts.
Infrastructure	Increased stress on the County’s infrastructure as extreme weather increases in frequency and magnitude, producing flash flooding and flooding.
Economy	Loss of business due to business closures after a severe weather event. Loss of agriculture product due to lack of rain or excessive rain.
Natural Systems	Increased CO^2 in the atmosphere would produce an increase in vegetation growth, increase in animal populations that thrive in warmer temperatures but loss of species that do not thrive in warmer weather, poorer water quality, loss of frozen habitats
Transportation	Change from fossil fuel-powered vehicles to electric or compressed natural gas-powered vehicles.

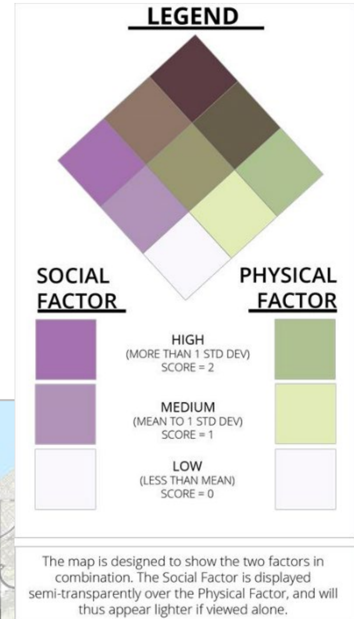
Community Vulnerability

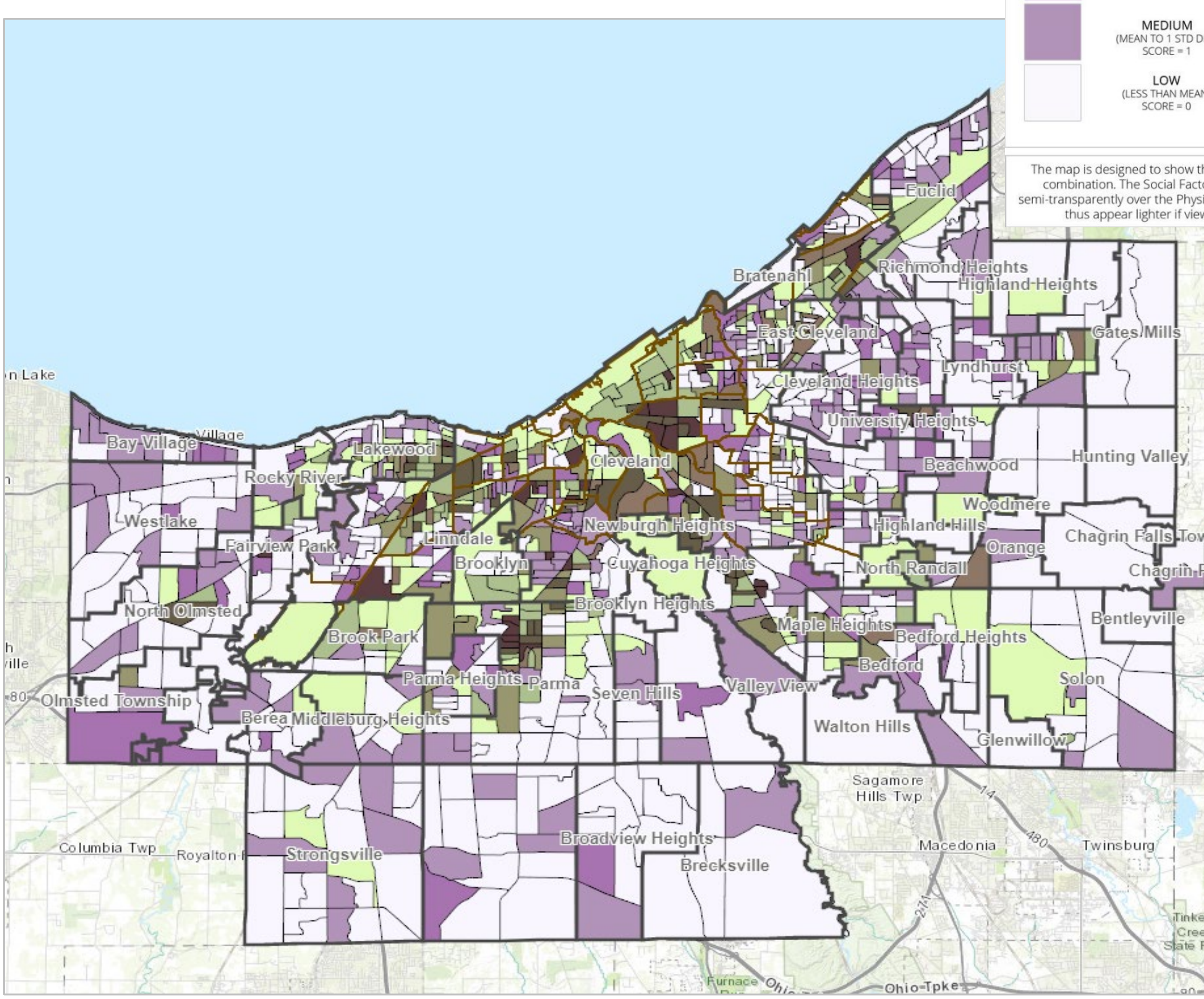
The Cuyahoga County Climate Change Action Plan from 2019 includes a vulnerability assessment of the County’s residents at the census block level. Within Cuyahoga County, there are more than 1,100 census blocks. The vulnerability assessment factors percent of land in floodplain, percent without tree canopy, percent of areas with waste heat over 2°F, percent of homes built before 1939, and percent of area with impervious cover for the physical vulnerability composite score. Then, the vulnerability assessment factors percent of population under age 5, percent of population with disability, percent of population age 65 and older, percent of population without high school diploma, percent of households without vehicles, percent of minority population, percent of population below poverty, and percent of rental housing units for the social vulnerability composite score. The following figure shows the combination of the social vulnerability factors and physical vulnerability factors for a combined vulnerability composite score.

4.13.7 Land Use & Development Trends

Land use and climate change have an intricate relationship. Land cover itself, driven by land use designations and practices, can affect the amount of carbon dioxide in the atmosphere as well as the global concentration of greenhouse gases. Additionally, climate change can affect land use and land cover. As a climate changes, crops that thrive in warmer, wetter climates may be planted in place of crops that do not yield as much product in such environments. In Cuyahoga County, 18.82% of the land cover is forest, 1.39% of the land cover is pasture/hay, 1.02% of the land cover is shrub/scrub and grasslands, and 0.12% of the land cover is cultivated crops. Residential, commercial, and industrial buildings also affect greenhouse gas emissions alike. According to the Environmental and Energy Study Institute (EESI), residential and commercial buildings make up approximately 40% of U.S. carbon dioxide emissions. Furthermore, 30% of the electricity used to power buildings in the United States use electricity from coal-burning power plants. Coal-burning power plants release greenhouse gases, a cause of climate change.

FIGURE 4-52 CUYAHOGA COUNTY CLIMATE CHANGE VULNERABILITY MAP





In Cuyahoga County, efforts are currently in action to reduce carbon pollution within the County in relation to transportation, energy source and consumption, and future development. According to the Cuyahoga County Department of Sustainability, three projects have been highlighted in current efforts to reduce carbon pollution. The UH Bikeshare launched in 2016, reducing carbon emissions by 73,840 pounds. The transition of approximately 100 to solar energy through the County's solar co-op program has reduced carbon emissions by 8,824,117 pounds. The Brooklyn landfill solar project, recognized by Solar Builder magazine as the "Solar Project of the Year" in 2018, powers the County Administration building. Future efforts are being planned for through local clean energy projects, new bike and pedestrian routes within the County, targeted development near public transit, and planting of more trees throughout the County.

Regulatory Environment

There are numerous regulatory actions and initiatives currently in place at the federal level to limit and track greenhouse gas emissions through presidential executive orders and bills passed by Congress. To see the full list of current regulatory efforts that are in place at the federal level to combat climate change, visit https://www.epa.gov/climate-change/regulatory-actions-and-initiatives. In Ohio, there are various air pollution regulations in the Ohio Administrative Code (OAC).

4.13.8 Climate Change Summary

Climate Change is one of the greatest threats to the modern way of life. Unless changes are made at a global scale, it can be expected that climate change will continue to increase the average global temperature, amount of average precipitation, and magnify natural disasters.

4.14. Terrorism/CBNRE Incident

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Terrorism/CBNRE Incident	2	0.3	3	0.3	2	0.2	4	0.1	4	0.1	**2.7**
Moderate Risk Hazard (2.0 – 2.9)											

4.14.1 Terrorism/CBNRE Description

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

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

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

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

Radiological terrorism involves the use of radiological dispersal devices or nuclear facilities to attack the population. Exposure to radiation can cause radiation sickness, long-term illness, and even death. Terrorism experts fear the use of explosive and radiological devices in the form of a "dirty bomb" to attack the population. A "dirty bomb" is a low-tech, easily assembled and transported device made up of simple explosives combined with a suitable radioactive agent.

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

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

NOAA Alerts

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

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

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

4.14.2 Terrorism Location

Due to the nature of the hazard, it is impossible to predict where a terrorist attack will take place. Generally, terrorist tend to target areas with large populations, gatherings, or infrastructure that will cause as much destruction as possible. Possible targets for such events include, but are no means limited to, the three airports within the County, the County's car and rail infrastructure, the multiple health facilities located within the County, the various colleges and universities that call Cuyahoga County home, any of the local school districts, the numerous malls that high amounts of consumers visit, the County's professional sporting venues, and tourist hotspots within the County.

4.14.3 Extent

Events classified as terrorism have been shown to impact as few as one person to tens of thousands. One of the inherent risks of terrorism is the unpredictability. Terrorism events impact not only those who are directly killed or injured, but also those around them through psychological trauma afterward. Terrorists are not always easily identified, and events can be unpredictable.

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

4.14.4 Historical Occurrences

While there have been no large-scale terrorist attacks on Cuyahoga County, there have been multiple attempts of terrorism in the County.

April 30, 2012: Five men, self-described as anarchists, were arrested after the FBI Joint Terrorism Task Force discovered the group was planning to use bombs to cause harm to the Route 82 Brecksville-Northfield High Level Bridge. The arrests of the five men were the result of an undercover FBI agent monitoring the suspects as well as the explosive devices that were purchased by the suspects. The explosive devices were never functional, unknown to the suspects.

July 2, 2018: A man was arrested prior to the Fourth of July celebration in downtown Cleveland in 2018 for plotting to attack the event. Approximately a year and a half before the arrest, the FBI was alerted to suspicious social media activity, linking to comments posted on a jihad training camp picture. After the initial alert, the FBI began to monitor the suspect's social media activity, eventually meeting with an undercover FBI agent to identify vulnerable locations within Cleveland.

January 8, 2020: A man was arrested after planning an attack on Cuyahoga Falls High School. The suspect also had written in his diary about killing the President as well as Ohio's Governor. The suspect was also accused of calling a police department in Kansas and making false claims that he was holding a hostage in the local high school, only for the SWAT response to enter the school and find that the phone call was a hoax. The suspect was arrested after trespassing on the Cuyahoga Falls school grounds filming the hallways. After his arrest, police searched his house and found materials to make explosive devices.

Additionally, incidents throughout the country have occurred in locations analogous to those found in the Cuyahoga County communities. Nationally, terrorism continues to be an issue of significant importance.

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

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

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

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

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

4.14.5 Probability of Future Occurrences

There is not enough historical precedence to determine frequency or future probability of terrorism or threatened terroristic events. The HMPC determined that it is "Possible" that a Terrorism/CBNRE Incident will occur in Cuyahoga County, meaning that there is between a 1% and 10% chance of an event occurring.

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

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

  Site Perimeter

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

Building Envelope

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

Facility Interior

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

4.14.6 Assets Exposed to Terrorism

Potential Losses

TABLE 4-90 POTENTIAL IMPACTS OF TERRORISM

Impact	Description
People	People can be killed or severely injured in terrorism attacks. Psychological scarring is also extremely likely after the events for those who survive.
Infrastructure	Infrastructure can be damaged or destroyed in an attack
Economy	The economy can be impacted and can slow after terrorism events
Natural Systems	Depending on the location of an attack, some natural systems can be damaged, particularly if the event is related to ecoterrorism. It is also possible for drinking water supplies to be damaged if they are the target.
Transportation	Transportation systems may be severely disrupted during an event. Transportation can be shut down for multiple hours as situations are contained.

Community Vulnerability

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

4.14.7 Land Use & Development Trends

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

Regulatory Environment

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

4.14.8 Mitigation Successes

In 2014, the Cleveland Field Office of the FBI conducted a terrorist training exercise at the SouthPark Mall in Strongsville. The exercise included a wide range of participants, including Joint Terrorism Task Force, Strongsville Mayor's Office, Strongsville Police Department, Cuyahoga County Sheriff's Office, Strongsville Fire & Emergency Services Department, Ohio State Highway Patrol, Cuyahoga County Emergency Management Agency, Northeast Regional Fusion Center, Department of Homeland Security, Bureau of Alcohol, Tobacco, Firearms and Explosives, Verizon, Professional Security Consultants, and Starwood Retail Property. The exercise began at 5 a.m., and the majority of the procedure occurred within the mall with command and control areas set up outside the mall.

4.14.9 Terrorism Summary

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

4.15. Dam/Levee Failure

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Dam/Levee Failure	2	0.3	3	0.3	2	0.2	3	0.1	4	0.1	**2.6**
Moderate Risk Hazard (2.0 – 2.9)											

4.15.1 Dam/Levee Failure Description

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

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

A levee, unlike a dam, is an elongated ridge constructed of fill or wall which regulates water levels. These are usually earthen hills built along a river's floodplain to prevent flooding in nearby population areas. Typically, these run parallel to a river. **According to the National Levee Inventory, there is one levee in Cuyahoga County.**

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

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

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

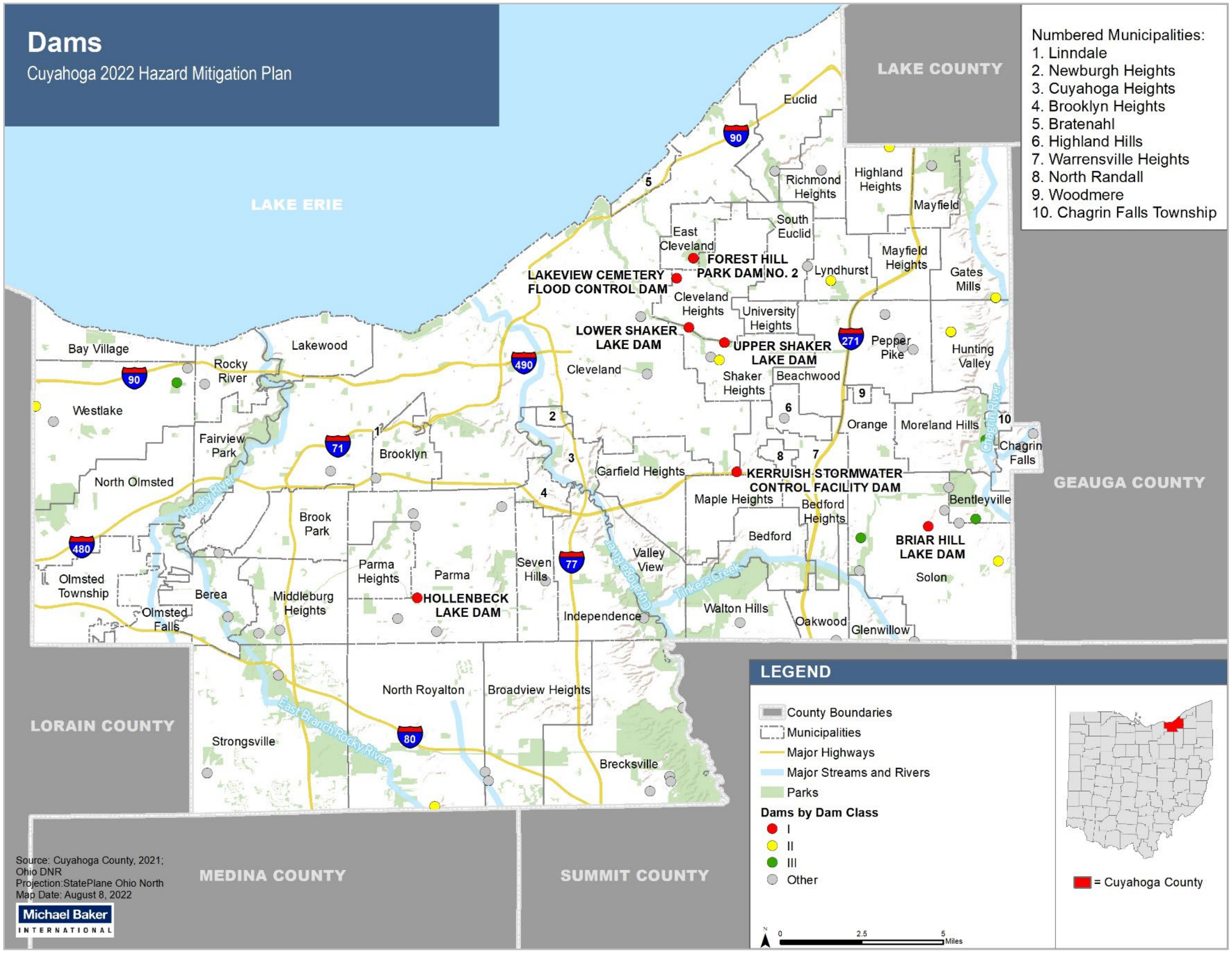
Dams are considered to be localized in the state and are most likely to affect inundation areas downstream and immediate areas around the dam or levee. Discharge from a dam breach is usually several times the 1% chance flood, and, therefore, typical flood studies are of limited use in estimating the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

Determining the impact of flooding is difficult to accomplish, especially for estimating loss of life. Loss of life is a function of the time of day, warning time, awareness of those affected and particular failure scenarios. Many dam safety agencies have used “population at risk”, a more quantifiable measurement of the impact to human life, rather than “loss of life”. Population at risk is the number of people in structures within the inundation area that would be subject to significant personal danger, if they took no action to evacuate. The impacts of a dam failure are contingent on many factors and, therefore, cannot be concisely described.

4.15.2 Dam/Levee Failure Location

There are 19 dams located in Cuyahoga County according to the National Inventory of Dams database.

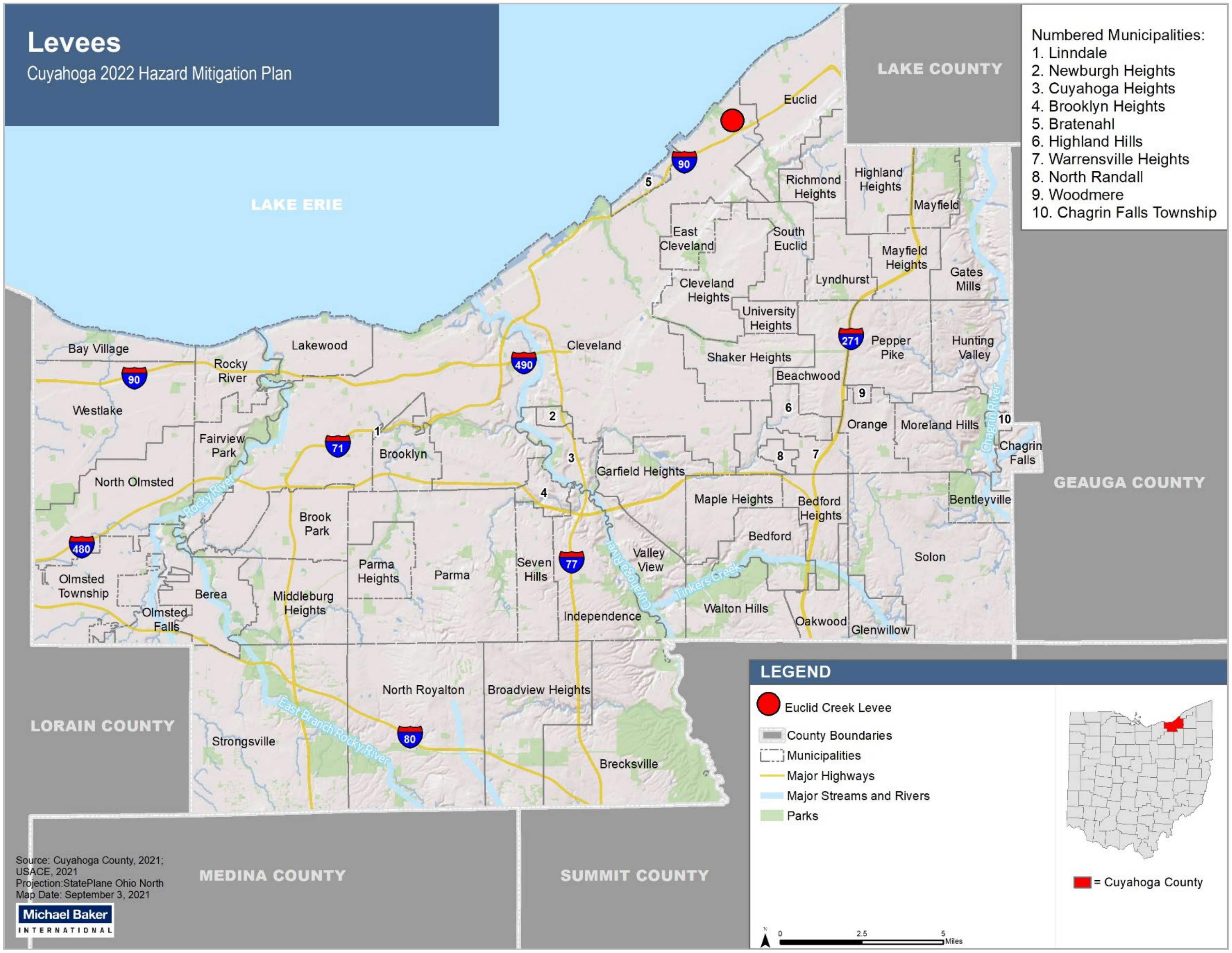
FIGURE 4-53 CUYAHOGA COUNTY DAMS



There is a levee located in Cleveland along Euclid Creek. The levee spans 0.28 miles in length, is located 3,750 feet upstream of Lake Erie, and was constructed in 1985 by the United States Army Corps of Engineers (USACE). The levee was built to manage flooding from the Euclid Creek. After completion of construction, USACE and the City of Cleveland developed an operations and maintenance manual that allowed for the City of Cleveland to begin the upkeep of the levee.

The levee has an average height of 5 feet, with a minimum height of 2 feet and a maximum height of 8.00 feet and is designed for a flow of 10,400 cfs. According to the National Levee Database, the levee was constructed as channel projections were being completed. The levee has experienced high water events since construction. A 25% increase in water level and a 50% increase in water level has both tested the levee system, but the levee has prevented an estimated $11,360,660 in flooding impacts over the past thirty years.

FIGURE 4-54 CUYAHOGA COUNTY LEVEE



4.15.3 Extent

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

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

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

ODNR also classifies dams by the height of dam:

- **Class I –** greater than 60 feet
- **Class II –** greater than 40 feet
- **Class III –** greater than 25 feet
- **Class IV –** less than or equal to 25 feet

Also by storage volume:

- **Class I –** greater than 5000 acre-feet
- **Class II –** greater than 500 acre-feet
- **Class III –** greater than 50 acre-feet
- **Class IV –** less than or equal to 50 acre-feet

Another way to classify dam failure in terms of extent is through FEMA's High Hazard Potential Classification. The classification has three categories of potential impacts a dam failure would create:

1. **Low Hazard Potential:** Dams assigned the low hazard potential classification are those where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
2. **Significant Hazard Potential:** Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
3. **High Hazard Potential:** Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life.

TABLE 4-91 HIGH-HAZARD DAM INFORMATION FOR CUYAHOGA COUNTY

Dam Name	Class	Hazard Potential	EAP	Owner
Hollenbeck Lake Dam	I	High	N	Private
Briar Hill Lake Dam	I	High	Y	Private
Kerruish Stormwater Control Facility Dam	I	High	N	City of Cleveland
Upper Shaker Lake Dam	I	High	Y	City of Cleveland
Lower Shaker Lake Dam	I	High	N	City of Cleveland
Lakeview Cemetery Flood Control Dam	I	High	Y	Northeast Ohio Regional Sewer District
Forest Hill Park Dam No. 2	I	High	N	City of East Cleveland
Marshfield Lake Dam	II	Significant	Y	Private
Hayes Lake Dam	II	Significant	N	Private
Luczek Lake Dam	II	Significant	Y	Private
City of Shaker Heights Dam	II	Significant	Y	City of Shaker Heights
Acacia Country Club Lake Dam	II	Low	N	License and Easement Agreement between City of Lyndhurst and Board of Park Commissioners of Cleveland Metropolitan Park District
Aberdeen Development North Retention Dam	II	Significant	Y	City of Highland Heights
University School Lake Dam	II	Significant	N	Private
Iroquois Lake Dam	II	Significant	Y	Private
Clague Park Lake Dam	III	Low	Y	City of Westlake
Ranger Lake Dam	III	Low	N	Cleveland Metropolitan Park District
O'Neil Lake Dam	III	Low	N	Private
Hawthorne Valley Country Club Lake Dam	III	Low	Y	Private

Ohio Department of Natural Resources classify levees into three different classes:

- **Class I:** probable loss of human life, structural collapse of at least one residence or one commercial or industrial business
- **Class II:** disruption of a public water supply or wastewater treatment facility, 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 correctional facilities as determined by the chief; damage or disruption to railroads or public utilities
- **Class III:** a levee having a height of not more than three feet and a levee having a height of more than three feet when sudden failure of the levee would result in at least one of the following conditions: property losses including but not limited to rural buildings not otherwise described in this rule; damage or disruption to local roads including but not limited to roads not otherwise listed as major roads in this rule; property losses restricted mainly to the levee and to the owner's property or to rural lands.

4.15.4 Historical Occurrences

Dam Failure

February 28, 2011: At 10:07 AM, the failure of the Gates Mills Dam was reported by the dam operator. The failure was caused by heavy rains. Water flooded the basement of the nearby historic St. Christopher's Church. It was decided several weeks later that the dam would not be replaced. The dam had previously supplied power to several businesses when it was built a century prior in 1906.

September 7, 2020: After a heavy rain event, the Horseshoe Lake Dam overtopped even though the reservoir had been emptied by ODNR in 2019 due to the state department deeming the dam to be structurally deficient. The lake filled and overtopped the high-hazard dam, but the dam held. When dams overtop, erosion or collapsing could cause the dam to fail. The dam, according to the Northeast Ohio Regional Sewer District's Watershed Programs Director, is in an active state of failure. Horseshoe Lake Dam is currently still standing, but the regional sewer district presented to the Shaker Heights and Cleveland Heights councils on August 9, 2021 to have the dam removed. The proposal for the manmade lake and dam to be replaced with a more natural waterway was not received in favor of the public, but regardless of what happens to the lake and dam, immediate repairs are required to stabilize the dam while the local officials decide how to proceed.

Levee Failure

There have been no recorded instances of levee failure in Cuyahoga County.

4.15.5 Probability of Future Occurrences

Based on their knowledge, the HMPC determined that there is an "Possible" chance of dam or levee failure occurring in Cuyahoga County, meaning that there is between a 1% and 10% chance.

For reasons previously mentioned in this section and uncontrollable by humans, it is possible a dam or levee can fail at any time, given the right circumstances. However, the probability of future occurrence for regulated dams and levees can be reduced due to proactive preventative action in compliance with the Ohio Department of Natural Resources – Dam Safety Program. Ohio's Dam Safety Program provides for the regulation and safety of high hazard dams and reservoirs throughout the state in order to protect the health, safety, and welfare of its citizens and their property.

The National Levee Database includes an Incipient Overtopping Annual Exceedance Probability (AEP). The Incipient Overtopping Annual Exceedance Probability for the Euclid Creek levee is 0.002.

4.15.6 Assets Exposed to Dam/Levee Failure

Potential Losses from Dam/Levee Failure

TABLE 4-92 POTENTIAL IMPACTS FROM DAM/LEVEE FAILURE

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

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

In FEMA's Federal Guidelines for Dam Safety, the following impacts are identified:

TABLE 4-93 FEMA DAM HAZARD CLASSIFICATION IMPACTS

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

Community Vulnerability

The probability of future occurrence for regulated dams is reduced through compliance with the Ohio's Department of Natural Resources, Dam Safety Program. 43% of the High Hazard Dams in Cuyahoga County have Emergency Action Plans (EAP) in place.

An Emergency Action Plan details possible scenarios for a dam break. Only the EAP for the Lakeview Cemetery Flood Control Dam was available at the time of plan development for analysis.

TABLE 4-94 DAMS IN CUYAHOGA COUNTY

Name	Owner	Owner Type	Type	Structure	Length (feet)	Height (feet)	Top of Dam Storage (Acre Ft.)
ODNR Class 1 Dams							
Hollenbeck Lake Dam	Private	Private	Earthfill	Dam and Spillway	400	23.5	95
Briar Hill Lake Dam	Private	Private	Earthfill	Dam and Spillway	885	24	52.4
Kerruish Stormwater Control Facility Dam	City of Cleveland	Public, Local	Earthfill	Dam and Spillway	300	40	312
Upper Shaker Lake Dam	City of Cleveland	Public, Local	Earthfill	Dam and Spillway	615	30	155
Lower Shaker Lake Dam	City of Cleveland	Public, Local	Earthfill	Dam and Spillway	600	17.3	178
Lakeview Cemetery Flood Control Dam	Northeast Ohio Regional Sewer District	Public, Local	Concrete, Gravity	Dam and Spillway	520	89	354
Forest Hill Park Dam No. 2	City of East Cleveland	Public, Local	Earthfill	Dam and Spillway	318	36.6	137
ODNR Class 2 Dams							
Marshfield Lake Dam	Private	Private	Earthfill	Dam and Spillway	220	15.3	82
Hayes Lake Dam	Private	Private	Earthfill	Dam and Spillway	1,200	44.7	93.8
Luczek Lake Dam	Private	Private	Earthfill, Homogeneous	Dam and Spillway	500	41	326
City of Shaker Heights Dam	City of Shaker Heights	Public, Local	Earthfill	Dam and Spillway	300	18.9	61.7
Acacia Country Club Lake Dam	License and Easement Agreement between City of Lyndhurst and Board of Park Commissioners of Cleveland Metropolitan Park District	Public, Local	Earthfill	Dam and Spillway	530	38	148.3
Aberdeen Development North Retention Dam	City of Highland Heights	Public, Local	Earthfill, Zoned	Dam and Spillway	290	12.6	64.9
University School Lake Dam	Private	Private	Earthfill	Dam and Spillway	175	52.5	83.6
Iroquois Lake Dam	Private	Private	Earthfill	Dam and Spillway	820	9	60.3
ODNR Class 3 Dams							
Clague Park Lake Dam	City of Westlake	Public, Local	Concrete, Gravity & Earthfill	Dam and Spillway	410	20.2	74.2
Ranger Lake Dam	Cleveland Metropolitan Park District	Public, Local	Earthfill	Dam and Spillway	165	25.8	23.4

O'Neil Lake Dam	Private	Private	Earthfill	Dam and Spillway	500	26	75.2
Hawthorne Valley Country Club Lake Dam	Private	Private	Earthfill	Dam and Spillway	440	31	42.1

Cleveland Heights, Chagrin Falls East Cleveland, Parma, Shaker Heights, Solon, and Warrensville Heights are located in proximity to Class I Dams (As classified by the Ohio Department of Natural Resources). Potential losses from dam failure in these areas are difficult to quantify. However, by using the populations, number of homes, and their average value, some vulnerability can be attributed to a dam failing. The following table presents this data for the previously identified cities and towns, using 2016 data from the Cuyahoga County Auditor as reference.

TABLE 4-95 POPULATIONS AND STRUCTURES VULNERABLE TO DAM FAILURE

City	Population	Number of Homes	Total at Risk	Average cost
Cleveland Heights	46,121	4,415	$ 579,967,400	$ 131,362.94
Chagrin Falls	4,039	2,010	$ 501,832,000	$ 286,433
East Cleveland	17,843	1,163	$ 51,659,400	$ 44,419.09
Parma	81,601	9,674	$ 958,379,200	$ 99,067.52
Shaker Heights	28,448	2,352	$ 600,276,500	$ 255,219.60
Solon	23,348	2,813	$ 830,401,300	$ 295,201.32
Warrensville Heights	13,542	1,005	$ 65,084,700	$ 64,760.90
Grand Total	**210,903**	**21,424**	**$ 3,085,966,900**	**$ 144,042.52**

According to the National Levee Database, behind the Euclid Creek Levee in Cleveland, there are 148 residents and 32 structures that would be impacted by levee failure. The property value for the structures behind the levee is valued at $10.3 million. The USACE completed a risk assessment for the levee in 2016. The risk assessment found that the levee is at low risk and will continue to function as designed. However, the levee has not been tested to the full extent, and there is vegetation located on the landslide that could create unstable embankments. The levee also does not have an EAP in place. If a 500-year flood event were to occur, water from the Euclid Creek could overtop the levee, but there would be minimal risk to life. A flooding event within the leveed area could still have an impact on life and property.

The following GIS vulnerability analysis conducted found 10 structures are vulnerable to levee failure in Cleveland. The 10 structures that are vulnerable to levee failure accounts for less than 1% of the total structures located within the city, and no critical facilities are vulnerable to levee failure in Cleveland.

TABLE 4-96 STRUCTURES AND CRITICAL FACILITIES VULNERABLE TO LEVEES

Municipality	Total Structures	Total Structures Vulnerable to Levee Failure	Percent Structures Vulnerable to Levee Failure	Total Critical Facilities	Critical Facilities Vulnerable to Levee Failure	Percent Critical Facilities Vulnerable to Levee Failure
Bay Village	4,092	0	0%	13	0	0%
Beachwood	2,352	0	0%	29	0	0%
Bedford	3,562	0	0%	21	0	0%
Bedford Heights	2,284	0	0%	8	0	0%
Bentleyville	203	0	0%	2	0	0%
Berea	4,561	0	0%	25	0	0%
Bratenahl	326	0	0%	8	0	0%
Brecksville	3,596	0	0%	18	0	0%
Broadview Heights	4,818	0	0%	11	0	0%
Brook Park	5,087	0	0%	15	0	0%
Brooklyn	2,793	0	0%	8	0	0%
Brooklyn Heights	520	0	0%	4	0	0%
Chagrin Falls	1,126	0	0%	9	0	0%
Chagrin Falls Township	27	0	0%	0	0	0%
Cleveland	99,020	10	0%	731	0	0%
Cleveland Heights	10,733	0	0%	58	0	0%
Cuyahoga Heights	215	0	0%	6	0	0%
East Cleveland	5,169	0	0%	41	0	0%
Euclid	11,074	0	0%	48	0	0%
Fairview Park	4,164	0	0%	19	0	0%
Garfield Heights	7,757	0	0%	33	0	0%
Gates Mills	650	0	0%	6	0	0%
Glenwillow	239	0	0%	1	0	0%
Highland Heights	2,187	0	0%	10	0	0%
Highland Hills	115	0	0%	7	0	0%
Hunting Valley	150	0	0%	2	0	0%
Independence	2,088	0	0%	13	0	0%
Lakewood	11,206	0	0%	59	0	0%
Linndale	45	0	0%	1	0	0%
Lyndhurst	3,835	0	0%	17	0	0%
Maple Heights	6,618	0	0%	32	0	0%
Mayfield	869	0	0%	6	0	0%
Mayfield Heights	3,786	0	0%	14	0	0%
Middleburg Heights	4,080	0	0%	19	0	0%
Moreland Hills	916	0	0%	2	0	0%
Newburgh Heights	568	0	0%	6	0	0%
North Olmsted	7,835	0	0%	31	0	0%
North Randall	145	0	0%	7	0	0%

Municipality	Total Structures	Total Structures Vulnerable to Levee Failure	Percent Structures Vulnerable to Levee Failure	Total Critical Facilities	Critical Facilities Vulnerable to Levee Failure	Percent Critical Facilities Vulnerable to Levee Failure
North Royalton	6,993	0	0%	22	0	0%
Oakwood	1,096	0	0%	6	0	0%
Olmsted Falls	2,177	0	0%	8	0	0%
Olmsted Township	3,465	0	0%	12	0	0%
Orange	863	0	0%	3	0	0%
Parma	20,666	0	0%	78	0	0%
Parma Heights	4,595	0	0%	17	0	0%
Pepper Pike	1,652	0	0%	17	0	0%
Richmond Heights	2,254	0	0%	17	0	0%
Rocky River	4,622	0	0%	29	0	0%
Seven Hills	3,351	0	0%	8	0	0%
Shaker Heights	5,839	0	0%	42	0	0%
Solon	5,671	0	0%	23	0	0%
South Euclid	5,852	0	0%	23	0	0%
Strongsville	11,101	0	0%	28	0	0%
University Heights	2,896	0	0%	12	0	0%
Valley View	660	0	0%	5	0	0%
Walton Hills	669	0	0%	4	0	0%
Warrensville Heights	2,703	0	0%	25	0	0%
Westlake	7,590	0	0%	35	0	0%
Woodmere	165	0	0%	2	0	0%
Grand Total	**313,691**	**10**	**0%**	**1,756**	**0**	**0%**

There are a total of 10 structures vulnerable to levee failure in Cuyahoga County. All 10 structures are residential homes that would be impacted by the levee failing.

TABLE 4-97 STRUCTURES VULNERABLE TO LEVEE FAILURE BY LAND USE TYPE

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Bay Village	0	0	0	0	0	0	0
Beachwood	0	0	0	0	0	0	0
Bedford	0	0	0	0	0	0	0
Bedford Heights	0	0	0	0	0	0	0
Bentleyville	0	0	0	0	0	0	0
Berea	0	0	0	0	0	0	0
Bratenahl	0	0	0	0	0	0	0
Brecksville	0	0	0	0	0	0	0
Broadview Heights	0	0	0	0	0	0	0
Brook Park	0	0	0	0	0	0	0
Brooklyn	0	0	0	0	0	0	0

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Brooklyn Heights	0	0	0	0	0	0	0
Chagrin Falls	0	0	0	0	0	0	0
Chagrin Falls Township	0	0	0	0	0	0	0
Cleveland	0	0	0	0	10	0	10
Cleveland Heights	0	0	0	0	0	0	0
Cuyahoga Heights	0	0	0	0	0	0	0
East Cleveland	0	0	0	0	0	0	0
Euclid	0	0	0	0	0	0	0
Fairview Park	0	0	0	0	0	0	0
Garfield Heights	0	0	0	0	0	0	0
Gates Mills	0	0	0	0	0	0	0
Glenwillow	0	0	0	0	0	0	0
Highland Heights	0	0	0	0	0	0	0
Highland Hills	0	0	0	0	0	0	0
Hunting Valley	0	0	0	0	0	0	0
Independence	0	0	0	0	0	0	0
Lakewood	0	0	0	0	0	0	0
Linndale	0	0	0	0	0	0	0
Lyndhurst	0	0	0	0	0	0	0
Maple Heights	0	0	0	0	0	0	0
Mayfield	0	0	0	0	0	0	0
Mayfield Heights	0	0	0	0	0	0	0
Middleburg Heights	0	0	0	0	0	0	0
Moreland Hills	0	0	0	0	0	0	0
Newburgh Heights	0	0	0	0	0	0	0
North Olmsted	0	0	0	0	0	0	0
North Randall	0	0	0	0	0	0	0
North Royalton	0	0	0	0	0	0	0
Oakwood	0	0	0	0	0	0	0
Olmsted Falls	0	0	0	0	0	0	0
Olmsted Township	0	0	0	0	0	0	0
Orange	0	0	0	0	0	0	0
Parma	0	0	0	0	0	0	0
Parma Heights	0	0	0	0	0	0	0
Pepper Pike	0	0	0	0	0	0	0
Richmond Heights	0	0	0	0	0	0	0
Rocky River	0	0	0	0	0	0	0
Seven Hills	0	0	0	0	0	0	0
Shaker Heights	0	0	0	0	0	0	0
Solon	0	0	0	0	0	0	0
South Euclid	0	0	0	0	0	0	0

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Strongsville	0	0	0	0	0	0	0
University Heights	0	0	0	0	0	0	0
Valley View	0	0	0	0	0	0	0
Walton Hills	0	0	0	0	0	0	0
Warrensville Heights	0	0	0	0	0	0	0
Westlake	0	0	0	0	0	0	0
Woodmere	0	0	0	0	0	0	0
Grand Total	0	0	0	0	10	0	10

4.15.7 Land Use & Development Trends

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

Regulatory Environment

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

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

ODNR also provides a template for EAP development. Emergency Action Plans include a description of the dam, the area at risk should the dam fail, and contact information for stakeholders. EAPs essentially identify actions that must be taken should an emergency occur. All dams regulated by Water Resources at ODNR are required by Ohio Administrative Code Rule 1501:21-15-07 to have an EAP in place.

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

4.15.8 Dam/Levee Failure Summary

As dams continue to age, the likelihood for failure increases as undesirable woody vegetation on the embankment, deteriorated concrete, inoperable gates, and corroded outlet pipes become problems. Since dam failures are often exacerbated by flooding, the probability of dam failures can be associated with projected flood frequencies. Overall, the probability of a dam failure throughout the state should remain low with continued maintenance of dams. Additionally, warning plans in place for designated high hazard dams will continue to decrease the danger for those residents in potential risk areas.

Mitigation Best Practices

Cuyahoga County jurisdictions can best prevent dam failure in the future by taking it upon themselves to learn more about dam safety from both the Ohio Department of Natural Resources (ODNR) and FEMA. Best practices for dam safety include regularly inspecting and maintaining dams as they age, providing educational materials to those who either live or do business beneath a dam, and to make sure that each dam in the community has an EAP.

ODNR's website has additional information and guides that relate to Dam Safety and can be found here: http://water.ohiodnr.gov/safety/dam-safety.

4.16. IT/Communications Disruption

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
IT/Communications Disruption	3	0.3	2	0.3	2	0.2	4	0.1	3	0.1	**2.6**
Moderate Risk Hazard (2.0 – 2.9)											

4.16.1 IT/Communications Disruption Description

Technological and communications disruptions are when radio, phone, and computer technologies are severely inhibited or are rendered inoperable. Technological and communication disruptions can be caused by several factors, including regularly scheduled maintenance, power outages, and space weather. Sabotage, criminal activity, terrorism, and cyber terrorism are also contributing factors to IT/Communications Disruptions.

The Internet has become integral to efficiently managing and running government, companies, households in the modern age. Cuyahoga County's Internet is served primarily by large cable companies such as Spectrum, Wide Open West, AT&T, and Cox Communications. Many businesses rely on the Internet to complete transactions, as well as their phone services which are now heavily tied into Voice over Internet Protocol (VOIP). As part of regular network maintenance, small outages occur often, usually at night when it will least affect businesses. However, longer outages can occur as a result of faulty equipment or damage to lines as a secondary result of hazards such as wind, tornadoes, fires, or earthquakes.

Power outages can disrupt communications. All technological devices run on electricity, either directly or through a battery. Without power, devices vital to communications such as routers and modems cannot function. Those phones that are connected through the internet cannot function, and most cell phones can only remain active for 1-2 days before they are drained. Power outages are typically localized are often caused by fallen trees or branches during storm events. These are typically short-lived, and power is restored within several hours. More damaging events can cause outages for multiple days or weeks.

Space weather that can affect communications are solar flares and geomagnetic storms. A solar flare is an intense burst of radiation coming from the release of magnetic energy associated with sunspots. Flares are our solar system's largest explosive events. They are seen as bright areas on the sun and they can last from minutes to hours. Similarly, a geomagnetic storm is when charged particles from the Sun buffet the Earth's magnetosphere. As these particles clash with the atmosphere, they can damage power grids, spacecraft operation, hinder satellite tracking, and high frequency radio propagation and satellite navigation can be blocked.

4.16.2 IT/Communications Disruption Location

IT/Communications Disruption events are generally region-wide events that can affect the entirety of Cuyahoga County. All communities can be affected during these occurrences.

4.16.3 Extent

The most severe communications disruptions will be regional or widespread outages. The hardest hit will be those working in emergency services who rely on efficient, real-time information to effectively perform their duties. Most communications disruptions are small, affecting highly localized areas, including city blocks or buildings. Though there would likely be no direct loss of life as a result of a communications disruption, the secondary effects of these services being unavailable would certainly lead to death. Shortly after the disruption, there would be an immediate confusion in the public as to why they are unable to call for of emergency services.

