# Draft Report

Erie County, Ohio Natural Hazard Mitigation Plan



## Executive Summary

This plan is the successor to hazard mitigation planning efforts begun in Erie County in 2004 when the County received a grant to develop and adopt a Natural Hazards Mitigation Plan for the County and the participating jurisdictions'.

Erie County assets are at risk of damage due to flooding, severe storms, or other natural hazards. This plan provides a long-term approach to reducing the likelihood that a natural hazard will result in severe damage. This plan updates the data upon which the assessment of risk and identification of vulnerabilities is based and presents updated strategies for making Erie County a safer and more sustainable community.

The Erie County Natural Hazards Mitigation Plan represents the work of residents, business leaders, and elected and appointed government officials to develop a blueprint for protecting community assets, preserving the economic viability of the community, and saving lives. Endorsed by FEMA as being in compliance with regulations based on the Disaster Mitigation Act of 2000, the plan will help the County to implement mitigation projects so that a natural hazard does not result in a natural disaster.

The hazard mitigation planning update consisted of gathering and analyzing data available from various sources within the county. The data show that the hazards most likely to result in costly damages are flooding, severe storms, and tornadoes. Erie County officials and representatives from local jurisdictions proposed and evaluated strategies that may be effective in mitigating the negative effects of natural hazards and the plan presents a conceptual-level approach for implementing these strategies. The plan recommends a number of public education efforts, structural efforts such as the elevation of structures above anticipated levels of flooding or the development of safe rooms in public schools to provide shelter during tornadoes, and the examination and the potential modification of zoning ordinances and other development regulations to ensure the risk of damage to new structures is minimized.

Most mitigation activities require funding. Under the Disaster Mitigation Act of 2000 (DMA2K, 42 USC 5165), a mitigation plan is a requirement for Federal mitigation funds. Therefore, a mitigation plan will both guide the best use of mitigation funding and meet the prerequisite for obtaining such funds from the Department of Homeland Security's Federal Emergency Management Agency (FEMA). This Mitigation Plan meets the criteria as set forth by FEMA in the DMA2K and provides a community with a "comprehensive guide" for future mitigation efforts as they relate to the natural hazards that affect their community.

This Mitigation Plan was developed in coordination with a Core Group of individuals from communities and agencies throughout Erie County. The Core Group met two separate times during the planning process to reevaluate the hazards that affect the County, the problems associated with these hazards, potential mitigation alternatives to minimize the effect of these hazards and goals that they would like to see achieved within the county.



Erie County has experienced many natural disasters in the past one hundred years. Through a strategic effort led by the Erie County EMA offices, the Core Group evaluated these hazards and chose to address the following hazards based on their impact on human health and property damage: floods, severe storms (summer and winter), tornadoes, earthquakes, droughts, lake/stream bank erosion, and invasive species.

The culmination of Erie County's Mitigation Plan was an Updated Action Plan for the communities to use to track progress on the implementation of their mitigation alternatives. By adopting this plan, county, township and incorporated jurisdictions of Erie County commit to working with citizens and business owners to make their communities safer.

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# Introduction

This plan is an update of the **Erie County Natural Hazards Mitigation Plan** that was originally adopted in 2005 by the Erie County Commissioners and all incorporated jurisdictions within the County.

Erie County is at risk of damage from a variety of natural hazards: flooding, tornadoes, severe storms, earthquakes, droughts, lake/stream bank erosion, and invasive species. This plan explains the analysis of the potential effects of these natural hazards on the structures and infrastructure within Erie County and proposes measures to reduce the risk of a natural hazard leading to a disaster with property loss, business disruption, or even loss of life.

In the past, natural hazards have led to costly disasters in Erie County resulting in a Presidential Declaration of Major Disaster. These disasters are listed in **Table 1** showing that their causes.

Date	Disaster Declaration Number	Hazard			
July 15, 1969	DR-266	Heavy Storms and Flooding			
November 24, 1972	DR-362	Storms and Flooding			
April 27,1973	DR-377	Storms and Flooding			
January 26, 1978	DR-3055-EM	Severe Blizzard Conditions			
August 25, 1995	DR-1065	Severe Storms and Flooding			
August 23, 2003	EM-3187	Power Outage			
January 11, 2005	EM-3198	Snow Removal and Response			
September 13, 2005	EM-3250	Hurricane Katrina Emergency Shelter Operations			
July 2, 2006	DR-1651	Severe Storms and Flooding			

#### Table 1: Past Presidential Disaster Declarations in Erie County

Flooding is a major hazard in terms of total damage costs. Out of the nine presidential disaster declarations, six of them are related to flooding.

# Purpose of the Plan

The emergency management community, citizens, elected officials and others in Erie County recognize the potential impacts of natural hazards on their community and have developed this plan to mitigate potential damages and reduce future losses. Hazard mitigation actions reduce the potential for loss of life and destruction of property. Mitigation actions are taken in advance of the occurrence of a potential hazard and are essential for breaking the disaster cycle of damage, reconstruction, and repeated damage.

This plan presents an evaluation of the potential negative consequences of the natural hazards that may affect Erie County and proposes strategies that will reduce or mitigate losses.

Adoption and implementation of this plan ensures that Erie County and participating jurisdictions continue to be eligible to apply for and receive certain Federal grant funds that are administered by the Ohio Emergency Management Agency (Ohio EMA) for the Federal Emergency Management Agency (FEMA). This plan complies with the requirements of the Disaster Mitigation Act of 2000 and its implementing regulations published in Title 44 of the Code of Federal Regulations (CFR) Section 201.6.

# Organization of the Plan

To make the plan easier to follow, this plan is organized by hazards identified by the Core Group. This plan explains all steps of the mitigation planning process for each hazard. By organizing the plan by hazard, the relationships among a hazard, the potential effect of the hazard, and the actions proposed for mitigating negative effects of that hazard are obvious.

The sections of this plan are:

- **Introduction:** Identifies the purposes of this plan and the jurisdictions that have participated in plan development.
- **Planning Process:** Summarizes the earlier planning process as well as the process of updating this plan.
- **Community Profile:** Discusses existing conditions, including development trends and current local government capabilities.
- **Hazard Identification:** Identifies the natural hazards that may affect Erie County.
- **Risk Assessment Sections for Each Identified Hazard:** Includes a summary of changes since the previous plan was adopted, a profile of each hazard, and an assessment of the potential impact of each hazard.
- Summary of Risk Assessment Findings: Highlights the conclusions of the previous Risk Assessment Sections.
- Mitigation Goals: Presents planning principles, mitigation goals, and objectives.
- Alternative Mitigation Actions: Explains the status of actions proposed in the previous plan, presents a comprehensive array of possible actions, and explains how actions were evaluated.
- **Proposed Mitigation Actions:** Explains how actions address existing and future development and continued compliance with the National Flood Insurance Program (NFIP), how actions will be incorporated into other plans, and how actions will be implemented.

- **Plan Maintenance:** Explains how mitigation actions will be monitored and how the plan will be evaluated and updated.
- **Sources of Information:** Lists Web sites and publications used to develop this plan.
- **Appendices:** Include sample plan adoption resolutions, public notices about the planning process, and the survey instruments used by participating jurisdictions.

# Jurisdictions Represented in the Plan

This is a multi-jurisdictional hazard mitigation plan. The jurisdictions that participated in the development of this plan are the same jurisdictions that participated in the development of the initial version of this plan and passed legislation adopting the plan. Along with the County government officials involved, the participating jurisdiction's included: Groton Township, Milan Township, Perkins Township, Village of Bay View, Village of Berlin Heights, Village of Castalia, City of Huron, Kelleys Island, Village of Milan, and the City of Sandusky. The adjacent Counties of Lorain, Huron and Sandusky were invited to participate in the planning process. A copy of the letter of invitation to adjacent counties in included in **Appendix IV**.

# Adoption Resolutions

**Appendix I** provides sample adoption resolutions that participating jurisdictions will adopt after FEMA Region V determines that this plan is approvable pending adoption. An approvable plan meets planning requirements specified in 44 CFR Section 201.6. A plan is fully approved after it is adopted; signed adoption resolutions will be included in **Appendix I** when the plan is submitted for final approval by FEMA Region V.

# Planning Process

The Erie County Natural Hazards Mitigation Plan represent the work of citizens, elected and appointed government officials, business leaders, and volunteers of non-profit organizations in developing a blueprint for protecting community assets, preserving the economic viability of the community, and saving lives.

# **Planning Process**

#### **Mitigation Core Group**

During the Planning Process, the plan was led by a Mitigation Core Group. Representatives of the previous Mitigation Core Group as well as other community leaders were invited in April of 2013 by the County EMA Office to actively participate in updating the plan; those who accepted the invitation comprise the current Mitigation Core Group members.

Mitigation Core Group members for the 2014 plan were:

- Bay View, Mayor- Barb Wobser
- Berlin Heights Village, Clerk- Sara Hoffman
- Berlin Twp., Trustee- John Zarvis
- Castalia Police Department, Michael Barefoot
- City of Huron, Fire Chief- Steve Osterling
- Earl Brown
- Erie County EMA, Administrative Assistant- Marianne Cheetham
- Erie County EMA, Bob Hall
- Erie County EMA, Director- Tim Jonovich
- Erie County Health Department, Division of Administrative Services- Matt Heyduk
- Erie County Health Department, Epidemiologist- Kelley Bemis
- Erie Regional Planning Commission, Director/Economic Development- Steve Poggiali
- Erie Regional Planning Commission, Senior Transportation Planning Engineer-Carrie Whitaker
- Erie Soil and Water Conservation District, Conservation Stewardship Specialist-John Rufo
- Columbus (CMH) Erie Soil and Water Conservation District, District Director-Jim White
- Friends of Pipe Creek Watershed, Kathie Mueller
- Friends of Pipe Creek Watershed, Norm Sherer
- Friends of Pipe Creek Watershed, Oran Sherer
- Friends of Pipe Creek Watershed, Patti Keller
- Friends of Pipe Creek Watershed, Ron Dorski



- Groton Twp., Fire, Chief- Kerry Jett
- Huron Twp., Trustee- Don Ritzenthaler
- Kalahari Resort, Directory of Security, Raul Gomez
- Kelleys Island Fire Department, Acting Chief- John Hostal
- Kelleys Island Police Department, Police Chief- Ron Ehrbar
- Kelleys Island, Mayor- Kyle Paine
- Milan Twp. Fire, Chief- Brian Rospert
- NASA Glenn Research Center, Contract Management- Bud Vance
- Ohio Veterans Home, Police Chief- Gabe Ferencz
- Ohio Veterans Home, Safety Directory- Tim Mahoney
- Perkins Twp Fire, Fire Chief- Keith Wohlever
- Perkins Twp, Trustee- Tim Coleman
- Perkins Twp., Chairman- Jeff Ferrell
- Perkins Twp., Donnell Butler
- Perkins Twp., Eric Dadrill
- Perkins Twp., John Butler
- Sandusky Fire, Communication and Dispatch- Captain Jim Green

To aid in the development of the plan, the county contracted the services of URS Corporation, a consulting firm with expertise in hazard mitigation planning.

As part of the effort of updating the initial mitigation plan, the Mitigation Core Group decided to re-organize the plan to make it simpler to follow. The Mitigation Core Group prioritized mitigation alternatives through an iterative process of document review during August 14<sup>th</sup>, 2013 Mitigation Core Group meeting until consensus was reached.

### **Jurisdictional Participation**

During the process of updating the plan, each meeting of the Mitigation Core Group was open to representatives of participating jurisdictions. Representatives were invited to attend the meetings in person or to take advantage of a conference call option to participate in the discussion.

The first meeting of the Mitigation Core Group was held in the evening to accommodate schedules on June  $5^{\text{th}}$ , 2013 at the Erie County Office Building. Representatives from each participating jurisdiction were invited by the Erie County EMA Director by letter and email to participate in the meeting, a copy of the e-mail invitation and notes from the meeting are included in **Appendix II**. During this meeting, Core Group members determined that the previous plan goals and action items were insufficient and did not fully represent the objectives the Core Group envisioned for the plan. Discussion for new plan goals and action items were brainstormed for preliminary goals and action items.

At the second Core Group meeting on August 14<sup>th</sup>, 2013, the Core Group approved the new goals there were created at the last meeting and revised leading up to the meeting. Action items generated at the first meeting and over communications leading up to the

second Core Group meeting were finalized and prioritized. A voting method was utilized which allowed Core Group members to consider multiple factors when selecting the importance of action items, which is explained in detail in the Benefit Cost Review of Mitigation Alternatives section. Also during this meeting, the Core Group unanimously agreed upon incorporating a new format for the plan that is better organized for the current FEMA requirements.

A digital copy of the draft plan was mailed to each participating jurisdiction along with a letter of explanation. A list of reviewers and a copy of the cover letter sent to jurisdictions is located in **Appendix III**. (add comments from review period)

Additional correspondence occurred throughout the planning process update through the Erie County Emergency Management Agency. When there were defined gaps in data, the Erie County EMA Director helped the consultant either locate the source of the needed data or directly supplied the data to the consultant for inclusion in the Mitigation Plan.

# Public Involvement

A notice about updating the hazard mitigation plan was posted on the home page of the Erie County's website beginning at the start of the updating process in May 2013 and continuing throughout the planning update. Residents of Erie County and neighboring communities who might be interested in participating in the process were invited to participate by the Erie County EMA. The volunteers that responded to this invitation are included in the Core Group roster.

An invitation to the public to review and comment on the draft plan was posted on the home page <u>http://www.eriecounty.oh.gov/departments-and-agencies/health-and-safety/emergency-management/</u>of the Erie County Government Website from [*insert dates*]. A screen shot of the Web page is displayed in **Appendix IV**.

Because public participation in the drafting of the plan has been poor, a press release inviting review and comment on the plan was issued on February 21, 2014. The press release was sent to the Sandusky Register. A copy of the press release is displayed in **Appendix IV**. Another press release will be released in correspondence with the Final Draft Plan's release and will be recorded and documented in the Plan.

The public was provided an opportunity to review and provide comment on the draft Erie County Natural Hazards Mitigation Plan throughout the entire planning process. The Plan was posted on the Erie County website as noted above. As of the final draft version of the plan Erie County received no comments via the public outreach effort including the website.

In addition to the press release, letters were sent to prior Core Group Members, large local businesses, all school districts and the Erie County Soil and Water Conservation District on [*insert date*]. Participants were able to view the Draft Plan via the Erie

County website. No comments were made by the deadline for any comments, [*insert date*]. A copy of this letter is included in **Appendix IV**.

The public was provided a final opportunity to comment on the draft of the updated plan at a public hearing when it was presented to the elected officials of each of the participating jurisdictions in Erie County for adoption during the months of [*actual dates to be inserted*] 2014.

### Other Planning Mechanisms

During the process of updating the plan, URS and the Mitigation Core Group reviewed existing planning mechanisms to ascertain community capabilities and identify opportunities for implementing mitigation actions. These plans are further referenced in the Capability Assessment section of this plan. The Erie County EMA office staff also worked directly with incorporated communities not present at any of the planning meetings so they have input into the planning process.

#### Gathering New Data

Gathering and analyzing new data about natural hazards and the community was critical to the process of updating the plan. New data used for the plan are identified throughout the plan; however, because flooding and severe storms are the most common and the most costly natural hazards that occurs in Erie County, particular attention was provided to gathering data on these hazards. Extra attention was also used when assessing structures and areas that have been damaged repeatedly by flooding.

# **Community Profile**

This section provides a large amount of information on the county for community leaders to make better informed decisions when dealing with mitigating natural disasters.

# **County Information**

Erie County is located in north central Ohio, along the shore of Lake Erie. According to the U.S. Census Bureau, the County has a total area of 626 mi<sup>2</sup>, with 255 mi<sup>2</sup> of land and 371 mi<sup>2</sup> of water. Erie County is bordered on the east by Lorain County, on the south by Huron County, on the west by Sandusky and Ottawa Counties and on the north by Lake Erie. The northern boundary of Erie County consists of 35 miles of shoreline along Lake Erie and Sandusky Bay. Erie County extends 28 miles in an east-west direction and 11 miles in a north-south direction.

The City of Sandusky, which is the County Seat, forms the largest incorporated area, with 27,844 residents according to the 2000 Census. Sandusky is 55 miles east of Toledo, 60 miles west of Cleveland and 106 miles north of Columbus. Other cities in the County, in the order of descending population, include Huron, Vermilion and Bellevue. Villages in the County, in the order of descending population, include Milan, Castalia, Bay View, Berlin Heights and Kelleys Island.

Erie County is highly suitable for agriculture because of its relatively mild temperatures. The County has annual mean temperature of 49°F, an average low of 20°F in February and an average high of 86°F in July. The average annual rainfall of Erie County is 34 inches. Over 50% of the County's land is used for farming various fruits and vegetables, as well as raising cattle and hogs.

Erie County is accessible by land, water or air. U.S. Highway 6 runs east-west along the coast of the County. The Ohio Turnpike (Interstates 80 and 90) also runs east-west through the County and provides access to the cities of Cleveland and Toledo. Six additional Federal and State Highways provide transportation access in the County. Two major railroads pass through Erie County. Shipping access to Lake Erie is available in Huron, Sandusky or Vermilion. There are two airports utilized by Erie County residents. The one, located within the county of Erie, is called Griffing Sandusky Airport. The other main airport, Erie-Ottawa Regional Airport is located close to the city of Port Clinton and is within Ottawa County.

The entire county population is 77,079. Shown in **Table 2** is the growth of the county since the 1800's.

Year	Total Population	Year	Total Population
1800	N/A	1910	38,327
1810	N/A	1920	39,789
1820	N/A	1930	42,133
1830	N/A	1940	43,201
1840	12,559	2,559 1950 52,565	
1850	18,568	1960	68,000
1860	24,474	1970	75,909
1870	28,188	1980	79,655
1880	32,640	1990	76,779
1890	35,462	2000	79,551
1900	37,650	2010	77,079

Table 2: Erie County's Overall Growth Since the 1800's

There are 9 townships in Erie County. **Table 3**, below, illustrates the change in population over the past decade.

Name	1990 Total	% Change 1990-2000	2000 Total	% Change 2000-2010	2010 Total
Erie County	76,779	3.5%	79,551	-3.2%	77,079
Berlin Township	2,628	12.9%	3,017	-0.3%	3,009
Berlin Heights Village	691	-0.9%	685	4.1%	714
Florence Township	2,101	16.0%	2,500	-2.1%	2,448
Groton Township	1,245	10.0%	1,384	3.1%	1,429
Huron Township	2,267	11.9%	2,572	27.5%	3,548
Huron City	7,030	11.7%	7,958	-11.3%	7,149
Kelleys Island Village	172	53.1%	367	-17.6%	312
Margaretta Township	4,601	1.3%	4,662	-3.7%	4,497
Bay View Village	739	-6.8%	692	-9.5%	632
Castalia Village	915	2.1%	935	-9.7%	852
Milan Township	2,093	21.3%	2,661	-2.3%	2,602
Milan Village*	1,056	-3.0%	1,025	-2.1%	1,004
Oxford Township	1,150	-4.9%	1,096	8.7%	1,201
Perkins Township	10,793	14.2%	12,578	-3.1%	12,202
Sandusky City	29,764	-6.9%	27,844	-8.0%	25,793
Vermilion Township	4,051	12.7%	4,638	6.2%	4,945
Vermilion City*	5,483	-11.1%	4,937	-4.1%	4,742

#### Table 3: Township Change in Population from 1990 to 2010

\*Erie County Portion Only

An Erie County demographic profile is also available on the Ohio Department of Development's website and provides more specific information for Erie County and its political jurisdictions. A map of Erie County is shown below in **Figure 1**.