In a possible worst-case-scenario, a major communications disruption occurs as a result of, or at the same time as a winter weather event. This would leave the County's population in sub-freezing temperatures with no electricity and no way of knowing when or if there is someone working to correct the situation. For those who rely on electricity for heat, they will be facing a critical situation. Meanwhile, power, phone, and cable lines are down and cannot be repaired due to the magnitude of the storm, leaving them in a state of disrepair for several days.

4.16.4 Historical Occurrences

There have been no significant historical occurrences of IT/Communications Disruption

Small-scale communications disruptions happen regularly, often coinciding with storm damage, but also occur as a result of scheduled maintenance and upgrades. Large-scale outages are considerably less frequent, usually occurring with catastrophic storms such as the June 2012 Derecho, Hurricane Ike, or Hurricane Sandy.

4.16.5 Probability of Future Occurrence

Minor IT/Communications Disruptions occur regularly throughout Cuyahoga County, while major (i.e. widespread, long outage) events take place once every few years. Power interruptions during severe weather are common and can cause a disruption in communications and technological equipment. Cable television, internet, and phone services, which are the primary forms of communication for many people, can go down for a variety of reasons. Regular maintenance of systems has the potential to disrupt communications systems temporarily.

There is not enough historical precedence to determine frequency or future probability of IT/Communications Disruption events. The HMPC determined that it is “Likely” that a IT/Communications Disruption incident will occur in Cuyahoga County, meaning that there is between a 10% and 100% of annual probability.

4.16.6 Assets Exposed to IT/Communications Disruptions

Potential Losses

Communications failure in and of itself would be unlikely to cause any sort of physical losses. Repercussions can instead be measured in the loss of life from emergency services being unable to react efficiently and effectively to situations. There would also be an economic loss as workers may be unable to perform their jobs. If the entire County were to lose a full day of work, based on the Gross Regional Product from 2019, the estimated loss would be approximately $277,209.75.

TABLE 4-98 POTENTIAL IMPACTS FROM IT/COMMUNICATIONS DISRUPTIONS

Impact	Description
People	Injured people or people in need could be stranded in the event of an IT/Communications Disruptions event. Unable to contact emergency personnel.
Infrastructure	IT infrastructure would not be able to be used, cell phone towers or other communication towers may be downed or damaged.
Economy	Loss of business due to business closures.
Natural Systems	No impact.
Transportation	Emergency vehicles, busses, public transportation, taxi and ride-share services may experience loss of function.

Community Vulnerability

All County assets can be considered at risk from IT/communications disruption. This includes 100% of the County population and all buildings and infrastructure, especially the critical facilities.

4.16.7 Land Use & Development Trends

Cuyahoga County is the second most populated county in all of Ohio, with most of its land having been developed with either homes or businesses. There is an extensive network of communications infrastructure tying these assets together. Telecommunications companies, utility companies, and government entities are constantly working to maintain and upgrade these systems.

Regulatory Environment

The Federal Communications Commission (FCC) regulates interstate and international communications by radio, television, wire, satellite, and cable in all 50 states, the District of Columbia, and all United States territories.

The National Oceanic and Atmospheric Administration (NOAA) is responsible for the monitoring and prediction of space weather through their Space Weather Prediction Center.

4.16.8 IT/Communications Disruption Summary

The probability of a catastrophic IT/Communications Disruption is low, but there is a vulnerability to interruptions. Minor disruptions occur regularly as a part of scheduled maintenance or severe storm events. These interruptions are generally short-lived, and are quickly remedied. They typically occur in small localized areas, but major disruptive events can cause outages to the whole planning area.

Mitigation Best Practices

The Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) is a branch of DHS created to help both public and private sector organizations to mitigate, defend against, and repel cyber-attacks. The Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) mission is to guide a cohesive effort between government and industry to improve the cyber security posture of control systems within the nation's critical infrastructure. Generally speaking, ICS-CERT is best positioned to assist organizations with threats that are targeted in nature. These types of threats typically involve:

- APT related threats;
- Well-crafted spear-phishing emails;
- Unusual or destructive malware; and
- Anything anomalous occurring or found in the control environment.

If an organization detects malicious activity but is unsure if they should be concerned, ICS-CERT recommends reporting the incident. In those cases, organizations can leverage ICS-CERT as a barometer to quickly evaluate, through a few questions and some quick analysis, whether the activity is targeted or severe in nature or is general non-targeted activity. Organizations can report to ICS-CERT by emailing ics-cert@hq.dhs.gov or calling 877-776-7585.

Source: About the Industrial Control Systems Cyber Emergency Response Team, ICS-CERT.

https://ics-cert.us-cert.gov/About-Industrial-Control-Systems-Cyber-Emergency-Response-Team

4.17. Transportation Incident

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Transportation Incident	2	0.3	3	0.3	1	0.2	4	0.1	3	0.1	**2.4**
Moderate Risk Hazard (2.0 – 2.9)											

4.17.1 Transportation Incident Description

Transportation accidents can result from any form of air, rail, water, or road travel. Certain accidents could have secondary regional impacts such as a hazardous materials release or disruption in critical supply/access routes, especially if vital transportation corridors or junctions are present. Traffic congestion in certain circumstances can also be hazardous. Traffic congestion is a condition that occurs when traffic demand approaches or exceeds the available capacity of the road network. This hazard should be carefully evaluated during emergency planning since it is a key factor in timely disaster or hazard response, especially in areas with high population density.

4.17.2 Transportation Incident Location

All County assets can be considered at risk from a transportation incident. This includes 100 percent of the County population and all buildings and infrastructure. The number of roads and interstates, the presence of numerous rail corridors, and the flight paths that pass overhead place all parts of the County at some level of risk.

According to the Ohio Office of Research's 2020 Cuyahoga County profile, there are 132 interstate highway miles located within the County, 18.83 of which are turnpike miles. There are 107.37 U.S. highway miles, 230.97 State highway miles, and 4,324.58 County, township, and municipal road miles. There are also three commercial airports located within the County.

Figure 4-41 shows the larger-scale road network in Cuyahoga County and the average annual daily traffic that occurs on those roads. The County is crossed by several major road networks, and transportation accidents involving those networks can have impacts on secondary roads, from increased travel to a higher likelihood of transportation accident occurring due to detoured traffic. Major roads in Cuyahoga County include the Ohio Turnpike, otherwise known as I-80, and I-90 cross the County east-west, along with the auxiliary highways of 480 and 490. Running north-south are I-71 and I-77, with I-271 as the auxiliary bypass highway. Several United States Highways run through the County, as well, including US-6, US-20, US-42, US-322, and US-422.

In addition to automobile travel, there are several other components to the County transportation infrastructure, as shown in Figure 4-56. These include airports, helipads, and railroads.

FIGURE 4-55 AVERAGE ANNUAL DAILY TRAFFIC IN CUYAHOGA COUNTY

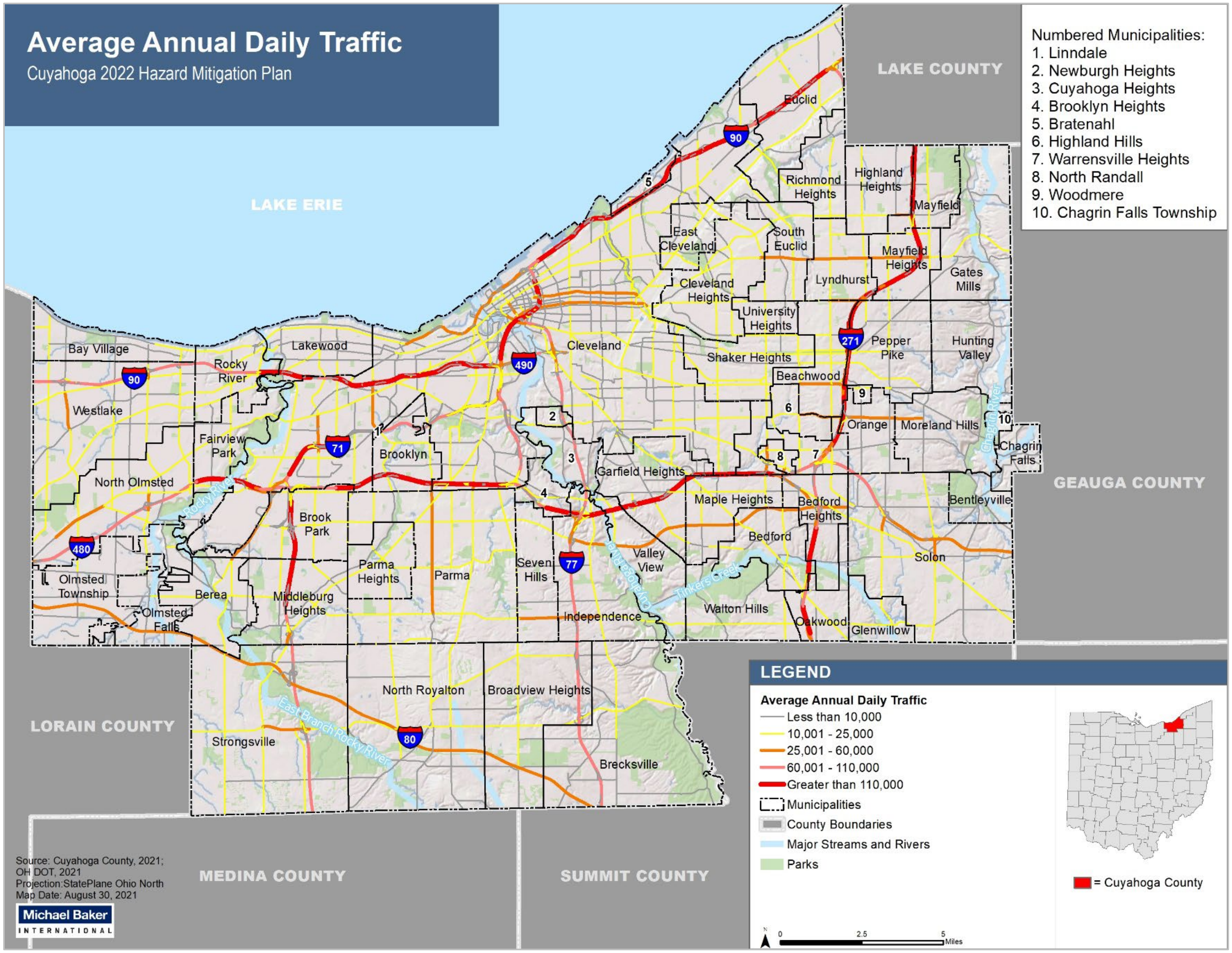
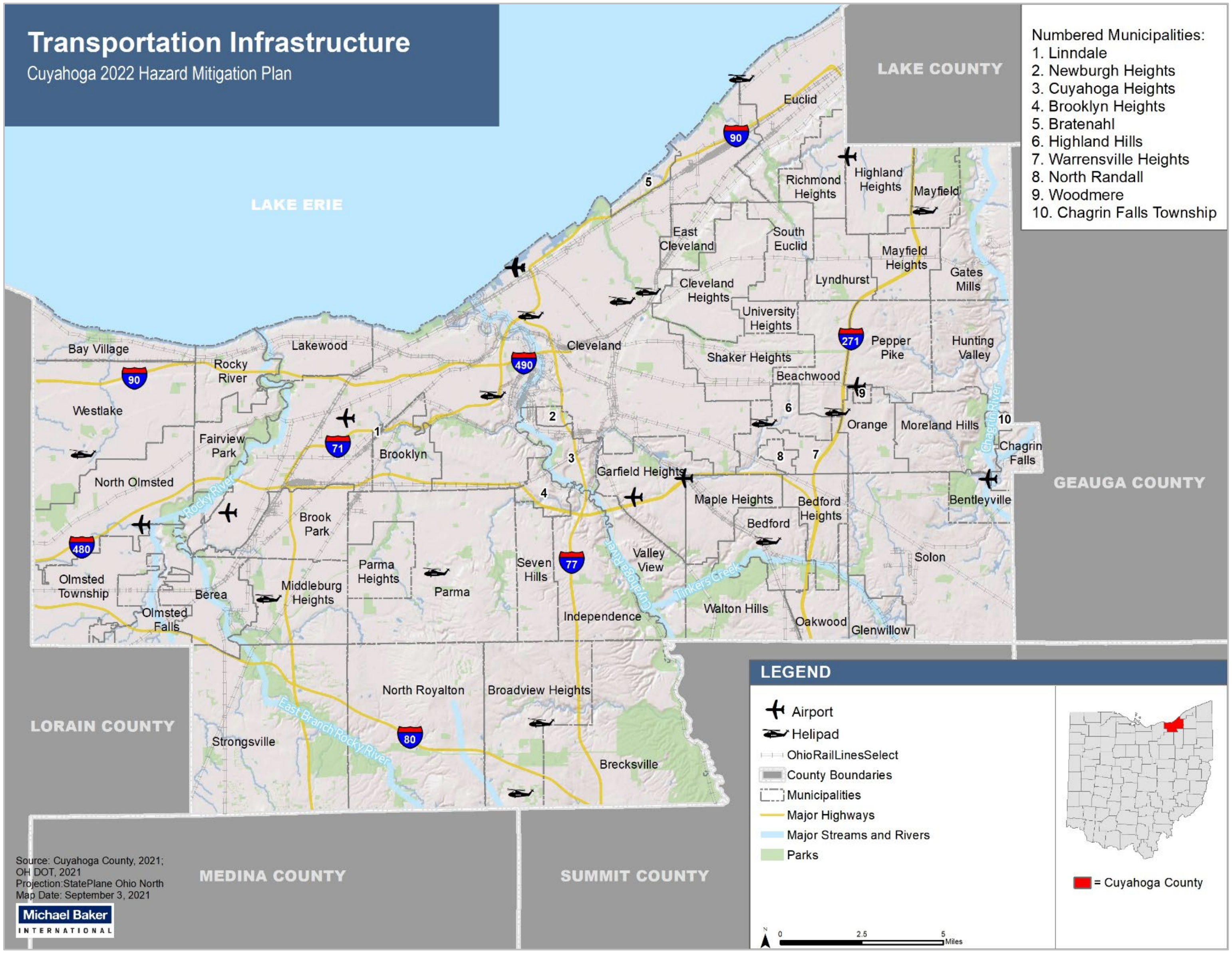


FIGURE 4-56 TRANSPORTATION INFRASTRUCTURE IN CUYAHOGA COUNTY



4.17.3 Extent

Road Traffic

There are well over 1.1 million registered motor vehicles in Cuyahoga County; 921,683 of the registered motor vehicles are passenger cars, and 64,739 are noncommercial trucks. Many people travel across and into the County for work every day. According to the 2020 Cuyahoga County Profile from the Ohio Office of Research, 22.9% of the County's residents have less than 15-minute commute to work. 43.2% of the residents have a 15 to 29-minute commute to work, and 23.2% have a 30 to 44-minute commute to work. 10.7% have a 45-minute or greater commute to work. There are numerous highways and interstates crisscrossing the County, all of which are used for transporting cargo and freight, with many of these roads running through the most populated areas of the County.

Rail Traffic

Throughout the County are railways that are used for freight as well as passengers. The RTA operates both a Light Rail and a Rapid Transit rail system, in addition to its bus services. The predominant purpose of these lines, however, is freight, with major owners including CSX, Norfolk Southern, River Terminal Railway Company, and the Wheeling & Lake Erie Railway Company.

These trains could be carrying:

- Automobiles
- Coal
- Metals
- Chemicals (Sulfur, Petroleum, Chlorine and Bleaching Products, Plastics, Chemical Waste, Plastics, Other Non-Hazardous Waste)
- Electronics
- Machinery

Railways extend throughout most of the County, putting all jurisdiction at risk during a railway incident.

Air Traffic

There are 3 airports available to the public in Cuyahoga County. One of these is the Cleveland-Hopkins International Airport, a major hub for travel in the region. The other two airports are smaller, but still make up substantial air traffic. These include Burke Lakefront Airport, and Cuyahoga County Airport. There is also significant private use of air space between the numerous hospitals in the County.

4.17.4 Historical Occurrences

Automotive

Auto accidents are a common enough occurrence that they are not catalogued as completely as other types of transportation incidents. According to the State Highway Patrol, there were 609 crashes investigated in 2021 as of August 30, 2021. In 2020, there were 529 crashes investigated. As of August 31, 2021, there have been 77 reported fatal crashes in the County in 2021 so far, compared to the 105 fatal car crashes that occurred within the County in 2020 and the 79 fatal car crashes that occurred within the County in 2019.

Rail Traffic

The majority of rail-involved accidents typically are when a train strikes a car or person that was on the tracks.

March 3, 2007: A train carrying Sodium Hydroxide derailed in Parma, resulting in road closures. A Hazardous Materials Team cleaned up after the incident.

July 31, 2013: A man was struck and killed by a train near Lakeside Avenue. The incident was determined to be a suicide. The Cuyahoga County Medical Examiner pronounced him dead on the scene.

October 26, 2020: A Lakewood resident passed away after her car was struck by a train on West 111th Street.

November 2, 2020: A 33-year-old woman passed away after being hit by a train. The driver attempted to avoid the railroad crossing gates and was struck by the train on the railroad tracks. The driver passed away at the scene, and the passenger in the car was taken to a hospital after sustaining many injuries.

Air Traffic

August 25, 2015: A small plane carrying 4 college students lost power and crashed in Willoughby Hills, Ohio, a Cleveland suburb. They had taken off from the Cuyahoga County Airport. None of the four passengers survived. There have been no serious commercial airline incidents reported in the County.

There have not been any airplane incidents since the previous plan was developed.

4.17.5 Probability of Future Occurrences

Automotive accidents happen daily throughout the County, with minor incidents making up the vast majority of these. Injuries, such as bruising or cuts are relatively common as a result of traffic accidents. Major incidents resulting in serious injury or death are more infrequent, but still happen regularly. The chance of both minor and major incidents is 100%.

There is not enough information to determine how often rail and air incidents are likely to occur. The HMPC determined that it is “Possible” that a Transportation Incident will occur in Cuyahoga County, meaning that there is between a 1% and 10% chance of the event occurring.

4.17.6 Assets Exposed to Transportation Incidents

Potential Losses

TABLE 4-99 POTENTIAL IMPACTS FROM TRANSPORTATION INCIDENTS

Impact	Description
People	Injuries from a transportation incident could range from minor to serious, requiring hospitalization. Loss of life could also be an impact of an incident.
Infrastructure	Damage could impact the infrastructure of where the transportation incident occurred. Serious incidents could require the roadway or railway to be closed for maintenance and repairs.
Economy	Loss of product, business, or profit.
Natural Systems	Contamination of natural systems if a hazardous material is spilled.
Transportation	Damage to involved transportation vehicles. Traffic congestion.

Community Vulnerability

Cuyahoga County’s has many critical facilities within 0.5 miles of a major highway, active rail line, or airport. Cleveland has the highest number of critical facilities within 0.5 miles of a major highway with 227 critical facilities. Rocky River has the second highest number of critical facilities with 18 critical facilities, and Garfield Heights has the third highest with 15 critical facilities. There are 7 jurisdictions that have all critical facilities within 100% within 0.5 miles of a major highway: Bedford Heights, Bratenahl, Brooklyn Heights, Cuyahoga

Heights, Linndale, Newburgh Heights, and Woodmere. Cleveland also has the highest number of critical facilities within 0.5 miles of an active rail line. Lakewood has the second highest number of critical facilities within 0.5 miles of an active rail line with 45 critical facilities, and East Cleveland has the third highest with 41 critical facilities located within 0.5 miles of an active rail line. There are 6 jurisdictions that all critical facilities are located within 0.5 miles of an active rail line: Chagrin Falls, Cuyahoga Heights, East Cleveland, Glenwillow, Linndale, and Woodmere. All jurisdictions' critical facilities are within 5 miles of an airport except Chagrin Falls Township.

TABLE 4-100 CRITICAL FACILITIES VULNERABLE TO TRANSPORTATION INCIDENTS

Municipality	Total Critical Facilities	Critical Facilities within .5 mi of a Major Highway	Percent Critical Facilities within .5 mi of a Major Highway	Critical Facilities within .5 mi of an Active Rail Line	Percent Critical Facilities within .5 mi of an Active Rail Line	Critical Facilities within 5 mi of an Airport	Percent Critical Facilities within 5 mi of an Airport
Bay Village	13	1	8%	12	92%	13	100%
Beachwood	29	12	41%	9	31%	29	100%
Bedford	21	2	10%	10	48%	21	100%
Bedford Heights	8	8	100%	1	13%	8	100%
Bentleyville	2	0	0%	1	50%	2	100%
Berea	25	3	12%	22	88%	25	100%
Bratenahl	8	8	100%	7	88%	8	100%
Brecksville	18	2	11%	0	0%	18	100%
Broadview Heights	11	2	18%	0	0%	11	100%
Brook Park	15	5	33%	6	40%	15	100%
Brooklyn	8	6	75%	2	25%	8	100%
Brooklyn Heights	4	4	100%	3	75%	4	100%
Chagrin Falls	9	0	0%	9	100%	9	100%
Chagrin Falls Township	0	0	0%	0	0%	0	0%
Cleveland	731	227	31%	468	64%	731	100%
Cleveland Heights	58	0	0%	21	36%	58	100%
Cuyahoga Heights	6	6	100%	6	100%	6	100%
East Cleveland	41	0	0%	41	100%	41	100%
Euclid	48	9	19%	34	71%	48	100%
Fairview Park	19	3	16%	15	79%	19	100%
Garfield Heights	33	15	45%	7	21%	33	100%
Gates Mills	6	0	0%	4	67%	6	100%
Glenwillow	1	0	0%	1	100%	1	100%
Highland Heights	10	1	10%	0	0%	10	100%
Highland Hills	7	0	0%	1	14%	7	100%
Hunting Valley	2	0	0%	0	0%	2	100%
Independence	13	6	46%	0	0%	13	100%
Lakewood	59	9	15%	45	76%	59	100%
Linndale	1	1	100%	1	100%	1	100%
Lyndhurst	17	0	0%	13	76%	17	100%
Maple Heights	32	8	25%	14	44%	32	100%

Municipality	Total Critical Facilities	Critical Facilities within .5 mi of a Major Highway	Percent Critical Facilities within .5 mi of a Major Highway	Critical Facilities within .5 mi of an Active Rail Line	Percent Critical Facilities within .5 mi of an Active Rail Line	Critical Facilities within 5 mi of an Airport	Percent Critical Facilities within 5 mi of an Airport
Mayfield	6	5	83%	0	0%	6	100%
Mayfield Heights	14	8	57%	6	43%	14	100%
Middleburg Heights	19	5	26%	7	37%	19	100%
Moreland Hills	2	0	0%	0	0%	2	100%
Newburgh Heights	6	6	100%	5	83%	6	100%
North Olmsted	31	13	42%	19	61%	31	100%
North Randall	7	2	29%	3	43%	7	100%
North Royalton	22	2	9%	0	0%	22	100%
Oakwood	6	1	17%	0	0%	6	100%
Olmsted Falls	8	2	25%	7	88%	8	100%
Olmsted Township	12	4	33%	3	25%	12	100%
Orange	3	0	0%	0	0%	3	100%
Parma	78	2	3%	3	4%	78	100%
Parma Heights	17	0	0%	0	0%	17	100%
Pepper Pike	17	3	18%	8	47%	17	100%
Richmond Heights	17	0	0%	0	0%	17	100%
Rocky River	29	18	62%	12	41%	29	100%
Seven Hills	8	1	13%	0	0%	8	100%
Shaker Heights	42	0	0%	33	79%	42	100%
Solon	23	0	0%	9	39%	23	100%
South Euclid	23	0	0%	10	43%	23	100%
Strongsville	28	6	21%	4	14%	28	100%
University Heights	12	0	0%	0	0%	12	100%
Valley View	5	0	0%	0	0%	5	100%
Walton Hills	4	0	0%	2	50%	4	100%
Warrensville Heights	25	6	24%	3	12%	25	100%
Westlake	35	9	26%	4	11%	35	100%
Woodmere	2	2	100%	2	100%	2	100%
Grand Total	**1,756**	**433**	**25%**	**893**	**51%**	**1,756**	**100%**

Cleveland has the highest number of structures within 0.5 miles of a major highway (35,354), highest number of structures within 0.5 miles of an active rail line (65,544), and highest number of structures within 5 miles of an airport (99,020).

TABLE 4-101 STRUCTURES VULNERABLE TO TRANSPORTATION INCIDENTS

Municipality	Total Structures	Structures within .5 mi of a Major Highway	Percent Structures within .5 mi of a Major Highway	Structures within .5 mi of an Active Rail Line	Percent Structures within .5 mi of an Active Rail Line	Structures within 5 mi of an Airport	Percent Structures within 5 mi of an Airport
Bay Village	4,092	741	18%	3,737	91%	4,092	100%
Beachwood	2,352	529	22%	509	22%	2,352	100%
Bedford	3,562	476	13%	1,755	49%	3,562	100%
Bedford Heights	2,284	1,750	77%	773	34%	2,284	100%
Bentleyville	203	0	0%	92	45%	203	100%
Berea	4,561	1,124	25%	3,414	75%	4,561	100%
Bratenahl	326	326	100%	240	74%	326	100%
Brecksville	3,596	971	27%	116	3%	3,596	100%
Broadview Heights	4,818	951	20%	0	0%	4,818	100%
Brook Park	5,087	2,066	41%	3,019	59%	5,087	100%
Brooklyn	2,793	1,736	62%	998	36%	2,793	100%
Brooklyn Heights	520	468	90%	252	48%	520	100%
Chagrin Falls	1,126	0	0%	961	85%	1,126	100%
Chagrin Falls Township	27	0	0%	0	0%	27	100%
Cleveland	99,020	35,354	36%	65,544	66%	99,020	100%
Cleveland Heights	10,733	0	0%	2,791	26%	10,733	100%
Cuyahoga Heights	215	201	93%	215	100%	215	100%
East Cleveland	5,169	0	0%	4,640	90%	5,169	100%
Euclid	11,074	2,789	25%	7,284	66%	11,074	100%
Fairview Park	4,164	694	17%	2,172	52%	4,164	100%
Garfield Heights	7,757	2,428	31%	2,117	27%	7,757	100%
Gates Mills	650	4	1%	207	32%	650	100%
Glenwillow	239	0	0%	159	67%	239	100%
Highland Heights	2,187	346	16%	0	0%	2,187	100%
Highland Hills	115	2	2%	2	2%	115	100%
Hunting Valley	150	0	0%	0	0%	150	100%
Independence	2,088	1,241	59%	151	7%	2,088	100%
Lakewood	11,206	2,977	27%	7,110	63%	11,206	100%
Linndale	45	45	100%	45	100%	45	100%
Lyndhurst	3,835	399	10%	1,495	39%	3,835	100%
Maple Heights	6,618	2,281	34%	1,964	30%	6,618	100%
Mayfield	869	326	38%	0	0%	869	100%
Mayfield Heights	3,786	1,909	50%	1,654	44%	3,786	100%
Middleburg Heights	4,080	1,430	35%	1,368	34%	4,080	100%
Moreland Hills	916	0	0%	355	39%	916	100%
Newburgh Heights	568	511	90%	324	57%	568	100%
North Olmsted	7,835	3,112	40%	3,184	41%	7,835	100%
North Randall	145	63	43%	84	58%	145	100%
North Royalton	6,993	1,009	14%	0	0%	6,908	99%

Municipality	Total Structures	Structures within .5 mi of a Major Highway	Percent Structures within .5 mi of a Major Highway	Structures within .5 mi of an Active Rail Line	Percent Structures within .5 mi of an Active Rail Line	Structures within 5 mi of an Airport	Percent Structures within 5 mi of an Airport
Oakwood	1,096	359	33%	180	16%	1,096	100%
Olmsted Falls	2,177	1,135	52%	1,187	55%	2,177	100%
Olmsted Township	3,465	1,198	35%	458	13%	3,465	100%
Orange	863	67	8%	47	5%	863	100%
Parma	20,666	2,092	10%	1,854	9%	20,666	100%
Parma Heights	4,595	0	0%	0	0%	4,595	100%
Pepper Pike	1,652	433	26%	312	19%	1,652	100%
Richmond Heights	2,254	0	0%	3	0%	2,254	100%
Rocky River	4,622	2,352	51%	1,926	42%	4,622	100%
Seven Hills	3,351	279	8%	0	0%	3,351	100%
Shaker Heights	5,839	0	0%	4,614	79%	5,839	100%
Solon	5,671	0	0%	2,440	43%	5,671	100%
South Euclid	5,852	0	0%	1,887	32%	5,852	100%
Strongsville	11,101	3,075	28%	2,223	20%	11,090	100%
University Heights	2,896	0	0%	0	0%	2,896	100%
Valley View	660	91	14%	235	36%	660	100%
Walton Hills	669	6	1%	184	28%	669	100%
Warrensville Heights	2,703	943	35%	401	15%	2,703	100%
Westlake	7,590	1,737	23%	575	8%	7,590	100%
Woodmere	165	68	41%	143	87%	165	100%
Grand Total	**313,691**	**82,094**	**26%**	**137,400**	**44%**	**313,595**	**100%**

There are a total of 82,094 structures within 0.5 miles of a major highway in Cuyahoga County. 3,995 of the structures are commercial buildings, 94 of the parcels are green space, 3,013 structures are industrial buildings, 408 structures are institutional buildings, 74,419 structures are residential buildings, and 101 are utility structures.

TABLE 4-102 STRUCTURES IN ROAD ACCIDENT ZONES BY LAND USE TYPE

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Total
Bay Village	6	0	0	0	734	1	741
Beachwood	50	0	0	3	476	0	529
Bedford	5	0	3	4	464	0	476
Bedford Heights	67	1	104	6	1572	0	1,750
Bentleyville	0	0	0	0	0	0	0
Berea	7	1	1	2	1112	1	1,124
Bratenahl	1	0	0	2	323	0	326
Brecksville	26	1	88	2	854	0	971
Broadview Heights	15	2	79	10	844	1	951
Brook Park	43	1	104	6	1909	3	2,066
Brooklyn	75	1	60	6	1592	2	1,736
Brooklyn Heights	7	1	78	1	381	0	468
Chagrin Falls	0	0	0	0	0	0	0
Chagrin Falls Township	0	0	0	0	0	0	0
Cleveland	2,318	33	1337	248	31317	47	35,354
Cleveland Heights	0	0	0	0	0	0	0
Cuyahoga Heights	6	2	42	3	140	8	201
East Cleveland	0	0	0	0	0	0	0
Euclid	60	0	110	9	2603	6	2,789
Fairview Park	12	1	0	1	679	1	694
Garfield Heights	92	1	77	14	2242	2	2,428
Gates Mills	0	0	0	0	4	0	4
Glenwillow	0	0	0	0	0	0	0
Highland Heights	8	0	17	0	321	0	346
Highland Hills	0	0	0	2	0	0	2
Hunting Valley	0	0	0	0	0	0	0
Independence	56	5	28	4	1143	5	1,241
Lakewood	51	0	14	5	2903	3	2,977
Linndale	5	0	8	3	29	0	45
Lyndhurst	3	1	0	1	394	0	399
Maple Heights	109	0	10	6	2155	1	2,281
Mayfield	26	3	21	8	267	1	326
Mayfield Heights	69	1	0	4	1835	0	1,909
Middleburg Heights	90	4	189	4	1142	1	1,430
Moreland Hills	0	0	0	0	0	0	0
Newburgh Heights	15	2	6	3	484	1	511
North Olmsted	95	1	31	7	2975	3	3,112
North Randall	18	0	1	1	43	0	63
North Royalton	24	7	182	2	793	1	1,009
Oakwood	22	0	47	4	286	0	359

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Total
Olmsted Falls	7	6	1	1	1118	2	1,135
Olmsted Township	9	4	7	4	1174	0	1,198
Orange	15	0	0	0	52	0	67
Parma	168	0	39	2	1875	1	2,092
Parma Heights	0	0	0	0	0	0	0
Pepper Pike	0	0	0	5	427	1	433
Richmond Heights	0	0	0	0	0	0	0
Rocky River	51	5	0	9	2286	1	2,352
Seven Hills	2	0	0	0	276	0	279
Shaker Heights	0	0	0	0	0	0	0
Solon	0	0	0	0	0	0	0
South Euclid	0	0	0	0	0	0	0
Strongsville	65	10	1	7	2988	4	3,075
University Heights	0	0	0	0	0	0	0
Valley View	8	0	50	0	32	1	91
Walton Hills	1	0	5	0	0	0	6
Warrensville Heights	33	0	104	4	801	1	943
Westlake	231	0	169	4	1331	2	1,737
Woodmere	24	0	0	1	43	0	68
Grand Total	**3,995**	**94**	**3,013**	**408**	**74,419**	**101**	**82,094**

There are a total of 137,400 structures located within 0.5 miles of an active rail line in Cuyahoga County. 7,926 of the structures are commercial buildings, 197 of the parcels are green space, 4,274 structures are industrial buildings, 918 structures are institutional buildings, 123,799 structures are residential buildings, and 177 are utility structures.

TABLE 4-103 STRUCTURES IN RAIL ACCIDENT ZONES BY LAND USE TYPE

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Bay Village	56	5	8	7	3659	2	3,737
Beachwood	79	1	60	4	364	1	509
Bedford	155	4	54	15	1525	1	1,755
Bedford Heights	44	1	133	1	592	2	773
Bentleyville	0	3	0	0	89	0	92
Berea	149	3	114	46	3099	3	3,414
Bratenahl	0	0	0	2	238	0	240
Brecksville	4	12	0	0	100	0	116
Broadview Heights	0	0	0	0	0	0	0
Brook Park	60	4	124	6	2822	3	3,019
Brooklyn	51	1	67	6	871	2	998
Brooklyn Heights	5	1	74	1	171	0	252
Chagrin Falls	107	1	6	8	837	2	961
Chagrin Falls Township	0	0	0	0	0	0	0
Cleveland	4,272	61	2335	548	58135	94	65,544
Cleveland Heights	171	3	8	34	2574	1	2,791
Cuyahoga Heights	7	2	49	3	145	9	215
East Cleveland	248	3	30	26	4327	6	4,640
Euclid	188	4	138	30	6916	8	7,284
Fairview Park	140	5	0	3	2024	0	2,172
Garfield Heights	90	3	70	6	1944	3	2,117
Gates Mills	9	2	0	5	190	1	207
Glenwillow	7	3	16	0	130	3	159
Highland Heights	0	0	0	0	0	0	0
Highland Hills	0	1	0	0	1	0	2
Hunting Valley	0	0	0	0	0	0	0
Independence	7	8	43	0	91	2	151
Lakewood	389	2	24	37	6654	4	7,110
Linndale	5	0	8	3	29	0	45
Lyndhurst	44	2	0	9	1440	0	1,495
Maple Heights	158	0	49	16	1733	5	1964
Mayfield	0	0	0	0	0	0	0
Mayfield Heights	93	1	0	1	1558	1	1,654
Middleburg Heights	42	5	18	6	1296	1	1,368
Moreland Hills	1	7	0	2	345	0	355
Newburgh Heights	13	0	8	3	298	2	324
North Olmsted	389	3	28	19	2743	2	3,184
North Randall	27	0	3	1	53	0	84
North Royalton	0	0	0	0	0	0	0
Oakwood	0	1	26	2	151	0	180

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Olmsted Falls	50	9	5	11	1109	3	1,187
Olmsted Township	7	1	9	4	436	1	458
Orange	13	0	0	0	34	0	47
Parma	177	0	99	2	1570	1	1,854
Parma Heights	0	0	0	0	0	0	0
Pepper Pike	29	0	0	4	278	1	312
Richmond Heights	0	0	0	0	3	0	3
Rocky River	101	1	18	4	1801	1	1,926
Seven Hills	0	0	0	0	0	0	0
Shaker Heights	102	9	6	23	4471	3	4,614
Solon	189	3	215	8	2022	3	2,440
South Euclid	103	1	24	6	1752	1	1,887
Strongsville	44	5	85	1	2085	3	2,223
University Heights	0	0	0	0	0	0	0
Valley View	15	12	69	0	138	1	235
Walton Hills	4	3	49	2	125	1	184
Warrensville Heights	12	0	79	1	309	0	401
Westlake	24	1	123	1	426	0	575
Woodmere	46	0	0	1	96	0	143
Grand Total	7,926	197	4,274	918	123,799	177	137,400

There are a total of 313,595 structures located within 5 miles of an airport in Cuyahoga County. 13,434 of the structures are commercial buildings, 535 of the parcels are green space, 5,834 structures are industrial buildings, 1,799 structures are institutional buildings, 291,547 structures are residential buildings, and 271 are utility structures.

TABLE 4-104 STRUCTURES IN AIR ACCIDENT ZONES BY LAND USE TYPE

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Bay Village	56	6	8	8	4012	2	4,092
Beachwood	106	1	100	19	2124	2	2,352
Bedford	210	5	54	33	3257	2	3,562
Bedford Heights	76	3	145	6	2052	2	2,284
Bentleyville	0	6	0	0	197	0	203
Berea	149	4	119	50	4236	3	4,561
Bratenahl	1	0	0	2	323	0	326
Brecksville	113	34	103	18	3320	7	3,596
Broadview Heights	154	4	95	29	4535	1	4,818
Brook Park	100	83	136	15	4750	3	5,087
Brooklyn	112	2	71	14	2592	2	2,793
Brooklyn Heights	7	1	126	1	385	0	520
Chagrin Falls	107	2	6	8	1001	2	1,126
Chagrin Falls Township	0	0	0	0	27	0	27
Cleveland	5,871	86	2548	849	89417	106	99,020
Cleveland Heights	356	14	9	72	10280	2	10,733
Cuyahoga Heights	7	2	49	3	145	9	215
East Cleveland	268	4	30	26	4835	6	5,169
Euclid	219	7	140	39	10660	8	11,074
Fairview Park	162	6	0	4	3990	2	4,164
Garfield Heights	292	4	136	32	7286	5	7,757
Gates Mills	9	4	0	10	626	1	650
Glenwillow	7	3	32	0	193	4	239
Highland Heights	17	3	30	2	2135	0	2,187
Highland Hills	3	8	0	16	88	0	115
Hunting Valley	1	6	0	5	138	0	150
Independence	121	15	54	17	1874	7	2,088
Lakewood	630	4	30	49	10485	6	11,206
Linndale	5	0	8	3	29	0	45
Lyndhurst	55	4	0	12	3764	0	3,835
Maple Heights	332	2	62	23	6191	5	6,618
Mayfield	38	5	21	9	795	1	869
Mayfield Heights	116	3	0	7	3659	1	3,786
Middleburg Heights	213	6	218	12	3628	3	4,080
Moreland Hills	4	12	0	3	897	0	916
Newburgh Heights	17	2	9	3	535	2	568
North Olmsted	416	7	40	27	7338	7	7,835
North Randall	45	0	3	1	96	0	145
North Royalton	217	16	213	18	6439	5	6,908
Oakwood	32	1	99	6	958	0	1,096

Municipality	Commercial	Green Space	Industrial	Institutional	Residential	Utility	Grand Total
Olmsted Falls	52	12	5	11	2094	3	2,177
Olmsted Township	28	21	14	9	3392	1	3,465
Orange	23	3	0	4	833	0	863
Parma	715	14	131	112	19664	9	20,666
Parma Heights	181	2	1	14	4396	1	4,595
Pepper Pike	29	1	0	12	1608	2	1,652
Richmond Heights	33	5	9	10	2194	3	2,254
Rocky River	186	6	18	14	4394	4	4,622
Seven Hills	34	1	1	5	3308	1	3,351
Shaker Heights	123	11	6	25	5670	4	5,839
Solon	195	11	267	26	5168	4	5,671
South Euclid	121	2	24	14	5689	2	5,852
Strongsville	369	34	135	23	10504	25	11,090
University Heights	60	1	0	26	2809	0	2,896
Valley View	21	16	130	2	490	1	660
Walton Hills	7	8	50	6	597	1	669
Warrensville Heights	100	1	167	12	2422	1	2,703
Westlake	467	11	182	22	6906	2	7,590
Woodmere	46	0	0	1	117	1	165
Grand Total	13,434	535	5,834	1,799	291,547	271	313,595

4.17.7 Land Use & Development Trends

Most of the existing transportation routes in, near, or through Cuyahoga County are already well-established. Steps can be taken to improve safety for pedestrians, and to control traffic patterns to make the roads as safe as possible. Rail lines are inspected regularly, and all policies are in place to mitigate potential losses along the lines. The FAA develops policies, and air operators follow recommended maintenance protocols to ensure that air travel is as safe as possible. Roads traces the vast majority of the County.

Regulatory Environment

Automotive: Auto accidents generally fall under the authority of the appropriate law enforcement agency. This will typically fall under each local jurisdiction's police department, or the State Highway Patrol when incidents occur on highways.

Rail Traffic: The Federal Railroad Administration is tasked with the safe, reliable, and efficient movement of people and goods.

Air Traffic: The Federal Aviation Administration is tasked with regulating air travel within the United States.

4.17.8 Transportation Incident Summary

Transportation incidents occur commonly, usually to the effect of traffic congestion during rush hour. However, the possibility does exist for a large-scale rail or air traffic incident to impact the County and its jurisdictions. In those cases, not only would people be at risk, but potentially infrastructure as well. These incidents can often have a secondary effect of causing a hazardous materials spill.

Mitigation Best Practices

Road Traffic: The Ohio Department of Transportation (ODOT) runs a Highway Safety Improvement Program, which aims to reduce high-crash and severe-crash locations through engineering programs. Funds are available to local governments and can be used to make improvements on any public roadway. ODOT funds a mix of spot safety projects, such as intersection and curve realignment, and systematic safety treatments, such as edge line rumble stripes and cable barrier, which can be installed across hundreds of miles.

More information on road safety can be found at: http://www.dot.state.oh.us/Divisions/Planning/ProgramManagement/HighwaySafety/HSIP/Pages/default.aspx

Rail Traffic: The Federal Railroad Administration Office of Railroad Safety promotes and regulates safety throughout the Nation's railroad industry. The office executes its regulatory and inspection responsibilities through a diverse staff of railroad safety experts. The staff includes 400 Federal safety inspectors who operate out of eight regional offices. Each regional administrator is supported by two deputy regional administrators, chief inspectors, supervisory specialists, grade crossing safety managers and safety inspectors for five of the safety disciplines focusing on compliance and enforcement in:

- Hazardous Materials
- Motive Power and Equipment
- Operating Practices
- Signal and Train Control
- Track

More information on rail safety can be found at: https://www.fra.dot.gov/Page/P0010.

Air Traffic: The Airport Safety and Operations Division includes the Safety and Certification Program. The division holds primary responsibility for the safety and certification of airports; airport operations and safety practices, including aircraft rescue and firefighting and the mitigation of wildlife hazards; promotion of emergency operations, emergency management planning, and damage control at civil airports; and Federal activities at airports and their restoration after attack or a natural disaster.

More information on air safety can be found at: https://www.faa.gov/about/office_org/headquarters_offices/arp/offices/aas/aas300/

Additional Mitigation Measures:

Driver Education: The risk of transportation accidents can be reduced through improvements in driver education, traffic law enforcement, and transportation planning that balances needs of public transportation conveyers with safety of the general public. Commercial operators also need training and skill enhancement programs.

Road Design: Improved design, routing, and traffic control at problem roadway areas can reduce risk of transportation accidents. Designated truck routes, as well as enforcement of weight and truck travel restrictions, can help. In long-term planning, communities can consider establishing more connector roads to reduce congestion on arterial roads.

Railroads: Accidents can be reduced through railroad inspections and improved designs at problem railway/roadway intersections.

Airports: Airport maintenance, security, and safety programs are essential for reducing accident risk.

Marine Safety: Accident risk can be reduced through programs that address marine safety and general boater awareness.

Mass Casualty Preparation: It is important to consider training, planning, and preparedness for mass-casualty incidents involving all modes of transportation. Cuyahoga County currently maintains a Mass Casualty Incident Annex to the Emergency Operations Plan (EOP).

Traffic Control: Road closures and traffic control in accident areas becomes especially critical during a hazardous material incident response.

Source: Wisconsin DEM, Mitigation Ideas: Possible Mitigation Measures by Hazard Type, 2002.