Figure 1: Erie County Map

# Jurisdictions

The nine incorporated jurisdictions that participated in the development of the Erie County hazard mitigation plan are the Village of Bay View, City of Bellevue, Village of Berlin Heights, Village of Castalia, City of Huron, Kelleys Island, Village of Milan, City of Sandusky, and the City of Vermilion. According to the 2010 Census, the largest areas of population are in City of Sandusky (25,793), City of Huron (7,149), and City of Vermilion (4,742).

**Bay View** 

The Village of Bay View is located in the northern part of Margaretta Township, 8 miles west of Sandusky, and comprises 0.3 square miles of land area. As of the Census of 2010, there are 632 people, 279 households and 172 families residing in the Village. The population density is 2,107 people per square mile. There are 342 housing units at an average density of 1,140 units per square mile.

#### Bellevue

The City of Bellevue is located in Huron, Sandusky, and Erie Counties. It is located in the southwest corner of Erie County in Groton Township, 15 miles southwest of Sandusky, and comprises a total land area of 5.2 square miles. According to the Census of 2010, there are 8,202 people, 3,296 households and 2,148 families residing in the City. The population density is 1,577 people per square mile. There are 3,662 housing units at an average density of 704.2 units per square mile. The City of Bellevue is participating in Sandusky County's Hazard Mitigation Plan.

#### **Berlin Heights**

The Village of Berlin Heights is located in the south central portion of Berlin Township, 18 miles southeast of Sandusky, and comprises a total land area of 1.6 square miles. As of the Census of 2010, there are 714 people, 269 households and 211 families residing in the Village. The population density is 446 people per square mile. There are 282 housing units at an average density of 176.3 units per square mile.

#### Castalia

The Village of Castalia is located in central Margaretta Township, 7.5 miles southwest of Sandusky, and comprised of 1.0 square mile of total land area. As of the Census of 2010, there are 852 people, 352 households, and 239 families residing in the Village. The population density is 852 people per square mile. There are 378 housing units at an average density of 378 units per square mile.

#### Huron

The City of Huron is located in the north central portion of the County in Huron Township, 10 miles southeast of Sandusky, bordering Lake Erie. The city has a total land area of 7.7 square miles. According to the 2010 Census, there are 7,149 people, 3,073 households and 1,988 families residing in the City. The population density is 928 people per square mile. There are 3,710 housing units at an average density of 481.8 units per square mile.

#### Kelleys Island

Kelleys Island, which is the largest freshwater American island, is located in Lake Erie, 11 miles northwest of Sandusky, and has a land area comprising 4.6 square miles. As of the Census of 2010, there are 312 people, 175 households and 99 families residing in the

Village. The population density is 68 people per square mile. There are 859 housing units at an average density of 186.7 units per square mile.

#### Milan

The Village of Milan is located in southern Milan Township. It has a land area of 1.2 square miles. Milan is 13 miles south of Sandusky. According to the Census of 2010, there are 1,367 people, 509 households and 370 families residing in the Village. The population density is 1,139 people per square mile. There are 551 housing units at an average density of 459.2 units per square mile.

#### Sandusky

The City of Sandusky is the County Seat of Erie County and was incorporated in 1824 and is located in the northwest portion of the County bordering Lake Erie. The City is comprised of 10.0 square miles of land area. As of the Census of 2010, there are 25,793 people, 11,082 households and 6,415 families residing in the City. The population density is 2,579 people per square mile. There are 13,386 housing units at an average density of 1,338.6 units per square mile.

#### Vermilion

The City of Vermilion is located in both Lorain County and Erie County. It is located on the western border of Lorain County and the eastern border of Erie County. The City has a total land area of 10.8 square miles. According to the Census of 2010, the population of the City is 10,594. There are 4,183 households and 3,033 families residing in the city. The population density is 981 people per square mile. There are 4,919 housing units at an average density of 455.5 units per square mile. The City of Vermilion is participating in Lorain County's Hazard Mitigation Plan.

# Land Use and Development Trends

Erie County lies in the Central Lowland Province. Lying in an area of lake plain and till plain physiography, the County has a relatively uniform, level topography. Berlin Township is the highest point in Erie County and is 320 feet above the approximate mean level of Lake Erie. Most of the County has a slope of six percent or less. The steeper areas are mainly a result of deep stream dissection. Beach ridges and bedrock ridges account for a small percentage of the steeper areas.

Erie County drains northward into Lake Erie. There are 17 distinct watersheds in the County. Primary watersheds include Mills Creek and Pipe Creek to the west, the Huron River in the central part of the County, Old Woman Creek in the east-central part of the County and the Vermilion River on the eastern edge of the County. Small creeks drain the other watersheds. **Figure 2** illustrates the existing general land use in the County.



#### Figure 2: Erie County Land Use Map

Soil surveys contain information that affects the land use planning of a county. The February 2002 Interim Report Soil Survey of Erie County, Ohio contains predictions of soil behavior for selected land uses, as well as emphasizes soil limitations, improvements needed to overcome the limitations and the impact of selected land uses on the environment. Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to us as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

Erie County has 38 soil types, grouped into 11 associations, which vary in drainage quality from very poorly drained to well drained. The 11 associations include: Toledo-Weyers-Endoaquents-Sandusky, Fulton. Del Rey-Milford, Bennington-Haskins-Pewamo-Bennington, Mahoning-Ellsworth-Orrville, Cardington, Allis-Bennington, Hornell-Fries-Colwood (bedrock substratum). Milton-Millsdale-Castalia, Kibbie-Colwood-Elnora, and Jimtown-Oshtemo-Millgrove Associations. According to the Ohio State University Extension Water Resources, 27% of these soils are very poorly drained and 38% somewhat poorly drained.

The natural resources of Erie County include water, sand and gravel and some layers of bedrock. The groundwater in Erie County varies considerably in quality and quantity. Water is obtained from glacial material or bedrock, depending on the location of the well site. Surface runoff, infiltration rates and geologic material affect the water supply. Typically good sources of water can be found in glacial deposits with lenses and stratified layers of sand and gravel and yield from 20 to 250 gallons per minute (gpm). However, most wells in glacial deposits have low yields on less than 10 gpm. Bedrock wells also

vary considerably in suitability according to the area and type of geologic material. For instance, up to 500 gpm can be obtained from the wells drilled in the cavernous limestone bedrock found in the western portion of the County. A large quantity of ground water obtained from similar formations in the western portion of Erie County has potential for contamination resulting from underground disposal of wastewater, or may have high concentrations of hydrogen sulfide. Aside from glacial or bedrock wells, water may also be obtained from Lake Erie, dug wells, cisterns, and ponds, as long as surface water and groundwater pollution are controlled to ensure a quality water supply.

The U.S. Department of Agriculture defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. Prime farmland includes cultivated land, pastureland, forest land or other land that is not urban or built-up land or water areas. It has a, adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from zero to six percent.

Approximately 129,000 acres of Erie County, or nearly 71% of the total acreage, meets the soil requirements for prime farmland; and are located primarily in the western part of the County. Most agricultural land is used for cash grain crops, particularly hay, corn, wheat and soybeans. Specialty crops, such as sugar beets, cabbage, tomatoes, and melons, are also grown. Dairy and livestock are also important sources of revenue. In 1997, approximately 89,871 acres were used as farmland. This acreage consisted of 380 farms, averaging 237 acres per farm. In 2001, corn generated the largest amount of crop cash receipts while cattle produced the largest amount of livestock cash receipts.

A small percentage of land is devoted to woodlands, usually on steep slopes along major streams and in undrained areas. According to the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), as of 1996, only about 21,800 acres remain forested, mainly in river bottoms and in small, scattered woodlots in the uplands. Most woodlands have been harvested repeatedly, and many have been pastured. Although farm products provide a larger income for the County residents, in properly managed and harvested woodlands, most Erie County soils may potentially provide income per acre that is similar to other agricultural products through the sale of timber products. Woodlands are also beneficial because they provide wildlife habitat, serve as windbreaks from erosion, produce nuts, lumber and fuel wood, and have aesthetic value. Pastures are common in areas where soils present severe limitations affecting row crops. The common pasture and hay plants include alfalfa, red clover, alsike clover, bluegrass, orchard grass, tall fescue, timothy and brome grass.

With good management practices, most soils are highly productive for crops and pasture. The major soil management concerns are seasonal wetness (including ponded areas), erosion, soil structure damage (compaction, crusting, clod formation), droughtiness, and soil fertility. Seasonal wetness and ponding are major concerns on approximately 117, 026 acres of land in Erie County. The very poorly drained Colwood, Condit, Holy, Mermill, Milford, Millgrove, Miner, and Pewamo soils are naturally so wet that crop production is typically not possible unless surface or subsurface drainage is installed. The somewhat poorly drained Bennington, Elliot, Haskins, Jimtown, Mahoning and Orrville soils are naturally so wet that crops are damaged during most years and planting and harvesting is delayed unless artificial drainage is installed. Existing County and private drainage systems should be maintained as adequate outlets for present and future land uses. Urban construction activities can damage and disrupt these existing systems. As a result, renewed wetness and ponding of these previously drained cropland areas now impact homeowners' use of this land. In order to maintain or improve these drainage systems, cooperation is necessary between the urban and agricultural communities.

Approximately 23,494 acres of Erie County land are affected by water erosion. Erosion becomes a hazard when the slope of the soil is greater than two percent, and increases as the slope increases. Erosion is a concern because it reduces the natural soil fertility and productivity as the original topsoil is removed and the more acid subsoil is incorporated into the surface layer through tillage. If the amount of annual soil loss exceeds the rate at which new soil is formed, long-term productivity and natural fertility are affected. Erosion is also a problem because it increases the cost of crop production, results in poor soil structure in the surface layer, increases the need for tillage to incorporate organic matter into the surface layer and reduces the available water capacity of the surface layer. Sediment removal is the most costly item in ditch maintenance. Controlling erosion protects the soil resource base, maintains long-term productivity, reduces drainage maintenance costs and improves water quality. Wind erosion is primarily a concern on the sandier soils. Sod strips and windbreaks can reduce the effects of wind velocity. Windbreaks protect livestock, buildings, and yards from wind and snow. Erosion can be controlled through crop rotations, cover crops, crop residue management, water-and sediment-control basins, grassed waterways and conservation tillage, as well as plowing in the spring rather than in the fall.

Agriculture is the primary land use in Erie County. According to the 2002 Soil Survey of Erie County, in 1982, farms comprised 100,000 acres of the County, or 55% of Erie County's land. Erie County had 535 farms, with an average size of 185 acres. Approximately 5,600 acres were used for pasture and 16,900 acres were urban or built-up land. However, this amount declined to 50%, or 90,000 acres of farmland, in 1992. These 90,000 acres consisted of 406 farms, with an average size of 219 acres. Approximately 94,900 acres were used for cropland, 6,700 acres were used for pasture, and 27,400 acres were urban or built-up land. Thus, although there was less farmland and a smaller number of farms, the average farm size increased. The difference in number of acres of farmland is most likely due to the conversion of farmland to urban or nonfarm uses.

In addition to land acres, the County is bordered by Lake Erie across the northern boundary of the County. The County also contains approximately 800 acres of lakes within its borders. According to an Environmental Protection Agency (EPA) estimate, Erie County also contains approximately 340 linear miles of streams and rivers. In addition, 55.9 miles of County-maintained open ditches, 17.3 of tile ditches and approximately 200 miles of privately-maintained ditches are used for land drainage. Approximately 8,600 acres of Erie County are considered wetlands (www.eriecountyohiocofc.com).

The community of Erie County has expressed several ideas and concerns about future land use in their 1995 Erie County Comprehensive Development Plan. Erie County is faced with development pressures due to expanding residential areas in and near villages. Below are some guidelines Erie County has established:

•Promote community development through redevelopment, economic development, and constructing infrastructure to meet the demands for development

•Provide all residents in the County adequate, affordable housing

•Preserve the County heritage and those structures significant to its salvation for future generations

•Maintain harmony between the man-made and natural environment by sustaining the County's dedication to protecting the environment through its support of legislation and programs intended to preserve open spaces and natural habitat

•Provide high quality recreation facilities to meet the increasing demands of all residents who reside within the planning area

•Ensure growth in employment will not be obtained through excessive costs to the environment or jeopardize the livability of the community

•Become efficient and accessible through improvements to street systems, developing along roadways, and through transportation planning

•Encourage growth in areas physically suited and already serviced by infrastructure

# Capability Assessment

The purpose of the Capability Assessment is to identify strengths and weaknesses that will affect the ability of the county and participating jurisdictions to implement mitigation actions. Capabilities include a variety of regulations, existing planning mechanisms, and administrative capabilities provided through established agencies or authorities.

# **Regulatory Capabilities**

**Table 4** summarizes the regulatory tools used in Erie County and participating jurisdictions. These regulations support the goals of this hazard mitigation plan and provide opportunities for further mitigating the potentially negative effects of natural hazards through regulation.



#### Table 4: Regulatory Capabilities

Jurisdiction	Zoning Ordinances	Development Regulations	Floodplain Regulations	Floodplain Management Regulations	Stormwater Management Regulations	Building Codes	Planning Commission	Comprehensive Plan	Capital Improvement Budget	Public Works Budget
Erie County	(none)	Yes	Yes	Yes (2008)	Yes	(none)	Yes	Yes		
Village of Bay View	Yes				Yes					
City of Bellevue										
Village of Berlin Heights	Yes	Yes	Yes	(none)		(none)	(none)			
Village of Castalia	Yes	Yes			Yes					
City of Huron	Yes	Yes	Yes			Yes	Yes	Yes		
Kelleys Island	Yes	Yes	(none)	(none)	Yes	Yes	Yes		Yes	
Village of Milan	Yes	Yes				Yes	Yes	(none)		
City of Sandusky	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City of Vermilion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Zoning Ordinances:** Regulates development by dividing the community into zones or districts and establishing the type of development allowed within each district. The floodplain can be designated as one or more separate zoning districts in which development is prohibited or allowed only if it is not susceptible to flood damage. Some districts that are appropriate for floodplains are those designated for public use, conservation or agriculture. Zoning works best in conjunction with a comprehensive plan or "road map" for future development and building codes.

**Development Regulations:** Further specify how development can occur. Subdivision Regulations govern how land will be broken up into individual lots. These regulations set construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers, stormwater retention or detention basins, and drainage ways.

The National Flood Insurance Program (NFIP) is a voluntary program which requires the development of a floodplain ordinance. Erie County has an approved **floodplain management ordinance**.

**Stormwater Management Regulations:** Provide for the conveyance of stormwater to decrease flooding. Erie County currently has drainage regulations in place.

Adoption and enforcement of **building codes** ensure that both residential and nonresidential structures are safe. Building codes provide some of the best methods of addressing all the hazards in this plan. They are the prime measure to protect new property from damage by high winds, tornadoes, earthquakes, hail, and winter storms. When properly designed and constructed according to code, the average building can withstand the impact of most of these forces.

A local **historic district ordinance** enables a community to regulate development in a specific, designated area of historic significance. A historic district ordinance is included in Erie County's comprehensive plan.

### **Planning Capabilities**

#### **Comprehensive Planning**

Comprehensive plans and land use plans specify how a community should be developed (and where development should not occur). Through these plans, uses of land can be tailored to match the land's hazards. Comprehensive planning reflects what a community wants to see happen to their land in the future. A comprehensive plan can look 5, 10, or even 20 years into the future to help a community plan and shape how they envision their community. However, planning is only one part of the puzzle and usually has limited authority. Tied with zoning comprehensive planning can be more effective.

A comprehensive plan has been completed for Erie County.

#### **Emergency Operations Planning**

The Erie County **Emergency Operations Plan** (EOP) is a requirement of the Ohio Revised Code, Section 5502.271. The purpose of this EOP is to predetermine, to the extent possible, actions to be taken by the governmental jurisdictions of Erie County to prevent avoidable disasters and respond quickly and adequately to emergencies in order to protect the lives and property of the residents of Erie County.

The EOP is designed to work for all types of natural and man-made disasters. The document has a Basic Plan which defines and identifies areas of potential risk, lists people and organizations involved in response situations, and discusses plan development and maintenance. The Basic Plan is augmented with annexes that describe the details of various aspects of emergency response. Some examples of these annexes include Direction and Control, Notification and Warning, Law Enforcement, Medical, Anti-Terrorism, and Resource Management.

The plan contains guidelines with respect to roles and responsibilities. The Emergency Operations Center (EOC) is responsible for directing and controlling the conduct of emergency operations from that center, or from an alternate facility during emergencies. The EOC, in coordination with the Incident Commander at the site, will be the point of contact for all operating/responding departments and agencies, other counties and the State.

#### Watershed Planning

Four river basins influence drainage in Erie County: The Black River and Rocky River in Loraine County drain the northeastern corner of Erie County, the eastern portion of the county drain to the Huron River and Vermilion River, the western portion of the county is drained by the Sandusky River and Green Creek, and the islands of Erie County drain to Lake Erie. All four river basins flow into Lake Erie.

Currently the only state endorsed watershed action plan in Erie County is for Old Woman Creek. In addition, the Firelands Coastal Tributaries Watershed Program (<u>http://www.firelandstributaries.net/about\_us.html</u>) covers Erie County's small watersheds.

#### **Emergency Action Planning for Dams**

In Ohio, most dams are constructed of earth. Dams must have spillway systems to safely convey normal stream and flood flows over, around, or through the dam. Spillways are commonly constructed of non-erosive materials such as concrete. Dams also have a drain or other water-withdrawal facility to control the pool or lake level and to lower or drain the lake for normal maintenance and emergency purposes.

There are no Class I dams in Erie County and no Emergency Action Plans (EAPs) for existing dams. Typically, each EAP addresses ways to safeguard lives and reduce

property damage within the inundation area; procedures for effective dam surveillance; procedures for prompt notification of emergency management officials; warning and evacuation procedures; and emergency response actions that will be taken in the event of potential or imminent failure of the dam. According to Ohio Administrative Code Rule 1501:21-13-01, dams are classified as follows:

Class I: A dam shall be placed in Class I when failure of the dam would result in probable loss of human life. Dams having a storage volume greater than 5,000 acre-feet or a height of greater than 60 feet shall be placed in Class I.

Class II: Dams having a storage volume greater than 500 acre-feet or a height of greater than 40 feet shall be placed in Class II. A dam shall be placed in Class II when failure of the dam would result in at least one of the following conditions, but loss of human life is not envisioned.

Class III: Dams having a height of greater than 25 feet, or a storage volume of greater than 50 acre-feet, shall be placed in Class III. A dam shall be placed in Class III when failure of the dam would result in at least one of the following conditions, but loss of human life or hazard to health is not envisioned.

Class IV: When failure of the dam would result in property losses restricted mainly to the dam and rural lands, and not loss of human life or hazard to health is envisioned, the dam may be placed in Class IV.

According to the ODNR, Erie County has three dams within its boundaries that fall under a classification. The number of dams and their classifications are as follows:

- Class I- 0
- Class II+III 3
- Other- 16

Erie County has 16 Class IV and unclassified dams, which have been determined by the ODNR's Chief of the Division of Water to not constitute a hazard to life, health or property in the event of a failure. (Information was obtained from Ohio Mitigation Plan Rev 2011)

The following information on **Table 5** lists Class I, II, and III dams in Erie County.

Name	Class	Stream Owner Type		Vulnerability
Berns Lake Dam	Ш	Tributary to Sugar Creek	Private	<1%
Work Lake No. 2 Dam	III	Tributary to Huron River	Private	<1%
Hire Lake Dam	III	Tributary to Huron River	Private	<1%

#### Table 5: Erie County Dam Summary

There are two dams in Erie County recorded in the National Inventory of Dams (NID). According to the National Performance of Dams Program (NPDP) both dams are a low hazard without any previous incidents. A map of damns in the county is included in **Appendix XI**.

# **Additional Capabilities**

A variety of additional capabilities are established in Erie County. These capabilities can support the implementation of mitigation actions that are proposed in this plan. These capabilities are:

State of Ohio Rain Snow Monitoring System (STORMS)

The State of Ohio Rain/Snow Monitoring System (STORMS) is an automated rain gauge system that monitors an area's snow and rainfall for potential flooding while transmitting current, real-time precipitation data to the State Emergency Operations Center, the ODNR, the NWS and county emergency management agencies. The rain gauges are usually positioned near watersheds and report data 24 hours a day to computers in Columbus and are used by NWS as a prediction tool for flood and flash flood watches and warnings. Local governments are also able to access the data through special computer systems connected to the gauges.

#### **Other Resources**

Support for mitigation planning actions is provided by the State of Ohio and the Federal Government. Programs that complement Erie County mitigation planning initiatives are:

- Ohio administered programs include the following:
  - **Hazard Mitigation Assistance Programs:** Provide grants for costeffective mitigation projects either in the absence of a disaster or after a disaster declaration has occurred.
  - **Ohio Department of Development:** Provide grants for job ready sites and community development block for economic development.
  - **Ohio Department of Natural Resources:** Provide support for land and water conservation efforts.
  - **Ohio Environmental Protection Agency:** Provide grants and loans for capital improvements within a community.
- Federal Government programs include the following:
  - **Hazard Mitigation Assistance Programs:** Provide grants for costeffective mitigation projects either in the absence of a disaster or after a disaster declaration has occurred.
    - Pre-Disaster Mitigation Assistance Program (PDM)
    - Flood Mitigation Assistance Program (FMA)
    - Repetitive Flood Claims Program (RFC)
    - Severe Repetitive Loss Program (SRL)
    - Hazard Mitigation Grant Program (HMGP)

- **Community Development Block Grants:** Provides funds to address a wide range of community development needs.
- Small Communities Program Fund: Supports water quality infrastructure projects.
- Weatherization Assistance Program: Enables low-income households to make their homes more energy-efficient.
- **Firewise Communities Program:** Involves homeowners and community leaders in protecting structures from fire damage.

# Structure Assessment

The purpose of this section is to identify type, quantity, and value associated with each structure within all the jurisdictions. This will provide information when preparing a vulnerability analysis for each hazard as well as give valuable information for estimating the damages when a disaster hits. **Table 6** was created from information given by the county auditor and shows the type and approximate value associated with each structure within Erie County.

#### Table 6: Structure Inventory

	Residential		Non-Residential		Critical Facilities	
	Count	Avg. Value	Count	Avg. Value	Count	Avg. Value
ERIE COUNTY	25,438	\$91,591	3,484	\$261,830	1,451	\$306,310

# Hazard Identification

To reduce the potential for damage due to hazards, it is necessary to identify hazards that may affect the county. This process is completed using published information and Web sites that address hazards globally, nationally, within Ohio, or specifically within Erie County as well as anecdotal information provided by members of the Mitigation Core Group and the public.

Hazards are identified and examined in this plan update as required by the Disaster Mitigation Act of 2000. The seven identified natural hazards are:

-Flooding -Severe Storms -Tornado -Earthquakes -Droughts -Lake/Stream Bank Erosion -Invasive Species

# **Description of Hazards**

The descriptions of hazards included in the 2014 Plan are largely based on publicly available data provided by the National Oceanographic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) and the Ohio Department of Natural Resources. The hazard data was evaluated by the Mitigation Core Group. The Mitigation Core Group unanimously agreed upon the prioritization based off of historical data on the hazards. **Table 7** summarizes each hazard that may affect Erie County.

#### Table 7: Descriptions of Natural Hazards Addressed in This Plan

Hazard	General Description of Hazard	
Flooding	A flood is a natural event for rivers and streams. In Erie County excess water from snowmelt or rainfall accumulates and overflows the stream banks into adjacent floodplains.	
	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 can occur during any season of the year. Serious flooding occurs regularly along one or more of Ohio's major rivers or streams.	
	Additionally, ice jams can cause flooding during winter months. Ice jams occur when water builds up behind a blockage of ice. Typically these are due to a heavy rain that causes a frozen river to swell, which breaks the ice on the surface of the river. Ice is carried by the current and accumulates at narrow passages or obstructions.	
Severe Storms (Thunderstorms, Hail, and Winter Storms)	Thunderstorms can occur at any time of the year and just about anywhere in the world. A thunderstorm forms when moist, unstable air is lifted vertically into the atmosphere. Lightning occurs in all thunderstorms. Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere, where they freeze into ice. Hail forms only in thunderstorms, in cumulonimbus clouds that contain vast amounts of energy in the form of updrafts and downdrafts.	
	Heavy snow and ice are caused by winter storms bringing frozen precipitation and cold temperatures to the area. Heavy accumulations of ice can cause extensive damage by bringing down trees and toppling utility poles and communication towers, which disrupts power and communications. Winter storms may also lead to the collapse of roofs in deteriorated structures.	
Tornado	A tornado is an extraordinary feature generally associated with severe thunderstorms or hurricanes. A tornado is characterized by a funnel of violently rotating winds. While the extent of tornado damage is usually localized, the extreme winds of a tornado are among the most destructive and can cause millions of dollars of damage and loss of life when they move through populated, developed areas.	
	Tornadoes can occur at any time but most frequently occur during the late afternoon or early evening, the warmest hours of the day. Peak months for tornado activity are April, May, and June.	
Lake/Stream Bank Erosion	Lake erosion is the gradual wearing and carrying away or land or beach materials by wave action, water, wind, general weather conditions and tidal currents. Stream bank erosion is the direct removal of banks and beds by flowing water. These types of erosion are typically caused by a rise in sea level and high stream flow.	
Invasive Species	The National Invasive Species Council defines an invasive species as one that "is both non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm, or harm to human health." Invasive species include plants, aquatic life, and insects.	

Earthquakes	Earthquakes are the sudden motion or trembling of the ground caused by the breaking and shifting of rock beneath the surface of the earth. Ground shaking from earthquakes can collapse buildings and bridges and disrupt gas, electric, and phone service.
Droughts	A drought is a period of prolonged dryness that contributes to depletion of ground water and surface water. Adverse consequences of drought include insufficient supplies of water for human consumption as well as agricultural and industrial uses and deterioration of water quality. High temperatures, prolonged winds, and low relative humidity can exacerbate the severity of drought. The probability of wildfires increases as the severity and duration of a drought increases.

# Flooding Risk Assessment

Due to flooding being a site specific hazard, data about the location and types of structures and infrastructure in the county were reviewed to identify changes in vulnerability. Erie County is currently in the process of getting new digital flood insurance rate maps which will result in a more accurate assessment of their vulnerability to flooding. New digital flood maps are based on a revised Flood Insurance Study that used more accurate topographic data than were available in the past and that accounted for additional impervious ground cover due to new development in the townships.

Information about flood loss was augmented in order to comply with the modifications of 44 CFR Part 201.6 that became effective in October 2007. Regulations now require that local hazard mitigation plans place special emphasis on the mitigation of Repetitive Loss Structures, which are structures insured by the NFIP that have had at least two paid flood losses of more than \$1,000 each in any 10-year period since 1978.

# Hazard Profile – Flooding

Flooding is an important issue for the residents and local business owners of Erie County. Whether it was riverine flooding or flash flooding events that occurred in the past, lives have been disrupted and damage has been extensive.

Erie County has special flood hazard zones identified within the county. The best way to combat disaster losses within these special flood hazard zone areas is through public awareness. Except for Berlin Heights and Kelleys Island, all of Erie County is in compliance with state floodplain management standards and participates in the National Flood Insurance Program (NFIP). The county has been involved since September 29, 1989. The following list gives the incorporated jurisdictions that participate in the NFIP and the date in which they entered the program.

- Village of Bay View September 15, 1977
- Village of Castalia May 25, 1978

[No Special Flood Hazard Area (NSFZA) – All Zone C]

- City of Huron April 3, 1978
- Village of Milan September 1, 1978
- City of Sandusky July 5, 1977
- City of Vermilion December 31, 1981

The following list gives the incorporated areas which have had special flood hazard areas identified but do not participate in the program and the date in which the hazard area was identified.

- Village of Berlin Heights April 5, 1974
- Village of Kelleys Island August 17, 1981



FIRM maps from August 28, 2008 are currently used and have been adopted by the county. Floodplain Administrators at county and local levels helped make floodplain regulations and enforce the regulations. Floodplain Administrators also monitor the floodplain on a regular basis, provide community assistance regarding floodplain ordinances and promote the upkeep of flood insurance.

#### Location

Erie County lies in the Central Lowland Province. Lying in an area of lake plain and till plain physiography, the County has a relatively uniform, level topography. Erie County drains northward into Lake Erie. There are 17 distinct watersheds in the County. Primary watersheds include Mills Creek and Pipe Creek to the west, the Huron River in the central part of the County, Old Woman Creek in the east-central part of the County and the Vermilion River on the eastern edge of the County. Small creeks drain the other watersheds.

### Extent

Flooding is a site-specific hazard. Therefore, floodplains are an important planning consideration. A floodplain is any land area susceptible to inundation by floodwaters from any source. Floodplains are measured in terms of the amount of stormwater that it takes to cover a given area of land. These storm events are measured in frequency of occurrence, such as 5-year, 100-year and 500-year, with the standard measurement being the 100-year storm or floodplain. In Erie County flooding can happen almost anytime however this number one hazard can be exacerbated when heavy rains occur in late winter and accelerate the melting of snow.

Flooding in Erie County can also be intensified if the flow of water is obstructed in some way such as by ice jams. Ice jams occur when large chunks of ice flow downstream and become trapped at a point in a creek or stream. This creates a sort of natural dam. Ice jams are not a danger in themselves but they can cause flooding upstream. Ice jams can typically be easily controlled and broken up so flooding is not always a problem.
Erie County also experiences flooding due to Karst landforms in the region. Dolomite, gypsum, and limestone are all vulnerable to dissolution by ground water. As a result, subsurface drainage systems can develop. Also, unlike typical flooding associated with flooding, it is very challenging to try and predict when or how severe future karst related flooding will be. According to ODNR, "the engineering means to prevent or mitigate the effects of karst related flooding is technically very difficult and cost-prohibitive. Wise land-use planning is encouraged for areas that are most likely to be flooded upon the return of this pattern of climatic and hydrologic conditions." The Bellevue-Castalia Karst Plain includes parts of western Erie County



Figure 3: Karst Landform

and contains more sinkholes than any other karst region in Ohio. Surface drainage in this region often flows into sinkholes and continues underground. **Figure 3** above demonstrates the process of karst landform.

Flooding can also be exacerbated locally by the presence of impermeable surfaces due to buildings and pavement or lack of appropriately sized flood water detention basins. All of these concerns were addressed by the Mitigation Core Group.

Any development within floodplains can impact the direction, flow and level of the watercourse during periods of high water or flooding. In other words, if fill material is placed or a house constructed in a floodplain, it will alter the boundaries of the floodplain upstream and downstream of that area. This alteration happens because structures or fill utilize valuable space that would otherwise act as a natural retaining area for floodwaters to spread and slow. Not only does development in the floodplain increase dangers downstream, developments within the floodplain are at higher risk of damage due to flooding. This damage includes fill material and debris from destroyed structures upstream colliding with structures in the floodplain downstream of an affected area. Many bridges are washed out in floods because river borne debris clogs their free-flow area.

There are a total of 2,136 structures in Erie County considered to be at-risk due to flooding. Of this number, approximately 1,292 of the structures are located in the unincorporated areas of the county. (This information was collected from the ODNR's Division of Water Floodplain Geographical Information Management System (GIMS) Project.) All the at-risk structures are located on the Multi-Hazard Maps in **Appendix V**. These at-risk structures are located within the 100-year floodplain and are therefore susceptible to damage during a flood.

At-risk structures in areas of flash flooding areas, which are not within the 100-year floodplain were not identified by the ODNR's GIMS project and consequently have not been mapped.

## **Previous Occurrences**

The National Climatic Data Center (NCDC) has comprehensive information available on flood events back to 1964, shown in **Appendix VI**. The county has suffered damage from numerous major floods and localized flash flooding. Flooding is the second most frequent disaster event: severe storms being the most common. The costliest disasters are flooding and severe storms, each with a total amount over 36 million dollars according to information available for historic events.

There were 88 flooding events documented between 1964 and 2013, as shown in the **Appendix VI**.

**Flood of July 1969.** The rain began at approximately 8:00 p.m., July 4, 1969 and ended between 1:00 and 3:00 p.m. July 5, 1969. It occurred about 20 miles on either side of a line running between Toledo, Ohio and Wheeling, West Virginia with centers of greater than 10 inches located around Wooster, Ohio and Norwalk, Ohio. Preliminary bucket surveys and reports from other unofficial rain gages indicated that up to 14 inches of rain occurred in certain localities.

This precipitation caused flooding which resulted in loss of life and considerable crop and property damages in a dozen Ohio counties. The hardest hit communities were Wooster, Ashland, Norwalk, Vermilion, Millersburg, Loudonville and Killbuck, Ohio. As of July 21, 1969, 46 fatalities were reported and fixe persons missing as a result of the 4<sup>th</sup> of July storm. Of these 46 fatalities, 30 were attributable to the floods.

Total flood damages were estimated to be between 70 and 140 million dollars. Of these flood damages, agricultural damages were estimated between 40 and 80 million while property damage was between 30 to 60 million dollars.

**Flood of August 1998.** The Huron River at Milan exceeded its flood stage of 14 feet and crested at 23.4 feet at 0700 EST on 08/26/98. Flooding occurred in the lagoon communities from Milan to near Huron and small businesses near US Route 250. Basements and streets were also flooded. Seventy five homes were evacuated in Franklin Flats, 10 to 12 homes on Mudbrook Road were evacuated and 70 campers at Huron Valley Campground. This crest level was more than nine feet above flood stage and the second highest in 30 years.

**Flood of January 2005.** Heavy rain and runoff from snowmelt caused widespread lowland flooding in Erie County during the first half of January. Some of the worst flooding occurred along the Huron River. At Milan, the river was already above the 14 foot flood stage at midnight on the 1st. The river continued in flood through the 14th with crests of 19.74 feet on the 1st and 19.66 feet on the 12th. The flooding on the 1st was caused by ice jamming on the river. Damage was reported to buildings in Franklin Flats on both the 1st and 12th. Businesses along U.S. Route 250 in Milan also sustained some damage from flooding. January 2005 was one of the wettest January's on record with 5.48 inches of rain measured by cooperative observers in Florence. In addition to this rain,

extensive snowpack existed over Erie County at the beginning of the month. Temperatures in the 40s and 50s the first three days of the month caused a rapid snowmelt and brought area streams and creeks to bankfull just in time for a significant winter storm on the 5th and 6th. Then, just as things began to return to normal, heavy rains fell on the area on the 11th, 12th and 13th causing conditions to once again worsen. Hundreds of homes in the county sustained damage from river, basement or nuisance flooding. Many secondary roads had to be closed because of flooding.

**Flood of June 2006.** Thunderstorms dumped torrential rains on Erie County during the evening of June 21st. Rainfall rates with the stronger storms exceeded three inches per hour. As much as 7 to 9 inches of rain fell on Perkins Township with 4 to 6 inches over the remainder of the county. Most of this rainfall fell between 8 and 11 p.m. Devastating flash flooding occurred across the county as result of this rainfall. Perkins, Milan, Huron and Margaretta Townships were the hardest hit by the flooding. Rapid rises in water levels occurred in the county forcing the closure of dozens of roads and streets. Hundreds of people had to be evacuated from flood prone areas. The flooding was especially bad along Pike Creek in Perkins Township which quickly left it's bank. Flooding also occurred along Mills Creek near Sandusky with several roads in the city flooded by two to three feet of water. The flooding worsened after daybreak on the 22nd as runoff from the heavy rains on the 21st made it's way into the larger creeks and rivers. Local officials stated that this flood event was the worst in the county since the July 4th, 1969. See the accompanying flood event write-up for damage estimates and more details on the damage.

Devastating and widespread flooding developed in Erie County on June 22nd as runoff from the heavy thunderstorm rains that fell during the evening of the 21st made it's way into area streams and rivers. Initially much of the flooding in the county was in urban areas where water several feet deep accumulated on streets and roads as a result of overwhelmed storm sewers and drainage ditches. But after the rain quit, this flooding diminished during the early morning hours of the 22nd. The improvement in conditions was short lived as runoff caused area streams and rivers to quickly rise as daybreak on the 22nd approached. By 5:30 a.m. evacuations were being conducted along the Huron River near Milan. Evacuations in Perkins Township began around 7:30 a.m. and by early afternoon residents in the Milan Township community of Franklin Flats were being evacuated. In Perkins Township, Pipe Creek left it's banks flooding six streets in the Lakeland Subdivision, Terrace Court Mobile Home Park and Searsville. Fifty homes on these streets were evacuated after flood waters reached three to four feet in depth. A total of 75 people had to be rescued by boat in this area. Franklin Flats was also devastated by flooding as the Huron River rose from a stage of 6.5 feet just after midnight to 23.95 feet around 2 pm on the 22nd. Much of this rise occurred after 9 a.m. At least half of the homes in Franklin Flats were heavily damaged by the flooding. Flooding along the Vermilion River resulted in several homes being evacuated along Riverside Drive in Vermilion. Three piers and several boats in this area were washed out into Lake Erie. A total of 20 homes were destroyed by flooding in Erie County with 25 homes suffering major damage and 79 more with minor damage. Several motorists had to be rescued from stranded vehicles. In addition, 64 mobile homes in Terrace Court and Franklin Flats were heavily damaged. Several hundred additional homes and businesses sustained damage from either basement or nuisance flooding. A total of 573 people were evacuated in the county by emergency personnel. Damage to roads, culverts and bridges was significant. Crop losses in the county are expected to be substantial as standing water was reported over most of the county. Local officials stated that this flooding was the worst in the county since the storms of July 4th, 1969.

# Probability of Future Flooding

In this plan, the term special flood hazard area is used in conjunction with floodplain to clarify that the area under consideration is identified on the Flood Insurance Rate Maps as having at least a 1-percent chance of flooding in any given year. Historically, the area with a 1-percent chance of flooding in any given year has been called the "100-year floodplain" and the area with a 0.2-percent chance of flooding in any given year has been called the "500-year floodplain." As these terms can be misleading by suggesting that there will be a flood only every 100 or 500 years respectively they are not used in this plan.

The NCDC data indicates that there have been 88 events in the past 50 years. Therefore, the probability of future events is 88/50 = 1.76 or 100 percent chance annually.

# Vulnerability Assessment – Flooding

## **Overview of Vulnerability**

Flood vulnerability is described in terms of what community assets, structures, and infrastructure lay in locations where flooding is anticipated.

	Estimated Property Damages
Total Losses Due to Flooding (1964–2013)	\$36,578,000
Average Annual Losses for 50 years	\$731,555

## Table 8: Summary of Past Losses Due to Flooding

According to NCDC and reflected above in **Table 8**, estimated significant property damage in Erie County attributable to flooding during the years 1964 through 2013 is 36,578,000. Thus the average annual loss for these 50 years is 36,578,000/50 = 731,555.

## Potential Impact of Flooding

Flooding can lead to property loss as well as to loss of life. Flooding damages structures, including homes and businesses, vehicles, and infrastructure, including roadways. People

who are surrounded by flood waters can require evacuation placing their lives as well as the lives of rescuers in danger. Flooding can disrupt the operation of businesses and schools and recovery from flood damages can be time consuming and costly.