4.18. Civil Disturbance

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Civil Disturbance	2	0.3	2	0.3	2	0.2	3	0.1	2	0.1	2.1
Moderate Risk Hazard (2.0 – 2.9)											

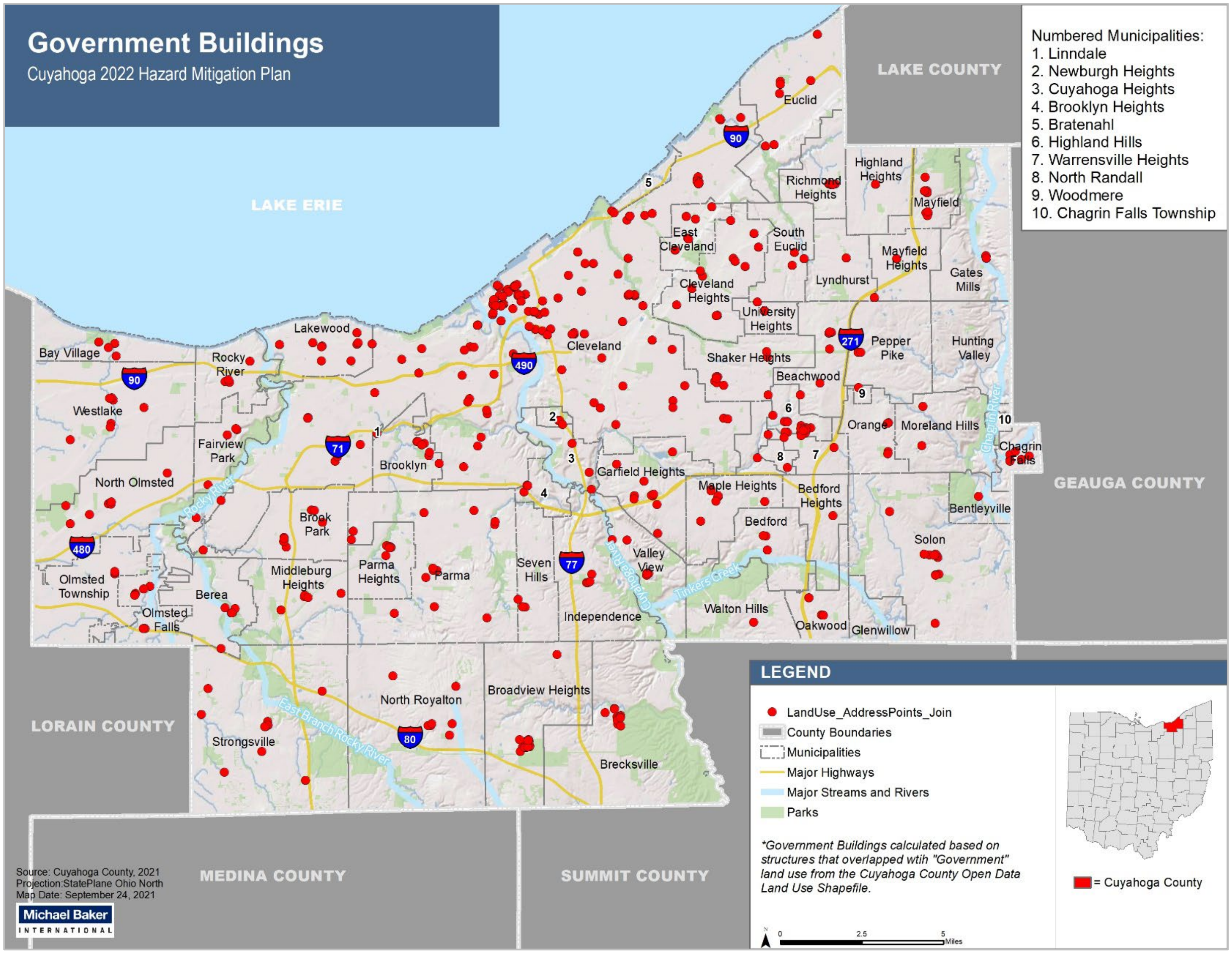
4.18.1 Civil Disturbance Description

Civil disturbance is a broad term that is typically used by law enforcement to describe one or more forms of disturbance caused by a group of people. Civil disturbance is typically a symptom of, and a form of protest against, major socio-political problems. Typically, the severity of the action coincides with the level of public outrage. In addition to a form of protest against major socio-political problems, civil disturbances can also arise out of union protest, institutional population uprising, or from large celebrations that become disorderly. The scale and scope of civil disturbance events varies widely. However, government facilities, landmarks, prisons, and universities are common sites where crowds and mobs may gather.

4.18.2 Civil Disturbance Location

Civil disturbance is likely to begin outside or near government buildings in protest of a governmental occurrence. Government buildings are also a known common area for people to reference for a gathering spot. The following map shows where government buildings are located throughout Cuyahoga County.

FIGURE 4-57 GOVERNMENT BUILDINGS IN CUYAHOGA COUNTY



4.18.3 Extent

Civil disturbances can take the form of small gatherings or large groups blocking or impeding access to a building, or disrupting normal activities by generating noise and intimidating people. They can range from a peaceful sit-in to a full scale riot, in which a mob burns or otherwise destroys property and terrorizes individuals. Even in its more passive forms, a group that blocks roadways, sidewalks, or buildings interferes with public order. Often that which was intended to be a peaceful demonstration to the public and the government can escalate into general chaos. There are two types of large gatherings typically associated with civil disturbances: a crowd and a mob. A crowd may be defined as a casual, temporary collection of people without a strong, cohesive relationship. Crowds can be classified into four categories (Blumer, 1946):

- **Casual Crowd**: A casual crowd is merely a group of people who happen to be in the same place at the same time. Violent conduct does not occur.
- **Cohesive Crowd**: A cohesive crowd consists of members who are involved in some type of unified behavior. Members of this group are involved in some type of common activity, such as worshipping, dancing, or watching a sporting event. Although they may have intense internal discipline, they require substantial provocation to arouse to action.
- **Expressive Crowd**: An expressive crowd is one held together by a common commitment or purpose. Although they may not be formally organized, they are assembled as an expression of common sentiment or frustration. Members wish to be seen as a formidable influence. One of the best examples of this type is a group assembled to protest.
- **Aggressive Crowd**: An aggressive crowd is comprised of individuals who have assembled for a specific purpose. This crowd often has leaders who attempt to arouse the members or motivate them to action. Members are noisy and threatening and will taunt authorities. They may be more impulsive and emotional, and require only minimal stimulation to arouse violence. Examples of this type of crowd could include demonstrators, though not all demonstrators are aggressive.

A mob can be defined as a large disorderly crowd or throng. Mobs are usually emotional, loud, tumultuous, violent and lawless. Similar to crowds, mobs have different levels of commitment and can be classified into four categories (Alvarez and Bachman, 2007):

- **Aggressive Mob**: An aggressive mob is one that attacks, riots and terrorizes. The object of violence may be a person, property, or both. An aggressive mob is distinguished from an aggressive crowd only by lawless activity. Examples of aggressive mobs are the inmate mobs in prisons and jails, mobs that act out their frustrations after political defeat, or violent mobs at political protests or rallies.
- **Escape Mob**: An escape mob is attempting to flee from something such as a fire, bomb, flood, or other catastrophe. Members of escape mobs are generally difficult to control can be characterized by unreasonable terror.
- **Acquisitive Mob**: An acquisitive mob is one motivated by a desire to acquire something. Riots caused by other factors often turn into looting sprees. This mob exploits a lack of control by authorities in safeguarding property.
- **Expressive Mob**: An expressive mob is one that expresses fervor or revelry following some sporting event, religious activity, or celebration. Members experience a release of pent-up emotions in highly charged situations.

Civil unrest and disturbances affect the following factions of society:

- **The Public**: The general population could serve as participants or targets in actions of civil unrest. Widespread unrest could cause fear amongst the populace and cause them to be absent from school or work activities. During an event, bystanders may be harmed because of the activities of participants.
- **Responders**: Responses to civil unrest events are generally handled at the local level. In a large event, the resources of a local jurisdiction may be exceeded. In this instance, State resources would be activated to fill the need. During an event, responders may become targets, which could hamper their effectiveness.
- **Continuity of Operations**: The outbreak of widespread rioting or looting could have potential impact on the State's ability to provide services and conduct its normal operations. Protesters could occupy government buildings and interrupt the normal functions of government, or targeted attacks on government facilities could interrupt operations entirely.
- **Property**: Private property often serves as a target in instances of civil unrest. Businesses can be targeted for looting or vandalism. If an event is particularly large, damage could reach millions of dollars and recovery could take years.
- **Facilities**: Often in acts of civil unrest government facilities become the focal point of protests or targets for vandalism. Damage suffered during an event or the inability of a worker to enter a facility may greatly reduce a facility's effective capacity or close it completely.
- **Infrastructure**: Similar to government facilities, public and private infrastructure can become targets of civil unrest. Damage to transportation, communications, or utilities infrastructure could further exacerbate the situation.
- **Environment**: Normally, instance of civil unrest will have a minimal impact on the environment. However, if petroleum or other chemical facilities were a target for vandalism or large-scale fires occurred, the impact on the environment could be significant.
- **Economic Condition of the State**: Civil unrest could prove economically crippling to the state. Large-scale events are usually accompanied by wide-spread absenteeism and damage to private property.
- **Public Confidence** in the State's Governance: If an event becomes prolonged or is perceived to be mismanaged, it could greatly decrease public confidence in the governance of the State. If the response is seen to be inadequate, individuals may attempt to protect their property by their own means and further degrade the situation.

4.18.4 Historical Occurrences

General Trends

The County has seen a variety of civil disturbance episodes in the past, most notably in response to racially charged political environments. Some have remained as peaceful protests, while others have turned violent.

Event Narratives

1966-1968: During the Civil Rights Movement, many African Americans and their supporters began to seek political, social, and economic equality. Some became quite outspoken after the Civil Rights Act of 1964 passed; they had gone from believing they would never see equality in their lifetimes, to seeing it just within their grasp. Throughout the country in 1965, civil unrest became common, the most famous outbreak occurring in the Watts District in Los Angeles. The first disturbance in Cleveland, the Hough Riots, lasted for several days in 1966, and the Cleveland Police proved ineffective in quelling violence. Arson fires destroyed several blocks of homes and businesses on the east side of Cleveland. Four people died. Only July 23, 1968, in what became known as the “Glenville Shootout,” police officers and a number of African Americans confronted each other. After several hours of violence, four civilians and three police officers had been killed. The incident set off another two days of violence, including arson, looting, and beatings.

2011-2012: The “Occupy Wall Street” movement gained traction in September of 2011 in order to protest income inequality, greed, and corruption in the United States. While the movement originated in New York City, protests spawned throughout the country, including some in Downtown Cleveland. By the end of 2012, the movement had largely dissolved.

November 2014: Two police officers responded to a call that a black male was sitting on a swing in a park pointing a gun at people. Upon arriving at the scene, one of the officers almost immediately opened fire on Tamir Rice, the young man in the park. Rice was hit once in the torso. Neither officer administered any first aid to Rice afterwards. He died the following day. The gun that Rice was holding was shown to be an airsoft gun that lacked the orange safety tip. Several days later, in a similar case involving the death of a man named Michael Brown, a grand jury made the decision to not indict the officer involved in that shooting. That day, in response to the Rice shooting, approximately 200 protestors marched from Public Square to the Cleveland Memorial Shoreway, causing the latter to temporarily shut down. Rice’s family asked protestors to remain peaceful in their activities. Protests continued through 2016. Mayor Frank Jackson of Cleveland and Police Chief Calvin Williams said that they planned to balance public safety with protesters’ First Amendment rights.

May-June 2020: After the death of George Floyd due to police brutality in Minneapolis, Minnesota, protests erupted across the United States, calling for police reform, including in Cuyahoga County. Demonstrations in protest of George Floyd’s death turned into violence and civil unrest. The demonstrations began in downtown Cleveland on May 30th, five days after George Floyd’s death. Protests and counterprotests emerged as a result of the police brutality, resulting in a curfew for Cleveland residents. During these protests, several businesses were damaged, and seventy arrests were made.

4.18.5 Probability of Future Occurrences

There is not historical precedence to accurately predict how often civil disturbances will occur. However, it may be possible to recognize the potential for an event to occur in the near-term, such as times of economic or political unrest. Large events that deal with a controversial topic can often draw protestors. Local law enforcement should anticipate these types of events and be prepared to handle a crowd so that peaceful gatherings are prevented from turning into unruly public disturbances. The HMPC, based on their knowledge, determined that civil disturbance events are “Possible,” meaning they have between a 1% and 10% chance of occurring each year.

4.18.6 Assets Exposed to Civil Disturbance

Potential Losses

TABLE 4-105 POTENTIAL IMPACTS FROM CIVIL DISTURBANCE

Impact	Description
People	Injuries could be sustained if people were to get trampled in a fast-moving crowd.
Infrastructure	Buildings and bridges could suffer cosmetic damages such as broken glass and graffiti. Fires could also be started and impact structures.
Economy	Loss of business due to business closures, curfew. Loss of product due to looting or fires.
Natural Systems	Most likely no impact to natural systems.
Transportation	Large gatherings may close roads, causing delay in travel time. Curfews may impact public transportation.

Community Vulnerability

All County assets can be considered at risk from civil disturbance. This includes 100% of the County population and all buildings and infrastructure. Government buildings could suffer increased damages as protests can begin due to political or social reasons.

Cleveland Metroparks Vulnerability

The Cleveland Metroparks operates the Cleveland Zoo which draws more than 1 million visitors annually. Should any kind of civil disturbance occur, there would be a need to quickly announce procedures for dealing with any disturbance and keeping the visitors safe. The zoo does not currently have any kind of public address system to quickly and uniformly inform its visitors of any breaking situations.

4.18.7 Land Use & Development Trends

Public spaces such as parks, government buildings, or sports or convention venues can be the scene of large civil disturbances. If the entire County were to lose a full day of work due to mass civil disturbance, based on the Gross Regional Product from 2016, the estimated loss would be approximately $240,000,000.

Regulatory Environment

The response to civil disturbance incidents usually falls to the responsible law enforcement agency. Spontaneous events may result in deployment of police forces to contend with the protestors, and the resulting crowds. Planned marches or events are often scheduled in advance, with a permitting process that allows law enforcement to adequately prepare for potential situations.

4.18.8 Civil Disturbance Summary

The vulnerability of individual jurisdictions is difficult to determine because civil disturbance hazards are tied to the current political and economic climate. Universities invite a variety of speakers through the course of the year, and impromptu crowds can develop at virtually any time. These events generally do not directly impact infrastructure and buildings.

Mitigation Best Practices

A document published by the Wisconsin Department of Military Affairs, Division of Emergency Management (WDEM) compiled a list of possible hazard mitigation measures from experiences and conversations within FEMA Region V, including Ohio. This document includes mitigation ideas for civil disturbance.

- **Law Enforcement**: Local and state governments can provide law enforcement agencies with training, staffing, and resources.

- **Planning and Documentation**: Local governments or other organizations can anticipate and plan for incidents. When a civil disturbance occurs, it may be a good idea to record the event on videotape for later study and use in prosecutions.
- **Facility Design**: Emergency and security provisions can be included in design requirements for schools, factories, office buildings, shopping malls, hospitals, correctional facilities, stadiums, recreation areas, and other similar facilities.
- **Environmental Design**: Crime Prevention Through Environmental Design (CPTED) is a field of planning that examines design, management, integration, and lowered density of poor or blighted areas with the goal of reducing vandalism, crime, and some types of riot events.

The full document can be found at:
http://emergencymanagement.wi.gov/mitigation/docs/mitigation_ideas.pdf.

4.19. Building/Structural Collapse

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Building/Structural Collapse	3	0.3	1	0.3	1	0.2	4	0.1	1	0.1	**1.9**
Low Risk Hazard (0.1 – 1.9)											

4.19.1 Building/Structural Collapse Description

Structural/building collapse is defined by the Occupational Safety and Health Administration when internal load-bearing structural elements fail, a building will collapse into itself and exterior walls are pulled into the falling structure. Structural collapse is often a secondary effect of a primary hazard, and seldom happens spontaneously. If a collapse is caused by the vibration of construction activity, earthquakes, or fire, and may result in a dense debris field within a small footprint. Alternatively, if a structure collapse is caused by an explosion or natural forces such as a flood, tornado, or high winds, the debris field may be less dense and more scattered with a wider footprint. The structures that pose the highest risk during collapse are mid-to-high rise buildings, and bridges.

There are several different causes for structural collapse:

Improper Design: Approximately 40% to 60% of all structural failures are due to flawed design. Flawed designs can be caused by errors such as failure to account for load, specifying incorrect materials, or not considering important factors and stresses.

Faulty Construction: Faulty construction is the second most common cause of structural failure. Construction errors can result from the use of poor quality materials, poor installation from either sloppiness or lack of expertise, or a combination of these.

Extraordinary Loads: Often these failures are not the result of poor design, but the result of unexpected events that create extraordinary loads on structures. An example of this would be an unexpectedly large accumulation of snow or ice on the roof of a building causing the roof to collapse.

Foundation Failure: This can be caused by poor soil conditions, poor installation, a foundation that is not large enough for the load of the structure, or earthquakes.

4.19.2 Building/Structural Collapse Location

The following figure depicts where bridges are located within Cuyahoga County, as well as the National Bridge Inventory Rating associated with the bridge. The National Bridge Inventory Rating includes ratings of good, fair, poor, or unknown.

Buildings are also vulnerable to collapse and can be found in any developed area of the County. Figure 4-42 shows the percentage of buildings within each jurisdiction that were constructed before 1960. The jurisdictions with the highest percentage of buildings constructed before 1960 are Newburgh Heights and University Heights, with over 80% of its total buildings being constructed before 1960. Cleveland, Lakewood, East Cleveland, Cleveland Heights, South Euclid, Shaker Heights , Maple Heights, Cuyahoga Heights, and Linndale all have the second highest percentage, or 70%-80% of its buildings were constructed before 1960.

FIGURE 4-58 LOCATION OF BRIDGES WITHIN CUYAHOGA COUNTY

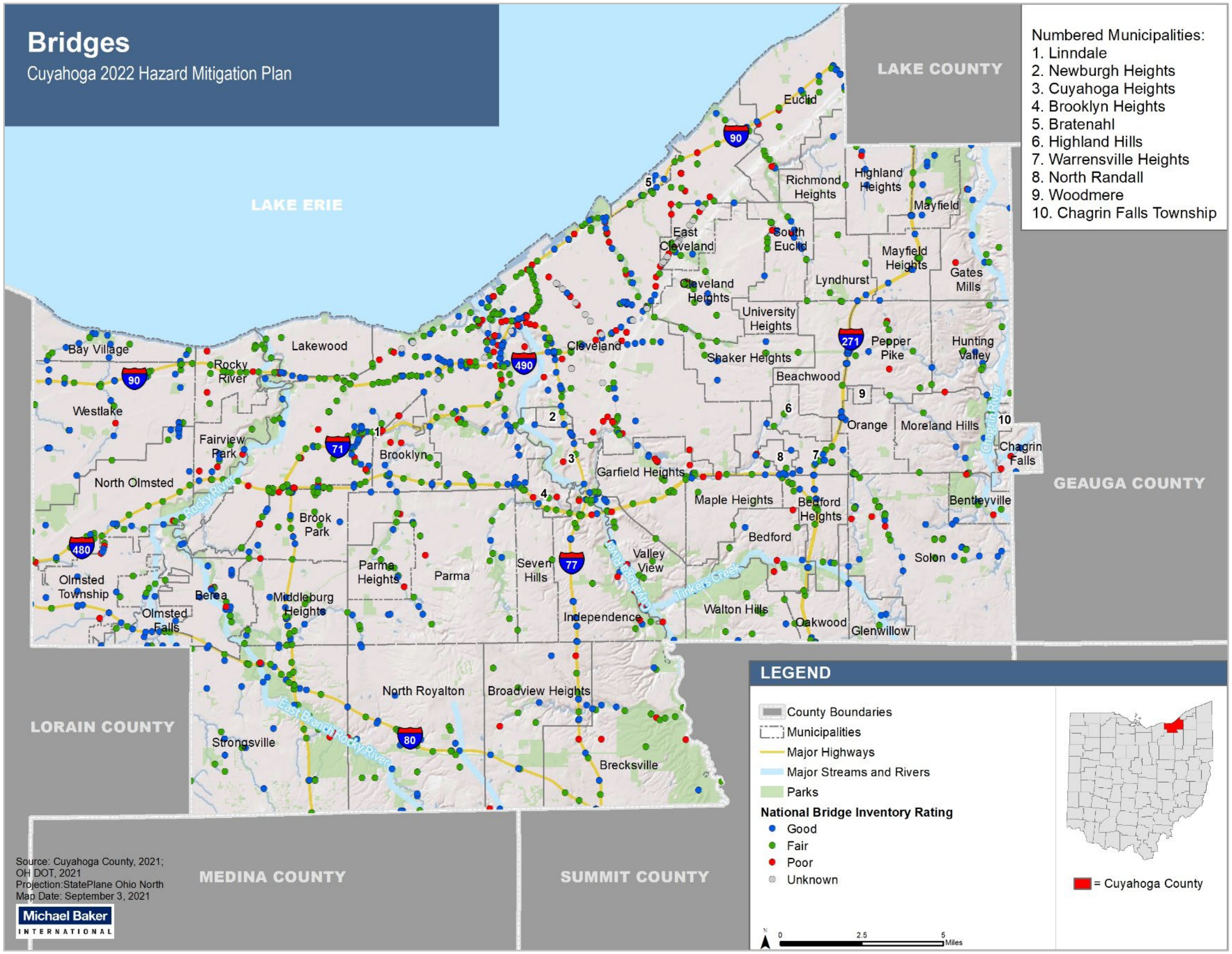
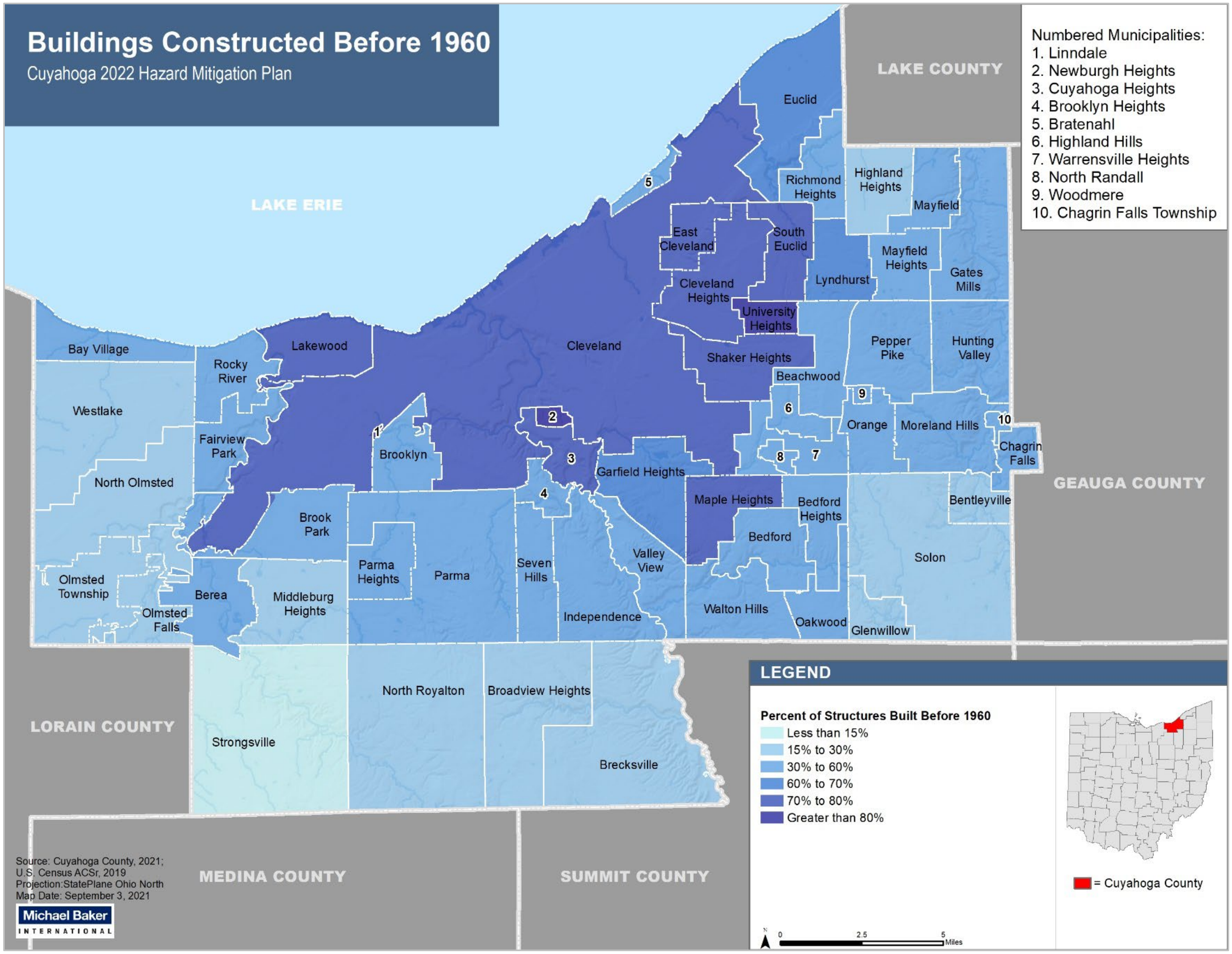


FIGURE 4-59 BUILDINGS CONSTRUCTED BEFORE 1960 IN CUYAHOGA COUNTY



4.19.3 Extent

Partial Collapse: When only a portion of a building or structure collapses. This can still render a structure unusable, unsafe, and unstable before it can be repaired. If a structure cannot be repaired, demolition will likely be necessary.

Total Collapse: A structure may undergo a total collapse if its foundation or support frame are in excessively poor condition or have been damaged through another hazard such as fires or floods. During a total collapse, none of the original structure is left standing.

4.19.4 Historical Occurrences

Event Narratives

January 24, 2012: Two demolition workers were killed when the structure they were working suddenly collapsed on them. The building did not have any occupants. Much of the weight of the building was at the top of the building which contributed to its collapse.

April 13, 2015: In afternoon of April 13, strong winds swept through Downtown Cleveland. These winds caused the partial collapse of a building, causing bricks and debris to fall to the ground below. Though there were pedestrians nearby, they managed to run out of the way before the building collapsed on them. An unoccupied minivan was crushed during the incident. The building was not occupied.

August 29, 2016: Three East Cleveland firefighters were injured when a roof collapsed while they were on the site of a call. The building had been damaged by a fire when they began their search for the home's occupants.

July 20, 2021: An abandoned apartment building had a partial collapse in Cleveland's East Side. Located on East Boulevard, the building is located next to occupied structures. After a fire in the early 2000s, the apartment building sustained significant damage from a fire, and the building has shifted owners since the fire damage occurred. The Cuyahoga County Land Bank gave the property to a revitalization non-profit in 2016 as a last resort due to lack of interest in the property, but the building was never remedied. Since the partial building collapse, the City of Cleveland has condemned the building. The next steps are to cut the utilities to the building and then demolish the structure.

August 6, 2021: The roof and partial building collapse of a vacant structure in Cleveland's East Side occurred around noon on Friday, August 6th, scattering debris and bricks into the street in front of the building, near the intersection of East 123rd Street and Tuscora Avenue. Nobody was injured from the collapse, and police, fire, and City of Cleveland Street Department responded to detour traffic and clean the area of the debris.

4.19.5 Probability of Future Occurrences

The HMPC determined that it is "Likely" that Building/Structural Collapse will continue to occur in Cuyahoga County, meaning that there is between a 10% and 100% chance of annual occurrence.

Reported building/structural collapse events over the past 20 years provide an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of a building/structural collapse occurring, although infrequent, can be difficult to quantify, but based on historical record of 5, according to the media reports of building/structural collapse events since 2001, it can reasonably be assumed that this type of event has occurred once every 4 years from 2001 through 2021.

(**2021** CY) - (**2001** HY) = **20 Years on Record**

(**20 Years**) / (**5 Events**) = **4 Years Between Events**

The historic frequency indicates that there is a 20% chance of this type of event occurring each year.

4.19.6 Assets Exposed to Building/Structural Collapse

Potential Losses

TABLE 4-106 POTENTIAL IMPACTS FROM BUILDING/STRUCTURAL COLLAPSE

Impact	Description
People	People could be impacted if the building or structure is occupied at the time of collapse. People could also be impacted if the collapse causes debris to fall onto pedestrians, transportation vehicles, or adjacent buildings.
Infrastructure	All infrastructure could be impacted by collapsing itself, suffering debris impacts, or higher volumes of traffic if a route is closed.
Economy	The economy could be impacted if a business is forced to close due to collapse or proximity to a building or structural collapse.
Natural Systems	The natural environment would most likely not be impacted by a collapse, unless a bridge over a river or valley were to collapse, sending debris into the protected area.
Transportation	Transportation systems are most likely to be adversely affected in the process. Large structural collapse could result in damage to cars driving on the road or bridge. A large building collapse could result in debris falling onto passing transportation vehicles.

Community Vulnerability

Improved and consistent building codes are considered a key measure to mitigate life and property losses associated with building/structural collapse. The entire County population is at risk from structural collapse. Older buildings are more susceptible to secondary collapse damage as the result of a primary hazard. The table below shows the decades that each bridge was constructed in that are located in Cuyahoga County. The following figure shows the location of historic bridges that are located within Cuyahoga County.

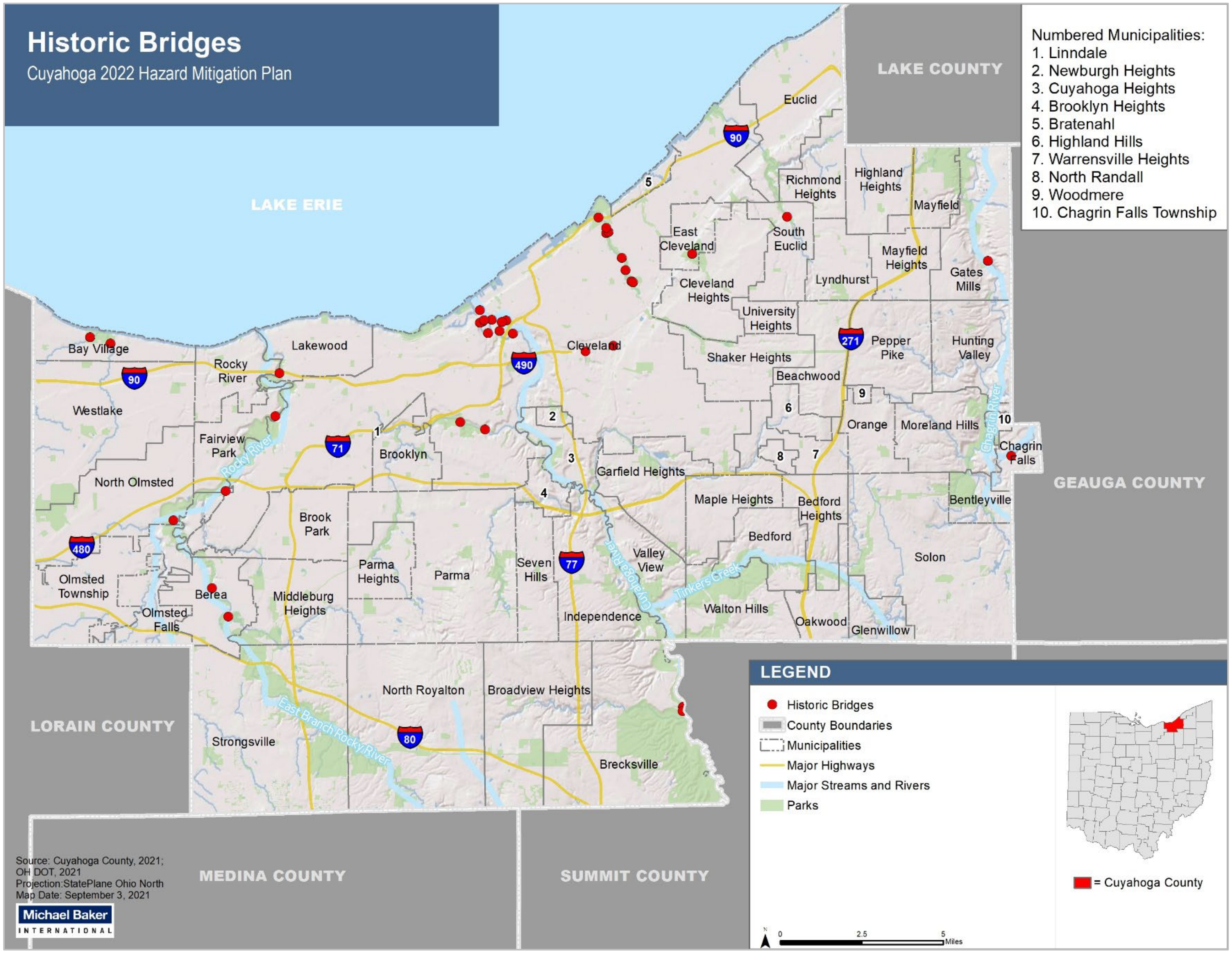
Cleveland State University Building/Structural Collapse Vulnerability.

The Wolstein Center at Cleveland State University plays host to a myriad of special events, including contemporary concerts by international recording artists, Division I basketball games for the Horizon League Conference, including the first two rounds of the NCAA Men's Basketball Championships in 2000 and 2005, nationally acclaimed family shows, rodeos, motorsports spectaculars, professional and amateur sporting events, equestrian events, trade shows and conventions, elaborate black-tie affairs and fund raisers in our Grand Ballroom, and a vast array of community and civic events. This facility is accessible to approximately 4,500,000 people within a 100 mile radius, making the facility a primary selection for many types of event programming and touring attractions. It plays a major economic role for not just the University but the region. The roof of this structure has seen damage in recent years from birds nesting and their activities that could lead to significant structural issues if not addressed.

TABLE 4-107 DATE OF CONSTRUCTION FOR CUYAHOGA COUNTY BRIDGES

Year Built	Number	Percentage
Built 2010 or later	99	7.22%
Built 2000 to 2009	99	7.22%
Built 1990 to 1999	133	9.69%
Built 1980 to 1989	110	8.02%
Built 1970 to 1979	202	14.72%
Built 1960 to 1969	241	17.57%
Built 1950 to 1959	117	8.53%
Built 1940 to 1949	39	2.84%
Built 1939 or earlier	332	24.20%
Grand Total	**1,372**	**100%**

FIGURE 4-60 HISTORIC BRIDGES WITHIN CUYAHOGA COUNTY



4.19.7 Land Use and Development Trends

Cuyahoga County is laced with rivers, streams, and hilly terrain, making bridges a necessary part of development. High-rise structures are prevalent throughout Downtown Cleveland and are mixed in with historic buildings. Older buildings and bridges will tend to be more susceptible to collapse as their materials corrode and deteriorate over time. Historic buildings can be found throughout the County, though are primarily located within or near the City of Cleveland.

Regulatory Environment

All buildings in Cuyahoga County are subject to the Ohio Building Code, the Ohio Mechanical Code, and the Ohio Plumbing Code as they apply to the construction, modification, location, and maintenance of structures.

All bridges are to be inspected by the Cuyahoga County Engineer. All bridges with vehicular traffic are subject to review by Ohio Department of Transportation.

4.19.8 Building/Structural Collapse Summary

Building collapses are rare but can happen at any time. Older buildings and structures, in particular, are susceptible to collapse. Older structures that are under the risk of collapsing in urban or populated areas pose the greatest threat, as people walking nearby could be trapped under falling debris. Bridges that have not been maintained pose the greatest threat for vehicles. All areas of the county are vulnerable to building or structural collapse.

Mitigation Best Practices

Cuyahoga County and its communities can help mitigate building collapse and structural failure by providing proper oversight to aging infrastructure. One major component is ensuring that all buildings are up to minimum zoning codes, and that nuisance buildings are either retrofitted to be safe, or are demolished. For those buildings that are considered historic, they must be properly maintained. Bridges, another concern, should be inspected regularly to ensure that they are on par with all Ohio Department of Transportation and US Department of Transportation specifications.

The Department of Homeland Security has a full field guide for building stabilization and shoring techniques that is to be used in the event of a building collapse. While this guide is mostly for emergency response, it addresses mitigation for hazardous buildings. Suggested mitigation actions are both structural and non-structural and include bracing a building so that it is no longer a hazard, and having people avoid a hazardous area.

Source: Field Guide for Building Stabilization and Shoring Techniques. DHS, 2011.
https://www.dhs.gov/xlibrary/assets/st/st-120108-final-shoring-guidebook.pdf

4.20. Active Shooter Incident

Hazard	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Rating
Active Shooter Incident	2	0.3	2	0.3	1	0.2	4	0.1	1	0.1	1.9
Low Risk Hazard (0.1 – 1.9)											

4.20.1 Active Shooter Incident Description

An Active Shooter, as defined by the US Department of Homeland Security, is an individual actively engaged in killing or attempting to kill people in a confined area; in most cases, active shooters use firearm[s] and there is no pattern or method to their selection of victims. Recent high-profile incidents involving active shooters include; the Sandy Hook Elementary school shootings in Newtown, Connecticut, the shooting in the Aurora, Colorado movie theater and the shooting in Tucson, Arizona involving U.S. Representative Gabrielle Giffords. Historical active shooter events include the Virginia Tech shootings, the Columbine High School shootings and the University of Texas, Austin shootings. No substantive research has yet been compiled to address the potential vulnerability to an active shooter incident. As a very open, public society, these incidents are easier to accomplish for those bent on doing harm. Some of these incidents have occurred in public places, and some in places that are considered more restricted (like elementary schools and high schools). There is no discernible pattern to the location chosen by the shooter.

There are many reasons why someone may decide to commit an act such as this, and attacks do not happen on impulse. Active shooters consider and plan their actions carefully. The exact amount of time one may spend on planning, however, may vary considerably. Motives that drive perpetrators have included revenge, attempting to solve a problem, suicide or desperation, and attempting to seek attention, fame, or recognition.

The United States Department of Homeland Security (DHS) has identified potential indicators of violence. Perpetrators typically do not just "snap," but display indicators of potentially violent behavior over time. If these behaviors are recognized, they can often be managed and treated. Potentially violent behaviors by someone may include one or more of the following (this list of behaviors is not comprehensive, nor is it intended as a mechanism for diagnosing violent tendencies):

- Increased use of alcohol and/or illegal drugs
- Unexplained increase in absenteeism; vague physical complaints
- Noticeable decrease in attention to appearance and hygiene
- Depression / withdrawal
- Resistance and overreaction to changes in policy and procedures
- Repeated violations of company policies
- Increased severe mood swings
- Noticeably unstable, emotional responses
- Explosive outbursts of anger or rage without provocation

- Suicidal; comments about "putting things in order"
- Behavior which is suspect of paranoia, ("everybody is against me")
- Increasingly talks of problems at home
- Escalation of domestic problems into the workplace; talk of severe financial problems
- Talk of previous incidents of violence
- Empathy with individuals committing violence
- Increase in unsolicited comments about firearms, other dangerous weapons and violent crimes

4.20.2 Active Shooter Incident Location

Schools and universities have also been sites around the nation where active shooters have been present, putting the many elementary, middle, and high schools at risk, as well as the fourteen higher-education institutions. Government-owned buildings of state or federal agencies and large arenas and gathering places also are a potential target.

4.20.3 Extent

Active shooter events impact not only those who are directly killed or injured, but also those around them through psychological trauma afterward. Active shooters are not always easily identified, and events can be unpredictable. Possible targets for such events may be the two major sports facilities in downtown Cleveland, Progressive Field and FirstEnergy Stadium which have capacities of 35,000 and 73,000, respectively. Schools and universities have also been sites around the nation where active shooters have been present, putting the many elementary, middle, and high schools at risk, as well as Cleveland State University, Case Western Reserve University, John Carroll University, or one of the many small colleges in the County. Government-owned buildings of county, state, or federal agencies also are a potential target.

Active shooter incidents can occur extremely quickly and without warning, with some events lasting just a few minutes from beginning to end. In a report published by the FBI that researched and identified 160 active shooter incidents, 44 of the 63 that they were able to get time estimates on were over in less than 5 minutes, and 23 ended in less than 2 minutes. Even when law enforcement was able to arrive quickly, civilians had already had to make life or death decisions. In at least 107 of the incidents, the event was over because either a civilian had intervened, the shooter fled, or the shooter committed suicide or was killed by someone at the scene.

4.20.4 Historical Occurrences

Event Narratives

May 9, 2003: At Case Western Reserve University, a gunman broke into the Peter B. Lewis Building at 4 PM, shooting and killing a graduate student and wounding two others. The perpetrator took the fifty people in the building hostage for seven hours, until he was later subdued by a SWAT team. He was taken alive. Shortly after, he was sentenced to life in prison.

October 10, 2007: In October of 2007, a fourteen-year-old freshman opened fire in the alternative high school, SuccessTech in Cleveland, Ohio. The student shot two fellow students and two teachers before committing suicide on the fourth floor of the building. Prior to the incident, the student had been placed on suspension following a fight. He had been repeatedly bullied for his gothic appearance and eccentric behavior. He also had a criminal record as well as a history of mental health problems, including threatening to commit suicide while in a mental health facility in 2006.

March 24, 2016: An active shooter opened fire at a Chagrin Falls retirement community. Two women were killed. The attacker was shot by police. The suspect and the victims all worked in the facility at the time of the attack.

There have been no active shooter events since the previous plan was developed. However, the County continues to see gun violence, and an active shooter even could still occur in the future.

4.20.5 Probability of Future Occurrences

There is not enough historical precedence to determine frequency or future probability of active shooter events in Cuyahoga County. The HMPC determined that it is "Possible" that an Active Shooter Incident will occur in Cuyahoga County, meaning that there is between a 1% and 10% chance of annual occurrence.

The Federal Bureau of Investigations released a report in 2014 that detailed 160 active shooter events through 2013. The report found that active shooter events have increased dramatically since 2000.

4.20.6 Assets Exposed to Active Shooter Incidents

Potential Losses

TABLE 4-108 POTENTIAL IMPACTS FROM ACTIVE SHOOTER INCIDENTS

Impact	Description
People	Injury or loss of life from active shooter incident. Emotional trauma of witnessing an incident could also be an impact.
Infrastructure	Roadways located near an incident could be closed to traffic.
Economy	Potential business closure.
Natural Systems	No impact to natural systems
Transportation	No impact to transportation systems other than delay in service or congestion in roadways due to any road closures.

Community Vulnerability

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

- Inherent vulnerability:
    - Visibility – How aware is the public of the existence of the facility?
    - Utility – How valuable might the place be in meeting the objectives of a potential terrorist?
    - Accessibility – How accessible is the place to the public?

  - Asset mobility – is the asset's location fixed or mobile?
  - Presence of hazardous materials – Are flammable, explosive, biological, chemical and/or radiological materials present on site? If so, are they well secured?
  - Potential for collateral damage – What are the potential consequences for the surrounding area if the asset is attacked or damaged?
  - Occupancy – What is the potential for mass casualties based on the maximum number of individuals on site at a given time?
- <u>Tactical vulnerability:</u>
  - **Site Perimeter**
    - Site planning and Landscape Design – Is the facility designed with security in mind – both site-specific and with regard to adjacent land uses?
    - Parking Security – Are vehicle access and parking managed in a way that separates vehicles and structures?
  - **Building Envelope**
    - Structural Engineering – Is the building's envelope designed to be blast-resistant? Does it provide collective protection against chemical, biological and radiological contaminants?
  - **Facility Interior**
    - Architectural and Interior Space Planning – Does security screening cover all public and private areas?
    - Mechanical Engineering – Are utilities and Heating, Ventilating and Air Conditioning (HVAC) systems protected and/or backed up with redundant systems?
    - Electrical Engineering – Are emergency power and telecommunications available? Are alarm systems operational? Is lighting sufficient?
    - Fire Protection Engineering – Are the building's water supply and fire suppression systems adequate, code-compliant and protected? Are on-site personnel trained appropriately? Are local first responders aware of the nature of the operations at the facility?
    - Electronic and Organized Security – Are systems and personnel in place to monitor and protect the facility?

4.20.7 Land Use & Development Trends

Land use and development are not directly tied to the prevention or discouragement of active shooter incidents. However, structures can be designed with safety devices meant to protect the populations inside. Alarm panels, security systems, radios, and silent alarms can be used by buildings throughout the County in order to better facilitate security forces during an active shooter incident.

Regulatory Environment

Active shooter is a term used by law enforcement agencies to describe a situation in which a shooting is in progress and any aspect of the crime may affect the protocols used in responding to and reacting at the scene of the incident. Unlike a defined crime, such as a murder or mass killing, the active aspect inherently implies that both law enforcement personnel and citizens have the potential to affect the outcome of the event based upon their responses. Because active shooter incidents occur and progress rapidly, the regulatory environment falls under local law enforcement to respond.