# **Identifying Structures**

## Plan Update Notes

The initial version of this mitigation plan revealed that 2,136 structures in the county were located in Special Flood Hazard Areas. The current data confirms this number showing there are 2,136 structures located in Special Flood Hazard Areas and have at least a 1-percent chance of flooding in any given year. The current best available data for this analysis was unable to determine the structure type or average values.

## Exposure of Existing Buildings to Damages Due to Flooding

The total number of at-risk structures for the county in the 100-year floodplain and the estimated property values are shown below in **Table 9**. The percentage of residential and non-residential structures was calculated keeping the same ratio shown in **Table 6**. Then the total at-risk structures cost was estimated using average structure values for each type based on **Table 6**.

County	Residential At-Risk Structures	Median Value of Housing Units	Non- residential At-Risk Structures	Median Value of Non- residential Structures	Potential Residential Dollars Lost	Potential Non- residential Dollars Lost
Erie	1,879	\$91,591	257	\$261,830	\$172,099,489	\$67,290,310

#### Table 9: County Inventory of At-Risk Structures

The total potential dollars lost for both residential and non-residential structures is approximately \$239,390,000.

A number of critical facilities are also located in flood-prone areas. These include fire stations, police stations, schools, and office buildings. Other facilities including motels, churches, and retirement facilities that may also require special attention during times of flooding for evacuation purposes are also located in flood-prone areas. **Appendix VII** lists all critical facilities and **Appendix V** provides a map of these critical facilities.

An additional assessment of at-risk structures was performed for Erie County using a HAZUS flood simulation. HAZUS is a multi-hazard loss estimation model developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The HAZUS flood event report for Erie County identified 307 critical facilities within flood-prone areas. The estimated exposure for critical facilities in this scenario is approximately \$59 million for a 100-year flood. The estimated exposure for residential and non-residential facilities is approximately \$939 million and \$404

million, respectively. The total number of buildings exposed is 4,847 and 2,081, respectively. The results of the HAZUS flood simulation are included in **Appendix VIII** and are the calculations used for the flooding vulnerability analysis in **Table 20**.

#### **Repetitive Loss Properties**

Some structures in Erie County have been flooded repeatedly and have received more than one payment through the National Flood Insurance Program (NFIP) for flood damages. A repetitive loss structure is defined as an NFIP-insured structure that has had at least two paid NFIP claims of more than \$1,000 each in any 10-year period since 1978. There are 99 structures in Erie County that have been classified as repetitive loss structures and 305 total losses. In **Table 10**, the repetitive loss properties are separated by jurisdictions and broke out by residential and non-residential with the total value of losses.

Community	Properties	Losses	Building Payments	Contents Payments	Total Payments
Bellevue	4	9	\$253,298	\$4,426	\$257,724
Erie County	25	59	\$559,237	\$126,895	\$686,132
City of Huron	12	44	\$339,883	\$98,013	\$437,896
City of Sandusky	25	65	\$262,376	\$86,531	\$348,907
City of Vermilion	33	128	\$926,015	\$408,484	\$1,334,499

#### Table 10: Incorporated Repetitive Loss Structures

#### Severe Repetitive Loss Properties

Severe repetitive loss properties are properties that have at least four NFIP payments over \$5,000 each and the cumulative amount of such claims exceeds \$20,000, or at least two separate claims payments with the cumulative amount exceeding the market value of the building. There are 10 structures in Erie County that have been classified as repetitive loss structures and 53 total losses. In **Table 11**, the repetitive loss properties are separated by jurisdictions and broke out by residential and non-residential with the total value of losses.

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Community	Structure Type	Properties	Losses	Building Payments	Contents Payments	Total Payments
Erie County	Residential:	1	2	\$21,471	\$1,945	\$23,416
	Non- Residential:	0	0	\$ -	\$	\$ -
City of Huron	Residential:	2	13	\$130,149	\$52,641	\$182,790
	Non- Residential:	0	0	\$ -	\$-	\$ -
City of Vermilion	Residential:	4	24	\$164,583	\$57,917	\$222,499
	Non- Residential:	3	14	\$ 310,118	\$135,836	\$445,954

## Exposure of Future Buildings to Damages Due to Flooding

Current zoning and development regulations allow future development to occur within the Special Flood Hazard Area; this suggests that there is potential for additional loss due to flooding in the future. Special Flood Hazard Area development regulations relate to the base flood elevation, which is the estimated level of flooding that has a 1-percent chance of being equaled or exceeded in any given year. Because Special Flood Hazard Area or floodplain development regulations specify that residential structures must be elevated to or above the base flood elevation and non-residential structures must either be elevated or flood-proofed to or above this level, the degree to which future structures are exposed to flood damages should be minimal.

However, calculations of base flood elevations are based on models that rely upon data about previous flood events; should future floods be greater than those experienced in the past, the base flood elevation may not provide sufficient protection. Therefore, mitigation strategy of this plan includes that communities adopt more stringent Special Flood Hazard Area or floodplain development regulations causing future structures to be built with freeboard, i.e. above the current base flood elevation.

#### Current Development Trends

Any development within floodplains can impact the direction, flow and level of the watercourse during periods of high water or flooding. If fill material is placed or a house constructed in a floodplain, the boundaries of the floodplain downstream will be altered. This results because structures or fill utilize valuable space that would otherwise act as a natural retaining area for floodwaters to spread and slow. As dangers in the floodplain increase downstream, developments within the floodplain are at higher risk of damage due to flooding. This damage includes upstream fill material and debris from destroyed structures colliding with edifices in the floodplain downstream. Many bridges are washed out during floods because river borne debris clog their free-flow area.

According to **Table 3**, the current development within Erie County has been primarily concentrated in the western part of the county. This development is centered in Huron Township, which is a metropolitan area to the city of Sandusky. Huron Township has floodplain ordinances that should serve as a guide in keeping new development from being constructed in high hazard areas with respect to flooding.

## Flood Damage Prevention Resolution

In 2008, the Erie County Flood Damage Prevention and Floodplain Regulations were adopted. This resolution applies to any areas of special flood hazard, which are defined in the resolution as "the land in the floodplain subject to a one percent or greater chance of flooding in any given year. Areas of special flood hazard are designated by the Federal Emergency Management Agency as Zone A, AE, AH, AO, A1-30, and A-99." The areas of special flood hazard have been identified by FEMA.

Under this resolution, any proposed development must be reviewed and a permit must be obtained from the Floodplain Administrator before construction or development can occur within any area of special flood hazard.

## **Estimating Potential Loss**

## Plan Update Notes

The 2005 plan had a method for estimating potential losses due to flooding using historical data from the NCDC. The method utilized in this update is based upon the same historical data updated through 2013, provided by NCDC and SHELDUS.

## Methodology

Damages due to one flooding event in the county have varied from no cost for damages to \$24.5 million.

According to NCDC, estimated property damage in Erie County attributable to flooding or flash floods over the period 1964 through 2013 is \$36,578,000. Past losses provided in NCDC are used to estimate the potential for annual losses due to flooding.

## **Estimated Potential Dollar Losses**

Since the total loss over these 50 years is 36,578,000, the average annual loss is 36,578,000/50 = 731,555.

# Severe Storms Risk Assessment

For this plan, features of severe storms include summer storms, winter storms, hail, thunderstorms, and high winds.

# Hazard Profile – Severe Storms

## Location

Erie County is located in the north central portion of the state and is susceptible to severe storms, which may be experienced at any location in Erie County. Because severe storms are random in nature, the entire county population is susceptible and should be prepared. All citizens should become familiar with locations of shelters in which they can seek safety in the event of severe weather.

Since severe storms typically present localized hazards, several homes may need repair, but usually homeowners will have insurance to cover these expenses and will not suffer any long term financial hardship. The populations located in mobile home parks and campgrounds should take particular care to seek adequate permanent shelter with approaching severe weather.

## Extent

Severe storms occur throughout the State of Ohio. All of Erie County is exposed to the hazards associated with severe storms. Severe storms can occur throughout the year. These storms can contain hail, thunder and lightning, high wind, and snow and ice.

Because the area receives a moderate amount of snowfall and can be stricken by ice storms, all of the structures erected in the county are susceptible to damage if not designed to the proper snow loading parameters.

High winds from severe storms that move in a straight line can cause extensive damage, much like a tornado. High winds are defined as sustained wind speeds of 40 mph or greater lasting for 1 hour or more, or winds of 58 mph or greater for any duration.

## **Previous Occurrences**

Erie County is highly susceptible to severe storms, which encompasses winter storms, thunderstorms, high winds, and hail.

According to the NCDC, there have been 477 severe storm events in Erie County reported since 1961, with total property losses of \$36.79 million and crop losses of \$1.9 million. Since 1961 the average annual losses reported for the county have been approximately \$707,500.

Erie County has had experienced several severe storms causing significant damage. Some of the most memorable and costly are described below.

Winter Storm December 2004. A record setting winter storm affected northern Ohio on December 22nd and 23rd. The impact and damage caused by this storm has been compared to the Blizzard of January 1978. Low pressure developed over eastern Texas early on the 22nd and then moved quickly northeast. The low eventually tracked across eastern Ohio during the morning hours of the 23rd after dumping nearly two feet of snow on portions of Ohio. The snow began around daybreak on the 22nd and then intensified around midday. Heavy snow with visibilities of a quarter mile or less then persisted into the early morning hours of the 23rd. Snowfall rates much of this time ranged from one to two inches per hour. Winds increased significantly during the evening hours of the 22nd as northerly winds developed on the backside of the low. Gusts to 30 mph caused significant blowing and drifting and near blizzard conditions from Marion County northeastward into Erie and Huron Counties. Drifts several feet deep were reported. Temperatures warmed slightly during the early morning hours of the 23rd as the low moved into southeast Ohio. This caused the snow to first mix with, and then change completely to freezing rain. This change occurred at Mansfield just before 3 a.m. and at Cleveland around 4 a.m. The heaviest freezing rain fell along and west of Interstate 71 between these two cities with over one half inch of ice accumulation over much of this corridor. Snowfall totals ranged from 12 to 18 inches from Marion and Morrow Counties northeast to Erie, Lorain and Cuyahoga Counties. Within that area, there was a narrow band of even heavier snow with greater than 18 inches of accumulation from northern Morrow County across Richland County and into Ashland County. Officially, 23.0 inches of snow was measured at Mansfield Lahm Airport (Richland County) establishing a new all-time record snowfall. In addition, 0.57 inches of freezing rain was measured at that location. At Cleveland Hopkins International Airport (Cuyahoga County) a total of 15.5 inches of snow fell along 0.58 inches of freezing rain. The freezing rain significantly compacted the snow and official measurements made by cooperative observers around daybreak likely underestimated the actual snowfall. Had measurements been taken around midnight, reported accumulations would have likely been several inches higher at most locations. The wet and very heavy snow made travel nearly impossible across northern Ohio. Hundreds of accidents were reported and holiday travel for many was not possible. Numerous power outages as a result of the freezing rain were reported. The outages were most widespread in southern portions of Ashland and Richland Counties where some areas were without power for several days. The weight of the heavy snow damaged the roofs of dozens of homes and buildings, several of which had complete roof failures. It took several days for road crews to completely clean up after this event. Damage and cleanup costs for this storm were historic with only the Blizzard of 1978 having more financial impact.

**Ice Storm January 2005.** For the second time in just over two weeks, a devastating and historic winter storm affected Northern Ohio. Significant ice accumulations occurred over most of the area downing thousands of trees, causing widespread power outages and making travel nearly impossible. Low pressure over Missouri moved rapidly northeast on January 5th. This low moved across eastern Ohio early on January 6th and was

responsible for producing a prolonged period of freezing rain. A mixture of rain and snow changed to freezing rain from west to east during the early morning hours of the 5th. Periods of freezing rain then continued for the remainder of the 5th and through the early morning hours of the 6th. Temperatures eventually warmed enough during the late morning hours of the 6th to change the freezing rain back to rain. The hardest hit locations were west of Interstate 71 along the U.S. Route 30 corridor. Ice accumulations of greater than three quarters of an inch were reported from Hancock County eastward across Wyandot, Crawford, Richland and Ashland Counties. Northern sections of Wyandot and Marion Counties along with the southern halves of Seneca and Huron County were also hard hit. Up to 80 percent of electric customers in these nine counties lost service during the storm, some for as much as ten days. In cities like Mansfield, Bucyrus and Findlay, nearly every property in some neighborhoods sustained tree damage. To the north and south of these areas ice accumulations ranged from one quarter to three quarters of an inch. Counties closer to Lake Erie saw snow mix with the freezing rain at times which kept ice accumulations down to around one quarter inch and resulted in only scattered power outages. A total of 3 to 5 inches of snow was also reported in these counties. Ice buildup at the Davis-Besse Nuclear Power Plant (Ottawa County) damaged the facility enough to force it to be temporarily shut down. Hundreds of crews were brought in from around the county to help restore the power outages. In addition to damage caused by fallen trees and limbs, a lot of basement flooding occurred as power outages prevented sump pumps from working. Clean up and repair costs for this storm were among the highest ever recorded for a natural disaster in Ohio. Damage in many counties topped \$1 million with a couple counties exceeding \$10 million in losses. In Richland County alone, cleanup cost accrued by local governments totaled nearly \$6 million. Estimates indicate that as many as one million people lost power during this storm. Several power companies reported the largest number of outages in their histories. Hundreds if not thousands of homes and businesses were damaged by fallen trees, limbs and utility poles.

**High Winds September 2008.** High winds associated with the remnants of Hurricane Ike began during the early evening hours of September 14th and continued through late evening. Peak wind gusts were estimated to be around 60 mph with the strongest winds occurring between 6 and 8 pm. Damage in the county was extensive with hundreds of trees and many utility poles downed. Widespread power outages occurred as well with some customers without power for a few days. Many homes and buildings were damaged across the county. The damage ranged from a few shingles torn off to significant structural damage caused by fallen trees landing on roofs. Numerous vehicles were damaged by fallen trees and limbs and also from flying debris. This storm hampered travel as downed trees and power lines forced the closure of many roads. Substantial cleanup costs were incurred by local governments. Some of the schools in the county were forced to close on Monday the 15th because of the power outages. Significant crop losses occurred as well. Corn yields were reduced between 3 and 5 percent in many areas with lesser losses to the soybean crop.

Hurricane Sandy October 2012. Winds in Erie County gusted to over 60 mph for a few hours. A peak gust of 62 mph was measured by an automated sensor at the Huron

Lighthouse. Hundreds of trees were downed in the county with most of the damage near the Lake Erie shoreline. Up to 4,000 electric customers lost power. There were reports of trees on houses and vehicles. Many homes also lost sections of roofing and siding. A lot of streets had to be closed because of downed trees and power lines.

## Probability of Future Severe Storms

Anecdotal evidence indicates that severe storms typically occur every year in Erie County. The NCDC and SHELDUS data supports this showing that there were a total of 477 damaging severe storms over the 52 years between 1961 and 2012. There were other severe storms during this period for which no damages were reported. Thus, the average number of damaging severe storms in Erie County is 477 / 52 = 9.17 storms per year. So the probability of the occurrence of a severe storm in Erie County in any given year is 100 percent.

# Vulnerability Assessment – Severe Storms

# **Overview of Vulnerability**

The most vulnerable structures are those that were poorly built or are dilapidated. The weight of severe storms may lead to structural collapse or to minor damage. Some shed roofs that protect township and borough road maintenance or firefighting equipment have large span roofs that may collapse under the weight of especially severe storms although none have collapsed due to recent severe storms. Strong winds can rip roofs off of any dilapidated structures and overturn mobile homes.

## **Potential Impact of Severe Storms**

Vulnerability to the effects of severe storms on buildings is considered to be somewhat dependent on the age of a building because as building codes become more stringent, buildings are capable of supporting heavier loads and enduring greater wind forces. As buildings age, various factors may deteriorate their structural integrity. Vulnerability also depends upon the type of construction and the degree to which a structure has been maintained.

The most common detrimental effects of severe storms are not collapsed structures but traffic accidents, interruptions in power supply and communications services, and roadway blockages due to downed trees.

Because severe storms affect the entire county, all structures within the county are at some risk. The total number and value of structures can be found in **Table 6**.

## **Identifying Structures**

## Plan Update Notes

For this mitigation plan, structures identified as potentially vulnerable to damage from severe storms are structures older than 50 years that may have deteriorated over time. Data on the age of structures was not available when the previous version of this plan was prepared, so an analysis of vulnerability was not completed.

#### Exposure of Existing Buildings to Severe Storms

Because the area receives a moderate amount of snowfall and can be stricken by ice storms, hail, thunderstorms and high wind, all of the structures erected in the county are susceptible to damage. If not designed to the proper parameters, extreme conditions could result in a structure collapsing.

Structures identified as potentially vulnerable to damage from severe storms are structures older than 50 years that may have deteriorated over time. Data is only available for housing units. Therefore, only housing unit structures will be evaluated.

It is not necessarily the case that older structures are at greater risk of damage due to severe storms. There are 26.3 percent of structures standing in Erie County that were built before 1939 and close to half of the structures in the county are more than 50 years old, and these have withstood many heavy snow and ice storms. Nevertheless, for this review, because the National Trust for Historic Preservation identifies structures greater than 50 years old as being eligible for designation as historic, the assumption is made that structures built before 1960 are at some risk of at least minor damage due to severe storms. There are 17,711 structures in the county that were built before 1960, thus the percent of structures considered to be particularly vulnerable to damage due to severe storms is 46.8 percent. **Figure 4** shows the number of structures built in Erie County and illustrates the fact that a large number of structures in the county are more than 50 years old.



Figure 4: Numbers of Structures Built

## Exposure of Future Buildings to Severe Storms

All structures and infrastructure in Erie County will be exposed to heavy snow, ice, and high winds. Currently Erie County has not adopted any building codes; however some of the cities and villages within Erie County have adopted and enforced building codes.

Due to the non-site specific nature of this hazard, current development trends have no effect. Current development within Erie County has been primarily concentrated in the western part of the county. This development is centered in Huron Township. Developers in these areas should give greater consideration to the importance of road design to maximize accessibility during a severe storm event. In this township especially, more effort should be placed on maintenance of trees in utility areas to reduce the number of power outages due to fallen trees and/or branches due to the accumulation of ice and/or snow or high winds.

## **Estimating Potential Loss**

## Methodology

Because severe storms are random in nature, the Core Group has chosen to look at historic events to determine Erie County's susceptibility. According to the National Climatic Data Center (NCDC), there have been 477 severe storm events in Erie County since 1961, totaling near \$37 million in damages. Estimated property damage in Erie County attributable to severe storms over the period 1961 through 2012 is \$36,789,000. Past losses provided in NCDC and SHEDUS are used to estimate the potential for annual losses due to severe storms.

#### **Estimated Potential Dollar Losses**

Since the total loss over these 52 years is 36,789,000, the average annual loss is 36,789,000 / 52 = 707,476.

#### Maximum Potential Dollars Lost

To predict the structural cost associated to a worst case scenario snow storm, it will be assumed that all structures older than 50 years will be damaged significantly. This analysis is based on the perception that building codes have become more stringent and that new buildings can withstand the 30 pounds per square foot snow loads expected for Ohio. To estimate the non-residential values, the same percentage of structures will be assumed to be built over 50 years ago, which is 46.8 percent. According to **Table 6**, the total count of residential and non-residential structures is 25,438 and 3,484, respectively. This estimates the maximum damage that is expected for a worst case scenario severe storm takes the total count multiplied by the percent of structures built over 50 years ago. Estimating 11,905 residential structures and 1,631 non-residential structures to be completely damaged, these numbers are multiplied by the respective average structure value to yield a maximum damage of \$1.09 billion for residential structures and \$427 million for non-residential structures. This estimate does not represent the total cost associated with the severe storm, which will also include damaged utilities and emergency services.

# **Tornadoes Risk Assessment**

This plan uses the Enhanced Fujita Scale, which has been used since 2007, to describe the extent of tornadoes. No new data was available through NCDC since no new occurrences were observed. The existing NCDC data was used in the estimated potential loss section, which was not available in the old plan.

# Hazard Profile – Tornadoes

## Location

Tornadoes can pose a threat to life and property in any part of Erie County by destroying most of everything in the path of one. Tornado forces have destructive impacts to trees, power lines and other utilities, which ultimately impacts residents. Downed trees also block roadways throughout the county and have to be cleared quickly to ensure emergency response vehicles continued to have access. All citizens should become familiar with locations of shelters in which they can seek safety in the event of severe weather that have the potential for developing tornadoes.

Since tornadoes typically present localized hazards, several homes may need repair, but typically homeowners will have insurance to cover these expenses and will not suffer any long term financial hardship. The populations located in mobile home parks and campgrounds should take particular care to seek adequate permanent shelter with approaching severe weather.

## Extent

Tornadoes are considered the most violent atmospheric

phenomenon on the face of the earth, having winds estimated at 300 mph in large tornadoes.



Average Annual Number of Tornadoes

Averaging Period: 1991 - 2010

Figure 5: Average Annual Number of Tornadoes

Although the number of tornadoes in Ohio does not rank high compared to other states in the United States, the State does average around 19 tornadoes a year as shown in **Figure 5**. Ohio's peak tornado season runs from April through July, with most tornadoes occurring between 2-10 p.m. Even though June has been the month with the most tornado occurrences, many of the State's major tornado outbreaks have taken place in April and May. However, history has shown that tornadoes can occur during any month

of the year and at any time of the day or night. Many of these tornadoes are weak (F0 or F1 on the Fujita Scale), but Ohio has been struck by some of the most destructive (F5) tornadoes ever, including the April 3, 1974 tornado which devastated Xenia, killing over 30 people and destroying 2,000 buildings.

Tornadoes can occur anywhere in the State of Ohio. All of Erie County is exposed to the hazards associated with tornadoes. Tornadoes can theoretically occur any time of the year, however the greatest chances of an occurrence is in the spring and summer months.

Since 2007 an Enhanced Fujita Scale (EF Scale) has been used in the United States to describe the magnitude of tornadoes. Prior to 2007, the Fujita Scale was commonly used to describe magnitude. This scale is based on new information about the relationship between wind speed given in miles per hour (mph) and corresponding damages. The EF Scale categorized tornadoes from EF0 to EF5 with EF0 being the most commonly occurring type of tornado. Recently, the most damaging tornado recorded in Erie County was in Kimball and categorized as an EF1 tornado. **Table 12** shows the relationship between the Fujita and the Enhanced Fujita Scales.

F	ujita Scale	Enhand	ced Fujita Scale
F Number	3-Second Gust (mph)	EF Number	3-Second Gust (mph)
0	45–78	0	65–85
1	79–117	1	86–110
2	118–161	2	111–135
3	162–209	3	136–165
4	210–261	4	166–200
5	262–317	5	Over 200

#### Table 12: Enhanced Fujita Scale

**Table 13**, below, provides a description of the types of damages that can be expected with each category of tornado.

#### Table 13: Expected Tornado Damages

F or EF Scale	Examples of Possible Damage
0	Light damage. Some damage to chimneys; broken tree branches; shallow-rooted
	trees pushed over; damage to sign boards.
1	Moderate damage. Surface peeled off roofs; mobile homes pushed off foundations or
	overturned; moving autos pushed off roads.
2	Considerable damage. Roofs torn off frame houses; mobile homes demolished;
	boxcars pushed over; large trees snapped or uprooted; light-object missiles
	generated.
3	Severe damage. Roofs and some walls torn off well-constructed houses; trains
	overturned; most trees in forest uprooted; cars lifted off ground and thrown.
4	Devastating damage. Well-constructed houses leveled; structures with weak
	foundations blown off some distance; cars thrown and large missiles generated.
5	Incredible damage. Strong frame houses lifted off foundations and carried

F or EF Scale	Examples of Possible Damage
	considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100 yards; trees debarked.

## **Previous Occurrences**

Erie County is moderately susceptible to tornadoes. According to the NCDC and SHELDUS, there have been 8 damaging tornado events in Erie County reported since 1961, with total property losses of \$1.36 million. The most powerful recorded by NCDC was an F2 that occurred back in 2000 and caused \$175,000 in property damage. The most damaging was back in November 2002, with a price tag of \$500,000 and had only a F1 magnitude.

## **Probability of Future Tornadoes**

The SHELDUS data lists 8 damaging tornadoes for Erie County for the entire 1961-2013 period. Thus the calculated probability of a damaging tornado in the county in any given year is 8/53 = .151, or 15.1 percent.

Based off the image below from the NOAA Storm Prediction Center, Erie County falls on the line for an estimated three tornadoes per 10,000 square miles as shown in **Figure 6**. At an area of 626 square miles, Erie County would be at 18.8 percent chance of having a tornado every year if we assumed an average of three tornadoes per 10,000 square miles based off the NOAA Storm Prediction Center.

For the purposes of this plan and for a conservative approach, the data from NOAA will be used, 18.8 percent.



Figure 6: Annual Tornado Reports

# Vulnerability Assessment – Tornadoes

# **Overview of Vulnerability**

For tornadoes, aged and dilapidated structures or structures not built to applicable building codes are more susceptible to damage. Mobile homes and campgrounds are especially susceptible to damage due to tornadoes. Strong winds can rip roofs off of any dilapidated structures and overturn mobile homes. Past experience with tornadoes in Erie County and adjacent counties shows that death and injury are indeed a possibility.

Based on the knowledge that tornadoes are a random event, the Core Group has decided to look at tornadoes as a hazard of chance. The best way to deal with a random hazard event is to look at historic information and try to be as prepared as possible. There have been eight damaging tornado events reported in Erie County since 1961. The Core Group realized that tornadoes are usually accompanied by other hazards when they affect their community. In fact, when tornadoes hit a community they are typically coupled by other natural events such as high winds, thunderstorms, lighting and possibly flash floods.

## Potential Impact of Tornadoes

Vulnerability to the effects of tornadoes is somewhat dependent upon the age of a structure because as building codes become more stringent, buildings are capable of

enduring greater wind forces. However, all parts of the county have the same probability of tornado touching down in the area.

In a worst case scenario, Erie County could be hit with an EF-5 tornado that would travel through the largest city in the county. To predict the structural cost associated with a worst case scenario for a tornado; an analysis will be run with an EF-5 tornado traveling on a straight path through the most densely populated and developed area within the county. This analysis assumes that the tornado were to completely encompass the city of Sandusky. If the tornado went through the heart of any city within the county, then that city would be expected to be completely destroyed due to the large footprint of an EF-5 tornado. Even with the current building codes, most buildings cannot handle the force an EF-5 is capable of. To perform this analysis the county auditor's information of average property values for the county was used. In addition, specific information for Sandusky was not available. The number of structures in Sandusky was estimated using a ratio of the population of the city from the 2010 census to the population of the county from the 2010 census. Since 33.5% of Erie County's population lives in Sandusky.

In **Table 14**, an assessment shows the total value loss that is expected per type of structure. It also shows the value of damage that is expected for this worst case scenario. Apart from the devastation within the path of the tornado, large regions of the county can also be expected to be without power.

Damage Assessment by Land Use and Appraised Value					
<u>Sandusky</u>	Count	Average Value	Total		
Residential	8,522	\$91,591	\$780,538,502		
Non-Residential	1,167	\$261,830	\$305,555,610		
Critical	486	\$306,310	\$148,866,660		
Total	10,175		\$1,234,960,772		

#### Table 14: Damage Assessment for an EF-5 Tornado through Erie County

## **Identifying Structures**

#### Plan Update Note

The methodology for identifying structures potentially at risk of damage due to tornadoes is the same as the methodology used for identify structures potentially at risk of damage due to severe storms. However, there may be less deviation between the amounts of damage from one age group to the other because of the destructive power a tornado can impose on a structure.

#### Exposure of Existing Buildings to Tornadoes

All structures and infrastructure might be exposed to the effects of a tornado. Depending upon the severity of a tornado, any existing structures can be damaged to some extent. However, in Erie County, there are 17,711 structures that were built before 1960. Thus the percentage of existing buildings considered at slightly higher risk of damage due to tornadoes is 46.8 percent.

#### Exposure of Future Buildings to Tornadoes

Any future structures might be exposed to tornadoes as this hazard does not occur in specific locations. However, future buildings will be somewhat better protected from the effects of tornadoes as they will meet the most current state building code requirements for bracing and roof design.

## **Estimating Potential Loss**

#### Plan Update Notes

In the previous plan, data was not used to estimate potential loss due to tornadoes. In this update, NCDC data is used to estimate potential loss.

#### Methodology

According to SHELDUS, the estimated property damage in Erie County attributable to tornadoes accounts for \$1,356,000 in damage. This amount is attributed to eight occurrences and was observed from 1961 to 2013.

#### **Estimated Potential Dollar Losses**

The total costs due to tornadoes over 53 years is 1,356,000 therefore the average annual losses due to tornadoes is 1,356,000 / 53 = 25,585.

# Earthquake Risk Assessment

## Hazard Profile – Earthquake

## Location

As seen in the hazard profile and as determined by the Core Group, Erie County has a very low risk of incurring damage from earthquakes. The map below in **Figure 7** shows

epicenters in the state of Ohio dating back to 1776. Although surrounding counties have been the source of earthquake

epicenters, Erie County has not recorded an earthquake.

It would be surprising to many Ohioans that the State has experienced more than 200 earthquakes since 1776, and that 15 of these events have caused minor to The largest historic moderate damage. earthquake in Ohio was centered in Shelby County in 1937. This event, estimated to have had a magnitude of 5.5 on the Richter scale, caused considerable damage in Anna and several other western Ohio communities. where at least 40 earthquakes have been felt since 1875. Northeastern Ohio, east of Cleveland, is the second most active area of the state. At least 20 earthquakes are recorded in the area since 1836, including a 5.0 magnitude

# Figure 7: Epicenters of past earthquakes in Ohio



Epicenters of past earthquakes in Ohio.

event in 1986 that caused moderate damage. A broad area of southern Ohio has experienced more than 30 earthquakes.

## Extent

Although Ohio is not thought of as an earthquake-prone state, at least 200 earthquakes with epicenters in Ohio have been felt since 1776. Most have been felt only locally and have caused no damage or injuries. The largest historic earthquake in the state occurred in 1937. This event had an estimated Magnitude 5.4 and caused considerable damage in the town of Anna and in several other western Ohio communities. Ohio is on the periphery of the New Madrid Seismic Zone, an area in Missouri and adjacent states that was the site of the largest earthquake sequence to occur in historical times in the continental United States. In 1980, an earthquake with a magnitude of 5.3 on the Richter Scale and centered in Sharpsburg, Kentucky, was strongly felt throughout Ohio and caused minor damage in communities along the Ohio River in southwestern Ohio. In

1998, a Magnitude 5.2 earthquake occurred in western Pennsylvania and caused some damage in the epicentral area. Two regions of Ohio have been identified as susceptible to seismic activity; however neither Erie County nor its contiguous counties are included in these regions.

There are two different ways of describing the magnitude of an earthquake. One way measures peak ground acceleration. Peak ground acceleration is the maximum horizontal ground acceleration measured in centimeters per second per second (cm/sec<sup>2</sup>). Peak ground acceleration can range from zero for an earthquake that is noticed by very few people to 350, which would a catastrophic event. A peak ground acceleration of 10 cm/sec<sup>2</sup> means that the shaking is equivalent to about 1 percent of the acceleration due to gravity. Generally, ground acceleration must exceed 15 cm/sec<sup>2</sup> for significant damage to occur. According to the U.S. Geological Survey (USGS) Earthquake Hazard Program and as shown in **Figure 8**, peak ground acceleration in Erie County during an earthquake would measure between 4 and 8 cm/sec<sup>2</sup>.



Figure 8: USGS Seismic Hazard Map - Ohio

Another way of measuring the intensity of an earthquake is the Modified Mercalli Intensity Scale. Measures on this scale range from 1, an earthquake that is not generally noticeable, to 12, an earthquake that causes complete destruction. On the Modified Mercalli Intensity Scale:

- A measure of 4 is a moderate earthquake that is felt indoors by many people and rattles dishes, windows, and doors.
- A measure of 5 is a rather strong earthquake that is felt outdoors by most people and causes some dishes and windows to break.
- A measure of 6 is a strong earthquake that frightens people, causes windows, dishes, and glassware to break, and overturns or moves some heavy furniture but that causes slight structural damage.

## **Previous Occurrences**

No earthquakes have previously been documented from this area. Due to the infrequency of earthquakes occurring in Eire County, the impact on the county's infrastructure is quite low.

# Probability of Future Damaging Earthquakes

Given that USGS lists zero damaging earthquakes occurring between 1776 and 2013, one might conclude that the probability of a damaging earthquake is less than 1 percent in any given year. The USGS database shows that there is a 0.687% chance of a Magnitude 5.0 earthquake within 31 miles (50 kilometers) of Pedro within the next 50 years. This means that there is 0.0138% chance that a Magnitude 5.0 will occur in any given year.

The level of damage expected from an earthquake in Erie County is very low. It would be expected to be on the order of a Magnitude 3.0-3.9 quake, or lower. A quake of this magnitude would be felt by most people and include some breakage of dishes, windows and plasters. For this plan, the estimated probability of a damaging earthquake affecting Erie County in any given year is estimated at less than 1 percent per year.

As part of the 2013 Erie County Natural Hazards Mitigation Plan it was decided that utilizing HAZUS would benefit Erie County and the other jurisdictions involved to determine loss estimates for this regional hazard. These loss estimates are utilized primarily to plan and stimulate efforts to reduce risks from natural hazards and to prepare for emergency response and recovery. Since an earthquake is a wide spread hazard HAZUS was utilized for this particular hazard in order to generate more accurate loss estimations for the planning effort.

# Vulnerability Assessment – Earthquake

## **Overview of Vulnerability**

All structures and infrastructure in Erie County are equally at risk of experiencing an earthquake. However, in a mild earthquake of the magnitude typically experienced in Ohio, none to minimal structural damage is anticipated. In most cases, damages are expected to be limited and examples of anticipated damages are broken dishes and windows and cracked plaster.

## Potential Impact of Earthquake

Based on historical occurrences of earthquakes in the county, the odds of an earthquake striking Erie County in any given year would be less than 1% (0.01). Within the past 238 years, there has not been an epicenter recorded in Erie County.

A very large earthquake affecting Erie County might cause structural damage in dilapidated structures or structures that do not meet current building codes. Roads and bridges might be damaged and trees and power lines might fall.

Thus the impact of an earthquake might range from negligible to minor damage. Based on over 200 years of experience in Erie County, there will most likely be no damage or very slight damage. If in the worst case scenario a magnitude 5.4 earthquake, the strongest earthquake in Ohio's history, were to have an epicenter in Sandusky, Erie County, then moderate damage would be expected.

HAZUS estimates that there are 36,000 buildings in the region which have an aggregate total replacement value of 7.149 billion dollars. For a 5.4 magnitude earthquake, HAZUS estimates that about 9,653 buildings will be at least moderately damaged. This is 26% of the total number of buildings in the scenario. There are an estimated 782 buildings that will be completely destroyed by having over 50% damage to the structure. **Table 15** shows an estimated total damage for each occupancy type within Erie County that can be expected.

	Expected Buildings Damaged					
Occupancy	None	Slight	Moderate	Extensive	Complete	
Single Family	13,920	6,750	4,408	1,322	432	
Other Residential	3,284	1,646	1,349	595	195	
Commercial	674	381	497	275	99	
Industrial	207	102	145	90	32	
Agricultural	84	33	44	27	9	
Religion	67	36	38	21	8	
Government	27	15	22	11	4	
Education	23	12	16	8	3	
Total:	18,286	8,974	6,519	2,351	783	

Table 15: Building Exposure for a 5.4 Magnitude Earthquake

The total building related economic losses are \$1,140,180,000. For capital stock loses only, loses are \$909,420,000; 55.4% of which was residential and 44.6% are non-residential. No critical facilities are expected to be completely damaged. However, functionality of these buildings will be limited. Before the earthquake, the region had 396 hospital beds available for use. On the day of the earthquake, HAZUS estimates that 197 hospital beds are available for use by patients already in the hospital and those injured by the earthquake. Of the 8 police stations and 12 fire stations there will be 1

(12.5%) and 3 (25%) stations, respectively, with greater than 50% functionality on day 1 of the event.

Please note that this is one data point and the use of HAZUS as part of the earthquake analysis generated slightly different number of structures and structure values within the region. It is still important to know that this tool is out there and can be updated to reflect the more accurate information contained in HAZUS.

The HAZUS earthquake analysis was used to determine the worst case scenario. Structures with at least moderate damage were counted as 'affected' and total damage was calculated from structure values within HAZUS, a summary table is below in **Table 16**.

Building Type	Number of Buildings	Exposure in Region
Residential	6,162	\$1,191,889,535
Non-residential	3,357	\$652,481,695
Critical	131	\$25,461,752
Total:	9,650	\$1,869,832,982

#### Table 16: HAZUS Earthquake Analysis

## **Identifying Structures**

#### Plan Update Notes

Structures identified as potentially at risk of damage due to an earthquake are older structures as assumed in the previous plan.

#### Exposure of Existing Buildings to Earthquake Damages

All existing buildings in Erie County have the potential to experience an earthquake. Given no history of damage in Erie County due to earthquake, damages are estimated to be limited to the more dilapidated structures and structures with unreinforced masonry.

## Exposure of Future Buildings to Earthquake Damages

All future structures will also have the potential to experience an earthquake. However, some of the jurisdictions have adopted building codes to mitigate the potential for damage from an earthquake.

## **Estimating Potential Loss**

#### Plan Update Notes

Potential loss estimates for damage due to earthquake have not changed from the previous plan and are very low.

#### Methodology

USGS data was used to identify that there is no evidence that an earthquake has caused any damage in Erie County. Therefore, no dollars have been lost to earthquakes.

#### Estimated Potential Dollar Losses

Estimated annual potential dollar losses, due to the type of very small earthquake, anticipated for Erie County are \$0.00.

# Drought Risk Assessment

# Hazard Profile – Drought

## Location

History has shown that in the event of a drought, the entire county with be affected. A drought is an extended period of months or years when a region notes a deficiency in its water supply whether surface or underground water. Droughts occur when a region receives consistently below average precipitation. In the event of a drought it is more likely that multiple counties will be affected. That is why drought conditions are monitored by areas. Erie County is in Ohio Climate Division 2. During an average year in Ohio, an estimated 15,000 wildfires and natural fuel fires occur. Although droughts can persist for several years, even a short drought with intense heat can cause significant damage and harm to the local economy. With Erie County's close proximity to the Lake Erie, most droughts will have smaller effect on water supplies.

## Extent

The Palmer Drought Severity Index is used to describe abnormally wet to abnormally dry conditions. Zero represents normal rainfall and temperature conditions; drought condition indices are described in **Table 17**.

Index	Description of Conditions
4.0 or more	Extremely wet
3.0 to 3.99	Very wet
2.0 to 2.99	Moderately wet
1.0 to 1.99	Slightly wet
0.5 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.5 to -0.99	Incipient dry spell
-1.0 to -1.99	Mild drought
-2.0 to -2.99	Moderate drought
-3.0 to -3.99	Severe drought
-4.0 or less	Extreme drought

 Table 17: Palmer Drought Severity Index

Data provided by NCDC show that drought conditions in Ohio Climate Division 2 have resulted in Palmer Drought Severity Index level as low as -5.85 for a four month period in 1934. **Figure 9**, below, shows the PDSI for the four month period of May-August between 1895 and 2013. Ohio has a generally temperate climate and infrequently has a severe drought experience over an extended period of time. Over the summer months when drought conditions are most severe and would have the greatest effect on crops,

region 2 in Ohio where Erie County is located, has only experienced 9 moderate drought conditions, 6 severe drought conditions and 4 of which was categorized as extreme drought.