4.20.8 Active Shooter Incident Summary

One of the primary attributes of active shooter incidents are their unexpected nature. While there are warning signs, they are far from guaranteed to produce an incident. This makes planning for potential attacks virtually impossible. All County assets, including 100 percent of the population, is at risk from an active shooter incident. The key to active shooter mitigation lies in the planning phase and understanding the potential vulnerability of a specific area. There is no accurate way to predict when an active shooter incident may occur.

Mitigation Best Practices

While current studies are underway, past research has proven a valuable resource. For example, in 2002, the FBI published a monograph on workplace violence, including problematic behaviors of concern that may telegraph violent ideations and plans. In 2010, the U.S. Secret Service (USSS), U.S. Department of Education, and the FBI collaborated to produce the report Campus Attacks: Targeted Violence Affecting Institutions of Higher Education, which examined lethal or attempted lethal attacks at U.S. universities and colleges from 1900 to 2008. The report featured several key observations related to pre-attack behaviors, including the following:

- Concerning behaviors were observed by friends, family, associates, professors, or law enforcement in 31 percent of the cases. These behaviors included, but were not limited to, paranoid ideas, delusional statements, changes in personality or performance, disciplinary problems on site, depressed mood, suicidal ideation, non-specific threats of violence, increased isolation, “odd” or “bizarre” behavior, and interest in or acquisition of weapons.
- In only 13 percent of the cases did subjects make verbal and/or written threats to cause harm to the target. These threats were both veiled and explicit and were conveyed directly to the target or to a third party about the target.
- In 19 percent of the cases, stalking or harassing behavior was reported prior to the attack. These behaviors occurred within the context of a current or former romantic relationship and in academic and other non-romantic settings. They took on various forms, including written communications (conventional and electronic), telephone contact, and harassment of the target and/or the target’s friends and/or family. Subjects also followed or visited the target(s) or their families or damaged property belonging to the target(s) or their families prior to the attack.
- In only 10 percent of the cases did the subject engage in physically aggressive acts toward the targets. These behaviors took the form of physical assault, menacing actions with weapons, or repeated physical violence to intimate partners.

Sources:

Workplace Violence: Issues in Response. U.S. Department of Justice, FBI Academy. 2002. http://www.fbi.gov/stats-services/publications/workplace-violence.

Planning and Response to an Active Shooter: An interagency Security Committee Policy and Best Practices Guide. Interagency Security Committee, 2015. https://www.dhs.gov/sites/default/files/publications/isc-planning-response-active-shooter-guide-non-fouo-nov-2015-508.pdf

Section 5. Mitigation Strategy

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

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

- **Mitigation goals** are general guidelines that explain what the County wants to achieve. Goals are usually expressed as broad policy statements representing desired long-term results.
- **Mitigation objectives** describe strategies or implementation steps to attain the identified goals. Objectives are more specific statements than goals; the described steps are usually measurable and can have a defined completion date.
- **Mitigation Actions** provide more detailed descriptions of specific work tasks to help the County and its municipalities achieve prescribed goals and objectives.

5.1. Goals

The following are the goals and objectives for this mitigation plan:

- **GOAL 1: Protect the people, property, and infrastructure of Cuyahoga County by minimizing the potential impacts of natural and man-made hazards.**
    - OBJECTIVE 1.1: Undertake structural improvements to reduce risk.
    - OBJECTIVE 1.2: Undertake planning initiatives to protect the residents of Cuyahoga County from the risks of flooding.
    - OBJECTIVE 1.1: Conduct cross-jurisdictional meetings to discuss floodplain regulations.
- **GOAL 2: Protect Cuyahoga County's assets through best practice hazard mitigation actions and projects**
    - OBJECTIVE 2.1: Build on the county's previous hazard mitigation successes to further resiliency by implementing the hazard mitigation plan's actions
- **GOAL 3: Increase public awareness of hazards, hazard impacts, and hazard mitigation techniques through a robust public outreach campaign.**
    - OBJECTIVE 3.1: Undertake public education and outreach programs.

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

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

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

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

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

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

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

4. **Education and Awareness Program:** These are actions to inform and educate students, faculty and staff about hazards and potential ways to mitigate them. Although this type of mitigation reduces risk less directly than structural projects or regulation, it is an important foundation. A greater understanding and awareness of hazards and risk among County officials, stakeholders, and the public is more likely to lead to direct actions.

5.2. 2022 Plan Update Mitigation Action Prioritization Methodology

Prioritizing mitigation actions for the 2017 plan was completed using FEMA's STAPLEE methodology for each jurisdiction's actions. The prioritization process for the 2022 update has changed from the previous plan in order to incorporate a more adaptable method that allows for a more comprehensive examination of the mitigation actions. The STAPLEE approach allows for a careful review of the feasibility of mitigation actions by using seven criteria. The criteria are described below:

- S - Social
- T - Technical
- A - Administrative
- P - Political

- L - Legal
- E - Economic
- E - Environmental

For the individual action plans, a STAPLEE score was calculated based on the number of favorable considerations that can be found on the STAPLEE document. Up to 23 considerations can be used to prioritize each action using this evaluation methodology. Typically, scores rank between 17 and 21. Infrastructure projects tend to incur a lower score due to their high price and lengthy completion times, while actions such as plans, regulations, and educational programs rank higher due to their ease of deployment. The table below shows an example of the STAPLEE tool.

FIGURE 5-1 EXAMPLE STAPLEE EVAULUATION

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

FEMA mitigation planning requirements indicate that any prioritization system used shall include a special emphasis on the extent to which benefits are maximized according to a cost-benefit review of the proposed projects. To do this in an efficient manner that is consistent with FEMA's guidance on using cost-benefit review in mitigation planning, the STAPLEE method was adapted to include a higher weighting for two elements of the economic feasibility factor – Benefits of Action and Costs of Action.

The prioritization process has changed from the previous plan in order to incorporate this adaptable method that allows for a more comprehensive examination of the mitigation actions. In the plan update, the jurisdictions used the criteria below to prioritize the new and deferred mitigation actions for the 2022 plan. The scale of 1-10 was used, with 1 being the lowest priority and 10 being the highest priority.

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

5.3. Cuyahoga County Capability Assessment

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

5.3.1 Ability to Expand on Existing Capabilities

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

Planning and Regulatory Capability: The table below summarizes Cuyahoga County and stakeholder's planning and regulatory capabilities. Each jurisdiction within Cuyahoga also completed the Capability Assessment form; their responses can be found in their respective planning region annex. These are the plans and policies that jurisdictions have in place that can help to further mitigation.

TABLE 5-1 PLANNING AND REGULATORY CAPABILITIES

Planning or Regulatory Tool/Program	Cuyahoga County	Cuyahoga Community College (Tri-C)	Cleveland Metroparks	Cleveland State University	Hunger Network
Hazard Mitigation Plan	Under Development				
Emergency Operations Plan	X	X	X	X	
Disaster Recovery Plan	X	X	X		
Evacuation Plan	X	X	X	X	X
Continuity of Operations Plan	X	X	X	X	
NFIP	X				
NFIP-CRS					
Floodplain Regulations	X	X	X		
Floodplain Management Plan	X	X			
Zoning Regulations	X	X			
Subdivision Regulations					
Comprehensive Plan	X		X		
Open Space Management Plan			X		
Stormwater Management Plan	X	X	X		
Natural Resource Protection Plan		X	X		
Capital Improvement Plan	X	X	X	X	
Economic Development Plan	X	X			
Historic Preservation Plan	X	X	X	X	
Farmland Preservation					
Building Code	X	X	X	X	
Fire Code	X	X	X	X	
Other				X*	

X* = Water Safety Plan

Administrative and Technical Capability: The table below provides a summary of administrative and technical capabilities organized by staff type and department. It is important to understand current administrative and technical capabilities before developing a myriad of mitigation activities.

Cleveland Metroparks is governed by the Cleveland Metroparks Board of Park Commissioners, which is made up of three citizens who serve a three-year term and are appointed by the presiding Judge of the Probate Court of Cuyahoga County.

TABLE 5-2 ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Administrative/Technical Capability	Cuyahoga County	Cuyahoga Community College (Tri-C)	Cleveland Metroparks	Cleveland State University	Hunger Network
Planners (with land use / development knowledge)	X	X	X	X	
Engineers	X	X	X	X	
Emergency Manager	X	X	X	X	
Floodplain Manager	X				
Land Surveyor	X		X	X	
Scientists	X	X	X	X	
GIS Personnel	X		X	X	
Grant Writers	X	X	X	X	X
Other					

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

TABLE 5-3 FISCAL CAPABILITIES

Fiscal Capability	Cuyahoga County	Cuyahoga Community College (Tri-C)	Cleveland Metroparks	Cleveland State University	Hunger Network
Capital Improvement Planning	X	X	X	X	
Community Development Block Grant	X				X
Special Purpose Taxes	X	X	X	X	
Gas / Electric utility fees	X			X	
Water / Sewer fees	X			X	
Stormwater utility fees	X			X	
Development impact fees					
General obligation, revenue, or special tax bonds	X	X	X	X	
Partnering / intergovernmental arrangements	X	X	X	X	X
Other					X*

X* = Ability to fundraise money to financially support hazard mitigation projects

Self-Assessment of Capability: The table below is Cuyahoga County's estimated degree of capability.

TABLE 5-4 OVERALL DEGREE OF CAPABILITY

Area	Cuyahoga County	Cuyahoga Community College (Tri-C)	Cleveland Metroparks	Cleveland State University	Hunger Network
Planning and Regulatory Capability	H	M	H	M	L
Administrative and Technical Capability	M	M	H	M	L
Fiscal Capability	M	M	M	M	L

L = Limited, M = Moderate, H = High

5.4. Mitigation Goals, Objectives and Actions

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

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

5.4.1 Goals and Objectives

The Planning Committee discussed goals and objectives for this plan at distinct points in the planning process. During the Regional Open Houses, the Planning Committee discussed the results of the risk assessment and the identified issues/weaknesses to be addressed by the Mitigation Goals and Objectives. More details of this particular meeting are provided in **Appendix A**.

5.4.2 2017 Mitigation Action Review

During the second planning meeting, each participating jurisdiction reviewed mitigation actions from the 2017 HMP and determined each action to be; deferred, or carried, into the new plan, changed to reflect an update in priorities, in progress, completed, or deleted. The status of the previous plan’s actions can be found in Table 5-5 for Cuyahoga County; the local jurisdictions’ previous actions statuses can be found in their respective planning region annex. Actions marked as “Completed” were finished between the drafting of the 2017 HMP, and the 2022 HMP. Deletion of an action generally refers to that action no longer being a priority to the community; any other reasoning for the action being deleted is identified in the table.

TABLE 5-5 PREVIOUS MITIGATION ACTION STATUS

Action	Jurisdiction (Find the action applicable to your community and fill out the status on the right)	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Develop partnerships to enhance stormwater regulations countywide.	All jurisdictions	Ongoing – Cuyahoga County
Create model ordinances addressing streambank erosion to establish increased continuity among communities.	All jurisdictions	Ongoing – Cuyahoga County
Install diversion devices on roadways prone to flash flooding throughout the County. The devices would be intended to either dissuade or inhibit drivers from attempting to navigate flooded roadways.	All jurisdictions	Carrying to New Plan – Cuyahoga County
Develop a plan that addresses maintenance of the waterways and drainage concerns.	All jurisdictions	Ongoing – Cuyahoga County
Map areas that flood that are outside of the SFHA.	All jurisdictions	Carrying to New Plan – Cuyahoga County
Coordinate higher floodplain regulation standards across all NFIP communities in the County	All jurisdictions	Carrying to New Plan – Cuyahoga County
Cuyahoga County will hire a contractor to facilitate the development of a comprehensive Long-Term Recovery Plan as an Annex to the Cuyahoga County Emergency Operations Plan (EOP). The plan would be developed in alignment with the National Recovery Framework (NRF) and replace Cuyahoga County's Emergency Support Function (ESF) 14 Annex.	Cuyahoga County	Carrying to New Plan
Cuyahoga County will hire a contractor to facilitate a comprehensive update to the Cuyahoga County Evacuation Annex to the County Emergency Operations Plan (EOP). The update would focus on reviewing and updating roles and responsibilities, evacuation routes, corresponding mapping, contra-flow procedures, and designated pick-up points. The update will strengthen local evacuation capabilities by including the following elements: 1. A base document to outline Cuyahoga County's overarching approach to evacuation planning. 2. Individual templates for political subdivisions to conduct local evacuation planning. These templates will be developed in alignment with the base document and enable political subdivisions to expand their planning through the identification and inclusion of community-specific	Cuyahoga County	Completed

Action	Jurisdiction (Find the action applicable to your community and fill out the status on the right)	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
information such as, local hazard areas (e.g. floodplains, railways), HAZMAT facilities, local evacuation routes, procedures, etc.		
Cuyahoga County will seek grant funding opportunities to purchase or put-together workplace preparedness kits to distribute to County offices as a part of the Cuyahoga County Employee Emergency Preparedness Program. The kits will be accounted for by department Floor Captains and include items such as weather radios, reflective vests, basic first aid supplies, pen + paper, flashlight w/ batteries, a whistle, etc.	Cuyahoga County	Ongoing
Cuyahoga County will seek grant funding opportunities to support the development, outfitting, and maintenance of a FEMA Type III All-hazards Incident Management Team (AHIMT).	Cuyahoga County	Removed from Plan
Cuyahoga County will hire a contractor to facilitate the development of a comprehensive Debris Management Annex to the Cuyahoga County Emergency Operations Plan (EOP).	Cuyahoga County	Carrying to New Plan
Cuyahoga County will contract with a vendor to assess, recommend upgrades, and complete recommended upgrades of the County's Data Sharing Warehouse in order to mitigate the impact to Countywide operations and investigative services during prolonged data/power outages.	Cuyahoga County	Completed
Cuyahoga County will contract with a vendor to assess, recommend upgrades, and complete recommended upgrades of the County's 9-1-1 system to mitigate the effect of prolonged 9-1-1 system loss for Cuyahoga County citizens.	Cuyahoga County	Ongoing
Coordinate with dam owners to ensure that their inundation mapping and response plans are being kept up to date	Cuyahoga County	Ongoing
Create an education campaign for those within the IEP about the risks posed by radiation.	Cuyahoga County	Carrying to New Plan
Provide first responders with the appropriate training and knowledge with how to respond efficiently and sensitively to civil disruptions.	Cuyahoga County	Ongoing
Cuyahoga County will create and distribute a newsletter informing residents and workers about disease entities, and how to prevent bacteria and viruses from spreading.	Cuyahoga County	Carrying to New Plan

Action	Jurisdiction (Find the action applicable to your community and fill out the status on the right)	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Install stream gauges in creeks and tributaries that cause flooding in areas not considered to be in the 100 year flood zone.	Cuyahoga County	Ongoing
Purchase Preliminary Damage Assessment (PDA) Field Guides to disseminate among first responders.	Cuyahoga County	Carrying to New Plan
Develop outreach educating citizens on the responsibility of tree maintenance and removal with regard to power outages caused by severe weather.	Cuyahoga County	Carrying to New Plan
Develop initiatives/PSAs to educate residents as it relates to non-flood zone flooding in the County.	Cuyahoga County	Ongoing
Add more USGS stream gauges with historical data to develop web based interactive flood-inundation maps.	Cuyahoga County	Removed from Plan
Create a strategic outreach program to promote a program for regional NWS Sky Warn classes to educate identified community/voluntary organizations (e.g. Neighborhood Watch, CERT, etc.).	Cuyahoga County	Ongoing
Work with established watershed groups to evaluate causes of erosion	Cuyahoga County	Ongoing
Map critical facilities within the County.	Cuyahoga County	Ongoing
Implement an outreach strategy targeting communities in the County that have repetitive loss properties.	Cuyahoga County	Ongoing
Develop outreach for school aged children in the form of PSA's or other innovative connection to educate them on the dangers of flash floods.	Cuyahoga County	Removed from Plan
Replace inadequate, undersized stormwater infrastructure.	Cuyahoga County	Ongoing

Action	Jurisdiction (Find the action applicable to your community and fill out the status on the right)	Status (Completed / Carrying to New Plan / Removed from Plan / In Progress)
Reinforce roadways prone to collapse with a permanent solution	Cuyahoga County	Ongoing
Cuyahoga County will work diligently to create and implement a public education and outreach campaign that educates Cuyahoga County residents on what they can do to prevent, protect, and respond to basement residential flooding.	Cuyahoga County	Ongoing
Create commercial/industrial microgrid districts in 6-8 cities throughout Cuyahoga County.	Cuyahoga County	Carrying to New Plan
Mitigating bluff erosion along ¾ of a mile of 13 private lakefront properties.	Cuyahoga County	Carrying to New Plan
Mitigate 8 priority segments of actively eroding shoreline stretching out along 2.25 miles of Lake Erie.	Cuyahoga County	Carrying to New Plan

5.4.3 Mitigation Action Development

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

Mitigation Costs

Cost effectiveness of each measure was a primary consideration when developing mitigation actions. Because mitigation is an investment to reduce future damages, it is important to select measures for which the reduced damages over the life of the measure are likely to be greater than the project cost. For structural projects, the level of cost effectiveness is primarily based on the likelihood of damages occurring in the future, the severity of the damages when they occur, and the level of effectiveness of the selected measure.

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

New mitigation actions for the 2022 plan are found below:

TABLE 5-6 CUYAHOGA COUNTY 2022 MITIGATION ACTIONS

Mit. Action #	Community	Hazard(s) Addressed	Action	Responsible Party	Cost	Timeframe	Potential Funding Sources	Priority
1	Cuyahoga County	Flooding	Develop partnerships to enhance stormwater regulations countywide	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
2	Cuyahoga County	Flooding/ Erosion	Create model ordinances addressing streambank erosion to establish increased continuity among communities.	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
3	Cuyahoga County	Flooding	Install diversion devices on roadways prone to flash flooding throughout the County. The devices would be intended to either dissuade or inhibit drivers from attempting to navigate flooded roadways.	Cuyahoga County Office of Emergency Management Director	$1,200,000	2-3 years	Local budget, FEMA HMGP/FMA/ BRIC	9
4	Cuyahoga County	Flooding	Develop a plan that addresses maintenance of the waterways and drainage concerns.	Cuyahoga County Office of Emergency Management Director	$20,000	2-3 years	Local budget, FEMA HMGP/FMA/ BRIC	10
5	Cuyahoga County	Flooding	Map areas that flood that are outside of the SFHA.	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
6	Cuyahoga County	Flooding	Coordinate higher floodplain regulation standards across all NFIP communities in the County	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
7	Cuyahoga County	All Hazards	Cuyahoga County will hire a contractor to facilitate the development of a comprehensive Long-Term Recovery Plan as an Annex to the Cuyahoga County Emergency Operations Plan (EOP). The plan would be developed in alignment with the National Recovery Framework (NRF) and replace Cuyahoga County's Emergency Support Function (ESF) 14 Annex.	Cuyahoga County Office of Emergency Management Director, selected contractor	$45,000	2-3 years	FEMA HMGP/BRIC, Local match	9
8	Cuyahoga County	Active Shooter/	Cuyahoga County will seek grant funding opportunities to purchase or	Cuyahoga County Office of Emergency	$5,000	2-3 years	FEMA HMGP, Local match	10

Mit. Action #	Community	Hazard(s) Addressed	Action	Responsible Party	Cost	Timeframe	Potential Funding Sources	Priority
		Utility Disruptions/Terrorism	put-together workplace preparedness kits to distribute to County offices as a part of the Cuyahoga County Employee Emergency Preparedness Program. The kits will be accounted for by department Floor Captains and include items such as weather radios, reflective vests, basic first aid supplies, pen + paper, flashlight w/ batteries, a whistle, etc.	Management Director				
9	Cuyahoga County	Severe Thunderstorm/Severe Winter Weather/Terrorism/Earthquake/Tornado	Cuyahoga County will hire a contractor to facilitate the development of a comprehensive Debris Management Annex to the Cuyahoga County Emergency Operations Plan (EOP).	Cuyahoga County Office of Emergency Management Director, selected contractor	$45,000	2-3 years	FEMA HMGP/BRIC, Local match	9
10	Cuyahoga County	IT/Communications Disruption	Cuyahoga County will contract with a vendor to assess, recommend upgrades, and complete recommended upgrades of the County's 9-1-1 system to mitigate the effect of prolonged 9-1-1 system loss for Cuyahoga County citizens.	Cuyahoga County PSJS Grants Supervisor, selected contractor	$500,000	4-5 years	FEMA HMGP/BRIC, Local match	9
11	Cuyahoga County	Dam Failure	Coordinate with dam owners to ensure that their inundation mapping and response plans are being kept up to date	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
12	Cuyahoga County	Nuclear Power Incident	Create an education campaign for those within the IEP about the risks posed by radiation.	Cuyahoga County Office of Emergency Management Director	$1,000	4-5 years	Local budget	10
13	Cuyahoga County	Civil Disturbance	Provide first responders with the appropriate training and knowledge with how to respond efficiently and sensitively to civil disruptions.	Cuyahoga County Office of Emergency Management Director	$10,000	4-5 years	Local budget	10
14	Cuyahoga County	Health-Related Emergency	Cuyahoga County will create and distribute a newsletter informing residents and workers about disease entities, and how to prevent bacteria and viruses from spreading.	Cuyahoga County Office of Emergency Management Director	$1,000	4-5 years	Local budget	10
15	Cuyahoga County	Flooding	Install stream gauges in creeks and tributaries that cause flooding in	Cuyahoga County Office of Emergency	$10,000	4-5 years	FEMA FMA/HMGP/BRIC, Local match	9

Mit. Action #	Community	Hazard(s) Addressed	Action	Responsible Party	Cost	Timeframe	Potential Funding Sources	Priority
			areas not considered to be in the 100-year flood zone.	Management Director				
16	Cuyahoga County	Flooding/Severe Thunderstorms/ Building Collapse	Purchase Preliminary Damage Assessment (PDA) Field Guides to disseminate among first responders.	Cuyahoga County Office of Emergency Management Director	$2,000	4-5 years	FEMA HMGP/BRIC, Local match	10
17	Cuyahoga County	Flooding/Severe Thunderstorms/Severe Winter Storms	Develop outreach educating citizens on the responsibility of tree maintenance and removal with regard to power outages caused by severe weather.	Cuyahoga County Office of Emergency Management Director	$3,000	4-5 years	FEMA HMGP/BRIC, Local match	10
18	Cuyahoga County	Flooding	Develop initiatives/PSAs to educate residents as it relates to non-flood zone flooding in the County.	Cuyahoga County Office of Emergency Management Director	$2,000	4-5 years	FEMA HMGP/BRIC/FMA, Local match	10
19	Cuyahoga County	Severe Thunderstorms	Create a strategic outreach program to promote a program for regional NWS Sky Warn classes to educate identified community/voluntary organizations (e.g. Neighborhood Watch, CERT, etc.).	Cuyahoga County Office of Emergency Management Director	$2,000	4-5 years	FEMA HMGP/BRIC, Local match	10
20	Cuyahoga County	Flooding	Work with established watershed groups to evaluate causes of erosion	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
21	Cuyahoga County	All Hazards	Map critical facilities within the County.	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	9
22	Cuyahoga County	Flooding	Implement an outreach strategy targeting communities in the County that have repetitive loss properties.	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	Local budget	10
23	Cuyahoga County	Flooding	Replace inadequate, undersized stormwater infrastructure.	Cuyahoga County Office of Emergency Management Director	$2,000,000	2-3 years	FEMA FMA/BRIC/HMGP, Local match	10
24	Cuyahoga County	Building/Structural Collapse/Erosion	Reinforce roadways prone to collapse with a permanent solution	Cuyahoga County Office of Emergency Management Director / City of Cleveland	$3,000,000	2-3 years	FEMA BRIC/HMGP, Local match	8

Mit. Action #	Community	Hazard(s) Addressed	Action	Responsible Party	Cost	Timeframe	Potential Funding Sources	Priority
25	Cuyahoga County	Flooding	Cuyahoga County will work diligently to create and implement a public education and outreach campaign that educates Cuyahoga County residents on what they can do to prevent, protect, and respond to basement residential flooding.	Cuyahoga County Office of Emergency Management Director	$12,000	0-1 years	FEMA BRIC, Local match	10
26	Cuyahoga County	Flooding, Extreme Temperatures, Severe Thunderstorms, Utility Disruption, Climate Change	Develop utility (electric) microgrid districts throughout Cuyahoga County	Cuyahoga County Public Works/Sustainability Director	$100,000,000	0-1 years	Developer, concession agreement to operate	9
27	Cuyahoga County	Climate Change	Replace tree canopy loss due to construction clear cutting	Cuyahoga County Department of Sustainability Director	$950,000	4-5 years	Healthy Urban Tree Canopy Grant	10
28	Cuyahoga County	All Hazards	Seek funding opportunities to hire a contractor to update County Mitigation Plan	Cuyahoga County Office of Emergency Management Director	$130,000	4-5 years	FEMA BRIC/HMGP, Local match	10
29	Cuyahoga Community College (Tri-C)	Public Health Emergencies	Create a dedicated website and guidance related to COVID-19 and work to create safe learning & working environments College-wide.	College-wide Director, Compliance & Risk Management	1,737,575	Near Term (0-1 years)	CARES Act and College funds	10
30	Hunger Network	Health Related Emergencies, Extreme Temperatures, Severe Winter Weather	Purchase additional shelters to be implemented during hazard events	Development Team	$10,000	Medium Term (2-3 years)	FEMA BRIC, local funds	6
31	Cleveland Metroparks	Flooding	The existing culvert under Chippewa Creek in Cleveland Metroparks Brecksville Reservation is undersized and contributes to flooding and streambank erosion. Project will remove culvert and replace with a bridge as well as stabilize the adjacent stretch of streambank.	Cleveland Metroparks Planning and Design Department	$4,000,000	Medium Term (2-3 years)	FEMA BRIC or HMGP, Ohio EPA, Local funds	8
32	Cleveland Metroparks	Building/Structural Collapse	Rehabilitate breakwaters and armor stone at Wildwood Marina.	Cleveland Metroparks Planning	$600,000	Medium Term (2-3 years)	FEMA BRIC or HMGP, Ohio Department of	7

Mit. Action #	Community	Hazard(s) Addressed	Action	Responsible Party	Cost	Timeframe	Potential Funding Sources	Priority
				and Design Department			Natural Resources, Local Funds	
33	Cleveland Metroparks	Civil Disturbance	Develop a plan to identify and determine the required logistics for installation and implementation of a public notification system which will provide emergency early warning capabilities for the entire Cleveland Metroparks Zoo grounds / buildings.	Cleveland Metroparks Police and Information Technology Services	$75,000	Medium Term (2-3 years)	Homeland Security Grant Program, UASI	8
34	Cleveland Metroparks	Flooding, Severe Thunderstorms, Building/Structural Collapse	Repair breakwaters at Wendy Park on Lake Erie	Cleveland Metroparks Planning and Design Department	$6,000,000	Medium Term (2-3 years)	USACE CAP Section 103 or 205, FEMA BRIC or HMGP	7
35	Cleveland State University	Building/Structural Collapse	Install a Grid Wire Deterrent System to deter birds on the Wolstein Centers rooftop	CSU's Executive of Facilities Management	$100,000	Near Term (0-1 years)	FEMA BRIC, local match	7
36	Cuyahoga County and All Participating Jurisdictions	Flooding	Acquisition, demolition, and/or retrofit of flood prone properties.	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	FEMA BRIC/HMGP, Local match	8
37	Cuyahoga County and All Participating Jurisdictions	Tornado	Construct and/or promote the construction of residential and community saferooms.	Cuyahoga County Office of Emergency Management Director	Staff time and resources	4-5 years	FEMA BRIC/HMGP, Local match	8
38	Cuyahoga County and All Participating Jurisdictions	Dam Failure	Obtaining Inundation mapping and EAP's for High Hazard Potential Dams.	Cuyahoga County Office of Emergency Management Director	$50,000	4-5 years	FEMA BRIC/HMGP, HHPD, Local match	8
39	Cuyahoga County and All Participating Jurisdictions	Dam Failure	Rehabilitate, retrofit, and/or removal of High Hazard Potential Dams.	Cuyahoga County Office of Emergency Management Director	$150,000	4-5 years	FEMA BRIC/HMGP, HHPD, Local match	8
40	Cuyahoga County	Utility Disruptions	Create commercial/industrial microgrid districts in 6-8 cities throughout Cuyahoga County.	Cuyahoga County Office of Emergency Management Director	$500,000	4-5 years	FEMA BRIC/HMGP, Local match	8
41	Cuyahoga County	Flooding	Mitigating bluff erosion along ¾ of a mile of 13 private lakefront properties.	Cuyahoga County Office of Emergency Management Director	$500,000	4-5 years	FEMA BRIC/HMGP, Local match	8

Mit. Action #	Community	Hazard(s) Addressed	Action	Responsible Party	Cost	Timeframe	Potential Funding Sources	Priority
42	Cuyahoga County	Flooding	Mitigate 8 priority segments of actively eroding shoreline stretching out along 2.25 miles of Lake Erie.	Cuyahoga County Office of Emergency Management Director	$500,000	4-5 years	FEMA BRIC/HMGP, Local match	8

Section 6. Plan Implementation and Maintenance

As a living document, it is important that this plan becomes a tool in County resources to ensure reductions in possible damage from a hazard event. This section discusses plan adoption, implementation, monitoring, evaluating, and updating the HMP. Plan implementation and maintenance procedures will ensure that the HMP remains relevant and continues to address the changing environment in Cuyahoga County. This section describes the incorporation of the HMP into existing planning mechanisms, and how the planning committee will continue to engage the public.

6.1. Planning Process for Setting Hazard Mitigation Goals and Objectives

The mitigation strategy represents the key outcomes of the 2022 Cuyahoga County HMP planning process. The hazard mitigation planning process conducted by the Planning Committee is a typical problem-solving methodology:

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

6.2. Plan Adoption

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

6.3. Evaluation, Monitoring and Updating

Monitoring, evaluating, and updating this plan is critical to maintaining its value and success in regards to identified mitigation efforts. Ensuring effective implementation of mitigation activities paves the way for continued momentum in the planning process and gives direction for the future. This section explains who will be responsible for maintenance activities and what those responsibilities entail. It also provides a methodology and schedule of maintenance activities including a description of how the public will be involved on a continued basis.

Cuyahoga County HMPC established for this 2022 Plan is designated to lead plan maintenance processes of monitoring, evaluation and updating with support and representation from all participating municipalities. The Hazard Mitigation Planning Committee will coordinate maintenance efforts, but the input needed for effective periodic evaluations will come from County-wide representatives and other important stakeholders.

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

The annual evaluation of the 2022 Plan will not only include an investigation of whether mitigation actions were completed, but also an assessment of how effective those actions were in mitigating losses. A review of the qualitative and quantitative benefits (or avoided losses) of mitigation activities will support this assessment. Results of the evaluation will then be compared to the goals and objectives established in the plan and decisions will be made regarding whether actions should be discontinued or modified in any way in light of new developments in the community. Progress will be documented by the Mitigation Planning Committee for use in the next Hazard Mitigation Plan update. Finally, the Mitigation Planning Committee will monitor and incorporate elements of this Plan into other planning mechanisms.

This Plan will be updated by the FEMA approved five-year anniversary date, as required by the Disaster Mitigation Act of 2000, or following a disaster event. Future plan updates will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. During the five-year review process, the following questions will be considered as criteria for assessing the effectiveness of the HMP.

- Has the nature or magnitude of hazards affecting the County changed?
- Are there new hazards that have the potential to impact the County?
- Do the identified goals and actions address current and expected conditions?
- Have mitigation actions been implemented or completed?
- Has the implementation of identified mitigation actions resulted in expected outcomes?
- Are current resources adequate to implement the plan?
- Should additional resources be committed to address identified hazards?

Issues that arise during monitoring and evaluation which require changes to the local hazard, risk and vulnerability summary, mitigation strategy, and other components of the plan will be incorporated during future updates.

Update process for plan prior to 5-year update: any interested party wishing for an update of this Plan sooner than the 5-year update will submit such a request to the HMPC for consideration. The request shall be accompanied by a detailed rationale. The request will be evaluated, and a determination will be made as to whether the update request should be acted upon. If the decision is in the affirmative, an assignment will be made for an individual to author the update. The draft updated section along with a detailed rationale will be submitted to the Mitigation Planning Committee. The committee will circulate the draft updated section of the plan for comment and after an appropriate period of time, the committee shall make a decision to update the plan at least partially based on the feedback received.

6.4. Plan Update and Maintenance

This section describes the schedule and process for monitoring, evaluating, and updating the 2022 HMP.

6.4.1 Schedule

Monitoring the progress of the mitigation actions will be on-going throughout the five-year period between the adoption of the HMP and the next update effort. The HMPC will meet on an annual basis to monitor the status of the implementation of mitigation actions and develop updates as necessary.

The HMP will be updated every five years, as required by DMA 2000. The update process will begin at least one year prior to the expiration of the HMP. However, should a significant disaster occur, the HMPC will reconvene within 30 days of the disaster to review and update the HMP as appropriate.

6.4.2 Process

The HMPC will coordinate with responsible agencies/organizations identified for each mitigation action. These responsible agencies/organizations will monitor and evaluate the progress made on the implementation of mitigation actions and report to the HMPC on an annual basis. Working with the HMPC, these responsible agencies/organizations will be asked to assess the effectiveness of the mitigation actions and modify the mitigation actions as appropriate.

Future updates to the HMP will account for any new hazard vulnerabilities, special circumstances, or new information that becomes available. Issues that arise during monitoring and evaluating the HMP, which require changes to the risk assessment, mitigation strategy and other components of the HMP, will be incorporated into the next update of the HMP. The questions identified above would remain valid during the preparation of the update.

Public Involvement

At all stages of the plan maintenance process, the general public of the County will be invited to participate. Prior to the HMP's annual review and after major disaster events when the HMP is revisited, the public will be invited through the Cuyahoga County's Emergency Management website ReadyCuyahoga, posts on social media, and through fliers posted in public locations throughout the county.

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

6.4.3 Integration into Existing Planning Mechanisms

An important implementation mechanism is to integrate the recommendation and underlying principles of the HMP into planning and development such as capital improvement budgeting, general plans and comprehensive plans. Mitigation is most successful when it is incorporated within the day-to-day functions and priorities of the entity attempting to implement risk reducing actions. The integration of a variety of departments on the HMPC provides an opportunity for constant and pervasive efforts to network, identify, and highlight mitigation activities and opportunities. This collaborative effort is also important to monitor funding opportunities which can be leveraged to implement the mitigation actions.

Please see the Plan Integration Annex for more details on how mitigation has been integrated into other existing planning capabilities throughout the county.

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Appendix A. Meeting Minutes & Agendas

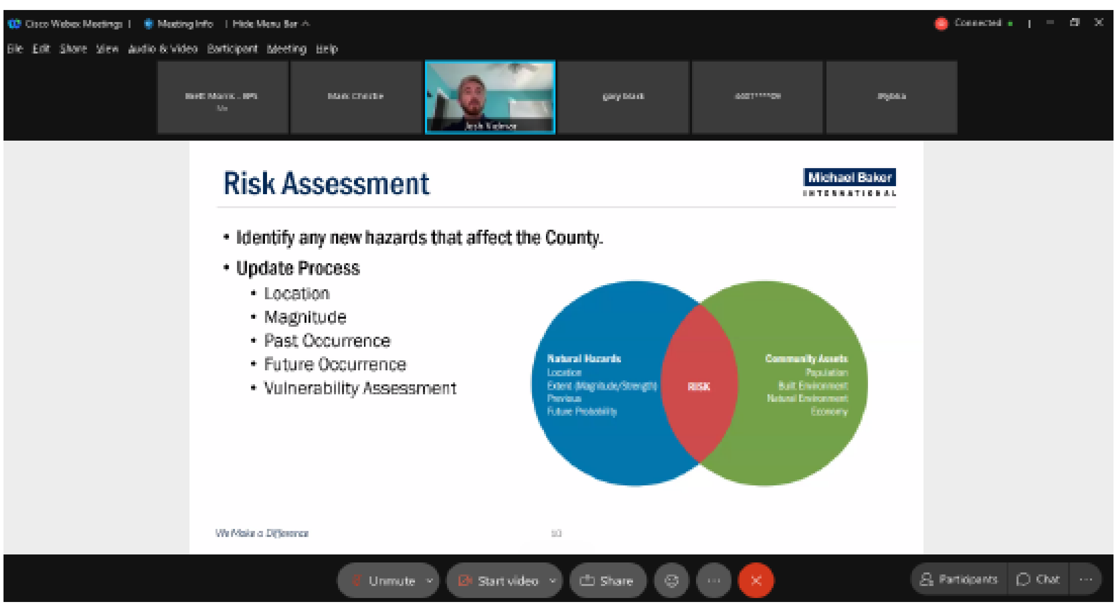
2021 Cuyahoga County All-Hazards Mitigation Plan Update: Stakeholder Kickoff Meeting

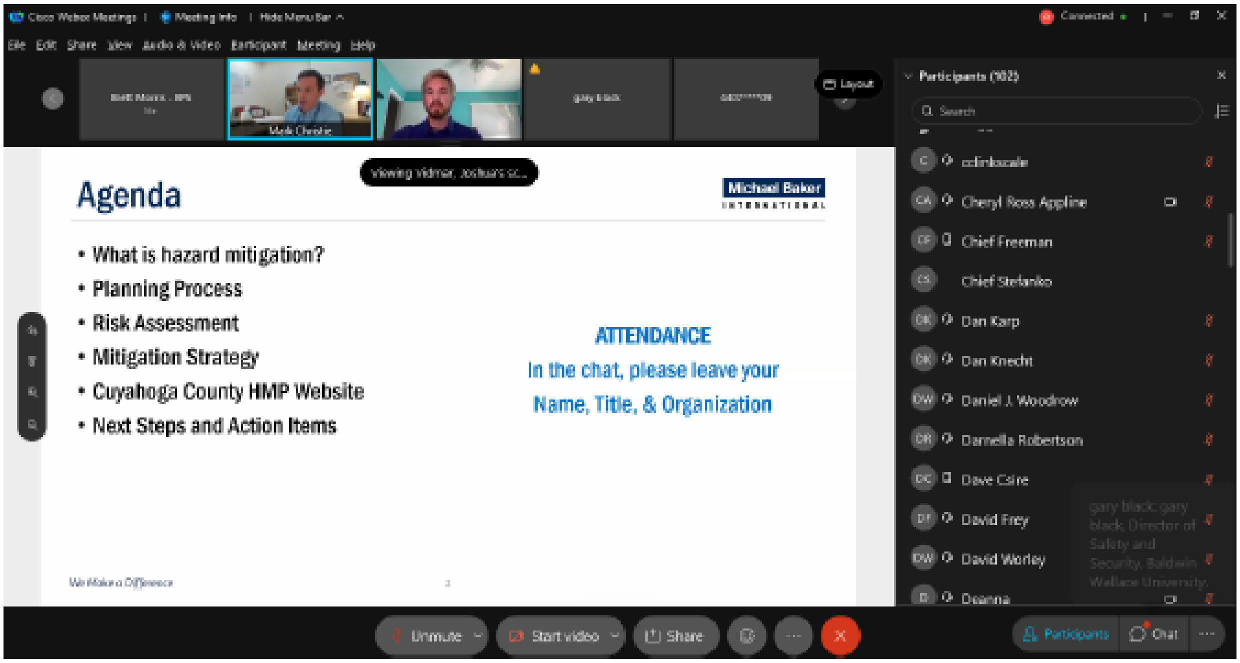
July 15, 2021 | Meeting Minutes

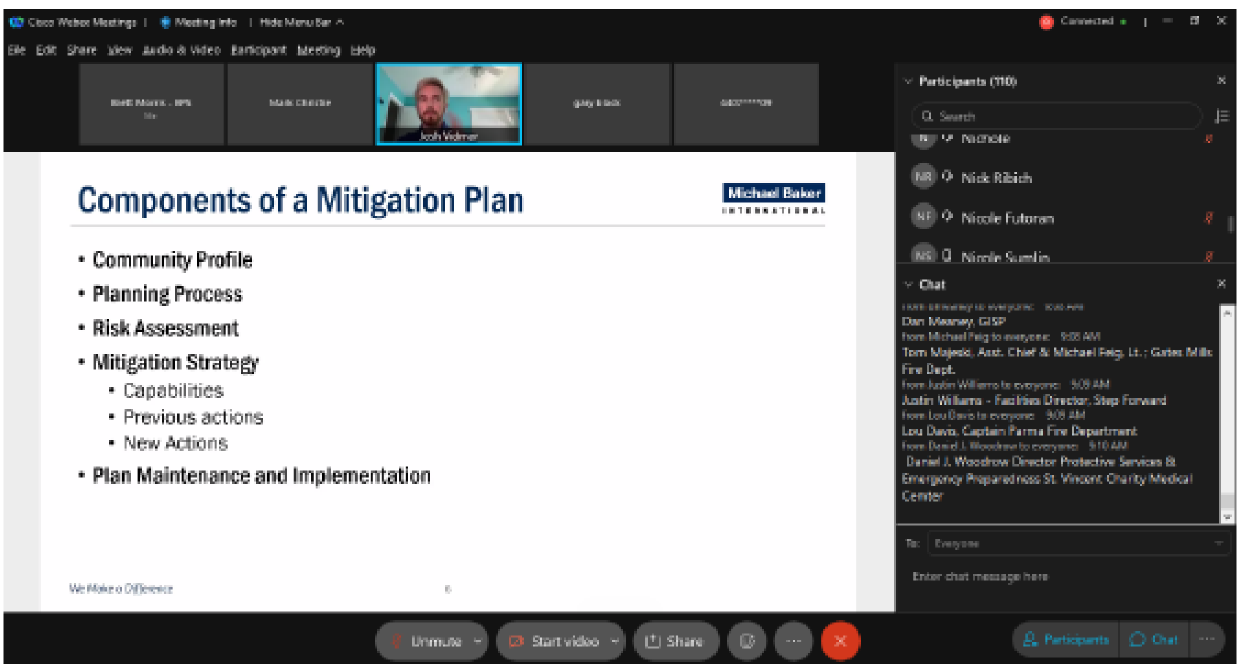
- Welcome
  - Josh welcomes everyone.
  - Mark Christie thanks everyone for participating.
  - Josh introduces team, including BPS and MBI team members
- Reminder: leave name, title, organization in chat
- What is hazard mitigation? A sustained action taken to reduce or eliminate long-term risk to life and property resulting from natural and human-caused hazards.
  - Mitigation is an investment – protecting lives, assets, costs
  - 2017 Plan & Why we need to update again
    - Components of mitigation plan: Community profile, planning process, risk assessment, mitigation strategy, maintenance
- Planning process: Regional Meetings for more localized input; workshops
- Review of hazards in previous plan. Is there anything missing?
- Regional annexes will be included in Plan Update
- Other critical facilities from meeting chat:
  - Transfer stations,
  - Wastewater Treatment Plants
  - Electric transmission grid lines and sub stations
  - Cyber risks
  - Sporting venues
  - Freshwater supply
  - Public transit
  - Blood collection & processing facilities
- Other hazards from chat:
  - Cyber risks
- Capability assessment
  - Planning & regulatory – plans in place
  - Administrative & technical – people at your disposal
  - Fiscal – what you have; financial abilities
- Goals & objectives will lead to actions that can be carried out to mitigate risk
- There are different types of mitigation actions that communities can implement
- Questions and comments from chat:
  - See recent County Climate Action Plan: https://www.countyplanning.us/projects/climate-action-plan/
  - Will you be providing your PowerPoint to participants?
    - Yes, PowerPoint will be provided to participants. (See website)
  - Can the link for [the online surveys] be shared again?
    - The link to the survey forms will be sent out to participants and will be on the website.
  - Is there an estimated time for the regional meetings?
    - Yes, date ranges were given in response to this question during the recorded meeting.
  - Will there be time to complete for forms during the regional meetings?
    - Yes. This question was answered during the recorded meeting.
  - If you are an organization and not a city or municipality, do you pair us with those folks?
    - For the purposes of regional meetings, organizations can attend the nearest regional meeting. This question was answered during the recorded meeting.

- How will we know which region we are in if we border two regions?
    - Either meeting can be attended. This question was answered during the recorded meeting.
- Do regional organizations need to complete the six forms or only municipal jurisdictions?
    - Only municipal jurisdictions are required to complete the forms, but participation from all groups is encouraged. This question was answered during the recorded meeting.

Photos




Agenda
Michael Baker INTERNATIONAL
• What is hazard mitigation?
• Planning Process
• Risk Assessment
• Mitigation Strategy
• Cuyahoga County HMP Website
• Next Steps and Action Items
ATTENDANCE
In the chat, please leave your
Name, Title, & Organization
We Make a Difference
Participants (102)
Cheryl Ross Appline
Chief Freeman
Chief Stefanko
Dan Karp
Dan Knecht
Daniel J. Woodrow
Darnella Robertson
Dave Caire
David Frey
David Worley
Deanna
Unmute
Start video
Share
Participants
Chat


Components of a Mitigation Plan
Michael Baker INTERNATIONAL
• Community Profile
• Planning Process
• Risk Assessment
• Mitigation Strategy
• Capabilities
• Previous actions
• New Actions
• Plan Maintenance and Implementation
We Make a Difference
Participants (110)
Nick Ribich
Nicole Futoran
Chat
Dan Meaney, GISP
Tom Majeski, Asst. Chief & Michael Feig, Lt.; Gates Mills Fire Dept.
Justin Williams - Facilities Director, Step Forward
Lou Davis, Captain Parma Fire Department
Daniel J. Woodrow Director Protective Services & Emergency Preparedness St. Vincent Charity Medical Center
Enter chat message here
Unmute
Start video
Share
Participants
Chat

Appendix B. Complete Hazard Event History

TABLE 7 CUYAHOGA COUNTY FLOODING EVENTS, JANUARY 1, 1996-MARCH 31,2021

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Countywide	4/23/1996	Flash Flood	0	0	$ -	$ -
Cuyahoga County	4/23/1996	Flood	0	0	$ -	$ -
Cuyahoga County	4/30/1996	Flood	0	0	$ -	$ -
East Half	5/10/1996	Flash Flood	0	0	$ -	$ -
Euclid	5/17/1996	Flash Flood	0	0	$ 10,000	$ -
Northeast	6/12/1996	Flash Flood	0	0	$ 50,000	$ -
Southwest	6/18/1996	Flash Flood	0	0	$ 10,000	$ -
Cleveland	6/19/1996	Flash Flood	0	0	$ 20,000	$ -
Newburgh Heights	8/20/1996	Flash Flood	0	0	$ -	$ -
Maple Heights	8/20/1996	Flash Flood	0	0	$ -	$ -
Countywide	9/7/1996	Flash Flood	0	0	$ 100,000	$ -
Berea	9/7/1996	Flash Flood	0	0	$ 100,000	$ -
Cleveland	9/13/1996	Flash Flood	0	0	$ -	$ -
Cleveland	9/13/1996	Flash Flood	0	0	$ -	$ -
Cuyahoga County	2/27/1997	Flood	0	0	$ -	$ -
Countywide	6/1/1997	Flash Flood	0	0	$ 40,000	$ 15,000
Cuyahoga County	6/1/1997	Flood	0	0	$ -	$ -
Cuyahoga County	6/1/1997	Flood	0	0	$ 100,000	$ -
Cuyahoga County	6/1/1997	Flood	0	0	$ 400,000	$ -
North Olmsted	9/20/1997	Flash Flood	0	0	$ 75,000	$ -
Strongsville	9/20/1997	Flash Flood	0	0	$ -	$ -
North Royalton	9/20/1997	Flash Flood	0	0	$ 75,000	$ -
Euclid	1/7/1998	Flash Flood	0	0	$ -	$ -
Cuyahoga County	1/8/1998	Flood	0	0	$ -	$ -
Cleveland	1/9/1998	Flash Flood	0	0	$ -	$ -
Countywide	4/16/1998	Flash Flood	0	0	$ -	$ -
Cuyahoga County	4/16/1998	Flood	0	0	$ 75,000	$ -
Chagrin Falls	5/31/1998	Flash Flood	0	0	$ -	$ -
Cleveland	8/10/1998	Flash Flood	0	0	$ 275,000	$ -
Cleveland	7/9/1999	Flash Flood	0	0	$ -	$ -
Cleveland	10/13/1999	Flash Flood	0	0	$ -	$ -
Cleveland	7/27/2000	Flash Flood	0	0	$ 250,000	$ -
North Olmsted	5/21/2001	Flash Flood	0	0	$ -	$ -
Countywide	8/31/2001	Flash Flood	0	0	$ -	$ -

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	7/21/2003	Flood	0	0	$ 5,000,000	$ -
Countywide	5/21/2004	Flash Flood	0	0	$ 750,000	$ -
Cuyahoga County	5/21/2004	Flood	0	0	$ 1,800,000	$ -
Countywide	5/22/2004	Flash Flood	0	0	$ 5,200,000	$ -
Countywide	6/9/2004	Flash Flood	0	0	$ 500,000	$ -
Cuyahoga County	9/17/2004	Flood	0	0	$ 75,000	$ -
Cuyahoga County	1/1/2005	Flood	0	0	$ 600,000	$ -
Broadview Heights	6/28/2005	Flash Flood	0	0	$ 50,000	$ -
Chagrin Falls	7/14/2005	Flash Flood	0	0	$ 250,000	$ -
Countywide	7/26/2005	Flash Flood	0	0	$ 35,000	$ -
West Portion	8/20/2005	Flash Flood	0	0	$ 1,800,000	$ -
Cuyahoga County	8/30/2005	Flood	0	0	$ 100,000	$ -
Rocky River	5/31/2006	Flash Flood	0	0	$ 250,000	$ -
East Portion	6/22/2006	Flash Flood	0	0	$ 35,000,000	$ -
Countywide	6/22/2006	Flood	0	0	$ 12,000,000	$ -
Euclid	7/27/2006	Flash Flood	0	0	$ 1,800	$ -
Southeast Portion	7/31/2006	Flash Flood	0	0	$ 150,000	$ -
Independence	1/5/2007	Flood	0	0	$ 500,000	$ -
Cleveland	8/2/2007	Flash Flood	0	0	$ 2,500,000	$ -
Berea	8/7/2007	Flash Flood	0	0	$ 2,200,000	$ -
North Royalton	2/28/2011	Flood	0	0	$ 700,000	$ -
Gates Mills	2/28/2011	Flood	0	0	$ -	$ -
Broadview Heights	5/12/2011	Flood	0	0	$ 5,000	$ -
Parma Heights	5/14/2011	Flash Flood	0	0	$ -	$ -
Olmsted Falls	5/25/2011	Flash Flood	0	0	$ -	$ -
Cleveland	7/19/2011	Flash Flood	0	0	$ 20,000	$ -
Westlake	7/19/2011	Flash Flood	0	0	$ 50,000	$ -
Short Line JCT	7/19/2011	Flash Flood	0	0	$ 50,000	$ -
Brooklyn Heights	10/30/2012	Flood	0	0	$ 100,000	$ -
(Bkl) Cleveland Lake	7/10/2013	Flash Flood	0	0	$ 140,000	$ -
Valley View	7/10/2013	Flash Flood	0	0	$ 500,000	$ -
Cleveland Heights	7/10/2013	Flash Flood	0	0	$ 200,000	$ -
(Bkl) Cleveland Lake	1/12/2014	Flood	0	0	$ 25,000	$ -
Lakewood	2/21/2014	Flash Flood	0	0	$ 100,000	$ -
Westlake	5/12/2014	Flash Flood	0	0	$ 13,000,000	$ -
Brooklyn	5/30/2015	Flash Flood	0	0	$ 600,000	$ -
Eagle Cliff	6/15/2015	Flood	0	0	$ 800,000	$ -

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
(Cgf) Cuyahoga Co Arp	6/27/2015	Flood	0	0	$ 1,000,000	$ -
Chagrin Falls	7/14/2015	Flash Flood	0	0	$ 120,000	$ -
Alexanders	1/12/2017	Flood	0	0	$ -	$ -
Cleveland	2/7/2017	Flood	0	0	$ 10,000	$ -
Short Line JCT	4/19/2017	Flash Flood	0	0	$ 400,000	$ -
Oakwood	6/30/2017	Flash Flood	0	0	$ 120,000	$ -
Beachwood	8/10/2017	Flash Flood	0	0	$ 2,000,000	$ -
Fairview	1/12/2018	Flood	0	0	$ -	$ -
Willowick	4/15/2018	Flood	0	0	$ 35,000	$ -
Valley View	4/16/2018	Flood	0	0	$ 3,000	$ -
Brecksville	5/28/2019	Flash Flood	0	0	$ -	$ -
Strongsville Arpt	6/5/2019	Flash Flood	0	0	$ 14,000	$ -
Bentleyville	6/5/2019	Flash Flood	0	0	$ 10,000	$ -
Short Line Jct	6/20/2019	Flash Flood	0	0	$ -	$ -
Parma	7/5/2019	Flash Flood	0	0	$ 25,000,000	$ -
Brooklyn Heights	7/5/2019	Flash Flood	0	0	$ -	$ -
Brooklyn Heights	3/29/2020	Flash Flood	0	0	$ 60,000	$ -
Parma Heights	3/29/2020	Flash Flood	0	0	$ 20,000	$ -
Short Line Jct	3/29/2020	Flash Flood	0	0	$ 10,000	$ -
Maple Heights	3/29/2020	Flash Flood	0	0	$ 1,000	$ -
South Park	3/29/2020	Flash Flood	0	0	$ 60,000	$ -
Garfield Heights	3/29/2020	Flash Flood	0	0	$ -	$ -
Bedford	3/29/2020	Flash Flood	0	0	$ -	$ -
Chagrin Falls	3/29/2020	Flash Flood	0	0	$ -	$ -
University Heights	3/29/2020	Flash Flood	0	0	$ -	$ -
Brooklyn	5/15/2020	Flash Flood	0	0	$ 3,000	$ -
Brecksville	5/15/2020	Flash Flood	0	0	$ 4,000	$ -
Short Line Jct	5/15/2020	Flash Flood	0	0	$ 75,000	$ -
Olmstead Falls Arpt	5/15/2020	Flood	0	0	$ 5,000	$ -
Cleveland Heights	5/15/2020	Flash Flood	0	0	$ -	$ -
Maple Heights	9/7/2020	Flash Flood	0	0	$ -	$ -
Berea	9/7/2020	Flash Flood	0	0	$ -	$ -
Lakewood	9/7/2020	Flash Flood	0	0	$ -	$ -
Bratenahl	9/7/2020	Flash Flood	0	0	$ 100,000	$ -
Newburgh Heights	9/7/2020	Flash Flood	0	0	$ 2,000	$ -
Garfield Heights	9/7/2020	Flash Flood	0	0	$ -	$ -
East Cleveland	9/7/2020	Flash Flood	0	0	$ 35,000	$ -
Solon	9/7/2020	Flash Flood	0	0	$ -	$ -
Pepper Pike	9/7/2020	Flash Flood	0	0	$ -	$ -
North Royalton	9/7/2020	Flash Flood	0	0	$ -	$ -

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Brecksville	9/7/2020	Flash Flood	0	0	$ -	$ -
Brecksville	9/7/2020	Flash Flood	0	0	$ -	$ -
Strongsville	9/7/2020	Flash Flood	0	0	$ -	$ -
Euclid	10/21/2020	Flood	0	0	$ -	$ -
Parkview	10/21/2020	Flash Flood	0	0	$ 2,000	$ -
Grand Total	-	-	0	0	$ 115,721,000	$ 15,000

TABLE 8 CUYAHOGA COUNTY EXTREME TEMPERATURE EVENTS, JANUARY 1, 1996-MARCH 31, 2021

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	1/15/2009	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga County	3/27/2012	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga County	4/29/2012	Extreme Cold/Wind Chill	0	0	$ 200,000	$ -
Cuyahoga County	1/6/2014	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga County	1/28/2014	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga County	2/15/2015	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga County	2/20/2015	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga County	1/30/2019	Extreme Cold/Wind Chill	3	0	$ 100,000	$ -
Grand Total	-	-	3	0	$ 300,000	$ 0

TABLE 9 CUYAHOGA COUNTY WINTER STORM EVENTS, JANUARY 1, 1996-MARCH 31, 2021

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga (Zone)	1/2/1996	Heavy Snow	0	0	$ 1,000,000	$ -
Cuyahoga (Zone)	2/2/1996	Cold/Wind Chill	1	0	$ 800,000	$ -
Cuyahoga (Zone)	3/20/1996	Heavy Snow	0	0	$ 40,000	$ -
Cuyahoga (Zone)	11/9/1996	Heavy Snow	0	13	$ 7,000,000	$ -
Cuyahoga (Zone)	12/3/1996	Cold/Wind Chill	1	0	$ -	$ -
Cuyahoga (Zone)	12/24/1996	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	1/9/1997	Cold/Wind Chill	1	0	$ -	$ -
Cuyahoga (Zone)	1/10/1997	Cold/Wind Chill	4	0	$ 20,000	$ -
Cuyahoga (Zone)	1/16/1997	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	11/15/1997	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	12/6/1997	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	12/30/1997	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	3/10/1998	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	12/22/1998	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	1/2/1999	Winter Storm	0	2	$ 75,000	$ -
Cuyahoga (Zone)	1/8/1999	Winter Storm	0	0	$ 2,000	$ -
Cuyahoga (Zone)	1/13/1999	Winter Storm	0	0	$ 5,000	$ -
Cuyahoga (Zone)	1/14/1999	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	2/12/1999	Heavy Snow	0	0	$ -	$ -
Cuyahoga (Zone)	3/5/1999	Heavy Snow	0	0	$ 50,000	$ -
Cuyahoga (Zone)	12/23/1999	Heavy Snow	0	0	$ 75,000	$ -
Cuyahoga (Zone)	1/19/2000	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	1/21/2000	Heavy Snow	0	0	$ 20,000	$ -
Cuyahoga (Zone)	1/26/2000	Heavy Snow	0	0	$ 20,000	$ -
Cuyahoga (Zone)	1/27/2000	Heavy Snow	0	0	$ 10,000	$ -
Cuyahoga (Zone)	2/13/2000	Winter Storm	0	0	$ 50,000	$ -
Cuyahoga (Zone)	3/11/2000	Winter Storm	0	0	$ 30,000	$ -
Cuyahoga (Zone)	11/20/2000	Heavy Snow	0	0	$ 300,000	$ -
Cuyahoga (Zone)	12/6/2000	Heavy Snow	0	0	$ 50,000	$ -
Cuyahoga (Zone)	12/13/2000	Winter Storm	0	0	$ 100,000	$ -
Cuyahoga (Zone)	12/27/2000	Heavy Snow	0	0	$ 60,000	$ -
Cuyahoga (Zone)	12/31/2000	Heavy Snow	0	0	$ 30,000	$ -
Cuyahoga (Zone)	1/5/2001	Heavy Snow	0	0	$ 40,000	$ -
Cuyahoga (Zone)	1/27/2001	Heavy Snow	0	0	$ 25,000	$ -
Cuyahoga (Zone)	3/5/2001	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	3/26/2001	Heavy Snow	0	0	$ 50,000	$ -
Cuyahoga (Zone)	12/28/2001	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	1/7/2002	Heavy Snow	0	0	$ 15,000	$ -
Cuyahoga (Zone)	2/27/2002	Heavy Snow	0	0	$ 40,000	$ -
Cuyahoga (Zone)	3/22/2002	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	3/24/2002	Winter Storm	0	0	$ 100,000	$ -

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga (Zone)	12/24/2002	Heavy Snow	0	0	$ 350,000	$ -
Cuyahoga (Zone)	1/6/2003	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	1/26/2003	Heavy Snow	0	0	$ 150,000	$ -
Cuyahoga (Zone)	12/17/2003	Heavy Snow	0	0	$ 750,000	$ -
Cuyahoga (Zone)	3/16/2004	Heavy Snow	0	0	$ 250,000	$ -
Cuyahoga (Zone)	12/13/2004	Winter Storm	0	0	$ 250,000	$ -
Cuyahoga (Zone)	12/19/2004	Winter Storm	0	0	$ 300,000	$ -
Cuyahoga (Zone)	12/22/2004	Winter Storm	0	0	$ 4,200,000	$ -
Cuyahoga (Zone)	1/5/2005	Ice Storm	0	0	$ 1,300,000	$ -
Cuyahoga (Zone)	1/16/2005	Winter Storm	0	0	$ -	$ -
Cuyahoga (Zone)	1/22/2005	Winter Storm	0	0	$ 500,000	$ -
Cuyahoga (Zone)	3/1/2005	Winter Storm	0	0	$ 200,000	$ -
Cuyahoga (Zone)	3/8/2005	Winter Storm	0	0	$ 150,000	$ -
Cuyahoga (Zone)	4/2/2005	Winter Storm	0	0	$ 500,000	$ -
Cuyahoga (Zone)	4/23/2005	Winter Storm	0	0	$ 1,000,000	$ -
Cuyahoga (Zone)	12/1/2005	Heavy Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	2/4/2006	Winter Storm	0	0	$ 65,000	$ -
Cuyahoga (Zone)	12/7/2006	Lake-Effect Snow	0	0	$ 20,000	$ -
Cuyahoga (Zone)	1/16/2007	Lake-Effect Snow	0	0	$ 50,000	$ -
Cuyahoga (Zone)	1/28/2007	Lake-Effect Snow	0	0	$ 75,000	$ -
Cuyahoga (Zone)	1/30/2007	Lake-Effect Snow	0	0	$ 50,000	$ -
Cuyahoga (Zone)	2/13/2007	Winter Storm	0	0	$ 150,000	$ -
Cuyahoga (Zone)	4/6/2007	Lake-Effect Snow	0	0	$ 125,000	$ -
Cuyahoga (Zone)	12/15/2007	Winter Storm	0	0	$ 800,000	$ -
Cuyahoga (Zone)	1/1/2008	Winter Storm	0	0	$ 150,000	$ -
Cuyahoga (Zone)	2/26/2008	Winter Storm	0	0	$ 250,000	$ -
Cuyahoga (Zone)	3/4/2008	Winter Storm	0	0	$ 750,000	$ -
Cuyahoga (Zone)	3/7/2008	Winter Storm	0	0	$ 7,500,000	$ -
Cuyahoga (Zone)	3/21/2008	Heavy Snow	0	0	$ 150,000	$ -
Cuyahoga (Zone)	12/19/2008	Winter Storm	0	0	$ 60,000	$ -
Cuyahoga (Zone)	1/9/2009	Winter Storm	0	0	$ 700,000	$ -
Cuyahoga (Zone)	1/15/2009	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga (Zone)	1/27/2009	Winter Storm	0	0	$ 750,000	$ -
Cuyahoga (Zone)	2/3/2009	Lake-Effect Snow	0	0	$ 1,000,000	$ -
Cuyahoga (Zone)	1/3/2010	Lake-Effect Snow	0	0	$ 600,000	$ -
Cuyahoga (Zone)	2/5/2010	Winter Storm	0	0	$ 400,000	$ -
Cuyahoga (Zone)	12/4/2010	Lake-Effect Snow	0	0	$ 300,000	$ -
Cuyahoga (Zone)	12/8/2010	Lake-Effect Snow	0	0	$ 1,000,000	$ -
Cuyahoga (Zone)	12/12/2010	Lake-Effect Snow	0	0	$ 300,000	$ -
Cuyahoga (Zone)	1/11/2011	Winter Storm	0	0	$ 300,000	$ -
Cuyahoga (Zone)	2/1/2011	Winter Storm	0	0	$ 500,000	$ -
Cuyahoga (Zone)	2/20/2011	Winter Storm	0	0	$ 500,000	$ -

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga (Zone)	3/10/2011	Winter Storm	0	0	$ 500,000	$ -
Cuyahoga (Zone)	1/1/2012	Lake-Effect Snow	0	0	$ 125,000	$ -
Cuyahoga (Zone)	2/10/2012	Lake-Effect Snow	0	0	$ 100,000	$ -
Cuyahoga (Zone)	3/27/2012	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga (Zone)	4/29/2012	Extreme Cold/Wind Chill	0	0	$ 200,000	$ -
Cuyahoga (Zone)	12/26/2012	Winter Storm	0	0	$ 100,000	$ -
Cuyahoga (Zone)	2/1/2013	Winter Storm	0	0	$ 125,000	$ -
Cuyahoga (Zone)	10/23/2013	Lake-Effect Snow	0	0	$ 500,000	$ -
Cuyahoga (Zone)	1/1/2014	Heavy Snow	0	0	$ 250,000	$ -
Cuyahoga (Zone)	1/6/2014	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga (Zone)	1/25/2014	Winter Storm	0	0	$ 400,000	$ -
Cuyahoga (Zone)	1/28/2014	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga (Zone)	2/4/2014	Winter Storm	0	0	$ 250,000	$ -
Cuyahoga (Zone)	2/17/2014	Winter Storm	0	0	$ 500,000	$ -
Cuyahoga (Zone)	3/12/2014	Winter Storm	0	0	$ 450,000	$ -
Cuyahoga (Zone)	11/13/2014	Lake-Effect Snow	0	0	$ 250,000	$ -
Cuyahoga (Zone)	11/20/2014	Lake-Effect Snow	0	0	$ 150,000	$ -
Cuyahoga (Zone)	2/1/2015	Winter Storm	0	0	$ 750,000	$ -
Cuyahoga (Zone)	2/15/2015	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga (Zone)	2/20/2015	Extreme Cold/Wind Chill	0	0	$ -	$ -
Cuyahoga (Zone)	12/8/2016	Lake-Effect Snow	0	0	$ 250,000	$ -
Cuyahoga (Zone)	12/15/2016	Lake-Effect Snow	0	0	$ 500,000	$ -
Cuyahoga (Zone)	1/29/2017	Lake-Effect Snow	0	0	$ 200,000	$ -
Cuyahoga (Zone)	4/6/2017	Winter Storm	0	0	$ 200,000	$ -
Cuyahoga (Zone)	1/12/2018	Winter Storm	0	0	$ 200,000	$ -
Cuyahoga (Zone)	1/29/2018	Winter Storm	0	0	$ 300,000	$ -
Cuyahoga (Zone)	3/1/2018	Winter Storm	0	0	$ 250,000	$ -
Cuyahoga (Zone)	3/8/2018	Lake-Effect Snow	0	0	$ 200,000	$ -
Cuyahoga (Zone)	3/20/2018	Heavy Snow	0	0	$ 50,000	$ -
Cuyahoga (Zone)	1/19/2019	Winter Storm	0	0	$ 200,000	$ -
Cuyahoga (Zone)	1/30/2019	Extreme Cold/Wind Chill	3	0	$ 100,000	$ -
Cuyahoga (Zone)	1/19/2020	Lake-Effect Snow	0	0	$ 20,000	$ -
Cuyahoga (Zone)	12/1/2020	Winter Storm	0	0	$ 300,000	$ -
Cuyahoga (Zone)	12/24/2020	Winter Storm	0	0	$ 50,000	$ -
Cuyahoga (Zone)	2/1/2021	Cold/Wind Chill	7	0	$ -	$ -
Cuyahoga (Zone)	2/15/2021	Winter Storm	0	0	$ -	$ -
Grand Total	-	-	17	15	$ 44,622,000	$ 0

TABLE 10 EARTHQUAKE EPICENTERS IN CUYAHOGA COUNTY

Location	Magnitude	Year	MMF
Cuyahoga Co.	3.1	1836	IV
Cuyahoga Co.	3.2	1850	IV
Lake Co.	3.3	1858	IV
Cuyahoga Co.	3	1868	F
Lorain Co.	3	1883	F
Summit Co.	3.8	1885	IV
Cuyahoga Co.	3.3	1888	III
Summit Co.	3.4	1888	V
Cuyahoga Co.	2.9	1898	II
Lorain Co.	3.3	1899	III
Cuyahoga Co.	2.9	1906	III
Cuyahoga Co.	2.9	1929	III
Lake Co.	4.4	1943	V
Lake Co.	2.9	1951	IV
Cuyahoga Co.	3.3	1955	V
Cuyahoga Co.	2.7	1955	IV
Lake Co.	2.5	1983	NF
Lake Co.	2.7	1983	NF
Lake Co.	2.4	1986	NF
Lake Co.	5	1986	IV
Cuyahoga Co.	1.0	1987	NF
Cuyahoga Co.	1.8	1987	NF
Geauga Co.	1.6	1987	NF
Portage Co.	1.3	1987	NF
Portage Co.	2.8	1988	-
Geauga Co.	2.8	1988	-
Cuyahoga Co.	1.3	1988	NF
Lake Co.	2.5	1988	-
Lake Co.	2.7	1988	-
Cuyahoga Co.	2	1989	NF
Cuyahoga Co.	1.1	1989	NF
Lake Co.	2	1989	NF
Cuyahoga Co.	3.5	1991	V
Portage Co.	2.3	1991	NF
Lake Co.	2	1991	-
Lake Co.	2	1991	-
Lake Co.	3.4	1992	IV
Lake Co.	3.4	1992	IV
Lake Co.	2.2	1992	NF
Lake Co.	3.6	1993	IV
Lake Co.	2.2	1997	NF

Location	Magnitude	Year	MMF
Summit Co.	2.8	1998	NF
Lake Co.	3	1998	NF
Lake Co.	2.4	1998	NF
Lake Co.	2.8	1999	III
Portage Co.	3	2000	IV
Lake Co.	2.7	2002	F
Lake Co.	2	2003	NF
Lake Co.	3.4	2003	NF
Lake Co.	3..5	2003	IV
Lake Co.	3.3	2004	III
Lake Co.	2.4	2004	III
Lake Co.	2.5	2005	F
Lake Co.	2.2	2005	F
Lake Co.	2.3	2006	F
Lake Co.	2.3	2006	NF
Lake Co.	2.1	2006	NF
Lake Co.	2.2	2006	NF
Lake Co.	2.2	2006	NF
Lake Co.	2.2	2006	NF
Lake Co.	2.3	2006	F
Lake Co.	2.6	2006	F
Lake Co.	2.2	2006	-
Lake Co.	3	2006	F
Lake Co.	2.6	2006	F
Lake Co.	2.1	2006	NF
Portage Co.	3.3	2007	F
Lake Co.	2.4	2007	NF
Lorain Co.	2.7	2007	NF
Lake Co.	3.2	2007	III
Lake Co.	2..1	2007	F
Lake Co.	2.3	2008	F
Lake Co.	2.8	2008	F
Lake Co.	2.3	2008	NF
Lake Co.	3.1	2008	F
Lake Co.	2.4	2009	NF
Lake Co.	2.2	2009	NF
Summit Co.	2.5	2010	NF
Lake Co.	2.1	2010	II
Lake Co.	2.3	2010	F
Lake Co.	2.5	2010	III
Lake Co.	2.5	2010	F
Cuyahoga Co.	2	2011	NF

Location	Magnitude	Year	MMF
Medina Co.	2	2011	II
Lake Co.	2.1	2011	NF
Lake Co.	2.5	2013	NF
Lake Co.	2.4	2013	F
Lake Co.	3.2	2013	F
Lake Co.	2.7	2013	F
Cuyahoga Co.	2.1	2014	NF
Cuyahoga Co.	2	2014	NF
Lake Co.	2.2	2014	F
Lake Co.	2.1	2014	NF
Lake Co.	2.1	2017	NF
Cuyahoga Co.	1.8	2017	NF
Cuyahoga Co.	1.8	2017	NF
Geauga Co.	2	2018	NF
Lake Co.	2.2	2018	NF
Lake Co.	2.1	2018	NF
Cuyahoga Co.	2.4	2019	F
Lake Co.	2.4	2019	NF
Lake Co.	2.7	2019	F
Lake Co.	2.1	2019	NF
Lake Co.	2.5	2019	NF
Lake Co.	2.4	2019	NF
Lake Co.	2.3	2019	NF
Lake Co.	4.2	2019	F
Lake Co.	2.6	2019	NF
Lake Co.	2.6	2019	NF
Lake Co.	2.4	2019	NF
Lake Co.	2.5	2020	NF

TABLE 11 DROUGHT EVENTS IN CUYAHOGA COUNTY, JANUARY 1, 1996-MARCH 31, 2021

Location	Date	Event	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	8/1/1996	Drought	0	0	$ -	$ -
Cuyahoga County	6/1/1999	Drought	0	0	$ -	$ -
Cuyahoga County	7/1/1999	Drought	0	0	$ -	$ -
Cuyahoga County	8/1/1999	Drought	0	0	$ -	$ -
Cuyahoga County	9/1/1999	Drought	0	0	$ -	$ 500,000
Grand Total	-	-	0	0	$ 0	$ 500,000