Figure 9: Summer PDSI in Climate Division 2 for the past 118 years

## **Previous Occurrences**

According to the NCDC, Erie County has experienced one drought of significance in the past 118 years. Drought conditions existed in Erie County in September of 1999. This drought only shows up as a -2.58 on the PDSI, which classify the event as moderate drought. Based on historical information, Erie County can expect to endure on average a moderate drought every ten years. In 2012, according to the Ohio County Profiles prepared by the Office of Policy, Research, and Strategic Planning, 53% of the land in the county was crop land, 16% was forest, 13% is urban, and 10% is pasture land. **Figure 10**, shown below, shows the precipitation for the summer of 1999.



Figure 10: Precipitation for the summer of 1999

# Probability of Future Damaging Drought

Having experienced one period of at least mild drought conditions over the course of 118 years from 1895 to 2013, probability of a mild drought in any given year is estimated to be 1/118 = 0.0085 or 0.85 percent.

However, not all drought periods lasted for a full year. **Figure 11**, below, is from the National Drought Mitigation Center at the University of Nebraska Lincoln shows the locations of severe drought conditions between 1895 and 1995. It also shows that severe and extreme drought occurs in the Erie County area in north Ohio between 10 and 14.9 percent of the time. For the purpose of this plan, 10 to 14.9 percent chance will be used to evaluate this hazard.



Figure 11: Percent of Time in Severe or Extreme Drought

# Vulnerability Assessment – Drought

## **Overview of Vulnerability**

A drought in Erie County can have significant detrimental effect on the domestic water supply, especially for well-water, agriculture, and water-dependent recreational activities. Economic effects in Erie County would include crop loss. No structural damage due to drought is anticipated in Erie County.

# Potential Impact of Drought

Negative impacts of drought would be experienced by agricultural interests, and the community would need to reduce its usage of water.

No damage to structures or infrastructure is anticipated due to drought.

## Identifying Structures

No structures would experience damage due to drought.

## Plan Update Notes

Since no structures would experience damage due to drought, this updated plan, like the previous plan, does not identify existing or future buildings at risk of loss due to drought.

## Exposure of Existing Buildings to Damages Due to Drought

No existing buildings are exposed to damage due to drought.

## Exposure of Future Buildings to Damages Due to Drought

No future buildings will be exposed to damage due to drought.

## **Estimating Potential Loss**

#### Plan Update Notes

There is no change in this updated plan in the estimate of loss due to drought.

#### Methodology

Estimated potential dollar loss due to drought is based on property damages provided from NCDC and USGS, which is \$0.

#### Estimated Potential Dollar Losses

The estimate potential dollar loss annually in Erie County due to structural damage due to drought is \$0.

# Lake and Stream Bank Erosion Assessment

# Hazard Profile – Lake and Stream Bank Erosion

## Location

Erosion is defined as the removal and transport of earth materials by natural agents. Some of these agents include glaciers, wind, water, earthquakes, volcanoes, tornadoes, hurricanes, mud flows, and avalanches.

Stream bank erosion is the direct removal of banks and beds by flowing water. Typically, it occurs during periods of high stream flow. It is sometimes confused with gully erosion because it has similarities with seasonal or ephemeral streams.

Erosion of stream or riverbanks through lateral (side) erosion and collapse often causes high sediment loads in creeks and rivers. The problem is often initiated by heavy rainfalls in catchments with poor vegetation cover, causing excess runoff. The resultant high volume and velocity runoff concentrates in the lower drainage lines or streams within catchments. When the stress applied by these stream flows exceeds the resistance of the local soil material, stream bank erosion occurs. As the sediment load increases, fast-flowing streams grind and excavate their banks lower in the landscape. Later, the stream becomes overloaded or velocity is reduced, and deposition of sediment takes place further downstream or finally in dams and reservoirs. Stream bank erosion is exacerbated by the lack of riparian zone vegetation and by direct stock access to stress.

Lake erosion, also known as coastal erosion, is the gradual wearing and carrying away of land or beach materials by wave action, water, wind, general weather conditions and tidal currents. It is a process which affects the landmass of an area as a consequence of the sea or lake acting upon it. It is usually caused by a relative rise in sea level and the fact that the amount of sediment removed by wave energy exceeds that supplied to the beach by longshore currents.

## Extent

In addition to loss of productive land due to bank erosion, dramatic changes in the course of a river or creek often restrict access on properties. Subsequent deposition of soil causes problems on productive land downstream and sedimentation in reservoirs. Other problems include reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities (roads, bridges and dams) and maintenance costs associated with trying to prevent or control erosion sites.

Soil that has eroded and washed into the water is the chief cause of pollution in the waters of Ohio, according to the ODNR. This soil is carried along with the water. When the water's velocity decreases, the soil settles out of the water. The sediment reduces the capacity of creeks, rivers, ponds, and streams, which leads to loss of habitat for insects and fish in that waterway.



Since the threat of stream bank erosion and lake erosion is typically localized, the County's population living near stream banks and the coast of Lake Erie needs to be aware of erosion hazards. Motorists traveling on roads that closely parallel stream banks also need to be aware of the damage that erosion can cause to pavement.

Property erosion results in accumulation of sediment and debris within and along the channel of streams and along the shores of Lake Erie. In streams, this accumulation occurs as sediment and debris settles in the channel simultaneously lowering the elevation of the stream banks and raising the elevation of the streambed. The subsequent result is a reduction in the carrying capacity of the streams, which causes higher water elevations during future floods. Since property damages due to flooding were high, property damages for stream bank erosion are also high due to similar effects on surrounding areas.

Factors that cause shoreline erosion include bluff recession, high lake levels, high winds and human activities. These cause many problems to the coastal communities of Bay View, Sandusky, Huron, Vermilion and Kelleys Island. Manmade shoreline structures that lie within a designated CEA along Lake Erie's coastline are susceptible to property damage over a 30-year period. Because of the large number of residential properties located within a CEA along the shoreline, property damages are expected to be high.

Stream bank and lake erosion are not considered to be life threatening. Some injuries may result from flooding but none have been recorded. Other injuries may be caused by motorists being unaware of damaged pavement and possibly driving off the road. However, damaged roads that may cause traffic accidents are typically closed for repairs to minimize the number of motorists traveling through that area. Therefore, the potential for death or injury is minimal.

Based on the property damage expected from stream bank and lake erosion, the impact on the local economy and local government expenditures is considered to be high. Manmade shoreline structures built along the Lake Erie shoreline trap sand supply, causing beachless shores. Lack of beaches may have an adverse effect upon tourism in Erie County. County roadways may be affected and in need of repair but this repair does not typically have an adverse effect on the economy as motorists will find an alternate route.

# **Previous Occurrences**

In Ohio, a Coastal Erosion Area (CEA) is a designated land area along Lake Erie's shore that is anticipated to be lost due to Lake Erie related erosion if preventative measures are not taken. More specifically, a CEA begins at the top of a bluff, bank or beach ridge and includes all land predicted to erode within a 30-year period if that distance totals nine or more feet. In June 1998, the ODNR finalized its official designation of CEAs, including those portions of property along Ohio's 262-mile Lake Erie coast which appear most threatened by erosion. They totaled 2,234 parcels, which represents about 37% of Ohio's Lake Erie coast line. The following diagram illustrates the effects of coast erosion over a

30-year period of time and is taken from ODNR's Office of Coastal Management. **Table 18** lists Ohio counties that lie along Lake Erie that describes the erosion distances and relates over long-term and short-term periods of time.

The northern boundary of Erie County consists of 35 miles of shoreline along Lake Erie and Sandusky bay. They City of Vermillion, Bay View, Sandusky and Huron are all located within the shoreline. A shore structure inventory was conducted in the late 1990s that included Erie County; however, this information is not currently available. The Division of Geological Survey plans to have the information regarding the mainland part of the County available in early 2005. The data regarding Sandusky Bay and Kelleys Island will not be included in that product, but may be available for limited distribution from the office of the Division of Geological Survey.

County	Long-term Distance in Feet	Long-term Rate in Feet per Year (1877- 1973)	Short-term Distance in Feet	Short-term Rate in Feet per Year (1973-1990)
Ashtabula	82	0.9	28	1.6
Lake	160	1.7	32	1.9
Cuyahoga	60	0.6	8	0.4
Loraine	80	0.8	12	0.7
Erie (Lake)	103	1.6	42	2.5
Ottawa (Lake)	208	2.0	27	1.6
Lucas	520	5.4	46	2.7
Erie (Bay)	241	2.8	32	1.9
Ottawa (Bay)	61	2.0	21	1.2

## Table 18: Ohio Lake Erie Erosion Statistics by County

## Probability of Future Damaging Lake and Stream Bank Erosion

Since erosion is a gradual process that occurs over time, there is not an easy way to calculate the number of erosion events in a given year. However, according to **Table 18** erosion is occurring in Erie County somewhere between one and three feet per year.

# Vulnerability Assessment – Lake and Stream Bank Erosion

# **Overview of Vulnerability**

As seen in the hazard profiles and as determined by the Core Group, Erie County has a countywide risk of incurring damage from lake erosion and stream bank erosion. The coastal area of Erie County extends inland on average from 1/8 mile to 1/4 mile on average, but continues to incorporate lake-influenced tributaries, embayments, wetlands and estuarine areas. In urban areas, the coastal boundary is generally less than 1/2 mile from the shore. Stream bank erosion occurs along the Vermilion River, Huron River,

Mills Creek and their tributaries and is accelerated during flooding due to higher than normal water velocities within the streams. If property protection measures are not taken to avoid lake erosion along Lake Erie, the risk of damage to or loss of property, possessions, infrastructure and life are greatly increased.

## Potential Impact of Lake and Stream Bank Erosion

In 1994, according to a study conducted by the H. John Henuz III Center for Science, Economics and the Environment, it is estimated that coastal erosion will destroy 87,000 buildings within 500 feet of the U.S. shoreline over the next 60 years, including the Great Lakes. Factors contributing to this erosion include rising sea levels, large storms, flooding, and powerful ocean waves. Other study findings indicate that those who live along the coast face as large a risk of damage from erosion as they do from flooding. Roughly 1,500 homes and the land on which they were built will be lost to erosion each year, with losses averaging \$530 million per year.

# **Identifying Structures**

## Exposure of Existing Buildings to Lake and Stream Bank Erosion Damages

As floodwaters overflow their banks, they carry sediment and debris from residential lawns, agricultural land and other sources further downstream and eventually into the channels of the creeks and their tributaries. This sediment and debris deposition has an adverse effect on aquatic and riparian habitats in Erie County and its watersheds. The bridges in Erie County act as collection sites for this debris, causing blockages of the floodway that raise flood elevations further downstream and also threaten evacuation routes during extreme flood emergencies. In addition, erosion left untreated may cause damage to roadways along stream banks and public piers and marinas along Lake Erie. Undermining of pavement may cause roadways to crumble and slip down the bank, creating hazards for motorists. Public piers and marinas that are affected by erosion could be potentially dangerous, especially near recreational areas or public parks.

## Exposure of Future Buildings to Lake and Stream Bank Erosion Damages

The areas within the County that are experiencing a higher rate of development will be more at risk for the occurrence of a landslide. Future structures on or near steep slopes may be a risk of damage due to landslide. If development on steep slopes were to disturb the land and vegetation to an unprecedented degree, the potential for damage due to landslide may increase.

# **Estimating Potential Loss**

## Estimated Potential Dollar Losses

Attempts were made to obtain more detailed information on the history of lake and stream bank erosion occurrences within Erie County in order to better predict both future
occurrences and dollars lost associated with those occurrences. However, these events are not recorded by the NCDC or SHELDUS so an estimate cannot be calculated.

#### Maximum Potential Dollar Losses

Due to the lack of information regarding dollars lost associated with lake and stream bank erosion occurrences, the value for the maximum potential dollar losses is not able to be accurately calculated.

## **Invasive Species**

### Hazard Profile – Invasive Species

### Location

According to the ODNR, Division of Wildlife, of the approximately 3,000 species of plants known to occur in Ohio, about 75 percent are native or have occurred in Ohio before the time of substantial European settlement, which was about 1750. The other 25 percent is not native to Ohio, having been introduced from other states or countries.

Most of these species never stray far from where they are introduced (gardens, urban areas, agricultural fields), yet some become very invasive and displace native plants in woodlands, wetlands, prairies, and other natural areas. Non-native plants have been introduced for erosion control, horticulture, forage crops, medicinal use, and wildlife foods as well as by accident.

Of the 18 aquatic invasive species noted at the national level there are three the Ohio Department of Natural Resources specifically notes: the Round Goby, Eurasian Ruffe and Zebra Mussel. The Round Goby and Eurasian Ruffe are species of fish which have proven in all Great Lakes region to rapidly increase in numbers and some have seen a decrease in native fish populations. Exact counts and range of impacted waters are difficult to determine. Often sport fishermen are the first to confirm their presence. The Zebra Mussel is a mollusk found throughout Lake Erie and in a few inland lakes that will attach to any unprotected surface which may include native clams. All three species pose the greatest threat to Lake Erie with the potential of moving inland. The counties immediately impacted are Lucas, Ottawa, Sandusky, Erie, Lorain, Cuyahoga, Lake and Ashtabula.

The Emerald Ash Borer is currently found in 50 of Ohio's 88 counties, six neighboring states and the province of Ontario. From its initial detecting in Northwest Ohio the insect has spread south to the Ohio River in the south and Pennsylvania in the East. One of the greatest problems increasing the spread of the insects is the transport of infected firewood. Quarantine areas have been established making the transport of firewood across county lines illegal. As of September 8, 2010, all 88 counties in the state comprise Ohio's quarantine area.

### Extent

Without natural predators or controls, invasive, non-native plants are able to spread quickly and force out native plants. In Ohio, several non-native plants are invading woodlands and displacing native spring wildflowers. Other non-native plants are impacting our wetlands by creating monocultures. Native plant diversity is important for wildlife habitat, as many animals depend on a variety of native plants for food and cover.

The Windor Star reports that there are more than 180 invasive species in the Great Lakes. According to a report by the Ohio State University in conjunction with NOAA and Ohio Sea Grant, the top ten aquatic invasive species in Lake Erie are as follows:

- 1. Zebra Mussel
- 2. Quagga Mussel
- 3. Round Goby
- 4. Spiny European Water Flea
- 5. Fishhook Water Flea
- 6. Sea Lamprey
- 7. White Perch
- 8. Eurasian Watermilfoil
- 9. Purple Loosestrife
- 10. Common Carp

According to the ODNR, Division of Forestry one of the most invasive insect species in Ohio is the Emerald Ash Borer. This Asian pest is part of a group of insects known as metallic wood-boring beetles. Emerald Ash Borer affects all species of native ash found in Ohio. Because North American ash trees did not coexist in association with this pest, they have little or no resistance to its attack. This ash tree-killing insect from Asia was unintentionally introduced to southeastern Michigan several years ago. In February of 2003, it was first found feeding on ash trees in northwest Ohio.

Emerald Ash Borer larvae feed on the living portion of the tree, directly beneath the bark. This eating habit restricts the tree's ability to move essential water and nutrients throughout the plant. In three to five years, even the healthiest tree is unable to survive an attack.

Another concern for Erie County is the eutrophication occurring in Lake Erie, especially due to the growing presence of blue/green algae. Algae blooms are caused by excess nitrogen and phosphorous in Lake Erie due incoming sources of polluted runoff, especially the Maumee and Detroit Rivers. The New York Times reported about the algae bloom issue in Lake Erie, "It is perhaps the greatest peril the lake has faced since the 1960s, when relentless and unregulated dumping of sewage and industrial pollutants spawned similar algae blooms and earned it the nickname "North America's Dead Sea."" The recovery during the 1970's and 1980's was an \$8 billion project to clean up Lake Erie. Recently the cause of the blooms is not unregulated dumping, but the phosphorus pollution mainly due to farming techniques.

The blue/green algae blooms also have effects on the plant and aquatic life in Lake Erie. Algae blooms can block sunlight at the surface of the water and not allow native plants to get a necessary amount to live. In addition, as algae die and sink to the bottom of the lake, bacteria decompose dead algae and consume oxygen in the water in the process. As a result, there is a dead zone in central Lake Erie that has covered up to a third of the lake bottom in recent years, according to the New York Times.

The zebra mussels, a dominant invasive species, are assisting the growth of toxic algae blooms. Zebra mussels consume nontoxic green algae and also produce phosphorus, therefore eliminating the toxic algae's competitor while also providing food for the toxic green/blue algae.

### **Previous Occurrences**

Invasive species of plants, fish and insects have been arriving in Ohio since the establishment of European settlers in the 1750s. With each improvement in the scale and speed of human transportation, the potential for unintended introduction of invasive species has increased. Organisms which could not survive the month-long journey from Europe or Africa to America can make the journey in a matter of hours today. Several examples of species introduction pathways follow:

The Round Goby species was introduced from Eurasia into the St. Clair River and vicinity on the Michigan-Ontario border where several collections were made in 1990 on both the U.S. and the Canadian side. Speculation exists the Goby was transported from its native Caspian Sea by way of ballast tanks on ocean going vessels. Today the Goby is found in all the Great Lakes and is making inroads in all contiguous state watersheds. The Multiflora Rose was introduced to the U.S. from Japan in 1886 as an under-stock for ornamental roses. Birds are responsible for spreading the seeds, which remain viable for a number of years. In the 1930s, the Soil Conservation Services advocated the use of Multiflora Rose have also been used as a crash barrier and to reduce headlight glare in

The Emerald Ash Borer was introduced into North America sometime in the 1990's. The insect is believed to have been introduced into the U.S. in wood packing material from China. It was first reported killing ash trees in the Detroit and Windsor areas in 2002. Only species of ash are hosts for the beetle, which usually kill infested trees within a couple of years. Since then, infestations have been found throughout Lower Michigan, Ohio, northern Indiana, the Chicago area, Maryland and recently in Pennsylvania.

Considering the thousands of plant, dozens of aquatic and unknown number of insect species introduced into Ohio over the past 250 years samples of the most often cited transfer media are provided here. Exotic species can arrive by a nearly endless number of vectors making a complete listing impossible.

highway medians.

### **Probability of Future Damaging Invasive Species**

Since the beginning of European colonization non-native species have been arriving in Ohio. With the increase in global trade and travel the probability of new and unexpected species arriving in Ohio will continue to grow. Legislation is in place around the world in an attempt to control the migration of unwanted species between ecosystems. The ODNR is currently battling the entrance of wild boars from Kentucky and West Virginia. In addition, there are several species of carp currently migrating up the Mississippi watershed from the Gulf Coast. Although not currently reported in any Ohio waterways, the probability of future infestations is near certain.

It is certain that new wanted and unwanted species will arrive in Ohio. The importance of controlling the integrity of existing ecosystems will require ongoing state, national and international efforts to avoid unwanted infestations.

### Vulnerability Assessment – Invasive Species

### **Overview of Vulnerability**

The county is located on Lake Erie that poses a high risk of introducing invasive species from Welland and Erie barge canals as well as ballast water from incoming ships.

### Potential Impact of Invasive Species

Invasive species might cause infiltration of crop lands, problems for drinking water processing facilities and utilities, impacts to in-water structures, and financial impacts to loggers.