TABLE 12 SEVERE THUNDERSTORM EVENTS IN CUYAHOGA COUNTY, JANUARY 1, 1955-MARCH 31, 2021

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	3/22/1955	Thunderstorm Wind	74	0	0	$ -	$ -
Cuyahoga County	5/12/1956	Hail	1	0	0	$ -	$ -
Cuyahoga County	5/12/1956	Thunderstorm Wind	62	0	0	$ -	$ -
Cuyahoga County	7/8/1956	Thunderstorm Wind	65	0	0	$ -	$ -
Cuyahoga County	8/5/1956	Thunderstorm Wind	62	0	0	$ -	$ -
Cuyahoga County	8/6/1956	Thunderstorm Wind	74	0	0	$ -	$ -
Cuyahoga County	8/18/1956	Thunderstorm Wind	65	0	0	$ -	$ -
Cuyahoga County	5/14/1957	Thunderstorm Wind	83	0	0	$ -	$ -
Cuyahoga County	6/25/1958	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/25/1958	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/7/1958	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	4/29/1959	Thunderstorm Wind	66	0	0	$ -	$ -
Cuyahoga County	5/10/1959	Hail	1	0	0	$ -	$ -
Cuyahoga County	4/16/1960	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	4/22/1962	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	5/20/1962	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	7/20/1962	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/20/1962	Thunderstorm Wind	90	0	0	$ -	$ -
Cuyahoga County	4/18/1963	Thunderstorm Wind	53	0	0	$ -	$ -
Cuyahoga County	6/10/1963	Thunderstorm Wind	59	0	0	$ -	$ -
Cuyahoga County	8/3/1963	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	8/3/1963	Thunderstorm Wind	74	0	0	$ -	$ -
Cuyahoga County	4/21/1964	Hail	1	0	0	$ -	$ -
Cuyahoga County	1/26/1965	Thunderstorm Wind	51	0	0	$ -	$ -
Cuyahoga County	5/16/1965	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	5/16/1965	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	5/16/1965	Hail	2.75	0	0	$ -	$ -
Cuyahoga County	8/6/1965	Hail	2	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	8/6/1965	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	3/23/1966	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/9/1966	Hail	1	0	0	$ -	$ -
Cuyahoga County	2/15/1967	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	3/23/1967	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/8/1967	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	7/23/1967	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/15/1968	Hail	1	0	0	$ -	$ -
Cuyahoga County	5/15/1968	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	5/15/1968	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/20/1968	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/25/1968	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/22/1968	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	8/6/1968	Thunderstorm Wind	62	0	0	$ -	$ -
Cuyahoga County	4/21/1969	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/4/1969	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/4/1969	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	5/23/1970	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	5/25/1970	Hail	1	0	0	$ -	$ -
Cuyahoga County	6/15/1970	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/10/1970	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	6/20/1971	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/20/1971	Hail	1.25	0	0	$ -	$ -
Cuyahoga County	8/10/1971	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	8/10/1971	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	7/18/1972	Thunderstorm Wind	56	0	0	$ -	$ -
Cuyahoga County	8/26/1972	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	6/3/1973	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	3/8/1974	Thunderstorm Wind	62	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	4/14/1974	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	4/14/1974	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	4/14/1974	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/11/1974	Thunderstorm Wind	65	0	0	$ -	$ -
Cuyahoga County	5/11/1974	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	6/30/1974	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	7/29/1974	Hail	1	0	0	$ -	$ -
Cuyahoga County	7/29/1974	Hail	1	0	0	$ -	$ -
Cuyahoga County	8/13/1974	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	8/13/1974	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/15/1975	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	2/18/1976	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	2/18/1976	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	3/4/1976	Thunderstorm Wind	53	0	0	$ -	$ -
Cuyahoga County	3/5/1976	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	3/12/1976	Thunderstorm Wind	51	0	0	$ -	$ -
Cuyahoga County	4/21/1976	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/10/1976	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	7/11/1976	Thunderstorm Wind	60	0	0	$ -	$ -
Cuyahoga County	7/15/1976	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/21/1976	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	7/7/1977	Hail	1	0	0	$ -	$ -
Cuyahoga County	7/7/1977	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/12/1977	Thunderstorm Wind	58	0	0	$ -	$ -
Cuyahoga County	5/20/1978	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	6/12/1978	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	8/19/1978	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	8/19/1978	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	6/10/1979	Thunderstorm Wind	0	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	6/20/1979	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/5/1979	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/13/1980	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	5/13/1980	Thunderstorm Wind	62	0	0	$ -	$ -
Cuyahoga County	6/7/1980	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	7/5/1980	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/2/1980	Thunderstorm Wind	70	0	0	$ -	$ -
Cuyahoga County	8/2/1980	Thunderstorm Wind	55	0	0	$ -	$ -
Cuyahoga County	8/2/1980	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	6/22/1981	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/22/1981	Thunderstorm Wind	61	0	0	$ -	$ -
Cuyahoga County	6/22/1981	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/14/1981	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/14/1981	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	1/4/1982	Thunderstorm Wind	53	0	0	$ -	$ -
Cuyahoga County	3/16/1982	Hail	1	0	0	$ -	$ -
Cuyahoga County	3/31/1982	Thunderstorm Wind	53	0	0	$ -	$ -
Cuyahoga County	6/15/1982	Thunderstorm Wind	67	0	0	$ -	$ -
Cuyahoga County	6/15/1982	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/15/1982	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	4/28/1983	Thunderstorm Wind	68	0	0	$ -	$ -
Cuyahoga County	4/28/1983	Thunderstorm Wind	63	0	0	$ -	$ -
Cuyahoga County	5/2/1983	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/2/1983	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	5/2/1983	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	7/4/1983	Thunderstorm Wind	54	0	0	$ -	$ -
Cuyahoga County	7/4/1983	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/21/1983	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/6/1983	Thunderstorm Wind	0	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	6/13/1984	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/18/1984	Thunderstorm Wind	60	0	0	$ -	$ -
Cuyahoga County	3/10/1986	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	3/10/1986	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	5/6/1986	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	5/6/1986	Hail	1	0	0	$ -	$ -
Cuyahoga County	7/25/1986	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/26/1986	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/26/1986	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/29/1987	Thunderstorm Wind	61	0	0	$ -	$ -
Cuyahoga County	6/29/1987	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/2/1987	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/2/1987	Thunderstorm Wind	56	0	0	$ -	$ -
Cuyahoga County	5/9/1988	Thunderstorm Wind	62	0	0	$ -	$ -
Cuyahoga County	5/9/1988	Thunderstorm Wind	61	0	0	$ -	$ -
Cuyahoga County	5/15/1988	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	5/15/1988	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	5/15/1988	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	6/25/1988	Thunderstorm Wind	73	0	0	$ -	$ -
Cuyahoga County	7/10/1988	Thunderstorm Wind	50	0	0	$ -	$ -
Cuyahoga County	8/5/1988	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/14/1988	Thunderstorm Wind	52	0	0	$ -	$ -
Cuyahoga County	5/25/1989	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/7/1989	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	10/10/1989	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	10/10/1989	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	11/15/1989	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	11/27/1989	Thunderstorm Wind	64	0	0	$ -	$ -
Cuyahoga County	6/3/1990	Thunderstorm Wind	0	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	9/6/1990	Thunderstorm Wind	0	3	3	$ -	$ -
Cuyahoga County	9/7/1990	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/14/1990	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	9/16/1990	Thunderstorm Wind	62	0	0	$ -	$ -
Cuyahoga County	9/23/1990	Thunderstorm Wind	58	0	0	$ -	$ -
Cuyahoga County	3/27/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	4/9/1991	Hail	1	0	0	$ -	$ -
Cuyahoga County	4/9/1991	Thunderstorm Wind	57	0	0	$ -	$ -
Cuyahoga County	4/9/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	4/15/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/24/1991	Hail	0.88	0	0	$ -	$ -
Cuyahoga County	5/30/1991	Hail	1	0	0	$ -	$ -
Cuyahoga County	5/30/1991	Thunderstorm Wind	65	0	0	$ -	$ -
Cuyahoga County	5/31/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	6/15/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/7/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/30/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/30/1991	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	5/17/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/10/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/14/1992	Thunderstorm Wind	0	0	1	$ -	$ -
Cuyahoga County	7/14/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	7/14/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/10/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	8/10/1992	Thunderstorm Wind	65	0	1	$ -	$ -
Cuyahoga County	8/30/1992	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	9/9/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Cuyahoga County	10/14/1992	Thunderstorm Wind	0	0	0	$ -	$ -
Shaker Heights	9/2/1993	Hail	2	0	0	$ 50,000	$ -
E Portion	9/10/1993	Thunderstorm Wind	0	0	0	$ 5,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Middleburg Heights	4/12/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Countywide	4/15/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Parma	4/27/1994	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	5/14/1994	Hail	0.75	0	0	$ -	$ -
Parma	6/13/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Garfield Heights And	6/15/1994	Thunderstorm Wind	0	1	0	$ 5,000	$ -
Countywide	6/20/1994	Thunderstorm Wind	0	0	0	$ 50,000	$ -
N Royalton	7/5/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Brecksville	7/6/1994	Hail	0.75	0	0	$ -	$ -
Bedford Heights	7/6/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Parma	7/24/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Cleveland	8/4/1994	Thunderstorm Wind	0	0	0	$ 5,000	$ -
E Portion	8/28/1994	Thunderstorm Wind	0	1	0	$ 5,000,000	$ -
E Portion	9/25/1994	Hail	1.75	0	1	$ 5,000,000	$ -
Countywide	3/20/1995	Thunderstorm Wind	0	0	0	$ 5,000	$ -
Cuyahoga County	5/10/1995	Hail	1.75	0	0	$ -	$ -
Green	5/10/1995	Hail	1.75	0	0	$ -	$ -
Cuyahoga County	5/10/1995	Hail	0.75	0	0	$ -	$ -
Cuyahoga County	5/28/1995	Thunderstorm Wind	0	0	0	$ 250,000	$ -
Cuyahoga County	5/28/1995	Thunderstorm Wind	0	0	0	$ 400,000	$ -
Cleveland/ N Olmsted	6/21/1995	Hail	0.75	0	0	$ 2,000	$ -
Countywide	6/27/1995	Hail	0.75	0	0	$ 20,000	$ -
Countywide	7/13/1995	Thunderstorm Wind	0	0	0	$ 600,000	$ -
Countywide	7/15/1995	Thunderstorm Wind	0	0	0	$ 40,000	$ -
Countywide	7/15/1995	Hail	0	0	0	$ -	$ -
Chagrin Falls	7/15/1995	Thunderstorm Wind	0	0	0	$ 4,000	$ -
Brookpark	7/15/1995	Thunderstorm Wind	0	0	0	$ 150,000	$ -
Cleveland	7/16/1995	Thunderstorm Wind	0	0	0	$ 2,000	$ -
Chagrin Falls	8/1/1995	Thunderstorm Wind	0	0	0	$ 15,000	$ -
Bay Village Westlake	8/13/1995	Thunderstorm Wind	0	0	0	$ 12,000	$ -
North Olmsted	9/13/1995	Thunderstorm Wind	0	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Countywide	4/12/1996	Thunderstorm Wind	72	1	1	$ 1,000,000	$ -
Parma	4/20/1996	Hail	0.75	0	0	$ -	$ -
Strongsville	4/22/1996	Hail	1	0	0	$ -	$ -
Cleveland Heights	4/22/1996	Thunderstorm Wind	55	0	0	$ -	$ -
Cleveland	4/22/1996	Hail	0.75	0	0	$ -	$ -
Rocky River	6/4/1996	Hail	0.75	0	0	$ -	$ -
Parma	6/4/1996	Hail	0.75	0	0	$ -	$ -
North Olmsted	6/13/1996	Thunderstorm Wind	50	0	0	$ -	$ -
Garfield Heights	6/24/1996	Lightning		0	2	$ 15,000	$ -
Bedford Heights	6/24/1996	Hail	0.88	0	0	$ -	$ -
Independence	7/16/1996	Thunderstorm Wind		0	0	$ -	$ -
Cleveland	7/24/1996	Lightning		0	3	$ -	$ -
Euclid	8/15/1996	Lightning		0	0	$ 10,000	$ -
Solon	8/15/1996	Lightning		0	0	$ 5,000	$ -
Brecksville	8/15/1996	Thunderstorm Wind		0	0	$ 2,000	$ -
Cleveland	8/20/1996	Lightning		0	0	$ 10,000	$ -
Cleveland Area	8/20/1996	Hail	0.75	0	0	$ -	$ -
Cleveland	8/20/1996	Thunderstorm Wind		0	0	$ -	$ -
Cleveland Area	8/20/1996	Hail	0.75	0	0	$ -	$ -
Solon	8/20/1996	Thunderstorm Wind		0	0	$ 2,000	$ -
Cleveland	8/20/1996	Lightning		1	0	$ -	$ -
Cuyahoga County	8/22/1996	Thunderstorm Wind		0	0	$ 2,000	$ -
Cuyahoga County	9/7/1996	Heavy Rain		0	0	$ -	$ -
Northern Portion	9/12/1996	Thunderstorm Wind	55	0	0	$ -	$ -
Western Portion	11/7/1996	Thunderstorm Wind	66	0	0	$ -	$ -
Northern Half	12/1/1996	Thunderstorm Wind	52	0	0	$ 20,000	$ -
Garfield Heights	12/1/1996	Thunderstorm Wind	51	0	0	$ -	$ -
Hunting Valley	2/22/1997	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Countywide	5/1/1997	Heavy Rain		0	0	$ -	$ 34,480
Bay Vlg	5/19/1997	Thunderstorm Wind		0	0	$ 5,000	$ -
Countywide	8/16/1997	Thunderstorm Wind	54	0	0	$ 5,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cleveland	8/16/1997	Thunderstorm Wind		2	0	$ 75,000	$ -
Westlake	8/16/1997	Thunderstorm Wind		0	0	$ 5,000	$ -
Highland Hgts	8/16/1997	Thunderstorm Wind	50	0	0	$ -	$ -
Cleveland	8/16/1997	Hail	0.75	0	0	$ -	$ -
Lakewood	4/8/1998	Hail	0.88	0	0	$ -	$ -
Cleveland	4/8/1998	Hail	0.75	0	0	$ -	$ -
Solon	4/8/1998	Hail	0.88	0	0	$ -	$ -
Cleveland Hgts	4/8/1998	Hail	1.75	0	0	$ -	$ -
Gates Mills	4/8/1998	Hail	0.88	0	0	$ -	$ -
Cleveland Hgts	4/8/1998	Hail	0.75	0	0	$ -	$ -
Euclid	5/31/1998	Hail	0.88	0	0	$ -	$ -
Richmond Hgts	5/31/1998	Hail	1	0	0	$ -	$ -
Lyndhurst	5/31/1998	Lightning		0	0	$ 50,000	$ -
Mayfield Hgts	5/31/1998	Hail	0.88	0	0	$ -	$ -
Westlake	5/31/1998	Hail	0.75	0	0	$ -	$ -
Cleveland	5/31/1998	Hail	0.75	0	0	$ -	$ -
North Olmsted	5/31/1998	Hail	0.75	0	0	$ -	$ -
Lakewood	5/31/1998	Thunderstorm Wind		1	0	$ 10,000	$ -
Cleveland	5/31/1998	Thunderstorm Wind		0	0	$ 6,000	$ -
Bay Vlg	5/31/1998	Hail	0.75	0	0	$ -	$ -
Brooklyn	5/31/1998	Hail	0.75	0	0	$ -	$ -
Euclid	5/31/1998	Hail	0.75	0	0	$ -	$ -
Cleveland	5/31/1998	Hail	0.75	0	0	$ -	$ -
Cleveland	5/31/1998	Thunderstorm Wind		0	0	$ 5,000	$ -
Cleveland	6/2/1998	Hail	0.88	0	0	$ -	$ -
Solon	6/12/1998	Lightning		0	0	$ 25,000	$ -
Countywide	6/12/1998	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Garfield Hgts	6/13/1998	Thunderstorm Wind	55	0	0	$ -	$ -
Walton Hills	6/27/1998	Hail	0.75	0	0	$ -	$ -
North Royalton	6/27/1998	Hail	1.75	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Countywide	7/21/1998	Thunderstorm Wind	52	0	0	$ 100,000	$ -
Countywide	9/7/1998	Thunderstorm Wind		0	0	$ 15,000	$ -
Countywide	11/10/1998	Thunderstorm Wind	52	0	0	$ 75,000	$ -
Bedford	6/10/1999	Thunderstorm Wind		0	0	$ 5,000	$ -
Lakewood	6/12/1999	Hail	0.75	0	0	$ -	$ -
North Olmsted	7/6/1999	Thunderstorm Wind		0	0	$ 40,000	$ -
Garfield Hgts	7/6/1999	Thunderstorm Wind	50	0	0	$ -	$ -
Parma	7/6/1999	Hail	1	0	0	$ -	$ -
Warrensville Hgts	7/6/1999	Lightning		1	0	$ -	$ -
Countywide	7/9/1999	Thunderstorm Wind		0	0	$ 30,000	$ -
Bay Vlg	7/24/1999	Thunderstorm Wind		3	0	$ 2,000	$ -
Bedford	7/28/1999	Hail	0.75	0	0	$ -	$ -
Cleveland Lakefront	7/28/1999	Thunderstorm Wind		0	0	$ 25,000	$ -
Cleveland Lakefront	7/28/1999	Thunderstorm Wind	56	0	0	$ -	$ -
Cle Hopkins Intl Arp	7/31/1999	Thunderstorm Wind	59	0	0	$ 50,000	$ -
Countywide	7/31/1999	Thunderstorm Wind		0	0	$ 200,000	$ -
North Olmsted	10/13/1999	Hail	0.88	0	0	$ -	$ -
Cleveland	10/13/1999	Hail	0.75	0	0	$ -	$ -
Countywide	10/13/1999	Thunderstorm Wind		0	0	$ 20,000	$ -
Countywide	10/13/1999	Thunderstorm Wind		0	0	$ 75,000	$ -
North Olmsted	4/20/2000	Thunderstorm Wind		0	0	$ 15,000	$ -
Cleveland	5/23/2000	Thunderstorm Wind		0	0	$ 5,000	$ -
Rocky River	5/31/2000	Hail	0.75	0	0	$ -	$ -
North Olmsted	5/31/2000	Hail	0.75	0	0	$ -	$ -
Fairview Park	5/31/2000	Thunderstorm Wind		0	0	$ 10,000	$ -
Brecksville	6/2/2000	Thunderstorm Wind	59	0	0	$ -	$ -
Shaker Hgts	6/14/2000	Hail	1.75	0	0	$ -	$ -
Independence	6/29/2000	Hail	1	0	0	$ -	$ -
Seven Hills	6/29/2000	Hail	1	0	0	$ -	$ -
Valley View	6/29/2000	Hail	0.75	0	0	$ -	$ -
Bay Vlg	7/14/2000	Thunderstorm Wind	54	0	0	$ 5,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cleveland	7/21/2000	Thunderstorm Wind	51	0	0	$ -	$ -
Countywide	8/6/2000	Thunderstorm Wind		0	0	$ 15,000	$ -
Countywide	8/9/2000	Thunderstorm Wind		0	0	$ 25,000	$ -
Parma	9/15/2000	Hail	0.75	0	0	$ -	$ -
Countywide	10/4/2000	Thunderstorm Wind		0	0	$ 1,000,000	$ -
Countywide	10/4/2000	Thunderstorm Wind		0	0	$ 250,000	$ -
Garfield Hgts	10/4/2000	Thunderstorm Wind	51	0	0	$ -	$ -
Strongsville	6/2/2001	Hail	0.75	0	0	$ -	$ -
North Royalton	6/20/2001	Thunderstorm Wind		0	1	$ 500,000	$ -
North Royalton	6/20/2001	Hail	1.75	0	0	$ 40,000	$ -
Shaker Hgts	6/21/2001	Hail	0.75	0	0	$ -	$ -
Fairview Park	9/21/2001	Thunderstorm Wind		0	0	$ 10,000	$ -
Shaker Hgts	9/21/2001	Thunderstorm Wind		0	0	$ 5,000	$ -
Olmsted Falls	10/24/2001	Thunderstorm Wind		0	0	$ 5,000	$ -
Seven Hills	4/9/2002	Thunderstorm Wind		0	0	$ 500,000	$ -
Solon	4/15/2002	Hail	1	0	0	$ 10,000	$ -
Cleveland	5/25/2002	Thunderstorm Wind		0	0	$ 10,000	$ -
North Royalton	6/4/2002	Hail	0.75	0	0	$ 2,000	$ -
University Hgts	6/14/2002	Thunderstorm Wind		0	0	$ 5,000	$ -
Cleveland	6/21/2002	Thunderstorm Wind		0	0	$ 25,000	$ -
Cleveland	6/21/2002	Hail	0.75	0	0	$ 2,000	$ -
Valley View	6/21/2002	Hail	0.75	0	0	$ 5,000	$ -
Garfield Hgts	6/21/2002	Thunderstorm Wind		0	0	$ 15,000	$ -
Garfield Hgts	6/21/2002	Hail	0.75	0	0	$ 5,000	$ -
North Royalton	7/22/2002	Thunderstorm Wind		0	0	$ 5,000	$ -
Parma	7/22/2002	Thunderstorm Wind		0	0	$ 2,000	$ -
Solon	7/28/2002	Thunderstorm Wind		0	0	$ 30,000	$ -
Seven Hills	7/28/2002	Thunderstorm Wind		0	0	$ 5,000	$ -
Countywide	7/28/2002	Thunderstorm Wind		0	0	$ 35,000	$ -
Rocky River	7/29/2002	Thunderstorm Wind	52	0	0	$ -	$ -
Cleveland	7/29/2002	Thunderstorm Wind	50	0	0	$ -	$ -
North Olmsted	7/29/2002	Thunderstorm Wind		0	0	$ 5,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Parma	8/4/2002	Thunderstorm Wind		0	0	$ 5,000	$ -
Cleveland	8/14/2002	Thunderstorm Wind		0	0	$ 5,000	$ -
Parma	8/16/2002	Hail	0.75	0	0	$ -	$ -
North Royalton	9/3/2002	Thunderstorm Wind		0	0	$ 5,000	$ -
Solon	9/19/2002	Thunderstorm Wind		0	0	$ 25,000	$ -
Bedford	11/10/2002	Thunderstorm Wind		0	0	$ 15,000	$ -
Countywide	4/4/2003	Thunderstorm Wind	50	0	0	$ 20,000	$ -
Cleveland	5/6/2003	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Brooklyn	5/9/2003	Hail	0.75	0	0	$ -	$ -
Garfield Hgts	5/10/2003	Hail	0.75	0	0	$ -	$ -
Parma	5/10/2003	Thunderstorm Wind	50	0	0	$ 5,000	$ -
North Royalton	5/10/2003	Hail	1	0	0	$ 2,000	$ -
	5/11/2003	Strong Wind	44	0	0	$ 35,000	$ -
Cleveland	6/8/2003	Thunderstorm Wind	31	0	3	$ 5,000	$ -
North Olmsted	7/4/2003	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Westlake	7/6/2003	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Solon	7/6/2003	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Cle Hopkins Intl Arp	7/7/2003	Thunderstorm Wind	53	0	0	$ -	$ -
Countywide	7/7/2003	Thunderstorm Wind	50	0	0	$ 50,000	$ -
North Olmsted	7/7/2003	Hail	0.88	0	0	$ 2,000	$ -
Strongsville	7/7/2003	Hail	0.88	0	0	$ 4,000	$ -
Strongsville	7/7/2003	Hail	1	0	0	$ 2,000	$ -
Cle Hopkins Intl Arp	7/8/2003	Thunderstorm Wind	50	0	0	$ -	$ -
Countywide	7/8/2003	Thunderstorm Wind	50	0	0	$ 300,000	$ -
Cleveland	7/21/2003	Thunderstorm Wind	50	0	0	$ 20,000	$ -
Moreland Hills	8/4/2003	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Brecksville	8/27/2003	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Shaker Hgts	9/27/2003	Thunderstorm Wind	50	0	0	$ 8,000	$ -
	10/14/2003	Strong Wind	41	0	0	$ 15,000	$ -
Mayfield	4/19/2004	Hail	0.75	0	0	$ -	$ -
Berea	4/19/2004	Hail	0.75	0	0	$ -	$ -
Seven Hills	5/17/2004	Hail	1	0	0	$ 2,000	$ -
North Olmsted	5/17/2004	Hail	0.88	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Strongsville	5/17/2004	Hail	1	0	0	$ 5,000	$ -
Rocky River	5/17/2004	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Strongsville	5/17/2004	Hail	1	0	0	$ 5,000	$ -
Brecksville	5/17/2004	Hail	0.75	0	0	$ -	$ -
Brecksville	5/17/2004	Hail	0.75	0	0	$ -	$ -
Westlake	5/21/2004	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Bay Vlg	5/21/2004	Hail	0.75	0	0	$ -	$ -
Fairview	5/21/2004	Hail	1	0	0	$ 2,000	$ -
Countywide	5/21/2004	Thunderstorm Wind	70	0	0	$ 1,000,000	$ -
Cleveland	5/21/2004	Hail	1	0	0	$ 2,000	$ -
Rocky River	5/21/2004	Hail	0.88	0	0	$ -	$ -
Oakwood	5/21/2004	Hail	0.75	0	0	$ -	$ -
Lakewood	5/22/2004	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Cleveland Hgts	5/22/2004	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Strongsville	6/9/2004	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Lyndhurst	6/9/2004	Hail	0.75	0	0	$ -	$ -
Berea	6/13/2004	Thunderstorm Wind	50	0	0	$ 8,000	$ -
Countywide	6/14/2004	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Euclid	7/14/2004	Hail	0.75	0	0	$ -	$ -
East Cleveland	7/22/2004	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Brooklyn	8/28/2004	Lightning		0	1	$ -	$ -
	11/27/2004	Strong Wind	34	0	0	$ 10,000	$ -
Lakewood	4/20/2005	Hail	0.88	0	0	$ -	$ -
Bedford Hgts	5/13/2005	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Parma	6/5/2005	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Brecksville	6/29/2005	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Warrensville Hgts	6/30/2005	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Bedford	6/30/2005	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Garfield Hgts	7/13/2005	Thunderstorm Wind	50	0	0	$ 8,000	$ -
Lakewood	7/18/2005	Thunderstorm Wind	50	0	0	$ 10,000	$ -
(Bkl)Cleveland Lakef	7/26/2005	Thunderstorm Wind	59	0	0	$ -	$ -
(Bkl)Cleveland Lakef	7/26/2005	Thunderstorm Wind	65	0	0	$ 750,000	$ -
Cleveland	7/26/2005	Thunderstorm Wind	50	0	0	$ 4,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Brecksville	7/26/2005	Thunderstorm Wind	50	0	0	$ 8,000	$ -
Berea	8/20/2005	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Berea	8/20/2005	Hail	0.75	0	0	$ -	$ -
Cleveland Hgts	9/22/2005	Lightning		0	0	$ 80,000	$ -
Lyndhurst	9/22/2005	Thunderstorm Wind	50	0	0	$ 6,000	$ -
Westlake	11/6/2005	Thunderstorm Wind	50	0	0	$ 4,000	$ -
North Royalton	11/6/2005	Hail	0.75	0	0	$ -	$ -
	3/10/2006	Strong Wind	44	0	0	$ 20,000	$ -
Olmsted Falls	4/7/2006	Hail	0.75	0	0	$ -	$ -
Solon	4/12/2006	Hail	0.75	0	0	$ -	$ -
Lakewood	5/31/2006	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Bentleyville	5/31/2006	Hail	0.75	0	0	$ -	$ -
Cleveland	5/31/2006	Thunderstorm Wind	50	0	0	$ 6,000	$ -
Westlake	6/19/2006	Hail	0.75	0	0	$ -	$ -
Valley View	6/19/2006	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Westlake	6/19/2006	Hail	0.75	0	0	$ -	$ -
Westlake	6/21/2006	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Broadview Hgts	6/22/2006	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Brecksville	6/22/2006	Hail	0.75	0	0	$ -	$ -
Mayfield Hgts	6/28/2006	Hail	0.75	0	0	$ -	$ -
Bay Vlg	6/28/2006	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Cleveland Hgts	6/28/2006	Thunderstorm Wind	50	0	0	$ 6,000	$ -
Gates Mills	6/28/2006	Hail	0.75	0	0	$ -	$ -
North Olmsted	7/4/2006	Thunderstorm Wind	50	0	0	$ 6,000	$ -
East Cleveland	7/10/2006	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Brecksville	7/30/2006	Thunderstorm Wind	50	0	0	$ 2,000	$ -
East Cleveland	10/28/2006	Thunderstorm Wind	50	0	0	$ -	$ -
Linndale	10/28/2006	Hail	0.88	0	0	$ -	$ -
Walton Hills	5/1/2007	Hail	0.75	0	0	$ -	$ -
Shaker Hgts	5/25/2007	Hail	0.88	0	0	$ -	$ -
Bedford	6/4/2007	Hail	0.88	0	0	$ -	$ -
Chagrin Falls	6/19/2007	Thunderstorm Wind	50	0	0	$ 6,000	$ -
Chagrin Falls	6/19/2007	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Olmsted Falls	6/27/2007	Hail	0.88	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Olmsted Falls	6/27/2007	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Cleveland	7/19/2007	Thunderstorm Wind	50	0	0	$ 5,000	$ -
(Bkl)Cleveland Lakef	8/2/2007	Thunderstorm Wind	51	0	0	$ -	$ -
(Bkl)Cleveland Lakef	8/2/2007	Thunderstorm Wind	51	0	0	$ -	$ -
(Bkl)Cleveland Lakef	8/2/2007	Hail	1	0	0	$ 30,000	$ -
Cleveland	8/7/2007	Thunderstorm Wind	50	0	0	$ 6,000	$ -
North Royalton	8/7/2007	Thunderstorm Wind	50	0	0	$ 15,000	$ -
(Bkl)Cleveland Lakef	1/9/2008	Thunderstorm Wind	50	0	0	$ -	$ -
Cleveland	5/31/2008	Thunderstorm Wind	50	0	0	$ 40,000	$ -
Olmsted Falls	6/9/2008	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Cleveland	6/9/2008	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Berea	6/13/2008	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Berea	6/21/2008	Hail	0.88	0	0	$ -	$ -
Cleveland	6/21/2008	Hail	0.75	0	0	$ -	$ -
Bedford	6/21/2008	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Strongsville	6/22/2008	Hail	1.25	0	0	$ 25,000	$ -
Strongsville	6/22/2008	Hail	0.88	0	0	$ -	$ -
Strongsville	6/22/2008	Hail	1.75	0	0	$ 50,000	$ -
Strongsville	6/22/2008	Hail	1.75	0	0	$ 50,000	$ -
North Royalton	6/22/2008	Hail	0.88	0	0	$ -	$ -
Seven Hills	6/22/2008	Hail	0.75	0	0	$ -	$ -
Parma	6/22/2008	Hail	1	0	0	$ -	$ -
Cleveland	6/22/2008	Hail	0.88	0	0	$ -	$ -
North Olmsted	6/22/2008	Hail	0.88	0	0	$ -	$ -
Cleveland	6/22/2008	Hail	1	0	0	$ -	$ -
Olmsted Falls	7/8/2008	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Cleveland	7/8/2008	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Cle Hopkins Intl Arp	8/7/2008	Hail	0.75	0	0	$ -	$ -
North Olmsted	8/7/2008	Hail	0.88	0	0	$ -	$ -
Middleburgh Hgts	8/7/2008	Hail	0.75	0	0	$ -	$ -
Cleveland	8/7/2008	Hail	0.88	0	0	$ -	$ -
Strongsville	8/7/2008	Hail	0.88	0	0	$ -	$ -
North Royalton	8/7/2008	Hail	1	0	0	$ -	$ -
Cleveland	8/7/2008	Hail	0.75	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
(Cle)Hopkins Intl Ar	12/28/2008	Thunderstorm Wind	50	0	0	$ -	$ -
(Cle)Hopkins Intl Ar	2/11/2009	Thunderstorm Wind	58	0	0	$ -	$ -
Westlake	5/27/2009	Thunderstorm Wind	50	0	0	$ 1,000	$ -
North Olmsted	5/27/2009	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Olmstead Falls Arpt	6/1/2009	Hail	1	0	0	$ -	$ -
Fairview Park	6/25/2009	Thunderstorm Wind	50	0	0	$ -	$ -
Westlake	6/25/2009	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Cle Hopkins Intl Arp	6/25/2009	Thunderstorm Wind	54	0	0	$ -	$ -
Rocky River	6/25/2009	Thunderstorm Wind	55	0	0	$ 30,000	$ -
Garfield Hgts	6/25/2009	Hail	0.75	0	0	$ -	$ -
Westlake	6/25/2009	Hail	0.75	0	0	$ -	$ -
Strongsville	7/17/2009	Hail	0.75	0	0	$ 50,000	$ -
(Bkl)Cleveland Lakef	8/10/2009	Thunderstorm Wind	63	0	0	$ -	$ -
Cleveland Hgts	8/10/2009	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Shaker Hgts	8/10/2009	Thunderstorm Wind	50	0	0	$ 150,000	$ -
Newburgh Hgts	8/10/2009	Hail	1.75	0	0	$ 25,000	$ -
Shaker Hgts	8/10/2009	Hail	0.75	0	0	$ -	$ -
Independence	8/20/2009	Thunderstorm Wind	50	0	0	$ 4,000	$ -
	10/7/2009	Strong Wind	46	0	0	$ 100,000	$ -
Solon	3/22/2010	Hail	0.75	0	0	$ -	$ -
Bay Vlg	5/7/2010	Hail	1.75	0	0	$ 125,000	$ -
Rocky River	5/7/2010	Hail	2.5	0	0	$ 250,000	$ -
Lakeshore	5/7/2010	Hail	1	0	0	$ -	$ -
Bay Vlg	5/7/2010	Thunderstorm Wind	65	0	0	$ 6,500,000	$ -
Bay Vlg	5/7/2010	Hail	1.25	0	0	$ 20,000	$ -
Cleveland	5/7/2010	Hail	0.75	0	0	$ -	$ -
Highland Hgts	5/7/2010	Hail	1	0	0	$ -	$ -
Cleveland	5/7/2010	Hail	1.75	0	0	$ 75,000	$ -
Euclid	5/7/2010	Hail	1	0	0	$ -	$ -
Lakewood	5/7/2010	Hail	1.75	0	0	$ 50,000	$ -
Garfield Hgts	5/7/2010	Hail	0.75	0	0	$ -	$ -
Gates Mills	5/7/2010	Hail	0.88	0	0	$ -	$ -
Cleveland	5/7/2010	Hail	1.75	0	0	$ 50,000	$ -
South Euclid	5/7/2010	Hail	1	0	0	$ -	$ -
Solon	5/7/2010	Hail	1	0	0	$ -	$ -
Brecksville	5/7/2010	Thunderstorm Wind	50	0	0	$ 1,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Strongsville	5/14/2010	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Westlake	6/6/2010	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Fairview Park	6/27/2010	Thunderstorm Wind	50	0	0	$ 1,000	$ -
North Olmsted	6/27/2010	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Parma	6/27/2010	Thunderstorm Wind	56	0	0	$ 25,000	$ -
Seven Hills	6/27/2010	Thunderstorm Wind	56	0	0	$ 2,000	$ -
Maple Hgts	6/27/2010	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Broadview Hgts	6/27/2010	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Walton Hills	6/27/2010	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Westlake	7/23/2010	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Bay Vlg	7/23/2010	Thunderstorm Wind	50	0	0	$ -	$ -
Westlake	7/23/2010	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Bay Vlg	7/28/2010	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Fairview Park	7/28/2010	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Lakewood	7/28/2010	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Parma	9/7/2010	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Cleveland	9/7/2010	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Shaker Hgts	9/7/2010	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Cleveland	9/7/2010	Hail	0.75	0	0	$ -	$ -
Cleveland	9/7/2010	Hail	1.25	0	0	$ 15,000	$ -
Beachwood	9/7/2010	Hail	1	0	0	$ 10,000	$ -
Garfield Hgts	3/23/2011	Hail	0.25	0	0	$ 1,000	$ -
Mayfield Hgts	4/4/2011	Hail	0.25	0	0	$ 1,000	$ -
(Cle)Hopkins Intl Ar	4/4/2011	Thunderstorm Wind	50	0	0	$ 20,000	$ -
North Olmsted	4/16/2011	Hail	0.88	0	0	$ 5,000	$ -
Mayfield	4/20/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Euclid	4/20/2011	Hail	1	0	0	$ -	$ -
(Cgf)Cuyahoga Co Arp	4/27/2011	Thunderstorm Wind	51	0	0	$ -	$ -
Solon	4/27/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Cleveland	5/12/2011	Hail	1	0	0	$ 10,000	$ -
North Olmsted	5/23/2011	Thunderstorm Wind	50	0	0	$ 500,000	$ -
Parma	5/23/2011	Thunderstorm Wind	50	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Olmsted Falls	5/23/2011	Hail	1.75	0	0	$ 90,000	$ -
Parma	5/23/2011	Hail	1	0	0	$ -	$ -
Parma	5/23/2011	Hail	1.25	0	0	$ 20,000	$ -
Middleburgh Hgts	5/23/2011	Hail	1.75	0	0	$ 90,000	$ -
North Royalton	5/23/2011	Hail	1	0	0	$ -	$ -
North Olmsted	5/25/2011	Hail	1	0	0	$ -	$ -
Westlake	5/25/2011	Hail	1	0	0	$ -	$ -
Lakewood	5/25/2011	Hail	1	0	0	$ -	$ -
Olmsted Falls	5/29/2011	Thunderstorm Wind	50	0	0	$ 20,000	$ -
Middleburgh Hgts	5/29/2011	Thunderstorm Wind	50	0	0	$ 100,000	$ -
Brecksville	5/29/2011	Hail	1	0	0	$ -	$ -
Solon	6/7/2011	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Cuyahoga Hgts	6/7/2011	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Fairview Park	6/21/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Westlake	6/21/2011	Hail	0.88	0	0	$ -	$ -
North Royalton	6/21/2011	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Cleveland	7/2/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
North Royalton	7/18/2011	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Cleveland	7/22/2011	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Middleburgh Hgts	7/22/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Brecksville	7/22/2011	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Cleveland	7/23/2011	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Cleveland	8/1/2011	Hail	1	0	0	$ -	$ -
Euclid	8/1/2011	Hail	1	0	0	$ -	$ -
Euclid	8/1/2011	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Highland Hgts	8/1/2011	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Richmond Hgts	8/1/2011	Hail	1	0	0	$ -	$ -
Mayfield	8/1/2011	Hail	0.88	0	0	$ -	$ -
Mayfield Hgts	8/1/2011	Hail	1	0	0	$ -	$ -
Pepper Pike	8/1/2011	Hail	0.75	0	0	$ -	$ -
Cleveland	8/1/2011	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Pepper Pike	8/1/2011	Hail	1	0	0	$ -	$ -
Moreland Hills	8/1/2011	Hail	1	0	0	$ -	$ -
Chagrin Falls	8/1/2011	Hail	0.75	0	0	$ -	$ -
Cleveland	8/9/2011	Hail	0.88	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cleveland	8/9/2011	Hail	1	0	0	$ -	$ -
Independence	8/9/2011	Hail	0.88	0	0	$ -	$ -
Cleveland	8/9/2011	Hail	1	0	0	$ -	$ -
Seven Hills	8/9/2011	Hail	1	0	0	$ -	$ -
Cleveland	8/18/2011	Hail	0.75	0	0	$ -	$ -
Mayfield Hgts	8/18/2011	Hail	0.75	0	0	$ -	$ -
Cleveland Hgts	8/18/2011	Hail	1	0	0	$ -	$ -
Cleveland	8/24/2011	Thunderstorm Wind	50	0	0	$ 50,000	$ -
Bratenahl	8/25/2011	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Brooklyn	8/25/2011	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Mayfield Hgts	9/1/2011	Hail	0.75	0	0	$ -	$ -
Bay Vlg	11/14/2011	Hail	0.88	0	0	$ -	$ -
Westlake	11/14/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Fairview	11/14/2011	Thunderstorm Wind	50	0	0	$ 1,000	$ -
South Euclid	1/17/2012	Thunderstorm Wind	50	0	0	$ -	$ -
Cleveland	3/15/2012	Hail	0.75	0	0	$ -	$ -
Bay Vlg	7/3/2012	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Bay Vlg	7/5/2012	Thunderstorm Wind	50	0	0	$ 75,000	$ -
Shaker Hgts	7/26/2012	Thunderstorm Wind	50	0	0	$ 8,000	$ -
Olmsted Falls	4/8/2013	Hail	1	0	0	$ 1,000	$ -
Lakeshore	5/10/2013	Hail	1	0	0	$ -	$ -
Lakeshore	5/10/2013	Hail	1.75	0	0	$ 25,000	$ -
South Euclid	5/10/2013	Hail	1	0	0	$ -	$ -
Lyndhurst	5/10/2013	Hail	0.75	0	0	$ -	$ -
Fairview Park	5/10/2013	Thunderstorm Wind	50	0	0	$ 25,000	$ -
North Olmsted	5/10/2013	Thunderstorm Wind	50	0	0	$ -	$ -
Westlake	5/10/2013	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Bay Vlg	5/31/2013	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Cleveland	5/31/2013	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Parma	6/13/2013	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Westlake	6/25/2013	Thunderstorm Wind	56	0	0	$ 150,000	$ -
Lakewood	6/25/2013	Thunderstorm Wind	50	0	0	$ 20,000	$ -
South Park	6/25/2013	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Solon	6/25/2013	Thunderstorm Wind	50	0	0	$ 2,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
North Royalton	6/25/2013	Hail	0.75	0	0	$ -	$ -
Garfield Hgts	7/10/2013	Hail	1	0	0	$ -	$ -
Warrensville Hgts	7/10/2013	Hail	1	0	0	$ -	$ -
Pepper Pike	7/10/2013	Hail	1	0	0	$ -	$ -
North Randall	7/10/2013	Hail	1	0	0	$ -	$ -
Beachwood	7/10/2013	Hail	1	0	0	$ -	$ -
North Randall	7/10/2013	Hail	1	0	0	$ -	$ -
North Randall	7/10/2013	Thunderstorm Wind	50	0	0	$ -	$ -
(Bkl)Cleveland Lakef	7/10/2013	Thunderstorm Wind	56	0	0	$ 100,000	$ -
Rocky River	7/10/2013	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Willowick	7/10/2013	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Lakeshore	7/23/2013	Hail	1	0	0	$ 5,000	$ -
South Euclid	7/23/2013	Hail	1	0	0	$ 4,000	$ -
Bedford Hgts	7/23/2013	Hail	1	0	0	$ 2,000	$ -
Bedford Hgts	7/23/2013	Hail	0.75	0	0	$ -	$ -
Euclid	9/12/2013	Hail	0.75	0	0	$ -	$ -
Middleburgh Hgts	10/6/2013	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Moreland Hills	11/1/2013	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Richmond Hgts	5/14/2014	Hail	1	0	0	$ -	$ -
Richmond Hgts	6/17/2014	Hail	1	0	0	$ 10,000	$ -
University Hgts	6/18/2014	Hail	0.88	0	0	$ -	$ -
Pepper Pike	6/18/2014	Thunderstorm Wind	50	0	0	$ -	$ -
Pepper Pike	6/18/2014	Hail	0.75	0	0	$ -	$ -
Lyndhurst	6/18/2014	Thunderstorm Wind	50	0	0	$ 40,000	$ -
Mayfield	6/18/2014	Thunderstorm Wind	50	0	0	$ 100,000	$ -
Mayfield	6/18/2014	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Parma	6/24/2014	Hail	0.88	0	0	$ -	$ -
Woodmere	6/24/2014	Hail	0.88	0	0	$ -	$ -
North Royalton	7/8/2014	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Lakewood	7/27/2014	Thunderstorm Wind	50	0	0	$ 20,000	$ -
Lyndhurst	7/27/2014	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Lakewood	8/19/2014	Thunderstorm Wind	50	0	0	$ 100,000	$ -
Lakewood	12/24/2014	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Solon	5/11/2015	Thunderstorm Wind	50	0	0	$ 15,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Bay Vlg	5/27/2015	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Parma	5/30/2015	Thunderstorm Wind	50	0	0	$ 35,000	$ -
Linndale	5/30/2015	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Lakeshore	5/30/2015	Hail	0.75	0	0	$ -	$ -
Jaite	5/30/2015	Hail	0.75	0	0	$ -	$ -
Brooklyn Hgts	5/30/2015	Thunderstorm Wind	50	0	0	$ 70,000	$ -
Garfield Hgts	5/30/2015	Hail	1	0	0	$ 10,000	$ -
Cleveland	6/23/2015	Thunderstorm Wind	50	0	0	$ 64,000	$ -
Chagrin Falls	7/14/2015	Thunderstorm Wind	50	0	0	$ 20,000	$ -
Strongsville	9/1/2015	Thunderstorm Wind	50	0	0	$ 4,000	$ -
Westlake	5/29/2016	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Solon	7/13/2016	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Lakeshore	7/18/2016	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Cuyahoga Hgts	8/9/2016	Thunderstorm Wind	50	0	0	$ 12,000	$ -
East Cleveland	8/9/2016	Thunderstorm Wind	50	0	0	$ 25,000	$ -
Fairview	8/11/2016	Thunderstorm Wind	61	0	0	$ 60,000	$ -
Eagle Cliff	8/11/2016	Thunderstorm Wind	50	0	0	$ 5,000	$ -
North Olmsted	9/10/2016	Thunderstorm Wind	50	0	0	$ 200,000	$ -
(Cle)Hopkins Intl Ar	3/1/2017	Thunderstorm Wind	53	0	0	$ -	$ -
Seven Hills	3/1/2017	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Lakeshore	3/1/2017	Thunderstorm Wind	50	0	0	$ 75,000	$ -
Shaker Hgts	3/1/2017	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Parma	3/30/2017	Hail	1	0	0	$ -	$ -
Brooklyn	3/30/2017	Hail	1.25	0	0	$ -	$ -
(Bkl)Cleveland Lakef	3/30/2017	Hail	0.75	0	0	$ -	$ -
Seven Hills	5/28/2017	Hail	1	0	0	$ -	$ -
Berea	5/28/2017	Hail	0.88	0	0	$ -	$ -
Parma Hgts	5/29/2017	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Independence	5/29/2017	Thunderstorm Wind	50	0	0	$ -	$ -
Garfield Hgts	6/18/2017	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Bay Vlg	6/19/2017	Thunderstorm Wind	50	0	0	$ 10,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Parma	7/7/2017	Thunderstorm Wind	52	0	0	$ -	$ -
North Royalton	7/7/2017	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Shaker Hgts	8/11/2017	Hail	0.88	0	0	$ -	$ -
Strongsville Arpt	11/5/2017	Thunderstorm Wind	74	0	0	$ 1,250,000	$ -
Parma Hgts	5/22/2018	Hail	0.75	0	0	$ -	$ -
North Royalton	5/22/2018	Thunderstorm Wind	50	0	0	$ 20,000	$ -
North Royalton	5/22/2018	Hail	1	0	0	$ -	$ -
North Royalton	5/22/2018	Hail	1	0	0	$ -	$ -
Broadview Hgts	5/22/2018	Hail	1.25	0	0	$ -	$ -
Fairview	7/5/2018	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Cleveland	7/5/2018	Thunderstorm Wind	50	0	0	$ 5,000	$ -
Strongsville	7/23/2018	Thunderstorm Wind	50	0	0	$ 40,000	$ -
Westlake	7/26/2018	Hail	0.75	0	0	$ -	$ -
Mayfield	8/6/2018	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Gates Mills	8/6/2018	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Hunting Vly	8/6/2018	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Linndale	8/6/2018	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Brook Park	8/6/2018	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Bay Vlg	8/7/2018	Thunderstorm Wind	50	0	0	$ 2,000	$ -
(Cgf)Cuyahoga Co Arp	8/7/2018	Thunderstorm Wind	50	0	0	$ -	$ -
Rocky River	9/5/2018	Thunderstorm Wind	50	0	0	$ 20,000	$ -
Brooklyn Hgts	9/5/2018	Thunderstorm Wind	50	0	0	$ 10,000	$ -
Brooklyn Hgts	9/5/2018	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Euclid	9/5/2018	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Strongsville	9/20/2018	Hail	0.75	0	0	$ -	$ -
Strongsville	9/20/2018	Thunderstorm Wind	50	0	0	$ 1,000	$ -
North Royalton	9/20/2018	Thunderstorm Wind	50	0	0	$ 1,000	$ -
Lakewood	9/21/2018	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Fairview Park	9/21/2018	Thunderstorm Wind	50	0	0	$ 2,000	$ -
Lakewood	9/21/2018	Thunderstorm Wind	50	0	0	$ 15,000	$ -
Bratenahl	9/21/2018	Thunderstorm Wind	50	0	0	$ 1,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
East Cleveland	9/21/2018	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Westlake	10/20/2018	Thunderstorm Wind	52	0	0	$ 50,000	$ -
Brook Park	10/20/2018	Thunderstorm Wind	50	0	0	$ -	$ -
	12/31/2018	Strong Wind	48	0	0	$ 25,000	$ -
	1/1/2019	Strong Wind	48	0	0	$ 25,000	$ -
(Cgf)Cuyahoga Co Arp	1/8/2019	Hail	1.25	0	0	$ -	$ -
Middleburgh Hgts	1/8/2019	Hail	0.75	0	0	$ -	$ -
Beachwood	1/8/2019	Hail	0.75	0	0	$ -	$ -
Strongsville Arpt	1/8/2019	Hail	1	0	0	$ -	$ -
Beachwood	1/8/2019	Hail	0.75	0	0	$ -	$ -
(Cgf)Cuyahoga Co Arp	1/8/2019	Hail	1.25	0	0	$ -	$ -
Lyndhurst	5/23/2019	Thunderstorm Wind	52	0	0	$ -	$ -
(Cgf)Cuyahoga Co Arp	5/23/2019	Thunderstorm Wind	55	0	0	$ -	$ -
Berea	5/23/2019	Thunderstorm Wind	56	0	0	$ 10,000	$ -
North Royalton	5/30/2019	Thunderstorm Wind	52	0	0	$ -	$ -
(Bkl)Cleveland Lakef	6/28/2019	Thunderstorm Wind	59	0	0	$ -	$ -
Lakewood	7/15/2019	Thunderstorm Wind	52	0	0	$ -	$ -
Cleveland	8/6/2019	Thunderstorm Wind	52	0	0	$ 1,000	$ -
Pepper Pike	8/6/2019	Thunderstorm Wind	56	0	0	$ -	$ -
Woodmere	8/6/2019	Thunderstorm Wind	52	0	0	$ -	$ -
Seven Hills	8/15/2019	Thunderstorm Wind	54	0	0	$ -	$ -
Westlake	8/18/2019	Thunderstorm Wind	52	0	0	$ 1,000	$ -
Fairview Park	8/18/2019	Thunderstorm Wind	52	0	0	$ 1,000	$ -
Parma	8/18/2019	Thunderstorm Wind	52	0	0	$ 5,000	$ -
Cleveland	8/18/2019	Thunderstorm Wind	52	0	0	$ 1,000	$ -
East Cleveland	8/18/2019	Thunderstorm Wind	52	0	0	$ -	$ -
Shaker Hgts	9/13/2019	Thunderstorm Wind	52	0	0	$ 10,000	$ -
Lyndhurst	9/13/2019	Thunderstorm Wind	52	0	0	$ 10,000	$ -
Lyndhurst	9/13/2019	Thunderstorm Wind	70	0	0	$ 100,000	$ -
Pepper Pike	9/13/2019	Thunderstorm Wind	52	0	0	$ 10,000	$ -
Lyndhurst	9/13/2019	Thunderstorm Wind	52	0	0	$ 1,000	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Mayfield	9/13/2019	Thunderstorm Wind	52	0	0	$ 10,000	$ -
Mayfield	9/13/2019	Thunderstorm Wind	52	0	0	$ -	$ -
East Cleveland	9/13/2019	Thunderstorm Wind	52	0	0	$ -	$ -
Shaker Hgts	9/13/2019	Thunderstorm Wind	52	0	0	$ 5,000	$ -
Linndale	4/7/2020	Hail	0.75	0	0	$ -	$ -
Newburgh Hgts	4/7/2020	Hail	2	0	0	$ -	$ -
Moreland Hills	4/7/2020	Thunderstorm Wind	55	0	0	$ -	$ -
Westlake	6/10/2020	Thunderstorm Wind	50	0	0	$ 3,000	$ -
East Cleveland	6/10/2020	Thunderstorm Wind	50	0	0	$ 3,000	$ -
Seven Hills	6/18/2020	Thunderstorm Wind	61	0	0	$ 115,000	$ -
Bay Vlg	6/26/2020	Thunderstorm Wind	50	0	0	$ -	$ -
Bedford	6/26/2020	Thunderstorm Wind	50	0	0	$ -	$ -
(Bkl)Cleveland Lakef	7/19/2020	Thunderstorm Wind	56	0	0	$ -	$ -
Broadview Hgts	9/7/2020	Thunderstorm Wind	50	0	0	$ -	$ -
Alexanders	10/23/2020	Hail	1	0	0	$ -	$ -
Fairview Park	10/23/2020	Thunderstorm Wind	50	0	0	$ -	$ -
Fairview Park	10/23/2020	Hail	1	0	0	$ -	$ -
Lakewood	10/23/2020	Hail	1	0	0	$ -	$ -
Cleveland Hgts	10/23/2020	Thunderstorm Wind	50	0	0	$ -	$ -
University Hgts	10/23/2020	Thunderstorm Wind	50	0	0	$ -	$ -
Highland Hgts	10/23/2020	Thunderstorm Wind	50	0	0	$ -	$ -
North Olmsted	11/15/2020	Thunderstorm Wind	60	0	0	$ -	$ -
Westlake	11/15/2020	Thunderstorm Wind	60	0	0	$ -	$ -
Fairview	11/15/2020	Thunderstorm Wind	60	0	0	$ -	$ -
(Cle)Hopkins Intl Ar	11/15/2020	Thunderstorm Wind	62	0	0	$ -	$ -
(Bkl)Cleveland Lakef	11/15/2020	Thunderstorm Wind	60	0	0	$ -	$ -
(Bkl)Cleveland Lakef	11/15/2020	Thunderstorm Wind	55	0	0	$ -	$ -
Parma Hgts	11/15/2020	Thunderstorm Wind	60	0	0	$ -	$ -
Broadview Hgts	11/15/2020	Thunderstorm Wind	55	0	0	$ -	$ -
Garfield Hgts	11/15/2020	Thunderstorm Wind	56	0	0	$ -	$ -
Shaker Hgts	11/15/2020	Thunderstorm Wind	60	0	0	$ -	$ -

Location	Date	Event	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Parma	3/26/2021	Thunderstorm Wind	50	0	0	$ -	$ -
Grand Total	-	-	-	14	17	$ 30,964,000	$ 34,480

TABLE 13 TORNADO EVENTS IN CUYAHOGA COUNTY, JANUARY 1, 1950-MARCH 31, 2021

Location	Date	Magnitude	Deaths	Injuries	Property Damage	Crop Damage
Cuyahoga County	6/22/1951	F2	0	0	$ 2,500,000	$ -
Cuyahoga County	5/24/1952	F1	0	0	$ 25,000	$ -
Cuyahoga County	6/8/1953	F4	6	300	$ -	$ -
Cuyahoga County	8/20/1962	F2	4	20	$ 2,500,000	$ -
Cuyahoga County	4/11/1965	F4	1	100	$ 25,000,000	$ -
Cuyahoga County	9/29/1966	F3	0	20	$ 2,500,000	$ -
Cuyahoga County	7/15/1970	F2	0	1	$ 250,000	$ -
Cuyahoga County	5/8/1973	F0	0	0	$ 2,500	$ -
Cuyahoga County	4/2/1977	F1	0	0	$ 2,500,000	$ -
Cuyahoga County	5/2/1983	F3	1	25	$ 25,000,000	$ -
Cuyahoga County	3/31/1985	F0	0	0	$ 250,000	$ -
Cuyahoga County	7/12/1992	F0	0	0	$ 250,000	$ -
Valley View	7/28/1999	F1	0	0	$ 175,000	$ -
Solon	11/10/2002	F1	0	0	$ 6,800,000	$ -
Lyndhurst	7/20/2013	EF1	0	0	$ 350,000	$ -
Oakwood	6/16/2019	EF1	0	0	$ 10,000	$ -
Grand Total	-	-	**12**	**466**	**$ 68,112,000**	**$ 0**

Appendix C. National Park Service's National Register of Historic Places in Cuyahoga County

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
12000391	Adams Bag Company Paper Mill and Sack Factory	Chagrin Falls	218 Cleveland St.	7/3/2012	Industry; Commerce	Building
75001368	Adams, John And Maria, House	Olmsted Falls	Address Restricted	10/10/1975	Social History; Architecture	Building
73001405	Adelbert Hall, Case Western Reserve University	Cleveland	Case Western Reserve University campus	10/30/1973	Education; Architecture	Building
79001805	Alcazar Hotel	Cleveland Heights	Surrey and Derbyshire Rds.	4/17/1979	Art; Architecture; Social History	Building
78002033	Aldrich, Aaron, House	Bay Village	30663 Lake Rd.	12/4/1978	Architecture; Social History	Building
82001365	Allen Memorial Medical Library	Cleveland	11000 Euclid Ave.	11/30/1982	Architecture	Building
05001143	Alta Public Library	Cleveland	12510 Mayfield Rd.	10/4/2005	Social History; Education; Entertainment/ Recreation	Building
02000883	Ambler Heights Historic District	Cleveland Heights	Roughly bounded by Martin Luther King, Jr. Blvd., Cedar Clen, N. Park Blvd., and along Harcourt Dr.	8/22/2002	Architecture; Community Planning and Development	District
92000174	Annis, John M., House	North Royalton	9271 State Rd.	3/19/1992	Architecture	Building
08000589	Ansel Road Apartment Buildings Historic District	Cleveland	1588 Ansel Rd to 9501 Wade Park Ave	7/2/2008	Architecture; Social History	District
87000428	Archwood Avenue Historic District	Cleveland	Archwood Ave. roughly bounded by W. Thirty-first Pl. and W. Thirty-seventh St.	3/19/1987	Architecture	District
94000416	Archwood Congregational Church	Cleveland	2800 Archwood Ave.	5/13/1994	Architecture	Building
100002875	Astrup Company Building, The	Cleveland	2397 W 25th St.	8/31/2018	Commerce; Industry	Building
07000071	Baker Motor Vehicle Company Building	Cleveland	7100-7122 Euclid Ave.	2/21/2007	Commerce; Invention	Building
12001210	Baldwin-Wallace College North Campus Historic District	Berea	Bounded by Bagley & E. 5th Aves., Front & Beech Sts.	1/23/2013	Architecture; Education	District
10000315	Baldwin-Wallace College South Campus Historic District	Berea	Seminary St between School and Church Front to Beach, variable W/E boundary	6/7/2010	Education; Religion; Architecture	District
74001428	Bay View Hospital	Bay Village	23200 Lake Rd.	8/27/1974	Engineering; Architecture; Social History	Building
04000712	Bedford Historic District	Bedford	Roughly bounded by Willis St., Franklin St., Broadway Ave., and columbus Rd.	7/14/2004	Architecture; Commerce; Transportation	District
02001455	Bedford Township Hall	Bedford	30 South Park St.	5/27/1975		BUILDING
84002910	Beehive School	Cleveland	4345 Lee Rd.	4/5/1984	Education	Building

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
86002878	Bell, Dr. James, House	Cleveland	1822 E. Eighty-ninth St.	10/16/1986	Architecture	Building
84000220	Benedict, Sarah, House	Cleveland	3751 Prospect Ave.	11/1/1984	Architecture	Building
75001355	Berea District 7 School	Berea	323 E. Bagley Rd.	4/3/1975	Architecture	Building
80002976	Berea Union Depot	Berea	30 Depot St.	11/21/1980	Transportation; Architecture	Building
73001406	Bingham Company Warehouse	Cleveland	1278 W. 9th St.	11/2/1973	Commerce; Architecture	Building
07000634	Birdtown Historic District	Lakewood	Roughly bounded by Magee Rd., Plover Rd., Halstead Rd., and Madison Ave.	6/27/2007	European; Architecture; Industry	District
01001523	Black, H., and Company Building	Cleveland	1900-2000 or 2010 Superior Ave.	1/24/2002	Architecture; Industry	Building
87001543	Blossom, Elizabeth B., Subdivision Historic District	Beachwood	Jct. of Richmond and Cedar Rds.	9/22/1987	Landscape Architecture; Social History	District
04000059	Blossom, Elzabeth B. and Dudley S., Estate Service Compound	Lyndhurst	24449 Cedar Rd.	2/20/2004	Architecture	Building
98001178	Body Block	Cleveland	4925-4955 Payne Ave.,1692-1696 E. 55th St.	9/18/1998	Architecture	Building
75001359	Bohemian National Hall	Cleveland	4939 Broadway St.	5/28/1975	European; Architecture; Social History	Building
84002911	Bolton, Chester and Frances, House	Lyndhurst	Address Restricted	3/29/1984	Politics/Government; Architecture; Social History	Building
87000441	Bomante House	Cleveland	3000 Mapledale Ave.	3/19/1987	Architecture	Building
73001404	Brecksville Town Hall	Brecksville	Public Sq.	7/2/1973	Architecture	Building
92000988	Brecksville Trailside Museum	Brecksville	Chippewa Cr. Dr. SE of jct. with OH 82	8/14/1992	Conservation; Architecture	Building
88001860	Broadway Avenue Historic District	Cleveland	Broadway and Hamlet Aves. and E. Fifty-fifth St.	10/19/1988	European; Architecture	District
84002912	Brooklyn Bank Building	Cleveland	3764 W. 25th St.	7/19/1984	Architecture	Building
99000238	Brooklyn Centre Historic District	Cleveland	Roughly bounded by I-71, Pearl Rd., and Big Creek Valley	3/4/1999	Architecture; Community Planning And Development; Exploration/Settlement	District
76001389	Brown, John Hartness, House	Cleveland Heights	2380 Overlook Rd.	11/7/1976	Community Planning And Development; Architecture	Building
05001576	Brownell School and Annex	Cleveland	1300-1360 Sumner St.	2/1/2006	Education	Building
100002120	Bruce-Macbeth Engine Company	Cleveland	2111 Center St.	2/14/2018	Industry; Invention	Building
14001051	Bryant Building	Cleveland	1261 Superior Ave.	12/11/2014	Commerce	Building
76001388	Buehl House	Berea	118 E. Bridge St.	4/30/1976	Industry; Architecture	Building
100001438	Building at 3101 Euclid Avenue	Cleveland	3101 Euclid Ave.	8/7/2017	Architecture; Community	Building

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
					Planning And Development	
74001434	Burdick, Harold B., House	Cleveland Heights	2424 Stratford Rd.	9/17/1974	Architecture	Building
79000286	Burt, William, House	Brecksville	9525 Brecksville Rd.	3/22/1979	Exploration/Settlement; Architecture	Building
12001211	Carroll, John, University North Quad Historic District	University Heights	1 John Carroll Blvd.	1/23/2013	Community Planning And Development; Education	District
73001407	Caxton Building	Cleveland	812 Huron Rd., SE.	10/30/1973	Commerce; Architecture; Communications	Building
94000594	Cedar Glen Apartments	Cleveland	11424--11432 Cedar Glen Pkwy.	6/17/1994	Architecture	Building
84000221	Central YMCA	Cleveland	2200 Prospect Ave.	11/1/1984	Architecture	Building
84000128	Cermak Building	Cleveland	3503 E. 93rd St.	10/18/1984	Community Planning And Development; Commerce	Building
13000387	Chagrin Falls East Side Historic District	Chagrin Falls	E. Washington & Philomethian Sts.	6/14/2013	Architecture	District
74001432	Chagrin Falls Township Hall	Chagrin Falls	83 N. Main St.	10/1/1974	Architecture	Building
78002036	Chagrin Falls Triangle Park Commercial District	Chagrin Falls	Main, Franklin, and Washington Sts.	12/29/1978	Community Planning And Development; Commerce; Architecture	District
95000634	Chagrin Falls Triangle Park Commercial District (Boundary Increase)	Chagrin Falls	Jct. of N. Main and E. Orange Sts., extending E and S	6/7/1995	Commerce	District
74001433	Chagrin Falls West Side District	Chagrin Falls	Bounded by W. Washington, Church, Maple, and Franklin Sts.	10/9/1974	Architecture; Social History	District
76001408	Clague House	Westlake	1371 Clague Rd.	1/11/1976	Exploration/Settlement; Architecture	Building
75001357	Clark, Jared, House	Broadview Heights	6241 Wallings Rd.	8/1/1975	Architecture	Building
75001351	Cleveland And Pittsburgh Railroad Bridge	Bedford	Tinker's Creek	7/24/1975	Engineering; Transportation; Architecture	Structure
73001408	Cleveland Arcade	Cleveland	401 Euclid Ave.	3/20/1973	Engineering; Architecture	Building
08000113	Cleveland Club	Cleveland	10660 Carnegie Ave.	2/28/2008	Entertainment/Recreation; Architecture	Building
04000936	Cleveland Dental Manufacturing Company Building	Cleveland	3307 Scranton Rd.	9/3/2004	Architecture	Building
91001416	Cleveland Discount Building	Cleveland	815 Superior Ave. NE.	10/2/1991	Commerce; Architecture	Building
91001855	Cleveland East Pierhead Light	Cleveland	E breakwater pierhead, entrance to Cleveland harbor	12/19/1991	Transportation; Architecture	Structure

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73001409	Cleveland Grays Armory	Cleveland	1234 Bolivar Rd.	3/28/1973	Architecture	Building
76001390	Cleveland Harbor Station, U.S. Coast Guard	Cleveland	New West Pier	1/1/1976	Architecture	Building
82001366	Cleveland Home For Aged Colored People	Cleveland	4807 Cedar Ave.	12/17/198 2	Social History	Building
75001360	Cleveland Mall	Cleveland	Roughly T-shaped mall area between E. 9th and W. 3rd Sts.	6/10/1975	Community Planning And Development; Art; Architecture	District
01000894	Cleveland Masonic Temple	Cleveland	3615 Euclid Ave.	8/17/2001	Social History; Architecture	Building
87002287	Cleveland Municipal Stadium	Cleveland	Erieview Dr.	11/13/198 7	Community Planning And Development; Entertainment/ Recreation; Architecture	Structure
84000222	Cleveland Packard Building	Cleveland	5100-5206 Prospect Ave.	11/1/1984	Commerce; Architecture	Building
16000603	Cleveland Public Carnegie Library Hough Branch	Cleveland	1765 Crawford Rd.	9/6/2016	Education; Social History; Architecture	
75001361	Cleveland Public Square	Cleveland	Superior Ave. and Ontario St.	12/18/197 5	Community Planning And Development; Art; Architecture	District
73001410	Cleveland Trust Company	Cleveland	900 Euclid Ave. at E. 9th St.	11/26/197 3	Art; Architecture	Building
82003558	Cleveland Warehouse District	Cleveland	Roughly bounded by Front and Superior Aves., Railroad, Summit, 3rd, and 10th Sts.	9/30/1982	Commerce; Engineering; Architecture	District
07000070	Cleveland Warehouse Historic District (Boundary Increase)	Cleveland	1384-1410 West 10th St.	2/21/2007	Commerce; Industry; Transportation; Architecture; Engineering	District
83001950	Cleveland West Pierhead Light	Cleveland	Cleveland Harbor on Lake Erie	8/4/1983	Commerce; Engineering; Transportation	Structure
85001695	Cleveland Worsted Mills Company	Cleveland	5846--6116 Broadway	8/8/1985	Industry; Architecture	Building
74001459	Clifton Park Lakefront District	Lakewood	Roughly bounded by Clifton Blvd., Rocky River, Lake Erie, and Webb Rd.	11/20/197 4	Community Planning And Development; Architecture	District
10000626 5	Clifton Park South Historic District	Lakewood	Portions of Clifton, Forest, and Lake Rds., Captain's Cove and West Clifton Blvd.	3/18/2021	Architecture; Community Planning And Development	District
06000199	Clinton Apartments	Cleveland	3607 Clinton Ave.	3/29/2006	Architecture	Building
87000660	Colonial and Euclid Arcades	Cleveland	508 and 600 Euclid Ave.	5/8/1987	Architecture	Building
83001951	Commodore Apartment Building	Shaker Heights	15610 Van Aken Blvd.	4/21/1983	Community Planning And	Building

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					Development; Architecture	
16000594	Commodore Hotel, The	Cleveland	11990 Ford Dr.;11309-11325 Euclid Ave.	9/2/2016	Community Planning And Development	Building
84000224	Cook Building	Cleveland	4600-4800 Prospect Ave.	11/1/1984	Commerce; Architecture	Building
79001823	Cooley Farms	Warrensville Heights	N of Warrensville Heights off OH 175	8/8/1979	Community Planning And Development; Politics/Government; Architecture; Social History	District
79000287	Coonrad, Jonas, House	Brecksville	SE of Brecksville at 10340 Riverview Rd.	7/24/1979	Agriculture; Architecture	Building
03001101	Corlett Building	Cleveland	1923-35 Euclid Ave.	10/29/2003	Architecture	Building
00001296	Courtland, The	Cleveland	5403 Detroit Ave.	11/2/2000	Architecture	Building
74001435	Cozad, Justus L., House	Cleveland	1508 Mayfield Rd.	1/18/1974	Architecture	Building
78002038	Crawford-Tilden Apartments	Cleveland	1831--1843 Crawford Rd. and 1878--1888 E. 84th St.	3/21/1978	Architecture	Building
84002913	Dall, Andrew, Jr. and James, Houses	Cleveland	2225 and 2229 E. 46th St.	7/19/1984	Industry	Building
09000095	Danalds, Samuel, House	Brookpark	6511 Ruple Rd.	8/11/1979	Social History; Exploration/Settlement	Building
79001812	Day, Erastus, House	Lakewood	16807 Hilliard Rd.	5/8/1979	Industry; Commerce; Transportation	Building
73001428	Detroit Avenue Bridge	Rocky River--Lakewood	Detroit Ave. at Rocky River	2/23/1973	Engineering; Transportation	Structure
74001437	Detroit-Superior High Level Bridge	Cleveland	Over Cuyahoga River Valley, between Detroit Ave. and Superior Ave.	1/18/1974	Engineering; Transportation	Structure
86001055	Detroit-Warren Building	Lakewood	14801--14813 Detroit Ave.	5/15/1986	Architecture	Building
74001438	Division Avenue Pumping Station	Cleveland	Division Ave., at the foot of W. 45th St.	1/18/1974	Engineering; Architecture	Building
84000225	Dixon Hall Apartments	Cleveland	3814 Prospect Ave.	11/1/1984	Architecture	Building
84002915	Doan School	Cleveland	1350 E. 105th St.	8/23/1984	Architecture	Building
78002047	Drake, Alonzo, House	Oakwood	24262 Broadway	11/28/1978	Architecture	Building
74001439	Dunham Tavern	Cleveland	6709 Euclid Ave.	7/25/1974	Commerce; Architecture	Building
75001352	Dunham, Hezekiah, House	Bedford	729 Broadway	6/18/1975	Community Planning And Development; Architecture	Building
88000678	East 89th Street Historic District	Cleveland	E. Eighty-ninth St. roughly between Chester and Hough Aves.	5/26/1988	Architecture	District
100001506	East Boulevard Apartment House	Cleveland	2691 E. 116th St.	8/24/2017		Building

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95001366	East Boulevard Historic District (Additional Documentation)	Cleveland	Roughly bounded by East Blvd., St. Clair Ave., East 99th St. and University Cir.	11/29/1995	Landscape Architecture; Architecture; Community Planning And Development	District
79001806	East Cleveland District 9 School	Cleveland Heights	14391 Superior Rd	7/26/1979	Education; Architecture	Building
87001179	East Fourth Street Historic District	Cleveland	Roughly on E. Fourth St. between Euclid and Prospect Aves.	7/9/1987	Architecture	District
12001212	East Ohio Building, The	Cleveland	1717 E. 9th St.	1/23/2013	Commerce; Architecture; Engineering	Building
03000043	East Ohio Gas Company Building	Cleveland	1403 E. Sixth St.	2/20/2003	Commerce; Architecture	Building
100005571	Eleanor B. Rainey Memorial Institute	Cleveland	1523 East 55th St.	9/21/2020	Social History	Building
84000226	Ensworth, Jeremiah, House	Cleveland	3214 Prospect Ave.	11/1/1984	Architecture	Building
84003614	Erie Railroad Cleveland Powerhouse	Cleveland	1246 River Rd.	7/19/1984	Industry	Building
100006084	Erieview Historic District	Cleveland	Roughly bounded by Lakeside Ave., Chester Ave., East 9th St., and East 12th St.	2/1/2021	Community Planning And Development; Architecture	District
100001655	Erieview Tower	Cleveland	1322 E. 12th St.	9/25/2017	Community Planning And Development	Building
02000702	Euclid Avenue Historic District	Cleveland	Roughly bounded by Public Square, Euclid Ave. to E. 17th St., E. 21st St.	6/28/2002	Transportation; Architecture; Commerce	District
07000524	Euclid Avenue Historic District (Boundary Increase)	Cleveland	205 St. Clair Ave., 1370 Ontario St., 1796-1808 E. 13th St.	5/29/2007	Commerce; Architecture	District
80002977	Euclid Avenue Presbyterian Church	Cleveland	11205 Euclid Ave.	3/12/1980	Architecture	Building
02000887	Euclid Golf Allotment	Cleveland Heights	Roughly bounded by Cedar Rd., Coventry Rd., Scarborough Rd., W. St. James Pkwy, and Ardleigh Dr.	8/23/2002	Architecture; Community Planning And Development	District
12000897	Euclid Heights Historic District	Cleveland Heights	Mayfield, Coventry, Cedar, Overlook	10/31/2012	Architecture; Community Planning And Development; Commerce	District
96000866	Euclid, The-Seventy-First Street Building	Cleveland	7002--70030 Euclid Ave.	8/8/1996	Architecture; Commerce; Community Planning And Development	Building
90000758	Fairhill Road Village Historic District	Cleveland	12309--12511 Fairhill Rd.	5/10/1990	Community Planning And Development; Landscape Architecture; Architecture	District

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15000038	Fairmont Creamery Company Ice Cream Building	Cleveland	1720 Willey Ave., 2306 W. 17th St.	2/23/2015	Commerce; Transportation	Building
76001391	Fairmount Boulevard District	Cleveland Heights	2485--3121 Fairmount Blvd.	12/12/1976	Community Planning And Development; Landscape Architecture; Architecture	District
13000388	Fairview Community Park Historic District	Fairview Park	21077 N. Park Dr.	6/14/2013	Community Planning And Development; Architecture; Art	District
00000421	Falls River Road	Chagrin Falls	Falls Rd.	4/28/2000	Transportation; Exploration/Settlement; Engineering	Structure
05001575	Federal Knitting Mills (Boundary Increase)	Cleveland	2820, 2811-21 Vermont Ave.,	2/1/2006	Industry	Building
00001662	Federal Knitting Mills Building	Cleveland	2860--2894 Detroit Ave.	1/16/2001	Industry	Building
76001392	Federal Reserve Bank Of Cleveland	Cleveland	E. 6th St. and Superior Ave.	10/8/1976	Architecture	Building
16000845	Fenway Hall	Cleveland	1986 Stokes Blvd.	12/13/2016	Architecture; Social History	Building
78002044	First Church of Christ in Euclid	East Cleveland	16200 Euclid Ave.	11/28/1978	Architecture; Religion	Building
03000042	First Church of Christ, Scientist	Cleveland	2200 Overlook Rd.	2/20/2003	Architecture	Building
84003953	First Methodist Church	Cleveland	3000 Euclid Ave.	9/1/1995	Architecture	Building
80002983	First Universalist Church of Olmsted	North Olmsted	5050 Porter Rd.	11/25/1980	Architecture; Religion; Social History	Building
76001393	Ford Motor Company Cleveland Plant	Cleveland	11610 Euclid Ave.	3/17/1976	Industry; Architecture	Building
86003827	Forest City Bank Building	Cleveland	1400 W. Twenty-fifth St.	8/31/1992	Architecture	Building
76001394	Forest City Brewery	Cleveland	6920--6922 Union Ave.	5/3/1976	Industry; Architecture	Building
86001662	Forest Hill Historic District	Cleveland	Roughly bounded by Glynn Rd., Northdale Blvd. and Cleviden Rd., Mt. Vernon Blvd. and Wyatt Rd., and Lee Blvd.	8/14/1986	Community Planning And Development; Architecture	District
98000072	Forest Hill Park	East Cleveland	Roughly along Lee Blvd., Superior, Terrace, and Mayfield Rds.	2/27/1998	Landscape Architecture	District
07000580	Forest Hill Realty Sales Office	Cleveland Heights	2419 Lee Blvd.	6/21/2007	Community Planning And Development; Architecture	Building
74001460	Fort Hill	North Olmsted	E of North Olmsted off OH 252	7/25/1974	Prehistoric	Site
89000430	Franklin Boulevard Historic District	Cleveland	Franklin Blvd. from W. 52nd to W. 38th Sts.	5/31/1989	Architecture	District

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93001334	Franklin Boulevard-West Clinton Avenue Historic District	Cleveland	5207--7625 Franklin Blvd., 5802-7325 W. Clinton Ave.	12/6/1993	Architecture	District
06000269	Franklin Boulevard-West Clinton Avenue Historic District (Boundary Increase)	Cleveland	5207-7625 Franklin Blvd., 5802-07325 W. Clinton Ave., 6801-7003,7319-7405 Detroit Ave.	12/5/2006	Architecture	District
76000211	Frazee, Stephen, House	Valley View	7733 Canal Rd.	5/4/1976	Exploration/Settlement; Architecture	Building
74001461	Froelich, John, House	Seven Hills	7095 Broadview Rd.	7/30/1974	Architecture	Building
99001242	Fuller-Bramley House	Independence	7489 Brecksville Rd.	10/7/1999	Architecture; Exploration/Settlement	Building
78002049	Gabel, Daniel, House	Seven Hills	1102 E. Ridgewood Dr.	5/23/1978	Exploration/Settlement; Architecture	Building
84000227	Gaensslen, Phillip, House	Cleveland	3056 Prospect Ave.	11/1/1984	Commerce; Architecture	Building
73001411	Garfield, President James A., Memorial (Additional Documentation)	Cleveland	12316 Euclid Ave. in Lakeview Cemetery	4/11/1973	Art; Architecture	Structure
91001491	Gates Mills Historic District	Gates Mills	Roughly, along Berkshire, Chagrin River, Epping, Old Mill and Sherman Rds.	10/9/1991	Community Planning And Development; Landscape Architecture; Agriculture; Architecture	District
75001367	Gates Mills Methodist Episcopal Church	Gates Mills	Old Mill Rd. off U.S. 322	7/18/1975	Architecture; Religion	Building
14000765	Gates Mills Village Historic District	Gates Mills	Area around Old Mill Rd.	6/28/1979	Architecture; Community Planning And Development	District
75001354	Gates, Holsey, House	Bedford	762 Broadway	6/30/1975	Commerce; Architecture	Building
84000228	Gifford, Dr. William, House	Cleveland	3047 Prospect Ave.	11/1/1984	Architecture	Building
93000075	Gleason, Edmund, Farm (Boundary Increase)	Valley View	7243 Canal Rd.	3/12/1993	Agriculture; Architecture	District
78000377	Gleason, Edmund, House	Valley View	7243 Canal Rd.	12/18/1978	Architecture	Building
88000054	Glidden, Francis K., House	Cleveland	1901 Ford Dr.	2/8/1988	Architecture	Building
94000245	Globe Iron Works Building	Cleveland	2320 Center St.	3/17/1994	Industry	Building
12001180	Globe Machine and Stamping Company	Cleveland	1250 W. 76th St.	1/14/2013	Industry; Law	Building
78002039	Goldsmith, Jacob, House	Cleveland	2200 E. 40th St.	3/8/1978	Black; Architecture; Social History	Building
85000944	Gordon Square Building	Cleveland	6500-6616 Detroit Ave. and 1396-1490 W. 65th St.	4/30/1985	Architecture	Building
02001209	Gordon Square Historic District	Cleveland	Detroit Ave. and W. 65th St.	10/25/2002	Architecture; Commerce	District
75001369	Grand Pacific Hotel	Olmsted Falls	8112 Columbia Rd.	10/10/1975	Commerce; Architecture	Building

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10000189	Grant Deming's Forest Hill Allotment Historic District	Cleveland Heights	Woodward Ave, Lincoln Blvd, Edgehill Rd, Parkway Dr, Redwood Rd,.....	4/13/2010	Architecture; Social History; Community Planning And Development	District
16000041	Greenwood Farm	Richmond Heights	264 Richmond Rd.	2/23/2016	Politics/Government; Social History	Building
91000302	Greyhound Bus Station	Cleveland	1465 Chester Ave.	6/2/1999	Architecture	Building
16000601	Grossman Paper Box Company	Cleveland	1729 Superior Ave.	8/15/2016	Industry	Building
74001430	Gwinn Estate	Bratenahl	12407 Lake Shore Blvd.	10/1/1974	Industry; Landscape Architecture; Architecture; Social History	Building
83001952	Hackenberg, Harvey, House	Lakewood	1568 Grace Ave.	7/7/1983	Architecture	Building
83001953	Halle Building	Cleveland	1228 Euclid Ave.	9/8/1983	Commerce; Architecture	Building
05000029	Halle's Shaker Square	Cleveland	13000 Shaker Blvd.	2/9/2005	Architecture; Commerce	Building
86000032	Hangar, The	Beachwood	24400 Cedar Rd.	1/9/1986	Art; Architecture	Building
74001431	Hanna, Howard M., Jr., House	Bratenahl	11505 Lake Shore Blvd.	7/24/1974	Architecture; Social History	Building
00000180	Harp Apartments	Cleveland	1389 W. 64th St.	3/9/2000	Architecture	Building
02000550	Harvard School	Cleveland	6900 Harvard Ave.	5/22/2002	Architecture	Building
76001395	Hay-McKinney and Bingham-Hanna House	Cleveland	10825 E. Blvd.	6/18/1976	Architecture; Social History	Building
86001058	Heights Rockfeller Building	Cleveland Heights	3091 Mayfield Rd.	5/15/1986	Architecture	Building
00000422	Henn, Albert W., Mansion	Euclid	23131 Lake Shore Blvd.	4/28/2000	Architecture; Industry	Building
03000859	Henninger, Phillip, House	Parma	5757 Broadview Rd.	8/28/2003	Exploration/Settlement; Architecture	Building
100004982	Henry W. Longfellow School	Cleveland	650 East 140th St.	2/20/2020	Education; Architecture	Building
78002048	Henry, Robert W., House	Parma Heights	6607 Pearl Rd.	12/8/1978	Architecture; Social History	Building
12001245	Herold Building	Cleveland	310 Prospect Ave.	1/29/2013	Architecture	Building
75001362	Hessler Court Wooden Pavement	Cleveland	11330 East Blvd. between Bellflower and Hessler Rds.	3/3/1975	Engineering	Structure
94000415	Hill, James, House	Cleveland	1840 W. 58th St.	5/13/1994	Architecture	Building
86003502	Hilliard Apartment Building	Cleveland	2804--2906 Sackett Ave.	3/17/1987	Architecture	Building
76001397	Holy Rosary Church	Cleveland	12021 Mayfield Rd.	6/16/1976	European; Architecture; Religion	Building
77001054	Honam, John, House	Lakewood	14710 Lake Ave.	4/13/1977	Exploration/Settlement; Architecture	Building
98000317	Hotel Statler	Cleveland	1127 Euclid Ave.	4/1/1998	Architecture; Community Planning And Development	Building

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82001367	House of Wills	Cleveland	2491 E. 55th St.	12/17/1982	Architecture	Building
74001440	Hoyt Block	Cleveland	608 W. St. Clair St.	1/18/1974	Commerce; Architecture	Building
79001807	Hruby Conservatory of Music	Cleveland	5417 Broadway St.	11/29/1979	European; Architecture; Performing Arts	Building
14001073	Hubbard Cooke Block	Cleveland	2206-2220 Superior Viaduct	12/22/2014	Architecture	Building
79001798	Huntington, John, Pumping Tower	Bay Village	28600 Lake Rd.	2/28/1979	Architecture; Social History	Structure
77001053	Independence Presbyterian Church	Independence	U.S. 21	4/13/1977	Architecture	Building
09000210	Inglewood Historic District	Cleveland Heights	Inglewood Dr., Oakridge Dr., Cleveland Heights Blvd., Yellowstone & Glenwood Rds., & Quilliams	4/15/2009	Architecture; Community Planning And Development; Social History	District
84000229	Ireland, Joseph, House	Cleveland	2074 E. 36th St.	11/1/1984	Architecture	Building
90000757	Irishtown Bend Archeological District	Cleveland	Address Restricted	5/25/1990	Historic - Non-Aboriginal; Economics; European; Architecture; Social History	District
79000288	Jaite Mill Historic District	Brecksville	SE of Brecksville at Riverview and Vaughan Rds.	5/21/1979	Industry	District
84003618	Jennings Apartments	Cleveland	2711 W. 14th St.	3/29/1984	Architecture	Building
87002636	Jones Home for Children	Cleveland	3518 W. Twenty-fifth St.	8/30/1996	Architecture	Building
12000031	Jones Home Subdivisions Historic District	Cleveland	Woodbridge, Marvin, Daisy, & Library Aves., & W. 25th St.	2/17/2012	Architecture; Community Planning And Development	District
10000873	Joseph and Feiss Clothcraft Shops, The	Cleveland	2149 W 53rd St	10/28/2010	Industry; Social History; European	Building
82001368	Karamu House	Cleveland	2355 E. 89th St.	12/17/1982	Performing Arts	Building
12001246	Kendel Building	Cleveland	210 Prospect Ave.	1/29/2013	Architecture	Building
85003764	Kennedy Apartments and Commercial Block	Cleveland	6425 Detroit Ave.	7/6/1989	Architecture	Building
82003560	Keyt, Gideon, House	Gates Mills	Chagrin River and Deerfield Rds.	6/1/1982	Architecture	Building
04000833	Kies, Lewis, House	Cleveland	4208 Prospect Ave.	8/11/2004	Architecture	Building
87000434	Kindra, W. H., Apartments	Cleveland	3802--2812 Mapledale Ave.	3/19/1987	Architecture	Building
79000289	Knapp, William, House	Valley View	7101 Canal Rd.	3/19/1979	Education; Politics/Government; Architecture; Social History	Building
78002035	Knowlton, Dr. William A., House	Brecksville	8937 Highland Dr.	12/4/1978	Architecture; Social History	Building
85002834	Krause Building-Otto Moser's Cafe	Cleveland	2042--2044 E. Fourth St.	11/14/1985	Social History; Performing Arts	Building

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74001458	Kuenzer, Joseph II, House	Independence	2345 Rockside Rd.	8/13/1974	Architecture	Building
88000206	Kulas, E. J., Estate Historic District	Gates Mills	W. Hill Dr.	3/23/1988	Architecture	District
01000051	Kundtz, Theodor, Company Building	Cleveland	2249 Elm St.	2/2/2001	Industry	Building
15000901	Lake Shore Bank and Cleveland Public Library St. Clair Branch	Cleveland	5410 St. Clair Ave. & 1368 E. 55th St.	12/15/2015	Architecture; Commerce; Education; Social History	Building
100005539	Lakewood Downtown Historic District	Lakewood	Detroit Ave., roughly bounded by Bunts Rd. and Hall Ave., plus Warren Rd., roughly bounded by Detroit Ave. and Franklin Blvd.	9/23/2020	Architecture; Commerce	District
11000365	LaSalle Theater Building	Cleveland	819-829 E. 185th St.	6/15/2011	Architecture	Building
79001814	Lay, Samuel, House	Olmsted Falls	7622 Columbia Rd.	6/20/1979	Industry; Architecture	Building
79001808	League Park	Cleveland	Lexington and 66th Sts	8/8/1979	Social History	Building
00000750	Lerner Building	Cleveland	322-324 Euclid Ave.	6/24/2000	Architecture	Building
06000270	Lilly House	Westlake	27946 Center Ridge Rd.	4/12/2006	Architecture	Building
78002040	Lindner Building	Cleveland	1331 Euclid Ave.	9/13/1978	Commerce; Architecture	Building
16000617	Lion Knitting Mills	Cleveland	3256 W. 25th St.	9/12/2016	Commerce; Invention; Industry	Building
14001074	Liquid Carbonic Corporation Dry Ice Plant	Cleveland	1318 W. 58th St.	12/22/2014	Commerce; Industry	Building
79000290	Lock No. 37 and Spillway	Valley View	Fitzwater Rd.	12/11/1979	Commerce; Engineering; Transportation; Exploration/Settlement	Structure
79000291	Lock No. 38 and Spillway	Valley View	Hillside Rd.	12/11/1979	Commerce; Engineering; Transportation; Exploration/Settlement	Structure
79000292	Lock No. 39 and Spillway	Valley View	Canal Rd.	12/11/1979	Commerce; Engineering; Transportation; Exploration/Settlement	Structure
79000293	Lock Tender's House and Inn	Valley View	7104 Canal Rd.	12/11/1979	Commerce; Transportation; Exploration/Settlement; Architecture	Building
06000271	Look About Lodge	Bentleyville	37374 Miles Rd.	4/12/2006	Architecture; Education	Building
94000596	Lorain Avenue Commercial Historic District	Cleveland	3202--5730 Lorain Ave.	6/17/1994	Commerce; Architecture	District
94000417	Lorain Station Historic District	Cleveland	9005--10134 Lorain Ave.	5/13/1994	Architecture; Commerce	District
76001398	Lorain-Carnegie Bridge	Cleveland	Spans Cuyahoga River between Lorain and Carnegie Aves.	10/8/1976	Engineering; Transportation; Architecture	Structure

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94000640	Lower Prospect-Huron Historic District	Cleveland	Seven blocks in downtown centered around jct. of Prospect Ave., Huron Rd. and E 9th St.	11/19/1995	Architecture; Commerce	District
05000580	Lower Prospect-Huron Historic District (Boundary Increase)	Cleveland	727, 737, 1020-1060, 1124 Bolivar Rd., 2217 E. 9th St., and 1303 Prospect Ave.	6/10/2005	Commerce; Architecture	District
75001356	Lyceum Village Square And German Wallace College	Berea	Seminary St.	10/29/1975	Community Planning And Development; Education; Architecture	District
90001566	Magnolia-Wade Park Historic District	Cleveland	Roughly bounded by Asbury Ave., E. 118th St., Wade Park Ave., Mistletoe Dr., Magnolia Dr., and E. 105th St.	10/25/1990	Community Planning And Development; Architecture	District
87000439	Malio House	Cleveland	3781 W. Twenty-fifth St.	3/19/1987	Architecture	Building
78002037	March, George, House	Chagrin Falls	126 E. Washington St.	4/20/1978	Exploration/Settlement	Building
74001442	Mather, Flora Stone, College District	Cleveland	Bellflower Rd. at Ford Dr.	2/15/1974	Education; Architecture	District
74001443	May Company (Additional Documentation)	Cleveland	158 Euclid Ave. at Public Sq.	1/18/1974	Commerce; Architecture	Building
15000611	Mayfield Heights Historic District	Cleveland Heights	Caldwell & Preyer Aves., Rock Ct., Euclid Heights Blvd., Hampshire, Mayfield, Middlehurst, Radnor & Somerton Rds.	9/17/2015	Architecture; Community Planning And Development	District
13000389	Mayfield Theatre Building, The	Cleveland	12300 Mayfield Rd.	6/14/2013	Entertainment/ Recreation	Building
01001258	McFarland, Duncan, House	Bentleyville	35069 Cannon Rd.	11/21/2001	Architecture	Building
85001527	McKinley Terrace	Cleveland	1406--1426 W. 81st St.	7/9/1985	Architecture	Building
84000621	Medical Centre Building	Cleveland	1001 Huron Rd.	12/20/1984	Health/Medicine; Architecture	Building
73001412	Merwin, George, House	Cleveland	3028 Prospect Ave.	6/4/1973	Architecture	Building
100006160	Midtown Historic District	Cleveland	Perkins (south side), Chester, Euclid, Prospect, and Carnegie (north side) Aves., roughly between I-90, East 27th, East 40th and East 55th Sts.	2/22/2021	Community Planning And Development; Architecture	District
74001444	Miles Park Historic District	Cleveland	Miles Park Ave. around Miles Park	5/17/1974	Architecture; Social History	District
84003624	Miller Block	Cleveland	3202-3214 Lorain Ave.	7/19/1984	Community Planning And Development; Architecture	Building
84000230	Montana Apartments	Cleveland	2061 E. 36th St.	11/1/1984	Architecture	Building
11000670	Moreland Theater Building	Cleveland	11810-11824 Buckeye Rd.	9/15/2011	Architecture; Entertainment/	Building

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
					Recreation; European	
82001369	Morgan, Garrett, House	Cleveland	5202 Harlem Ave.	12/17/1982	Invention	Building
16000042	Mueller Electric Company Building	Cleveland	1587 E. 31st St.	2/23/2016	Invention; Industry	Building
88000436	Murray Hill School	Cleveland	2026 Murray Hill Rd. and 2043 Random Rd.	4/28/1988	Health/Medicine; Education; European; Architecture	Building
100004778	Myrtle-Highview Historic District	Cleveland	16209 to 16408 Highview Dr. & 16200 to 16409 Myrtle Ave; Roughly bounded by Lee Rd, Myrtle Ave., Highview Dr. & dead end.	12/23/2019	Black; Architecture; Ethnic Heritage; Community Planning And Development	District
16000599	NASA Lewis Research Center-Development Engineering Building & Annex	Fairview	21000 Brookpark Rd.	8/15/2016	Engineering; Other	Building
03001102	National Town and Country Club	Cleveland	2401 Euclid Ave.	10/30/2003	Architecture	Building
12000834	Neal Terrace	Cleveland	8811 Detroit Ave.	10/3/2012	Community Planning And Development	Building
84000231	Neff Apartments	Cleveland	3606 Prospect Ave.	11/1/1984	Architecture	Building
75001365	Nela Park	East Cleveland	Entrance at 1901 Noble Rd.	5/29/1975	Industry; Landscape Architecture; Architecture	District
00001065	New England Building	Cleveland	617-637 Euclid Ave., 614-626 Vincent Ave.	9/8/2000	Architecture; Commerce	Building
88001298	Newton Avenue Historic District	Cleveland	9700--10003 Newton Ave.	8/31/1988	Architecture	District
79001813	Nicholson, James, House	Lakewood	13335 Detroit Ave	8/24/1979	Exploration/Settlement; Architecture	Building
80002984	North Olmsted Town Hall	North Olmsted	5186 Dover Center Rd.	11/25/1980	Politics/Government	Building
74001445	North Presbyterian Church	Cleveland	4001 Superior Ave.	10/29/1974	Architecture; Social History	Building
74001446	North Union Shaker Site	Cleveland	Address Restricted	8/13/1974	Industry; Commerce; Historic - Non-Aboriginal; Engineering; Social History	Site
14000353	Northern Ohio Blanket Mills	Cleveland	3160 & 3166 W. 33rd St., 3401 Paris Ave., 3167 Fulton Rd.	6/27/2014	Commerce; Industry; European	Building
75001370	Northrop, Julia Carter, House	Olmsted Falls	7872 Columbia Rd.	10/14/1975	Architecture; Social History	Building
88000637	Notre Dame Academy	Cleveland	1325 Ansel Rd.	5/26/1988	Architecture	Building
83004267	Notre Dame College of Ohio	South Euclid	4545 College Rd.	12/8/1983	Architecture	Building
100006098	Oakwood Club Subdivision Historic District	Cleveland Heights	1538-1688 Oakwood Dr., 1598,1681 Wood Rd.	2/5/2021	Architecture	District

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
66000607	Ohio and Erie Canal	Valley View	OH 631	11/13/1966	Industry; Commerce	District
84000232	Ohio Bell Henderson-Endicott Exchange Building	Cleveland	5400-5420 Prospect Ave.	11/1/1984	Commerce; Architecture	Building
74001447	Ohio City Preservation District	Cleveland	Bounded by W. 26th, Clinton, W. 38th, and Carroll Sts.	10/9/1974	Architecture; Social History	District
89000435	Ohio City Preservation District (Boundary Increase)	Cleveland	Roughly Franklin Blvd. NW., W. 38th St., Bridge Ave. NW., & W. 44th St., & Stone, W. 25th, Bridge Ave. NW., & W. 28th	5/25/1989	Architecture	District
73001426	Old Center School	Mayfield Village	784 S.O.M. Center Rd.	4/3/1973	Architecture	Building
73001427	Old District 10 Schoolhouse	Middleburg Heights	Corner of Sheldon and Fry Rds.	10/15/1973	Education; Politics/Government; Architecture	Building
80002982	Old Euclid District 4 Schoolhouse	Lyndhurst	Richmond Rd.	4/16/1980	Politics/Government	Building
74001448	Old Federal Building and Post Office	Cleveland	201 Superior Ave., NE	5/3/1974	Community Planning And Development; Art; Architecture	Building
05001574	Old River Road Historic District	Cleveland	1220-1330 Old River Rd.	2/1/2006	Commerce; Architecture	District
73001414	Old Stone Church	Cleveland	91 Public Sq.	2/23/1973	Architecture	Building
00000963	Olmsted Falls Depot	Olmsted Falls	25802 Garfield Rd.	8/10/2000	Architecture	Building
00000798	Olmsted Falls Historic District	Olmsted Falls	Roughly bounded by Bagley Rd., Brookside Dr., Rocky River, Nobottom Rd.	7/14/2000	Architecture	District
88000633	Olney, Charles, House and Gallery	Cleveland	2241--2255 W. Fourteenth St.	6/6/1988	Community Planning And Development; Art; European; Architecture	Building
12000800	Oppmann Terrace	Cleveland	10119 Detroit Ave.	9/19/2012	Architecture; Community Planning And Development	Building
74001449	Overlook Road Carriage House District	Cleveland Heights	1--5 Herrick Mews	5/6/1974	Architecture; Social History	District
79000294	Packard-Doubler House	Independence	7634 Riverview Rd.	3/9/1979	Architecture; Agriculture	Building
86003503	Panek Block	Cleveland	3154 E. Fourty-ninth St.	12/18/1986	Architecture	Building
96000674	Park Building	Cleveland	140 Public Sq.	7/1/1996	Architecture	Building
75001364	Peerless Motor Company Plant No. 1	Cleveland	9400 Quincy Ave.	5/29/1975	Industry; Architecture	Building
95000492	Pennsylvania Railway Ore Dock	Cleveland	On Lake Erie at Whiskey Island	10/15/1997	Transportation; Industry; Invention; Engineering	District
73001415	Perry-Payne Building	Cleveland	740 Superior Ave.	7/16/1973	Architecture	Building

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
79001799	Pickands, Jay M., House	Bratenahl	9619 Lake Shore Blvd	8/24/1979	Architecture	Building
76001399	Pilgrim Congregational Church	Cleveland	2592 W. 14th St.	3/17/1976	Education; Architecture; Social History	Building
78002041	Playhouse Square Group	Cleveland	2067 E. 14th St.; 1422, 1501, 1515, 1621 Euclid Ave.	10/5/1978	Art; Architecture; Performing Arts	Building
84000233	Plaza Apartments	Cleveland	3206 Prospect ave.	11/1/1984	Architecture	Building
75001371	Pomeroy, Alanson, House	Strongsville	Pearl Rd. at Westwood Dr.	6/20/1975	Architecture; Social History	Building
74001450	Prospect Avenue Row House Group	Cleveland	3645, 3649, 3651, 3657 Prospect Ave.	3/27/1974	Architecture	District
88000642	Quad Hall	Cleveland	7500 Euclid Ave.	5/26/1988	Architecture	Building
12001213	Record Rendezvous	Cleveland	300 Prospect Ave.	1/23/2013	Commerce; Social History	Building
10000299 9	Reidy Bros. & Flanigan Building	Lakewood	11730 Detroit Ave.	10/2/2018	Commerce	Building
79000295	Rich, Charles B., House	Brecksville	9367 Brecksville Rd.	2/22/1979	Exploration/Set tlement; Law; Architecture	Building
03000322	Rich, N.J., and Co. Building	Cleveland	1974 E. 61st St.	5/1/2003	Industry; Engineering; Education	District
12000795	Richman Brothers Company, The	Cleveland	1600 E. 55th St.	9/19/2012	Architecture; Industry	Building
87000445	Riverside Cemetery Building	Cleveland	3607 W. Twenty-fifth St.	3/19/1987	Architecture	Building
87000446	Riverside Cemetery Chapel	Cleveland	3607 Pearl Rd.	3/19/1987	Architecture	Building
73001416	Rockefeller Building	Cleveland	614 Superior Ave.	6/4/1973	Architecture	Building
05000382	Rockefeller Park and Cleveland Cultural Gardens Historic District	Cleveland	Roughly bounded by Mt. Sinai Rd., East Boulevard, Conrail Tracks, and Ansel Rd.	5/4/2005	Entertainment/ Recreation; Community Planning And Development; Other-Ethnic; Landscape Architecture; Art	District
77001051	Rockefeller Park Bridges	Cleveland	Rockefeller Park	9/27/1977	Landscape Architecture; Engineering	District
80002978	Root and McBride-Bradley Building	Cleveland	1220-1230 W. 6th St.	7/18/1980	Commerce; Architecture	Building
94000413	Rose Hill and Community House	Bay Village	Jct. of Cahoon and Lake Rds.	5/13/1994	Social History	Building
10000352 6	Roundwood Manor at Daisy Hill Farm	Hunting Valley	3450 Roundwood Rd.	3/22/2019	Community Planning And Development; Transportation; Architecture	Building
73001417	Schweinfurth, Charles, House	Cleveland	1915 E. 75th St.	5/22/1973	Architecture	Building
10000482 3	Scofield, Levi, House	Cleveland	2438 Mapleside Rd.	12/31/201 9	Architecture	Building
15000371	Scranton South Side Historic District (Additional Documentation)	Cleveland	2314-2658, 3339 Scranton Rd., 1632-2101 Holmden, 1644-	6/30/2015	Community Planning And Development;	District

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
			2115 Brainard, 1724-2105 Corning, and 1701-2034 Clover Aves.		European; Transportation	
12000032	Shaker Farm Historic District	Cleveland Heights	Roughly bounded by Scarborough, Colchester, St. James, Roxboro, N. Park, Fairmount, Idlewood. E. Monmouth & Lee Sts.	2/15/2012	Architecture; Community Planning And Development	District
76001400	Shaker Square	Cleveland	Shaker and Moreland Blvds.	7/1/1976	Community Planning And Development; Commerce; Transportation; Architecture	District
83004367	Shaker Square Historic District (Boundary Increase)	Cleveland	Shaker and Moreland Blvds.	12/9/1983	Community Planning And Development; Commerce; Transportation; Architecture	District
84003882	Shaker Village Historic District	Shaker Heights	Roughly bounded by Fairmount and Lomand Blvds., Green, Warrensville Center, Becket and Coventry Rd.	5/31/1984	Community Planning And Development; Landscape Architecture; Transportation; Architecture	District
00001557	Shaker Village Historic District (Boundary Increase)	Shaker Heights	Roughly bounded by Lomond Blvd., Lytel Rd., Scottsdale Blvd., and Lindholm Rd.	1/5/2001	Architecture; Community Planning And Development	District
82001371	Shiloh Baptist Church	Cleveland	5500 Scovill Ave.	12/17/1982	Architecture; Religion	Building
00000097	Shore High School	Euclid	291 E. 222nd St.	2/10/2000	Architecture	Building
82001873	Snow, Russ and Holland, Houses	Brecksville	12911 and 13114 Snowville Rd.	9/28/1982	Agriculture; Architecture; Social History	Building
76001401	Society for Savings Building	Cleveland	Public Sq.	11/7/1976	Architecture	Building
05000092	South Brooklyn Commercial District	Cleveland	Roughly along Pearl and Broadview Rds.	2/25/2005	Architecture	District
76000212	South Park Site	Independence	Address Restricted	6/22/1976	Prehistoric	Site
84000234	Southworth House	Cleveland	3334 Prospect Ave.	11/1/1984	Commerce; Architecture	Building
100002551	Spang, J., Baking Company	Cleveland	2707 Barber Ave.	6/14/2018	Commerce; Ethnic Heritage	Building
76001402	St. Elizabeth's Magyar Roman Catholic Church	Cleveland	9016 Buckeye Rd.	1/30/1976	European; Architecture	Building
74001451	St. Ignatius High School	Cleveland	1911 W. 30th St. at Carroll Ave.	1/21/1974	Education; Architecture	Building
82001370	St. John's AME Church	Cleveland	2261 E. 40th St.	12/17/1982	Architecture	Building
73001418	St. John's Episcopal Church	Cleveland	2600 Church St.	2/23/1973	Architecture	Building
06000272	St. Joseph Convent and Academy Complex	Garfield Heights	12215 Granger Rd.	4/12/2006	Religion; Education	District