### **Identifying Structures**

#### Exposure of Existing Buildings to Invasive Species Damages

Invasive species pose a very limited impact on buildings and state-owned facilities. The most prominent impact to state facilities relates to the maintenance of marinas in Zebra Mussel impacted areas. However, invasive species are not a fixed hazard and have the potential to affect all state-owned facilities.

#### Exposure of Future Buildings to Invasive Species Damages

Invasive species are not expected to have a significant impact on future buildings.

### **Estimating Potential Loss**

#### Estimated Potential Dollar Losses

The effect of invasive species is hard to estimate for Erie County because of the lack of information isolating Erie County. Every invasive species is unique and therefore mitigation costs vary widely. Impacts of invasive species tend to have non-residential operational impacts, as opposed to many built environment impacts of the other hazards covered. Due to this unique situation, rather than a matrix of counties and losses the loss estimates will be presented using historical response costs to predict future losses in unadjusted dollars. These costs are for the State of Ohio and not specifically for Erie County but they give an idea of how costly invasive species can be.

From the perspective of invasive plant species the Multiflora Rose is one of most expensive to combat in Ohio. Each individual plant's ability to produce 500,000 seeds a year allows this invasive species to spread over large area with incredible speed. Agricultural groups are facing the highest exposure and expense in the form of infiltration of crop lands and eradication programs. According to agricultural experts associated with The Ohio State University, Ohioans are estimated to spend millions of dollars combating the Multiflora Rose. Precise dollar figures are not available due to the majority of response activities being performed by non-governmental entities.

Four known methods of responding to the species exist. First, the removal of the plant as a whole, including the roots, can be cost effective in small applications. Second, repeated defoliation or mowing down the plants will eventually kill almost any plant. Third, the use of herbicides can be effective if applied at specific stages of the plant's growth. All of the above management techniques can be expensive and labor intensive. The last method is the use of Rose Rosette Disease, a mite-vectored virus, which is giving rise to a hope for a lower cost control agent.

Turning to invasive aquatic species, the Zebra Mussel is one of the most expensive to control. The mussels naturally collect on any solid surface and create significant problems for drinking water processing facilities and utilities. All in-water structures are impacted including, but not limited to, piers, breakwalls, vessel hulls and vessel engines cooled with external water. Estimates for controlling infestations run between \$2 and \$10 million per year depending on how many sources are aggregated. Should the Zebra Mussel effectively invade the river systems of Ohio, it is suggested the annual control costs could rise 10-fold.

Invasive insect species are both the direct source of damage to trees and a vector for other parasites. In the last century the North American population of Elm trees was decimated by a fungus which arrived on infected trees shipped to an Ohio furniture company. One of the primary transport methods is though beetles which the fungus uses as a host to move from tree to tree. The beetle's ability to fly exponentially increased the number of trees impacted. Trees located in non-urban areas posed financial impact only to loggers; however, the Elm was a popular urban tree and the cost to remove them ran into the millions over the years.

The Emerald Ash Borer, which is currently impacting the North American Ash tree, has already cost millions of dollars in attempts to identify and isolate infected trees. In Ohio alone there are an estimated 5 billion Ash trees at risk. Although many research centers are searching for an effective means of combating the insect, the only method currently available is the use of insecticides which have to be applied annually. The un-captured cost to treat Ash trees in Ohio will likely reach into the millions, as urban areas combat the insect.

#### Maximum Potential Dollar Losses

Due to the lack of information regarding dollars lost associated with invasive species occurrences, the value for the maximum potential dollar losses is not able to be accurately calculated.

## Summary of Risk Assessment Findings

The purpose of completing a rigorous assessment of risk is to inform decision-making about the mitigation actions that are most appropriate for the county. **Table 19** shows that Erie County can expect the greatest losses from flooding. Annualized anticipated losses due to flooding are more than three times the losses anticipated due to all hazards combined. Thus, the majority of actions proposed in this mitigation plan address potential damage due to flooding.

Hazard	Vulnerable Locations	Annual Probability of Occurrence in Erie County	Estimated Annual Dollar Loss
Flood	Special Flood Hazard Areas	100%	\$731,555
Severe Storms	Entire County	100%	\$707,476
Tornado	Entire County	18.8%	\$25,585
Earthquake	Localized	<1%	\$0
Drought	Entire County	<1%	\$0
Lake and Stream Bank Erosion	Localized	100%	\$ -
Invasive Species	Entire County	100%	\$ -

#### Table 19: Risk Assessment Findings

The conclusion of the risk assessment is that the greatest damages attributable to a single hazard occurring in Erie County can be expected to be caused by flooding.

Worst case scenarios were also performed for each hazard. A vulnerability analysis of these scenarios is shown in **Table 20**. Unlike the annual estimated losses, the total anticipated losses due to a worst case scenario cannot be compared due to the significance variations for each one of these hazards. For example, even though the damage value is on the same magnitude for severe storms and earthquakes, the probability of a severe storm event occurring is significantly higher than a catastrophic earthquake in Erie County. It is also important to note that this table represents the total number of at-risk structures. Based off of multiple circumstances that are unpredictable in nature, the damage values may over/underestimate the actual damage if a worst case scenario were to happen. **Table 20** demonstrates the worst case scenario potential damage as it relates to each hazard and delineates residential, non-residential and critical structures throughout Erie County. The number of structures at-risk due to flooding is broken out into residential and non-residential based on the results of a HAZUS-MH Flood Event Report in **Appendix VIII**.

Hazards	Number of Structures At-Risk				Damage in De	ollars (\$1000)		
	<u>Residential</u>	<u>Non-</u> <u>Residential</u>	<u>Critical</u>	<u>Total</u>	<u>Residential</u>	<u>Non-</u> <u>Residential</u>	<u>Critical</u>	<u>Total</u>
Flood	4,847	2,081	307	7,235	\$938,843	\$403,649	\$59,025	\$1,401,517
Severe Storms	11,905	1,631	0	13,536	\$1,090,391	\$427,045	\$0	\$1,517,436
Tornado	8,522	1,167	486	10,175	\$780,539	\$305,556	\$148,867	\$1,234,961
Earthquake	6,162	3,357	131	9,650	\$1,191,890	\$652,482	\$25,462	\$1,869,833
Drought	0	0	0	0	\$0	\$0	\$0	\$0
Lake and Stream Bank Erosion	0	0	0	0	\$0	\$0	\$0	\$0
Invasive Species	0	0	0	0	\$0	\$0	\$0	\$0

#### Table 20: Vulnerability Analysis

For each hazard, aside from flooding, tornadoes and earthquakes, all critical facilities are assumed to withstand normal forces and events based on the hazards affecting Erie County. This is assumed because these facilities are typically designed to meet building code and they are usually maintained by the personnel occupying the building. Therefore, no damages are assumed for these types of facilities. In the case of flooding and earthquakes, the estimated value for structures is the total value of the structure and may be overestimated if only a portion of the building is damaged. In the case of flooding of critical facilities, the total average value of the determined structures was given which is an overestimation because not all of the structures will be totally damaged. To evaluate the amount of damage to critical facilities in the worst case scenario for a tornado, each facility in the path of most destruction was evaluated on an individual basis and assigned a value. This is the same path that the other structures were evaluated on. The value for this item is merely an estimate and can greatly differ by the path of the tornado. The damage to critical facilities for an earthquake was taken from the HAZUS report and buildings with any damage in the education and government categories were counted as critical facilities. Damage estimates for an earthquake represent the estimate from the HAZUS report and number of structures at-risk includes structures with slight to complete damage. Therefore, the estimated value of structures is not the total value of structures due to the varying degree of impact an earthquake has on structures depending on structural characteristics.

## **Mitigation Goals**

## Mitigation Goals Update

Goals express aspirations about long-term conditions rather than specific measures. The goals expressed in this plan regarding natural hazards are basically the goals that were established when the plan was initially developed for adoption in 2005, but the presentation of goals, objectives, and actions has been re-written.

### Mitigation Planning Principles

Goals were needed for this planning effort to guide the review of the possible mitigation measures. The recommended actions of this plan are consistent with what is appropriate for Erie County. Mitigation goals reflected community priorities and should be consistent with other plans for the county.

After the determination of the draft problem statements, the Mitigation Core Group agreed to goals that they wanted to achieve for each hazard. These goals are listed in the following section.

### Goals

- 1) Flooding
  - a) Save lives and property, reduce damage and to increase education (awareness) of flooding and how floods can affect a community

#### 2) Severe Storms

- a) Increases awareness of severe storms and reduce property damage by evaluating current means of response and determining where Erie County needs to coordinate better in reacting and planning for severe storms
- b) Evaluate needs to prepare for severe storms such as the need for back-up generators for critical facilities within Erie County

#### 3) Tornados

- a) Evaluate the need for shelters, safe rooms, and a siren warning system for Erie County, especially in high risk areas
- 4) Ice Jams
  - a) Identify, monitor, and evaluate high risk areas of concern

#### 5) Lake and Stream Bank Erosion

- a) Evaluate true needs as it relates to what mitigation activities can go in place to lessen stream and lake bank erosion
- 6) Invasive Species
  - a) Proactively evaluate the effects of blue/green algae on Erie County and its residents
- 7) Droughts
  - a) Reduce potential damage and to increase awareness of drought occurrences throughout Erie County by increased preparedness
  - b) Increase awareness and fire prevention



### 8) Earthquakes

- a) Increase awareness events
- b) Review additional administrative controls before construction and establish

## Alternative Mitigation Actions

## Mitigation Alternatives Update

Actions that were proposed in the previous mitigation plan were reviewed by the Erie County EMA Director and members of the Mitigation Core Group to determine their status. These actions are recorded in this updated plan as having been completed, deleted, deferred, or ongoing. The Mitigation Core Group felt that by going through this exercise that they were benefiting their community and their alternative mitigation actions as well.

These actions were part of the review of range of actions suggested for inclusion in this updated plan.

During this planning process vernacular such as "action items" and "alternatives" was used interchangeably to describe those activities that the participating jurisdictions, including the county, evaluated or considered for implementation.

## **Review of Previously Proposed Mitigation Actions**

**Appendix IX** lists the 37 mitigation actions that were proposed in the previous version of the Erie County mitigation plan that relate to natural hazards and indicates the status of actions. Actions are either reworded and combined with other actions in the plan update, ongoing and included in the plan update, or deleted because they are no longer relevant.

## **Benefit Cost Review of Mitigation Alternatives**

A number of different criteria were used during plan development to prioritize suggested mitigation actions. The Mitigation Core Group subjectively prioritized alternatives through an iterative process of document review during 2013 planning process until consensus was reached.

Additional measures were taken to evaluate the benefit/cost of each of the alternatives. The review identified the degree to which suggested actions might provide economic and environmental benefits to the community as well as might be acceptable from an administrative, political or social standpoint. The Mitigation Core Group utilized a process recommended by FEMA called STAPLEE. The Mitigation Core Group modified their process somewhat and only utilized four considerations verses the seven suggested by STAPLEE. The STAPLEE method of prioritization is typically used for planning purposes; when a local jurisdiction applies for a Federal grant for project implementation.

STAPLEE stands for:

**S** – **Social:** Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the communities social and cultural values.

**T – Technical:** Mitigation actions are technically most effective if they provide long-term reduction of losses and have minimal secondary adverse impacts.

**A** – Administrative: Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.

P - Political: Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support of the action.

L - Legal: It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.

E - Economical: Budget constraints can significantly deter the implementation of mitigations actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost-benefit review, and possible to fund.

**E** – **Environmental:** Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with Federal, State, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

For each criterion, the prioritization methodology assigned a 1 if there would be a benefit, a -1 if there would be a cost, and a 0 if no cost or benefit could be associated with the suggested action. For example, if an action might have a positive effect on the natural environment, the score for environmental impact would be 1; and if a proposed action might be met with public resistance, the score for social support would be -1.

However, because the risk assessment showed that estimated annual dollar losses due to flooding and severe storms would be substantial, the economic benefits of suggested actions for mitigating the effects of these hazards were assigned a weight. A weight of three (3) was given to economic impacts for flood mitigation actions because annualized flood damages are substantially higher than all hazards; a weight of two (2) was given to economic impacts of severe storms because annualized repair costs due to this hazard is the second most costly; a weight of one (1) was given to economic impacts of tornadoes and lake and stream bank erosion because annualized repair costs due to these hazards have a lower cost associated with them; and a weight of zero (0) was given to economic impacts of the remaining hazards mitigation actions because repairs due to these hazards have no reported cost associated with them.

**Table 21** displays the results of this cost benefit review showing scores assigned to suggested mitigation actions for each of the four different evaluation criteria.

Hazard	Mitigation Alternative Considered	Economic Impact	Admin.	Political/ Social	Enviro. Impact	Summary
Flooding	Provide maintenance for ditches and waterways to avoid overflow due to sediment and debris build up.	3	-1	1	1	4
Flooding/ Lake & Stream Bank Erosion	Update flood insurance rate maps (FIRMs). Current maps are from 1970-1980 generation	3	-1	0	0	2
Flooding/ Severe Storms/ Tornadoes	Provide back-up generators (both temporary and permanent) for pumping and lift stations in sanitary sewer systems.	3	-1	1	0	3
Flooding	Eliminate cross contamination of storm and sanitary sewers by eliminating CSO and SSO systems.	3	-1	1	1	4
Flooding	Increase capacity of sanitary sewer lift stations to avoid overflow.	3	-1	0	1	3
Flooding	Assess and inventory problems with undersized culverts within Erie County	3	0	0	1	4
Flooding/ Lake & Stream Bank Erosion	Assess and inventory problems with roadways susceptible to flooding within Erie County	3	0	0	1	4
Flooding	Identify and assess Pipe Creek Watershed to identify actual hazard	3	-1	1	1	4
Flooding	Identify and assess culverts and undersized drainage pipe property and drainage affected on Kelley's Island	3	-1	1	1	4
Flooding	Identify and assess Chapel Creek watershed to benefit Berlin Heights-Florence Twp.	3	-1	1	1	4
Flooding	Re-evaluate Franklin Flats neighborhood for a buyout program.	3	-1	1	1	4
Flooding	Identify and assess other localized flooding areas and direct tributaries to the Bay and Lake	3	-1	1	1	4
Flooding	Identify a flood notification system and a river gauge system	3	-1	1	1	4

### Table 21: Ranking of Proposed Mitigation Actions



Hazard	Mitigation Alternative Considered	Economic Impact	Admin.	Political/	Enviro. Impact	Summary
	<b>-</b>			Social		
Flooding	Foster inter-agency coordination of floodplain management (Round Table)	3	0	1	0	4
Flooding	Provide public education of floodplain regulations for new construction through brochures distributed county-wide.	3	0	1	0	4
Flooding (Ice Jams)	Evaluate the need to consider Ice Jams as concern for those communities that are affected directly from these winter flooding hazard	3	0	1	1	5
Karst Flooding	Identify high risk areas and evaluate land-use planning techniques to mitigate future events	3	0	1	1	5
Severe Storms- Summer and Winter/ Tornadoes	Provide more NOAA radios in critical facilities to move toward achieving a "Storm Ready" community status. Provide additional NOAA radios for other facilities such as private businesses	2	-1	1	0	2
Severe Storms- Summer and Winter	Evaluate the potential to develop a Countywide Program for pre- wiring structures to accept generators	2	0	0	0	2
Severe Storms- Summer and Winter/ Tornadoes	Provide additional interoperable sirens to provide early warnings to citizens of approaching severe weather.	2	-1	1	0	2
Severe Storms- Summer and Winter/ Tornadoes	Develop and provide outreach program for County residents and those in the sensitive/special needs population covering the dangers associated with severe storms.	2	0	1	0	3
Severe Storms- Summer and Winter	Construct designated safe shelters that would provide protection from severe weather throughout the County.	2	-1	1	0	2
Severe Storms- Summer and Winter/ Tornadoes	Develop a tree maintenance program to prune or remove those trees recognized to be hazards.	2	-1	0	1	2

Hazard	Mitigation Alternative Considered	Economic	Admin.	Political/	Enviro. Impact	Summary
	, and the second se	Impact		Social		
Severe Storms- Summer and Winter	Evaluate the need for shelters for marinas and for high tourist areas within the County	2	0	1	0	3
SevereDevelop and provide outreach onStorms-the unique weather patterns inSummer andErie CountyWinter		2	0	1	0	3
Tornadoes (Straight- Line Winds)	Evaluate the need for multi- use shelters for marinas and for high tourist areas within the County	1	0	1	0	2
Lake & Stream Bank Erosion	Provide additional monitoring of water levels in streams and rivers with stream gauges	1	-1	1	1	2
Lake & Stream Bank Erosion	Identify and evaluate areas and tributaries impacted by stormwater	1	-1	1	1	2
Lake & Stream Bank Erosion	Identify and evaluate Best Management Practices for stormwater and localized stream and lake bank erosion	1	-1	1	1	2
Lake & Stream Bank Erosion	Develop and provide educational information and promotion of urban and agricultural impacts of stormwater	1	0	1	1	3
Drought	Develop a public education program for restrictions on water usage during drought conditions.	0	0	1	1	2
Drought	Develop a public education program on the hazards associated with droughts and extreme heat.	0	0	1	1	2
Fire	Develop educational program for restrictions on water usage during fire events	0	0	1	1	2
Earthquakes	Develop a public education program on the dangers of earthquakes	0	0	1	1	2
Earthquakes Develop and enforce appropriate building codes for structures to be constructed in seismic areas		0	0	1	1	2
Earthquakes	Evaluate the potential association of injection wells and how that is affected by earthquakes	0	0	1	1	2
Invasive Species	Evaluate the types and effects of Invasive Species on Erie County and its residents	0	0	1	1	2



After rating the actions relative to the 4 different feasibility criteria, the Mitigation Core Group reviewed the results and selected actions for inclusion in the plan ensuring that there would be actions directed toward mitigating the effects of each identified hazard, actions addressing existing structures, and actions addressing future structures. Alternatives that were not proposed below for implementation during the next 5 years may very well be proposed when this plan is next updated.

## Prioritization Methodology

A number of different criteria were used during plan development to prioritize suggested mitigation actions. The Mitigation Core Group chose a total of 37 potential mitigation activities. Of those 37 activities, 20 were labeled as 'prioritized' activities based on the ranking process and scored a 3 or higher. The activities were initially ranked first taking into account the risk assessment ranking of hazards the Mitigation Core Group decided to continue to utilize this ranking process. The various hazards had been ranked according to past historical events and the cumulative costs of each potential disaster. The Mitigation Core Group subjectively prioritized alternatives through an iterative process of document review during 2013 planning process until consensus was reached. The Mitigation Core Group reached consensus on the prioritization of the Action Items based directly on the prioritized ranking of the hazards themselves. For example, in Erie County the hazard of flooding is their number one hazard and concern. The Mitigation Core Group felt that prioritizing those action items that fell under flooding should be ranked number one. The same goes for the next re-prioritized hazard severe storms. Severe storms are now ranked number two as it relates to their overall effect on the County and its participating jurisdictions so all the Action Items that fall under this hazard are affectively ranked number two.

## **Proposed Mitigation Actions**

### Mitigation Actions Update

Mitigation actions that were proposed in the earlier version of this plan and have been completed are not included in this plan. Mitigation actions that were proposed in the earlier version of this plan and have not been completed are once again proposed for implementation. No previously proposed mitigation actions have been deleted from the mitigation plan for the County. There are several mitigation actions that the Mitigation Core Group realized were not implementable on their own such as requesting back-up generators for public facilities. The Mitigation Core Group has decided to keep these mitigation actions as a stand-alone action item but will consider grouping these types of mitigation strategies with other implementable mitigation alternatives. New mitigation actions have also been identified and evaluated, and are proposed for implementation in this plan.