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
76001403	St. Joseph's Church and Friary	Cleveland	2543 E. 23rd St. at Woodland	6/17/1976	Architecture; Religion	Building
05000579	St. Luke's Hospital	Cleveland	11311 Shaker Blvd.	6/10/2005	Health/Medicine; Architecture	Building
74001452	St. Michael the Archangel Catholic Church	Cleveland	3114 Scranton Rd.	1/18/1974	Architecture; Religion; Social History	Building
80002979	St. Paul's Episcopal Church	Cleveland	4120 Euclid Ave.	11/25/1980	Architecture	Building
84000130	St. Paul's Episcopal Church of East Cleveland	East Cleveland	15837 Euclid Ave.	10/18/1984	Art; Architecture	Building
76001404	St. Stanislaus Church	Cleveland	Forman and E. 65th Sts.	6/22/1976	Art; Architecture; Religion; Social History	Building
77001052	St. Stephen Church	Cleveland	1930 W. 54th St.	11/25/1977	Art; Architecture	Building
74001453	St. Theodosius Russian Orthodox Cathedral	Cleveland	733 Starkweather Ave.	1/18/1974	Architecture; Religion; Social History	Building
100005214	Stadium Square Historic District	Cleveland Heights	South Taylor Rd., Superior Park Dr.	4/27/2020	Commerce; Architecture; Community Planning And Development	District
78002042	Stager-Beckwith House	Cleveland	3813 Euclid Ave.	4/20/1978	Architecture; Social History	Building
94000591	Stanley Block	Cleveland	2115--2121 Ontario St.	4/27/2011	Commerce; Architecture	Building
79000312	Station Road Bridge	Brecksville	E of Brecksville at Cuyahoga River	3/7/1979	Engineering	Structure
81000431	Stearns, Lyman, Farm	Parma	6975 Ridge Rd.	10/1/1981	Exploration/Settlement; Agriculture	Building
96000381	Stebbens Farm	Brecksville	8255 Riverview Rd.	4/17/1996	Agriculture	Building
85001693	Stockbridge Apartment Building	Cleveland	3328 Euclid Ave.	8/8/1985	Industry; Architecture; Social History	Building
78002050	Stone, Valerius C., House	Strongsville	21706 Lunn Rd.	12/22/1978	Architecture	Building
75001358	Stoneman, Joseph, House	Chagrin Falls	18 E. Orange St.	5/29/1975	Industry; Commerce; Architecture	Building
80002985	Strong, John Stoughton, House	Strongsville	18910 Westwood St.	11/24/1980	Exploration/Settlement	Building
08000147	Strongsville Town Hall	Strongsville	18825 Royalton Rd.	3/6/2008	Politics/Government; Education; Social History; Architecture	Building
15000612	Stuyvesant Motor Company Building	Cleveland	1937 Prospect Ave.	9/22/2015	Commerce	Building
07000072	Superior Avenue Historic District	Cleveland	1860-2553 Superior Ave.	2/21/2007	Commerce; Industry; Architecture	District
78002043	Superior Avenue Viaduct	Cleveland	Superior Ave.	6/9/1978	Commerce; Engineering; Transportation; Architecture	Structure

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
84000235	Tavern Club	Cleveland	3522 Prospect Ave.	11/1/1984	Architecture	Building
86001573	Taylor Mansion-Lakehurst	Bratenahl	193 Bratenahl Rd.	7/10/1986	Architecture; Social History	Building
74001463	Telling, William E., House	South Euclid	4645 Mayfield Rd.	10/16/1974	Landscape Architecture; Architecture	Building
84000237	Templar-Farrell Motor Sales Building	Cleveland	3134 Prospect Ave.	11/1/1984	Commerce; Architecture	Building
84003653	Temple on the Heights	Cleveland Heights	3130 Mayfield Rd.	3/29/1984	Architecture; Religion	Building
74001455	Temple, The	Cleveland	University Circle at Silver Park	8/30/1974	Architecture; Religion; Social History	Building
13000390	Templin-Bradley Company	Cleveland	5700 Detroit Ave.	6/14/2013	Agriculture; Commerce; Other	Building
78000378	Terra Vista Archeological District	Independence	Address Restricted	5/23/1978	Prehistoric	District
87000444	Third Church of Christ Scientist	Cleveland	3648 W. Twenty-fifth St.	3/19/1987	Architecture	Building
78002046	Thorp, W. A., House	Mayfield Heights	6183--6185 Mayfield Rd.	12/4/1978	Architecture	Building
82004417	Tiedemann, Hannes, House	Cleveland	4308 Franklin Blvd.	3/15/1982	Commerce; Architecture	Building
79000296	Tinkers Creek Aqueduct	Valley View	Tinkers Creek	12/11/1979	Commerce; Engineering; Transportation; Exploration/Settlement	Structure
100000663	Tinnerman Steel Range Company	Cleveland	2048 Fulton Rd.	2/21/2017	Industry; Invention	Building
87000435	Townes, Clayton, House	Cleveland	3800 W. Thirty-third St.	3/19/1987	Politics/Government; Architecture	Building
73001419	Tremaine-Gallagher Residence	Cleveland Heights	3001 Fairmount Blvd.	10/30/1973	Architecture; Social History	Building
94000719	Tremont Historic District	Cleveland	Roughly bounded by I-490, I-71, University Ct., W. 7th St., Starkweather Ave., Brayton, Fruit Ave. and Auburn Ave.	7/15/1994	Architecture; European	District
73001420	Trinity Cathedral	Cleveland	Euclid Ave. at E. 22nd St.	6/4/1973	Art; Architecture	Building
84000239	Trinity Cathedral Church Home	Cleveland	2227 Prospect Ave.	11/1/1984	Architecture	Building
79000297	Ulyatt, Abraham, House	Valley View	6579 Canal Rd.	2/27/1979	Architecture	Building
74001456	Union Club	Cleveland	1211 Euclid Ave.	2/15/1974	Architecture	Building
88003193	Union Steel Screw Office Building	Cleveland	1675--7 E. 40th St.	1/13/1989	Industry	Building
76001405	Union Terminal Group	Cleveland	Public Sq.	3/17/1976	Community Planning And Development; Commerce; Transportation; Architecture	Building
84000240	United Motor Service Building	Cleveland	4019 Prospect Ave.	11/1/1984	Architecture	Building

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
83001954	Universal Terminal Company Dock and Warehouse	Cleveland	5451 N. Marginal Rd.	9/8/1983	Commerce; Transportation	Building
73001421	University Hall, Cleveland State University	Cleveland	2605 Euclid Ave.	2/6/1973	Architecture	Building
74001457	Upson-Walton Company Building	Cleveland	1310 Old River Rd. (W. 11th St.)	1/21/1974	Commerce; Architecture	Building
86000088	USS COD (submarine)	Cleveland	N. Marginal Dr.	1/14/1986	Military	Structure
85001123	Valley Railway Historic District	Independence to Akron	Cuyahoga Valley between Rockside Rd. at Cuyahoga National Recreation Area and Howard St. at Little Cuyahoga Valley	5/17/1985	Transportation	District
04000608	Van Rooy Coffee Company Building	Cleveland	2900 Detroit Ave.	6/16/2004	Industry; Commerce	Building
82003559	Variety Store Building and Theatre	Cleveland	11801-11825 Lorain Ave.	4/1/1982	Commerce; Architecture	Building
87001902	Vaughn Site (33CU65)	Brecksville	Address Restricted	11/12/1987	Prehistoric	Site
93000081	Vaughn, Richard, Farm	Brecksville	9570 Riverview Rd.	3/12/1993	Architecture; Agriculture	Building
90001496	Venice Building	Cleveland	8401--8417 Euclid Ave.	10/1/1990	Architecture	Building
15000559	Villa San Bernardo Historic District	Bedford	1160 Broadway Ave.	9/1/2015	Architecture; Education; Religion	District
04001148	Vitrolite Building	Cleveland	2911--2915 Detriot Ave.	10/13/2004	Architecture; Art	Building
73001422	Wade Memorial Chapel	Cleveland	12316 Euclid Ave., inside Lakeview Cemetery	6/18/1973	Architecture	Building
82001372	Wade Park District	Cleveland	Roughly bounded by E. 105 St., East Blvd., Chester and Euclid Aves.	10/2/1982	Landscape Architecture; Art; Architecture	District
84000259	Walker and Weeks Office Building	Cleveland	2341 Carnegie Ave.	11/1/1984	Architecture	Building
100004410	Warner & Swasey Company Building	Cleveland	5701 Carnegie Ave.	9/20/2019	Engineering; Industry	Building
74001462	Warren, Moses, House	Shaker Heights	3535 Ingleside Rd.	10/22/1974	Architecture; Social History	Building
80002980	Warszawa Neighborhood District	Cleveland	E. 65th St. and Forman Ave.	11/28/1980	Exploration/Settlement; Architecture; Religion; Social History	District
01000897	Waterman Service Building	Cleveland	3030 E. 63rd St.	8/17/2001	Architecture	Building
92001354	Watterson School	Cleveland	1422 W. 74th St.	10/8/1992	Architecture	Building
02001360	Weizer Building	Cleveland	11801 Buckeye Rd.	11/21/2002	Architecture; European	Building
88000055	Weizer Building	Cleveland	8935 Buckeye Rd.	2/8/1988	European; Architecture	Building
12001214	West 25th Street-Detroit Avenue Historic District	Cleveland	Roughly bounded by Detroit Ave., Aust Ct., W. 25th & W. 28th Sts.	1/23/2013	Commerce; Industry; Transportation	District
73001423	West Side Market	Cleveland	W. 24th St. and Lorain Ave.	12/18/1973	Commerce; Architecture	Building

Ref#	Property Name	City	Street & Number	Listed Date	Area of Significance	Category of Property
01000898	West Technical High School	Cleveland	2201 W. 93rd St.	8/21/2001	Education; Architecture	Building
13000841	Westerly Apartments	Lakewood	14300 Detroit Ave.	9/27/2013	Architecture; Social History	Building
73001424	Western Reserve Building	Cleveland	1468 W. 9th St.	10/30/1973	Commerce; Engineering; Architecture	Building
83004278	Westlake Hotel	Rocky River	19000 Lake Rd.	10/20/1983	Entertainment/ Recreation	Building
79001809	Wheatley, Phillis, Association	Cleveland	4450 Cedar Ave.	8/24/1979	Architecture; Social History	Building
78002034	Wheeler, John, House	Berea	445 S. Rocky River Dr.	12/1/1978	Education; Architecture	Building
00000181	White Chewing Gum Company Building	Cleveland	10307 Detroit Ave.	3/9/2000	Industry	Building
73001425	White, Henry P., House	Cleveland	NW corner of Euclid Ave. and E. 90th St.	7/16/1973	Architecture	Building
74001429	Whitney, George W., House	Berea	330 S. Rocky River Dr.	10/22/1974	Industry; Architecture; Social History	Building
100004561	WHK Studio One	Cleveland	4900-5002 Euclid	11/1/2019	Social History; Communications; Entertainment/ Recreation	Building
01000200	William Tricker Inc. Historic District	Independence	7125 Tanglewood Rd.	3/2/2001	Invention; Agriculture; Other	District
79000298	Wilson Feed Mill	Valley View	7604 Canal Rd.	12/17/1979	Commerce; Exploration/Settlement; Architecture	Building
80002981	Wilson's Mills Settlement District	Gates Mills	Chagrin River Rd.	5/29/1980	Exploration/Settlement	District
79001810	Woodland Avenue and West Side Railroad Powerhouse	Cleveland	1180 Cathan Ave., NW	6/4/1979	Industry; Commerce; Transportation; Architecture	Building
86001253	Woodland Cemetery	Cleveland	6901 Woodland Ave.	6/4/1986	Landscape Architecture; Social History	Structure
15000560	Woodland-Larchmere Commercial Historic District	Cleveland	12019-13165 Larchmere, 2618 N. Moreland	9/1/2015	Transportation; Community Planning And Development; Architecture	District
85002801	Zero Gravity Research Facility (B-2)	Cleveland	Lewis Research Center	10/3/1985	Other; Engineering; Science	Structure
84000261	Zion Lutheran Church	Cleveland	2062 E. 30th St.	11/1/1984	Architecture; Religion	Building
84000264	Zion Lutheran School	Cleveland	2074 E. 30th St.	11/1/1984	Architecture	Building

Appendix D. Adoption Resolutions

Appendix E. Plan Review Tool

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Appendix F. Public Comments Received

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Source of Comment	Comment Submitted by: Public / Stakeholder / Jurisdiction	Public Comment Received	Status of Comment: Accepted & Incorporated into the HMP / Declined / Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Thunderstorms cause down trees and electric wires. It takes crews days to repair these wires. Perhaps underground wiring would eliminate this delay.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	More needs to be done to eliminate hackers capturing consumers info. Corporations need to be held accountable if leaks occur.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	City and state vehicles should have PM done in the summer so there will be no delays in clearing side streets so people can get to work or medical appointments. Trucks should be purchased new on a regular basis and additional drivers should be trained to sub in case of absences. Work with Unions to cross train personnel for winter emergencies and absences.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	"All firefighters and police should receive advanced first aid training. First aid kits in all of their vehicles. This includes training on mentally ill persons, deaf, autistic, and how to handle diabetic individuals, who may need assistance."	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Most every time a heavy rain happens, the same areas flood. These areas should be studied and repaired, avoiding rescuing drivers who are trapped. Save money by just asking citizens where they are located. Don't need to spend millions for consultants on this point. Include citizens in this repair planning so they know when their basements will stop flooding. So will the stores on Brookpark road. It happens every year, its cost insurance increases as well as aggravation because nothing is e	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Concerns: damage from downed trees & powerlines as well as flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Concerns: the structural damage (interior and exterior) to homes caused by flooding around foundations as well as caused by land erosion	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Concern: the unseen dangers to residents and the environment caused by the drilling and presence of gas wells and fracking	Forwarded to Cuyahoga County Office of Emergency Management

Source of Comment	Comment Submitted by: Public / Stakeholder / Jurisdiction	Public Comment Received	Status of Comment: Accepted & Incorporated into the HMP / Declined / Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Concern: the potential of isolation of residents and their lack of ability to communicate the loss of electricity and heat due to downed trees and power lines caused by extreme winds, weight of snow and ice	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I don't feel threatened by flooding or drought, but your survey required five choices.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	9/11 response	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding after severe thunderstorms, county-wide trees knocked down after microbursts and winds with velocities over 40 mph.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	No plan for climate crisis impacts due to rising temperatures, increased precipitation and related health hazards, infrastructure damage. Continuing clear cutting of mature trees for construction reducing further the tree canopy cover adding more impermeable surfaces, exacerbating stormwater runoff, erosion, reducing water quality and biodiversity with added impacts on ecosystem services and functions. General ignorance regarding planning for climate crisis impacts on human and ecosystem health.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flash flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The worst events are definitely extreme winter snow. It's made driving difficult/dangerous on many occasions and makes me want to avoid responsibilities outside the house.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	My kids experienced lead exposure that showed up in their blood levels from living in both Little Italy and Old Brooklyn. Now living near an old uranium processing plant by the steelyard. Air quality is dirty and sometimes smelly. Neighbor's house in Tremont exploded.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	1.The blizzards for 1977 and 1978 along with the fuel shortage at the time. 2. The Covid pandemic of 2020-now.	Forwarded to Cuyahoga County Office of Emergency Management

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		3. The electric grid going out in August of 2003 4. Hurricane Sandy	
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Storm damage	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	COVID, localized flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Downed tree branches and power outages due to severe thunderstorms or snowstorms. I was not impacted by the 2 microbursts in Cleveland Heights that happened in the last 10 years, but many of my friends and neighbors were.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	So far (besides the pandemic), there have been several severe thunder and rain storms. While the storms themselves aren't very dangerous, they leave wake of downed wires and tree branches that are not properly dealt with.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Power outage in early 2000s	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Superstorm Sandy or the 2003 East Coast blackout	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Deep freezes. Several years ago, the house I was renting had a flood in the kitchen and throughout the basement because a small dishwasher part near an improperly insulated exterior wall broke. This was around 2015	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	2020-2021: Winter ice storms that take down trees, causing power outages. Flooding of street making it impassible for a period of time. Severe thunderstorms that knock out power.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I have only lived here two years, so the worst hazard I have experienced is Covid-19.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The current COVID-19 pandemic is the worst hazard I have experienced.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I was directly impacted by the 2019 Dayton Ohio tornado outbreak as a resident of Montgomery County Ohio. While my residence received a minor	Forwarded to Cuyahoga County Office of Emergency Management

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		impact, I was without power, water, and spotty cell service for 1.5 weeks.	
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Not enough citizen participation or involvement in at-home disaster preparedness.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The great blizzard of 1976	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flood June 24, 2006	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	COVID-19	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Covid	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Tree damage and flooding from severe thunderstorms	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Community gossip, speculation, and misinformation in the absence of timely and factual information reporting	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Wind from a severe thunderstorm tore siding off of the house	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Loss of heat in winter, utility companies not able to repair	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I am a senior. When I clear my driveway, the snowplows block the apron. This is a problem for everyone. If there is an emergency how can I drive away? If the electric is out, it is a hazard for me to go from an air-conditioned shelter to home where there are no lights, and it is unbearable hot.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	No money for proactive repairs and two-way communication, between City/county governments and its citizens. What's going on to pass on public information, and legislation	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Providers aren't as communicative about resolution of problems	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	COVID epidemic	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Power outage	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	During super storm Sandy (October 2012?) Tree fell on the house causing extensive damage. Many years ago, a severe summer storm knocked out power for more than a week.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding at past homes	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The blizzard of 1987	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Last winter, two significant storms toppled multiple trees on my property and in my neighborhood	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Many winter storms along with LONG power outages. We have just installed a whole house generator.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Severe thunderstorms that cause extended power outages.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Weeklong power outage.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	First Energy is the source of the emergency personnel, and they can become overwhelmed in a large power outage.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Chemical Flooding of my basement and yard	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	1) Power outage in early 2000s that took power out across the eastern US. 2) Other power outages due to severe storms that have lasted days. 3)Severe snowstorms. 4) Climate change has me worried about flooding and droughts.	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding, downed trees due to heavy snow	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	- winter blizzard of 1978. - covid pandemic -back up of Cuyahoga County run storm and sanitary lines several times	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Severe storms autumn, 2020 which caused thousands of dollars of tree damage and 15K damage to my car. Also have had to spend $20-30k in the last 20 years to prevent flooding and erosion from a stream on property. Also had to purchase a generator for 10K due to frequent and prolonged power outages.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding of the Chagrin River in Gates Mills Village	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Driving in blizzard conditions	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Winter storm with prolonged loss of power and many road closures	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Blizzards in the 1970's and 80's	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Long power outages following thunderstorms and early season snow/ice storms are a problem. Twice in the past three years we have personally been without power for 5+ days. First Energy simply couldn't keep up.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	power failure due to snowstorm	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Winter Snow damage, power outages, no available water due to water main breaks	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding due to poor drainage on surrounding land and in storm drains	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding due to storm drains overflowing and backing into my house.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Heavy snowfall	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Neared is addressing flooding issues as is our Fed Decree Consent plan for Cleveland Heights	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I'm unable to mark locations. Map is inactive; but flooding; Parma along Big Creek. Brecksville towards low-lying areas near the Metroparks. North Olmstead along the Rock River.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	There's a history of flooding in this area. Includes FEMA flood zones.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Storm water management	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	There's a history of flooding in this area.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	This area of highway is dangerous in winter weather with the curves.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Lead in housing stock	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Lead in housing stock	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Old uranium plant that has not been cleaned up is in floodplain	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Air quality- my fans are always dirty. This did not happen when I lived in a different city.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Power goes out frequently. Once during the winter there was a long outage that was a health hazard because the inside temperature dropped so low for so long.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Sewage overflow into Lake Erie. Husband got sick after swimming in lake.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Safety concerns.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Basements flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The underpass routinely floods in even moderate rain	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The parkway experiences serious flash flooding issues due to its topography. It was under feet of water during summer 2020's severe thunderstorm event.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Canal Road frequently floods due to its proximity to the River and canal and its low elevation.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Extremely low tree cover in this neighborhood makes it vulnerable to extreme heat from the urban heat island effect.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I'm not affected as my apartment is in the eighth floor, but Parma has several areas that flood badly. There were some bad choices made in earlier development like the large stores and parking lots along Brookpark in a flood plain. Past changes to the creek push more water into this area.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	City of Parma is trying to address flooding, but methods include controversial changes to local parks.	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Street flooding/poor stormwater drainage services	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	At least 3 storm events in the past 12 months have caused impassable street flooding on Wayne Dr.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Stormwater Drainage - street and residential back yards	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I believe Wayne Dr. residents have requested remediation to the street flooding, but have not been responded to by the City of Berea	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Cuyahoga River Flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Seasonal and affects use of Towpath	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Electrical outages and poor city services with snow removal	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Big Creek Flooding due to construction and floodplain issues	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The valley on Green Rd is frequently flooded when there are heavy rains.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Frequent basement floods after heavy rains.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Any rainfall causes extensive flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Personnel to address hazards	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Lack of available beds at hospitals	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Lower part of NR.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Basements backfilling from street	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	When it rains very heavily in a short period of time the storm sewers become overwhelmed and back up into people's homes and make streets impassable. In some places, the streets wash out or sink holes form	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The trees in this part of town are very old and susceptible to storm damage. A more comprehensive and longer-term plan for tree management, and tree replanting program is needed.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Gun violence is out of control in this neighborhood.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Gun violence is out of control in this neighborhood.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	It was a stream which was put underground. Basements often have water issues	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Many traffic accidents	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Problems with robberies & beatings	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Every time it rains Parma's basements flood. Other areas flood also, same areas nothing is ever fixed to eliminate this when streets and sewers were put in and streets were dug up and replaced. Then a sign is erected saying flood hazard. What was the reason this was not remedied when the street was dismantled?	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Roadway in this area needs repair and becomes more dangerous in inclement weather	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Curb lanes eastbound often have standing water during storms	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The hills - this is the steepest - need more attention in the winter.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Chagrin River	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Frequent power outage	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flood	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Chagrin River flooding	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	1: Electric grid sustainability during and following weather-related incidents.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	2: Adequate emergency personnel (I.e., medical, safety clean up).	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Control property development and improvements to ensure erosion control and reduce water pollutants resulting from lawn pesticides, fertilizers	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	River	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	River	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Street	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Power outages	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Chagrin river overflowing banks	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Power outages	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Hazardous chemicals	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding due to severe rain	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Multiple power outages across the village	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Multiple power outages	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Chagrin River Watershed	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Chagrin River watershed	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Low area along Chagrin River subject to flash flooding and flooding due to extensive rain over longer periods of time	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Utilities need to be put underground	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	River overflow	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Helped with significant action from village	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	High traffic	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Bridge at Chagrin River collects debris (entire trees) and suffers heightened flooding that is damaging the bridge and its durability.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding due to poor drainage on {REDACTED – PII] vacant property	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Lack of care of property leads to poor drainage that backs up on all surrounding properties and out to street drainage as well	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Storm drains overflowing	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Storm drains overflowing	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Flooding concerns	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Stop spending our money we send to you on tourism hotels and sports arenas.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Notify us where to go what to do in event of total utility/ internet failure and or terroir attack	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Adapt the Cuyahoga County Climate Change Action Plan and form compacts with other surrounding cities to jointly cooperate on hazard mitigation and pooling resources. There's too little collaboration due to politics.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	As above, with the addition of holding plastic manufactures responsible for their products which now constitute over 30% of municipal solid waste in landfills. This also goes for lawn cuttings and garden waste which constitutes 50% of solid waste in the US. Both are hazards which impact all other components of mitigation and adaptation to climate change and impacts on human health.	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	More regional planning efforts and active collaboration with communities to improve storm water management.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Invest more of its resources in regular maintenance of its storm water and sewer infrastructure. Implement stricter requirements for storm water management with new construction.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Quick response teams to weather hazards	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Quick response teams to weather hazards	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Continuing to address the deterioration of Cleveland's housing stock for all residents is a big one.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Strengthen safety forces, stronger broadband for all, infrastructure updates - sewers and electrical lines below ground.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Infrastructure updates.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Make electricity grid more resilient and redundant. Support conversion to solar. Better oversite on pollution - air and water. Clean the lake already. Take lead poisoning seriously!!! I know so many families in Cleveland whose kids have been affected by this that I tell every pregnant person to get their house checked. These resources need tube free and automatic - sync them with the OB depts as part of pre-natal care. The costs otherwise to even test, never mind correct, can be prohibitive.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	especially in heavily populated areas, ensure the entities in charge of post-storm clean ups (e.g., the City of Cleveland) is doing their job.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Form community action teams that are tasked by the City/County to lead the clean ups. If the City won't do it, we will. But we need guidance and clearance to do so.	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Develop heat mitigation plans focused on reducing the urban heat island effect and increasing access to cooling centers.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Develop heat mitigation plans focused on reducing the urban heat island effect and increasing access to cooling centers.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Develop more robust public transit to minimize cars on roads in winter and to end the waits of up to an hour for transfers.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	We need public education about how our choices cause problems like flooding. Metroparks doing some good work, but more people need to be reached. West Creek Conservancy doing good work restoring creekside areas to natural state. Those efforts need support	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	"Expand Solar energy options for residential homes	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Offer stormwater/flooding remediation funds/services	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	improve IT/internet connectivity throughout the county"	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	City officials contact residents on Wayne and surrounding streets to discuss flooding mitigation, develop a plan to improve stormwater drainage	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Address complete dysfunction of services at City of Cleveland	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Personally - I am looking at solar...hoping to move out of Cleveland at some point.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Increase awareness of winter storms and severe thunderstorms.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Keep storm drains clear of debris. Ensure proper drainage when new buildings are erected.	Forwarded to Cuyahoga County Office of Emergency Management

Source of Comment	Comment Submitted by: Public / Stakeholder / Jurisdiction	Public Comment Received	Status of Comment: Accepted & Incorporated into the HMP / Declined / Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Community involvement	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Being prepared for an event with 48-72 hours' worth of food, water, and backup communication.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	More first responders	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	More first responders	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Communicate plans	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Ensure safety forces are properly staffed	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Continue to modernize our sewer and storm water systems. We're working to do this, but it will take funding from the County, State, and Federal governments to fully mitigate the risk.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Understand and address underlying reasons for gun violence in the region. Better sewer system management and long-term planning for projected increases in rain fall. Better long-term planning for the tree canopy. Stop investing in 400k+ tax abated concrete and plastic jungle condo developments and start investing in (a) housing that addresses other socioeconomic groups and (b) green spaces that help manage climate change. Restructure taxes to the state level	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Support plan for post incident clean up, almost FEMA for Cuyahoga County	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Have regional support plans	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	If the County would purchase needed supplies in bulk, in theory it would be cheaper. Then make it available to cities at cost. I THOUGHT THATS WHY THEY HAVE COUNTY REPRESENTAVES.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Listen to Dale Miller, he is experienced in getting things accomplished in government areas. There are probably other underused members that can make this happen"	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Have C.E.R.T training and have residents that are certified go out and help	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Build better sewer systems. Keep trees cut back from power lines. Fix roads, focus more on infrastructure then political debates.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	upgrade power grid in our area	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Protect the area from over population	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Provide service to those in need. Keep out the riff raff.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Require First Energy to beef-up their grid and maintenance work.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Encourage large tree pruning and removal around the electrical infrastructure.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Support watershed initiatives for protection of lakes and streams. Prop up educational programs related to environmental impacts, particularly in Metroparks.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	They are working on it. Committed to Chagrin River Watershed Partners and working on mitigation plans.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Keep sewer drains clear DURING storms.	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Be much more aggressive trimming trees near power lines, pay for tree trimming and removal that homeowners think would impact power lines. Vote Republicans out of office in order for Cuyahoga County to receive proper assistance.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	assist with tree trimming around critical power lines. support First Energy with support crews.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Identify vulnerable power lines.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Hazmat	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Hazmat	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	The county needs to take responsibility for their sanitary and storm lines. There have been multiple floods in our area and the county always blamed the homeowner. Finally, after numerous floods, they finally saw that they were wrong, and they did some work on our street. Problem is that we lost a lot of property in our basement and spent tens of thousands of dollars repairing the damage from their floods. The county needs to check the lines automatically for both storm and sanitary annually.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Clean the storm drain culverts often to keep our streets from flooding.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	With loss of power, cable goes out. Without cable there is loss of communications (no phone and no email/information [internet]).	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Communities need to require that cable company has means to provide backup power to ALL nodes in time of crisis in a timely fashion (within hours-not days)	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Improve mental health opportunities for those in urban areas	Forwarded to Cuyahoga County Office of Emergency Management

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Cuyahoga County Hazard Mitigation Plan Public Survey	Public	I'm fortunate to have lived in Gates Mills and Hunting Valley - great action by leaders and residents	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Work with FE to encourage them to move utilities underground	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Downed power lines are not a government problem	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Keep electric grid intact and maintain lines. Maintain water infrastructure. Timely severe weather alerts on phones, email, etc.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Spend more on infrastructure repair and flooding mitigation.	Forwarded to Cuyahoga County Office of Emergency Management
Cuyahoga County Hazard Mitigation Plan Public Survey	Public	Request clean-up support more quickly.	Forwarded to Cuyahoga County Office of Emergency Management
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	NEORSD Annex pg. 2. second paragraph Table not numbered, pg. 3 no number for table, page 7 section 3.1.5 first paragraph number of classes don't add up the 8 ODNR regulations, page 12 under Fiscal Capability fourth bullet capitalize "I" in intergovernmental, and section 5 pg. III first paragraph "lawsuit" should be one word.	Accepted & Incorporated into the HMP
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	Cuyahoga Region, Table 1-4: it seems extremely low that there are only 4 daycares within the 8 cities of the Cuyahoga Region.	Accepted & Incorporated into the HMP
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	1.1.1 they talk about the communities on decline but Cleveland had growth TABLE 1-4 CRITICAL FACILITIES : double check the amount of schools in Bratenahl 3.1.3 Regional Vulnerability: Bratenahl has homes that are very close together and are a small compact community as is. They should reconsider being vulnerable especially after covid-19. Linndale I believe is in the same boat. They are economically vulnerable as well.	Accepted & Incorporated into the HMP

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		3.5.3 Bratenahl is against the lake as well, they receive lake effect snow as well	
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	The table that has the critical facilities (nursing homes and schools) does not correspond with the map below as to how many are in the table. Were schools and daycare centers lumped together because some schools have daycare services as well?	Accepted & Incorporated into the HMP
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	Base Plan: • Section 2.2.1 Effects of Population Change on Mitigation p. 15, Third Sentence, change like to likely. Westshore Annex: Section 1.1 Population, Occupancy, and Demographics pg. 2, 2nd paragraph, last sentence: • Change part of sentence from allows the region to assess hazard magnitudes better and develop more specific mitigation plans. Section 1.1.1 Effects of Population Change on Mitigation pg. 2 • Third sentence - Vacant homes are more likely to sustain heavy damage during events such as thunderstorms, high winds, tornadoes, and winter storms. Section 1.1.1 pg. 5 • Change sentence structure to Each community's responses to the Changes to Development form are displayed in the following table. 1.1.3 Critical Facilities table 1-4 Critical Facilities in Westshore Planning Region pg. 5 • Bay Village has a fire station Table 2-1 Jurisdictional Participation Pg. 8 • Changing O to a green check, due to potential confusion with a zero Table 3-1 Westshore Planning Region Risk Evaluation Pg. 11 • Place abbreviation at the bottom of the table.	Accepted & Incorporated into the HMP
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	Base Plan, 4.18 Civil Disturbance - Section may need to change to reflect Civil Unrest in 2020	Accepted & Incorporated into the HMP
Online Draft Plan Comment Form	Jurisdiction (University Heights)	Heights Region Annex, p. 33. Change to "We are in the exclusion zone of the Perry County power plant."	Accepted & Incorporated into the HMP

Source of Comment	Comment Submitted by: Public / Stakeholder / Jurisdiction	Public Comment Received	Status of Comment: Accepted & Incorporated into the HMP / Declined / Forwarded to Cuyahoga County Office of Emergency Management
Online Draft Plan Comment Form	Public	The low lying areas in and around Valley View, Ohio being filled in and up in the last 1-5 years. The residents of Murray and Fosdick have no way of dealing with these drastic changes to the land right above them. The City View Shopping Center and the the Boyas and Kurtz projects on Rockside Rd from Valley View to Garfield Hts. This has caused NEW massive runoff. Now they are dumping mounds of dirt on West Canal Rd. The residents have no way of keeping up with these changes. Was there any consideration to what would happen to the residents of Murray and Fosdick before these projects moved forward? Did the Army Corp approve these changes? I guess those of us that moved into Valley View knew what we were getting into when we moved in. But the changes in the last 1-3 yrs to the surrounding areas have been too much fast for the residents. Our situation has only become worse and more frequent and the value of our homes has declined; not to mention the neighborhood looking trashed by unkept homes, most of them vacant. Also will the city help us by snaking out our footers from all the mud that is contained in them from the floods? If not, we need government assistance, our walls will not dry out because the water has nowhere to go. There are so many issues that need to be addressed. I hope we can get some of this resolved. Can we discover (or count on) Federal funding to make the necessary corrections? That's going to be the most difficult part. But I have discussed this with several different entities. On the positive side of things, I think we will be successful in accomplishment. The discussion of roadway elevation in front of Murray and Fosdick was something thought of a long time ago with the front installation of Mile 9 Landing of the Ohio & Erie Canal. In similar to the old continuous mounding plan, they have added re-routing of Mud Creek and natural levies along the Cinemark side. Please review and advise the status of helping us here in Valley View, Ohio ASAP. There are several new issues and obvious changes over the years they should be addressing immediately that are changing the flood plain as they know it. We have communicated many years now with the US Army Corps of Engineers.	Forwarded to Cuyahoga County Office of Emergency Management

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		[REDACTED – PII] Chief, Public Affairs Officer Great Lakes and Ohio River Division U.S. Army Corps of Engineers Please review and advise the status of helping us here in Valley View Ohio ASAP. We have lived here at [REDACTED – PII] in Valley View, Ohio for 23 years and just began to have floods that are extremely devastating beginning in 2006 at which time we rebuilt our basement after having 7 feet of mud water and replaced our losses. No one realizes how difficult this is unless they witness this type of loss. This was unexpected and very traumatic; we lost a lot in our basement since we have a ranch and the basement is used for living quarters. We live in a floodzone but we are very far from the canal and never used to get water until businesses were allowed to be put up all around us with no restrictions or investigations by the Army Corp of Engineers (in Buffalo, NY since there is no floodplain department in Cleveland). I wrote them a letter a 1991 to determine if there was any solution. There was obviously no proper inspections done. My husband and all members of our family worked hard to rebuild what we lost and were able to enjoy it for 3 years. Now again we were flooded with 6 feet of water nearly coming to our second floor. Again we are devastated. The stress and the costs have been unbelievable. We are carrying flood insurance with the national flood insurance program which is very expensive in addition to our home insurance. Now they are considering canceling the flood insurance program in the future because it is so costly. What about us? Will they just leave us continue to flood and destroy our homes while the government sits back? Money goes to other countries and they are not concerned about us. FEMA offered to pay to raise our home. We would have to pay to add to the back of our home to compensate for the loss of our basement living quarters since it is a ranch. We would also lose value in our home with less square footage. With my back issues, I am also unable to live with as many steps as would be needed if it was raised. Our lender is Third Federal. How can they continue to allow this to happen to the property they have invested in? Why has nothing been done to	

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		help our streets and reroute the water from coming into our homes? Why are flood gates or flood walls not a consideration? I asked for a flood wall and I was refused. I cannot afford to walk away from the home since we have a mortgage or allow FEMA to only give us a small percentage of what the home is worth and be financially able to move to another location. We are also unable to raise our house because of the steps and the inability for me to use steps of this nature since I have knee trouble. I also have a weak heart along with a blood clot in my left ventricle in my heart and COPD. Raising the home is not an option. We are getting no assistance from the government or the Army Corp of Engineers in getting any relief. Our mayor said the Army Corp is proposing floodwalls and levies now. The river study should be completed by around 2014. Does it really take them since 1991 to complete this study and why? Why is this not a priority? What could be more important than helping prevent people from going through frequent disasters like this? While they are taking their time we are losing our homes and our health. In 2006 we applied for additional assistance from the government and were denied assistance because we both work 2 full time jobs. Please advise if you will be able to assist us. My letter sent to The Army Corp of Engineers in 1991 and another letter to the state of Ohio government for assistance in 2006 are attached for your review. Why haven't our Cuyahoga County representatives been visiting us and researching gathering government dollars to help us? We need Federal cooperation to get the job done now. Low interest loans are the not the answer; we cannot afford any more loans or debt. Note from Owner [REDACTED – PII]: It seems to me that more dollars are going overseas then to our own citizens that have recently encountered flood disasters. It is a shame that millions of dollars are being spent to help victims overseas when I could not even get a check from our flood insurance company cashed for advance of $2,000 at our lending institution, Third Federal Savings & Loan to pay for work that had already been done not paid for!! (our insurance adjustor advised us to move quickly to get back to comfortable living quarters, ie furnace, electric, water tank, etc). This country and its politics are so "messed" up - you have no idea what we have gone through in one month's time and yet everyone is getting aid and we have so much red tape	

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		just to get an advance check cashed. Our government offices ought to be ashamed of themselves. You never even proclaimed this flood in February as a state disaster - we are not sure why. In addition, other items in this area need to be addressed to alleviate the flooding in the future. Construction on the towpath was being done in 2006 at the intersection of Granger and Canal which restricted the flow of water in the canal as well as construction near Tinkers Creek Road on Canal Road. This could have contributed to the massive amount of water overflow are draining into Valley View causing overflow possibilities even more. The creek called Mud creek needs to cleaned periodically and nothing is being done which also is causing the water to overflow more than necessary. The access road proposed years ago for the residents on Murray Road and Fosdick Road in Valley View to help the residents during flooding has been held up by the government as well. Commercial buildings such as the movie theater and restaurants have been when the heavy rains came. Pipes coming from City View in Garfield Heights built on high ground causing water to flow into our homes at a more rapid pace. Nothing has been done to help contain the flow of the water for the residents here. Please advise what you as our state representative will be doing for the residents here. Lack of maintenance of the culvert between Murray and Fosdick with the Army Corp of Engineers in 1991. This culvert was initially put in to alleviate the water as well. Nothing has ever been done to address this issue. The residents keep trying to fill it in because no one ever maintained it properly – big mistake.	
Online Draft Plan Comment Form	Jurisdiction (Cuyahoga County Office of Emergency Management)	Base Plan: Page 9 • In the paragraph under 2.1.3 Climate Change "shirt-sleeve" to "short-sleeve" Page 15 • In the first paragraph under 2.2.1 Effects of Population Change on Mitigation it states "Vacant homes are more likely to sustain heavy damage" • "Severe summer storms" should be "severe thunderstorms". Page 82 • Under the Lightning section, the comment "Invisible to the human eye" isn't accurate. As	Accepted & Incorporated into the HMP

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		the stepped leader extends to the ground it is reflected as light and once it makes contact with the ground and the positive and negative charges exchange accordingly is when you see that pulse in the lightning current. But as the negative charges descend is the beginning of the lightning you see in a storm. • Under the Lightning section, the last sentence "The rapid expansion of the heated air causes thunder". To be more accurate, when the negative charge makes contact with the positive charge at the surface and the positive charges begin to move up the current to the cloud the negative charge expands out away from the lightning bolt and rapidly contract back to the current. The charges collide with one another as they reach the bolt and that collision makes the thunder sound. Page 83 • Under the Heavy Rain section, a period is missing in the third line down. "6 PM and midnight. Rain develops..." • In the 4.2.3 Extent section, after "National Weather Service" should be (NWS) and then throughout the rest of the document the NWS abbreviate should be used. Page 85 • In the paragraph under Table 4-11 the last sentence, "However, various coins and balls are often used when reporting hail size." It might be beneficial to specify they use "sport balls" for identification. Page 88 • The chart under Heavy Rain Events is title "Hail Events by Month". The information looks different than the hail chart I just think the title is misrepresented. Page 97 • Under the Seiche section "atmosphere pressure" change to "atmospheric pressure" Page 105 • Section Cuyahoga County's River Characteristics the NOAA abbreviation is used before identifying what it means. I would put National Oceanic and Atmospheric	

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		Administration (NOAA) and then use the NOAA abbreviation moving forward. • Same section: the NWS has already been identified just use the NWS acronym without National Weather Service. Page 106 • Put a space under the Table 4-20 and the 4.3.4 Historical Occurrences title • Under section 4.3.4 Historical Occurrences – General Trends change the sentence accordingly “These events have caused a total of $114,141,000 in property damage but no crop damages.” Page 110 • Under section 4.3.5 Probability of Future Occurrences typically for probability especially with meteorology they look at 30 years of data at a minimum. Page 117 • 2 emergency operation centers Page 118 • Under the General Building Stock Damage section should Hazus be Hazus-MH? Page 133 • In the first paragraph under the table it states, “Heat is one of the leading weather-related killers in the United States, resulting in hundreds of fatalities each year.” • In the second paragraph under the Extreme Heat section it states, “Extreme Heat is the number one weather-related killer in the United States.” Is it the number one killer or one of the leading weather-related killers? • The second paragraph under Extreme Cold the last sentence ends with (National Weather Sentence) is that last sentence being cited? Page 134 • The first sentence of the last paragraph mentions “National Weather Service” should be NWS. Page 155 • Under 4.6.2 Tornado Location section the last sentence is “Generally, an entire county or region is under a tornado warning or watch.”	

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		This method of warning is outdated. Tornado Watches and Warnings used to be issued by county and now they are issued via polygons to be more specific. • Under 4.6.3 Extent edit the first sentence to reflect "The Enhanced Fujita Scale, also known as the "EF-Scale," measures tornado strength though its associated damages and is the current scale used to define the intensity of a tornado in the United States." Page 159 • Under the General Trends section, it states "March through October" but on page 155 it says "March through June" Page 160 • The sentence just above Table 4-57 "Tornadoes" should be lower case Page 162 • The sentence before 4.6.6 Assets Exposed to Tornadoes "Tornadoes" should be lower case Page 173 • The couple sentences under Table 4-61 is almost word for word on page 169. Page 174 • In the section under General Trends after Ohio Department of Natural Resources should have (ODNR) since it referenced as ODNR later in the same paragraph. Page 189 • The last sentence in the first paragraph under Building-Related Losses is unfinished. • In the second paragraph under the same section there's a space between 46_%. Please change to 46%. Page 204 • There's a highlighted bar between "the" and "County" in paragraph 4. Plan Integration Annex: Page 1 • The second paragraph under Background and Purpose edit "an" to be "a" before HMP Page I • The third paragraph under Appendix A. Plan Integration Annex please reword the sentence	

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		“These plans and were reviewed to inform the recommendation in this section.” Page VII • In the second paragraph under 2.3 Housing Policies and Plans “severe summer storms” should be “severe weather” or “severe thunderstorms” and “tornadoes” Southcentral Region Annex: Page 8 • The green circles are confusing, maybe change to checkmarks or something similar Page 15 • In the paragraph under 3.2.1 History of Occurrences NCDC is now known as National Centers for Environmental Information (NCEI). Page 17 • What does the CY and HY mean in the equation? Page 21 • NCDC is mentioned change to NCEI Page 31 • Spell out USGS Page 38 • Second paragraph under 3.12.2 Future Probability change 100 percent to 100% Page 39 • “Climate Change” should not be capitalized • The second sentence under 3.12.1 ends in “climate chance” should be “climate change” Page 46 • Last sentence before Table 3-8 “jurisdictions’” should be capitalized. Page 49 • First sentence “Civil Disturbance” disturbance should be lower case Page 50 • In Figure 3-10 can we label the number or percentages in each category to know the value?	
Online Draft Plan Comment Form	Jurisdiction (Cleveland)	I appreciate the time and effort put into 2022 Cuyahoga County All-Hazards Mitigation Plan update. I feel there is good detail in both the Base Plan and Hillcrest Annex. This make me feel better about the community in which I	Accepted & Incorporated into the HMP

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		live and that with this plan in place the community will have constant improvements in the future.	
Online Draft Plan Comment Form	Stakeholder (Cleveland Metroparks)	Throughout document - Cleveland Metroparks should read as Cleveland Metroparks; Metroparks is one word. Page 102. We are experiencing coastal erosion at Wendy Park, which is not depicted in the red zone on your map. Page 122 - Cleveland Metroparks Zoo, not Zoological Park	Accepted & Incorporated into the HMP
Online Draft Plan Comment Form	Stakeholder (Cleveland Metroparks)	Page 259 and 262 - Dam and Levee Failure Section 4.15. Regarding Acacia Country Club Dam: Board of Park Commissioners of Cleveland Metropolitan Park District does not own the dam. There is a license and easement agreement granting the City of Lyndhurst the right construct, reconstruct, repair, and maintain all parts of the dam. These documents can be forwarded upon request. Please email me at [REDACTED – PII] if you would like these documents.	Accepted & Incorporated into the HMP