For each hazard, the Mitigation Core Group decided to propose for implementation only the suggested alternatives for each hazard that received higher scores as a result of the prioritization process. The Mitigation Core Group reevaluated and ranked the hazards for this effort based on their understanding and susceptibility to each hazard that was agreed upon during our subsequent mitigation core group meetings.

### **Selected Actions**

Actions selected and proposed for implementation are grouped together as:

- Actions that reduce risk to existing structures/infrastructure
- Actions that reduce risk to future structures/infrastructure
- Actions that address continued participation in the NFIP
- Actions that incorporate mitigation into other community plans
- Other proposed actions such as further study or data collection

Some actions fit into more than one of these categories and are listed in more than one of the tables presented below.

### Selected Actions Addressing Existing Development

Some mitigation actions will provide further protection to existing structures and infrastructure. The eleven actions listed in **Table 22** will reduce the likelihood of damage due to natural hazards in existing structures.

Hazard	Proposed Mitigation Action
Flooding/ Lake & Stream	Update flood insurance rate maps (FIRMs). Current maps are from
Bank Erosion	1970-1980 generation
Flooding	Provide maintenance for ditches and waterways to avoid overflow
	due to sediment and debris build up.
Flooding/ Severe Storms/ Tornadoes	Provide back-up generators (both temporary and permanent) for pumping and lift stations in sanitary sewer systems.
Flooding	Eliminate cross contamination of storm and sanitary sewers by eliminating CSO and SSO systems.
Flooding	Increase capacity of sanitary sewer lift stations to avoid overflow.
Flooding	Assess and inventory problems with undersized culverts within Erie
_	County
Flooding/ Lake & Stream	Assess and inventory problems with roadways susceptible to
Bank Erosion	flooding within Erie County
Severe Storms-Summer and Winter	Evaluate the potential to develop a Countywide Program for pre- wiring structures to accept generators
Severe Storms-Summer	Develop a tree maintenance program to prune or remove those
and Winter/ Tornadoes	trees recognized to be hazards.
Severe Storms-Summer	Evaluate the need for shelters for marinas and for high tourist areas
and Winter	within the County
Tornadoes (Straight-Line	Evaluate the need for multi- use shelters for marinas and for high
Winds)	tourist areas within the County

#### Table 22: Actions Addressing Existing Development

### **Selected Actions Addressing Future Development**

Some proposed mitigation actions will affect the degree to which future structures and infrastructure are protected against damage due to natural hazards. **Table 23** lists seven actions in this category.

#### Table 23: Actions Addressing Future Development

Hazard	Proposed Mitigation Action
Flooding/ Lake &	Update flood insurance rate maps (FIRMs). Current maps are from
Stream Bank Erosion	1970-1980 generation
Flooding	Identify and assess Pipe Creek Watershed to identify actual hazard
Flooding	Identify and assess Chapel Creek watershed to benefit Berlin Twp
	Florence Twp.
Flooding	Re-evaluate Franklin Flats neighborhood for a buyout program.
Flooding	Identify and assess other localized flooding areas and direct tributaries
	to the Bay and Lake
Flooding	Provide public education of floodplain regulations for new construction
	through brochures distributed county-wide.
Earthquakes	Develop and enforce appropriate building codes for structures to be
	constructed in seismic areas.

### Selected Actions Addressing Continued Participation in the NFIP

All local jurisdictions, except Berlin Heights and Kelley's Island, in Erie County participate in the NFIP. Nevertheless, flooding continues to threaten the safety and security of County residents. The eight mitigation actions displayed in **Table 24** address participation in the NFIP beyond meeting the usual minimum NFIP standards.

Hazard	Proposed Mitigation Action		
Flooding/ Lake & Stream	Update flood insurance rate maps (FIRMs). Current maps are from		
Bank Erosion	1970-1980 generation		
Flooding	Provide public education of floodplain regulations for new		
	construction through brochures distributed county-wide.		
Flooding	Foster inter-agency coordination of floodplain management (Round		
	Table)		
Flooding	Identify and assess culverts and undersized drainage pipe property		
_	and drainage affected on Kelley's Island		
Flooding	Identify a flood notification system and a river gauge system		
-			
Flooding (Ice Jams)	Evaluate the need to consider Ice Jams as concern for those		
	communities that are affected directly from these winter flooding		
	hazards		
Lake/Stream Bank	Provide additional monitoring of water levels in streams and rivers		
Erosion	with stream gauges		
Flooding/ Lake & Stream	Assess and inventory problems with roadways susceptible to		
Bank Erosion	flooding within Erie County		

#### **Table 24: NFIP Continued Participation Proposed Actions**

### **Selected Actions That Incorporate Mitigation into Other Plans**

Some mitigation actions involve the incorporation of mitigation strategies into existing planning mechanisms. Six proposed mitigation actions, not necessarily different from those listed elsewhere in this section, involve such incorporation.

**Table 25** lists proposed mitigation actions that will involve the incorporation of hazard mitigation actions into other planning mechanisms. As discovered in the reconnaissance for the overall planning effort and the potential incorporation of alternative mitigation actions into other planning mechanisms the Erie County EMA and the Mitigation Core Group felt it necessary to delineate planning mechanism(s) as well as agencies due to the lack of existing planning mechanisms in place for Erie County. This strategy was implemented so that local governments as well as agencies within Erie County could utilize the alternative mitigation actions most efficiently and when documentation is created for these agencies that these alternative mitigation actions are considered.

Hazard	Proposed Mitigation Action	Related Planning Mechanism(s)
Earthquakes	Develop and enforce appropriate building codes for structures to be	Emergency Operation Plan
	constructed in seismic areas.	Erie County Engineers Office
Lake & Stream Bank	Identify and evaluate areas and tributaries impacted by stormwater	Emergency Operation Plan
Erosion		Erie County Engineers Office
Tornadoes (Straight-	Evaluate the need for multi- use shelters for marinas and for high	Emergency Operation Plan
Line Winds)		Erie County Engineers Office
	tourist areas within the County	
Severe Storms- Summer and Winter	Evaluate the potential to develop a Countywide Program for pre-wiring structures to accept generators	Emergency Operation Plan
Flooding	Foster inter-agency coordination of floodplain management (Round Table)	Emergency Operation Plan
Flooding/ Lake &	Assess and inventory problems with roadways susceptible to flooding	Emergency Operation Plan
Stream Bank Erosion	within Erie County	Erie County Engineers Office

Table 25: Actions to Incorporate into Other Planning Mechanisms

### **Other Selected Mitigation Actions**

Some proposed mitigation actions call for further planning or community education efforts. While these may eventually result in actions that will reduce the likelihood of damage due to natural hazards, the actions displayed in **Table 26** do not necessarily affect existing or future structures, do not augment participation in the NFIP, and do not involve other planning mechanisms.

Hazard	Proposed Mitigation Action
Severe Storms-	Provide more NOAA radios in critical facilities to move toward
Summer and Winter	achieving a "Storm Ready" community status. Provide additional NOAA radios for other facilities such as private businesses

Hazard	Proposed Mitigation Action
Severe Storms-	Evaluate the need for additional back-up generators (both
Summer and Winter	temporary and permanent) for critical facilities.
Severe Storms-	Provide additional interoperable sirens to provide early
Summer and Winter	warnings to citizens of approaching severe weather.
Severe Storms-	Develop and provide outreach program for County residents
Summer and Winter	and those in the sensitive/special needs population covering the
	dangers associated with severe storms.
Severe Storms-	Construct designated safe shelters that would provide
Summer and Winter	protection from severe weather throughout the County.
Severe Storms-	Develop and provide outreach on the unique weather patterns
Summer and Winter	in Erie County
Severe Storms-	Develop and provide outreach program for County residents
Summer and Winter	and those in the sensitive/special needs population covering the
	dangers associated with severe storms.
Tornadoes (Straight-	Develop and provide outreach program for County residents
Line Winds)	and those in the sensitive/special needs population covering the
	dangers associated with tornadoes.
Lake & Stream Bank	Identify and evaluate Best Management Practices for
Erosion	stormwater and localized stream and lake bank erosion
Lake & Stream Bank	Develop and provide educational information and promotion of
Erosion	urban and agricultural impacts of stormwater
Drought	Develop a public education program for restrictions on water
	usage during drought conditions.
Tornadoes (Straight-	Provide additional interoperable sirens to provide early
Line Winds)	warnings to citizens of approaching severe weather
Tornadoes (Straight-	Provide NOAA radios in critical facilities to move forward on
Line Winds)	the "Storm Ready" Community status.
Lake & Stream Bank	Update flood insurance maps (FIRMs). Current maps are from
Erosion	1970-1980 generation.
Lake & Stream Bank	Identify and evaluate areas and tributaries impacted by
Erosion	stormwater
Drought	Develop a public education program on the nazards associated
Eino	With droughts and extreme heat.
Fire	Develop educational program for restrictions on water usage
Forthqualzas	Develop a public advantion program on the dengars of
Larinquakes	Develop a public education program on the dangers of
Farthquakes	Evaluate the notential association of injection wells and how
Lailiquares	that is affected by earthquakes
Invasive Species	Evaluate the types and effects of Invasive Species on Frie
	County and its residents
	County and its residents

Hazard	Proposed Mitigation Action							
Karst Flooding	Identify	high	risk	areas	and	evaluate	land-use	planning
	techniques to mitigate future events							

### **Implementation Strategies**

**Appendix X** provides an overview of the strategy that will be utilized in order to implement each of the proposed mitigation actions. For each proposed alternative, the associated strategy identifies the agency or job title that will be responsible for initiating the work and potential sources of funding for the work. Each strategy also indicates when the action will happen and identifies all of the parties responsible for implementation of each action.

The county plans on using the Erie County Natural Hazards Mitigation Plan to help in updating and developing other plans in the county as well as information needed for applying for grants. These other plans would include:

- The County Emergency Operations Plan (EOP)
- Various Emergency Action Plans (EAP) for festivals and community functions
- Various grants as they become available
- Emergency Action Plans for other potential emergency situations within individual jurisdictions

To implement mitigation strategies into local government plans, the Core Group will be responsible for identifying which local plans the mitigation plan can benefit from. With having a wide range of government representatives within the Core Group, the Core Group members are best suited to identify local plans that align with the mitigation action items; such as comprehensive or capital improvement plans. It will be the Core Group member's responsibility to align both parties interested to maximize the potential for action item completion.

## Plan Maintenance

### Plan Maintenance Update

An annual review of mitigation actions will be conducted. The process for evaluating the plan has been modified slightly from that presented in the previous version of the plan. The protocols for updating the plan and continued public involvement have been elaborated upon in this version of the plan.

Currently, the Erie County EMA office has ownership of the plan and will governor the document for the foreseeable future. With sole proprietorship of the plan, the EMA office with be able to organize the proper meeting and document any changes for proper plan maintenance.

### **Monitoring Mitigation Actions**

The Erie County EMA Director will monitor the progress made on the implementation of the identified action items annually at about the anniversary date of plan adoption. Monitoring will be accomplished by calling or e-mailing each county or municipal agency that, through adoption of the plan, has assumed the responsibility of implementing one or more mitigation actions.

By monitoring mitigation actions, when the plan is next updated, information about the status of proposed mitigation actions will be readily available. The updated plan will include a section explaining if previously proposed mitigation actions have been implemented, completed, or deferred. The updated plan will identify actions that are no longer appropriate for the community and should be deleted. The updated plan will identify obstacles to implementation that caused proposed actions to be deferred and will recommend strategies for overcoming those obstacles.

The Mitigation Core Group will not only monitor the implementation of mitigation actions proposed in this plan, but will also monitor actions of participating jurisdictions and surrounding communities that may affect the ability of Erie County to withstand the effects of natural hazards or to recover from a disaster in the future. The method for gathering information about actions beyond those proposed in this plan will be informal; as active members of the Erie County community, Mitigation Core Group members will bring their own knowledge of the area to monitoring meetings to provide information about actions of participating jurisdictions as well as of nearby communities.

### Evaluating the Plan

One month after conducting the annual monitoring of mitigation actions, the Erie County EMA Director will schedule an annual meeting of the Mitigation Core Group to evaluate the mitigation planning process, implementation of the plan, and conditions in Erie County that suggest the need to modify either planning data or planning actions.

Participating incorporated jurisdictions' and townships will be invited to attend the evaluation meetings. The evaluation meeting will include a presentation of the results of the monitoring of mitigation actions and will answer the following questions:

- Do mitigation goals and objectives reflect current community concerns as well as the finding of the risk assessment?
- Have conditions in the county changed so that findings of the risk assessment should be updated?
- What hazards have caused damage in the county since the plan was written? Were these anticipated and evaluated in the plan or should these hazards be added to the plan?
- Have conditions in the county changed so that the magnitude of risk as expressed in this plan has changed?
- Are new sources of data available that will improve the risk assessment?
- Are current resources sufficient for implementing mitigation actions?
- For each mitigation action that has not been completed, what are the obstacles to implementation? What are potential solutions for overcoming these obstacles?
- Is each completed mitigation action effective in reducing risk? What action is required to further reduce the risk addressed by the completed action?
- What mitigation actions should be added to the plan and proposed for implementation?
- Should any proposed mitigation actions be deleted from the plan? What is the rationale for deleting previously proposed actions from the plan?
- Based upon the evaluation, should the plan be updated as soon as possible or should the plan be updated as scheduled 5 years after it was adopted?

The Erie County EMA Director will document the results of the annual evaluation meeting and submit the findings to each incorporated jurisdiction and townships in the county for review within 2 weeks. If the Mitigation Core Group determined that the plan should be updated as soon as possible, the Erie County EMA Director will take action to initiate the plan update.

## Updating the Plan

This plan must be updated within 5 years and again adopted by the county and participating jurisdictions in order to maintain compliance with the regulations stated in 44 CFR Part 201.6 and ensure eligibility for applying for and receiving certain Federal mitigation grant funds.

Monitoring and evaluation will identify necessary modifications to the plan including changes in mitigation strategies and actions that should be incorporated in the next update. The update will have more current information about previous occurrences of hazards and improved information about wind speed for high wind events will be sought.

The Erie County EMA Director will initiate the process of updating the plan no more than 3 years after the plan was adopted, or immediately upon a determination by the

Mitigation Core Group that the plan should be updated sooner. This will allow approximately 1 year for securing funding and/or staff for updating the plan and 1 year for conducting research and writing the updated plan.

### **Continued Public Involvement**

The Erie County EMA Director will provide printed copies of the plan to key Erie County offices including the public library in the county so that the public has access to printed copies of the plan. A copy of the adopted plan will be posted on the county web site for 5 years so that the public has electronic access to the plan. The website will include contact information for anyone to provide comment so that residents, business owners, and others who read the plan will be able to provide a comment about the plan or about the mitigation strategies. The Erie County EMA will maintain these comments and will provide them to the Mitigation Core Group for consideration at the annual plan evaluation meetings.

The Erie County EMA Director will post notices of annual mitigation plan evaluation meetings using the usual methods for posting meeting announcements in the county to invite the public to participate. In addition to posting announcements on the county web site, at least one newspaper press release will be published at the onset of the process of updating the plan inviting public participation.

The Erie County EMA Director will document the number of people who participate in the annual meetings and the results of the meeting for inclusion in the plan when it is next updated. In this way, the public will have an opportunity to become involved in the planning process and to influence mitigation planning decisions.

The Erie County EMA Director will provide a written report and/or make a presentation to the Erie County Commissioners to advise them of the status of the plan and of proposed mitigation actions. In this way, the public will have another opportunity to become aware of local mitigation efforts.

## List of Sources

- American Association of States Climatologists. (<u>http://www.stateclimate.org/</u>)
- Draft State of Ohio Enhanced Mitigation Plan, Ohio Emergency Management Agency
- FEMA. Community Rating System (CRS) Communities and their Classes (<u>http://www.fema.gov/library/viewRecord.do?id=3629</u>)
- FEMA. 2010a. Community Status Book Report. (http://www.fema.gov/cis/OH.pdf)
- FEMA. Disaster Search Results. (<u>http://www.fema.gov/femaNews/disasterSearch.do</u>)
- National Inventory of Dams. (<u>http://geo.usace.army.mil/pgis/f?p=397:1:153856584285701::NO</u>)
- National Oceanic and Atmospheric Administration (NOAA). Enhanced Fujita Scale for Tornado Damage. (<u>http://www.spc.noaa.gov/faq/tornado/ef-scale.html</u>)
- National Performance of Dams Program. (<u>http://ce-npdp-</u> serv2.stanford.edu/DamDirectory/DamEAPQuery/EAPForm.jsp)
- Natural Resources Conservation Service. 2010. (http://www.nrcs.usda.gov/)
- National Weather Service. (<u>http://www.erh.noaa.gov</u>)
- NOAA. Snowfall Average Total in Inches. (<u>http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/snowfall.html</u>)
- NOAA. Ohio, Climate Division 2, Palmer Drought Severity Index (PDSI) (<u>http://www.ncdc.noaa.gov/cag/time-series/us/33/9/pdsi/6/4/1895-</u>2011?base\_prd=true&firstbaseyear=1901&lastbaseyear=2000&filter=true)
- Ohio Department of Development (ODOD). Current Projects Overview, (http://development.columbus.gov/planning/currentprojects.aspx)
- Ohio Development Services Agency. Erie County Profile (http://development.ohio.gov/files/research/C1023.pdf)
- Ohio EMA. State of Ohio: Hazard Identification and Risk Analysis (HIRA) (http://ema.ohio.gov/Documents/OhioMitigationPlan/2011/Appendix%20I\_Ohio %20HIRA.pdf)
- Ohio EMA. Drought Annex (<u>http://ema.ohio.gov/Documents/Ohio\_EOP/drought\_annex.pdf</u>)
- Ohio DOA. Plant Health Division Emerald Ash Borer (<u>http://www.agri.ohio.gov/eab/</u>)
- Ohio Department of Natural Resources (ODNR). Earthquakes in Ohio (<u>http://www.dnr.state.oh.us/Portals/10/pdf/EL/el09.pdf</u>)



- Richter, C. F., Elementary Seismology. (http://www.uwiseismic.com/Downloads/Eq\_mercalli\_scale.pdf)
- State of Ohio Disaster History. Presidential Disaster Declarations (1964 2011). (<u>http://ema.ohio.gov/Documents/OhioMitigationPlan/2011/Appendix%20A\_State</u>%200f%20Ohio%20Disaster%20History%20Chart.pdf)
- U.S. Census. 2010. (http://2010.census.gov/2010census/popmap/)
- U.S. Census. Population Census Count by County, City, Village and Township, March 2011. (<u>http://www.development.ohio.gov/research/documents/ALLSUBCOUNTY2010.</u> pdf)
- U.S. Census. State & County QuickFacts (<u>http://quickfacts.census.gov/qfd/states/39/39049.html</u>)
- U.S. Department of Agriculture (USDA). National Agricultural Statistical Service. (<u>http://www.nass.usda.gov/Statistics\_by\_State/Ohio/index.asp</u>)
- U.S. Department of the Interior, U.S. Geological Survey. U.S. State Information on Drought, last updated May 25, 2010. (<u>http://waterwatch.usgs.gov/?m=dryw</u>)
- USGS Ohio Seismic Hazard Map (<u>http://earthquake.usgs.gov/earthquakes/states/ohio/hazards.php</u>)
- USGS Ohio Earthquake History (<u>http://www.usgs.gov/</u>)

# List of Acronyms

CDBG	Community Development Block Grant
CRS	Community Rating System
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
HUD	Housing and Urban Development
MORPC	Mid-Ohio Regional Planning Commission
NCDC	National Climate Data Center
NFIP	National Flood Insurance Rate Program
NOAA	National Oceanic and Atmospheric Administration
ODNR	Ohio Department of Natural Resources
OEMA	Ohio Emergency Management Agency
OSU	Ohio State University
USDA	United States Department of Agriculture
USGS	United States Geological Survey